Transmitting transistors and modules
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GENERAL

TRANSMITTING TRANSISTORS AND MODULES

ACCESSORIES
DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of three series of handbooks each comprising several parts.

ELECTRON TUBES

SEMICONDUCTORS AND INTEGRATED CIRCUITS

COMPONENTS AND MATERIALS

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

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ELECTRON TUBES (BLUE SERIES)

Part 1a December 1975 ET1a 12-75 Transmitting tubes for communication, tubes for r.f. heating Types PE05/25 to TBW15/25

Part 1b August 1977 ET1b 08-77 Transmitting tubes for communication, tubes for r.f. heating, amplifier circuit assemblies

Part 2a November 1977 ET2a 11-77 Microwave tubes Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches

Part 2b May 1978 ET2b 05-78 Microwave semiconductors and components Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators

Part 3 January 1975 ET3 01-75 Special Quality tubes, miscellaneous devices

Part 4 March 1975 ET4 03-75 Receiving tubes

Part 5a March 1978 ET5a 03-78 Cathode-ray tubes Instrument tubes, monitor and display tubes, C.R. tubes for special applications

Part 5b December 1978 ET5b 12-78 Camera tubes and accessories, image intensifiers

Part 6 January 1977 ET6 01-77 Products for nuclear technology Channel electron multipliers, neutron tubes, Geiger-Müller tubes

Part 7a March 1977 ET7a 03-77 Gas-filled tubes Thytratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes

Part 7b March 1977 ET7b 03-77 Gas-filled tubes Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units

Part 8 May 1977 ET8 05-77 TV picture tubes

Part 9 March 1978 ET9 03-78 Photomultiplier tubes; phototubes

September 1978
SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a August 1978 SC1a 08-78 Rectifier diodes, thyristors, triacs
Rectifier diodes, voltage regulator diodes (> 1,5 W),
transient suppressor diodes, rectifier stacks, thyristors, triacs

Part 1b May 1977 SC1b 05-77 Diodes
Small signal germanium diodes, small signal silicon diodes,
special diodes, voltage regulator diodes (< 1,5 W), voltage
reference diodes, tuner diodes

Part 2 November 1977 SC2 11-77 Low-frequency and dual transistors

Part 3 January 1978 SC3 01-78 High-frequency, switching and field-effect transistors

Part 4a December 1978 SC4a 12-78 Transmitting transistors and modules

Part 4b September 1978 SC4b 09-78 Devices for optoelectronics
Photosensitive diodes and transistors, light emitting diodes,
photocouplers, infrared sensitive devices,
photoconductive devices

Part 4c July 1978 SC4c 07-78 Discrete semiconductors for hybrid thick and thin-film circuits

Part 5a November 1976 SC5a 11-76 Professional analogue integrated circuits

Part 5b March 1977 SC5b 03-77 Consumer integrated circuits
Radio-audio, television

Part 6 October 1977 SC6 10-77 Digital integrated circuits
LOCMOS HE4000B family

Signetics integrated circuits 1978
Bipolar and MOS memories
Bipolar and MOS microprocessors
Analogue circuits
Logic - TTL
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|        |            |       | High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products |
| Part 2a| October 1977| CM2a 10-77 | Resistors
|        |            |       | Fixed resistors, variable resistors, voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC), test switches |
| Part 2b| February 1978| CM2b 02-78 | Capacitors
|        |            |       | Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors |
| Part 3 | January 1977 | CM3 01-77 | Radio, audio, television
|        |            |       | Components for black and white television, components for colour television |
| Part 3a| September 1978| CM3a 09-78 | FM tuners, television tuners, surface acoustic wave filters |
| Part 3b| October 1978  | CM3b 10-78 | Loudspeakers |
| Part 4a| November 1978 | CM4a 11-78 | Soft ferrites
|        |            |       | Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores |
| Part 4b| December 1976 | CM4b 12-76 | Piezoelectric ceramics, permanent magnet materials |
| Part 6 | April 1977  | CM6 04-77 | Electric motors and accessories
|        |            |       | Small synchronous motors, stepper motors, miniature direct current motors |
| Part 7 | September 1971 | CM7 09-71 | Circuit blocks
|        |            |       | Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive |
| Part 8 | February 1977 | CM8 02-77 | Variable mains transformers |
| Part 9 | March 1976  | CM9 03-76 | Piezoelectric quartz devices |
| Part 10| April 1978  | CM10 04-78 | Connectors |
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AD = Silicon alloyed diodes
GB = Germanium gold bonded diodes
HFSW = High-frequency and switching transistors
LF = Low-frequency transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
PC = Germanium point contact diodes
R = Rectifier diodes
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

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DT = Dual transistors  
FET = Field-effect transistors  
LF = Low-frequency transistors  
Mm = Discrete semiconductors for hybrid thick and thin-film circuits  
P = Low-frequency power transistors
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FET = Field-effect transistors
HFSW = High-frequency and switching transistors
P = Low-frequency power transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
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FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
R = Rectifier diodes
Tra = Transmitting transistors and modules
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+ = series.

- **FET** = Field-effect transistors
- **HFSW** = High-frequency and switching transistors
- **Mm** = Discrete semiconductors for hybrid thick and thin-film circuits
- **P** = Low-frequency power transistors
- **PDT** = Photodiodes or transistors
- **Th** = Thyristors
- **Tra** = Transmitting transistors and modules
- **Tri** = Triacs

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+ = series.

Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
R = Rectifier diodes
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes
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AD = Silicon alloyed diodes  
GB = Germanium gold bonded diodes  
I = Infrared devices  
LED = Light-emitting diodes  
PC = Germanium point contact diodes  
Ph = Photoconductive devices  
PhC = Photocouplers  
R = Rectifier diodes  
St = Rectifier stacks  
Vrf = Voltage reference diodes  
Vrg = Voltage regulator diodes  
WD = Silicon whiskerless diodes
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<p>| A        | = Accessories |
| DH       | = Diecast heatsinks |
| FET      | = Field-effect transistors |
| HE       | = Heatsink extrusions |
| HFSW     | = High-frequency and switching transistors |
| I        | = Infrared devices |
| LF       | = Low-frequency transistors |
| P        | = Low-frequency power transistors |
| Tra      | = Transmitting transistors and modules |
| Vrg      | = Voltage regulator diodes |</p>
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*A = Accessories*
GENERAL

Type designation
Rating systems
Letter symbols
s-parameters
PRO ELECTRON TYPE DESIGNATION CODE
FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices — as opposed to integrated circuits —, multiples of such devices and semiconductor chips.

A basic type number consists of:

**TWO LETTERS FOLLOWED BY A SERIAL NUMBER**

**FIRST LETTER**

The first letter gives information about the material used for the active part of the devices.

A. GERMANIUM or other material with band gap of 0.6 to 1.0 eV.
B. SILICON or other material with band gap of 1.0 to 1.3 eV.
C. GALLIUM-ARSENIDE or other material with band gap of 1.3 eV or more.
R. COMPOUND MATERIALS (e.g. Cadmium-Sulphide).

**SECOND LETTER**

The second letter indicates the function for which the device is primarily designed.

A. DIODE; signal, low power
B. DIODE; variable capacitance
C. TRANSISTOR; low power, audio frequency \( R_{thj-mb} > 15 \, ^\circ C/W \)
D. TRANSISTOR; power, audio frequency \( R_{thj-mb} \leq 15 \, ^\circ C/W \)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency \( R_{thj-mb} > 15 \, ^\circ C/W \)
G. MULTIPLE OF DISSIMILAR DEVICES — MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency \( R_{thj-mb} \leq 15 \, ^\circ C/W \)
N. PHOTO-COUPLER
P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power \( R_{thj-mb} > 15 \, ^\circ C/W \)
S. TRANSISTOR; low power, switching \( R_{thj-mb} > 15 \, ^\circ C/W \)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power \( R_{thj-mb} \leq 15 \, ^\circ C/W \)
U. TRANSISTOR; power, switching \( R_{thj-mb} \leq 15 \, ^\circ C/W \)
X. DIODE: multiplier, e.g. varactor, step recovery
Y. DIODE; rectifying, booster
Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)
SERIAL NUMBER

Three figures, running from 100 to 999, for devices primarily intended for consumer equipment.
One letter (Z, Y, X, etc.) and two figures, running from 10 to 99, for devices primarily intended for
industrial/professional equipment.
This letter has no fixed meaning except W, which is used for transient suppressor diodes.

VERSION LETTER

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a
fixed meaning, except letter R, indicating reverse voltage, e.g. collector to case or anode to stud.

SUFFIX

Sub-classification can be used for devices supplied in a wide range of variants called associated types.
Following sub-coding suffixes are in use:

1. VOLTAGE REFERENCE and VOLTAGE REGULATOR DIODES: ONE LETTER and ONE
   NUMBER
   The LETTER indicates the nominal tolerance of the Zener (regulation, working or reference) voltage
   A. 1% (according to IEC 63: series E96)
   B. 2% (according to IEC 63: series E48)
   C. 5% (according to IEC 63: series E24)
   D. 10% (according to IEC 63: series E12)
   E. 20% (according to IEC 63: series E6)
   The number denotes the typical operating (Zener) voltage related to the nominal current rating for
   the whole range.
   The letter 'V' is used instead of the decimal point.

2. TRANSIENT SUPPRESSOR DIODES: ONE NUMBER
   The NUMBER indicates the maximum recommended continuous reversed (stand-off) voltage $V_R$. The
   letter 'V' is used as above.

3. CONVENTIONAL and CONTROLLED AVALANCHE RECTIFIER DIODES and THYRISTORS:
   ONE NUMBER
   The NUMBER indicates the rated maximum repetitive peak reverse voltage ($V_{RPM}$) or the rated
   repetitive peak off-state voltage ($V_{DPM}$), whichever is the lower. Reversed polarity is indicated by
   letter R, immediately after the number.

4. RADIATION DETECTORS: ONE NUMBER, preceded by a hyphen (-)
   The NUMBER indicates the depletion layer in $\mu$m. The resolution is indicated by a version LETTER.

5. ARRAY OF RADIATION DETECTORS and GENERATORS: ONE NUMBER, preceded by a stroke (/).
   The NUMBER indicates how many basic devices are assembled into the array.
RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note
This definition excludes inductors, capacitors, resistors and similar components.

Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note
Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note
The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.
DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.
LETTER SYMBOLS FOR TRANSISTORS AND SIGNAL DIODES
based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters
The basic letters to be used are:

I, i = current
V, v = voltage
P, p = power

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.
In all other instances upper-case basic letters shall be used.

Subscripts

A, a
        Anode terminal
(AV), (av)
        Average value
B, b
        Base terminal, for MOS devices: Substrate
(BR)
        Breakdown
C, c
        Collector terminal
D, d
        Drain terminal
E, e
        Emitter terminal
F, f
        Forward
G, g
        Gate terminal
K, k
        Cathode terminal
M, m
        Peak value
O, o
        As third subscript: The terminal not mentioned is open circuited
R, r
        As first subscript: Reverse. As second subscript: Repetitive.
        As third subscript: With a specified resistance between the terminal not mentioned and the reference terminal.
(RMS), (rms)
        R.M.S. value
        As first or second subscript: Source terminal (for FETS only)
S, s
        As second subscript: Non-repetitive (not for FETS)
        As third subscript: Short circuit between the terminal not mentioned and the reference terminal
X, x
        Specified circuit
Z, z
        Replaces R to indicate the actual working voltage, current or power of voltage reference and voltage regulator diodes.

Note: No additional subscript is used for d.c. values.
LETTER SYMBOLS

Upper-case subscripts shall be used for the indication of:

a) continuous (d.c.) values (without signal)  
   Example $I_B$

b) instantaneous total values  
   Example $i_B$

c) average total values  
   Example $I_B( AV)$

d) peak total values  
   Example $I_{BM}$

e) root-mean-square total values  
   Example $I_B( RMS)$

Lower-case subscripts shall be used for the indication of values applying to the varying component alone:

a) instantaneous values  
   Example $i_b$

b) root-mean-square values  
   Example $I_b( rms)$

c) peak values  
   Example $I_{bm}$

d) average values  
   Example $I_b( av)$

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

Additional rules for subscripts

Subscripts for currents

Transistors: If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: $I_B$, $i_B$, $i_b$, $I_{bm}$

Diodes: To indicate a forward current (conventional current flow into the anode terminal) the subscript $F$ or $f$ should be used; for a reverse current (conventional current flow out of the anode terminal) the subscript $R$ or $r$ should be used.

Examples: $I_F$, $I_R$, $i_F$, $i_f( rms)$
Subscripts for voltages

Transistors: If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

Examples: \( V_{BE} \), \( v_{BE} \), \( v_{be} \), \( V_{bem} \)

Diodes: To indicate a forward voltage (anode positive with respect to cathode), the subscript \( F \) or \( f \) should be used; for a reverse voltage (anode negative with respect to cathode) the subscript \( R \) or \( r \) should be used.

Examples: \( V_F \), \( V_R \), \( v_F \), \( V rm \)

Subscripts for supply voltages or supply currents

Supply voltages or supply currents shall be indicated by repeating the appropriate terminal subscript.

Examples: \( V_{CC} \), \( I_{EE} \)

Note: If it is necessary to indicate a reference terminal, this should be done by a third subscript

Example: \( V_{CCE} \)

Subscripts for devices having more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal followed by a number; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: \( I_{B2} \) = continuous (d.c.) current flowing into the second base terminal

\( V_{B2-E} \) = continuous (d.c.) voltage between the terminals of second base and emitter

Subscripts for multiple devices

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: \( I_{2C} \) = continuous (d.c.) current flowing into the collector terminal of the second unit

\( V_{1C-2C} \) = continuous (d.c.) voltage between the collector terminals of the first and the second unit.
Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (d.c.) current and a varying component.

---

LETTER SYMBOLS FOR ELECTRICAL PARAMETERS

Definition

For the purpose of this Publication, the term "electrical parameter" applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

Basic letters

The following is a list of the most important basic letters used for electrical parameters of semiconductor devices.

- B, b = susceptance; imaginary part of an admittance
- C = capacitance
- G, g = conductance; real part of an admittance
- H, h = hybrid parameter
- L = inductance
- R, r = resistance; real part of an impedance
- X, x = reactance; imaginary part of an impedance
- Y, y = admittance;
- Z, z = impedance;
Upper-case letters shall be used for the representation of:

a) electrical parameters of external circuits and of circuits in which the device forms only a part;

b) all inductances and capacitances.

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

Subscripts

General subscripts

The following is a list of the most important general subscripts used for electrical parameters of semiconductor devices:

- \( F, f \) = forward; forward transfer
- \( I, i \) (or \( 1 \)) = input
- \( L, l \) = load
- \( O, o \) (or \( 2 \)) = output
- \( R, r \) = reverse; reverse transfer
- \( S, s \) = source

Examples: \( Z_S, h'_{Fe}, h_F \)

The upper-case variant of a subscript shall be used for the designation of static (d.c.) values.

Examples: \( h_{FE} \) = static value of forward current transfer ratio in common-emitter configuration (d.c. current gain)

\( R_E \) = d.c. value of the external emitter resistance.

Note: The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript shall be used for the designation of small-signal values.

Examples: \( h_{fe} \) = small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration

\( Z_e = R_e + jX_e \) = small-signal value of the external impedance

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

Examples: \( h_{FE}, y_{RE}, h_{fe} \)
Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer

Examples: \( h_i \) (or \( h_{1i} \)), \( h^i \) (or \( h_{11}^i \)), \( h^0 \) (or \( h_{22}^0 \)), \( h^r \) (or \( h_{21}^r \))

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: \( h_{fe} \) (or \( h_{21e} \)), \( h_{FE} \) (or \( h_{21E} \))

Distinction between real and imaginary parts

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples:
\[
Z_i = R_i + jX_i \\
y_{fe} = g_{fe} + jb_{fe}
\]

If such symbols do not exist or if they are not suitable, the following notation shall be used:

Examples: \( \text{Re} (h_{ib}) \) etc. for the real part of \( h_{ib} \)
\( \text{Im} (h_{ib}) \) etc. for the imaginary part of \( h_{ib} \)
SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to traveling wave conditions. The figure below shows a two-port network with the incident and reflected waves $a_1$, $b_1$, $a_2$ and $b_2$.

$$Z_0 = \text{characteristic impedance of the transmission line in which the two-port is connected.}$$

$V_i$ = incident voltage

$V_r$ = reflected (generated) voltage

The four-pole equations for s-parameters are:

$$b_1 = s_{11}a_1 + s_{12}a_2$$

$$b_2 = s_{21}a_1 + s_{22}a_2$$

Using the subscripts i for 11, r for 12, f for 21 and o for 22, it follows that:

$$s_i = s_{11} = \frac{b_1}{a_1} \quad a_2 = 0$$

$$s_r = s_{12} = \frac{b_1}{a_2} \quad a_1 = 0$$

$$s_f = s_{21} = \frac{b_2}{a_1} \quad a_2 = 0$$

$$s_o = s_{22} = \frac{b_2}{a_2} \quad a_1 = 0$$

1) The squares of these quantities have the dimension of power.
The s-parameters can be named and expressed as follows:

\[ s_1 = s_{11} = \text{Input reflection coefficient.} \]
The complex ratio of the reflected wave and the incident wave at the input, under the conditions \( Z_1 = Z_0 \) and \( V_{S2} = 0 \).

\[ s_r = s_{12} = \text{Reverse transmission coefficient.} \]
The complex ratio of the generated wave at the input and the incident wave at the output, under the conditions \( Z_s = Z_0 \) and \( V_{S1} = 0 \).

\[ s_f = s_{21} = \text{Forward transmission coefficient.} \]
The complex ratio of the generated wave at the output and the incident wave at the input, under the conditions \( Z_1 = Z_0 \) and \( V_{S2} = 0 \).

\[ s_o = s_{22} = \text{Output reflection coefficient.} \]
The complex ratio of the reflected wave and the incident wave at the output, under the conditions \( Z_s = Z_0 \) and \( V_{S1} = 0 \).
TRANSMITTING TRANSISTORS AND MODULES

- Type number survey
- Selection guide
- Line-ups
- Envelopes
- Soldering recommendations
In this alphanumeric list we present all transmitting transistors and modules mentioned in this handbook together with the most important data.

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<thead>
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<th>Type number</th>
<th>Envelope</th>
<th>Mode of operation</th>
<th>$V_{CE}$ V</th>
<th>Frequency MHz</th>
<th>Output power W</th>
<th>Power gain dB</th>
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Notes:
1. $P_0$ sync at $d_{im} < -60$ dB.
2. P.E.P. at $d_3 < -30$ dB.
3. $P_0$ sync at $d_{im} < -55$ dB.
4. P.E.P. at $d_3 < -40$ dB.
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Notes:
1. P.E.P. at $d_3 < -30$ dB.
2. P.E.P. at $d_3 < -40$ dB.
3. $P_o$ sync at $d_{im} < -60$ dB.

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Note:
1. $P_0$ sync at $d_{im} < -60$ dB.

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In this list we present a survey of all transmitting transistors and modules grouped in accordance with the main r.f. power application area together with the most important data.

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s.s.b. class-AB; $f = 28$ MHz; $d_3; d_5 < -30$ dB

s.s.b. class-A; $f = 28$ MHz; $d_3; d_5 < -40$ dB
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> v.h.f. base stations; class-B operation

> v.h.f. mobile transmitters; class-B operation

> Emitter connected to case.
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<th>PD (dB)</th>
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<th>GD (dB)</th>
<th>VCE (V)</th>
<th>IC (mA)</th>
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\* Without stud.
In this section we present information on recommended circuit line-ups in the main r.f. power application areas. A comprehensive range of output power levels is indicated together with our recommended types in the particular line-up configuration. The necessary drive power level for each line-up is indicated in the first column.

More detailed application information as well as computer aided design parameters are available on request.

**S.S.B. TRANSMITTERS (1.5 MHz – 30 MHz)**

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<th>Input power (mW)</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>( P_L ) (P.E.P.) (W)</th>
<th>( V_{CE} ) (V)</th>
<th>Stud Type</th>
<th>Flange (F)</th>
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**MILITARY COMMUNICATION TRANSMITTERS (25 MHz – 80 MHz)**

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<th>3rd stage</th>
<th>( P_L ) (W)</th>
<th>( V_{CE} ) (V)</th>
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<th>Flange (F)</th>
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* Class-A operation.

** 28 V supply voltage; class-A operation.
### MOBILE TRANSMITTERS (68 MHz – 87.5 MHz)

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<td>14</td>
<td>13</td>
<td>S</td>
</tr>
<tr>
<td>10</td>
<td>BSX19</td>
<td>BGY32</td>
<td></td>
<td>18</td>
<td>13</td>
<td>F</td>
</tr>
<tr>
<td>70</td>
<td>BFQ42</td>
<td>BLW31</td>
<td></td>
<td>28</td>
<td>13</td>
<td>S</td>
</tr>
<tr>
<td>160</td>
<td>BFQ43</td>
<td>BLW60C</td>
<td></td>
<td>45</td>
<td>13</td>
<td>S</td>
</tr>
<tr>
<td>160</td>
<td>BFQ43</td>
<td>BLW85</td>
<td></td>
<td>45</td>
<td>13</td>
<td>F</td>
</tr>
</tbody>
</table>

### BASE STATIONS (68 MHz – 87.5 MHz)

<table>
<thead>
<tr>
<th>input power mW</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>PL W</th>
<th>VCE V</th>
<th>stud S flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>BFS23A</td>
<td>BLY93C</td>
<td></td>
<td>25</td>
<td>28</td>
<td>S</td>
</tr>
<tr>
<td>65</td>
<td>BFS23A</td>
<td>BLW84</td>
<td></td>
<td>25</td>
<td>28</td>
<td>F</td>
</tr>
<tr>
<td>125</td>
<td>BLX92A</td>
<td>BLX39</td>
<td></td>
<td>50</td>
<td>28</td>
<td>S</td>
</tr>
<tr>
<td>15</td>
<td>2N3866</td>
<td>BLV21</td>
<td>BLW78</td>
<td>100</td>
<td>28</td>
<td>S</td>
</tr>
<tr>
<td>50</td>
<td>2N3866</td>
<td>BLY93C</td>
<td>BLX15</td>
<td>150</td>
<td>50</td>
<td>S</td>
</tr>
<tr>
<td>50</td>
<td>2N3866</td>
<td>BLW84</td>
<td>BLW95</td>
<td>150</td>
<td>50</td>
<td>F</td>
</tr>
</tbody>
</table>

### F.M. BROADCAST TRANSMITTERS (87.5 MHz – 108 MHz)

<table>
<thead>
<tr>
<th>input power mW</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>P_L W</th>
<th>V_CE V</th>
<th>stud S flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>BGY33</td>
<td></td>
<td>2 x BLW85</td>
<td>80</td>
<td>13</td>
<td>F</td>
</tr>
<tr>
<td>140</td>
<td>BLX92A</td>
<td>BLX39</td>
<td></td>
<td>50</td>
<td>28</td>
<td>S</td>
</tr>
<tr>
<td>40</td>
<td>2N3866</td>
<td>BLV21</td>
<td>BLW78</td>
<td>100</td>
<td>28</td>
<td>F</td>
</tr>
<tr>
<td>75</td>
<td>BLX92A</td>
<td>BLX39</td>
<td>BLX15</td>
<td>150</td>
<td>50</td>
<td>S</td>
</tr>
<tr>
<td>75</td>
<td>BLX92A</td>
<td>BLW86</td>
<td>BLW95</td>
<td>150</td>
<td>50</td>
<td>S/F</td>
</tr>
<tr>
<td>140</td>
<td>BLX92A</td>
<td>BLX39</td>
<td>2 x BLX15</td>
<td>250</td>
<td>50</td>
<td>S</td>
</tr>
<tr>
<td>140</td>
<td>BLX92A</td>
<td>BLW86</td>
<td>2 x BLW95</td>
<td>250</td>
<td>50</td>
<td>S/F</td>
</tr>
</tbody>
</table>

### A.M. AIRCRAFT TRANSMITTERS (118 MHz – 136 MHz)

<table>
<thead>
<tr>
<th>input power mW</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>P_L(carr) W</th>
<th>V_CE V</th>
<th>stud S flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>BLX92A</td>
<td>BLY93C</td>
<td></td>
<td>6</td>
<td>13/28</td>
<td>S</td>
</tr>
<tr>
<td>240</td>
<td>BLY91C</td>
<td>BLX39</td>
<td></td>
<td>12</td>
<td>13/28</td>
<td>S</td>
</tr>
<tr>
<td>240</td>
<td>BLV20</td>
<td>BLW86</td>
<td></td>
<td>12</td>
<td>13/28</td>
<td>S</td>
</tr>
<tr>
<td>100</td>
<td>BLX92A</td>
<td>BLY93C</td>
<td>BLW78</td>
<td>25</td>
<td>13/28</td>
<td>S/F</td>
</tr>
<tr>
<td>100</td>
<td>BLX92A</td>
<td>BLW84</td>
<td>BLW78</td>
<td>25</td>
<td>13/28</td>
<td>S/F</td>
</tr>
</tbody>
</table>

- **28 V supply voltage.

September 1978
## PORTABLE AND MOBILE TRANSMITTERS (132 MHz – 174 MHz)

<table>
<thead>
<tr>
<th>Input Power (mW)</th>
<th>1st Stage</th>
<th>2nd Stage</th>
<th>3rd Stage</th>
<th>( P_L ) (W)</th>
<th>( V_{CE} ) (V)</th>
<th>Stud S</th>
<th>Flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>2N4427</td>
<td>BFQ43</td>
<td></td>
<td>2</td>
<td>7.5</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2N4427</td>
<td>BLY87C</td>
<td></td>
<td>8</td>
<td>13</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2N4427</td>
<td>BLV10</td>
<td></td>
<td>8</td>
<td>13</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>BFQ42</td>
<td>BLW29</td>
<td></td>
<td>14</td>
<td>13</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>BGY36</td>
<td></td>
<td></td>
<td>18</td>
<td>13</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>BFQ43</td>
<td>BLW31</td>
<td></td>
<td>28</td>
<td>13</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>BFQ42</td>
<td>BLW29</td>
<td>BLW60C</td>
<td>45</td>
<td>13</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>BGY36</td>
<td>BLW85</td>
<td></td>
<td>45</td>
<td>13</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

## BASE STATIONS (132 MHz – 174 MHz)

<table>
<thead>
<tr>
<th>Input Power (mW)</th>
<th>1st Stage</th>
<th>2nd Stage</th>
<th>3rd Stage</th>
<th>( P_L ) (W)</th>
<th>( V_{CE} ) (V)</th>
<th>Stud S</th>
<th>Flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>BLY91C</td>
<td>BLY93C</td>
<td></td>
<td>25</td>
<td>28</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>BLV20</td>
<td>BLW84</td>
<td></td>
<td>25</td>
<td>28</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>25</td>
<td>2N3866</td>
<td>BLY91C</td>
<td>BLX39</td>
<td>50</td>
<td>28</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>25</td>
<td>2N3866</td>
<td>BLV20</td>
<td>BLW86</td>
<td>50</td>
<td>28</td>
<td>S</td>
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</tr>
<tr>
<td>200</td>
<td>BFS23A</td>
<td>BLY93C</td>
<td>2 x BLX39</td>
<td>100</td>
<td>28</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>200</td>
<td>BFS23A</td>
<td>BLW84</td>
<td>2 x BLW86</td>
<td>100</td>
<td>28</td>
<td>S</td>
<td>F</td>
</tr>
</tbody>
</table>

## TV TRANSMITTERS AND TRANSPOSERS (Band III: 174 MHz – 230 MHz)

<table>
<thead>
<tr>
<th>Input Power (mW)</th>
<th>1st Stage</th>
<th>2nd Stage</th>
<th>3rd Stage</th>
<th>4th Stage</th>
<th>( P_o ) sync (W)</th>
<th>( V_{CE} ) (V)</th>
<th>Stud S</th>
<th>Flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>BLX93A</td>
<td>BLW64</td>
<td>2 x BLW75</td>
<td></td>
<td>25</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>BLX94A</td>
<td>BLW75</td>
<td>4 x BLW75</td>
<td></td>
<td>50</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>BLX93A</td>
<td>BLW64</td>
<td>2 x BLW75</td>
<td>8 x BLW75</td>
<td>100</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

## PORTABLE AND MOBILE TRANSMITTERS (400 MHz – 470 MHz)

<table>
<thead>
<tr>
<th>Input Power (mW)</th>
<th>1st Stage</th>
<th>2nd Stage</th>
<th>3rd Stage</th>
<th>4th Stage</th>
<th>( P_L ) (W)</th>
<th>( V_{CE} ) (V)</th>
<th>Stud S</th>
<th>Flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>BFR96</td>
<td>BLW79</td>
<td>BLW80</td>
<td></td>
<td>2</td>
<td>7.5</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BLW79</td>
<td>BLW80</td>
<td>BLW81</td>
<td></td>
<td>10</td>
<td>13</td>
<td>S</td>
<td></td>
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<tr>
<td>220</td>
<td>BLW79</td>
<td>BLW81</td>
<td>BLX69A</td>
<td>BLW82</td>
<td>18</td>
<td>13</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>BLW79</td>
<td>BLW80</td>
<td>BLW81</td>
<td>BLW82</td>
<td>30</td>
<td>13</td>
<td>S/F</td>
<td></td>
</tr>
</tbody>
</table>

*See Handbook SC3.*
### BASE STATIONS (400 MHz — 470 MHz)

<table>
<thead>
<tr>
<th>input power (mW)</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>4th stage</th>
<th>PL (W)</th>
<th>VCE (V)</th>
<th>stud S</th>
<th>flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>BLX91A</td>
<td>BLX93A</td>
<td>BLX94A</td>
<td>2 x BLX95</td>
<td>25</td>
<td>28</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>BLX91A</td>
<td>BLX93A</td>
<td>BLX94A</td>
<td>2 x BLX95</td>
<td>72</td>
<td>28</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

### TV TRANSMITTERS AND TRANSPOSERS (Band IV/V: 470 MHz — 860 MHz)

<table>
<thead>
<tr>
<th>input power (mW)</th>
<th>1st stage</th>
<th>2nd stage</th>
<th>3rd stage</th>
<th>4th stage</th>
<th>PO sync (W)</th>
<th>VCE (V)</th>
<th>stud S</th>
<th>flange F</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>BFQ34</td>
<td>BLW34</td>
<td>BLW98</td>
<td></td>
<td>3</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>BFQ34</td>
<td>BLW33</td>
<td>BLW98</td>
<td>2 x BLW98</td>
<td>6</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BLW32</td>
<td>BLW34</td>
<td>2 x BLW98</td>
<td>4 x BLW98</td>
<td>12</td>
<td>25</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

• See Handbook SC3.
This envelope is also supplied with different collector identification (bevelled collector lead).
MECHANICAL DATA
SOT-75A

Dimensions in mm

SOT-105

September 1978
MECHANICAL DATA

SOT-121A

Dimensions in mm

SOT-121B is identical to SOT-121A except for the thickness of the leads which lies between 0.23 and 0.27 mm.

SOT-122
MECHANICAL DATA

SOT-132

Dimensions in mm

[Diagram with measurements]
MECHANICAL DATA

TO-39; collector connected to case.

TO-39; emitter connected to case.

TO-60
RULES FOR MOUNTING QUARTER-INCH CAPSTAN HEADERS
AS USED FOR R.F. POWER TRANSISTORS

A 5 mm thick brass nut is supplied with each transistor for securing it to a heatsink. To ensure optimum heat transfer and avoid damage to the threaded stud of the transistor the following recommendations should be observed:

- Diameter of mounting hole in heatsink: 4.10 mm (+0.05; -0.00)
- Heatsink to be at least 3 mm thick. Attachment to a thinner heatsink may damage the mounting stud.
- Heatsink surfaces at the mounting hole to be flat, parallel, and free of burrs or oxidation.
- Mounting nut torque: 0.80 Nm (+0.05; -0.00)
  8.0 kg cm (+0.5; -0.0)
If security against vibration is required, use a locking compound such as Lock-tite. Do not use washers; they impair the heat transfer.

- Recommended distance from the top surface of heatsink to surface of printed wiring board: 2.9 mm (0.0; -0.2)
  Tension in the transistor leads sets the limit on spacing between heatsink and printed wiring board; in general, the leads can withstand more pull in the downward than in the upward direction.
- Solder the leads to the connection pads with resin-cored lead-tin solder, using an iron of normal temperature. Soldering iron temperatures as high as 350 °C are safely tolerable; the transistor can withstand an interior temperature of 250 °C for about ten minutes. The leads may be tinned, if required, by dipping them into a solder bath at about 230 °C; each lead may be dipped up to its full length. A flux of the quality of Super-Safe is recommended; after tinning, surplus flux should be rinsed away in tap water.

September 1974
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B or C operated mobile transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V. The BFQ42 is especially suited as a driver transistor for the BLW29 in a two-stage wide-band or semi-wide-band v.h.f. amplifier delivering 15 W output power.

It has a TO-39 metal envelope with the collector connected to the case.

QUICK REFERENCE DATA

R.F. performance up to $T_{\text{amb}} = 25 \, ^\circ\text{C}$; $R_{\text{th c-a}} = 32 \, ^\circ\text{C/W}$

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{\text{CE}}$</th>
<th>$f$</th>
<th>$P_L$</th>
<th>$G_D$</th>
<th>$\eta$</th>
<th>$\overline{Z_i}$</th>
<th>$\overline{Y_L}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. class-B</td>
<td>13,5</td>
<td>175</td>
<td>2</td>
<td>&gt; 11</td>
<td>&gt; 60</td>
<td>7,8 - j4,6</td>
<td>22 - j18</td>
</tr>
<tr>
<td>c.w. class-B</td>
<td>12,5</td>
<td>175</td>
<td>2</td>
<td>typ. 10,5</td>
<td>typ. 65</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories supplied on request: 56218 (package); 56245 (distance disc).
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

Total power dissipation up to $T_{mb} = 25$ °C

Storage temperature

Junction temperature

$$
\begin{align*}
V_{CESM} & \quad \text{max.} \quad 36 \text{ V} \\
V_{CEO} & \quad \text{max.} \quad 18 \text{ V} \\
V_{EBO} & \quad \text{max.} \quad 4 \text{ V} \\
i_C(\text{AV}) & \quad \text{max.} \quad 0,6 \text{ A} \\
i_C(\text{CM}) & \quad \text{max.} \quad 1,8 \text{ A} \\
P_{\text{tot}} & \quad \text{max.} \quad 7,2 \text{ W} \\
T_{\text{stg}} & \quad -65 \text{ to } +200 \text{ °C} \\
T_j & \quad \text{max.} \quad 200 \text{ °C}
\end{align*}
$$

(1) Mounted on a heatsink.

(2) Free-air operation; using a spring cooling clip.

(1) Short-time r.f. operation during mismatch;

$$R_{\text{th mb-h}} = 3 \text{ °C/W}; R_{\text{th c-a}} = 32 \text{ °C/W}; f > 1 \text{ MHz}.$$  

(2) Continuous d.c. and r.f. operation;

$$R_{\text{th mb-h}} = 3 \text{ °C/W}; R_{\text{th c-a}} = 32 \text{ °C/W}.$$  

Fig. 3 Total power dissipation; $V_{CE} \leq 16,5$ V.

--- Mounted on a heatsink.
--- Free-air operation; using a spring cooling clip having a thermal resistance of 32 °C/W.
V.H.F. power transistor

BFQ42

THERMAL RESISTANCE
From junction to mounting base
From junction to case
From mounting base to heatsink

\[ R_{th\ j-mb} = 24 \, ^\circ\text{C/W} \]
\[ R_{th \ j-c} = 29 \, ^\circ\text{C/W} \]
\[ R_{th \ mb-h} = 3 \, ^\circ\text{C/W} \]

CHARACTERISTICS
\( T_j = 25 \, ^\circ\text{C} \)

Collector-emitter breakdown voltage
\( V_{BE} = 0; \, I_C = 2 \, \text{mA} \)

Collector-emitter breakdown voltage
open base; \( I_C = 25 \, \text{mA} \)

Emitter-base breakdown voltage
open collector; \( I_E = 1 \, \text{mA} \)

Collector cut-off current
\( V_{BE} = 0; \, V_{CE} = 18 \, \text{V} \)

Second breakdown energy; \( L = 25 \, \text{mH}; \, f = 50 \, \text{Hz} \)
open base
\( R_{BE} = 10 \, \Omega \)

D.C. current gain *
\( I_C = 0,25 \, \text{A}; \, V_{CE} = 5 \, \text{V} \)

Collector-emitter saturation voltage *
\( I_C = 0,75 \, \text{A}; \, I_B = 0,15 \, \text{A} \)

Transition frequency at \( f = 100 \, \text{MHz} \) *
\( -I_E = 0,25 \, \text{A}; \, V_{CB} = 13,5 \, \text{V} \)
\( -I_E = 0,75 \, \text{A}; \, V_{CB} = 13,5 \, \text{V} \)

Collector capacitance at \( f = 1 \, \text{MHz} \)
\( I_E = I_C = 0; \, V_{CB} = 13,5 \, \text{V} \)

Feedback capacitance at \( f = 1 \, \text{MHz} \)
\( I_C = 20 \, \text{mA}; \, V_{CE} = 13,5 \, \text{V} \)

\( V_{(BR)CES} > 36 \, \text{V} \)
\( V_{(BR)CEO} > 18 \, \text{V} \)
\( V_{(BR)EBO} > 4 \, \text{V} \)

\( I_{CES} < 1 \, \text{mA} \)
\( E_{SO} > 0,5 \, \text{mJ} \)
\( E_{SBR} > 0,5 \, \text{mJ} \)

\( h_{FE} \) typ. 30

\( V_{CESat} \) typ. 0,9 \, \text{V}

\( f_T \) typ. 750 MHz
\( f_T \) typ. 625 MHz

\( C_c \) typ. 8,6 \, \text{pF}
\( C_{re} \) typ. 3,8 \, \text{pF}

* Measured under pulse conditions: \( t_p \leq 200 \, \mu\text{s}; \, \delta \leq 0,02. \)
Fig. 4 Typical values; $T_j = 25 \, ^\circ\text{C}$.

Fig. 5 $I_E = I_e = 0$; $f = 1 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$.

Fig. 6 $V_{CB} = 13.5 \, \text{V}$; $f = 100 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_{\text{amb}} = 25 ^\circ \text{C}; \quad R_{\text{th c-a}} = 32 ^\circ \text{C/W} \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{\text{CE}} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_i ) (Ω)</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>2</td>
<td>&lt;0,16</td>
<td>&gt; 11</td>
<td>&lt;0,25</td>
<td>&gt; 60</td>
<td>7,8 – j4,6</td>
<td>22 – j18</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>2</td>
<td>–</td>
<td>typ. 10,5</td>
<td>typ. 65</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

\[ L5 \]

\[ C2 \]

\[ L1 \]

\[ C1 \]

\[ C3 \]

\[ L2 \]

\[ R1 \]

\[ +V_{\text{CC}} \]

Fig. 7 Test circuit; c.w. class-B.

List of components:

- \( C1 = C2 = C5 = 4 \) to \( 40 \) pF film dielectric trimmer (cat. no. 2222 809 07008)
- \( C3 = 100 \) pF ceramic capacitor
- \( C4 = 100 \) nF polyester capacitor
- \( C6 = 2,5 \) to \( 20 \) pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( L1 = 3 \) turns enamelled Cu wire (1,0 mm); int. dia. 4,0 mm; length 4 mm; leads 2 × 5 mm
- \( L2 = L4 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L3 = L5 = 4 \) turns Cu wire (1,0 mm); int. dia. 6,0 mm; length 6 mm; leads 2 × 5 mm
- \( R1 = 220 \) Ω carbon resistor
- \( R2 = 10 \) Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.

Material of printed-circuit board: 1,6 mm epoxy fibre-glass.

The length of the external emitter lead is 1,2 mm.
V.H.F. power transistor

**Fig. 9** Typical values; $f = 175$ MHz; $T_{amb} = 25$ °C; $R_{th \, c-a} = 32$ °C/W.

**Fig. 10** Typical values; $f = 175$ MHz; $T_{amb} = 25$ °C; $V_{CE} = 13.5$ V; $V_{CE} = 12.5$ V; $R_{th \, c-a} = 32$ °C/W.
APPLICATION INFORMATION (continued)

Fig. 11 R.F. SOAR (short-time operation during mismatch); f = 175 MHz; $T_h = 70 \, ^\circ C$; $R_{th \, mb-h} = 3 \, ^\circ C/W$; $V_{CE} = 13.5 \, V$ or $12.5 \, V$; $P_S = P_{Snom}$ at $V_{CE} = 1$

Fig. 12 R.F. SOAR (short-time operation during mismatch); f = 175 MHz; $T_{amb} = 70 \, ^\circ C$; $R_{th \, c-a} = 32 \, ^\circ C/W$; $V_{CE} = 13.5 \, V$ or $12.5 \, V$; $P_S = P_{Snom}$ at $V_{CE} = 1$

Note to Figs 11 and 12:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions ($V_{SWR} = 1$), as a function of the expected supply over-voltage ratio with $V_{SWR}$ as parameter.

The graph applies to the situation in which the drive ($P_S/P_{Snom}$) increases linearly with supply over-voltage ratio.
OPERATING NOTE Below 100 MHz a base-emitter resistor of 22 \( \Omega \) is recommended to avoid oscillation. This resistor must be effective for r.f. only.

![Fig. 13.](image1)

![Fig. 14.](image2)

![Fig. 15.](image3)

Conditions for Figs 13, 14 and 15:
Typical values; \( V_{CE} = 13.5 \) V; \( P_L = 2 \) W;
\( T_{amb} = 25^\circ C; R_{th c-a} = 32^\circ C/W. \)
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B or C operated mobile transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V. The BFQ43 is especially suited as a driver transistor for the BLW31 in a two-stage wide-band or semi-wide-band v.h.f. amplifier delivering 28 W output power.

It has a TO-39 metal envelope with the emitter connected to the case, which enables excellent heatsinking and emitter grounding.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \degree C$

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$Z_l$ $\Omega$</th>
<th>$\overline{V_L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. class-B</td>
<td>13,5</td>
<td>175</td>
<td>4</td>
<td>$&gt;12$</td>
<td>$&gt;55$</td>
<td>$3,2+j0,03$</td>
<td>53$ - j29$</td>
</tr>
<tr>
<td>c.w. class-B</td>
<td>12,5</td>
<td>175</td>
<td>4</td>
<td>typ. 12</td>
<td>typ. 60</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 TO-39; emitter connected to case.

Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories supplied on request: 56218 (package); 56245 (distance disc).
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

Total power dissipation up to $T_{mb} = 25$ °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CESM}$</td>
<td>max. 36 V</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>max. 18 V</td>
</tr>
<tr>
<td>$V_{EBO}$</td>
<td>max. 4 V</td>
</tr>
<tr>
<td>$I_{C(AV)}$</td>
<td>max. 1.25 A</td>
</tr>
<tr>
<td>$I_{CM}$</td>
<td>max. 3.75 A</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>max. 12 W</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>$T_{j}$</td>
<td>max. 200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{tot}$</td>
<td>(1)</td>
</tr>
<tr>
<td>$T_{h}$</td>
<td>(2)</td>
</tr>
</tbody>
</table>

(1) Short-time r.f. operation during mismatch; $f \geq 1$ MHz.
(2) Continuous d.c. and r.f. operation; derate by 0.05 W/°C.

Fig. 3 Total power dissipation; $V_{CE} \leq 16.5$ V.

THERMAL RESISTANCE (dissipation = 4 W; $T_{mb} = 82$ °C, i.e. $T_{h} = 70$ °C)

From junction to mounting base

From mounting base to heatsink

$R_{th \_j-mb} = 18$ °C/W

$R_{th \_mb-h} = 3$ °C/W

March 1978
CHARACTERISTICS

$T_j = 25 \, ^{\circ}\text{C}$

Collector-emitter breakdown voltage

$V_{BE} = 0; \, I_C = 5 \, \text{mA}$

Collector-emitter breakdown voltage

open base; $I_C = 50 \, \text{mA}$

Emitter-base breakdown voltage

open collector; $I_E = 2 \, \text{mA}$

Collector cut-off current

$V_{BE} = 0; \, V_{CE} = 18 \, \text{V}$

Second breakdown energy; $L = 25 \, \text{mH}; \, f = 50 \, \text{Hz}$

open base

$R_{BE} = 10 \, \Omega$

D.C. current gain

$I_C = 0,5 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage

$I_C = 1,5 \, \text{A}; \, I_B = 0,3 \, \text{A}$

Transition frequency at $f = 100 \, \text{MHz}$

$-I_E = 0,5 \, \text{A}; \, V_{CB} = 13,5 \, \text{V}$

$-I_E = 1,5 \, \text{A}; \, V_{CB} = 13,5 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$

$I_E = I_C = 0; \, V_{CB} = 13,5 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$

$I_C = 20 \, \text{mA}; \, V_{CE} = 13,5 \, \text{V}$

$V_{(BR)CES} > 36 \, \text{V}$

$V_{(BR)CEO} > 18 \, \text{V}$

$V_{(BR)EBO} > 4 \, \text{V}$

$I_{CES} < 2 \, \text{mA}$

$E_{SO} > 0,5 \, \text{mJ}$

$E_{SBR} > 0,5 \, \text{mJ}$

$h_{FE}$ typ. 40

$10 \, \text{to} \, 80$

$V_{CEsat}$ typ. 0,9 \, \text{V}$

$f_T$ typ. 750 \, \text{MHz}$

$f_T$ typ. 625 \, \text{MHz}$

$C_C$ typ. 15 \, \text{pF}$

$C_{re}$ typ. 7,3 \, \text{pF}$

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \, \delta \leq 0,02.$
Fig. 4 Typical values; $T_J = 25 \, ^\circ C$.

Fig. 5 $I_E = I_e = 0$; $f = 1 \, MHz$; $T_J = 25 \, ^\circ C$.

Fig. 6 $V_{CB} = 13,5 \, V$; $f = 100 \, MHz$; $T_J = 25 \, ^\circ C$. 

March 1978
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V&lt;sub&gt;CE&lt;/sub&gt; (V)</th>
<th>P&lt;sub&gt;L&lt;/sub&gt; (W)</th>
<th>P&lt;sub&gt;S&lt;/sub&gt; (W)</th>
<th>G&lt;sub&gt;p&lt;/sub&gt; (dB)</th>
<th>I&lt;sub&gt;C&lt;/sub&gt; (A)</th>
<th>η (%)</th>
<th>Z&lt;sub&gt;j&lt;/sub&gt; (Ω)</th>
<th>Y&lt;sub&gt;L&lt;/sub&gt; (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13.5</td>
<td>4</td>
<td>&lt;0.25</td>
<td>&gt;12</td>
<td>&lt;0.54</td>
<td>&gt;55</td>
<td>3.2 + j0.03</td>
<td>53 – j29</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>4</td>
<td>–</td>
<td>typ. 12</td>
<td>–</td>
<td>typ. 60</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:
C1 = C5 = 2.5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = C6 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C3 = 100 pF ceramic capacitor
C4 = 100 nF polyester capacitor
L1 = 2 turns Cu wire (1.0 mm); int. dia. 4.0 mm; length 3 mm; leads 2 x 5 mm
L2 = 7 turns enameled Cu wire (0.5 mm); int. dia. 3.0 mm; length 4 mm; leads 2 x 5 mm
L3 = L5 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 4 turns enameled Cu wire (1.0 mm); int. dia. 5.5 mm; length 5 mm; leads 2 x 5 mm
L6 = 5 turns enameled Cu wire (1.0 mm); int. dia. 5.5 mm; length 7.5 mm; leads 2 x 5 mm
R1 = R2 = 10 Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets. Material of printed-circuit board: 1,6 mm epoxy fibre-glass. The case is directly grounded on the printed-circuit board.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (PS/PSnom) increases linearly with supply over-voltage ratio.
OPERATING NOTE Below 140 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Fig. 12.

Fig. 13.

Fig. 14.

Conditions for Figs 12, 13 and 14:
Typical values; $V_{CE} = 13.5$ V; $P_L = 4$ W; $T_h = 25$ °C.
N-P-N epitaxial planar transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 13,5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply over-voltage to 16,5 V. It has a TO-39 metal envelope with the collector connected to the case.

QUICK REFERENCE DATA

R.F. performance up to $T_{mb} = 25$ °C in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$\tilde{z}_j$ Ω</th>
<th>$\overline{V_L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>4</td>
<td>&gt; 8</td>
<td>&gt; 60</td>
<td>3,9 + j2,2</td>
<td>37 - j22</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>4</td>
<td>typ. 8</td>
<td>typ. 60</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories: 56218 (package); 56245 (distance disc).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter) peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Currents

Collector current (average)

Collector current (peak value) \( f > 1 \text{MHz} \)

Power dissipation

Total power dissipation up to \( T_{mb} = 25 \degree \text{C} \)

\( f > 1 \text{MHz} \)

\[
\begin{array}{c|c|c}
\text{VCBOM} & \text{max.} & 36 \text{ V} \\
\text{VCEO} & \text{max.} & 18 \text{ V} \\
\text{VEBO} & \text{max.} & 4 \text{ V} \\
\text{IC(AV)} & \text{max.} & 0.75 \text{ A} \\
\text{ICM} & \text{max.} & 2.25 \text{ A} \\
\end{array}
\]

Temperature

Storage temperature

Operating junction temperature

THERMAL RESISTANCE

From junction to mounting base

From mounting base to heatsink with a boron nitride washer for electrical insulation

\[
R_{th \ j-mb} = 22 \degree \text{C/W}
\]

\[
R_{th \ mb-h} = 2.5 \degree \text{C/W}
\]

April 1971
CHARACTERISTICS

Collector cut-off current

I_B = 0; V_CE = 14 V

I_CEO < 5 mA

Breakdown voltages

Collector-base voltage
open emitter, I_C = 1 mA

V_(BR)CBO > 36 V

Collector-emitter voltage
open base, I_C = 10 mA

V_(BR)CEO > 18 V

Emitter-base voltage
open collector, I_E = 1 mA

V_(BR)EBO > 4 V

Transient energy

L = 25 mH; f = 50 Hz

open base

E > 0.5 mWs

E > 0.5 mWs

D.C. current gain

I_C = 500 mA; V_CE = 5 V

h_FE > 5

Transition frequency

I_C = 350 mA; V_CE = 10 V

f_T typ. 700 MHz

Collector capacitance at f = 1 MHz

I_E = I_C = 0; V_GB = 15 V

C_c typ. 15 pF

< 20 pF

Feedback capacitance at f = 1 MHz

I_C = 50 mA; V_CE = 15 V

C_re typ. 11 pF

T_j = 25°C unless otherwise specified
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralised common-emitter class B circuit)

\( f = 175 \text{ MHz}; \quad T_{\text{mb}} \text{ up to 25 °C} \)

<table>
<thead>
<tr>
<th>(V_{\text{CC}}(\text{V}))</th>
<th>(P_S(\text{W}))</th>
<th>(P_L(\text{W}))</th>
<th>(I_C(\text{A}))</th>
<th>(G_p(\text{dB}))</th>
<th>(\eta(%))</th>
<th>(Z_i(\Omega))</th>
<th>(\overline{V}_L(\text{mA/V}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5</td>
<td>&lt; 0.63</td>
<td>4</td>
<td>&lt; 0.49</td>
<td>&gt; 8</td>
<td>&gt; 60</td>
<td>3.9 + j22</td>
<td>37 - j22</td>
</tr>
<tr>
<td>12.5 typ. 0.63</td>
<td>4</td>
<td>typ. 0.53</td>
<td>typ. 8</td>
<td>typ. 60</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test circuit

\[ C_1 = C_6 = 4 \text{ to } 29 \text{ pF air trimmer with insulated rotor} \]
\[ C_2 = C_7 = 4 \text{ to } 29 \text{ pF air trimmer with non-insulated rotor} \]
\[ C_3 = 39 \text{ pF ceramic} \]
\[ C_4 = 100 \text{ pF ceramic} \]
\[ C_5 = 15 \text{ nF polyester} \]
\[ L_1 = 1 \text{ turn enameled Cu wire (1.0 mm); int. diam. 10 mm; leads 2 x 10 mm} \]
\[ L_2 = 6 \text{ turns enameled Cu wire (0.7 mm); int. diam. 4 mm; leads 2 x 10 mm} \]
\[ L_3 = L_6 = \text{ferroxcube choke (code number 4312 020 36640)} \]
\[ L_4 = 8 \text{ turns enameled Cu wire (0.7 mm); int. diam. 4 mm; leads 2 x 10 mm} \]
\[ L_5 = 5 \text{ turns enameled Cu wire (1.0 mm); winding pitch 1.0 mm; int. diam. 8 mm; leads 2 x 10 mm} \]
\[ L_7 = 7 \text{ turns enameled Cu wire (1.0 mm); winding pitch 1.0 mm; int. diam. 6 mm; leads 2 x 5 mm} \]
\[ R_1 = R_2 = 10 \Omega \text{ carbon} \]
BFS22A

**Graph:**
- **Label:** $P_L$ (W)
- **Range:** 0 to 7.5
- **Label:** $P_S$ (W)
- **Range:** 0 to 1

- **Line:** $V_{CC}$ = 13.5V
- **Line:** $V_{CC}$ = 12.5V

- **Note:** $f$ = 175 MHz
- **Note:** $T_{mb}$ = 25°C
- **Note:** See page 5

**Specifications:**
- $V_{CC} = 13.5V$
- $V_{CC} = 12.5V$
- $f = 175MHz$
- $T_{mb} = 25^\circ C$

**Date:** April 1971
Conditions for R.F. SOAR:

\[ f = 175 \text{ MHz} \]
\[ T_{mb} = 70 \text{ °C} \]
\[ V_{CCnom} = 12.5 \text{ or } 13.5 \text{ V} \]

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graphs above for safe operation at supply voltages other than the nominal. The graphs show the allowable output power under nominal conditions, as a function of the supply overvoltage ratio, with V.S.W.R. as parameter.

The left hand graph applies to the situation in which the drive \((P_S/P_{Snom})\) increases linearly with supply overvoltage ratio. The right hand graph shows the derating factor to be applied when the drive \((P_S/P_{Snom})\) increases as the square of the supply overvoltage ratio \((V_{CC}/V_{CCnom})\). Depending on the operating conditions, the appropriate derating factor may lie in the region between the linear and the square-law functions.
OPERATING NOTE Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 28 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions.

It has a TO-39 metal envelope with the collector connected to the case.

QUICK REFERENCE DATA

R.F. performance up to $T_{mb} = 25 \degree C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_D$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_i$</th>
<th>$\bar{V}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>-</td>
<td>$&gt;10$</td>
<td>$&gt;65$</td>
<td>2.3 + j1.6</td>
<td>8.9 – j18.1</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12.7 mm.

Accessories: 56218 (package); 56245 (distance disc).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to $T_{mb} = 25 \, ^\circ C$

\[ P_{tot} \] 

\[ f > 1 \, MHz \]

Temperature
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink with a boron nitride washer for electrical insulation

\[ R_{th \, j-mb} = 22 \, ^{\circ}C/W \]

\[ R_{th \, mb-h} = 2.5 \, ^{\circ}C/W \]

April 1971
CHARACTERISTICS

T\textsubscript{j} = 25 \textdegree C unless otherwise specified

Collector cut-off current

\[ I\textsubscript{B} = 0; \ V\textsubscript{CE} = 28 \text{ V} \]

\[ I\textsubscript{CEO} < 5 \text{ mA} \]

Breakdown voltages

Collector-base voltage

open emitter, \( I\textsubscript{C} = 1 \text{ mA} \)

\[ V\textsubscript{(BR)CBO} > 65 \text{ V} \]

Collector-emitter voltage

open base, \( I\textsubscript{C} = 10 \text{ mA} \)

\[ V\textsubscript{(BR)CEO} > 36 \text{ V} \]

Emitter-base voltage

open collector; \( I\textsubscript{E} = 1 \text{ mA} \)

\[ V\textsubscript{(BR)EBO} > 4 \text{ V} \]

Transient energy

\[ L = 25 \text{ mH}; \ f = 50 \text{ Hz} \]

open base \( -V\textsubscript{BE} = 1.5 \text{ V}; \ R\textsubscript{BE} = 33 \text{ \Omega} \)

\[ E > 0.5 \text{ mWs} \]

D. C. current gain

\[ I\textsubscript{C} = 500 \text{ mA}; \ V\textsubscript{CE} = 5 \text{ V} \]

\[ h\textsubscript{FE} > 5 \]

Transition frequency

\[ I\textsubscript{C} = 400 \text{ mA}; \ V\textsubscript{CE} = 20 \text{ V} \]

\[ f\textsubscript{T} \text{ typ.} 500 \text{ MHz} \]

Collector capacitance at \( f = 1 \text{ MHz} \)

\[ I\textsubscript{E} = I\textsubscript{E} = 0; \ V\textsubscript{CB} = 30 \text{ V} \]

\[ C\textsubscript{C} \text{ typ.} 10 \text{ pF} \]

Feedback capacitance at \( f = 1 \text{ MHz} \)

\[ I\textsubscript{C} = 25 \text{ mA}; \ V\textsubscript{CE} = 30 \text{ V} \]

\[ C\textsubscript{re} \text{ typ.} 7.5 \text{ pF} \]
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralised common-emitter class B circuit)

\[ V_{CC} = 28 \, V; \, T_{mb} \text{ up to } 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>f(MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_P ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( z_1 ) (( \Omega ))</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>&lt; 0.40</td>
<td>4</td>
<td>&lt; 0.22</td>
<td>&gt; 10</td>
<td>&gt; 65</td>
<td>2.3 + j1.6</td>
<td>8.9 - j18.1</td>
</tr>
</tbody>
</table>

Test circuit

\[ 50\Omega \]

\[ BFS23A \]

\[ C1 = C6 = 4 \text{ to } 29 \, \text{pF} \text{ air trimmer with insulated rotor} \]
\[ C2 = C7 = 4 \text{ to } 29 \, \text{pF} \text{ air trimmer with non-insulated rotor} \]
\[ C3 = 39 \, \text{pF} \text{ ceramic} \]
\[ C4 = 100 \, \text{pF} \text{ ceramic} \]
\[ C5 = 15 \, \text{nF} \text{ polyester} \]
\[ L1 = 1 \text{ turn enamelled Cu wire (1.0 mm); int. diam. 10 mm; leads 2 x 10 mm} \]
\[ L2 = 6 \text{ turns enamelled Cu wire (0.7 mm); int. diam. 4 mm; leads 2 x 10 mm} \]
\[ L3 = L6 = \text{ferroxcube choke (code number 4312 020 36640)} \]
\[ L4 = 8 \text{ turns enamelled Cu wire (0.7 mm); int. diam. 4 mm; leads 2 x 10 mm} \]
\[ L5 = 5 \text{ turns enamelled Cu wire (1.0 mm); winding pitch 1.0 mm; int. diam. 8 mm; leads 2 x 10 mm} \]
\[ L7 = 4 \text{ turns enamelled Cu wire (1.0 mm); winding pitch 1.0 mm; int. diam. 6 mm; leads 2 x 5 mm} \]
\[ R1 = R2 = 10 \, \Omega \text{ carbon} \]
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heatsink temperature as parameter.
**OPERATING NOTE** Below 100 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

---

**Power Gain Versus Frequency (class B Operation)**

- $V_{CC} = 28$ V
- $P_L = 4$ W
- $T_{mb} = 25$ °C
- typ. values

---

**Input Impedance (Series Components) Versus Frequency (class B Operation)**

- $V_{CC} = 28$ V
- $P_L = 4$ W
- $T_{mb} = 25$ °C
- typ. values

---

**Load Impedance (Parallel Components) Versus Frequency (class B Operation)**

- $V_{CC} = 28$ V
- $P_L = 4$ W
- $T_{mb} = 25$ °C
- typ. values
Broadband amplifier modules primarily designed for mobile applications operating directly from 12 V vehicle electrical systems. The module will produce 2.5 W output into a 50 Ω load over the bands 380 to 512 MHz for the BGY22, and 420 to 480 MHz for the BGY22A.

<table>
<thead>
<tr>
<th>Type</th>
<th>Mode of operation</th>
<th>Freq. range (MHz)</th>
<th>$V_B$ (V)</th>
<th>$P_D$ (mW)</th>
<th>$P_L$ (W)</th>
<th>$\eta$ (%)</th>
<th>$Z_S = Z_L$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGY22</td>
<td>c.w.</td>
<td>380 to 512</td>
<td>13,5</td>
<td>50</td>
<td>&gt; 2.5</td>
<td>&gt; 40</td>
<td>50</td>
</tr>
<tr>
<td>BGY22</td>
<td>c.w.</td>
<td>380 to 512</td>
<td>13,5</td>
<td>50</td>
<td>typ. 2.9</td>
<td>typ. 50</td>
<td>50</td>
</tr>
<tr>
<td>BGY22A</td>
<td>c.w.</td>
<td>420 to 480</td>
<td>12,5</td>
<td>50</td>
<td>&gt; 2.5</td>
<td>&gt; 40</td>
<td>50</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-75A

Dimensions in mm

Terminal connections

1 = input lead
2 = $+V_B$
3 = output lead
4 = r.f. and d.c. ground

To ensure good thermal contact between mounting base and heatsink, burrs or thickening at the edges of the heatsink holes should be removed and the package bolted down onto a flat surface.

Devices may be soldered directly into a circuit with a soldering iron at a maximum iron temperature of 245 °C for 10 seconds at least 1 mm from the plastic.

July 1976
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

D.C. voltages (with respect to flange)

Supply terminal
Input terminal
Output terminal

Current
Supply current (d.c.)

Drive power

Supply voltages (with respect to flange)

Current
Supply current (d.c.)

Temperatures

Storage temperature
Operating heatsink temperature

Where $P_{Lnom} = P_L$ at $V_B = 13.5$ V; $Z_L = 50$ Ω (BGY22)
and $P_{Lnom} = P_L$ at $V_B = 12.5$ V; $Z_L = 50$ Ω (BGY22A)
CHARACTERISTICS

$T_h = 25 \degree C$ unless otherwise specified

Reference planes at r.f. input and output terminals are 1 mm from the plastic encapsulation.

Frequency range 380-512 MHz; $V_B = 13.5 \, V$ (BGY22)
Frequency range 420-480 MHz; $V_B = 12.5 \, V$ (BGY22A)

Quiescent current

$P_D = 0$

$P_D = 50 \, mW$

Load power

Load power

$P_D = 50 \, mW$

Efficiency

$P_D = 50 \, mW$

$\eta > 40 \, %$

Supply current

$P_D = 50 \, mW$

Harmonic content

$P_D = 50 \, mW$

Any harmonic is at least $20 \, dB$ down relative to carrier

Input VSWR with respect to $50 \, \Omega$

$P_D = 50 \, mW$

$\text{VSWR} < 2$

Temperature coefficient of $P_L$

$P_D = 50 \, mW; \, T_h = 25 \, to \, 70 \, \degree C$

Stability

$V_B = 10, 5 \, to \, 15 \, V; \, P_D = 10 \, mW \, to \, 100 \, mW$

$T_h = -40 \, to \, +90 \, \degree C$

Output load VSWR $\leq 3$, all phases

Output load VSWR $\leq 10$, all phases

No instabilities

No appreciable instabilities
Typical values

$P_D = 50 \text{ mW}$
$T_h = 25 \degree \text{C}$

$V_B = 15 \text{ V}$

$V_B = 13.5 \text{ V}$

$V_B = 12.5 \text{ V}$

$\eta = \%$

$P_D = 100 \text{ mW}$

$P_D = 50 \text{ mW}$

$P_D = 20 \text{ mW}$
APPLICATION INFORMATION

R.F. performance in c.w. operation; \( T_h = 25 \, ^\circ\text{C} \)

Drive source and load impedance \( Z_S = Z_L = 50 \, \Omega \)

<table>
<thead>
<tr>
<th>Type number</th>
<th>( f ) (MHz)</th>
<th>( V_B ) (V)</th>
<th>( P_D ) (mW)</th>
<th>( P_L ) (W)</th>
<th>( \eta ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGY22</td>
<td>380 to 512</td>
<td>15,0</td>
<td>50</td>
<td>typ. 3,5</td>
<td>typ. 47</td>
</tr>
<tr>
<td>BGY22</td>
<td>380 to 512</td>
<td>13,5</td>
<td>50</td>
<td>&gt; 2,5</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>BGY22</td>
<td>380 to 512</td>
<td>13,5</td>
<td>50</td>
<td>typ. 2,9</td>
<td>typ. 47</td>
</tr>
<tr>
<td>BGY22A</td>
<td>420 to 480</td>
<td>12,5</td>
<td>50</td>
<td>typ. 2,5</td>
<td>typ. 47</td>
</tr>
</tbody>
</table>

The modules are designed to withstand full load mismatch under the following conditions:

\[
P_D = P_{D\text{nom}} + 20\% ; \quad T_h = 70 \, ^\circ\text{C}
\]

\[
V_B = 16,5 \, \text{V (BGY22)}
\]

\[
V_B = 15,0 \, \text{V (BGY22A)}
\]

\[
\text{VSWR} = 50 \text{ at any phase}
\]

where \( P_{D\text{nom}} = P_D \) for 2.5 W module output under nominal conditions.
Typical variation of input impedance with frequency

\[ V_B = 13.5 \text{ V} \]
\[ f = 470 \text{ MHz} \]

Typical variation of power dissipation with load impedance

\[ P_{\text{tot}} = 7.0 \text{ W} \]
\[ V_{\text{SWR}} = 10 \]
$V_B = 13.5 \text{ V}$
$P_D = 50 \text{ mW}$
$f = 470 \text{ MHz}$

Typical variation of load power with load impedance

$V_B = 13.5 \text{ V}$
$P_D = 50 \text{ mW}$
$f = 470 \text{ MHz}$

Typical variation of efficiency with load impedance
U.H.F. POWER AMPLIFIER MODULES

Broadband amplifier modules primarily designed for mobile applications operating directly from 12 V vehicle electrical systems. The modules are suitable for driving directly from the BGY22 and BGY22A respectively, and when so driven will produce 7 W output into a 50 Ω load over the band 380 to 480 MHz for the BGY23, and 7 W over the band 420 to 480 MHz for the BGY23A.

<table>
<thead>
<tr>
<th>Type number</th>
<th>Mode of operation</th>
<th>Freq. range (MHz)</th>
<th>$V_B$ (V)</th>
<th>$P_D$ (W)</th>
<th>$P_L$ (W)</th>
<th>$\eta$ (%)</th>
<th>$Z_S = Z_L$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGY23</td>
<td>c.w.</td>
<td>380 - 480</td>
<td>13.5</td>
<td>2.5</td>
<td>&gt; 7.0</td>
<td>&gt; 60</td>
<td>50</td>
</tr>
<tr>
<td>BGY23</td>
<td>c.w.</td>
<td>380 - 480</td>
<td>13.5</td>
<td>2.5</td>
<td>typ. 8.3</td>
<td>typ. 71</td>
<td>50</td>
</tr>
<tr>
<td>BGY23</td>
<td>c.w.</td>
<td>480 - 512</td>
<td>13.5</td>
<td>2.5</td>
<td>typ. 7.5</td>
<td>typ. 69</td>
<td>50</td>
</tr>
<tr>
<td>BGY23A</td>
<td>c.w.</td>
<td>420 - 480</td>
<td>12.5</td>
<td>2.5</td>
<td>&gt; 7.0</td>
<td>&gt; 60</td>
<td>50</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-75A

Terminal connections
1 = input lead
2 = $+V_B$
3 = output lead
4 = r.f. and d.c. ground

To ensure good thermal contact between mounting base and heatsink, burrs or thickening at the edges of the heatsink holes should be removed and the package bolted down onto a flat surface.

Devices may be soldered directly into a circuit with a soldering iron at a maximum iron temperature of 245 °C for 10 seconds at least 1 mm from the plastic.
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134)

D.C. voltages (with respect to flange)

Supply terminal

<table>
<thead>
<tr>
<th>VB</th>
<th>max. 18 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>±VI</td>
<td>max. 0.5 V</td>
</tr>
<tr>
<td>±VO</td>
<td>max. 25 V</td>
</tr>
</tbody>
</table>

Input terminal (no external d.c. connection)

Output terminal

Current

Supply current (d.c.)

Drive power

\[ V_B = 13.5 \text{ V}; Z_L = 50 \Omega \]

\[ P_D \text{ max.} \quad 3.5 \text{ W} \]

Temperatures

Storage temperature

Operating heatsink temperature

\[ T_{stg} \quad -40 \text{ to } +100 \text{ °C} \]

\[ T_h \text{ max.} \quad 90 \text{ °C} \]

---

Where \( P_{Lnom} = P_L \) at \( V_B = 13.5 \text{ V}; Z_L = 50 \Omega \) (BGY23)

and \( P_{Lnom} = P_L \) at \( V_B = 12.5 \text{ V}; Z_L = 50 \Omega \) (BGY23A)
CHARACTERISTICS

Reference planes at r.f. input and output terminals are 1 mm from the plastic encapsulation.

Frequency range 380-512 MHz; $V_B = 13.5$ V (BGY23)
Frequency range 420-480 MHz; $V_B = 12.5$ V (BGY23A)

Quiescent current

$P_D = 0$

Load power

$P_D = 2.5$ W: $f =$ 380-480 MHz  
$P_D = 2.5$ W: $f =$ 480-512 MHz  
$P_D = 2.5$ W: $f =$ 420-480 MHz

$P_D = 2.5$ W; $f =$ 380-480 MHz  
$P_D = 2.5$ W; $f =$ 480-512 MHz  
$P_D = 2.5$ W; $f =$ 420-480 MHz

Efficiency

$P_D = 2.5$ W

Supply current

$P_D = 2.5$ W

Harmonic content

$P_D = 2.5$ W

Input VSWR with respect to 50 $\Omega$

$P_D = 2.5$ W

Temperature coefficient of $P_L$

$P_D = 2.5$ W; $T_h =$ 25 to 70 $^\circ$C

Stability

$V_B =$ 10.5 V to 15 V; $P_D =$ 1 W to 3.5 W  
$T_h =$ -40 $^\circ$C to +90 $^\circ$C  
Output load VSWR $\leq$ 3, all phases  
Output load VSWR $\leq$ 10, all phases

Any harmonic is at least 20 dB down relative to carrier

$VSWR < 2$

$\eta > 60 \%$

$I_{tot}$ typ. 900 mA

$P_L$ typ. 7,0 to 9,5 W

$P_L$ typ. 7,5 W

$P_L$ typ. 7,0 to 9,5 W

$P_L$ typ. -20 mW/$^\circ$C

$T_h = 25$ $^\circ$C unless otherwise specified
typical values
$P_D = 2.5 \text{ W}$
$T_h = 25 \degree \text{ C}$

$V_B = 15 \text{ V}$
$13.5 \text{ V}$
$12.5 \text{ V}$

$P_D = 3.0 \text{ W}$
$2.5 \text{ W}$
$2.0 \text{ W}$

$V_B = 13.5 \text{ V}$
$T_h = 25 \degree \text{ C}$

$P = 2.5 \text{ W}$
$3.0 \text{ W}$
$2.0 \text{ W}$
APPLICATION INFORMATION

R.F. performance in c.w. operation: \( T_h = 25 \, ^\circ C \)

Drive source and load impedance \( Z_S = Z_L = 50 \, \Omega \)

<table>
<thead>
<tr>
<th>Type number</th>
<th>( f ) (MHz)</th>
<th>( V_B ) (V)</th>
<th>( P_D ) (W)</th>
<th>( P_L ) (W)</th>
<th>( \eta ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGY23</td>
<td>380 to 512</td>
<td>15,0</td>
<td>2,5</td>
<td>typ. 9,0</td>
<td>typ. 65</td>
</tr>
<tr>
<td>BGY23</td>
<td>380 to 480</td>
<td>13,5</td>
<td>2,5</td>
<td>&gt; 7,0</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>BGY23A</td>
<td>380 to 480</td>
<td>13,5</td>
<td>2,5</td>
<td>typ. 8,3</td>
<td>typ. 69</td>
</tr>
<tr>
<td>BGY23</td>
<td>480 to 512</td>
<td>13,5</td>
<td>2,5</td>
<td>typ. 7,5</td>
<td>typ. 70</td>
</tr>
<tr>
<td>BGY23</td>
<td>380 to 512</td>
<td>12,5</td>
<td>2,5</td>
<td>typ. 7,4</td>
<td>typ. 70</td>
</tr>
<tr>
<td>BGY23A</td>
<td>420 to 480</td>
<td>12,5</td>
<td>2,5</td>
<td>&gt; 7,0</td>
<td>&gt; 60</td>
</tr>
</tbody>
</table>

Connection of the BGY22/BGY22A to the BGY23/BGY23A respectively can be either by 50 \( \Omega \) transmission line or directly with a total lead length not greater than 2 \( \text{mm} \).

The modules are designed to withstand full load mismatch under the following conditions:

\[
P_D = P_{D\text{nom}} + 20\%; \quad T_h = 70 \, ^\circ C
\]

\[
V_B = 16,5 \, V \, (\text{BGY23})
\]

\[
V_B = 15,0 \, V \, (\text{BGY23A})
\]

\[
\text{VSWR} = 50 \, \text{at any phase}
\]

where \( P_{D\text{nom}} = P_D \) for 7,0 W module output under nominal conditions.
Typical variation of input impedance with frequency

$V_B = 13.5 \text{ V}$

$f = 470 \text{ MHz}$

BGY22/23 or BGY22A/23A cascaded amplifier

Typical variation of overall power dissipation with load impedance
$V_B = 13.5 \text{ V}$

$f = 470 \text{ MHz}$

BGY22/23 or BGY22A/23A cascaded amplifier

Typical variation of load power with load impedance

BGY22/23 or BGY22A/23A cascaded amplifier

Typical variation of overall efficiency with load impedance
V.H.F. POWER AMPLIFIER MODULES

A range of broadband amplifier modules designed for mobile communications equipments, operating directly from 12 V vehicle electrical systems. The devices will produce 18 W output into a 50 Ω load. The modules consist of a two stage r.f. amplifier using n-p-n transistor chips, together with lumped-element matching components.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>type number</th>
<th>mode of operation</th>
<th>frequency range f (MHz)</th>
<th>nominal supply voltages $V_{B1} = V_{B2}$ (V)</th>
<th>drive power $P_D$ (mW)</th>
<th>load power $P_L$ (W)</th>
<th>nominal input impedance $z_I$ (Ω)</th>
<th>nominal load impedance $Z_L$ (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGY32</td>
<td>c.w.</td>
<td>68 to 88</td>
<td>12.5</td>
<td>100</td>
<td>&gt; 18 typ 23</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>BGY33</td>
<td>c.w.</td>
<td>80 to 108</td>
<td>12.5</td>
<td>100</td>
<td>&gt; 18 typ 22</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>BGY35</td>
<td>c.w.</td>
<td>132 to 156</td>
<td>12.5</td>
<td>150</td>
<td>&gt; 18 typ 22</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>BGY36</td>
<td>c.w.</td>
<td>148 to 174</td>
<td>12.5</td>
<td>150</td>
<td>&gt; 18 typ 21</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

CIRCUIT DIAGRAM

CAUTION These devices incorporate beryllium oxide, the dust of which is toxic. The devices are entirely safe provided that they are not dismantled.
Mounting and soldering recommendations

To ensure good thermal transfer the module should be mounted using heatsink compound onto a heatsink with a flat surface; if an isolation washer is used heatsink compound should be used on both sides of the insulator. Burrs and thickening of the holes in the heatsink should be removed and 3 mm bolts tightened to torques of 0.5 Nm minimum.

Devices may be soldered directly into a circuit with a soldering iron at maximum iron temperature of 245 °C for 10 seconds at least 1 mm from the plastic.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

D.C. voltages (with respect to flange)

| D.C. supply terminals | V_{B1} and V_{B2} | max 15 V
| R.F. input terminal   | ±V_{I}            | max 25 V
| R.F. output terminal  | ±V_{O}            | max 25 V

Power

| Input drive power BGY32 and BGY33 | P_{D} | max 200 mW
| Input drive power BGY35 and BGY36 | P_{D} | max 300 mW
| Load power                      | P_{L} | max 30 W

Temperatures

| Storage temperature | T_{stg} | -40 to 100 °C
| Operating heatsink temperature | T_{h} | max 90 °C

July 1977
CHARACTERISTICS

$T_H = 25 \degree C$

Quiescent current

$V_{B1} = V_{B2} = 12.5 \, V; \, P_D = 0;$

$R_S = R_L = 50 \, \Omega$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BGY32</th>
<th>BGY33</th>
<th>BGY35</th>
<th>BGY36</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{BQ1}$ typ</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>$I_{BQ2}$ typ</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>Frequency range</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f$ &gt; 68 MHz</td>
<td>80</td>
<td>132</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>$f$ &lt; 88 MHz</td>
<td>108</td>
<td>156</td>
<td>174</td>
<td></td>
</tr>
</tbody>
</table>

Load power

$V_{B1} = V_{B2} = 12.5 \, V; \, R_S = R_L = 50 \, \Omega$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BGY32</th>
<th>BGY33</th>
<th>BGY35</th>
<th>BGY36</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_L$ typ</td>
<td>18</td>
<td>18</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\eta$ typ</td>
<td>40</td>
<td>40</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$P_L$ typ</td>
<td>23</td>
<td>22</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\eta$ typ</td>
<td>50</td>
<td>50</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Harmonic output

Any single harmonic will be at least 25 dB down relative to carrier

Input VSWR with respect to 50 $\Omega$

Stability

The module is stable with load VSWR up to 3 (all phases) when operated with matched output power greater than 6 W.

Ruggedness

The modules are capable of withstanding load mismatch of up to 50 VSWR for short period overload conditions, with $P_D$, $V_{B1}$ and $V_{B2}$ at maximum values providing the combination does not result in the matched r.f. output power rating being exceeded.

APPLICATION INFORMATION

Supply

An electrolytic capacitor of 10 $\mu F$ (25 V), in parallel with a polyester capacitor of 100 nF to earth, is recommended as decoupling arrangement for each power supply pin.

Power rating

In general it is recommended that the output power from the module under nominal design conditions should not exceed 23 W in order to provide adequate safety margin under fault conditions.

Gain control

Power output can be controlled by variation of the driver stage supply voltage $V_{B1}$. The supply required is a voltage regulator with a current rating of 0.75 A, and an output voltage range of 3 V to 12 V.
Typical values for BGY32 and BGY33:

- $V_{B1} = V_{B2} = 12.5 \text{ V}$
- $P_D = 100 \text{ mW}$

Graphs showing $d_2$ and $d_3$ vs. $f$ (MHz) for BGY32.

Typical values for BGY33:

- $P_L = 23 \text{ W}$
- $V_{B1} = V_{B2} = 12.5 \text{ V}$

Graphs showing $P_L$ (W) vs. $f$ (MHz) for BGY33.
V.H.F. power amplifier modules

V\textsubscript{B1} = V\textsubscript{B2} = 12.5 V
P\textsubscript{D} = 100 mW
typical values

\begin{align*}
P\textsubscript{L} &\text{(W)} \\
V\textsubscript{B1} &\text{(V)}
\end{align*}

\begin{align*}
P\textsubscript{L} &\text{(W)} \\
f &\text{(MHz)}
\end{align*}

\begin{align*}
d\textsubscript{2} &\text{(dB)} \\
f &\text{(MHz)}
\end{align*}

\begin{align*}
\Delta G\textsubscript{D} &\text{(dB)} \\
T\textsubscript{h} &\text{(°C)}
\end{align*}

July 1977
### Typical Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>150 mW</td>
</tr>
<tr>
<td>$V_{B1}$</td>
<td>13.8 V</td>
</tr>
<tr>
<td>$V_{B2}$</td>
<td>12.5 V</td>
</tr>
<tr>
<td>$V_{B1} = V_{B2}$</td>
<td>12.5 V</td>
</tr>
</tbody>
</table>

### Graphs

1. **Graph 1**
   - Title: $P_L$ vs. $f$ (MHz)
   - Parameters: $V_{B1} = V_{B2} = 12.5$ V, $P_D = 150$ mW

2. **Graph 2**
   - Title: $P_L$ vs. $f$ (MHz)
   - Parameters: $V_{B1} = V_{B2} = 12.5$ V, $P_D = 150$ mW

3. **Graph 3**
   - Title: Efficiency ($\eta$) vs. $f$ (MHz)
   - Parameters: $V_{B1} = V_{B2} = 12.5$ V, $P_D = 150$ mW

4. **Graph 4**
   - Title: Efficiency ($\eta$) vs. $f$ (MHz)
   - Parameters: $V_{B1} = V_{B2} = 12.5$ V, $P_D = 150$ mW
V.H.F. power amplifier modules

**V_B1 = V_B2 = 12.5 V**

**P_D = 150 mW**

Typical values

**P_L = 23 W**

Typical values

**f =**

- 161 MHz
- 174 MHz
- 148 MHz
$V_{B2} = 12.5 \text{ V}$
$P_D = 150 \text{ mW}$
typical values

$f = 161 \text{ MHz}$
$174 \text{ MHz}$
$148 \text{ MHz}$

$P_L$ (W)

$V_{B1} = V_{B2} = 12.5 \text{ V}$
$P_D = 150 \text{ mW}$
typical values

$P_L$ (W)

$\eta$ (%)

$V_{B1} = V_{B2} = 12.5 \text{ V}$
$P_L = 23 \text{ W}$
typical values

$\Delta G_p$ (dB)

$T_H (\text{\textdegree C})$

10 July 1977
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, h.f. and v.h.f. transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_L$ Ω</th>
<th>$\overline{V_L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>8</td>
<td>&gt; 9,0</td>
<td>&gt; 70</td>
<td>2,8 + j1,2</td>
<td>76 − j16</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>8</td>
<td>typ. 10,5</td>
<td>typ. 75</td>
<td>−</td>
<td>−</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

Torque on screw: min. 0,6 Nm (6 kg cm) max. 0,75 Nm (7,5 kg cm)
Recommended screw: raised cheese-head 4-40 UNC/2A
Heatsink compound must be applied sparingly and evenly.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
  peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25$ °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CESM}$</td>
<td>max. 36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{CEO}$</td>
<td>max. 18 V</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{EBO}$</td>
<td>max. 4 V</td>
</tr>
<tr>
<td>Collector current (AV)</td>
<td>$I_{C(AV)}$</td>
<td>max. 1,5 A</td>
</tr>
<tr>
<td>Collector current (peak)</td>
<td>$I_{CM}$</td>
<td>max. 4,0 A</td>
</tr>
<tr>
<td>R.F. power dissipation</td>
<td>$P_{rf}$</td>
<td>max. 20 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>Operating junction temp.</td>
<td>$T_j$</td>
<td>max. 200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; $V_{CE} \leq 16,5$ V; $f > 1$ MHz.

I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 8 W; $T_{mb} = 72,4$ °C, i.e. $T_h = 70$ °C)

From junction to mounting base (d.c. dissipation) $R_{th j-mb (dc)} = 10,7$ °C/W
From junction to mounting base (r.f. dissipation) $R_{th j-mb (rf)} = 8,6$ °C/W
From mounting base to heatsink $R_{th mb-h} = 0,3$ °C/W

September 1978
V.H.F. power transistor

**CHARACTERISTICS**

\( T_j = 25 \, \text{°C} \)

- **Collector-emitter breakdown voltage**
  \( V_{BE} = 0; \, I_C = 5 \, \text{mA} \)
  \( V_{(BR)CES} > 36 \, \text{V} \)

- **Collector-emitter breakdown voltage**
  open base; \( I_C = 25 \, \text{mA} \)
  \( V_{(BR)CEO} > 18 \, \text{V} \)

- **Emitter-base breakdown voltage**
  open collector; \( I_E = 1 \, \text{mA} \)
  \( V_{(BR)EBO} > 4 \, \text{V} \)

- **Collector cut-off current**
  \( V_{BE} = 0; \, V_{CE} = 18 \, \text{V} \)
  \( I_{CES} < 2 \, \text{mA} \)

- **Second breakdown energy**
  \( L = 25 \, \text{mH}; \, f = 50 \, \text{Hz} \)
  \( R_{BE} = 10 \, \Omega \)
  \( E_{SBO} > 0,5 \, \text{mA} \)
  \( E_{SBR} > 0,5 \, \text{mJ} \)

- **D.C. current gain** *
  \( I_C = 0,75 \, \text{A}; \, V_{CE} = 5 \, \text{V} \)
  \( h_{FE} \) typ. 40
  \( 10 \) to \( 100 \)

- **Collector-emitter saturation voltage** *
  \( I_C = 2 \, \text{A}; \, I_B = 0,4 \, \text{A} \)
  \( V_{CEsat} \) typ. 0,85 V

- **Transition frequency at \( f = 100 \, \text{MHz} \)** *
  \( I_E = 0,75 \, \text{A}; \, V_{CB} = 13,5 \, \text{V} \)
  \( f_T \) typ. 950 MHz
  \( f_T \) typ. 850 MHz

- **Collector capacitance at \( f = 1 \, \text{MHz} \)**
  \( I_E = I_E = 0; \, V_{CB} = 13,5 \, \text{V} \)
  \( C_c \) typ. 16,5 pF

- **Feedback capacitance at \( f = 1 \, \text{MHz} \)**
  \( I_C = 100 \, \text{mA}; \, V_{CE} = 13,5 \, \text{V} \)
  \( C_{re} \) typ. 12 pF

- **Collector-flange capacitance**
  \( C_{cf} \) typ. 2 pF

* Measured under pulse conditions: \( t_p \leq 200 \, \mu \text{s}; \, \delta \leq 0,02. \)

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3
Fig. 4  Typical values; $T_j = 25 \, ^\circ C$.

Fig. 5  $I_E = I_e = 0$; $f = 1 \, MHz$; $T_j = 25 \, ^\circ C$.

Fig. 6  Typical values; $f = 100 \, MHz$; $T_j = 25 \, ^\circ C$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V_Ce (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_P (dB)</th>
<th>I_C (A)</th>
<th>n (%)</th>
<th>Z_I (Ω)</th>
<th>Y_L (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>8</td>
<td>&lt; 1,0</td>
<td>&gt; 9,0</td>
<td>&lt; 0,85</td>
<td>&gt; 70</td>
<td>2,8 + j1,2</td>
<td>76 – j16</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- C2 = C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- C3a = C3b = 47 pF ceramic capacitor (500 V)
- C4 = 120 pF ceramic capacitor
- C5 = 100 nF polyester capacitor
- C6 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- L1 = 2 turns Cu wire (1,6 mm); int. dia. 4,5 mm; length 5,7 mm; leads 2 x 5 mm
- L2 = 100 nH; 7 turns closely wound enamedled Cu wire (0,5 mm); int. dia. 3 mm
- L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
- L6 = 3 turns Cu wire (1,6 mm); int. dia. 7,5 mm; length 7,5 mm; leads 2 x 5 mm
- L7 = 3 turns Cu wire (1,6 mm); int. dia. 6,5 mm; length 7,4 mm; leads 2 x 5 mm
- L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16”.
- R1 = 10 Ω carbon resistor
- R2 = 4,7 Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; \( f = 175 \text{ MHz} \):
- \( V_{CE} = 13.5 \text{ V} \);
- \( V_{CE} = 12.5 \text{ V} \).

Fig. 10 Typical values; \( f = 175 \text{ MHz} \):
- \( V_{CE} = 13.5 \text{ V} \);
- \( V_{CE} = 12.5 \text{ V} \).

Fig. 11 R.F. SOAR (short-time operation during mismatch); \( f = 175 \text{ MHz} \);
- \( T_h = 70 \degree \text{C} \);
- \( R_{th \_mb-h} = 0.3 \text{ °C/W} \);
- \( V_{CE\_nom} = 13.5 \text{ V} \) or \( 12.5 \text{ V} \);
- \( P_S = P_{Snom} \) at \( V_{CE\_nom} \) and \( V_{SWR} = 1 \).

Note to Fig. 11:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions \( (V_{SWR} = 1) \), as a function of the expected supply over-voltage ratio with \( V_{SWR} \) as parameter.

The graph applies to the situation in which the drive \( (P_S/P_{Snom}) \) increases linearly with supply over-voltage ratio.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13 and 14:
Typical values: $V_{CE} = 13.5 \, \text{V}$; $P_L = 8 \, \text{W}$; $T_h = 25 \, ^\circ \text{C}$.

OPERATING NOTE
Below 70 MHz a base-emitter resistor of 10 $\Omega$ is recommended to avoid oscillation. This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, h.f. and v.h.f. transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25$ °C in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$Z_L$ $\Omega$</th>
<th>$V_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>15</td>
<td>$&gt; 8,0$</td>
<td>$&gt; 60$</td>
<td>2,3 + j2,2</td>
<td>130 - j4,4</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>15</td>
<td>typ. 7,5</td>
<td>typ. 67</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

- Ceramic dimensions:
  - 0,17 mm (cabinet)
  - 0,11 mm (cabinet)

- Metal dimensions:
  - 5 mm (min)
  - 3,2 mm
  - 2,9 mm
  - 2,54 mm (min)
  - 7,25 mm (max)

- Torque on screw: min. 0,6 Nm (6 kg cm)
  - max. 0,75 Nm (7,5 kg cm)

- Recommended screw: raised cheese-head
  - 4-40 UNC/2A

- BeO disc must be applied sparingly and evenly.

CAUTION  This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \( V_{BE} = 0 \)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); \( f > 1 \) MHz

R.F. power dissipation \( (f > 1 \) MHz); \( T_{mb} = 25 \) °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage (peak value)</td>
<td>( V_{CESM} )</td>
<td>36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>( V_{CEO} )</td>
<td>18 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>( V_{EBO} )</td>
<td>4 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>( I_{C(AV)} )</td>
<td>3 A</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>( I_{CM} )</td>
<td>8 A</td>
</tr>
<tr>
<td>R.F. power dissipation</td>
<td>( P_{rf} )</td>
<td>36 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>( T_{j} )</td>
<td>max. 200 °C</td>
</tr>
</tbody>
</table>

![Fig. 2 D.C. SOAR.](image)

![Fig. 3 R.F. power dissipation; \( V_{CE} \leq 16.5 \) V; \( f > 1 \) MHz.](image)

**THERMAL RESISTANCE** (dissipation = 15 W; \( T_{mb} = 74.5 \) °C, i.e. \( T_{h} = 70 \) °C)

- From junction to mounting base (d.c. dissipation)
- From junction to mounting base (r.f. dissipation)
- From mounting base to heatsink

<table>
<thead>
<tr>
<th>Resistance Type</th>
<th>Formula</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{th j-mb(dc)} )</td>
<td>6.55 °C/W</td>
<td></td>
</tr>
<tr>
<td>( R_{th j-mb(rf)} )</td>
<td>4.95 °C/W</td>
<td></td>
</tr>
<tr>
<td>( R_{th mb-h} )</td>
<td>0.3 °C/W</td>
<td></td>
</tr>
</tbody>
</table>
CHARACTERISTICS

$T_j = 25 \, ^\circ C$

Collector-emitter breakdown voltage
$V_{BE} = 0; \, I_C = 10 \, mA$

Collector-emitter breakdown voltage
open base; $I_C = 50 \, mA$

Emitter-base breakdown voltage
open collector; $I_E = 4 \, mA$

Collector out-off current
$V_{BE} = 0; \, V_{CE} = 18 \, V$

Second breakdown energy; $L = 25 \, mH; \, f = 50 \, Hz$
open base
$R_{BE} = 10 \, \Omega$

D.C. current gain *
$I_C = 1,5 \, A; \, V_{CE} = 5 \, V$

Collector-emitter saturation voltage *
$I_C = 4,5 \, A; \, I_B = 0,9 \, A$

Transition frequency at $f = 100 \, MHz$

$-I_E = 1,5 \, A; \, V_{CB} = 13,5 \, V$

$-I_E = 4,5 \, A; \, V_{CB} = 13,5 \, V$

Collector capacitance at $f = 1 \, MHz$
$I_E = I_B = 0; \, V_{CB} = 13,5 \, V$

Feedback capacitance at $f = 1 \, MHz$
$I_C = 200 \, mA; \, V_CE = 13,5 \, V$

Collector-flange capacitance

$V_{(BR)CES} > 36 \, V$

$V_{(BR)CEO} > 18 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 4 \, mA$

$E_{SBO} > 2,5 \, mJ$

$E_{SBR} > 2,5 \, mJ$

$h_{FE} \: \text{typ.} \: 40$

$V_{CE\text{sat}} \: \text{typ.} \: 1,0 \, V$

$f_T \: \text{typ.} \: 850 \, MHz$

$f_T \: \text{typ.} \: 800 \, MHz$

$C_c \: \text{typ.} \: 32 \, pF$

$C_{re} \: \text{typ.} \: 23 \, pF$

$C_{cf} \: \text{typ.} \: 2 \, pF$

* Measured under pulse conditions: $t_p < 200 \, \mu s; \, \delta < 0,02$. 

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Fig. 4 Typical values; $T_j = 25 \, ^\circ C$.

Fig. 5 $I_E = I_C = 0$; $f = 1 \, MHz$; $T_j = 25 \, ^\circ C$.

Fig. 6 Typical values; $f = 100 \, MHz$; $T_j = 25 \, ^\circ C$.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[
T_h = 25 ^\circ C
\]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_i ) (( \Omega ))</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>15</td>
<td>&lt; 2,4</td>
<td>&gt; 8,0</td>
<td>&lt; 1,85</td>
<td>&gt; 60</td>
<td>2,3 + j2,2</td>
<td>130 - j4,4</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>15</td>
<td></td>
<td>typ. 7,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- \( C1 = 2,5 \) to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( C2 = C7 = 4 \) to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- \( C3a = C3b = 47 \) pF ceramic capacitor (500 V)
- \( C4 = 120 \) pF ceramic capacitor
- \( C5 = 100 \) nF polyester capacitor
- \( C6 = 5 \) to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- \( L1 = 2 \) turns Cu wire (1,6 mm); int. dia. 4,5 mm; length 5,7 mm; leads 2 x 5 mm
- \( L2 = 100 \) nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm
- \( L3 = L8 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L4 = L5 = \) strip (12 mm x 6 mm); taps for \( C3a \) and \( C3b \) at 5 mm from transistor
- \( L6 = 3 \) turns Cu wire (1,6 mm); int. dia. 7,5 mm; length 7,5 mm; leads 2 x 5 mm
- \( L7 = 3 \) turns Cu wire (1,6 mm); int. dia. 6,5 mm; length 7,4 mm; leads 2 x 5 mm
- \( L4 \) and \( L5 \) are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16”.

- \( R1 = 10 \) \( \Omega \) carbon resistor
- \( R2 = 4,7 \) \( \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; \( f = 175 \text{ MHz} \);
- \( V_{CE} = 13.5 \text{ V} \);
- - - \( V_{CE} = 12.5 \text{ V} \).

Fig. 10 Typical values; \( f = 175 \text{ MHz} \);
- \( V_{CE} = 13.5 \text{ V} \);
- - - \( V_{CE} = 12.5 \text{ V} \).

Fig. 11 R.F. SOAR (short-time operation during mismatch); \( f = 175 \text{ MHz} \); \( T_{h} = 70 \text{ °C} \);
\( R_{\text{th mb-h}} = 0.3 \text{ °C/W} \); \( V_{\text{CEnom}} = 13.5 \text{ V} \) or
12.5 V; \( P_{S} = P_{\text{Snom}} \) at \( V_{\text{CEnom}} \) and \( \text{VSWR} = 1 \).

Note to Fig. 11:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (\( \text{VSWR} = 1 \)), as a function of the expected supply over-voltage ratio with \( \text{VSWR} \) as parameter.

The graph applies to the situation in which the drive (\( P_{S}/P_{\text{Snom}} \)) increases linearly with supply over-voltage ratio.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13 and 14:
Typical values: $V_{CE} = 13.5$ V; $P_L = 15$ W; $T_H = 25$ °C.

OPERATING NOTE
Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation.
This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8” flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to \( T_h = 25 \) °C in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>( V_{CE} ) V</th>
<th>( f ) MHz</th>
<th>( P_{L} ) W</th>
<th>( G_p ) dB</th>
<th>( \eta ) %</th>
<th>( \overline{z}_t ) Ω</th>
<th>( V_L ) mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>8</td>
<td>&gt; 12</td>
<td>&gt; 65</td>
<td>1,8 + j0,7</td>
<td>18 – j20</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

Torque on screw: min. 0,6 Nm (6 kg cm) max. 0,75 Nm (7.5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.

CAUTION  This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage (V_{BE} = 0) peak value</td>
<td>V_{CESM} max. 65 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_{CEO} max. 36 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>V_{EBO} max. 4 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>I_{C(AV)} max. 0,9 A</td>
</tr>
<tr>
<td>Collector current (peak value); f &gt; 1 MHz</td>
<td>I_{CM} max. 2,5 A</td>
</tr>
<tr>
<td>R.F. power dissipation (f &gt; 1 MHz); T_{mb} = 25 °C</td>
<td>P_{rf} max. 20 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg} -65 to + 150 °C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>T_{j} max. 200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V; f > 1 MHz.
I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 8 W; T_{mb} = 72,4 °C, i.e. T_{h} = 70 °C)

- From junction to mounting base (d.c. dissipation): R_{th j-mb(dc)} = 10,7 °C/W
- From junction to mounting base (r.f. dissipation): R_{th j-mb(rf)} = 8,6 °C/W
- From mounting base to heatsink: R_{th mb-h} = 0,3 °C/W
**CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{BE}$</td>
<td>0 mV</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage open base</td>
<td>$I_C$</td>
<td>2 mA</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage open base</td>
<td>$V_{CE}$</td>
<td>36 V</td>
</tr>
<tr>
<td>Emitter-base breakdown voltage open collector</td>
<td>$I_E$</td>
<td>1 mA</td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td>$I_{CES}$</td>
<td>&lt; 1 mA</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage open base</td>
<td>$V_{BE}$</td>
<td>0 mV</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage open base</td>
<td>$V_{CE}$</td>
<td>36 V</td>
</tr>
<tr>
<td>Collector-cut-off current</td>
<td>$R_{BE}$</td>
<td>10 Ω</td>
</tr>
<tr>
<td>D.C. current gain</td>
<td>$I_C$</td>
<td>0.4 A</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>$I_C$</td>
<td>1.25 A</td>
</tr>
<tr>
<td>Transition frequency at $f = 100$ MHz</td>
<td>$f_T$</td>
<td>600 MHz</td>
</tr>
<tr>
<td>Collector capacitance at $f = 1$ MHz</td>
<td>$C_C$</td>
<td>10 pF</td>
</tr>
<tr>
<td>Feedback capacitance at $f = 1$ MHz</td>
<td>$C_{re}$</td>
<td>7.1 pF</td>
</tr>
<tr>
<td>Collector-flange capacitance</td>
<td>$C_{cf}$</td>
<td>2 pF</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p \leq 200 \mu s; \delta \leq 0.02$. 

*Typo* indicates a typographical error or an intended value.
Fig. 4 Typical values; $T_j = 25 \, ^\circ C$.

Fig. 5 $I_E = I_e = 0$; $f = 1 \, MHz$; $T_j = 25 \, ^\circ C$.

Fig. 6 Typical values; $f = 100 \, MHz$; $T_j = 25 \, ^\circ C$. 
V.H.F. power transistor

APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( \overline{Z}_i ) (( \Omega ))</th>
<th>( \overline{V}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>8</td>
<td>&lt; 0,5</td>
<td>&gt; 12</td>
<td>&lt; 0,44</td>
<td>&gt; 65</td>
<td>1,8 + j0,7</td>
<td>18 − j20</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

C1 = C6 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3 = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor
C5 = 100 nF polyester capacitor
C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
L1 = 1 turn Cu wire (1,6 mm); int. dia. 8,4 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm
L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); tap for C3 at 5 mm from transistor
L6 = 6 turns enamelled Cu wire (1,0 mm); int. dia. 9,0 mm; length 9,2 mm; leads 2 x 5 mm
L7 = 4 turns enamelled Cu wire (1,0 mm); int. dia. 8,2 mm; length 5,0 mm; leads 2 x 5 mm
L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
R1 = 10 \( \Omega \) carbon resistor
R2 = 4,7 \( \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

Fig. 10 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

Fig. 11 R.F. SOAR; c.w. class-B operation; $f = 175$ MHz; $V_{CE} = 28$ V; $R_{th_{mb-h}} = 0.3$ °C/W.

The graph shows the permissible output power under nominal conditions ($VSWR = 1$) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13, and 14.
Typical values: $V_{CE} = 28$ V; $P_L = 8$ W; $T_h = 25^\circ$C.

OPERATING NOTE
Below 100 MHz a base-emitter resistor of 10 $\Omega$ is recommended to avoid oscillation.
This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8” flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_l$ $\Omega$</th>
<th>$\mathcal{V}_l$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>15</td>
<td>&gt; 10</td>
<td>&gt; 65</td>
<td>1,4 + j1,85</td>
<td>33 – j27,5</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

Torque on screw: min. 0,6 Nm (6 kg cm) max. 0,75 Nm (7,5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
  peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)
Collector current (average)
Collector current (peak value); f > 1 MHz
R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C
Storage temperature
Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CESM} max.</td>
<td>65 V</td>
</tr>
<tr>
<td>V_{CEO} max.</td>
<td>36 V</td>
</tr>
<tr>
<td>V_{EBO} max.</td>
<td>4 V</td>
</tr>
<tr>
<td>I_{CM} max.</td>
<td>1.75 A</td>
</tr>
<tr>
<td>I_{CM} max.</td>
<td>5.0 A</td>
</tr>
<tr>
<td>P_{rf} max.</td>
<td>36 W</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>T_{j} max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_{rf} (W)</td>
<td></td>
</tr>
<tr>
<td>V_{CE} (V)</td>
<td></td>
</tr>
<tr>
<td>I_{C} (A)</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V; f > 1 MHz.
I  Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 15 W; T_{mb} = 74.5 °C, i.e. T_{h} = 70 °C)
From junction to mounting base (d.c. dissipation) 
R_{th j-mb(dc)} = 6.55 °C/W
From junction to mounting base (r.f. dissipation)
R_{th j-mb(rf)} = 4.95 °C/W
From mounting base to heatsink
R_{th mb-h} = 0.3 °C/W
CHARACTERISTICS

\( T_j = 25 \, ^\circ\text{C} \)

Collector-emitter breakdown voltage
\( V_{BE} = 0; \, I_C = 5 \, \text{mA} \)

Collector-emitter breakdown voltage
open base; \( I_C = 25 \, \text{mA} \)

Emitter-base breakdown voltage
open collector; \( I_E = 2 \, \text{mA} \)

Collector cut-off current
\( V_{BE} = 0; \, V_{CE} = 36 \, \text{V} \)

Second breakdown energy; \( L = 25 \, \text{mH}; \, f = 50 \, \text{Hz} \)
open base
\( R_{BE} = 10 \, \Omega \)

D.C. current gain *
\( I_C = 0,7 \, \text{A}; \, V_{CE} = 5 \, \text{V} \)

Collector-emitter saturation voltage *
\( I_C = 2 \, \text{A}; \, I_B = 0,4 \, \text{A} \)

Transition frequency at \( f = 100 \, \text{MHz} \)

\(-I_E = 0,7 \, \text{A}; \, V_{CB} = 28 \, \text{V} \)

\(-I_E = 2 \, \text{A}; \, V_{CB} = 28 \, \text{V} \)

Collector capacitance at \( f = 1 \, \text{MHz} \)
\( I_E = I_S = 0; \, V_{CB} = 28 \, \text{V} \)

Feedback capacitance at \( f = 1 \, \text{MHz} \)
\( I_C = 100 \, \text{mA}; \, V_{CE} = 28 \, \text{V} \)

Collector-flange capacitance

* Measured under pulse conditions: \( t_p \leq 200 \, \mu\text{s}; \, \delta \leq 0,02. \)
Fig. 4 Typical values; $T_j = 25^\circ C$.

Fig. 5 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

Fig. 6 Typical values; $f = 100$ MHz; $T_j = 25^\circ C$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V_{CE} (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_p (dB)</th>
<th>I_C (A)</th>
<th>( \bar{Z}_i ) (Ω)</th>
<th>( V_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>15</td>
<td>&lt; 1,5</td>
<td>&gt; 10</td>
<td>&lt; 0,83</td>
<td>1,4 + j1,85</td>
<td>33 + j27,5</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- C1 = C6 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- C3 = 47 pF ceramic capacitor (500 V)
- C4 = 120 pF ceramic capacitor
- C5 = 100 nF polyester capacitor
- C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- L1 = 1 turn Cu wire (1,6 mm); int. dia. 8,4 mm; leads 2 x 5 mm
- L2 = 100 nH; 7 turns closely wound enameled Cu wire (0,5 mm); int. dia. 3 mm
- L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L4 = L5 = strip (12 mm x 6 mm); tap for C3 at 5 mm from transistor
- L6 = 6 turns enameled Cu wire (1,0 mm); int. dia. 9,0 mm; length 9,2 mm; leads 2 x 5 mm
- L7 = 4 turns enameled Cu wire (1,0 mm); int. dia. 8,2 mm; length 5,0 mm; leads 2 x 5 mm
- L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
- R1 = 10 Ω carbon resistor
- R2 = 4,7 Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
V.H.F. power transistor

**Fig. 9** Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

**Fig. 10** Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

**Fig. 11** R.F. SOAR; c.w. class-B operation; $f = 175$ MHz; $V_{CE} = 28$ V; $R_{th}mb-h = 0.3$ °C/W.

The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13 and 14.
Typical values; \( V_{CE} = 28 \) V; \( P_L = 15 \) W; \( T_h = 25 \) °C.

OPERATING NOTE
Below 100 MHz a base-emitter resistor of 10 \( \Omega \) is recommended to avoid oscillation. This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B or C operated mobile transmitters with a nominal supply voltage of 13.5 V. Because of the high gain and excellent power handling capability, the transistor is especially suited for design of wide-band and semi-wide-band v.h.f. amplifiers. Together with a BFQ42 driver stage, the chain can deliver 15 W with a maximum drive power of 120 mW at 175 MHz. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16.5 V.

It has a 3/8” capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_L$ Ω</th>
<th>$V_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. class-B</td>
<td>13.5</td>
<td>175</td>
<td>15</td>
<td>&gt;10</td>
<td>&gt;60</td>
<td>1.3 + j0.68</td>
<td>180 – j54</td>
</tr>
<tr>
<td>c.w. class-B</td>
<td>12.5</td>
<td>175</td>
<td>15</td>
<td>typ. 10.5</td>
<td>typ. 67</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Torque on nut: min. 0.75 Nm (7.5 kg cm)
max. 0.85 Nm (8.5 kg cm)

Diameter of clearance hole in heatsink: max. 4.2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \( (V_{BE} = 0) \)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); \( f > 1 \text{ MHz} \)

R.F. power dissipation \( (f > 1 \text{ MHz}) \); \( T_{mb} = 25^\circ \text{C} \)

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>( V_{CESM} )</td>
<td>36 V</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>( V_{CEO} )</td>
<td>18 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>( I_{EBO} )</td>
<td>4 V</td>
</tr>
<tr>
<td>Collector current (peak)</td>
<td>( I_{C(AV)} )</td>
<td>2.75 A</td>
</tr>
<tr>
<td>R.F. power dissipation</td>
<td>( P_{rf} )</td>
<td>53 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td>-65 to +150 ^\text{C}</td>
</tr>
<tr>
<td>Operating junction temp.</td>
<td>( T_{j} )</td>
<td>200 ^\text{C}</td>
</tr>
</tbody>
</table>

Fig. 2  D.C. SOAR.

THERMAL RESISTANCE (dissipation = 15 W; \( T_{mb} = 77 \^\text{C} \), i.e. \( T_{h} = 70 \^\text{C} \))

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

\[
\begin{align*}
R_{th \ j-mb (dc)} &= 3.7 \ ^\circ \text{C/W} \\
R_{th \ j-mb (rf)} &= 3.05 \ ^\circ \text{C/W} \\
R_{th \ mb-h} &= 0.45 \ ^\circ \text{C/W} 
\end{align*}
\]

Fig. 3  R.F. power dissipation; \( V_{CE} < 16.5 \text{ V} \);
\( f > 1 \text{ MHz} \).
CHARACTERISTICS

\( T_j = 25 \, ^\circ C \)

**Collector-emitter breakdown voltage**
\[ V_{BE} = 0; \, I_C = 15 \, mA \]

**Collector-emitter breakdown voltage**
open base; \( I_c = 100 \, mA \)

**Emitter-base breakdown voltage**
open collector; \( I_E = 5 \, mA \)

**Collector cut-off current**
\[ V_{BE} = 0; \, V_{CE} = 18 \, V \]

**Second breakdown energy; \( L = 25 \, mH; \, f = 50 \, Hz \)**
open base
\[ R_{BE} = 10 \, \Omega \]

**D.C. current gain**
\( I_c = 1,75 \, A; \, V_{CE} = 5 \, V \)

**Collector-emitter saturation voltage**
\( I_c = 5 \, A; \, I_b = 1 \, A \)

**Transition frequency at \( f = 100 \, MHz \)**
\(-I_E = 1,75 \, A; \, V_{CB} = 13,5 \, V \)
\(-I_E = 5 \, A; \, V_{CB} = 13,5 \, V \)

**Collector capacitance at \( f = 1 \, MHz \)**
\( I_E = I_e = 0; \, V_{CB} = 13,5 \, V \)

**Feedback capacitance at \( f = 1 \, MHz \)**
\( I_C = 100 \, mA; \, V_{CE} = 13,5 \, V \)

**Collector-stud capacitance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{(BR)CES} )</td>
<td>&gt; 36 V</td>
</tr>
<tr>
<td>( V_{(BR)CEO} )</td>
<td>&gt; 18 V</td>
</tr>
<tr>
<td>( V_{(BR)EBO} )</td>
<td>&gt; 4 V</td>
</tr>
<tr>
<td>( I_{CES} )</td>
<td>&lt; 5 mA</td>
</tr>
<tr>
<td>( E_{SBO} )</td>
<td>&gt; 4 mJ</td>
</tr>
<tr>
<td>( E_{SBR} )</td>
<td>&gt; 4 mJ</td>
</tr>
<tr>
<td>( h_{FE} )</td>
<td>typ. 40</td>
</tr>
<tr>
<td></td>
<td>10 to 80</td>
</tr>
<tr>
<td>( V_{CEsat} )</td>
<td>typ. 1,5 V</td>
</tr>
<tr>
<td>( f_T )</td>
<td>typ. 900 MHz</td>
</tr>
<tr>
<td>( f_T )</td>
<td>typ. 825 MHz</td>
</tr>
<tr>
<td>( C_{C} )</td>
<td>typ. 43 pF</td>
</tr>
<tr>
<td>( C_{re} )</td>
<td>typ. 27 pF</td>
</tr>
<tr>
<td>( C_{cs} )</td>
<td>typ. 2 pF</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: \( t_p \leq 200 \, \mu s; \, \delta \leq 0,02. \)
Fig. 4 Typical values; $T_j = 25\, ^\circ\text{C}$.

Fig. 5 $I_E = I_E = 0$; $f = 1\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$.

Fig. 6 $V_{CB} = 13.5\, \text{V}$; $f = 100\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\( T_h = 25 \, ^\circ\text{C} \)

<table>
<thead>
<tr>
<th>( f (\text{MHz}) )</th>
<th>( V_{CE} (V) )</th>
<th>( P_L (W) )</th>
<th>( P_S (W) )</th>
<th>( G_p (\text{dB}) )</th>
<th>( I_C (\text{A}) )</th>
<th>( \eta (%) )</th>
<th>( Z_i (\Omega) )</th>
<th>( V_L (\text{mA}/\text{V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13.5</td>
<td>15</td>
<td>&lt; 1.5</td>
<td>&gt; 10</td>
<td>&lt; 1.85</td>
<td>&gt; 60</td>
<td>1,3 + j0.68</td>
<td>180 − j54</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>15</td>
<td>typ. 1.34</td>
<td>typ. 10.5</td>
<td>typ. 1.8</td>
<td>typ. 67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- \( C_1 = 2.5 \) to \( 20 \) pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( C_2 = C_6 = C_7 = 4 \) to \( 40 \) pF film dielectric trimmer (cat. no. 2222 809 07008)
- \( C_{3a} = C_{3b} = 47 \) pF ceramic capacitor (500 V)
- \( C_4 = 1 \) nF ceramic capacitor
- \( C_5 = 100 \) nF polyester capacitor
- \( L_1 = \frac{1}{2} \) turn Cu wire (1.6 mm); int. dia. 6.0 mm; leads 2 x 5 mm
- \( L_2 = L_6 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L_3 = L_4 = \) strip (12 mm x 6 mm); taps for \( C_{3a} \) and \( C_{3b} \) at 5 mm from transistor
- \( L_5 = 4\frac{1}{2} \) turns closely wound enamelled Cu wire (1.6 mm); int. dia. 6.0 mm; leads 2 x 5 mm
- \( L_7 = 2 \) turns closely wound enamelled Cu wire (1.6 mm); int. dia. 6.0 mm; leads 2 x 5 mm

\( L_3 \) and \( L_4 \) are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

\( R_1 = R_2 = 10 \, \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
V.H.F. power transistor

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (P_S/P_Snom) increases linearly with supply over-voltage ratio.
OPERATING NOTE Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Fig. 12.

Conditions for Figs 12, 13 and 14:
Typical values: $V_{CE} = 13.5$ V; $P_L = 15$ W; $T_h = 25$ °C.

Fig. 13.

Fig. 14.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B or C operated mobile transmitters with a nominal supply voltage of 13,5 V. Because of the high gain and excellent power handling capability, the transistor is especially suited for design of wide-band and semi-wide-band v.h.f. amplifiers. Together with a BFQ43 driver stage, the chain can deliver 28 W with a maximum drive power of 250 mW at 175 MHz. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

It has a 3/8” capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>R.F. performance up to $T_h = 25, ^\circ C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode of operation</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>c.w. class-B</td>
</tr>
<tr>
<td>c.w. class-B</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Dimensions in mm

Torque on nut: min. 0,75 Nm
(7,5 kg cm)
max. 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

March 1978
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Collector-emitter voltage \((V_{BE} = 0)\)
peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)
Collector current (average)
Collector current (peak value); \(f > 1\) MHz
R.F. power dissipation \((f > 1\) MHz); \(T_{mb} = 25\) °C
Storage temperature
Operating junction temperature

\[
\begin{array}{ccc}
V_{CESM} & \text{max.} & 36\ V \\
V_{CEO} & \text{max.} & 18\ V \\
V_{EBO} & \text{max.} & 4\ V \\
I_{C(AV)} & \text{max.} & 6\ A \\
I_{CM} & \text{max.} & 15\ A \\
P_{rf} & \text{max.} & 96\ W \\
T_{stg} & \text{max.} & -65 \text{ to } +150\ °C \\
T_{j} & \text{max.} & 200\ °C \\
\end{array}
\]

\[T_{mb} = 25\ °C\]
\[T_{h} = 70\ °C\]

**Fig. 2** D.C. SOAR.

**Fig. 3** R.F. power dissipation; \(V_{CE} \leq 16.5\ V; f > 1\) MHz.

**THERMAL RESISTANCE** (dissipation = 25 W; \(T_{mb} = 81\ °C\), i.e. \(T_{h} = 70\ °C\))

- From junction to mounting base (d.c. dissipation)
- From junction to mounting base (r.f. dissipation)
- From mounting base to heatsink

\[
\begin{align*}
R_{th\ j-mb(dc)} &= 2,4\ °C/W \\
R_{th\ j-mb(rf)} &= 1,85\ °C/W \\
R_{th\ mb-h} &= 0,45\ °C/W
\end{align*}
\]
CHARACTERISTICS

$T_j = 25 \, ^\circ C$

Collector-emitter breakdown voltage

$V_{BE} = 0; \, I_C = 25 \, mA$

Collector-emitter breakdown voltage

open base; $I_C = 100 \, mA$

Emitter-base breakdown voltage

open collector; $I_E = 10 \, mA$

Collector cut-off current

$V_{BE} = 0; \, V_{CE} = 18 \, V$

Second breakdown energy; $L = 25 \, mH; \, f = 50 \, Hz$

open base

$R_{BE} = 10 \, \Omega$

D.C. current gain*

$I_C = 3,5 \, A; \, V_{CE} = 5 \, V$

Collector-emitter saturation voltage*

$I_C = 10 \, A; \, I_B = 2 \, A$

Transition frequency at $f = 100 \, MHz^*$

$-I_E = 3,5 \, A; \, V_{CB} = 13,5 \, V$

$-I_E = 10 \, A; \, V_{CB} = 13,5 \, V$

Collector capacitance at $f = 1 \, MHz$

$I_E = I_E = 0; \, V_{CB} = 13,5 \, V$

Feedback capacitance at $f = 1 \, MHz$

$I_C = 100 \, mA; \, V_{CE} = 13,5 \, V$

Collector-stud capacitance

$V_{(BR)CES} > 36 \, V$

$V_{(BR)CEO} > 18 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 10 \, mA$

$E_{SBO} > 8 \, mJ$

$E_{SBR} > 8 \, mJ$

$h_F E \quad \text{typ.} \quad 40$

$V_{CEsat} \quad \text{typ.} \quad 1,8 \, V$

$f_T \quad \text{typ.} \quad 850 \, MHz$

$f_T \quad \text{typ.} \quad 700 \, MHz$

$C_{C} \quad \text{typ.} \quad 92 \, pF$

$C_{re} \quad \text{typ.} \quad 58 \, pF$

$C_{cs} \quad \text{typ.} \quad 2 \, pF$

* Measured under pulse conditions: $t_p < 200 \, \mu s; \, \delta < 0,02$. 
Fig. 4  Typical values; $T_j = 25^\circ$C.

Fig. 5  $I_e = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ$C.

Fig. 6  $V_{CB} = 13.5$ V; $f = 100$ MHz; $T_j = 25^\circ$C.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_i ) (( \Omega ))</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>28</td>
<td>&lt;3,5</td>
<td>&gt;9</td>
<td>&lt;3,45</td>
<td>&gt;60</td>
<td>0,9 + j0,9</td>
<td>380 + j40</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>28</td>
<td>typ. 3,15</td>
<td>typ. 9,5</td>
<td>typ. 3,2</td>
<td>typ. 70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List of components:

C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C3a = C3b = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor
C5 = 100 nF polyester capacitor
C6 = 7 to 100 pF film dielectric trimmer (cat. no. 2222 809 07015)

L1 = \( \frac{1}{2} \) turn Cu wire (1,6 mm); int. dia. 6,0 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
L3 = L7 = Ferroxcube wide-band h.f. choke, grade 38 (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
L6 = 3½ turns closely wound enamelled Cu wire (1,6 mm) int. dia. 6,0 mm; leads 2 x 5 mm
L8 = 1 turn Cu wire (1,6 mm) int. dia. 6,0 mm; leads 2 x 5 mm

L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

R1 = R2 = 10 \( \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (P_S/P_Snom) increases linearly with supply over-voltage ratio.
OPERATING NOTE  Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Fig. 12.

Fig. 13.

Conditions for Figs 12, 13 and 14:
Typical values; V_{CE} = 13.5 V; P_L = 28 W; T_h = 25 °C.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production.

U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor primarily intended for use in linear u.h.f. amplifiers for television transmitters and transposers. The excellent d.c. dissipation properties for class-A operation are obtained by means of diffused emitter ballasting resistors and a multi-base structure, providing an optimum temperature profile on the crystal area. The combination of optimum thermal design and the application of gold sandwich metallization realizes excellent reliability properties.

The transistor has a ¾" capstan envelope with ceramic cap.

QUICK REFERENCE DATA

R.F. performance

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>( f_{\text{vision}} ) MHz</th>
<th>( V_{\text{ce}} ) V</th>
<th>( I_C ) mA</th>
<th>( T_h ) ( ^{\circ} \text{C} )</th>
<th>( d_{\text{im}} ) dB</th>
<th>( P_o ) ( \text{sync} ) dB</th>
<th>( G_p ) dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>class-A; linear amplifier</td>
<td>860</td>
<td>25</td>
<td>150</td>
<td>70</td>
<td>-60</td>
<td>&gt; 0,5</td>
<td>&gt; 11</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>150</td>
<td>25</td>
<td>-60</td>
<td>typ. 0,63</td>
<td>typ. 12,2</td>
<td></td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Fig. 1 SOT-122.

Dimensions in mm

- Diameter of clearance hole in heatsink: max. 4,2 mm.
- Mounting hole to have no burrs at either end.
- De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage
(peak value); $V_{BE} = 0$
open base

Emitter-base voltage (open collector)
Collector current
d.c. or average
(peak value); $f > 1$ MHz

Total power dissipation up to $T_{mb} = 25^\circ C$
Storage temperature
Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CESM}$ max.</td>
<td>50 V</td>
</tr>
<tr>
<td>$V_{CEO}$ max.</td>
<td>30 V</td>
</tr>
<tr>
<td>$V_{EBO}$ max.</td>
<td>4 V</td>
</tr>
<tr>
<td>$I_C$ max.</td>
<td>650 mA</td>
</tr>
<tr>
<td>$I_{CM}$ max.</td>
<td>1000 mA</td>
</tr>
<tr>
<td>$P_{tot}$ max.</td>
<td>10.8 W</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>-65 to +150 $^\circ C$</td>
</tr>
<tr>
<td>$T_j$ max.</td>
<td>200 $^\circ C$</td>
</tr>
</tbody>
</table>

(1) Second breakdown limit (independent of temperature).

Fig. 2 D.C. SOAR.

**THERMAL RESISTANCE** (see Fig. 4)
From junction to mounting base
(dissipation = 3,75 W; $T_{mb} = 72,3^\circ C$; i.e. $T_h = 70^\circ C$)
From mounting base to heatsink

$$R_{th\ j\ -\ mb} = 15,0^\circ C/W$$
$$R_{th\ mb\ -\ h} = 0,6^\circ C/W$$

Fig. 3 Power derating curve vs. temperature.
Fig. 4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters. ($R_{th\,mb-h} = 0.6 \,^\circ\text{C/W}$).

Example

Nominal class-A operation: $V_{CE} = 25 \,\text{V}; I_C = 150 \,\text{mA}; T_h = 70 \,^\circ\text{C}$.

Fig. 4 shows:
- $R_{th\,j-h}$ max. 15.6 $^\circ\text{C/W}$
- $T_j$ max. 130 $^\circ\text{C}$

Typical device:
- $R_{th\,j-h}$ typ. 13.5 $^\circ\text{C/W}$
- $T_j$ typ. 120 $^\circ\text{C}$
CHARACTERISTICS

$T_j = 25 \, ^\circ C$ unless otherwise specified

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{(BR)CES} &gt; 50 , V$</td>
</tr>
<tr>
<td>open base; $I_C = 15 , mA$</td>
<td>$V_{(BR)CEO} &gt; 30 , V$</td>
</tr>
<tr>
<td>$V_{(BR)EBO} &gt; 4 , V$</td>
<td>$I_{CES} &lt; 0.5 , mA$</td>
</tr>
<tr>
<td>Emitter-base breakdown voltage</td>
<td>$I_{CES} &lt; 1.2 , mA$</td>
</tr>
<tr>
<td>open collector; $I_E = 1 , mA$</td>
<td>$h_{FE} &gt; 20$</td>
</tr>
<tr>
<td>$h_{FE}$ typ. 120</td>
<td>$V_{CE sat}$ typ. 500 mV</td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td>$f_T$ typ. 3.5 GHz</td>
</tr>
<tr>
<td>$V_{BE} = 0; V_{CE} = 30 , V$</td>
<td>$f_T$ typ. 3.4 GHz</td>
</tr>
<tr>
<td>$V_{BE} = 0; V_{CE} = 30 , V; T_j = 175 , ^\circ C$</td>
<td>$C_c$ typ. 3.7 pF</td>
</tr>
<tr>
<td>$I_C = 150 , mA; V_{CE} = 25 , V$</td>
<td>$C_{re}$ typ. 1.9 pF</td>
</tr>
<tr>
<td>D.C. current gain *</td>
<td>$C_{cs}$ typ. 2 pF</td>
</tr>
<tr>
<td>$I_C = 150 , mA; V_{CE} = 25 , V; T_j = 175 , ^\circ C$</td>
<td>$I_{CES} &lt; 0.5 , mA$</td>
</tr>
<tr>
<td>$I_C = 150 , mA; V_{CE} = 25 , V; T_j = 175 , ^\circ C$</td>
<td>$I_{CES} &lt; 1.2 , mA$</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage *</td>
<td>$h_{FE}$ typ. 120</td>
</tr>
<tr>
<td>$I_C = 300 , mA; I_B = 30 , mA$</td>
<td>$V_{CE sat}$ typ. 500 mV</td>
</tr>
<tr>
<td>Transition frequency at $f = 500 , MHz$ **</td>
<td>$f_T$ typ. 3.5 GHz</td>
</tr>
<tr>
<td>$-I_E = 150 , mA; V_{CB} = 25 , V$</td>
<td>$f_T$ typ. 3.4 GHz</td>
</tr>
<tr>
<td>$-I_E = 300 , mA; V_{CB} = 25 , V$</td>
<td>$C_c$ typ. 3.7 pF</td>
</tr>
<tr>
<td>Collector capacitance at $f = 1 , MHz$</td>
<td>$C_{re}$ typ. 1.9 pF</td>
</tr>
<tr>
<td>$I_E = I_E = 0; V_{CB} = 25 , V$</td>
<td>$C_{cs}$ typ. 2 pF</td>
</tr>
<tr>
<td>Feedback capacitance at $f = 1 , MHz$</td>
<td></td>
</tr>
<tr>
<td>$I_C = 10 , mA; V_{CE} = 25 , V$</td>
<td></td>
</tr>
<tr>
<td>Collector-stud capacitance</td>
<td></td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p \leq 300 \, \mu s; \delta \leq 0.02$.

** Measured under pulse conditions: $t_p \leq 50 \, \mu s; \delta \leq 0.01$. 

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Fig. 5 Typical values; $T_j = 25 \, ^\circ\mathrm{C}$.

Fig. 6 $I_E = I_e = 0$; $f = 1 \, \mathrm{MHz}$; $T_j = 25 \, ^\circ\mathrm{C}$.

Fig. 7 $V_{CB} = 25 \, \mathrm{V}$; $f = 500 \, \mathrm{MHz}$; $T_j = 25 \, ^\circ\mathrm{C}$.
APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>f_vision (MHz)</th>
<th>V_CE (V)</th>
<th>I_C (mA)</th>
<th>T_H (°C)</th>
<th>d_im (dB)</th>
<th>P_sync (W)</th>
<th>G_p (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>25</td>
<td>150</td>
<td>70</td>
<td>-60</td>
<td>&gt; 0,5</td>
<td>&gt; 11</td>
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<tr>
<td>860</td>
<td>25</td>
<td>150</td>
<td>70</td>
<td>-60</td>
<td>typ. 0,58</td>
<td>typ. 12,2</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>150</td>
<td>25</td>
<td>-60</td>
<td>typ. 0,63</td>
<td>typ. 12,2</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

List of components:

C1 = C3 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
C2 = C6 = C8 = 1 to 3,5 pF film dielectric trimmer (cat. no. 2222 809 05001)
C4 = C5 = 3 pF chip capacitor
C7 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
C9 = C12 = 1 nF chip capacitor
C10 = 100 nF polyester capacitor
C11 = C13 = 470 nF polyester capacitor
C14 = 10 nF polyester capacitor
C15 = 3,3 µF/40 V solid aluminium electrolytic capacitor
L1 = stripline (13,2 mm x 4,3 mm)
L2 = stripline (15,2 mm x 4,3 mm)
L3 = micro choke 0,47 µH (4322 057 04770)
L4 = 4 turns closely wound enameled Cu wire (1,0 mm); int. dia. 5,5 mm; leads 2 x 5 mm
L5 = stripline (37,0 mm x 4,3 mm)
L6 = stripline (13,5 mm x 4,3 mm)
L1; L2; L5 and L6 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (ε_r = 2,74); thickness 1,5 mm.

Fig. 8 Test circuit at f_vision = 860 MHz.
List of components:
C1 = C2 = C3 = 100 nF polyester capacitor
C4 = 10 μF/25 V solid aluminium electrolytic capacitor
R1 = 150 Ω carbon resistor (0,25 W)
R2 = 100 Ω carbon resistor (0,25 W)
R3 = 82 Ω carbon resistor (0,25 W)
R4 = R5 = 2,2 kΩ carbon resistor (0,25 W)
R6 = 12 Ω carbon resistor (0,5 W)
R7 = R8 = 820 Ω carbon resistor (0,5 W)
R9 = 33 Ω carbon resistor (0,25 W)

D1 = BZY88-C3V3
D2 = BY206
TR1 = BD136

(1) Three-tone test method (vision carrier −8 dB, sound carrier −7 dB, sideband signal −16 dB), zero dB corresponds to peak sync level. Intermodulation distortion of input signal ≤ −75 dB.

Fig. 10 Intermodulation distortion as a function of output power.
Typical values; VCE = 25 V; IC = 150 mA; fvision = 860 MHz.

Information for wide-band application from 470 to 860 MHz available on request.
Ruggedness

The BLW32 is capable of withstanding a load mismatch (VSWR = 50) under the following conditions:

\[ f = 860 \text{ MHz}; \ V_{CE} = 25 \text{ V}; \ I_C = 150 \text{ mA}; \]
\[ T_h = 70 \text{ °C} \text{ and } P_L(AV) = 1 \text{ W}. \]
This holds for single-tone as well as for two-tone operation (vision and sound).
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production.

U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor primarily intended for use in linear u.h.f. amplifiers for television transmitters and transposers. The excellent d.c. dissipation properties for class-A operation are obtained by means of diffused emitter ballasting resistors and a multi-base structure, providing an optimum temperature profile on the crystal area. The combination of optimum thermal design and the application of gold sandwich metallization realizes excellent reliability properties.

The transistor has a 3/8" capstan envelope with ceramic cap.

QUICK REFERENCE DATA

R.F. performance

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>f_{vision} MHz</th>
<th>V_{CE} V</th>
<th>I_{C} mA</th>
<th>T_{h} °C</th>
<th>d_{im} dB</th>
<th>P_{o sync} * W</th>
<th>G_{P} dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>class-A; linear amplifier</td>
<td>860</td>
<td>25</td>
<td>300</td>
<td>70</td>
<td>-60</td>
<td>&gt; 1,0</td>
<td>&gt; 10,0</td>
</tr>
<tr>
<td></td>
<td>860</td>
<td>25</td>
<td>300</td>
<td>25</td>
<td>-60</td>
<td>typ. 1,15</td>
<td>typ. 10,5</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-122.

Torque on nut: min. 0,75 Nm (7,5 kg cm)
max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
732BLY/A (BLW33)

RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage
(peak value); $V_{BE} = 0$
open base

Emitter-base voltage (open collector)

Collector current
d.c. or average
(peak value); $f > 1$ MHz

Total power dissipation up to $T_{mb} = 25$ °C

Storage temperature

Operating junction temperature

---

$V_{CESM}$ max. 50 V
$V_{CEO}$ max. 30 V
$V_{EBO}$ max. 4 V

$I_C$ max. 1,25 A
$I_{CM}$ max. 1,9 A

$P_{tot}$ max. 19,3 W
$T_{stg}$ $-65$ to $+150$ °C
$T_j$ max. 200 °C

---

From junction to mounting base
(dissipation = 7,5 W; $T_{mb} = 74,5$ °C; i.e. $T_h = 70$ °C)

From mounting base to heatsink

$R_{th j-mb} = 10,1$ °C/W
$R_{th mb-h} = 0,6$ °C/W
Fig. 4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters. ($R_{th\ mb-h} = 0,6 \, ^\circ C/W$).

Example

Nominal class-A operation: $V_{CE} = 25 \, V$; $I_C = 300 \, mA$; $T_h = 70 \, ^\circ C$.

Fig. 4 shows: $R_{th\ j-h}$ max. $10,7\, ^\circ C/W$  
$T_j$ max. $150\, ^\circ C$

Typical device: $R_{th\ j-h}$ typ. $8,25\, ^\circ C/W$  
$T_j$ typ. $132\, ^\circ C$
CHARACTERISTICS

$T_j = 25 \, ^\circ C$ unless otherwise specified

Collector-emitter breakdown voltage

$V_{BE} = 0; I_C = 4 \, mA$

open base; $I_C = 30 \, mA$

Emitter-base breakdown voltage

open collector; $I_E = 2 \, mA$

Collector cut-off current

$V_{BE} = 0; V_{CE} = 30 \, V$

$V_{BE} = 0; V_{CE} = 30 \, V; T_j = 175 \, ^\circ C$

D.C. current gain

$I_C = 300 \, mA; V_{CE} = 25 \, V$

$I_C = 300 \, mA; V_{CE} = 25 \, V; T_j = 175 \, ^\circ C$

Collector-emitter saturation voltage *

$I_C = 600 \, mA; I_B = 60 \, mA$

Transition frequency at $f = 500 \, MHz$ **

$-I_E = 300 \, mA; V_{CB} = 25 \, V$

$-I_E = 600 \, mA; V_{CB} = 25 \, V$

Collector capacitance at $f = 1 \, MHz$

$I_E = I_0 = 0; V_{CB} = 25 \, V$

Feedback capacitance at $f = 1 \, MHz$

$I_C = 20 \, mA; V_{CE} = 25 \, V$

Collector-stud capacitance

$V_{(BR)CES} > 50 \, V$

$V_{(BR)CEO} > 30 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 1,0 \, mA$

$I_{CES} < 2,5 \, mA$

$h_{FE} > 20$

$h_{FE} < 120$

$V_{CE\text{sat}} \text{ typ.} 450 \, mV$

$f_T \text{ typ.} 3,4 \, GHz$

$f_T \text{ typ.} 3,1 \, GHz$

$C_C \text{ typ.} 6,6 \, pF$

$C_{re} \text{ typ.} 3,5 \, pF$

$C_{cs} \text{ typ.} 2 \, pF$

* Measured under pulse conditions: $t_p \leq 300 \, \mu s; \delta \leq 0,02.$

** Measured under pulse conditions: $t_p \leq 50 \, \mu s; \delta \leq 0,01.$
U.H.F. power transistor

7Z8617

Fig. 5 Typical values; $T_j = 25^\circ C$.

7Z8619

Fig. 6 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

7Z8623

Fig. 7 $V_{CB} = 25$ V; $f = 500$ MHz; $T_j = 25^\circ C$.

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APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>( f_{\text{vision}} ) (MHz)</th>
<th>( V_{\text{CE}} ) (V)</th>
<th>( I_{\text{C}} ) (mA)</th>
<th>( T_{\text{h}} ) (°C)</th>
<th>( d_{\text{im}} ) (dB) *</th>
<th>( P_{\text{O sync}} ) (W) *</th>
<th>( G_{\text{p}} ) (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>25</td>
<td>300</td>
<td>70</td>
<td>-60</td>
<td>&gt; 1,0</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>300</td>
<td>70</td>
<td>-60</td>
<td>typ. 1,07</td>
<td>typ. 10,5</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>300</td>
<td>25</td>
<td>-60</td>
<td>typ. 1,15</td>
<td>typ. 10,5</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier –8 dB, sound carrier –7 dB, sideband signal –16 dB), zero dB corresponds to peak sync level.

Fig. 8 Test circuit at \( f_{\text{vision}} = 860 \) MHz.

List of components:

- \( C1 = C3 = 2 \) to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- \( C2 = C6 = C8 = 1 \) to 3,5 pF film dielectric trimmer (cat. no. 2222 809 05001)
- \( C4 = C5 = 3 \) pF chip capacitor
- \( C7 = 2 \) to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- \( C9 = C12 = 1 \) nF chip capacitor
- \( C10 = 100 \) nF polyester capacitor
- \( C11 = C13 = 470 \) nF polyester capacitor
- \( C14 = 10 \) nF polyester capacitor
- \( C15 = 3,3 \) µF/40 V solid aluminium electrolytic capacitor

- \( L1 = \) stripline (13,2 mm x 4,3 mm)
- \( L2 = \) stripline (15,2 mm x 4,3 mm)
- \( L3 = \) micro choke 0,47 µH (4322 057 04770)
- \( L4 = 4 \) turns closely wound enamelled Cu wire (1,0 mm); int. dia. 5,5 mm; leads 2 x 5 mm
- \( L5 = \) stripline (37,0 mm x 4,3 mm)
- \( L6 = \) stripline (13,5 mm x 4,3 mm)

\( L1; L2; L5 \) and \( L6 \) are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric \( (\epsilon_r = 2,74) \); thickness 1,5 mm.
**Fig. 9** Bias circuit for class-A linear amplifier at $f_{\text{vision}} = 860$ MHz.

List of components:
- $C_1 = C_2 = C_3 = 100 \, \text{nF polyester capacitor}$
- $C_4 = 10 \, \mu\text{F}/25 \, \text{V solid aluminium electrolytic capacitor}$
- $R_1 = 150 \, \Omega$ carbon resistor (0.25 W)
- $R_2 = 100 \, \Omega$ carbon resistor (0.25 W)
- $R_3 = 82 \, \Omega$ carbon resistor (0.25 W)
- $R_4 = R_5 = 2.2 \, \text{k}\Omega$ carbon resistor (0.25 W)
- $R_6 = 5.6 \, \Omega$ carbon resistor (1 W)
- $R_7 = R_8 = 820 \, \Omega$ carbon resistor (0.5 W)
- $R_9 = 33 \, \Omega$ carbon resistor (0.25 W)
- $R_1 = 150 \, \Omega$ carbon resistor (0.25 W)
- $R_2 = 100 \, \Omega$ carbon resistor (0.25 W)
- $R_3 = 82 \, \Omega$ carbon resistor (0.25 W)
- $R_4 = R_5 = 2.2 \, \text{k}\Omega$ carbon resistor (0.25 W)
- $R_6 = 5.6 \, \Omega$ carbon resistor (1 W)
- $R_7 = R_8 = 820 \, \Omega$ carbon resistor (0.5 W)
- $R_9 = 33 \, \Omega$ carbon resistor (0.25 W)

$D_1 = \text{BZY88-C3V3}$
$D_2 = \text{BY206}$
$\text{TR1} = \text{BD136}$

---

**Fig. 10** Intermodulation distortion as a function of output power. Typical values; $V_{\text{CE}} = 25 \, \text{V}$; $I_{\text{C}} = 300 \, \text{mA}; f_{\text{vision}} = 860 \, \text{MHz}$.

Information for wide-band application from 470 to 860 MHz available on request.
Fig. 11 Input impedance (series components).

Fig. 12 Load impedance (series components).

Fig. 13.

Conditions for Figs 11, 12 and 13:
Typical values; $V_{CE} = 25\, \text{V}$; $I_C = 300\, \text{mA}$; $T_h = 70\, ^\circ\text{C}$.

Ruggedness
The BLW33 is capable of withstanding a load mismatch ($\text{VSWR} = 50$) under the following conditions:

- $f = 860\, \text{MHz}$; $V_{CE} = 25\, \text{V}$; $I_C = 300\, \text{mA}$;
- $T_h = 70\, ^\circ\text{C}$ and $P_L(\text{AV}) = 2\, \text{W}$.

This holds for single-tone as well as for two-tone operation (vision and sound).
DEVELOPMENT SAMPLE DATA

This information is derived from development samples made available for evaluation. It does not form part of our data handbook system and does not necessarily imply that the device will go into production.

U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor primarily intended for use in linear u.h.f. amplifiers for television transmitters and transposers. The excellent d.c. dissipation properties for class-A operation are obtained by means of diffused emitter ballasting resistors and a multi-base structure, providing an optimum temperature profile on the crystal area. The combination of optimum thermal design and the application of gold sandwich metallization realizes excellent reliability properties.

The transistor has a ¾” capstan envelope with ceramic cap.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>R.F. performance</th>
<th>( f_{\text{vision}} ) MHz</th>
<th>( V_{CE} ) V</th>
<th>( I_C ) mA</th>
<th>( T_h ) oC</th>
<th>( d_{\text{im}} ) dB</th>
<th>( P_{\text{sync}} ) W</th>
<th>( G_{\text{p}} ) dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>class-A; linear amplifier</td>
<td>860</td>
<td>25</td>
<td>600</td>
<td>70</td>
<td>-60</td>
<td>&gt; 1,8</td>
<td>&gt; 9</td>
</tr>
<tr>
<td></td>
<td>860</td>
<td>25</td>
<td>600</td>
<td>25</td>
<td>-60</td>
<td>typ. 2,15</td>
<td>typ. 10,2</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier –8 dB, sound carrier –7 dB, sideband signal –16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-122.

Torque on nut: min. 0,75 Nm (7,5 kg cm) max. 0,85 Nm (8,5 kg cm)

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION: This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

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**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>peak value; $V_{BE} = 0$</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>open base</td>
</tr>
<tr>
<td>Collector current</td>
<td>d.c. or average (peak value); $f &gt; 1$ MHz</td>
</tr>
<tr>
<td>Total power dissipation at $T_{mb} = 25^\circ C$</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td></td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td></td>
</tr>
</tbody>
</table>

- $V_{CESM}$ max. 50 V
- $V_{CEO}$ max. 30 V
- $V_{EBO}$ max. 4 V
- $I_C$ max. 2.25 A
- $I_{CM}$ max. 3.5 A
- $P_{tot}$ max. 31 W
- $T_{stg}$ -65 to +150 °C
- $T_j$ max. 200 °C

**Fig. 2** D.C. SOAR.

**THERMAL RESISTANCE** (see Fig. 4)

From junction to mounting base (dissipation = 15 W; $T_{mb} = 79^\circ C$; i.e. $T_h = 70^\circ C$)

From mounting base to heatsink

$$R_{th \ j-mb} = 6.2 ~^\circ C/W$$

$$R_{th \ mb-h} = 0.6 ~^\circ C/W$$

**Fig. 3** Power derating curve vs. temperature.
Fig. 4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters. ($R_{th\ mb-h} = 0.6 \, ^\circ\text{C}/\text{W})$.

Example

Nominal class-A operation: $V_{CE} = 25 \, \text{V}$; $I_C = 600 \, \text{mA}; T_h = 70 \, ^\circ\text{C}$.

Fig. 4 shows: $R_{th\ j-h}$ max. 6.75 $^\circ\text{C}/\text{W}$
$T_j$ max. 170 $^\circ\text{C}$

Typical device: $R_{th\ j-h}$ typ. 5.45 $^\circ\text{C}/\text{W}$
$T_j$ typ. 152 $^\circ\text{C}$
CHARACTERISTICS

Tj = 25 °C unless otherwise specified

Collector-emitter breakdown voltage

\( V_{BE} = 0; I_C = 8 \text{ mA} \)
open base; \( I_C = 60 \text{ mA} \)

Emitter-base breakdown voltage
open collector; \( I_E = 4 \text{ mA} \)

Collector cut-off current

\( V_{BE} = 0; V_{CE} = 30 \text{ V} \)

\( I_{CES} \leq 2,0 \text{ mA} \)

\( V_{BE} = 0; V_{CE} = 30 \text{ V}; T_j = 175 \degree \text{C} \)

D.C. current gain

\( I_C = 600 \text{ mA}; V_{CE} = 25 \text{ V} \)

\( h_{FE} \geq 20 \)

\( I_C = 600 \text{ mA}; V_{CE} = 25 \text{ V}; T_j = 175 \degree \text{C} \)

\( h_{FE} \leq 120 \)

Collector-emitter saturation voltage *

\( I_C = 1,2 \text{ A}; I_B = 0,12 \text{ A} \)

\( V_{CE_{Sat}} \text{ typ.} 450 \text{ mV} \)

Transition frequency at \( f = 500 \text{ MHz} \)**

\(-I_E = 0,6 \text{ A}; V_{CB} = 25 \text{ V} \)
\(-f_T \text{ typ.} 3,3 \text{ GHz} \)
\(-I_E = 1,2 \text{ A}; V_{CB} = 25 \text{ V} \)
\(-f_T \text{ typ.} 3,0 \text{ GHz} \)

Collector capacitance at \( f = 1 \text{ MHz} \)

\( I_E = I_E = 0; V_{CB} = 25 \text{ V} \)

\( C_c \text{ typ. 13,5 \text{ pF}} \)

Feedback capacitance at \( f = 1 \text{ MHz} \)

\( I_C = 40 \text{ mA}; V_{CE} = 25 \text{ V} \)

\( C_{re} \text{ typ. 8,4 \text{ pF}} \)

Collector-stud capacitance

\( C_{cs} \text{ typ. 2 \text{ pF}} \)

* Measured under pulse conditions: \( t_p \leq 300 \mu s; \delta \leq 0,02. \)

** Measured under pulse conditions: \( t_p \leq 50 \mu s; \delta \leq 0,01. \)
U.H.F. power transistor

Fig. 5 Typical values; $T_j = 25 \, ^\circ C$.

Fig. 6 $I_E = I_C = 0$; $f = 1 \, MHz$; $T_j = 25 \, ^\circ C$.

Fig. 7 $V_{CB} = 25 \, V$; $f = 500 \, MHz$; $T_j = 25 \, ^\circ C$
APPLICATION INFORMATION

\[
\begin{array}{|c|c|c|c|c|c|c|}
\hline
f_{vision} (MHz) & V_{CE} (V) & I_C (mA) & T_h (\degree C) & d_{im} (dB)^* & P_{o sync} (W)^* & G_p (dB) \\
\hline
860 & 25 & 600 & 70 & -60 & > 1,8 & > 9 \\
860 & 25 & 600 & 70 & -60 & typ. 1,9 & typ. 10,2 \\
860 & 25 & 600 & 25 & -60 & typ. 2,15 & typ. 10,2 \\
\hline
\end{array}
\]

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

VSWR input < 1,1

VSWR output < 2

50 \Omega

Fig. 8 Test circuit at \( f_{vision} = 860 \) MHz.

List of components:

\begin{itemize}
  \item C1 = C2 = 1,4 pF to 5,5 pF film dielectric trimmer (cat. no. 2222 809 09001)
  \item C3 = 2 x 5,6 pF chip capacitors (in parallel)
  \item C4 = C5 = 100 nF polyester capacitor
  \item C6 = C7 = 1 nF feed-through capacitor
  \item C8 = 10 \mu F/40 V solid aluminium electrolytic capacitor
  \item C9 = 470 nF polyester capacitor
  \item C10 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
  \item C11 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
  \item C12 = 5,6 pF ceramic capacitor
\end{itemize}
List of components (continued):

R1 = 1,8 kΩ carbon resistor (0,5 W)
R2 = 150 Ω carbon resistor (0,25 W)
R3 = 100 Ω wirewound potentiometer (3 W)
R4 = 33 Ω carbon resistor (0,5 W)
R5 = 220 Ω carbon resistor (1 W)
R6 = 3 Ω; parallel connection of 4 x 12 Ω carbon resistors (1 W each)

L1 = stripline (13,6 mm x 6,9 mm)
L2 = microchoke 0,47 µH (cat. no. 4322 057 04770)
L3 = 1 turn Cu wire (1 mm); internal diameter 5,5 mm; leads 2 x 5 mm
L4 = stripline (40,8 mm x 6,9 mm)

L1 and L4 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric ($\varepsilon_r = 2,74$); thickness 1,5 mm.

(1) Three-tone test method (vision carrier –8 dB, sound carrier –7 dB, sideband signal –16 dB), zero dB corresponds to peak sync level. Intermodulation distortion of input signal ≤ –75 dB.

Fig. 9 Intermodulation distortion as a function of output power.
Typical values; $V_{CE} = 25$ V; $I_C = 600$ mA; $f_{vision} = 860$ MHz.

Information for wide-band application from 470 to 860 MHz available on request.
Fig. 10 Input impedance (series components).

Fig. 11 Load impedance (series components).

Conditions for Figs 10, 11 and 12:
Typical values; $V_{CE} = 25$ V; $I_C = 600$ mA; $T_h = 70 \degree C$.

Ruggedness
The BLW34 is capable of withstanding a load mismatch ($V_{SWR} = 50$) under the following conditions:
$f = 860$ MHz; $V_{CE} = 25$ V; $I_C = 600$ mA;
$T_h = 70 \degree C$ and $P_{L(AV)} = 4$ W.
This holds for single-tone as well as for two-tone operation (vision and sound).
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a nominal supply voltage of 12.5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply over-voltage to 15 V. Matched $h_{FE}$ groups are available on request.

It has a plastic encapsulated stripline package. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25$ °C

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$z_i$ $\Omega$</th>
<th>$\overline{Y_L}$ mA/V</th>
<th>$d_3$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>12,5</td>
<td>175</td>
<td>45</td>
<td>&gt; 6,5</td>
<td>&gt; 75</td>
<td>1,1 + j1,4</td>
<td>310 + j95</td>
<td>−</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>12,5</td>
<td>1,6–28</td>
<td>3–30</td>
<td>typ. 19,5</td>
<td>typ. 35</td>
<td>−</td>
<td>−</td>
<td>typ. −33</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-56.

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 1,5 Nm (15 kg cm)
max. 1,7 Nm (17 kg cm)

Diameter of clearance hole in heatsink: max. 5,0 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltagess
Collector-base voltage (open emitter)
  peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value); $f \geq 1\text{MHz}$

Power dissipation
Total power dissipation at $T_h = 70\, ^\circ\text{C}$
  $f \geq 1\, \text{MHz}$; $V_{CE} \leq 15\, \text{V}$; $R_{th\, mb-h} \leq 0,3\, ^\circ\text{C}/\text{W}$
  Derate by $0,5\, \text{W}/^\circ\text{C}$ for $50\, ^\circ\text{C} \leq T_h \leq 100\, ^\circ\text{C}$

\begin{align*}
  V_{CBOM} &\text{ max. } 36\, \text{V} \\
  V_{CEO} &\text{ max. } 18\, \text{V} \\
  V_{EBO} &\text{ max. } 4\, \text{V} \\
  I_{C(AV)} &\text{ max. } 8\, \text{A} \\
  I_{CM} &\text{ max. } 20\, \text{A} \\
  P_{tot} &\text{ max. } 65\, \text{W}
\end{align*}

Temperature
Storage temperature

\[ T_{stg} \quad -65 \text{ to } +200\, ^\circ\text{C} \]
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
  open emitter; \( I_C = 100 \text{ mA} \)
  \( V_{BR(CBO)} > 36 \text{ V} \)

Collector-emitter voltage
  open base; \( I_C = 100 \text{ mA} \)
  \( V_{BR(CEO)} > 18 \text{ V} \)

Emitter-base voltage
  open collector; \( I_E = 25 \text{ mA} \)
  \( V_{BR(EBO)} > 4 \text{ V} \)

Transient energy

\( L = 25 \text{ mH}; f = 50 \text{ Hz} \)
  open base
  \( E > 8 \text{ mWs} \)
  \( V_{BE} = 1.5 \text{ V}; R_{BE} = 33 \Omega \)
  \( E > 8 \text{ mWs} \)

D.C. current gain

\( I_C = 1 \text{ A}; V_{CE} = 5 \text{ V} \)
  \( h_{FE} \text{ typ. 20 to 100} \)

D.C. current gain ratio of matched devices

\( I_C = 1 \text{ A}; V_{CE} = 5 \text{ V} \)
  \( h_{FE1}/h_{FE2} < 1.2 \)

Transition frequency

\( I_C = 6 \text{ A}; V_{CE} = 10 \text{ V} \)
  \( f_T \text{ typ. 550 MHz} \)

Collector capacitance at \( f = 1 \text{ MHz} \)

\( I_E = I_e = 0; V_{CB} = 15 \text{ V} \)
  \( C_C \text{ typ. 120 pF} \)

Feedback capacitance

\( I_C = 200 \text{ mA}; V_{CE} = 15 \text{ V} \)
  \( C_{RE} \text{ typ. 80 pF} \)

Collector-stud capacitance

\( C_{CS} \text{ typ. 2 pF} \)

\( T_j = 25 \degree C \text{ unless otherwise specified} \)

June 1976
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class B circuit)

\( f = 175 \text{ MHz}; T_h \text{ up to } 25 ^\circ \text{C}; R_{\text{th mb-h}} \leq 0.3 \text{ } ^\circ \text{C/W.} \)

<table>
<thead>
<tr>
<th>( V_{\text{CC}} (\text{V}) )</th>
<th>( P_S (\text{W}) )</th>
<th>( P_L (\text{W}) )</th>
<th>( I_C (\text{A}) )</th>
<th>( G_p (\text{dB}) )</th>
<th>( \eta (%) )</th>
<th>( \bar{z}_1 (\Omega) )</th>
<th>( \bar{Y}_L (\text{mA/V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,5</td>
<td>&lt; 12,7</td>
<td>45</td>
<td>&lt; 4,8</td>
<td>&gt; 5,5</td>
<td>&gt; 75</td>
<td>1, 1 + j1, 4</td>
<td>310 + j95</td>
</tr>
</tbody>
</table>

Test circuit for 175 MHz:

C1 = 2 to 20 pF film dielectric trimmer
C2 = 4 to 40 pF film dielectric trimmer
C3 = C4 = C5 = C6 = 56 pF ceramic capacitor
C7 = 100 pF ceramic capacitor
C8 = 100 nF polyester capacitor
C9 = 4 to 80 pF film dielectric trimmer
C10 = 4 to 60 pF film dielectric trimmer

L1 = 1, 5 turns enamelled Cu wire (1, 5 mm); int. diam. 6 mm; length 4 mm; leads 2 x 5 mm
L2 = 7 turns closely wound enamelled Cu wire (0, 5 mm); int. diam. 3 mm; leads 2 x 5 mm
L3 = L4 = ferroxcube choke (code number 4312 020 36640)
L5 = bifilar wound enamelled Cu wire (1, 0 mm); see figure on page 6
R1 = 10 Ω carbon resistor
R2 = 4, 7 Ω carbon resistor

Component lay-out for 175 MHz test circuit see page 6.
The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
At $P_L = 45\, \text{W}$ and $V_{CC} = 12.5\, \text{V}$, the output power at heatsink temperatures between 25°C and 70°C relative to that at 25°C is diminished by 60 mW/°C.

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power ($P_{L\text{nom}}$) must be derated in accordance with the adjacent graph for safe operation at supply voltages other than nominal. The graph shows the allowable output power under nominal conditions as a function of the supply overvoltage ratio with VSWR as parameter. The graph applies to the situation in which the drive ($P_S/P_{S\text{nom}}$) increases linearly with supply overvoltage ratio ($V_{CC}/V_{CC\text{nom}}$).
power gain versus frequency

\[ V_{CC} = 12.5 \, V \]
\[ P_L = 45 \, W \]

input impedance (series components) versus frequency

\[ V_{CC} = 12.5 \, V \]
\[ P_L = 45 \, W \]

typ. values

load impedance (parallel components) versus frequency

\[ V_{CC} = 12.5 \, V \]
\[ P_L = 45 \, W \]

typ. values

September 1974
APPLICATION INFORMATION (continued)

R.F. performance in s.s.b. class-AB operation

\[ V_{CE} = 12.5 \, \text{V}; \, T_h \text{ up to } 25 \, ^\circ\text{C}; \, R_{\text{th \\ mb-h}} \leq 0.3 \, \text{°C/W} \]

\[ f_1 = 28,000 \, \text{MHz}; \, f_2 = 28,001 \, \text{MHz} \]

<table>
<thead>
<tr>
<th>Output Power [W]</th>
<th>( G_p ) [dB]</th>
<th>( \eta_{dt} ) [%]</th>
<th>( d_3 ) [dB]</th>
<th>( d_5 ) [dB]</th>
<th>( I_{C(ZS)} ) [mA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 30 (P.E.P.)</td>
<td>typ. 19.5</td>
<td>typ. 35</td>
<td>typ. -33</td>
<td>typ. -36</td>
<td>25</td>
</tr>
</tbody>
</table>

Test circuit; s.s.b. class-AB.

List of components on page 10.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

List of components:

**Tr1 = Tr2 = BD137**

- **C1** = 100 pF air dielectric capacitor (single insulated rotor)
- **C2** = 27 pF ceramic capacitor
- **C3** = 180 pF ceramic capacitor
- **C4** = 100 pF air dielectric capacitor (single non-insulated rotor)
- **C5** = **C7** = 3.9 nF polyester capacitor (±10%)
- **C6** = 2 x 270 pF polystyrene capacitors in parallel
- **C8 = C15 = C16 =** 100 nF polyester capacitor (±10%)
- **C9** = 2.2 μF moulded metallized polyester capacitor
- **C10** = 2 x 385 pF film dielectric trimmers in parallel
- **C11** = 68 pF ceramic capacitor
- **C12** = 2 x 82 pF ceramic capacitors in parallel
- **C13** = 47 pF ceramic capacitor
- **C14** = 385 pF film dielectric trimmer

**L1** = 88 nH; 3 turns Cu wire (1.0 mm); internal diameter 9 mm; coil length 6.1 mm; leads 2 x 5 mm

**L2 = L5** = ferroxcube bead, grade 3B (code number 4312 020 36640)

**L3** = 68 nH; 3 turns enamelled Cu wire (1.6 mm); internal diameter 8 mm; coil length 8.3 mm; leads 2 x 5 mm

**L4** = 96 nH; 3 turns enamelled Cu wire (1.6 mm); internal diameter 10 mm; coil length 7.6 mm; leads 2 x 5 mm

- **R1** = 27 Ω carbon resistor (±5%)
- **R2** = 4.7 Ω carbon resistor (±5%)
- **R3** = 1.5 kΩ carbon resistor (±5%)
- **R4** = 10 Ω wire-wound potentiometer (3 W)
- **R5** = 47 Ω wire-wound resistor (5.5 W)
- **R6** = 150 Ω carbon resistor (±5%)
1) Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
S.S.B. class AB operation

Conditions:

\[
\begin{align*}
P_L &= 30 \text{ W (PEP)} & P_L &= 35 \text{ W (PEP)} \\
V_{CC} &= 12.5 \text{ V} & V_{CC} &= 13.5 \text{ V} \\
I_{C(ZS)} &= 25 \text{ mA} & I_{C(ZS)} &= 25 \text{ mA} \\
T_h &= 25 \text{ °C} & T_h &= 25 \text{ °C} \\
R_{th \ mb-h} &\leq 0.3 \text{ °C/W} & R_{th \ mb-h} &\leq 0.3 \text{ °C/W} \\
Z_L &= 1.9 \Omega & Z_L &= 1.9 \Omega
\end{align*}
\]

The curve (both conditions) holds for an unneutralized amplifier.
S.S.B. class AB operation

Conditions:

\[ P_L = 30 \text{ W (PEP)} \]  
\[ V_{CC} = 12.5 \text{ V} \]  
\[ I_{C(ZS)} = 25 \text{ mA} \]  
\[ T_h = 25 \text{ °C} \]  
\[ R_{th mb-h} \leq 0.3 \text{ °C/W} \]  
\[ Z_L = 1.9 \Omega \]  

\[ P_L = 35 \text{ W (PEP)} \]  
\[ V_{CC} = 13.5 \text{ V} \]  
\[ I_{C(ZS)} = 25 \text{ mA} \]  
\[ T_h = 25 \text{ °C} \]  
\[ R_{th mb-h} \leq 0.3 \text{ °C/W} \]  
\[ Z_L = 1.9 \Omega \]  

The curve (both conditions) holds for an unneutralized amplifier.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a nominal supply voltage of 12,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V. Matched hFE groups are available on request.

It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CC}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\frac{1}{R}$ Ω</th>
<th>$Y_L$ mA/V</th>
<th>$d_3$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>12,5</td>
<td>175</td>
<td>45</td>
<td>$&gt; 5,5$</td>
<td>$&gt; 75$</td>
<td>$1,1 + j1,4$</td>
<td>$310 + j95$</td>
<td>-</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>12,5</td>
<td>1,6–28</td>
<td>3–30 (P.E.P.)</td>
<td>typ 19,5</td>
<td>typ 35</td>
<td>-</td>
<td>-</td>
<td>typ $-33$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-120

Dimensions in mm

Diameter of clearance hole in heatsink: max 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134).

- Collector-emitter voltage \( (V_{BE} = 0) \) peak value
- Collector-emitter voltage (open base)
- Emitter-base voltage (open-collector)
- Collector current (average)
- Collector current (peak value); \( f > 1 \text{ MHz} \)
- R.F. power dissipation \( (f > 1 \text{ MHz}) \); \( T_{mb} = 25 \text{ °C} \)
- Storage temperature
- Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CESM} ) max.</td>
<td>36 V</td>
</tr>
<tr>
<td>( V_{CE0} ) max.</td>
<td>18 V</td>
</tr>
<tr>
<td>( V_{EBO} ) max.</td>
<td>4 V</td>
</tr>
<tr>
<td>( I_{CM} ) max.</td>
<td>22 A</td>
</tr>
<tr>
<td>( P_{rf} ) max.</td>
<td>100 W</td>
</tr>
<tr>
<td>( T_{stg} ) -65 to +150 \text{ °C}</td>
<td></td>
</tr>
<tr>
<td>( T_{j} ) max.</td>
<td>200 \text{ °C}</td>
</tr>
</tbody>
</table>

**Fig. 2** D.C. SOAR.

**Fig. 3** R.F. power dissipation; \( V_{CE} \leq 16.5 \text{ V} \); \( f > 1 \text{ MHz} \).

1. Continuous d.c. operation
2. Continuous r.f. operation
3. Short-time operation during mismatch

---

**THERMAL RESISTANCE** (dissipation = 40 W; \( T_{mb} = 88 \text{ °C} \), i.e. \( T_{h} = 70 \text{ °C} \))

- From junction to mounting base (d.c. dissipation) \( R_{th j-mb(dc)} = 2.8 \text{ °C/W} \)
- From junction to mounting base (r.f. dissipation) \( R_{th j-mb(rf)} = 2.05 \text{ °C/W} \)
- From mounting base to heatsink \( R_{th mb-h} = 0.45 \text{ °C/W} \)

---

September 1978
V.H.F. power transistor

CHARACTERISTICS

$T_j = 25 \, ^\circ C$

Breakdown voltage

Collector-emitter voltage

$V_{BE} = 0; \; I_C = 50 \, mA$

$V(BR)CES > 36 \, V$

Collector-emitter voltage

open base; $I_C = 100 \, mA$

$V(BR)CEO > 18 \, V$

Emitter-base voltage

open collector; $I_E = 25 \, mA$

$V(BR)EBO > 4 \, V$

Collector cut-off current

$V_{BE} = 0; \; V_{CE} = 15 \, V$

$I_{CES} < 25 \, mA$

Transient energy

$L = 25 \, mH; \; f = 50 \, Hz$

open base

$E < 8 \, mWs$

$-V_{BE} = 1,5 \, V; \; R_{BE} = 33 \, \Omega$

D.C. current gain *

$I_C = 4 \, A; \; V_{CE} = 5 \, V$

$hFE \quadtyp 50$

10 to 80

D.C. current gain ratio of matched devices *

$I_C = 4 \, A; \; V_{CE} = 5 \, V$

$hFE1/hFE2 < 1,2$

Collector-emitter saturation voltage *

$I_C = 12,5 \, A; \; I_B = 2,5 \, A$

$V_{CE}sat \quadtyp 1,5 \, V$

Transition frequency at $f = 100 \, MHz$ *

$I_C = 4 \, A; \; V_{CE} = 12,5 \, V$

$f_T \quadtyp 650 \, MHz$

$I_C = 12,5 \, A; \; V_{CE} = 12,5 \, V$

$f_T \quadtyp 600 \, MHz$

Collector capacitance at $f = 1 \, MHz$

$I_E = I_e = 0; \; V_{CB} = 15 \, V$

$C_c < 160 \, pF$

Feedback capacitance at $f = 1 \, MHz$

$I_C = 200 \, mA; \; V_{CE} = 15 \, V$

$C_re \quadtyp 80 \, pF$

Collector-stud capacitance

$C_{cs} \quadtyp 2 \, pF$

* Measured under pulse conditions: $t_p \leq 200 \, \mu s; \; \delta \leq 0,02.$
BLW60C

**7Z77251**

Typical values

- $T_j = 25 \degree C$

- $V_{CE} = 12.5 \, V$

- $V_{CE} = 5 \, V$

**7Z87077,1**

$I_E = I_e = 0$

- $f = 1 \, MHz$

**7Z77257**

Typical values

- $f = 100 \, MHz$
- $T_j = 25 \degree C$

- $V_{CE} = 12.5 \, V$
- $10 \, V$
- $5 \, V$

*July 1977*
### APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f (\text{MHz}) )</th>
<th>( V_{CC} (\text{V}) )</th>
<th>( P_L (\text{W}) )</th>
<th>( P_S (\text{W}) )</th>
<th>( G_P (\text{dB}) )</th>
<th>( I_C (\text{A}) )</th>
<th>( \eta (%) )</th>
<th>( Z_i (\Omega) )</th>
<th>( V_L (\text{mA/V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>12,5</td>
<td>45</td>
<td>&lt;12,7</td>
<td>&gt;5,5</td>
<td>&lt;4,8</td>
<td>&gt;75</td>
<td>1,1 + j1,4</td>
<td>310 + j95</td>
</tr>
<tr>
<td>175</td>
<td>13,5</td>
<td>45</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Test circuit for 175 MHz

![Test circuit for 175 MHz](image)

List of components:

- \( C_1 = 2,5 \) to \( 20 \) pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( C_2 = C_8 = 4 \) to \( 40 \) pF film dielectric trimmer (cat. no. 2222 809 07008)
- \( C_{3a} = C_{3b} = 47 \) pF ceramic capacitor (500 V)
- \( C_4 = 120 \) pF ceramic capacitor
- \( C_5 = 100 \) nF polyester capacitor
- \( C_{6a} = C_{6b} = 8,2 \) pF ceramic capacitor (500 V)
- \( C_7 = 5 \) to \( 60 \) pF film dielectric trimmer (cat. no. 2222 809 07011)
- \( L_1 = 1 \) turn Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
- \( L_2 = 100 \) nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
- \( L_3 = L_8 = \) Ferroxcube choke coil (cat. no. 4312 020 36640)
- \( L_4 = L_5 = \) strip (12 mm x 6 mm); taps for \( C_{3a} \) and \( C_{3b} \) at 5 mm from transistor
- \( L_6 = 2 \) turns enamelled Cu wire (1,6 mm); int. dia. 5,0 mm; length 6,0 mm; leads 2 x 5 mm
- \( L_7 = 2 \) turns enamelled Cu wire (1,6 mm); int. dia. 4,5 mm; length 6,0 mm; leads 2 x 5 mm
- \( L_4 \) and \( L_5 \) are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
- \( R_1 = 10 \) \( \Omega \) (±10%) carbon resistor
- \( R_2 = 4,7 \) \( \Omega \) (±5%) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit on page 6.
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (P_S/P_Snom) increases linearly with supply over-voltage ratio.
Power gain versus frequency (class-B operation)

Measuring conditions for the graphs on this page

\[ V_{CC} = 12.5 \, \text{V} \]
\[ P_L = 45 \, \text{W} \]
\[ T_h = 25 \, ^\circ\text{C} \]

Typical values

Input impedance (series components) versus frequency (class-B operation)

Load impedance (parallel components) versus frequency (class-B operation)
APPLICATION INFORMATION (continued)

R.F. performance in s.s.b. class-AB operation

$V_{CE} = 12.5 \, V; \, T_h \, \text{up to} \, 25 \, ^{\circ}C; \, R_{th \, mb-h} \leq 0.45 \, ^{\circ}C/W$

$f_1 = 28,000 \, MHz; \, f_2 = 28,001 \, MHz$

<table>
<thead>
<tr>
<th>output power W</th>
<th>$G_p , dB$</th>
<th>$\eta_{dt} , %$</th>
<th>$d_3 , dB^*$</th>
<th>$d_5 , dB^*$</th>
<th>$I_{C(ZS)} , mA$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 30 (P.E.P.)</td>
<td>typ 19.5</td>
<td>typ 35</td>
<td>typ -33</td>
<td>typ -36</td>
<td>25</td>
</tr>
</tbody>
</table>

Test circuit

S.S.B. class-AB

List of components:

TR1 = TR2 = BD137

C1 = 100 pF air dielectric trimmer (single insulated rotor type)
C2 = 27 pF ceramic capacitor
C3 = 180 pF ceramic capacitor
C4 = 100 pF air dielectric trimmer (single non-insulated rotor type)
C5 = C7 = 3.9 nF polyester capacitor
C6 = 2 x 270 pF polystyrene capacitors in parallel
C8 = C15 = C16 = 100 nF polyester capacitor
C9 = 2.2 μF moulded metallized polyester capacitor
C10 = 2 x 385 pF film dielectric trimmer
C11 = 68 pF ceramic capacitor

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

List of components (continued)

- C12 = 2 x 82 pF ceramic capacitors in parallel
- C13 = 47 pF ceramic capacitor
- C14 = 385 pF film dielectric trimmer
- L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9 mm; length 6,1 mm; leads 2 x 5 mm
- L2 = L5 = Ferroxcube choke coil (cat. no. 4312 020 36640)
- L3 = 68 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 8 mm; length 8,3 mm; leads 2 x 5 mm
- L4 = 96 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 7,6 mm; leads 2 x 5 mm
- R1 = 27 Ω (±5%) carbon resistor
- R2 = 4,7 Ω (±5%) carbon resistor
- R3 = 1,5 kΩ (±5%) carbon resistor
- R4 = 10 Ω wirewound potentiometer (3 W)
- R5 = 47 Ω wirewound resistor (5,5 W)
- R6 = 150 Ω (±5%) carbon resistor

Measuring conditions for the upper graphs on page 11

- VCC = 12,5 V
- f1 = 28,000 MHz
- f2 = 28,001 MHz
- TH = 25 °C
- Rth mb-h ≤ 0,45 °C/W
- Ic(ZS) = 25 mA
- typical values

Measuring conditions for the lower graphs on page 11

- VCC = 13,5 V
- f1 = 28,000 MHz
- f2 = 28,001 MHz
- TH = 25 °C
- Rth mb-h ≤ 0,45 °C/W
- Ic(ZS) = 25 mA
- typical values
intermodulation distortion versus output power

double-tone efficiency versus output power

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
S.S.B. class-AB operation

Conditions for the graphs above:

\[
\begin{align*}
V_{CC} &= 12,5 \text{ V} \\
P_L &= 30 \text{ W (P.E.P.)} \\
T_h &= 25 ^\circ \text{C} \\
R_{th \text{ mb-h}} &\leq 0,45 ^\circ \text{C/W} \\
I_C(ZS) &= 25 \text{ mA} \\
Z_L &= 1,9 \Omega \\
\end{align*}
\]

\[
\begin{align*}
V_{CC} &= 13,5 \text{ V} \\
P_L &= 35 \text{ W (P.E.P.)} \\
T_h &= 25 ^\circ \text{C} \\
R_{th \text{ mb-h}} &\leq 0,45 ^\circ \text{C/W} \\
I_C(ZS) &= 25 \text{ mA} \\
Z_L &= 1,9 \Omega \\
\end{align*}
\]

The typical curves (both conditions) hold for an unneutralized amplifier.
TV TRANSPOSER TRANSISTOR FOR BAND III

N-P-N silicon planar epitaxial transistor assembled in a plastic encapsulated stripline package all leads of which are isolated from the stud. Excellent d.c. dissipation properties have been obtained by means of internal emitter-ballasting resistors and gold metallization. Detailed information is presented for application of this device in preamplifiers for television transposers and transmitters in band III.

QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value) \( V_{CBOM} \) max. 60 V
Collector-emitter voltage (open base) \( V_{CEO} \) max. 32 V
Collector current (average) \( I_C(AV) \) max. 3 A
D.C. power dissipation up to \( T_H = 70 \, ^\circ\text{C} \) \( P_{tot} \) max. 40 W
Thermal resistance from junction to mounting base \( R_{th\ j-mb} \) = 3,0 \( ^\circ\text{C}/\text{W} \)
Transition frequency \( f_T \) typ. 900 MHz
Output power at \( f_{vision} = 224,25 \, \text{MHz} \) *
\( I_C = 1,6 \, \text{A}; \, V_{CE} = 25 \, \text{V}; \, T_H = 70 \, ^\circ\text{C}; \, d_{im} = -55 \, \text{dB} \)
\( P_{o\ sync} > 10,0 \, \text{W} \)
\( P_{o\ sync} \) typ. 13,5 W
Power gain at \( f_{vision} = 224,25 \, \text{MHz} \)
\( I_C = 1,6 \, \text{A}; \, V_{CE} = 25 \, \text{V}; \, T_H = 70 \, ^\circ\text{C} \)
\( G_p > 9,5 \, \text{dB} \)

* Three-tone test method (vision carrier –8 dB, sound carrier –7 dB, sideband signal –16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Fig. 1 SOT-56.

When locking is required an adhesive is preferred instead of a lock washer.
Torque on nut: min. 1,5 Nm (15 kg cm)
max. 1,7 Nm (17 kg cm)

Dimensions in mm

Diameter of clearance hole in heatsink: max. 5,0 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)
peak value

Collector-emitter voltage (R_{BE} = 10\,\Omega)
peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Currents

Collector current (average)

Collector current (peak value) f > 1\,MHz

Power dissipation

D.C. power dissipation up to T_h = 70\,°C

\[
\begin{align*}
V_{CBOM} & \quad \text{max.} \quad 60 \, \text{V} \\
V_{CERM} & \quad \text{max.} \quad 60 \, \text{V} \\
V_{CEO} & \quad \text{max.} \quad 32 \, \text{V} \\
V_{EBO} & \quad \text{max.} \quad 4 \, \text{V} \\
I_{C(AV)} & \quad \text{max.} \quad 3.0 \, \text{A} \\
I_{CM} & \quad \text{max.} \quad 9.0 \, \text{A} \\
P_{\text{tot}} & \quad \text{max.} \quad 40 \, \text{W}
\end{align*}
\]

Temperatures

Storage temperature

Junction temperature

THERMAL RESISTANCE

From junction to mounting base

From mounting base to heatsink

\[
\begin{align*}
R_{th\, j-mb} & = 3.0 \, \text{°C/W} \\
R_{th\, mb-h} & = 0.3 \, \text{°C/W}
\end{align*}
\]

Tstg \quad -65 \text{ to } +200 \, \text{°C}

max. \quad 200 \, \text{°C}

February 1975
CHARACTERISTICS

Breakdown voltages

Tj = 25 °C unless otherwise specified

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{BR}CBO</td>
<td>&gt;</td>
<td>60 V</td>
</tr>
<tr>
<td>V_{BR}CER</td>
<td>&gt;</td>
<td>60 V</td>
</tr>
<tr>
<td>V_{BR}CEO</td>
<td>&gt;</td>
<td>32 V</td>
</tr>
<tr>
<td>V_{BR}EBO</td>
<td>&gt;</td>
<td>4 V</td>
</tr>
</tbody>
</table>

Collector -base voltage
open emitter, IC = 50 mA

Collector -emitter voltage
R_{BE} = 10 Ω, IC = 50 mA

Collector -emitter voltage
open base , IC = 50 mA

Emitter -base voltage
open collector, IE = 10 mA

Transitory energy

L = 25 mH; f = 50 Hz

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Energy</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E open base</td>
<td>&gt;</td>
<td>4.5 mWs</td>
</tr>
<tr>
<td>E -V_{BE} = 1.5 V; R_{BE} = 33 Ω</td>
<td>&gt;</td>
<td>4.5 mWs</td>
</tr>
</tbody>
</table>

D.C. current gain

I_C = 1.0 A; V_{CE} = 5 V

h_{FE} typ. 40

Transition frequency

I_C = 4 A; V_{CE} = 25 V

f_T typ. 900 MHz

Collector capacitance at f = 1 MHz

I_E = I_e = 0; V_{CB} = 30 V

C_C typ. 68 pF

Feedback capacitance at f = 1 MHz

I_C = 200 mA; V_{CE} = 30 V

C_{re} typ. 39 pF

Collector -stud capacitance

C_{cs} typ. 2 pF
APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>( d_{\text{im}} ) (*) (dB)</th>
<th>( f_{\text{vision}} ) (MHz)</th>
<th>( V_{\text{CE}} ) (V)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( P_0 \text{ sync} ) (*) (W)</th>
<th>( T_h ) (°C)</th>
<th>( R_{\text{th mb-h}} ) (°C/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-55</td>
<td>224,25</td>
<td>25</td>
<td>1,6</td>
<td>&gt; 9,5</td>
<td>&gt; 10,0</td>
<td>70</td>
<td>( \leq 0,3 )</td>
</tr>
<tr>
<td>-52</td>
<td>224,25</td>
<td>25</td>
<td>1,6</td>
<td>&gt; 9,5</td>
<td>typ. 13,5</td>
<td>70</td>
<td>( \leq 0,3 )</td>
</tr>
</tbody>
</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, side band signal -16 dB), zero dB corresponds to peak sync level.

Test circuit at \( f = 224,25 \) MHz

List of components: see page 6.

Component lay-out and printed circuit board for \( f = 224,25 \) MHz test circuit on page 7.
APPLICATION INFORMATION  (continued)

List of components:

Tr 1 = BD135
Tr 2 = BD136

C1 = 330 pF chip capacitor
C2 = 4 to 40 pF film dielectric trimmer
C3 = 4 to 60 pF film dielectric trimmer
C4 = C5 = 82 pF chip capacitor, placed 5 mm from transistor edge
C6 = 4 to 100 pF film dielectric trimmer
C7 = 4 to 60 pF film dielectric trimmer
C8 = C10 = 820 pF chip capacitor
C9 = 47 μF electrolytic capacitor 6.3 V
C11 = 22 μF electrolytic capacitor 40 V
C12 = 47 μF electrolytic capacitor 40 V
C13 = 100 nF polyester capacitor

L1 = 24.7 nH; 1.5 turns closely wound enamelled Cu wire (0.7 mm); int. diam. 4.5 mm;
leads 2 x 5 mm.

L2 = 8.3 nH formed by metallization on printed board.
L3 = formed by metallization on printed board.
L4 = 100 nH; 3.5 turns closely wound enamelled Cu wire (0.7 mm); int. diam. 5.5 mm;
leads 2 x 5 mm.
L5 = 22 nH; 1.5 turns closely wound enamelled Cu wire (1.6 mm); int. diam. 4.5 mm;
leads 2 x 8 mm.
L6 = 36 nH; 1.5 turns closely wound enamelled Cu wire (1.6 mm); int. diam. 4.0 mm;
leads 2 x 10 mm.

R1 = 4.7 Ω carbon resistor
R2 = 330 Ω
R3 = 470 Ω potentiometer
R4 = 4.7 kΩ
R5 = 2.7 kΩ
R6 = R7 = R8 = 4.7 Ω (5.5 W)
R9 = 180 Ω (5.5 W)
R10 = 68 Ω
Component lay-out and printed circuit board for $f = 224.25$ MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.

Component lay-out and printed circuit board for bias circuit.
intermodulation distortion versus peak-sync power
three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level

\[ \begin{align*}
\text{IC} &= 1.6 \text{ A} \\
\text{VCE} &= 25 \text{ V} \\
T_h &= 70 \degree \text{C} \\
R_{th mb-h} &= 0.3 \degree \text{C/W} \\
f_{vision} &= 224.25 \text{ MHz}
\end{align*} \]

input impedance (series components) versus frequency (class A operation)

\[ \begin{align*}
r_i &= 2 \\
x_i &= 0
\end{align*} \]

typ. values
\[ \begin{align*}
\text{IC} &= 1.6 \text{ A} \\
\text{VCE} &= 25 \text{ V}
\end{align*} \]

load impedance (parallel components) versus frequency (class A operation)

\[ \begin{align*}
R_L &= -100 \\
C_L &= -50
\end{align*} \]

typ. values
\[ \begin{align*}
\text{IC} &= 1.6 \text{ A} \\
\text{VCE} &= 25 \text{ V}
\end{align*} \]
TV TRANSPOSER TRANSISTOR FOR BAND III

N-P-N silicon planar epitaxial transistor assembled in a stripline package with a ceramic cap. All leads are isolated from the stud. Excellent d.c. dissipation properties have been obtained by means of internal emitter-ballasting resistors and gold metallization. Detailed information is presented for application of this device in preamplifiers for television transposers and transmitters in band III.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter; peak value)</td>
<td>V_{CBOM} max. 60 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_{CEO} max. 32 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>I_{C(AV)} max. 4 A</td>
</tr>
<tr>
<td>D.C. power dissipation at T_{j} = 70 °C</td>
<td>P_{tot} max. 60 W</td>
</tr>
<tr>
<td>Thermal resistance from junction to mounting base</td>
<td>R_{th j-mb} = 1,9 °C/W</td>
</tr>
<tr>
<td>Transition frequency</td>
<td>f_{T} typ. 800 MHz</td>
</tr>
<tr>
<td>Output power at f_{vision} = 224,25 MHz *</td>
<td>P_{o sync} &gt; 14,0 W</td>
</tr>
<tr>
<td></td>
<td>I_{C} = 2,4 A; V_{CE} = 25 V; T_{j} = 70 °C; d_{im} = -55 dB</td>
</tr>
<tr>
<td></td>
<td>I_{C} = 2,4 A; V_{CE} = 25 V; T_{j} = 70 °C; d_{im} = -52 dB</td>
</tr>
<tr>
<td>Power gain at f_{vision} = 224,25 MHz</td>
<td>G_{p} typ. 19,5 W</td>
</tr>
<tr>
<td></td>
<td>I_{C} = 2,4 A; V_{CE} = 25 V; T_{j} = 70 °C</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier −8 dB, sound carrier −7 dB, sideband signal −16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Fig. 1 SOT-105.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 1,5 Nm (15 kg cm) max. 1,7 Nm (17 kg cm)

Diameter of clearance hole in heatsink: max. 5,0 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

* Three-tone test method (vision carrier −8 dB, sound carrier −7 dB, sideband signal −16 dB), zero dB corresponds to peak sync level.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)  
peak value  \( V_{CBOM} \)  max.  60 V
Collector-emitter voltage (R\(_{BE} = 10 \, \Omega\))  
peak value  \( V_{CERM} \)  max.  60 V
Collector-emitter voltage (open base)  
\( V_{CEO} \)  max.  32 V
Emitter-base voltage (open collector)  
\( V_{EBO} \)  max.  4 V

Currents

Collector current (average)  
\( I_{C(AV)} \)  max.  4,0 A
Collector current (peak value)  \( f > 1 \, MHz \)  
\( I_{CM} \)  max.  12,0 A

Power dissipation

D.C. power dissipation at \( T_h = 70 \, ^\circ C \)  
\( P_{tot} \)  max.  60 W

Temperatures

Storage temperature  
\( T_{stg} \)  -65 to +125 \( ^\circ C \)
Operating junction temperature  
\( T_j \)  max.  200 \( ^\circ C \)

THERMAL RESISTANCE

From junction to mounting base  
\( R_{th \, j-mb} \)  =  1,9 \( ^\circ C/W \)
From mounting base to heatsink  
\( R_{th \, mb-h} \)  =  0,3 \( ^\circ C/W \)
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, \( I_C = 50 \text{ mA} \)
\[ V_{(BR)CBO} > 60 \text{ V} \]

Collector-emitter voltage
\( R_{BE} = 10 \Omega, \ I_C = 50 \text{ mA} \)
\[ V_{(BR)CER} > 60 \text{ V} \]

Collector-emitter voltage
open base, \( I_C = 50 \text{ mA} \)
\[ V_{(BR)CEO} > 32 \text{ V} \]

Emitter-base voltage
open collector, \( I_E = 10 \text{ mA} \)
\[ V_{(BR)EBO} > 4 \text{ V} \]

Transient energy
\( L = 25 \text{ mH; } f = 50 \text{ Hz} \)
open base
-\( V_{BE} = 1.5 \text{ V; } R_{BE} = 33 \Omega \)
\[ E > 8.0 \text{ mWs} \]

D.C. current gain
\( I_C = 2.0 \text{ A; } V_{CE} = 25 \text{ V} \)
\[ h_{FE} > 20 \]
\[ \text{typ. } 45 \]

Transition frequency
\( I_C = 6.0 \text{ A; } V_{CE} = 25 \text{ V} \)
\[ f_T \text{ typ. } 800 \text{ MHz} \]

Collector capacitance at \( f = 1 \text{ MHz} \)
\( I_E = I_e = 0; \ V_{CB} = 30 \text{ V} \)
\[ C_C \text{ typ. } 95 \text{ pF} \]
\[ < 120 \text{ pF} \]

Feedback capacitance at \( f = 1 \text{ MHz} \)
\( I_C = 0.2 \text{ A; } V_{CE} = 30 \text{ V} \)
\[ C_{re} \text{ typ. } 55 \text{ pF} \]

Collector-stud capacitance
\( I_C = 0.2 \text{ A; } V_{CE} = 30 \text{ V} \)
\[ C_{cs} \text{ typ. } 2 \text{ pF} \]

\( T_j = 25 \text{ °C unless otherwise specified} \)
APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>$d_{im}$ *) (dB)</th>
<th>$f_{vision}$ (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$I_C$ (A)</th>
<th>$G_D$ (dB)</th>
<th>$P_0 \text{ sync}$ *) (W)</th>
<th>$T_h$ (°C)</th>
<th>$R_{th \text{ mb-h}}$ (°C/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-55</td>
<td>224,25</td>
<td>25</td>
<td>2,4</td>
<td>&gt; 8,0</td>
<td>&gt; 14,0</td>
<td>70</td>
<td>≤ 0,3</td>
</tr>
<tr>
<td>-52</td>
<td>224,25</td>
<td>25</td>
<td>2,4</td>
<td>&gt; 8,0</td>
<td>typ. 19,5</td>
<td>70</td>
<td>≤ 0,3</td>
</tr>
</tbody>
</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

Test circuit for $f = 224.25$ MHz

List of components: see page 6.

Component layout and printed-circuit board for $f = 224.25$ MHz test circuit on page 7.
APPLICATION INFORMATION (continued)

List of components:

TR1 = BD135
TR2 = BD136

C1 = 220 pF ceramic plate capacitor
C2 = 4 to 40 pF film dielectric trimmer
C3 = 5 to 60 pF film dielectric trimmer
C4 = C5 = 82 pF chip capacitor, placed 1 mm from transistor edge
C6 = 7 to 100 pF film dielectric trimmer
C7 = 4 to 40 pF film dielectric trimmer
C8 = C10 = 820 pF chip capacitor
C9 = 220 µF electrolytic capacitor 10 V
C11 = 47 µF electrolytic capacitor 40 V
C12 = 47 µF electrolytic capacitor 40 V
C13 = 100 nF polyester capacitor
C14 = 33 nF polyester capacitor

L1 = 24.7 nH; 1.5 turns closely wound enamelled Cu wire (0.7 mm); int. dia. 4.5 mm; leads 2 x 5 mm.
L2 = 8.3 nH formed by metallization on printed-circuit board
L3 = 0.7 nH formed by metallization on printed-circuit board
L4 = 100 nH; 3.5 turns closely wound enamelled Cu wire (0.7 mm); int. dia. 5.5 mm; leads 2 x 5 mm.
L5 = 15.0 nH; 1 turn enamelled Cu wire (1.6 mm); int. dia. 4.5 mm; leads 2 x 8 mm.
L6 = 26.4 nH; 1.5 turns closely wound enamelled Cu wire (1.6 mm); int. dia. 5.1 mm; leads 2 x 10 mm.

R1 = 4.7 Ω carbon resistor
R2 = 15 Ω carbon resistor
R3 = 180 Ω carbon resistor (1 W)
R4 = 470 Ω potentiometer
R5 = 4.7 kΩ carbon resistor
R6 = 2.7 kΩ carbon resistor
R7 = 4 x 4.7 Ω (2 W); in parallel
R8 = 150 Ω (5, 5 W)
R9 = 68 Ω carbon resistor (1 W)
R10 = 10 Ω carbon resistor
APPLICATION INFORMATION (continued)

Component layout and printed-circuit board for $f = 224, 25$ MHz test circuit without bias circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
cross modulation and intermodulation distortion versus peak, sync power

Sample text:

1) Two-tone test method (vision carrier 0 dB, sound carrier -7 dB), zero dB corresponds to peak sync level.

2) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

In the application information a collector-emitter voltage $V_{CE} = 25 \, \text{V}$ and collector current $I_C = 2.4 \, \text{A}$ are recommended.

If a higher collector voltage (within the limiting values) is used, precautions must be taken to ensure that the impedance presented to the collector circuit does not vary excessively with frequency. This is especially important in wideband circuits where a relatively wide variation of load impedance over the frequency band may be expected. Tuning of the output circuit at high level should be avoided or, if essential, it should be performed very carefully, otherwise very high load impedances may occur during which the maximum ratings of the transistor can be exceeded.
Power gain versus frequency (class-A operation)

\[ G_p (\text{dB}) = \begin{cases} 20 & \text{typ} \\ 1 & \text{t} \end{cases} \]

input impedance (series components) versus frequency (class-A operation)

\[ r_i, x_i (\Omega) \]

load impedance (parallel components) versus frequency (class-A operation)

\[ R_L (\Omega), C_L (\text{pF}) \]

April 1976
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-AB or class-B operated high power transmitters in the h.f. and v.h.f. bands. The transistor presents excellent performance as a linear amplifier in the h.f. band. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Transistors are delivered in matched hFE groups.

The transistor has a ⅝” flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$I_{C(ZS)}$ A</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_R$ dB</th>
<th>$\eta$ %</th>
<th>$d_3$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>0,05</td>
<td>1,6–28</td>
<td>8–80 (P.E.P.)</td>
<td>&gt;13</td>
<td>&gt;35*</td>
<td>&lt;–30</td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>–</td>
<td>108</td>
<td>80</td>
<td>typ. 7,9</td>
<td>typ. 70</td>
<td>–</td>
</tr>
</tbody>
</table>

* At 80 W P.E.P.

MECHANICAL DATA

SOT-121A (see page 2)

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
MECHANICAL DATA
Fig. 1 SOT-121A.

Dimensions in mm

Torque on screw: min. 0,6 Nm (6 kg cm)
max. 0,75 Nm (7,5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25 \, ^\circ C$

Storage temperature

Operating junction temperature

THERMAL RESISTANCE (dissipation = 60 W; $T_{mb} = 82 \, ^\circ C$, i.e. $T_{j} = 70 \, ^\circ C$)

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

$$R_{th \, j-mb (dc)} = 1.92 \, ^\circ C/W$$

$$R_{th \, j-mb (rf)} = 1.33 \, ^\circ C/W$$

$$R_{th \, mb-h} = 0.2 \, ^\circ C/W$$
CHARACTERISTICS

\$T_J = 25 \, ^\circ\text{C}\$

Collector-emitter breakdown voltage
\[ V_{BE} = 0; \ I_C = 50 \, \text{mA} \]

Collector-emitter breakdown voltage
open base; \( I_C = 50 \, \text{mA} \)

Emitter-base breakdown voltage
open collector; \( I_E = 10 \, \text{mA} \)

Collector cut-off current
\[ V_{BE} = 0; \ V_{CE} = 35 \, \text{V} \]

D.C. current gain* 
\[ I_C = 4 \, \text{A}; \ V_{CE} = 5 \, \text{V} \]

D.C. current gain ratio of matched devices*
\[ I_C = 4 \, \text{A}; \ V_{CE} = 5 \, \text{V} \]

Collector-emitter saturation voltage*
\[ I_C = 12,5 \, \text{A}; \ I_B = 2,5 \, \text{A} \]

Transition frequency at \( f = 100 \, \text{MHz} \)*
\[ -I_E = 4 \, \text{A}; \ V_{CB} = 28 \, \text{V} \]
\[ -I_E = 12,5 \, \text{A}; \ V_{CB} = 28 \, \text{V} \]

Collector capacitance at \( f = 1 \, \text{MHz} \)
\[ I_E = I_E = 0; \ V_{CB} = 28 \, \text{V} \]

Feedback capacitance at \( f = 1 \, \text{MHz} \)
\[ I_C = 50 \, \text{mA}; \ V_{CE} = 28 \, \text{V} \]

Collector-flange capacitance

\[ V_{(BR)CES} > 70 \, \text{V} \]
\[ V_{(BR)CEO} > 35 \, \text{V} \]
\[ V_{(BR)EBO} > 4 \, \text{V} \]
\[ I_{CES} < 10 \, \text{mA} \]
\[ h_{FE} \quad 15 \, \text{to} \, 80 \]
\[ h_{FE1}/h_{FE2} < 1,2 \]
\[ V_{CEsat} \quad \text{typ.} \, 2,5 \, \text{V} \]
\[ f_T \quad \text{typ.} \, 315 \, \text{MHz} \]
\[ f_T \quad \text{typ.} \, 305 \, \text{MHz} \]
\[ C_C \quad \text{typ.} \, 125 \, \text{pF} \]
\[ C_{re} \quad \text{typ.} \, 85 \, \text{pF} \]
\[ C_{cf} \quad \text{typ.} \, 3 \, \text{pF} \]

* Measured under pulse conditions: \( t_p < 200 \, \mu\text{s}; \delta < 0,02. \)
Fig. 4 Typical values; $T_j = 25\,\text{°C}$.

Fig. 5 $I_E = I_e = 0; f = 1\,\text{MHz}; T_j = 25\,\text{°C}$.

Fig. 6 $V_{CB} = 28\,\text{V}; f = 100\,\text{MHz}; T_j = 25\,\text{°C}$.
APPLICATION INFORMATION

R.F. performance in s.s.b. class-AB operation (linear power amplifier)

\[ V_{CE} = 28 \text{ V}; \quad T_h = 25 \text{ }^\circ\text{C}; \quad f_1 = 28,000 \text{ MHz}; \quad f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power W</th>
<th>( G_p ) dB</th>
<th>( \tau_{dt} ) (%) at 80 W P.E.P.</th>
<th>( d_3 ) dB</th>
<th>( d_5 ) dB</th>
<th>( I_C(ZS) ) A</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 to 80 (P.E.P.)</td>
<td>&gt; 13</td>
<td>&gt; 35</td>
<td>&lt; -30</td>
<td>&lt; -30</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; s.s.b. class-AB.

List of components:

- \( C_1 = 27 \text{ pF ceramic capacitor (500 V)} \)
- \( C_2 = 100 \text{ pF air dielectric trimmer (single insulated rotor type)} \)
- \( C_3 = 100 \text{ pF polystyrene capacitor} \)
- \( C_4 = C_6 = C_9 = 100 \text{ nF polyester capacitor} \)
- \( C_5 = 280 \text{ pF air dielectric trimmer (single non-insulated rotor type)} \)
- \( C_7 = C_8 = 3.9 \text{ nF ceramic capacitor} \)
- \( C_{10} = 2.2 \mu\text{F moulded metallized polyester capacitor} \)
- \( C_{11} = 180 \text{ pF polystyrene capacitor} \)
- \( C_{12} = 2 \times 68 \text{ pF ceramic capacitors in parallel (500 V)} \)
- \( C_{13} = 120 \text{ pF polystyrene capacitor} \)

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C14 = C15 = 280 pF air dielectric trimmer (single insulated rotor type)
C16 = 56 pF ceramic capacitor (500 V)
L1 = 108 nH; 4 turns Cu wire (1,6 mm); int. dia. 8,7 mm; length 11,2 mm; leads 2 x 7 mm
L2 = L4 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L3 = 88 nH; 3 turns Cu wire (1,6 mm); int. dia. 8,0 mm; length 8,0 mm; leads 2 x 7 mm
L5 = 120 nH; 4 turns Cu wire (1,6 mm); int. dia. 9,3 mm; length 11,2 mm; leads 2 x 7 mm
R1 = 1,5 kΩ (± 5%) carbon resistor (0,5 W)
R2 = 10 Ω wirewound potentiometer (3 W)
R3 = 0,9 Ω; parallel connection of 2 x 1,8 Ω carbon resistors (± 5%; 0,5 W each)
R4 = 60 Ω; parallel connection of 2 x 120 Ω wirewound resistors (5,5 W each)
R5 = 56 Ω (± 5%) carbon resistor (0,5 W)
R6 = 33 Ω (± 5%) carbon resistor (0,5 W)
R7 = 4,7 Ω (± 5%) carbon resistor (0,5 W)

Fig. 8 Intermodulation distortion as a function of output power.*

Fig. 9 Double-tone efficiency and power gain as a function of output power.

Conditions for Figs 8 and 9:
VCE = 28 V; IC(ZS) = 50 mA; f1 = 28,000 MHz; f2 = 28,001 MHz; Th = 25 °C; typical values.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

Fig. 10 Power gain as a function of frequency.

Fig. 11 Input impedance (series components) as a function of frequency.

Figs 10 and 11 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
$V_{CE} = 28 \text{ V}$; $I_C(ZS) = 50 \text{ mA}$; $P_L = 80 \text{ W}$; $T_h = 25 \degree \text{C}$; $Z_L = 3.9 \Omega$. 
Fig. 12 Power gain as a function of frequency.

Fig. 13 Input impedance (series components) as a function of frequency.

Figs 12 and 13 are typical curves and hold for a push-pull amplifier with cross-neutralization in s.s.b. class-AB operation.

Conditions:
\( V_{CE} = 28 \text{ V}; \, I_C(ZS) = 50 \text{ mA}; \, P_L = 80 \text{ W}; \, T_h = 25 \text{ °C}; \, Z_L = 3.9 \Omega; \) neutralizing capacitor: 68 pF.
Fig. 14  R.F. SOAR; s.s.b. class-AB operation; $f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz; $V_{CE} = 28$ V; $R_{th\ mb\ h} = 0,2$ °C/W.

The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

$T_h = 25^\circ C$

<table>
<thead>
<tr>
<th>$f$ (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_L$ (W)</th>
<th>$P_S$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$I_C$ (A)</th>
<th>$\eta$ (%)</th>
<th>$z_i$ (Ω)</th>
<th>$\overline{Y_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>108</td>
<td>28</td>
<td>80</td>
<td>typ. 13</td>
<td>typ. 7,9</td>
<td>typ. 4,1</td>
<td>typ. 70</td>
<td>0,85 + j1,0</td>
<td>174 – j40</td>
</tr>
</tbody>
</table>

Fig. 15 Test circuit; c.w. class-B.

List of components:

- $C_1 = C_9 = C_{10} = 4$ to $40$ pF film dielectric trimmer (cat. no. 2222 809 07008)
- $C_2 = 5$ to $60$ pF film dielectric trimmer (cat. no. 2222 809 07011)
- $C_3 = 22$ pF ceramic capacitor (500 V)
- $C_{4ab} = 2 \times 82$ pF ceramic capacitors in parallel (500 V)
- $C_5 = 270$ pF polystyrene capacitor
- $C_6 = 100$ nF polyester capacitor
- $C_{7a} = 8,2$ pF ceramic capacitor (500 V)
- $C_{7b} = 10$ pF ceramic capacitor (500 V)
- $C_8 = 5,6$ pF ceramic capacitor (500 V)
- $C_{11} = 10$ pF ceramic capacitor (500 V)

- $L_1 = 21$ nH; 2 turns Cu wire (1,0 mm); int. dia. 4,0 mm; length 3,5 mm; leads 2 x 5 mm
- $L_2 = L_5 = 2,4$ nH; strip (12 mm x 6 mm); tap for L4 at 6 mm from transistor
- $L_3 = L_7 =$ Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- $L_4 = 100$ nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
- $L_6 = 49$ nH; 2 turns Cu wire (1,6 mm); int. dia. 9,0 mm; length 4,7 mm; leads 2 x 5 mm
- $L_8 = 56$ nH; 2 turns Cu wire (1,8 mm); int. dia. 10,0 mm; length 4,5 mm; leads 2 x 5 mm

$L_2$ and $L_5$ are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric.

- $R_1 = R_2 = 10 \Omega$ (± 10%) carbon resistor

Component layout and printed-circuit board for 108 MHz test circuit are shown in Fig. 16.
Fig. 16 Component layout and printed-circuit board for 108 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 17  $V_{CE} = 28 \text{ V}; f = 108 \text{ MHz}; T_h = 25 \degree \text{C}$.

Fig. 18  $V_{CE} = 28 \text{ V}; f = 108 \text{ MHz}; T_h = 25 \degree \text{C};$ typical values.

Fig. 19  R.F. SOAR; c.w. class-B operation; $f = 108 \text{ MHz}; V_{CE} = 28 \text{ V}; R_{th \text{ mb-h}} = 0.2 \degree \text{C/W}$. The graph shows the permissible output power under nominal conditions ($V_{SWR} = 1$) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
APPLICATION INFORMATION (continued)

Fig. 20  $V_{CE} = 28$ V; $P_L = 80$ W; $T_h = 25$ °C; typical values.

Fig. 21  $V_{CE} = 28$ V; $P_L = 80$ W; $T_h = 25$ °C; typical values.

Fig. 22  $V_{CE} = 28$ V; $P_L = 80$ W; $T_h = 25$ °C.
N-P-N silicon planar epitaxial transistor intended for use in class-AB or class-B operated high power transmitters in the h.f. and v.h.f. bands. The transistor presents excellent performance as a linear amplifier in the h.f. band. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Transistors are delivered in matched hFE groups.

The transistor has a 1/4" flange envelope with a ceramic cap. All leads are isolated from the flange.

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Mode of Operation</th>
<th>$V_{CE}$ (V)</th>
<th>$I_{C(ZS)}$ (A)</th>
<th>$f$ (MHz)</th>
<th>$P_L$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$d_3$ (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>0,1</td>
<td>1,6–28</td>
<td>15–130</td>
<td>&gt; 12</td>
<td>&gt; 37,5*</td>
<td>&lt; -30</td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>-</td>
<td>87,5</td>
<td>130</td>
<td>typ. 7,5</td>
<td>typ. 75</td>
<td>-</td>
</tr>
</tbody>
</table>

* At 130 W P.E.P.

**MECHANICAL DATA**

SOT-121B (see page 2)

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**CAUTION** This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
MECHANICAL DATA
Fig. 1 SOT-121B.

Dimensions in mm

Torque on screw: min. 0,6 Nm (6 kg cm)
max. 0,75 Nm (7,5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25 \, ^\circ C$

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CESM}$ max.</td>
<td>70 V</td>
</tr>
<tr>
<td>$V_{CEO}$ max.</td>
<td>35 V</td>
</tr>
<tr>
<td>$V_{EBO}$ max.</td>
<td>4 V</td>
</tr>
<tr>
<td>$I_{C(AV)}$ max.</td>
<td>12 A</td>
</tr>
<tr>
<td>$I_{CM}$ max.</td>
<td>30 A</td>
</tr>
<tr>
<td>$P_{rf}$ max.</td>
<td>245 W</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>-65 to +150 , ^\circ C</td>
</tr>
<tr>
<td>$T_j$ max.</td>
<td>200 , ^\circ C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; $V_{CE} \leq 28$ V; $f \geq 1$ MHz.

I Continuous d.c. operation

II Continuous r.f. operation

III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 100 W; $T_{mb} = 90 \, ^\circ C$, i.e. $T_h = 70 \, ^\circ C$)

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

$$R_{th \, j-mb \, (dc)} = 1,03 \, ^\circ C/W$$

$$R_{th \, j-mb \, (rf)} = 0,71 \, ^\circ C/W$$

$$R_{th \, mb-h} = 0,2 \, ^\circ C/W$$
CHARACTERISTICS

$T_J = 25 \, ^\circ \text{C}$

Collector-emitter breakdown voltage
$V_{BE} = 0; \, I_C = 50 \, \text{mA}$

Collector-emitter breakdown voltage
open base; $I_C = 100 \, \text{mA}$

Emitter-base breakdown voltage
open collector; $I_E = 20 \, \text{mA}$

Collector cut-off current
$V_{BE} = 0; \, V_{CE} = 35 \, \text{V}$

D.C. current gain*
$I_C = 7 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

D.C. current gain ratio of matched devices*
$I_C = 7 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage*
$I_C = 20 \, \text{A}; \, I_B = 4 \, \text{A}$

Transition frequency at $f = 100 \, \text{MHz}^*$
$-I_E = 7 \, \text{A}; \, V_{CB} = 28 \, \text{V}$
$-I_E = 20 \, \text{A}; \, V_{CB} = 28 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$
$I_E = I_e = 0; \, V_{CB} = 28 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$
$I_C = 100 \, \text{mA}; \, V_{CE} = 28 \, \text{V}$

Collector-flange capacitance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{(BR)CES}$</td>
<td>$&gt; 70 , \text{V}$</td>
</tr>
<tr>
<td>$V_{(BR)CEO}$</td>
<td>$&gt; 35 , \text{V}$</td>
</tr>
<tr>
<td>$V_{(BR)EBO}$</td>
<td>$&gt; 4 , \text{V}$</td>
</tr>
<tr>
<td>$I_{CES}$</td>
<td>$&lt; 20 , \text{mA}$</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>15 to 80</td>
</tr>
<tr>
<td>$h_{FE1}/h_{FE2}$</td>
<td>$&lt; 1.2$</td>
</tr>
<tr>
<td>$V_{CEset}$</td>
<td>typ. 2 , \text{V}$</td>
</tr>
<tr>
<td>$f_T$</td>
<td>typ. 320 , \text{MHz}$</td>
</tr>
<tr>
<td>$f_T$</td>
<td>typ. 300 , \text{MHz}$</td>
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<tr>
<td>$C_c$</td>
<td>typ. 255 , \text{pF}$</td>
</tr>
<tr>
<td>$C_{re}$</td>
<td>typ. 175 , \text{pF}$</td>
</tr>
<tr>
<td>$C_{cf}$</td>
<td>typ. 3 , \text{pF}$</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \, \delta \leq 0.02$. 

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H.F./V.H.F. power transistor

Fig. 4 Typical values; $T_j = 25^\circ$C.

Fig. 5 $I_E = I_0 = 0; f = 1$ MHz; $T_j = 25^\circ$C.

Fig. 6 $V_{CB} = 28$ V; $f = 100$ MHz; $T_j = 25^\circ$C.
APPLICATION INFORMATION
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

V\textsubscript{CE} = 28 V; T\textsubscript{h} = 25 °C; f\textsubscript{1} = 28,000 MHz; f\textsubscript{2} = 28,001 MHz

<table>
<thead>
<tr>
<th>output power</th>
<th>G\textsubscript{p} dB</th>
<th>%\text{det} (%) at 130 W P.E.P.</th>
<th>I\textsubscript{C} (A)</th>
<th>d\textsubscript{3} dB</th>
<th>d\textsubscript{5} dB</th>
<th>I\textsubscript{C(ZS)} A</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 130 (P.E.P.)</td>
<td>&gt; 12</td>
<td>&gt; 37,5</td>
<td>&lt; 6,2</td>
<td>&lt; -30</td>
<td>&lt; -30</td>
<td>0,1</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; s.s.b. class-AB.

List of components:
C1 = 27 pF ceramic capacitor (500 V)
C2 = 100 pF air dielectric trimmer (single insulated rotor type)
C3 = 180 pF polystyrene capacitor
C4 = C6 = C9 = 100 nF polyester capacitor
C5 = 100 pF air dielectric trimmer (single non-insulated rotor type)
C7 = C8 = 3,9 nF ceramic capacitor
C10 = 2,2 µF moulded metallized polyester capacitor
C11 = 2 x 180 pF polystyrene capacitors in parallel
C12 = 3 x 56 pF and 33 pF ceramic capacitors in parallel (500 V)
C13 = 4 x 56 pF and 68 pF ceramic capacitors in parallel (500 V)
C14 = 360 pF air dielectric trimmer (single insulated rotor type)
C15 = 360 pF air dielectric trimmer (single non-insulated rotor type)
L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9,0 mm; length 6,1 mm; leads 2 x 7 mm
L2 = L4 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L3 = L5 = 80 nH; 2,5 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 10,0 mm;
leads 2 x 7 mm
R1 = 470 Ω wirewound resistor (5,5 W)
R2 = 4,7 Ω wirewound potentiometer (3 W)
R3 = 0,55 Ω; parallel connection of 4 x 2,2 Ω carbon resistors (± 5%; 0,5 W each)
R4 = 45 Ω; parallel connection of 4 x 180 Ω wirewound resistors (5,5 W each)
R5 = 56 Ω (± 5%) carbon resistor (0,5 W)
R6 = 27 Ω (± 5%) carbon resistor (0,5 W)
R7 = 4,7 Ω (± 5%) carbon resistor (0,5 W)

Fig. 8 Intermodulation distortion as a function of output power.

Fig. 9 Double-tone efficiency and power gain as a function of output power.

Conditions for Figs 8 and 9:
VCE = 28 V; IC(ZS) = 100 mA; f1 = 28,000 MHz; f2 = 28,001 MHz; TH = 25 °C; typical values.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

Fig. 10 Power gain as a function of frequency.

Fig. 11 Input impedance (series components) as a function of frequency.

Figs 10 and 11 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
$V_{CE} = 28 \text{ V}$; $l_{C(ZS)} = 100 \text{ mA}$; $P_L = 130 \text{ W}$; $T_h = 25 \text{ °C}$; $Z_L = 2.5 \Omega$. 
Fig. 12 Power gain as a function of frequency.

Fig. 13 Input impedance (series components) as a function of frequency.

Figs 12 and 13 are typical curves and hold for a push-pull amplifier with cross-neutralization in s.s.b class-AB operation.

Conditions:

\[ V_{CE} = 28 \, \text{V}; \quad I_C(ZS) = 100 \, \text{mA}; \quad P_L = 130 \, \text{W}; \quad T_H = 25 \, ^\circ\text{C}; \quad Z_L = 2,5 \, \Omega; \quad \text{neutralizing capacitor: 150 pF}. \]
APPLICATION INFORMATION (continued)

Fig. 14 R.F. SOAR; s.s.b. class-AB operation; 
f₁ = 28,000 MHz; f₂ = 28,001 MHz; V_Cₑ = 28 V; 
Rₜₘₐₜ₋ₜₜ = 0.2 °C/W.

The graph shows the permissible output power 
under nominal conditions (VSWR = 1) as a 
function of the expected VSWR during short-
time mismatch conditions with heatsink temper-
atures as parameter.
R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>VCE (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_D (dB)</th>
<th>I_C (A)</th>
<th>η (%)</th>
<th>z_i (Ω)</th>
<th>Y_L (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>87,5</td>
<td>28</td>
<td>130</td>
<td>typ. 23.2</td>
<td>typ. 7,5</td>
<td>typ. 6,2</td>
<td>typ. 75</td>
<td>0,62+j0,73</td>
<td>273 – j42</td>
</tr>
</tbody>
</table>

Fig. 15 Test circuit; c.w. class-B.

List of components:

C1 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C2 = C9 = C10 = 7 to 100 pF film dielectric trimmer (cat. no. 2222 809 07015)
C3 = C8 = 22 pF ceramic capacitor (500 V)
C4 = 4 x 82 pF ceramic capacitors in parallel (500 V)
C5 = 390 pF polystyrene capacitor
C6 = 220 nF polyester capacitor
C7a = 2 x 10 pF ceramic capacitors in parallel (500 V)
C7b = 2 x 8,2 pF ceramic capacitors in parallel (500 V)
L1 = 25 nH; 2 turns Cu wire (1,6 mm); int. dia. 5,0 mm; length 4,6 mm; leads 2 x 5 mm
L2 = L5 = 2,4 nH; strip (12 mm x 6 mm); tap for L4 and L6 at 5 mm from transistor
L3 = L7 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
L6 = 46 nH; 2 turns Cu wire (2,0 mm); int. dia. 9,0 mm; length 6,0 mm; leads 2 x 5 mm
L8 = 44 nH; 2 turns Cu wire (2,0 mm); int. dia. 9,0 mm; length 6,7 mm; leads 2 x 5 mm
L2 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric.

Component layout and printed-circuit board for 87,5 MHz test circuit are shown in Fig. 16.
Fig. 16 Component layout and printed-circuit board for 87.5 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 17 $V_{CE} = 28 \, \text{V}; \, f = 87.5 \, \text{MHz}; \, T_h = 25 \, \text{°C}$.

Fig. 18 $V_{CE} = 28 \, \text{V}; \, f = 87.5 \, \text{MHz}; \, T_h = 25 \, \text{°C}$; typical values.

Fig. 19 R.F. SOAR; c.w. class-B operation; $f = 87.5 \, \text{MHz}; \, V_{CE} = 28 \, \text{V}; \, R_{th \text{ mb-h}} = 0.2 \, \text{°C/W}$.

The graph shows the permissible output power under nominal conditions ($\text{VSWR} = 1$) as a function of the expected $\text{VSWR}$ during short-time mismatch conditions with heatsink temperatures as parameter.
APPLICATION INFORMATION (continued)

Fig. 20 \( V_{CE} = 28 \text{ V}; \ P_L = 130 \text{ W}; \ T_h = 25 \, ^\circ\text{C}; \) typical values.

Fig. 21 \( V_{CE} = 28 \text{ V}; \ P_L = 130 \text{ W}; \ T_h = 25 \, ^\circ\text{C}; \) typical values.

Fig. 22 \( V_{CE} = 28 \text{ V}; \ P_L = 130 \text{ W}; \ T_h = 25 \, ^\circ\text{C}. \)
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, AB or B operated mobile, industrial and military transmitters in the h.f. and v.h.f. bands. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a ½" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$</th>
<th>$f$</th>
<th>$P_L$</th>
<th>$P_S$</th>
<th>$G_p$</th>
<th>$\eta$</th>
<th>$d_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>150</td>
<td>100</td>
<td>&lt; 25</td>
<td>&gt; 6</td>
<td>&gt; 70</td>
<td>—</td>
</tr>
<tr>
<td>s.s.b. (class-A; $I_C = 3$ A)</td>
<td>26</td>
<td>28</td>
<td>35 (P.E.P.)</td>
<td>typ. 0,4</td>
<td>typ. 19,5</td>
<td>—</td>
<td>typ. —40</td>
</tr>
</tbody>
</table>

MECHANICAL DATA
SOT-121A (see page 2)

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
MECHANICAL DATA
Fig. 1 SOT-121A.

Torque on screw: min. 0.6 Nm (6 kg cm)
max. 0.75 Nm (7.5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.

January 1978
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); f > 1 MHz

R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CESM} max.</td>
<td>70 V</td>
</tr>
<tr>
<td>V_{CEO} max.</td>
<td>35 V</td>
</tr>
<tr>
<td>V_{EBO} max.</td>
<td>4 V</td>
</tr>
<tr>
<td>I_{C(AV)} max.</td>
<td>10 A</td>
</tr>
<tr>
<td>I_{CM} max.</td>
<td>25 A</td>
</tr>
<tr>
<td>P_{rf} max.</td>
<td>160 W</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>T_{j} max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V;
- f > 1 MHz.
- Continuous d.c. operation
- Continuous r.f. operation
- Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 80 W; T_{mb} = 86 °C; i.e. T_{h} = 70 °C)

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

\[
R_{th j-mb(dc)} = 1.45 \text{ °C/W}
\]

\[
R_{th j-mb(rf)} = 1.06 \text{ °C/W}
\]

\[
R_{th mb-h} = 0.2 \text{ °C/W}
\]
CHARACTERISTICS

$T_J = 25 \, ^\circ C$

- Collector-emitter breakdown voltage
  $V_{BE} = 0; \, I_C = 50 \, mA$

- Collector-emitter breakdown voltage
  open base; $I_C = 100 \, mA$

- Emitter-base breakdown voltage
  open collector; $I_E = 5 \, mA$

- Collector cut-off current
  $V_{BE} = 0; \, V_{CE} = 35 \, V$

- D.C. current gain*
  $I_C = 5 \, A; \, V_{CE} = 5 \, V$

- Collector-emitter saturation voltage
  $I_C = 15 \, A; \, I_B = 3 \, A$

- Transition frequency at $f = 100 \, MHz^*$
  $-I_E = 5 \, A; \, V_{CB} = 28 \, V$
  $-I_E = 15 \, A; \, V_{CB} = 28 \, V$

- Collector capacitance at $f = 1 \, MHz$
  $I_E = I_C = 0; \, V_{CB} = 28 \, V$

- Feedback capacitance at $f = 1 \, MHz$
  $I_C = 100 \, mA; \, V_{CE} = 28 \, V$

- Collector-flange capacitance

$V_{(BR)CES} > 70 \, V$

$V_{(BR)CEO} > 35 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 5 \, mA$

$h_{FE} \, 20 \text{ to } 85$

$V_{CEsat} \, \text{typ. } 2 \, V$

$f_T \, \text{typ. } 370 \, MHz$

$f_T \, \text{typ. } 350 \, MHz$

$C_c \, \text{typ. } 155 \, pF$

$C_{re} \, \text{typ. } 102 \, pF$

$C_{cf} \, \text{typ. } 3 \, pF$

* Measured under pulse conditions: $t_p \leq 200 \, \mu s; \, \delta \leq 0,02.$
Fig. 4 Typical values; $T_j = 25^\circ$C.

Fig. 5 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ$C.

Fig. 6 Typical values; $f = 100$ MHz; $T_j = 25^\circ$C.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit); \( T_h = 25 \, ^\circ C \)

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_D ) (W)</th>
<th>( \eta ) (%)</th>
<th>( Z_l ) (( \Omega ))</th>
<th>( \gamma_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>28</td>
<td>100</td>
<td>&lt;25</td>
<td>&gt;70</td>
<td>0,73 + j1,35</td>
<td>225 - j35</td>
</tr>
</tbody>
</table>

![Fig. 7 Test circuit; c.w. class-B; \( f = 150 \, MHz \).](image)

List of components:

- \( C1 = C2 = C7 = C8 = 5 \) to \( 100 \) pF film dielectric trimmer
- \( C3 = 203 \) pF; \( 2 \times 82 \) pF and \( 39 \) pF ceramic capacitors in parallel (500 V)
- \( C4 = 39 \) pF ceramic capacitor (500 V)
- \( C5 = 1 \) nF feed-through capacitor
- \( C6 = 100 \) nF polyester capacitor
- \( L1 = \) strip (30 mm x 8 mm); bent to form inverted ‘U’ shape with top 15 mm above heatsink, and bottom 5 mm above heatsink
- \( L2 = 1 \) \( \mu \)H r.f. choke
- \( L3 = \) strip; shape as shown in Fig. 8; 5 mm above heatsink
- \( L4 = \) strip (40 mm x 8 mm); bent in form \( --- \), 25 mm at 15 mm above heatsink, 5 mm at 5 mm above heatsink
- \( L5 = \) strip (75 mm long; width 8 mm); 5 mm above base

L1, L3, L4, and L5 are copper strips with a thickness of 0,6 mm.

Heatsink: aluminium; 0,9 \( ^\circ \)C/W

At \( P_L = 100 \) W and \( V_{CE} = 28 \) V, the output power at heatsink temperatures between 25 \( ^\circ \)C and 90 \( ^\circ \)C relative to that at 25 \( ^\circ \)C is diminished by typ. 0,12 W/\( ^\circ \)C.

Component layout on an aluminium heatsink for 150 MHz test circuit is shown in Fig. 8.
Fig. 8 Component layout on an aluminium heatsink for 150 MHz test circuit. Earthing bolts.
Fig. 9 $V_{CE} = 28\, V$; $f = 150\, MHz$; $T_h = 25\, ^\circ C$.

Fig. 10 $V_{CE} = 28\, V$; $f = 150\, MHz$; $T_h = 25\, ^\circ C$; typical values.

Fig. 11 R.F. SOAR; c.w. class-B operation; $f = 150\, MHz$; $V_{CE} = 28\, V$; $R_{th\, mb-h} = 0,2\, ^\circ C/W$. The graph shows the permissible output power under nominal conditions ($VSWR = 1$) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
OPERATING NOTE Below 50 MHz a base-emitter resistor of 4,7 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Fig. 12.

Fig. 13.

Fig. 14.

Conditions for Figs 12, 13 and 14:

$V_{CE} = 28 \text{ V}; P_L = 100 \text{ W}; T_h = 25 \degree \text{C};$ typical values.
APPLICATION INFORMATION (continued)

R.F. performance in s.s.b. class-A operation

\[ V_{CE} = 26 \text{ V}; T_h = 40 ^\circ \text{C}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power</th>
<th>( G_d )</th>
<th>( I_C )</th>
<th>( d_3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 (P.E.P.)</td>
<td>typ. 19,5</td>
<td>3</td>
<td>typ. -40</td>
</tr>
</tbody>
</table>

Fig. 15 Test circuit; s.s.b. class-A; \( f = 28 \text{ MHz} \).

List of components:

- **C1** = 33 pF ceramic capacitor (500 V)
- **C2** = 100 pF air dielectric trimmer (single insulated rotor type)
- **C3** = 280 pF air dielectric trimmer (single non-insulated rotor type)
- **C4** = 180 pF polystyrene capacitor
- **C5 = C6 = C7** = 3,9 nF polyester capacitor
- **C8** = 2 x 33 pF ceramic capacitors in parallel (500 V)
- **C9** = 330 nF polyester capacitor
- **C10** = 82 pF ceramic capacitor (500 V)
- **C11** = 100 pF air dielectric trimmer (single insulated rotor type)
- **C12** = 180 pF air dielectric trimmer (single non-insulated rotor type)
- **C13** = 150 pF polystyrene capacitor
- **C14** = 390 nF polyester capacitor
H.F./V.H.F. power transistor

List of components in Fig. 15 (continued):

L1 = 72 nH; 3 turns Cu wire (1,0 mm); int. dia. 7 mm; length 4,8 mm; leads 2 x 5 mm
L2 = Cu strip (28 mm x 5 mm x 0,2 mm); 18 mm at 3 mm above printed-circuit board
L3 = Ferroxcube choke coil (cat. no. 4312 020 36640)
L4 = 297 nH; 6 turns Cu wire (1,5 mm); int. dia. 12 mm; length 16 mm; leads 2 x 5 mm
L5 = 331 nH; 7 turns Cu wire (1,5 mm); int. dia. 12 mm; length 20,8 mm; leads 2 x 5 mm

R1 = 1,5 kΩ (± 5%) carbon resistor (0,5 W)
R2 = 100 Ω (± 5%) carbon resistor (0,5 W)
R3 = 68 Ω (± 5%) carbon resistor (0,5 W)
R4 = 100 Ω wirewound potentiometer (1 W)
R5 = 33 Ω (± 5%) carbon resistor (0,5 W)
R6 = 0,68 Ω (± 10%) wirewound resistor (7 W)
R7 = 120 Ω wirewound resistor (8 W)
R8 = 10 Ω (± 10%) carbon resistor (0,5 W)

Fig. 16 Intermodulation distortion as a function of output power; $V_{CE} = 26$ V; $I_C = 3$ A;
$f_1 = 28,000$ MHz; $f_2 = 28,001$ MHz; $T_h = 40$ °C.
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C in the u.h.f. and v.h.f. range for nominal supply voltages up to 13,5 V. The resistance stabilization of the transistor provides protection against device damage at severe load mismatch conditions. The transistor is housed in a ¼” capstan envelope with a ceramic cap.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25\,^\circ\text{C}$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CC}$</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_o$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_i$ $\Omega$</th>
<th>$\sqrt{V_L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>470</td>
<td>2</td>
<td>$&gt; 9,0$</td>
<td>$&gt; 60$</td>
<td>$3,5 + j0,4$</td>
<td>$28 - j38$</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>2</td>
<td>typ 13,5</td>
<td>typ 60</td>
<td>$4,2 - j3,4$</td>
<td>$25 - j24$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-122

Dimensions in mm

| Torque on nut: min 0,75 Nm (7,5 kg cm) |  
| max 0,85 Nm (8,5 kg cm) |

Diameter of clearance hole in heatsink: max 4,2 mm. Mounting hole to have no burrs at either end. De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC134)

**Voltages**

<table>
<thead>
<tr>
<th>Collector-emitter voltage (V_{BE} = 0)</th>
<th>Collector-emitter voltage (open base)</th>
<th>Emitter-base voltage (open collector)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CESM} max 36 V</td>
<td>V_{CEO} max 17 V</td>
<td>V_{EBO} max 4 V</td>
</tr>
</tbody>
</table>

**Currents**

<table>
<thead>
<tr>
<th>Collector current (d.c.)</th>
<th>Collector current (peak value); f &gt; 1 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_C max 0,5 A</td>
<td>I_{CM} max 1,5 A</td>
</tr>
</tbody>
</table>

**Power dissipation**

Total power dissipation (d.c. and r.f.) up to T_h = 70 °C

\[ P_{tot} \text{ max } 8,5 \text{ W} \]

**Temperatures**

<table>
<thead>
<tr>
<th>Storage temperature</th>
<th>Operating junction temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_{stg} -65 to +150 °C</td>
<td>T_{j} max 200 °C</td>
</tr>
</tbody>
</table>

**THERMAL RESISTANCE**

<table>
<thead>
<tr>
<th>From junction to mounting base</th>
<th>From mounting base to heatsink</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{th j-mb} = 14,5 °C/W</td>
<td>R_{th mb-h} = 0,6 °C/W</td>
</tr>
</tbody>
</table>
U.H.F. power transistor

CHARACTERISTICS

\[ T_j = 25 \, ^\circ C \]

Breakdown voltages

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td></td>
<td>( V_{BE} = 0; I_C = 5 , mA )</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td></td>
<td>( V_{BR}^{(CES)} &gt; 36 , V )</td>
</tr>
<tr>
<td>open base; ( I_C = 25 , mA )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td></td>
<td>( V_{BR}^{(CEO)} &gt; 17 , V )</td>
</tr>
<tr>
<td>open collector; ( I_E = 2 , mA )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td></td>
<td>( I_{CES} &lt; 2 , mA )</td>
</tr>
<tr>
<td>( V_{BE} = 0; V_{CE} = 17 , V )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D.C. current gain *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_C = 250 , mA; V_{CE} = 5 , V )</td>
<td>( h_{FE} &gt; 10 ) typ 35</td>
</tr>
</tbody>
</table>

Collector-emitter saturation voltage *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_C = 750 , mA; I_B = 150 , mA )</td>
<td>( V_{CE_{sat}} ) typ 0,6 , V</td>
</tr>
</tbody>
</table>

Transition frequency at \( f = 500 \, MHz \) *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_C = 250 , mA; V_{CE} = 12,5 , V )</td>
<td>( f_T ) typ 1,5 , GHz</td>
</tr>
<tr>
<td>( I_C = 750 , mA; V_{CE} = 12,5 , V )</td>
<td>( f_T ) typ 1,0 , GHz</td>
</tr>
</tbody>
</table>

Collector capacitance at \( f = 1 \, MHz \)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_E = I_E = 0; V_{CB} = 12,5 , V )</td>
<td>( C_C ) typ 8 , pF</td>
</tr>
</tbody>
</table>

Feedback capacitance at \( f = 1 \, MHz \)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_C = 20 , mA; V_{CE} = 12,5 , V )</td>
<td>( C_{re} ) typ 3,6 , pF</td>
</tr>
</tbody>
</table>

Collector-stud capacitance

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( C_{cs} ) typ 2 , pF</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: \( t_p < 200 \, \mu s; \delta \leq 0,02 \).
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V_CE (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_p (dB)</th>
<th>I_C (A)</th>
<th>η (%)</th>
<th>( \overline{z}_i ) (Ω)</th>
<th>( \overline{Y}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>12,5</td>
<td>&lt;0,25</td>
<td>&gt; 9,0</td>
<td>&lt;0,27</td>
<td>60</td>
<td>3,5+j0,4</td>
<td>28 - j38</td>
<td></td>
</tr>
<tr>
<td>470</td>
<td>13,5</td>
<td>2</td>
<td>typ 10,5</td>
<td>typ 70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>2</td>
<td>typ 13,5</td>
<td>typ 60</td>
<td>4,2 - j3,4</td>
<td>25 - j24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz

List of components:

- C1 = 2,2 pF (± 0,25 pF) ceramic capacitor
- C2 = C4 = C7 = 1,4 to 5,5 pF film dielectric trimmer (cat. no. 2222 809 09001)
- C3 = 3,3 pF (± 0,25 pF) ceramic capacitor
- C5 = 100 pF ceramic feed-through capacitor
- C6 = 100 nF polyester capacitor
- C8 = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- L1 = stripline (35,6 mm x 6,0 mm)
- L2 = L3 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L4 = 178 nH; 4 turns Cu wire (1 mm); int. dia. 6 mm; length 7 mm; leads 2 x 5 mm
- L5 = stripline (10,0 mm x 6,0 mm)
- L6 = 28 nH; ¾ turn Cu wire (1 mm); int. dia. 10 mm

L1 and L5 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric \( (e_r = 2,74) \); thickness 1/16″.

- R1 = 100 Ω (± 5%) carbon resistor
- R2 = 10 Ω (± 5%) carbon resistor

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
U.H.F. power transistor

---

**Conditions for R.F. SOAR**

- **f** = 470 MHz
- **T_h** = 70 °C
- **R_{th mb-h}** = 0,6 °C/W
- **V_{CCnom}** = 12,5 V or 13,5 V
- **P_{S} = P_{Snom} at V_{CCnom} and VSWR = 1**

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio, with VSWR as parameter.

The graph applies to the situation in which the drive \( \frac{P_S}{P_{Snom}} \) increases linearly with supply over-voltage ratio.
OPERATING NOTE Below 300 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Measuring conditions for the graphs on this page

V_{CC} = 12.5 V  
P_L = 2 W  
T_h = 25 °C  
typical values

---

BLW79
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C in the u.h.f. and v.h.f. range for nominal supply voltages up to 13,5 V. The resistance stabilization of the transistor provides protection against device damage at severe load mismatch conditions. The transistor is housed in a ¼" capstan envelope with a ceramic cap.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \degree C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CC}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_D$ dB</th>
<th>$\eta$ %</th>
<th>$z_j$ $\Omega$</th>
<th>$V_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>470</td>
<td>4</td>
<td>$&gt; 8,0$</td>
<td>$&gt; 60$</td>
<td>$2,1 + j2,3$</td>
<td>57 - j56</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>4</td>
<td>typ 15,0</td>
<td>typ 60</td>
<td>$2,0 - j2,2$</td>
<td>51 - j48</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-122

Dimensions in mm

Torque on nut: min 0,75 Nm
(7,5 kg cm)
max 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
BLW80

RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-emitter voltage ($V_{BE} = 0$) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (d.c.)
Collector current (peak value); $f > 1$ MHz

Power dissipation
Total power dissipation (d.c. and r.f.) up to $T_{mb} = 25^\circ C$

Temperatures
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

---

\[
\begin{align*}
V_{CESM} & \quad \text{max} \quad 36 \ V \\
V_{CEO} & \quad \text{max} \quad 17 \ V \\
V_{EBO} & \quad \text{max} \quad 4 \ V \\
I_C \quad \text{max} & \quad 1 \ A \\
I_{CM} \quad \text{max} & \quad 3 \ A \\
P_{\text{tot}} \quad \text{max} & \quad 17 \ W
\end{align*}
\]

---

![Graph](image-url)
CHARACTERISTICS

$T_j = 25 \, ^\circ \text{C}$

Breakdown voltages

Collector-emitter voltage

\[ V_{BE} = 0; \, I_C = 10 \, \text{mA} \]

Collector-emitter voltage

open base; \( I_C = 50 \, \text{mA} \)

Emitter-base voltage

open collector; \( I_E = 4 \, \text{mA} \)

Collector cut-off current

\[ V_{BE} = 0; \, V_{CE} = 17 \, \text{V} \]

D.C. current gain *

\[ I_C = 0,5 \, \text{A}; \, V_{CE} = 5 \, \text{V} \]

Collector-emitter saturation voltage *

\[ I_C = 1,5 \, \text{A}; \, I_B = 0,3 \, \text{A} \]

Transition frequency at \( f = 500 \, \text{MHz} \) *

\[ I_C = 0,5 \, \text{A}; \, V_{CE} = 12,5 \, \text{V} \]
\[ I_C = 1,5 \, \text{A}; \, V_{CE} = 12,5 \, \text{V} \]

Collector capacitance at \( f = 1 \, \text{MHz} \)

\[ I_E = I_e = 0; \, V_{CB} = 12,5 \, \text{V} \]

Feedback capacitance at \( f = 1 \, \text{MHz} \)

\[ I_C = 40 \, \text{mA}; \, V_{CE} = 12,5 \, \text{V} \]

Collector-stud capacitance

\[ V_{(BR)\text{CES}} > 36 \, \text{V} \]

\[ V_{(BR)\text{CEO}} > 17 \, \text{V} \]

\[ V_{(BR)\text{EBO}} > 4 \, \text{V} \]

\[ I_{\text{CES}} < 4 \, \text{mA} \]

\[ h_{FE} \geq 10 \]

\[ V_{\text{CEsat}} \text{typ} 0,75 \, \text{V} \]

\[ f_T \text{typ} 1,75 \, \text{GHz} \]

\[ f_T \text{typ} 1,25 \, \text{GHz} \]

\[ C_c \text{typ} 14 \, \text{pF} \]

\[ C_{re} \text{typ} 7,1 \, \text{pF} \]

\[ C_{cs} \text{typ} 2 \, \text{pF} \]

* Measured under pulse conditions: \( t_p < 200 \, \mu\text{s}; \, \delta \leq 0,02. \)
- $V_{CE} = 5 \text{ V}$
  - $T_j = 25 \text{ °C}$

- $C_e$ (pF)
- $I_e = I_E = 0$
- $f = 1 \text{ MHz}$
- $T_j = 25 \text{ °C}$

- $f_T$ (GHz)
- $V_{CE} = 12.5 \text{ V}$
- $f = 500 \text{ MHz}$
- $T_j = 25 \text{ °C}$
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

T_h = 25 °C

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V_CE (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_p (dB)</th>
<th>I_C (A)</th>
<th>\eta (%)</th>
<th>\bar{z}_i (\Omega)</th>
<th>\sqrt{\lambda} (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>12,5</td>
<td>4</td>
<td>&lt;0,63</td>
<td>8,0</td>
<td>&lt;0,53</td>
<td>&gt; 60</td>
<td>2,1 + j2,3</td>
<td>57 – j56</td>
</tr>
<tr>
<td>470</td>
<td>13,5</td>
<td>4</td>
<td>–</td>
<td>typ 9,5</td>
<td>–</td>
<td>typ 65</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>4</td>
<td>–</td>
<td>typ 15,0</td>
<td>–</td>
<td>typ 60</td>
<td>2,0 – j2,2</td>
<td>51 – j48</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz

List of components:

- C1 = 2,2 pF (± 0,25 pF) ceramic capacitor
- C2 = C7 = C8 = 1,4 to 5,5 pF film dielectric trimmer (cat. no. 2222 809 09001)
- C3 = 5,6 pF (± 0,25 pF) ceramic capacitor
- C4 = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- C5 = 100 pF ceramic feed-through capacitor
- C6 = 100 nF polyester capacitor
- L1 = stripline (22,5 mm x 6,0 mm)
- L2 = 13 turns closely wound enameled Cu wire (0,5 mm); int. dia. 4 mm; leads 2 x 5 mm
- L3 = L4 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L5 = 51 nH; 3,5 turns Cu wire (1 mm); int. dia. 6 mm; coil length 7 mm; leads 2 x 5 mm
- L6 = stripline (10,0 mm x 6,0 mm)
- L7 = 15 nH; 1 turn Cu wire (1 mm); int. dia. 5 mm; leads 2 x 5 mm

L1 and L6 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (\(\varepsilon_r = 2,74\)); thickness 1/16".

R1 = R2 = 10 Ω (± 5%) carbon resistor

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio, with VSWR as parameter.

The graph applies to the situation in which the drive (PS/PSnom) increases linearly with supply over-voltage ratio.
OPERATING NOTE: Below 300 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Measuring conditions for the graphs on this page:

- $V_{CC} = 12.5$ V
- $P_L = 4$ W
- $T_h = 25$ °C
- Typical values
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C in the u.h.f. and v.h.f. range for nominal supply voltages up to 13,5 V.
The resistance stabilization of the transistor provides protection against device damage at severe load mismatch conditions.
The transistor is housed in a ¼" capstan envelope with a ceramic cap.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CC}$</th>
<th>$f$</th>
<th>$P_L$</th>
<th>$G_P$</th>
<th>$\eta$</th>
<th>$\overline{z}_l$</th>
<th>$\overline{V}_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>470</td>
<td>10</td>
<td>$&gt; 6,0$</td>
<td>$&gt; 60$</td>
<td>$1,3 + j2,5$</td>
<td>$150 - j66$</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>10</td>
<td>typ 13,5</td>
<td>typ 60</td>
<td>$1,2 - j0,6$</td>
<td>$140 - j80$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-122

Dimensions in mm

Torque on nut: min 0,75 Nm
(7,5 kg cm)
max 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or
countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely
safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-emitter voltage (V_{BE} = 0) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (d.c. or average)
Collector current (peak value); f > 1 MHz

Power dissipation
R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C

Temperatures
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

---

$V_{CESM}$ max 36 V
$V_{CEO}$ max 17 V
$V_{EBO}$ max 4 V

$IC$ max 2.5 A
$ICM$ max 7.5 A

$P_{tot}$ max 40 W

---

$T_{mb}$ = 25 °C
$T_h$ = 70 °C

---

$T_{stg}$ -65 to +150 °C
$T_j$ max 200 °C

$R_{th j-mb} = 4.3 \, ^{°}\text{C/W}$
$R_{th mb-h} = 0.6 \, ^{°}\text{C/W}$

---

May 1977
# CHARACTERISTICS

$T_j = 25 \degree \mathrm{C}$

## Breakdown voltages

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{BE} = 0; I_C = 25 , \text{mA}$</td>
<td>$V_{(BR)CES} &gt; 36 , \text{V}$</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{BE} = 0; I_C = 100 , \text{mA}$</td>
<td>$V_{(BR)CEO} &gt; 17 , \text{V}$</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>open base; $I_E = 10 , \text{mA}$</td>
<td>$V_{(BR)EBO} &gt; 4 , \text{V}$</td>
<td></td>
</tr>
</tbody>
</table>

## Collector cut-off current

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BE} = 0; V_{CE} = 17 , \text{V}$</td>
<td>$I_{CES} &lt; 10 , \text{mA}$</td>
</tr>
</tbody>
</table>

## D.C. current gain *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 1,25 , \text{A}; V_{CE} = 5 , \text{V}$</td>
<td>$h_{FE} &gt; 10$</td>
</tr>
<tr>
<td></td>
<td>typ 35</td>
</tr>
</tbody>
</table>

## Collector-emitter saturation voltage *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 3,75 , \text{A}; I_B = 0,75 , \text{A}$</td>
<td>$V_{CESat}$ typ 0,75 , \text{V}$</td>
</tr>
</tbody>
</table>

## Transition frequency at $f = 500 \, \text{MHz}$ *

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 1,25 , \text{A}; V_{CE} = 12,5 , \text{V}$</td>
<td>$f_T$ typ 1,3 , \text{GHz}$</td>
</tr>
<tr>
<td>$I_C = 3,75 , \text{A}; V_{CE} = 12,5 , \text{V}$</td>
<td>$f_T$ typ 0,9 , \text{GHz}$</td>
</tr>
</tbody>
</table>

## Collector capacitance at $f = 1 \, \text{MHz}$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_E = I_e = 0; V_{CB} = 12,5 , \text{V}$</td>
<td>$C_c$ typ 34 , \text{pF}$</td>
</tr>
</tbody>
</table>

## Feedback capacitance at $f = 1 \, \text{MHz}$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 100 , \text{mA}; V_{CE} = 12,5 , \text{V}$</td>
<td>$C_{re}$ typ 18 , \text{pF}$</td>
</tr>
</tbody>
</table>

## Collector-stud capacitance

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>typ 2 , \text{pF}$</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \delta \leq 0,02$. 

May 1977
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( \bar{x}_i ) (Ω)</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>12,5</td>
<td>10</td>
<td>&lt; 2,5</td>
<td>&gt; 6,0</td>
<td>&lt; 1,33</td>
<td>&gt; 60</td>
<td>1,3 + j2,5</td>
<td>150 – j66</td>
</tr>
<tr>
<td>470</td>
<td>13,5</td>
<td>10</td>
<td>typ 1,9</td>
<td>typ 7,2</td>
<td>–</td>
<td>typ 75</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>10</td>
<td>typ 0,45</td>
<td>typ 13,5</td>
<td>–</td>
<td>typ 60</td>
<td>1,2 – j0,6</td>
<td>140 – j80</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz

List of components:

- \( C1 = 2,2 \, \mu F \) (±0,25 \( \mu F \)) ceramic capacitor
- \( C2 = C9 = C10 = 2 \) to 18 \( \mu F \) film dielectric trimmer (cat. no. 2222 809 09003)
- \( C3 = 3,9 \, \mu F \) (±0,25 \( \mu F \)) ceramic capacitor
- \( C4 = 1,4 \) to 5,5 \( \mu F \) film dielectric trimmer (cat. no. 2222 809 09001)
- \( C5 = C6 = 15 \, \mu F \) ceramic chip capacitor (cat. no. 2222 851 13159)
- \( C7 = 100 \, \mu F \) ceramic feed-through capacitor
- \( C8 = 100 \, nF \) polyester capacitor
- \( L1 = \) stripline (27,9 mm x 6,0 mm)
- \( L2 = 13 \) turns closely wound enamelled Cu wire (0,5 mm); int. dia. = 4 mm; leads 2 x 5 mm
- \( L3 = 17 \, nH \); 1\% turns enamelled Cu wire (1 mm); spacing 1 mm; int. dia. = 6 mm; leads 2 x 5 mm
- \( L4 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L5 = \) stripline (45,8 mm x 6,0 mm)

\( L1 \) and \( L5 \) are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (\( \varepsilon_r = 2,74 \)); thickness 1/16".

- \( R1 = 1 \, \Omega \) (±5\%)
- \( R2 = 10 \, \Omega \) (±5\%)

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio, with VSWR as parameter.

The graph applies to the situation in which the drive \( PS/P_{\text{Snom}} \) increases linearly with supply over-voltage ratio.

Measuring conditions for R.F. SOAR
- \( f = 470 \text{ MHz} \)
- \( T_h = 70 ^\circ \text{C} \)
- \( R_{\text{th mb-h}} = 0,6 ^\circ \text{C/W} \)
- \( V_{\text{CConom}} = 12,5 \text{ V or } 13,5 \text{ V} \)
- \( PS = P_{\text{Snom}} \) at \( V_{\text{CConom}} \) and VSWR = 1

see page 5
OPERATING NOTE Below 200 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Measuring conditions for the graphs on this page

\[ V_{CC} = 12.5 \text{ V} \]
\[ P_L = 10 \text{ W} \]
\[ T_h = 25 \degree C \]

typical values
U.H.F. POWER TRANSISTOR

Internally matched n-p-n silicon planar epitaxial transistor intended for use in high-power wide-band and semi-wide-band u.h.f. amplifiers with a nominal supply voltage of 12.5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16.5 V. Diffused emitter-ballasting resistors and the application of a gold sandwich metallization give optimum features of ruggedness and reliability.

The transistor is especially suited as add-on-final stage for low-power modules.

The transistor has a ½” 6-lead flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_i$ $\Omega$</th>
<th>$\nabla_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>470</td>
<td>30</td>
<td>$&gt; 5$</td>
<td>$&gt; 60$</td>
<td>$1.4 + j3.0$</td>
<td>$250 + j200$</td>
</tr>
<tr>
<td>c.w.</td>
<td>13.5</td>
<td>470</td>
<td>30</td>
<td>typ. 6.1</td>
<td>typ. 65</td>
<td>$-$</td>
<td>$-$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-119 (see page 2).

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
MECHANICAL DATA

Fig. 1 SOT-119.

Torque on screw: min. 0.6 Nm (6 kg cm)
max. 0.75 Nm (7.5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.
U.H.F. power transistor

BLW82

RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); f > 1 MHz

R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage</td>
<td>V_{CESM}</td>
<td>max.</td>
<td>36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>V_{CEO}</td>
<td>max.</td>
<td>17 V</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>V_{EBO}</td>
<td>max.</td>
<td>4 V</td>
</tr>
<tr>
<td>Collector current (AV)</td>
<td>I_{C(AV)}</td>
<td>max.</td>
<td>7 A</td>
</tr>
<tr>
<td>Collector current (peak)</td>
<td>I_{CM}</td>
<td>max.</td>
<td>18 A</td>
</tr>
<tr>
<td>R.F. power dissipation</td>
<td>P_{rf}</td>
<td>max.</td>
<td>100 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg}</td>
<td>-65 to +150 °C</td>
<td></td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>T_{j}</td>
<td>max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 16,5 V; f > 1 MHz.
I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 40 W; T_{mb} = 78 °C, i.e. T_{h} = 70 °C)

From junction to mounting base (d.c. dissipation)
R_{th j-mb(dc)} = 2,8 °C/W

From junction to mounting base (r.f. dissipation)
R_{th j-mb(rf)} = 1,95 °C/W

From mounting base to heatsink
R_{th mb-h} = 0,2 °C/W

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CHARACTERISTICS

$T_J = 25 \, ^\circ\text{C}$

Collector-emitter breakdown voltage
$V_{BE} = 0; \, I_C = 50 \, \text{mA}$

Collector-emitter breakdown voltage
open base; $I_C = 100 \, \text{mA}$

Emitter-base breakdown voltage
open collector; $I_E = 20 \, \text{mA}$

Collector cut-off current
$V_{BE} = 0; \, V_{CE} = 17 \, \text{V}$

Second breakdown energy; $L = 25 \, \text{mH}; \, f = 50 \, \text{Hz}$
on-open base
$R_{BE} = 10 \, \Omega$

D.C. current gain *
$I_C = 4 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage *
$I_C = 12 \, \text{A}; \, I_B = 2.4 \, \text{A}$

Transition frequency at $f = 500 \, \text{MHz}$ *
$-I_E = 4 \, \text{A}; \, V_{CB} = 12.5 \, \text{V}$
$-I_E = 12 \, \text{A}; \, V_{CB} = 12.5 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$
$I_E = I_C = 0; \, V_{CB} = 12.5 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$
$I_C = 200 \, \text{mA}; \, V_{CE} = 12.5 \, \text{V}$

Collector-flange capacitance

$V_{(BR)CES} > 36 \, \text{V}$

$V_{(BR)CEO} > 17 \, \text{V}$

$V_{(BR)EBO} > 4 \, \text{V}$

$I_{CES} < 20 \, \text{mA}$

$E_{SBO} > 4.5 \, \text{mJ}$

$E_{SBR} > 4.5 \, \text{mJ}$

$h_{FE} \text{ typ.} \quad 40$

$10 \text{ to } 80$

$V_{CE\text{sat}} \text{ typ.} \quad 1.4 \, \text{V}$

$f_T \text{ typ.} \quad 2.2 \, \text{GHz}$

$f_T \text{ typ.} \quad 1.5 \, \text{GHz}$

$C_c \text{ typ.} \quad 88 \, \text{pF}$

$C_{re} \text{ typ.} \quad 56 \, \text{pF}$

$C_{cf} \text{ typ.} \quad 3 \, \text{pF}$

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \, \delta \leq 0.02$. 

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Fig. 4 Typical values; $T_j = 25 \, ^\circ\text{C}$.

Fig. 5 $I_E = I_e = 0$; $f = 1 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$.

Fig. 6 Typical values; $f = 500 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\( T_h = 25 \, ^\circ C \)

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_l ) (( \Omega ))</th>
<th>( \overline{V}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>12.5</td>
<td>30</td>
<td>&lt;9.5</td>
<td>5</td>
<td>&lt;4</td>
<td>&gt; 60</td>
<td>1.4 + j3.0</td>
<td>250 + j200</td>
</tr>
<tr>
<td>470</td>
<td>13.5</td>
<td>30</td>
<td>–</td>
<td>typ. 6.1</td>
<td>–</td>
<td>typ. 65</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- C1 = C2 = C7 = C8 = 2 to 9 pF film dielectric trimmer (cat. no. 22228090902)
- C3 = C6 = 3.9 pF ceramic capacitor (500 V)
- C4 = 100 pF feed-through capacitor
- C5 = 100 nF polyester capacitor
- L1 = stripline (24.0 mm x 6.7 mm)
- L2 = 10 turns closely wound enamelled Cu wire (0.4 mm); int. dia. 4 mm
- L3 = 2 turns enamelled Cu wire (0.6 mm); Ferroxcube tube core, grade 3B5 (cat. no. 431302015170)
- L4 = 12.6 nH; 2.5 turns enamelled Cu wire (0.7 mm); int. dia. 4 mm; length 3 mm; leads 2 x 5 mm
- L5 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 431202036640)
- L6 = stripline (28.4 mm x 6.7 mm)

L1 and L6 are striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric \( \varepsilon_r = 2.74 \); thickness 1/16".

R1 = R2 = 10 \( \Omega \) carbon resistor

Component layout and printed-circuit board for 470 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Conditions for Figs 9, 10 and 11:
Typical values; $f = 470$ MHz;

- $V_{CE} = 12.5$ V;  
- $V_{CE} = 13.5$ V.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (PS/PSnom) increases linearly with supply over-voltage ratio.

Note to Figs 12 and 13:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (PS/PSnom) increases linearly with supply over-voltage ratio.
Fig. 14 Input impedance (series components).

Fig. 15 Load impedance (parallel components).

Fig. 16.

Conditions for Figs 14, 15 and 16:
Typical values; $V_{CE} = 12.5\,V$; $P_L = 30\,W$; $T_h = 25\,^\circ C$. 
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor for use in transmitting amplifiers operating in the h.f. and v.h.f. bands, with a nominal supply voltage of 28 V. The transistor is specified for s.s.b. applications as linear amplifier in class-A and AB. The device is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

Matched hFE groups are available on request.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>VCE V</th>
<th>f MHz</th>
<th>PL W</th>
<th>GD dB</th>
<th>ηdt %</th>
<th>IC A</th>
<th>d3 dB</th>
<th>Th °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-A)</td>
<td>26</td>
<td>1,6 - 28</td>
<td>0 - 10 (P.E.P.)</td>
<td>&gt; 20</td>
<td>-</td>
<td>1,35</td>
<td>&lt; -40</td>
<td>70</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>1,6 - 28</td>
<td>3 - 30 (P.E.P.)</td>
<td>typ. 21</td>
<td>typ. 40</td>
<td>typ. 1,34</td>
<td>typ. -30</td>
<td>25</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Torque on screw: min. 0,6 Nm (6 kg cm) max. 0,75 Nm (7,5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.

CAUTION  This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Collector-emitter voltage \((V_{BE} = 0)\)
  peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open-collector)
Collector current (average)
Collector current (peak value); \(f > 1\) MHz
R.F. power dissipation \((f > 1\) MHz); \(T_{mb} = 25\) °C
Storage temperature
Operating junction temperature

\[
\begin{align*}
  V_{CESM} & \max. \quad 65\ V \\
  V_{CEO} & \max. \quad 36\ V \\
  V_{EBO} & \max. \quad 4\ V \\
  I_{C(AV)} & \max. \quad 3\ A \\
  I_{CM} & \max. \quad 9\ A \\
  P_{rf} & \max. \quad 76\ W \\
  T_{stg} & -65\ \text{to} +150\ \text{°C} \\
  T_j & \max. \quad 200\ \text{°C}
\end{align*}
\]

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; \(V_{CE} \leq 28\ V;\)
\(f > 1\) MHz.

THERMAL RESISTANCE (dissipation = 35 W; \(T_{mb} = 80\) °C, i.e. \(T_h = 70\) °C)
From junction to mounting base (d.c. dissipation)
From junction to mounting base (r.f. dissipation)
From mounting base to heatsink

\[
\begin{align*}
  R_{th\ j-mb(dc)} & = 3,15\ \text{°C/W} \\
  R_{th\ j-mb(rf)} & = 2,35\ \text{°C/W} \\
  R_{th\ mb-h} & = 0,3\ \text{°C/W}
\end{align*}
\]

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CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector-emitter breakdown voltage

V_{BE} = 0; I_C = 10 mA

Collector-emitter breakdown voltage
open base; I_C = 50 mA

Emitter-base breakdown voltage
open collector; I_E = 10 mA

Collector cut-off current

V_{BE} = 0; V_{CE} = 36 V

Second breakdown energy; L = 25 mH; f = 50 Hz
open base

R_{BE} = 10 Ω

D.C. current gain*

I_C = 1,25 A; V_{CE} = 5 V

D.C. current gain ratio of matched devices*

I_C = 1,25 A; V_{CE} = 5 V

Collector-emitter saturation voltage*

I_C = 3,75 A; I_B = 0,75 A

Transition frequency at f = 100 MHz*

-I_E = 1,25 A; V_{CB} = 28 V

-I_E = 3,75 A; V_{CB} = 28 V

Collector capacitance at f = 1 MHz

I_E = I_B = 0; V_{CB} = 28 V

Feedback capacitance at f = 1 MHz

I_C = 100 mA; V_{CE} = 28 V

Collector-flange capacitance

V_{(BR)CES} > 65 V
V_{(BR)CEO} > 36 V
V_{(BR)EBO} > 4 V
I_{CES} < 4 mA

ESBO > 8 mJ
ESBR > 8 mJ

h_{FE} typ. 50

10 to 100

h_{FE1}/h_{FE2} < 1,2

V_{CEsat} typ. 1,5 V

f_T typ. 530 MHz

530 MHz

C_c typ. 50 pF

31 pF

C_{cf} typ. 2 pF

* Measured under pulse conditions: t_p ≤ 200 μs; δ ≤ 0,02.

Fig. 4 Typical values; V_{CE} = 28 V.

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Fig. 5 Typical values; $T_j = 25^\circ C$.

Fig. 6 $I_E = I_E = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

Fig. 7 Typical values; $f = 100$ MHz; $T_j = 25^\circ C$. 
APPLICATION INFORMATION

R.F. performance in s.s.b. class-A operation (linear power amplifier)

\[ V_{CE} = 26 \text{ V}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power</th>
<th>G_d dB</th>
<th>I_C A</th>
<th>d_3 dB^*</th>
<th>d_5 dB^*</th>
<th>T_h °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 10 (P.E.P.)</td>
<td>&gt; 20</td>
<td>1.35</td>
<td>-40</td>
<td>&lt; -40</td>
<td>70</td>
</tr>
<tr>
<td>typ. 11 (P.E.P.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>typ. 12 (P.E.P.)</td>
<td>typ. 24</td>
<td>1.35</td>
<td>-40</td>
<td>&lt; -40</td>
<td>25</td>
</tr>
</tbody>
</table>

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.

Fig. 8 Test circuit; s.s.b. class-A.

List of components on page 6.
List of components in Fig. 8:

C1 = C2 = 10 to 780 pF film dielectric trimmer
C3 = 22 nF ceramic capacitor (63 V)
C4 = 47 µF/10 V electrolytic capacitor
C5 = 56 pF ceramic capacitor (500 V)
C6 = 47 µF/35 V electrolytic capacitor
C7 = C8 = 220 nF polyester capacitor
C9 = 10 µF/35 V electrolytic capacitor
C10 = C11 = 7 to 100 pF film dielectric trimmer
C12 = 82 pF ceramic capacitor (500 V)

L1 = 3 turns closely wound enamelled Cu wire (1.6 mm); int. dia. 9.0 mm; leads to 2 x 5 mm
L2 = L3 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 11 turns closely wound enamelled Cu wire (1.6 mm); int. dia. 11.0 mm
L5 = 14 turns closely wound enamelled Cu wire (1.6 mm); int. dia. 11.0 mm

R1 = 600 Ω; parallel connection of 2 x 1,2 kΩ carbon resistors (±5%; 0.5 W each)
R2 = 15 Ω carbon resistor (±5%; 0.25 W)
R3 = 1,2 Ω; parallel connection of 4 x 4,7 Ω carbon resistors (±5%; 0.125 W each)
R4 = 33 Ω carbon resistor (±5%; 0.25 W)
R5 = 18 Ω carbon resistor (±5%; 0.25 W)
R6 = 120 Ω wirewound resistor (±5%; 5.5 W)
R7 = 1 Ω carbon resistor (±5%; 0.125 W)
R8 = 47 Ω wirewound potentiometer (3 W)
R9 = 1,57 Ω; parallel connection of 3 x 4,7 Ω wirewound resistors (±5%; 5.5 W each)

Fig. 9 Intermodulation distortion as a function of output power.
Typical values; VCE = 26 V; T_h = 70 °C; T_h = 25 °C.
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

\[ V_{CE} = 28 \text{ V}; \quad f_1 = 28,000 \text{ MHz}; \quad f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>Output Power</th>
<th>( G_p ) dB</th>
<th>( \eta_{dt} ) (%)</th>
<th>( I_C ) (A) at 30 W P.E.P.</th>
<th>( d_3 ) dB*</th>
<th>( d_5 ) dB*</th>
<th>( I_{C(ZS)} ) mA</th>
<th>( T_h ) ( ^\circ \text{C} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 30 (P.E.P.)</td>
<td>typ. 21</td>
<td>typ. 40</td>
<td>typ. 1.34</td>
<td>typ. -30</td>
<td>(-30)</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>3 to 25 (P.E.P.)</td>
<td>typ. 21</td>
<td>-</td>
<td>-</td>
<td>typ. -30</td>
<td>(-30)</td>
<td>25</td>
<td>70</td>
</tr>
</tbody>
</table>

List of components:

- \( C_1 = C_2 = 10 \text{ to } 780 \text{ pF film dielectric trimmer} \)
- \( C_3 = C_5 = C_6 = 220 \text{ nF polyester capacitor} \)
- \( C_4 = 56 \text{ pF ceramic capacitor (500 V)} \)
- \( C_7 = C_8 = 15 \text{ to } 575 \text{ pF film dielectric trimmer} \)
- \( L_1 = 4 \text{ turns closely wound enamelled Cu wire (1.6 mm); int. dia. 7.0 mm; leads 2 x 5 mm} \)
- \( L_2 = \text{Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)} \)
- \( L_3 = 4 \text{ turns enamelled Cu wire (1.6 mm); int. dia. 10 mm; length 9.4 mm; leads 2 x 5 mm} \)
- \( L_4 = 7 \text{ turns enamelled Cu wire (1.6 mm); int. dia. 12 mm; length 17.2 mm; leads 2 x 5 mm} \)
- \( R_1 = 1.2 \Omega; \text{ parallel connection of } 4 \times 4.7 \Omega \text{ carbon resistors} \)
- \( R_2 = 39 \Omega \text{ carbon resistor} \)

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
Fig. 11 Intermodulation distortion as a function of output power.*

Conditions for Fig. 11:
\[V_{CE} = 28\, V;\, I_{C(ZS)} = 25\, mA;\, f_1 = 28,000\, MHz;\, f_2 = 28,001\, MHz;\, \text{typical values.}\]

Fig. 12 Double-tone efficiency and power gain as a function of output power.

Conditions for Fig. 12:
\[V_{CE} = 28\, V;\, I_{C(ZS)} = 25\, mA;\, f_1 = 28,000\, MHz;\, f_2 = 28,001\, MHz;\, T_h = 25^\circ C;\, \text{typical values.}\]

* See note on page 7.
Fig. 13 Power gain as a function of frequency. Fig. 14 Input impedance (series components) as a function of frequency.

Figs 13 and 14 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
$V_{CE} = 28 \, \text{V}$; $I_C(ZS) = 25 \, \text{mA}$; $P_L = 30 \, \text{W}$; $T_h = 25 \, ^\circ\text{C}$; $Z_L = 9.5 \, \Omega$.

Ruggedness in s.s.b. operation
The BLW83 is capable of withstanding a load mismatch ($\text{VSWR} = 50$) under the following conditions:
$f_1 = 28,000 \, \text{MHz}$; $f_2 = 28,001 \, \text{MHz}$; $V_{CE} = 28 \, \text{V}$; $T_h = 70 \, ^\circ\text{C}$ and $P_{\text{Lnom}} = 35 \, \text{W (P.E.P.)}$. 
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to \( T_h = 25 \, ^\circ C \) in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>( V_{CE} ) V</th>
<th>( f ) MHz</th>
<th>( P_L ) W</th>
<th>( G_p ) dB</th>
<th>( \eta ) %</th>
<th>( \frac{z_i}{\Omega} )</th>
<th>( \frac{V_L}{mA/V} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>25</td>
<td>&gt; 9</td>
<td>&gt; 60</td>
<td>1,0 + j1,2</td>
<td>59−j54</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); f > 1 MHz

R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C

Storage temperature

Operating junction temperature

---

THERMAL RESISTANCE (dissipation = 20 W; T_{mb} = 76 °C, i.e. T_h = 70 °C)

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

---

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} < 28 V; f > 1 MHz.
CHARACTERISTICS

**Tj = 25 °C**

- **Collector-emitter breakdown voltage**
  \( V_{BE} = 0; \, I_C = 10 \, mA \)**
  \( V(\text{BR})_{CES} > 65 \, V \)

- **Collector-emitter breakdown voltage**
  open base; \( I_C = 50 \, mA \)**
  \( V(\text{BR})_{CEO} > 36 \, V \)

- **Emitter-base breakdown voltage**
  open collector; \( I_E = 10 \, mA \)**
  \( V(\text{BR})_{EBO} > 4 \, V \)

- **Collector cut-off current**
  \( V_{BE} = 0; \, V_{CE} = 36 \, V \)**
  \( I_{CES} < 4 \, mA \)

- **Second breakdown energy**
  \( L = 25 \, mH; \, f = 50 \, Hz \)
  open base
  \( R_{BE} = 10 \, \Omega \)
  \( E_{SBO} > 8 \, mJ \)
  \( E_{SBR} > 8 \, mJ \)

- **D.C. current gain**
  \( I_C = 1,25 \, A; \, V_{CE} = 5 \, V \)**
  \( h_{FE} \, \text{typ.} \, 45 \)
  \( h_{FE} \, \text{typ.} \, 10 \, \text{to} \, 100 \)

- **Collector-emitter saturation voltage**
  \( I_C = 3,75 \, A; \, I_B = 0,75 \, A \)**
  \( V_{CESat} \, \text{typ.} \, 1,5 \, V \)

- **Transition frequency at f = 100 MHz**
  \( I_E = 1,25 \, A; \, V_{CB} = 28 \, V \)**
  \( f_T \, \text{typ.} \, 650 \, MHz \)
  \( f_T \, \text{typ.} \, 650 \, MHz \)

- **Collector capacitance at f = 1 MHz**
  \( I_E = 0; \, V_{CB} = 28 \, V \)**
  \( C_c \, \text{typ.} \, 45 \, pF \)

- **Feedback capacitance at f = 1 MHz**
  \( I_C = 100 \, mA; \, V_{CE} = 28 \, V \)**
  \( C_{re} \, \text{typ.} \, 28 \, pF \)
  \( C_{cf} \, \text{typ.} \, 2 \, pF \)

* Measured under pulse conditions: \( t_p \leq 200 \, \mu s; \, \delta \leq 0,02. \)
Fig. 4 Typical values; $T_j = 25 \, ^\circ C$.

Fig. 5 $I_E = I_C = 0; f = 1 \, MHz; T_j = 25 \, ^\circ C$.

Fig. 6 Typical values; $f = 100 \, MHz; T_j = 25 \, ^\circ C$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_L$ (W)</th>
<th>$P_S$ (W)</th>
<th>$G_P$ (dB)</th>
<th>$I_C$ (A)</th>
<th>$\eta$ (%)</th>
<th>$\overline{Z_I}$ ($\Omega$)</th>
<th>$\overline{Y_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>25</td>
<td>&lt;3,15</td>
<td>&gt;9</td>
<td>&lt;1,49</td>
<td>&gt;60</td>
<td>1,0 + j1,2</td>
<td>59 – j54</td>
</tr>
</tbody>
</table>

List of components

C1 = C7 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3a = C3b = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor (500 V)
C5 = 100 nF (± 10%) polyester capacitor
C6a = 2,2 pF ceramic capacitor (500 V)
C6b = 1,8 pF ceramic capacitor (500 V)
C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)

L1 = 14 nH; 1 turn enamelled Cu wire (1.6 mm); int. dia. 7.7 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0.5 mm); int. dia. 3 mm; leads 2 x 5 mm
L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
L6 = 80 nH; 3 turns enamelled Cu wire (1.6 mm); int. dia. 9.0 mm; length 8.0 mm; leads 2 x 5 mm
L7 = 62 nH; 3 turns enamelled Cu wire (1.6 mm); int. dia. 7.5 mm; length 8.1 mm; leads 2 x 5 mm
L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16”.
R1 = R2 = 10 $\Omega$ (± 10%) carbon resistor (0,25 W)

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.
V.H.F. power transistor

**Fig. 9** $V_{CE} = 28\, V$; $f = 175\, MHz$; typical values.

**Fig. 10** $V_{CE} = 28\, V$; $f = 175\, MHz$; typical values;

- $- - - T_h = 25\, ^{\circ}C$;
- $--- T_h = 70\, ^{\circ}C$.

**Fig. 11** R.F. SOAR; c.w. class-B operation; $f = 175\, MHz$; $V_{CE} = 28\, V$; $R_{th\, mb-h} = 0.3\, ^{\circ}C/W$.

The graph shows the permissible output power under nominal conditions ($VSWR = 1$) as a function of the expected $VSWR$ during short-time mismatch conditions with heatsink temperatures as parameter.
OPERATING NOTE Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Conditions for Figs 12, 13 and 14:
Typical values; $V_{CE} = 28$ V; $P_L = 25$ W; $T_h = 25$ °C.
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile h.f. and v.h.f. transmitters with a nominal supply voltage of 12.5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16.5 V. Matched $h_{FE}$ groups are available on request.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of Operation</th>
<th>$V_{CE}$</th>
<th>$f$ (MHz)</th>
<th>$P_L$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$z_i$ (Ω)</th>
<th>$\overline{Y_L}$ (mA/V)</th>
<th>$d_3$ (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>12,5</td>
<td>175</td>
<td>45</td>
<td>&gt; 5</td>
<td>&gt; 75</td>
<td>1,2 + j1,4</td>
<td>320 + j150</td>
<td>-</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>12,5</td>
<td>1,6–28</td>
<td>3–30 (P.E.P.)</td>
<td>typ. 19,5</td>
<td>typ. 35</td>
<td>-</td>
<td>-</td>
<td>typ. –33</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

**CAUTION** This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
  peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open-collector)
Collector current (average)
Collector current (peak value); f > 1 MHz
R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C
Storage temperature
Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CESM} max.</td>
<td>36 V</td>
</tr>
<tr>
<td>V_{CEO} max.</td>
<td>18 V</td>
</tr>
<tr>
<td>V_{EBO} max.</td>
<td>4 V</td>
</tr>
<tr>
<td>I_{CM} max.</td>
<td>22 A</td>
</tr>
<tr>
<td>I_{C(AV)} max.</td>
<td>9 A</td>
</tr>
<tr>
<td>P_{rf} max.</td>
<td>105 W</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>T_{j} max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

THERMAL RESISTANCE (dissipation = 30 W; T_{mb} = 79 °C, i.e. T_{h} = 70 °C)

From junction to mounting base (d.c. dissipation)
From junction to mounting base (r.f. dissipation)
From mounting base to heatsink

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{th j-mb(dc)}</td>
<td>2,5 °C/W</td>
</tr>
<tr>
<td>R_{th j-mb(rf)}</td>
<td>1,8 °C/W</td>
</tr>
<tr>
<td>R_{th mb-h}</td>
<td>0,3 °C/W</td>
</tr>
<tr>
<td>CHARACTERISTICS</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---</td>
</tr>
<tr>
<td>$T_j = 25 , ^\circ C$</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td></td>
</tr>
<tr>
<td>$V_{BE} = 0; I_C = 50 , mA$</td>
<td>$V_{(BR)CES} &gt; 36 , V$</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage open base; $I_C = 100 , mA$</td>
<td>$V_{(BR)CEO} &gt; 18 , V$</td>
</tr>
<tr>
<td>Emitter-base breakdown voltage open collector; $I_E = 25 , mA$</td>
<td>$V_{(BR)EBO} &gt; 4 , V$</td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td></td>
</tr>
<tr>
<td>$V_{BE} = 0; V_{CE} = 18 , V$</td>
<td>$I_{CES} &lt; 25 , mA$</td>
</tr>
<tr>
<td>Second breakdown energy; $L = 25 , mH; f = 50 , Hz$ open base</td>
<td></td>
</tr>
<tr>
<td>$R_{BE} = 10 , \Omega$</td>
<td>$E_{SBO} &gt; 8 , mJ$</td>
</tr>
<tr>
<td>$E_{SBR} &gt; 8 , mJ$</td>
<td></td>
</tr>
<tr>
<td>D.C. current gain*</td>
<td></td>
</tr>
<tr>
<td>$I_C = 4 , A; V_{CE} = 5 , V$</td>
<td>$h_{FE} \ \text{typ.} \ 50$</td>
</tr>
<tr>
<td>10 to 80</td>
<td></td>
</tr>
<tr>
<td>D.C. current gain ratio of matched devices*</td>
<td></td>
</tr>
<tr>
<td>$I_C = 4 , A; V_{CE} = 5 , V$</td>
<td>$h_{FE1}/h_{FE2} &lt; 1,2$</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage*</td>
<td></td>
</tr>
<tr>
<td>$I_C = 12,5 , A; I_B = 2,5 , A$</td>
<td>$V_{CEsat} \ \text{typ.} \ 1,5 , V$</td>
</tr>
<tr>
<td>Transition frequency at $f = 100 , MHz$*</td>
<td></td>
</tr>
<tr>
<td>$I_E = 4 , A; V_{CB} = 12,5 , V$</td>
<td>$f_T \ \text{typ.} \ 650 , MHz$</td>
</tr>
<tr>
<td>$f_T \ \text{typ.} \ 600 , MHz$</td>
<td></td>
</tr>
<tr>
<td>Collector capacitance at $f = 1 , MHz$</td>
<td></td>
</tr>
<tr>
<td>$I_E = I_E = 0; V_{CB} = 15 , V$</td>
<td>$C_c \ \text{typ.} \ 120 , pF$</td>
</tr>
<tr>
<td>Feedback capacitance at $f = 1 , MHz$</td>
<td></td>
</tr>
<tr>
<td>$I_C = 200 , mA; V_{CE} = 15 , V$</td>
<td>$C_{re} \ \text{typ.} \ 82 , pF$</td>
</tr>
<tr>
<td>Collector-flange capacitance</td>
<td></td>
</tr>
<tr>
<td>$C_{cf} \ \text{typ.} \ 2 , pF$</td>
<td></td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p < 200 \, \mu s; \delta < 0,02$. 

February 1978
Fig. 4. Typical values 
$T_j = 25^\circ C$

Fig. 5. $T_j = 25^\circ C$

Fig. 6. Typical values 
$f = 100 \text{ MHz}$ 
$T_j = 25^\circ C$

$V_{CB} = 12.5 \text{ V}$ 
$V_{CE} = 12.5 \text{ V}$ 
$V_{CE} = 10 \text{ V}$ 
$V_{CE} = 5 \text{ V}$
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

$T_h = 25^\circ C$

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_L$ (W)</th>
<th>$P_S$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$I_C$ (A)</th>
<th>$\eta$ (%)</th>
<th>$Z_i$ ((\Omega))</th>
<th>$\overline{V_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>12.5</td>
<td>45</td>
<td>&lt;14.2</td>
<td>&gt;5</td>
<td>&lt;4.8</td>
<td>&gt;75</td>
<td>1.2 + j1.4</td>
<td>320 + j150</td>
</tr>
<tr>
<td>175</td>
<td>13.5</td>
<td>45</td>
<td></td>
<td>typ. 6.0</td>
<td></td>
<td>typ. 75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List of components:

- **C1**: 2.5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- **C2** = **C3**: 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- **C3a** = **C3b**: 47 pF ceramic capacitor (500 V)
- **C4**: 120 pF ceramic capacitor (500 V)
- **C5**: 100 nF polyester capacitor
- **C6a** = **C6b**: 8.2 pF ceramic capacitor (500 V)
- **C7**: 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- **L1**: 1 turn Cu wire (1.6 mm); int. dia. 9.0 mm; leads 2 x 5 mm
- **L2**: 100 nH; 7 turns closely wound enamelled Cu wire (0.5 mm); int. dia. 3 mm; leads 2 x 5 mm
- **L3** = **L8**: Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- **L4** = **L5**: strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
- **L6**: 2 turns enamelled Cu wire (1.6 mm); int. dia. 5.0 mm; length 6.0 mm; leads 2 x 5 mm
- **L7**: 2 turns enamelled Cu wire (1.6 mm); int. dia. 4.5 mm; length 6.0 mm; leads 2 x 5 mm
- **L4** and **L5** are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
- **R1**: 10 \(\Omega\) (±10%) carbon resistor (0.25 W)
- **R2**: 4.7 \(\Omega\) (±5%) carbon resistor (0.25 W)

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive \( \frac{P_S}{P_{\text{Snom}}} \) increases linearly with supply over-voltage ratio.
APPLICATION INFORMATION (continued)

Fig. 12.

Fig. 13.

Fig. 14.

Conditions for Figs 12, 13 and 14:

Typical values; $V_{CE} = 12.5$ V; $P_L = 45$ W; $T_h = 25$ °C.
R.F. performance in s.s.b. class-AB operation

\[ V_{CE} = 12.5 \text{ V}; \quad T_h \text{ up to } 25 \, ^\circ\text{C}; \quad R_{th \text{ mb-h}} \leq 0.3 \, ^\circ\text{C/W} \]
\[ f_1 = 28,000 \text{ MHz}; \quad f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power W</th>
<th>( G_0 ) d( \text{B} )</th>
<th>( \eta_{dt} ) %</th>
<th>( d_3 ) dB*</th>
<th>( d_5 ) dB*</th>
<th>( I_{C(ZS)} ) mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 30 (P.E.P.)</td>
<td>typ. 19.5</td>
<td>typ. 35</td>
<td>typ. -33</td>
<td>typ. -36</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 15 Test circuit; s.s.b. class-AB.

List of components:

- **TR1** = **TR2** = BD137
- C1 = 100 pF air dielectric trimmer (single insulated rotor type)
- C2 = 27 pF ceramic capacitor (500 V)
- C3 = 180 pF polystyrene capacitor
- C4 = 100 pF air dielectric trimmer (single non-insulated rotor type)
- C5 = C7 = 3.9 nF polyester capacitor
- C6 = 2 x 270 pF polystyrene capacitors in parallel
- C8 = C15 = C16 = 100 nF polyester capacitor
- C9 = 2.2 \( \mu \text{F} \) moulded metallized polyester capacitor
- C10 = 2 x 385 pF (sections in parallel) film dielectric trimmer
- C11 = 68 pF ceramic capacitor (500 V)

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

List of components (continued)

- C12 = 2 x 82 pF ceramic capacitors in parallel (500 V)
- C13 = 47 pF ceramic capacitor (500 V)
- C14 = 385 pF film dielectric trimmer
- L1 = 88 nH; 3 turns Cu wire (1,0 mm); int. dia. 9 mm; length 6,1 mm; leads 2 x 5 mm
- L2 = L5 = Ferroxcube choke coil (cat. no. 431202036640)
- L3 = 68 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 8 mm; length 8,3 mm; leads 2 x 5 mm
- L4 = 96 nH; 3 turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 7,6 mm; leads 2 x 5 mm
- R1 = 27 Ω (±5%) carbon resistor (0,5 W)
- R2 = 4,7 Ω (±5%) carbon resistor (0,25 W)
- R3 = 1,5 kΩ (±5%) carbon resistor (0,5 W)
- R4 = 10 Ω wirewound potentiometer (3 W)
- R5 = 47 Ω wirewound resistor (5,5 W)
- R6 = 150 Ω (±5%) carbon resistor (0,25 W)

![Graph 16](intermodulation distortion versus output power)

![Graph 17](double-tone efficiency versus output power)

Conditions for Figs 16 and 17:

- VCE = 12.5 V; f1 = 28,000 MHz; f2 = 28,001 MHz; Tth = 25 °C; Rth mb-h < 0,3 °C/W; IC(ZS) = 25 mA; typical values.

* See page 11.
intermodulation distortion versus output power

double-tone efficiency versus output power

Fig. 18.

Fig. 19.

Conditions for Figs 18 and 19:
\[ V_{CE} = 13.5 \, V; \, f_1 = 28,000 \, \text{MHz}; \, f_2 = 28,001 \, \text{MHz}; \, T_h = 25 \, ^\circ\text{C}; \, R_{th \, mb-h} < 0.3 \, ^\circ\text{C/W}; \, I_C(ZS) = 25 \, \text{mA}; \]

typical values.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
APPLICATION INFORMATION (continued)

Fig. 20 Power gain as a function of frequency.  Fig. 21 Input impedance (series components) as a function of frequency.

Fig. 20 and 21 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:

- $V_{CE} = 12.5$ V
- $P_L = 30$ W (P.E.P.)
- $T_h = 25$ °C
- $R_{th\,mb-h} \leq 0.3$ °C/W
- $I_{C(ZS)} = 25$ mA
- $Z_L = 1.8$ Ω

- $V_{CE} = 13.5$ V
- $P_L = 35$ W (P.E.P.)
- $T_h = 25$ °C
- $R_{th\,mb-h} \leq 0.3$ °C/W
- $I_{C(ZS)} = 25$ mA
- $Z_L = 1.8$ Ω

September 1978
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, AB and B operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Matched hFE groups are available on request. It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25\,^\circ\text{C}$

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_1$ $\Omega$</th>
<th>$\bar{Y}_L$ mA/V</th>
<th>$d_3$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>175</td>
<td>45</td>
<td>&gt; 7,5</td>
<td>&gt; 70</td>
<td>0,7 + j1,3</td>
<td>110 - j62</td>
<td>-</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>1,6 - 28</td>
<td>5 - 47,5 (P.E.P.)</td>
<td>typ. 19</td>
<td>typ. 45</td>
<td>-</td>
<td>-</td>
<td>typ. -30</td>
</tr>
<tr>
<td>s.s.b. (class-A)</td>
<td>26</td>
<td>1,6 - 28</td>
<td>17 (P.E.P.)</td>
<td>typ. 22</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>typ. -42</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \( (V_{BE} = 0) \)
peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open-collector)
Collector current (average)
Collector current (peak value); \( f > 1 \text{ MHz} \)
R.F. power dissipation \( (f > 1 \text{ MHz}); T_{mb} = 25^\circ \text{C} \)
Storage temperature
Operating junction temperature

\[
\begin{align*}
V_{CESM} & \quad \text{max.} \quad 65 \text{ V} \\
V_{CEO} & \quad \text{max.} \quad 36 \text{ V} \\
V_{EBO} & \quad \text{max.} \quad 4 \text{ V} \\
I_{C(AV)} & \quad \text{max.} \quad 4 \text{ A} \\
I_{CM} & \quad \text{max.} \quad 12 \text{ A} \\
P_{rf} & \quad \text{max.} \quad 105 \text{ W} \\
T_{stg} & \quad -65 \text{ to } +150^\circ \text{C} \\
T_j & \quad \text{max.} \quad 200^\circ \text{C}
\end{align*}
\]

---

**Fig. 2** D.C. SOAR.

**Fig. 3** R.F. power dissipation; \( V_{CE} \leq 28 \text{ V} \);
\( f > 1 \text{ MHz} \).

| I | Continuous d.c. operation |
| II | Continuous r.f. operation |
| III | Short-time operation during mismatch |

**THERMAL RESISTANCE** (dissipation = 45 W; \( T_{mb} = 83,5^\circ \text{C}, \text{i.e. } T_h = 70^\circ \text{C} \))

From junction to mounting base (d.c. dissipation)

\[
R_{th \ j-mb(d)} = 2,65^\circ \text{C/W}
\]

From junction to mounting base (r.f. dissipation)

\[
R_{th \ j-mb(rf)} = 1,95^\circ \text{C/W}
\]

From mounting base to heatsink

\[
R_{th \ mb-h} = 0,3^\circ \text{C/W}
\]

---

July 1978
CHARACTERISTICS

T_J = 25 °C unless otherwise specified

Collector-emitter breakdown voltage
V_BE = 0; I_C = 25 mA

Collector-emitter breakdown voltage
open base; I_C = 100 mA

Emitter-base breakdown voltage
open collector; I_E = 10 mA

Collector cut-off current
V_BE = 0; V_CE = 36 V

Second breakdown energy; L = 25 mH; f = 50 Hz
open base
R_BE = 10 Ω

D.C. current gain*
I_C = 2,5 A; V_CE = 5 V

D.C. current gain ratio of matched devices*
I_C = 2,5 A; V_CE = 5 V

Collector-emitter saturation voltage*
I_C = 7,5 A; I_B = 1,5 A

Transition frequency at f = 100 MHz*
-I_E = 2,5 A; V_CCB = 28 V
-I_E = 7,5 A; V_CCB = 28 V

Collector capacitance at f = 1 MHz
I_E = I_e = 0; V_CCB = 28 V

Feedback capacitance at f = 1 MHz
I_C = 100 mA; V_CE = 28 V

Collector-flange capacitance

\[ V(BR)CES > 65 \text{ V} \]
\[ V(BR)CEO > 36 \text{ V} \]
\[ V(BR)EBO > 4 \text{ V} \]
\[ I_{CES} < 10 \text{ mA} \]
\[ E_{SBO} > 8 \text{ mJ} \]
\[ E_{SBR} > 8 \text{ mJ} \]
\[ h_{FE} \text{ typ.} 45 \]
\[ h_{FE1}/h_{FE2} < 1,2 \]
\[ V_{CEsat} \text{ typ.} 1,5 \text{ V} \]
\[ f_T \text{ typ.} 570 \text{ MHz} \]
\[ C_c \text{ typ.} 82 \text{ pF} \]
\[ C_{re} \text{ typ.} 54 \text{ pF} \]
\[ C_{cf} \text{ typ.} 2 \text{ pF} \]

* Measured under pulse conditions: \( t_p \leq 200 \mu s; \delta \leq 0,02. \)

Fig. 4 Typical values; \( V_{CE} = 28 \text{ V} \).
Fig. 5 Typical values; $T_j = 25^\circ C$.

Fig. 6 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

Fig. 7 Typical values; $f = 100$ MHz; $T_j = 25^\circ C$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\( T_h = 25 \, ^\circ C \)

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( \bar{z}_1 ) (( \Omega ))</th>
<th>( \overline{\gamma}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>45</td>
<td>&lt; 8</td>
<td>&gt; 7,5</td>
<td>&lt; 2,47</td>
<td>&gt; 70</td>
<td>0,7 + j1,3</td>
<td>110 – j62</td>
</tr>
</tbody>
</table>

Fig. 8 Test circuit; c.w. class-B.

List of components:

- \( C1 = C7 = 2,5 \) to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( C2 = 5 \) to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- \( C3a = C3b = 47 \) pF ceramic capacitor (500 V)
- \( C4 = 120 \) pF ceramic capacitor
- \( C5 = 100 \) nF polyester capacitor
- \( C6a = 2,2 \) pF ceramic capacitor (500 V)
- \( C6b = 1,8 \) pF ceramic capacitor (500 V)

- \( C8 = 4 \) to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)

- \( L1 = 14 \) nH; 1 turn Cu wire (1,6 mm); int. dia. 7,7 mm; leads 2 x 5 mm
- \( L2 = 100 \) nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
- \( L3 = L8 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L4 = L5 = \) strip (12 mm x 6 mm); taps for \( C3a \) and \( C3b \) at 5 mm from transistor
- \( L6 = 80 \) nH; 3 turns Cu wire (1,6 mm); int. dia. 9,0 mm; length 8,0 mm; leads 2 x 5 mm
- \( L7 = 62 \) nH; 3 turns Cu wire (1,6 mm); int. dia. 7,5 mm; length 8,1 mm; leads 2 x 5 mm

- \( L4 \) and \( L5 \) are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

- \( R1 = R2 = 10 \) \( \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 9.
The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.

Fig. 9 Component layout and printed-circuit board for 175 MHz test circuit.
Fig. 10 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

Fig. 11 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz; 

--- $T_h = 25$ °C; --- $T_h = 70$ °C.

Fig. 12 R.F. SOAR; c.w. class-B operation; 
$f = 175$ MHz; $V_{CE} = 28$ V; $R_{th mb-h} = 0.3$ °C/W.

The graph shows the permissible output power under nominal conditions ($\text{VSWR} = 1$) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
OPERATING NOTE
Below 75 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Conditions for Figs 13; 14 and 15.
Typical values; $V_{CE} = 28 \, \text{V}$; $P_L = 45 \, \text{W}$; $T_h = 25 \, ^\circ\text{C}$.
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

$V_{CE} = 28\,\text{V}; f_1 = 28,000\,\text{MHz}; f_2 = 28,001\,\text{MHz}$

<table>
<thead>
<tr>
<th>output power W</th>
<th>$G_p$ dB</th>
<th>$\gamma_{dt}$ (%)</th>
<th>$I_C$ (A)</th>
<th>$d_3$ dB*</th>
<th>$d_5$ dB*</th>
<th>$I_C(ZS)$ mA</th>
<th>$T_h$ $^\circ\text{C}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 47,5 (P.E.P.)</td>
<td>typ. 19</td>
<td>typ. 45</td>
<td>typ. 1,9</td>
<td>typ. $-30$</td>
<td>$&lt;-30$</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>5 to 42,5 (P.E.P.)</td>
<td>typ. 19</td>
<td>--</td>
<td>--</td>
<td>typ. $-30$</td>
<td>$&lt;-30$</td>
<td>50</td>
<td>70</td>
</tr>
</tbody>
</table>

Fig. 16 Test circuit; s.s.b. class-AB.

List of components:

- $C_1 = C_2 = 10 \text{ to } 780\,\text{pF film dielectric trimmer}$
- $C_3 = C_5 = C_6 = 220\,\text{nF polyester capacitor}$
- $C_4 = 56\,\text{pF ceramic capacitor (500 V)}$
- $C_7 = C_8 = 15 \text{ to } 575\,\text{pF film dielectric trimmer}$
- $L_1 = 4 \text{ turns closely wound enameled Cu wire (1,6 mm); int. dia. } 7,0\,\text{mm}; \text{ leads } 2 \times 5\,\text{mm}$
- $L_2 = \text{ Ferroxcube wide-band h.f. choke, grade } 3B \text{ (cat. no. 431202036640)}$
- $L_3 = 4 \text{ turns enameled Cu wire (1,6 mm); int. dia. } 10\,\text{mm}; \text{ length } 9,4\,\text{mm}; \text{ leads } 2 \times 5\,\text{mm}$
- $L_4 = 7 \text{ turns enameled Cu wire (1,6 mm); int. dia. } 12\,\text{mm}; \text{ length } 17,2\,\text{mm}; \text{ leads } 2 \times 5\,\text{mm}$
- $R_1 = 1,2\,\Omega; \text{ parallel connection of } 4 \times 4,7\,\Omega \text{ carbon resistors}$
- $R_2 = 39\,\Omega \text{ carbon resistor}$

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
Fig. 17 Intermodulation distortion as a function of output power.※

Conditions for Fig. 17:
V_{CE} = 28 V; I_{C(ZS)} = 50 mA; f_1 = 28,000 MHz; f_2 = 28,001 MHz; typical values.

Fig. 18 Double-tone efficiency and power gain as a function of output power.

Conditions for Fig. 18:
V_{CE} = 28 V; I_{C(ZS)} = 50 mA; f_1 = 28,000 MHz; f_2 = 28,001 MHz; T_h = 25 °C; typical values.

※ See note on page 9.
Figs 19 and 20 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
VCE = 28 V; IC(ZS) = 50 mA; PL = 47.5 W; T, = 25 °C; ZL = 6.4 Ω.

Ruggedness in s.s.b. operation
The BLW86 is capable of withstanding a load mismatch (VSWR = 50) under the following conditions: class-AB operation; f1 = 28,000 MHz; f2 = 28,001 MHz; VCE = 28 V; T, = 70 °C and PLnom = 50 W P.E.P.
R.F. performance in s.s.b. class-A operation (linear power amplifier)

\[ V_{CE} = 26 \text{ V}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power</th>
<th>( G_d ) dB</th>
<th>( I_C ) A</th>
<th>( d_3 ) dB*</th>
<th>( d_5 ) dB*</th>
<th>( T_h ) °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 (P.E.P.)</td>
<td>typ. 22</td>
<td>1,7</td>
<td>typ. -40</td>
<td>&lt; -40</td>
<td>70</td>
</tr>
<tr>
<td>17 (P.E.P.)</td>
<td>typ. 22</td>
<td>1,7</td>
<td>typ. -42</td>
<td>&lt; -40</td>
<td>25</td>
</tr>
</tbody>
</table>

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
List of components in Fig. 21:

C1 = C2 = 10 to 780 pF film dielectric trimmer
C3 = 22 nF ceramic capacitor (63 V)
C4 = 47 μF/10 V electrolytic capacitor
C5 = 56 pF ceramic capacitor (500 V)
C6 = 47 μF/35 V electrolytic capacitor
C7 = C8 = 220 nF polyester capacitor
C9 = 10 μF/35 V electrolytic capacitor
C10 = 10 to 210 pF film dielectric trimmer
C11 = 15 to 575 pF film dielectric trimmer

L1 = 3 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
L2 = L3 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 11 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 11,0 mm
L5 = 14 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 11,0 mm

R1 = 600 Ω; parallel connection of 2 x 1,2 kΩ carbon resistors (±5%; 0,5 W each)
R2 = 15 Ω carbon resistor (±5%; 0,25 W)
R3 = 1,2 Ω; parallel connection of 4 x 4,7 Ω carbon resistors (±5%; 0,125 W each)
R4 = 33 Ω carbon resistor (±5%; 0,25 W)
R5 = 18 Ω carbon resistor (±5%; 0,25 W)
R6 = 120 Ω wirewound resistor (±5%; 5,5 W)
R7 = 1 Ω carbon resistor (±5%; 0,125 W)
R8 = 47 Ω wirewound potentiometer (3 W)
R9 = 1,57 Ω; parallel connection of 3 x 4,7 Ω wirewound resistors (±5%; 5,5 W each)

Fig. 22 Intermodulation distortion as a function of output power.
Typical values; VCE = 26 V; TH = 70 °C; f1 = 28,000 MHz; f2 = 28,001 MHz.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile h.f. and v.h.f. transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V.

It has a 3/8" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_L$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$\overline{z_l}$ (Ω)</th>
<th>$\overline{Y_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>25</td>
<td>$&gt; 6$</td>
<td>$&gt; 70$</td>
<td>$1,6 + j1,4$</td>
<td>$210 + j5,5$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-123.

Dimensions in mm

<table>
<thead>
<tr>
<th>Torque on screw:</th>
<th>min. 0,6 Nm (6 kg cm)</th>
<th>max. 0,75 Nm (7,5 kg cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended screw:</td>
<td>raised cheese-head 4-40 UNC/2A</td>
<td></td>
</tr>
</tbody>
</table>

Heatsink compound must be applied sparingly and evenly.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \((V_{BE} = 0)\)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); \(f > 1\) MHz

R.F. power dissipation \((f > 1\) MHz); \(T_{mb} = 25\) °C

Storage temperature

Operating junction temperature

\[
\begin{align*}
V_{CESM} & \leq 36\ V \\
V_{CEO} & \leq 18\ V \\
V_{EBO} & \leq 4\ V \\
I_{C(AV)} & \leq 6\ A \\
I_{CM} & \leq 12\ A \\
P_{rf} & \leq 76\ W \\
T_{stg} & = -65\ \text{to}\ +150\ °C \\
T_{j} & \leq 200\ °C
\end{align*}
\]

\[
\begin{align*}
V_{CESM} & = 36\ V \\
V_{CEO} & = 18\ V \\
V_{EBO} & = 4\ V \\
I_{C(AV)} & = 6\ A \\
I_{CM} & = 12\ A \\
P_{rf} & = 76\ W \\
T_{stg} & = -65\ \text{to}\ +150\ °C \\
T_{j} & \leq 200\ °C
\end{align*}
\]

Fig. 2 D.C. SOAR.

\[
\begin{align*}
I_{C} & \leq 20\ A \\
V_{CE} & \leq 30\ V \\
T_{mb} & = 25\ °C \\
T_{h} & = 70\ °C
\end{align*}
\]

Fig. 3 R.F. power dissipation; \(V_{CE} \leq 16,5\ V;\)
\(f \geq 1\ MHz.

THERMAL RESISTANCE (dissipation = 20 W; \(T_{mb} = 76\ °C;\) i.e. \(T_{h} = 70\ °C)\)

- From junction to mounting base (d.c. dissipation)
- From junction to mounting base (r.f. dissipation)
- From mounting base to heatsink

\[
R_{th}\ j-mb(dcc) = 3,0\ °C/W \\
R_{th}\ j-mb(rf) = 2,25\ °C/W \\
R_{th}\ mb-h = 0,3\ °C/W
\]
**CHARACTERISTICS**

T<sub>j</sub> = 25 °C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;BE&lt;/sub&gt; = 0; I&lt;sub&gt;C&lt;/sub&gt; = 25 mA</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td></td>
</tr>
<tr>
<td>open base; I&lt;sub&gt;C&lt;/sub&gt; = 50 mA</td>
<td></td>
</tr>
<tr>
<td>Emitter-base breakdown voltage</td>
<td></td>
</tr>
<tr>
<td>open collector; I&lt;sub&gt;E&lt;/sub&gt; = 10 mA</td>
<td></td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;BE&lt;/sub&gt; = 0; V&lt;sub&gt;CE&lt;/sub&gt; = 18 V</td>
<td></td>
</tr>
<tr>
<td>Second breakdown energy; L = 25 mH; f = 50 Hz</td>
<td></td>
</tr>
<tr>
<td>open base</td>
<td></td>
</tr>
<tr>
<td>R&lt;sub&gt;BE&lt;/sub&gt; = 10 Ω</td>
<td></td>
</tr>
<tr>
<td>D.C. current gain*</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 2,5 A; V&lt;sub&gt;CE&lt;/sub&gt; = 5 V</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage*</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 7,5 A; I&lt;sub&gt;B&lt;/sub&gt; = 1,5 A</td>
<td></td>
</tr>
<tr>
<td>Transition frequency at f = 100 MHz*</td>
<td></td>
</tr>
<tr>
<td>-I&lt;sub&gt;E&lt;/sub&gt; = 2,5 A; V&lt;sub&gt;CB&lt;/sub&gt; = 13,5 V</td>
<td></td>
</tr>
<tr>
<td>-I&lt;sub&gt;E&lt;/sub&gt; = 7,5 A; V&lt;sub&gt;CB&lt;/sub&gt; = 13,5 V</td>
<td></td>
</tr>
<tr>
<td>Collector capacitance at f = 1 MHz</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;E&lt;/sub&gt; = I&lt;sub&gt;E&lt;/sub&gt; = 0; V&lt;sub&gt;CB&lt;/sub&gt; = 15 V</td>
<td></td>
</tr>
<tr>
<td>Feedback capacitance at f = 1 MHz</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 100 mA; V&lt;sub&gt;CE&lt;/sub&gt; = 15 V</td>
<td></td>
</tr>
<tr>
<td>Collector-flange capacitance</td>
<td></td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: t<sub>p</sub> < 200 µs; δ < 0,02.
**Fig. 4.**

<table>
<thead>
<tr>
<th>$h_{FE}$</th>
<th>100</th>
<th>75</th>
<th>50</th>
<th>25</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C$ (A)</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

Typical values
$T_j = 25 \, ^\circ C$

$V_{CE} = 13.5 \, V$
$V_{CE} = 5 \, V$

**Fig. 5.**

$T_j = 25 \, ^\circ C$

Typical $C_c$

$f = 1 \, MHz$

**Fig. 6.**

$V_{CB} = 13.5 \, V$

Typical $f_T$

$f = 100 \, MHz$
$T_j = 25 \, ^\circ C$
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

$$T_h = 25 \, ^\circ C$$

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_L$ (W)</th>
<th>$P_S$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$I_C$ (A)</th>
<th>$\eta$ (%)</th>
<th>$z_i$ (Ω)</th>
<th>$Y_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>25</td>
<td>$&lt; 6,25$</td>
<td>$&gt; 6$</td>
<td>$&lt; 2,64$</td>
<td>$&gt; 70$</td>
<td>1,6 + j1,4</td>
<td>210 + j5,5</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>25</td>
<td>-</td>
<td>typ. 6,6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

![Diagram of test circuit](image)

**Fig. 7 Test circuit; c.w. class-B.**

List of components:

- **C1** = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- **C2** = C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- **C3a** = **C3b** = 47 pF ceramic capacitor (500 V)
- **C4** = 120 pF ceramic capacitor (500 V)
- **C5** = 100 nF polyester capacitor
- **C6a** = **C6b** = 8,2 pF ceramic capacitor (500 V)
- **C7** = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- **L1** = 1 turn Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
- **L2** = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
- **L3** = **L8** = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- **L4** = **L5** = strip (12 mm x 6 mm); taps for **C3a** and **C3b** at 5 mm from transistor
- **L6** = 2 turns Cu wire (1,6 mm); int. dia. 5,0 mm; length 6,0 mm; leads 2 x 5 mm
- **L7** = 2 turns Cu wire (1,6 mm); int. dia. 4,5 mm; length 6,0 mm; leads 2 x 5 mm

**L4 and L5** are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

- **R1** = 10 Ω (± 10%) carbon resistor (0,25 W)
- **R2** = 4,7 Ω (± 5%) carbon resistor (0,25 W)

Component layout and printed-circuit board for 175 MHz test circuit are shown in Fig. 8.
**Fig. 8** Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (PS/PSnom) increases linearly with supply over-voltage ratio.

February 1978
OPERATING NOTE Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

![Graph 1](image1)

**Fig. 12.**

![Graph 2](image2)

**Fig. 13.**

![Graph 3](image3)

**Fig. 14.**

Conditions for Figs 12, 13 and 14:
Typical values; $V_{CE} = 13.5 \, \text{V}$; $P_L = 25 \, \text{W}$; $T_h = 25 \, ^\circ\text{C}$.
H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-AB operated high power industrial and military transmitting equipment in the h.f. band. The transistor presents excellent performance as a linear amplifier in s.s.b. applications. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Matched $h_{FE}$ groups are available on request.

The transistor has a ⅛" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>R.F. performance up to $T_h = 25 , ^\circ C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode of operation</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
</tr>
</tbody>
</table>

* At 160 W P.E.P.

MECHANICAL DATA

SOT-121A (see page 2)

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
MECHANICAL DATA

Fig. 1 SOT-121A.

Torque on screw: min. 0.6 Nm (6 kg cm)
max. 0.75 Nm (7.5 kg cm)

Recommended screw: raised cheese-head 4-40 UNC/2A

Heatsink compound must be applied sparingly and evenly.
H.F. power transistor

RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \( (V_{BE} = 0) \)
peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)
Collector current (average)
Collector current (peak value); \( f > 1 \text{ MHz} \)
R.F. power dissipation (\( f > 1 \text{ MHz} \)); \( T_{mb} = 25 \text{ °C} \)
Storage temperature
Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CESM} )</td>
<td>max. 110 V</td>
</tr>
<tr>
<td>( V_{CEO} )</td>
<td>max. 53 V</td>
</tr>
<tr>
<td>( V_{EBO} )</td>
<td>max. 4 V</td>
</tr>
<tr>
<td>( I_{C(AV)} )</td>
<td>max. 8 A</td>
</tr>
<tr>
<td>( I_{CM} )</td>
<td>max. 20 A</td>
</tr>
<tr>
<td>( P_{RF} )</td>
<td>max. 245 W</td>
</tr>
<tr>
<td>( T_{stg} )</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>( T_{j} )</td>
<td>max. 200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

![Graph](image1)

Fig. 3 R.F. power dissipation; \( V_{CE} \leq 50 \text{ V} \);

\( f > 1 \text{ MHz} \).

I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 100 W; \( T_{mb} = 90 \text{ °C} \), i.e. \( T_h = 70 \text{ °C} \))

<table>
<thead>
<tr>
<th>From junction to mounting base (d.c. dissipation)</th>
<th>( R_{th j-mb} ) (dc) = 1.0 ( ^\circ \text{C/W} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>From junction to mounting base (r.f. dissipation)</td>
<td>( R_{th j-mb} ) (rf) = 0.7 ( ^\circ \text{C/W} )</td>
</tr>
<tr>
<td>From mounting base to heatsink</td>
<td>( R_{th mb-h} ) = 0.2 ( ^\circ \text{C/W} )</td>
</tr>
</tbody>
</table>
CHARACTERISTICS

$T_J = 25 \, {^{\circ}}C$

Collector-emitter breakdown voltage
$V_{BE} = 0; \, I_C = 25 \, mA$

Collector-emitter breakdown voltage
open base; $I_C = 100 \, mA$

Emitter-base breakdown voltage
open collector; $I_E = 20 \, mA$

Collector cut-off current
$V_{BE} = 0; \, V_{CE} = 53 \, V$

Second breakdown energy; $L = 25 \, mH; \, f = 50 \, Hz$
open base
$R_{BE} = 10 \, \Omega$

D.C. current gain *
$I_C = 4 \, A; \, V_{CE} = 5 \, V$

D.C. current gain ratio of matched devices *
$I_C = 4 \, A; \, V_{CE} = 5 \, V$

Collector-emitter saturation voltage *
$I_C = 12,5 \, A; \, I_B = 2,5 \, A$

Transition frequency at $f = 100 \, MHz$ *
$-I_E = 4 \, A; \, V_{CB} = 40 \, V$
$-I_E = 12,5 \, A; \, V_{CB} = 40 \, V$

Collector capacitance at $f = 1 \, MHz$
$I_E = I_E = 0; \, V_{CB} = 50 \, V$

Feedback capacitance at $f = 1 \, MHz$
$I_C = 150 \, mA; \, V_{CE} = 50 \, V$

Collector-flange capacitance

$V_{(BR)CES} > 110 \, V$

$V_{(BR)CEO} > 53 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 10 \, mA$

$E_{SBO} > 12,5 \, mJ$

$E_{SBR} > 12,5 \, mJ$

$h_{FE} \, \text{typ.} \, 30$

$h_{FE1/h_{FE2}} < 1,2$

$V_{CEsat} \, \text{typ.} \, 2,2 \, V$

$f_T \, \text{typ.} \, 270 \, MHz$

$f_T \, \text{typ.} \, 285 \, MHz$

$C_c \, \text{typ.} \, 185 \, pF$

$C_{re} \, \text{typ.} \, 115 \, pF$

$C_{cf} \, \text{typ.} \, 3 \, pF$

* Measured under pulse conditions: $t_p < 200 \, \mu s; \, \delta < 0,02$. 

September 1978
H.F. power transistor

Fig. 4 $V_{CE} = 40\, V;\, T_h = 25\, ^\circ C$.

Fig. 5 Typical values; $T_j = 25\, ^\circ C$.

Fig. 6 Typical values; $f = 100\, MHz;\, T_j = 25\, ^\circ C$.

Fig. 7 $I_E = I_e = 0;\, f = 1\, MHz;\, T_j = 25\, ^\circ C$. 

September 1978 5
APPLICATION INFORMATION

R.F. performance in s.s.b. class-AB operation (linear power amplifier)

\( V_{CE} = 50 \text{ V}; \quad T_h = 25 \degree \text{C}; \quad f_1 = 28,000 \text{ MHz}; \quad f_2 = 28,001 \text{ MHz} \)

<table>
<thead>
<tr>
<th>output power (W)</th>
<th>( G_p ) dB</th>
<th>( \eta_{dt} ) (%) at 160 W (P.E.P.)</th>
<th>( I_C ) (A)</th>
<th>( d_3 ) dB *</th>
<th>( d_5 ) dB *</th>
<th>( I_C(ZS) ) (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 to 160 (P.E.P.)</td>
<td>&gt;14</td>
<td>&gt;40</td>
<td>&lt;4,0</td>
<td>&lt;−30</td>
<td>&lt;−30</td>
<td>0,1</td>
</tr>
</tbody>
</table>

![Test Circuit](image)

Fig. 8 Test circuit; s.s.b. class-AB.

List of components:

- \( C_1 = C_{10} = 100 \text{ pF film dielectric trimmer} \)
- \( C_2 = C_6 = 27 \text{ pF ceramic capacitor (500 V)} \)
- \( C_3 = 220 \text{ pF polystyrene capacitor} \)
- \( C_4 = C_{13} = 100 \text{ pF film dielectric trimmer} \)
- \( C_5 = C_7 = 3,9 \text{ nF ceramic capacitor} \)
- \( C_8 = 100 \text{ nF polyester capacitor} \)
- \( C_9 = 2,2 \mu\text{F moulded metallized polyester capacitor} \)
- \( C_{11} = 68 \text{ pF ceramic capacitor (500 V)} \)
- \( C_{12} = 220 \text{ pF polystyrene capacitor} \)
- \( L_1 = 88 \text{ nH; 3 turns Cu wire (1,0 mm); int. dia. 9,0 mm; length 6,1 mm; leads 2 x 5 mm} \)
- \( L_2 = L_5 = \text{Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)} \)
- \( L_3 = 180 \text{ nH; 4 turns enamelled Cu wire (1,6 mm); int. dia. 12,0 mm; length 9,9 mm; leads 2 x 10 mm} \)
- \( L_4 = 350 \text{ nH; 7 turns enamelled Cu wire (1,6 mm); int. dia. 12,0 mm; length 19,1 mm; leads 2 x 10 mm} \)
- \( R_1 = 0,66 \Omega; \text{parallel connection of 5 x 3,3} \Omega \text{ carbon resistors (± 5%); 0,5 W each} \)
- \( R_2 = 27 \Omega \text{ carbon resistor (± 5%; 0,5 W)} \)
- \( R_3 = 4,7 \Omega \text{ carbon resistor (± 5%; 0,5 W)} \)

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
H.F. power transistor

Fig. 9 Intermodulation distortion as a function of output power.*

Conditions for Figs 9 and 10:
V_{CE} = 50 \text{ V}; I_{C(ZS)} = 0.1 \text{ A}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz}; T_h = 25 \text{ °C}; typical values.

Ruggedness
The BLW95 is capable of withstanding full load mismatch (VSWR = 50) up to 150 W (P.E.P.) under the following conditions:
V_{CE} = 45 \text{ V}; f = 28 \text{ MHz}; T_h = 70 \text{ °C}; R_{th mb-h} = 0.2 \text{ °C/W}.

* See note on page 6.
Fig. 11 Power gain as a function of frequency.

Fig. 12 Input impedance (series components) as a function of frequency.

Figs 11 and 12 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
\[ V_{CE} = 50 \text{ V}; \quad I_{C(ZS)} = 0.1 \text{ A}; \quad P_L = 160 \text{ W (P.E.P.)}; \quad T_h = 25 \text{ °C}; \quad Z_L = 6.25 \Omega \text{ in series with } 7.3 \text{ nH (in parallel with } -188 \text{ pF).} \]
H.F. power transistor

Figs 13 and 14 are typical curves and hold for one transistor of a push-pull amplifier with cross-neutralization in s.s.b. class-AB operation.

Conditions:
\( V_{CE} = 50 \text{ V} \); \( I_{C(ZS)} = 0.1 \text{ A} \); \( P_L = 160 \text{ W (P.E.P.)} \); \( T_h = 25 \text{ °C} \); \( Z_L = 6.25 \Omega \) in series with \( 10.4 \text{ nH} \) (in parallel with \(-267 \text{ pF}\)); neutralizing capacitor: 82 pF.
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in u.h.f. power amplifiers, where optimum linearity is required. The transistor is specially suited for all transistorized television transposers and transmitters in band IV and V, as well as for driver stages in tube systems. The combination of excellent d.c. dissipation properties, which have been obtained by means of diffused emitter-ballasting resistors and the application of a Ti-Pt-Au sandwich metallization, gives an optimum reliability.

The transistor has a ¾” capstan envelope with ceramic cap.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of Operation</th>
<th>( f_{\text{vision}} ) MHz</th>
<th>( V_{CE} ) V</th>
<th>( I_C ) mA</th>
<th>( T_h ) °C</th>
<th>( \text{dim}^* ) dB</th>
<th>( P_{\text{sync}}^* ) W</th>
<th>( G_D ) dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-A; linear amplifier</td>
<td>860</td>
<td>25</td>
<td>850</td>
<td>70</td>
<td>-60</td>
<td>&gt;3,5</td>
<td>&gt;6,5</td>
</tr>
<tr>
<td></td>
<td>860</td>
<td>25</td>
<td>850</td>
<td>25</td>
<td>-60</td>
<td>typ. 4,4</td>
<td>typ. 7</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Dimensions in mm

Torque on nut: min. 0.75 Nm (7.5 kg cm)
max. 0.85 Nm (8.5 kg cm)

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

January 1978
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter; peak value)</td>
<td>$V_{CBOM}$</td>
<td>max.</td>
<td>50 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$</td>
<td>max.</td>
<td>27 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>$V_{EBO}$</td>
<td>max.</td>
<td>3,5 V</td>
</tr>
<tr>
<td>Collector current (d.c.)</td>
<td>$I_C$</td>
<td>max.</td>
<td>2 A</td>
</tr>
<tr>
<td>Collector current (peak value) $f &gt; 1$ MHz</td>
<td>$I_{CM}$</td>
<td>max.</td>
<td>4 A</td>
</tr>
<tr>
<td>Total power dissipation at $T_J = 70$ °C</td>
<td>$P_{tot}$</td>
<td>max.</td>
<td>21,5 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td></td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>$T_J$</td>
<td>max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

THERMAL RESISTANCE
From junction to mounting base
$R_{th j-mb} = 5,5$ °C/W
From mounting base to heatsink
$R_{th mb-h} = 0,6$ °C/W

Fig. 2 D.C. SOAR.
### CHARACTERISTICS

**$T_J = 25 \, ^\circ C$**

**Collector-base breakdown voltage**
- open emitter; $I_C = 10 \, mA$

**Collector-emitter breakdown voltage**
- open base; $I_C = 25 \, mA$

**Emitter-base breakdown voltage**
- open collector; $I_E = 5 \, mA$

**D.C. current gain**
- $I_C = 0.85 \, A; \ V_{CE} = 25 \, V$

**Collector-emitter saturation voltage**
- $I_C = 500 \, mA; \ I_B = 100 \, mA$

**Transition frequency at $f = 500 \, MHz$**
- $I_E = 0.85 \, A; \ V_{CB} = 25 \, V$

**Collector capacitance at $f = 1 \, MHz$**
- $I_E = I_e = 0; \ V_{CE} = 25 \, V$

**Feedback capacitance at $f = 1 \, MHz$**
- $I_C = 50 \, mA; \ V_{CE} = 25 \, V; \ T_{mb} = 25 \, ^\circ C$

**Collector-stud capacitance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base breakdown</td>
<td>50 V</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter breakdown</td>
<td>27 V</td>
<td></td>
</tr>
<tr>
<td>Emitter-base breakdown</td>
<td>3.5 V</td>
<td></td>
</tr>
<tr>
<td>D.C. current gain</td>
<td>$&gt; 15$</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>typ. 40</td>
<td></td>
</tr>
<tr>
<td>Transition frequency at $f = 500 , MHz$</td>
<td>2.5 GHz</td>
<td></td>
</tr>
<tr>
<td>Collector capacitance at $f = 1 , MHz$</td>
<td>typ. 24 pF</td>
<td></td>
</tr>
<tr>
<td>Feedback capacitance at $f = 1 , MHz$</td>
<td>typ. 15 pF</td>
<td></td>
</tr>
<tr>
<td>Collector-stud capacitance</td>
<td>typ. 2 pF</td>
<td></td>
</tr>
</tbody>
</table>

* Measured under pulse conditions; $t_p \leq 200 \, \mu s; \ \delta \leq 0.02$. 

---

*U.H.F. power transistor*
Fig. 3 Typical values; $T_j = 25 \, ^\circ\text{C}$.

Fig. 4 $I_E = I_e = 0$; $f = 1 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$.

Fig. 5 $V_{CB} = 25 \, \text{V}$; $f = 500 \, \text{MHz}$; $T_j = 25 \, ^\circ\text{C}$. 
**APPLICATION INFORMATION**

<table>
<thead>
<tr>
<th>$f_{\text{vision}}$ (MHz)</th>
<th>$V_{\text{CE}}$ (V)</th>
<th>$I_C$ (mA)</th>
<th>$T_h$ (°C)</th>
<th>$d_{\text{im}}$ (dB)*</th>
<th>$P_{\text{O sync}}$ (W)*</th>
<th>$G_p$ (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>860</td>
<td>25</td>
<td>850</td>
<td>70</td>
<td>-60</td>
<td>&gt;3,5</td>
<td>&gt;6,5</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>850</td>
<td>70</td>
<td>-60</td>
<td>typ. 3,8</td>
<td>typ. 7</td>
</tr>
<tr>
<td>860</td>
<td>25</td>
<td>850</td>
<td>25</td>
<td>-60</td>
<td>typ. 4,4</td>
<td>typ. 7</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

![Test circuit](image)

Fig. 6 Test circuit at $f_{\text{vision}} = 860$ MHz.

List of components (see also page 6):

- **C1** = C2 = 1,4 to 5,5 pF film dielectric trimmers (cat. no. 2222 809 09001)
- **C3** = C4 = 100 nF polyester capacitors
- **C5** = C6 = 1 nF feed-through capacitors
- **C7** = 5,6 pF ceramic capacitor
- **C8** = 2 to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- **C9** = 2 to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- **C10** = 10 µF/40 V solid aluminium electrolytic capacitor
- **C11** = 470 nF polyester capacitor
- **C12** = 2 x 3,3 pF chip capacitors (in parallel)
APPLICATION INFORMATION (continued)

List of components (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>150 Ω carbon resistor (0.25 W)</td>
</tr>
<tr>
<td>R2</td>
<td>1.8 kΩ carbon resistor (0.5 W)</td>
</tr>
<tr>
<td>R3</td>
<td>33 Ω carbon resistor (0.5 W)</td>
</tr>
<tr>
<td>R4</td>
<td>220 Ω carbon resistor (1 W)</td>
</tr>
<tr>
<td>R5</td>
<td>4 x 12 Ω carbon resistors in parallel (1 W each)</td>
</tr>
<tr>
<td>R6</td>
<td>1 kΩ carbon resistor (0.25 W)</td>
</tr>
<tr>
<td>R7</td>
<td>220 Ω carbon potentiometer (0.25 W)</td>
</tr>
<tr>
<td>L1</td>
<td>stripline (13.6 mm x 6.9 mm)</td>
</tr>
<tr>
<td>L2</td>
<td>microchoke 0.47 µH (cat. no. 4322 057 04770)</td>
</tr>
<tr>
<td>L3</td>
<td>1 turn Cu wire (1 mm); internal diameter 5.5 mm; leads 2 x 5 mm</td>
</tr>
<tr>
<td>L4</td>
<td>stripline (40.8 mm x 6.9 mm)</td>
</tr>
<tr>
<td>L1 and L4</td>
<td>striplines on a double Cu-clad printed-circuit board with PTFE fibre-glass dielectric (εr = 2.74); thickness 1.5 mm</td>
</tr>
</tbody>
</table>

Note
Hole in printed-circuit board: φ 9.7 mm.

Fig. 7 Component layout and printed-circuit board for 860 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
Information for wide-band application from 470 to 860 MHz available on request.
Fig. 9 Input impedance (series components) as a function of frequency.

Fig. 10 Load impedance (parallel components) as a function of frequency.

Fig. 11 Power gain as a function of frequency.

Conditions for Figs 9, 10 and 11

$V_{CE} = 25 \, V; \, I_C = 850 \, mA; \, \text{typical values.}$
H.F./V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for s.s.b. in class-A and AB and in f.m. transmitting applications in class-C with a supply voltage up to 28 V. The transistor is resistance stabilized and tested under severe load mismatch conditions. It has a ½” capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of Operation</th>
<th>( V_{CE} ) V</th>
<th>( f_1 ) MHz</th>
<th>( f_2 ) MHz</th>
<th>( P_L ) W</th>
<th>( G_D ) dB</th>
<th>( d_3 ) dB</th>
<th>( I_C ) A</th>
<th>( \eta_{dt} ) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-A)</td>
<td>26</td>
<td>28,000</td>
<td>28,001</td>
<td>0-8 (P.E.P.)</td>
<td>&gt; 18</td>
<td>&lt; -40</td>
<td>&lt; 1,2</td>
<td>-</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>28,000</td>
<td>28,001</td>
<td>25 (P.E.P.)</td>
<td>&gt; 18</td>
<td>typ. -35</td>
<td>typ. 1,28</td>
<td>typ. 35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of Operation</th>
<th>( V_{CE} ) V</th>
<th>( f ) MHz</th>
<th>( P_S ) W</th>
<th>( P_L ) W</th>
<th>( G_D ) dB</th>
<th>( I_C ) A</th>
<th>( \eta ) %</th>
<th>( Z_j ) Ω</th>
<th>( V_L ) mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.W. (class-B)</td>
<td>28</td>
<td>70</td>
<td>typ. 0,5</td>
<td>25</td>
<td>typ. 17</td>
<td>typ. 1,49</td>
<td>typ. 60</td>
<td>0,53 - j1,4</td>
<td>42,5 - j54</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-56.

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 1,5 Nm
(15 kg cm)
max. 1,7 Nm
(17 kg cm)

Diameter of clearance hole in heatsink: max. 5,0 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter) peak value  \( V_{CBOM} \) max. 65 V
Collector-emitter voltage (open base)  \( V_{CEO} \) max. 36 V
Emitter-base voltage (open collector)  \( V_{EBO} \) max. 4.0 V

Currents

Collector current (average)  \( I_{C(AV)} \) max. 3.0 A
Collector current (peak value) \( f > 1 \text{ MHz} \)  \( I_{CM} \) max. 6 A

Power dissipation

Total power dissipation up to \( T_h = 25 \, ^\circ\text{C} \)  \( f > 1 \text{ MHz} \)

\[
\begin{array}{c|c|c}
V_{CE} (V) & I_C (A) & P_{tot} (W) \\
\hline
25 & 5 & 75 \\
50 & 4 & 70 \\
75 & 3 & 65 \\
100 & 2 & 60 \\
200 & 1 & 55 \\
\end{array}
\]

Temperature

Storage temperature  \( T_{stg} \) -30 to +200 \, ^\circ\text{C}
Operating junction temperature  \( T_j \) max. 200 \, ^\circ\text{C}

THERMAL RESISTANCE

From junction to mounting base  \( R_{th \, j-mb} = 2.5 \, ^\circ\text{C/W} \)
From mounting base to heatsink  \( R_{th \, mb-h} = 0.3 \, ^\circ\text{C/W} \)
## CHARACTERISTICS

$T_j = 25\, ^\circ\text{C}$ unless otherwise specified

### Breakdown voltages

**Collector-base voltage**
- open emitter; $I_C = 50\, \text{mA}$
  - $V_{(BR)CBO} > 65\, \text{V}$

**Collector-emitter voltage**
- open base; $I_C = 50\, \text{mA}$
  - $V_{(BR)CEO} > 36\, \text{V}$

**Emitter-base voltage**
- open collector; $I_E = 10\, \text{mA}$
  - $V_{(BR)EBO} > 4.0\, \text{V}$

### Transient energy

$L = 25\, \text{mH}; f = 50\, \text{Hz}$
- open base
  - $E > 8\, \text{mWs}$
  - $-V_{BE} = 1.5\, \text{V}; R_{BE} = 33\, \Omega$
  - $E > 8\, \text{mWs}$

### D.C. current gain

$I_C = 1.0\, \text{A}; V_{CE} = 5\, \text{V}$

$h_{FE}$
- typ. $50$
- $10$ to $100$

### Transition frequency

$I_C = 3.0\, \text{A}; V_{CE} = 20\, \text{V}$

$f_T$
- typ. $500\, \text{MHz}$

### Collector capacitance at $f = 1\, \text{MHz}$

$I_E = I_e = 0; V_{CB} = 30\, \text{V}$

$C_C$
- typ. $50\, \text{pF}$
- $< 65\, \text{pF}$

### Feedback capacitance

$I_C = 100\, \text{mA}; V_{CE} = 30\, \text{V}$

$C_{re}$
- typ. $31\, \text{pF}$

### Collector-stud capacitance

$C_{cs}$
- typ. $2\, \text{pF}$

---

May 1971
V<sub>CE</sub> = 20V

**Top Graph:**
- Parameter: $f_t$ (MHz)
- X-axis: $I_C$ (A)
- Y-axis: $f_t$ (MHz)
- Typical curve

**Bottom Graph:**
- Parameter: $C_C$ (pF)
- X-axis: $V_{CB}$ (V)
- Y-axis: $C_C$ (pF)
- Typical curve

- $I_E = I_C = 0$
- $f = 1$ MHz

Date: May 1971
VCE = 28V
T junction = 25°C

VBE (V)

Ic (A)

May 1971
APPLICATION INFORMATION

R.F. performance in S.S.B. operation (linear power amplifier)

\[ V_{CE} = 26 \text{ V}; \ T_h \text{ up to 25 }^\circ\text{C} \]
\[ f_1 = 28.000 \text{ MHz}; \ f_2 = 28.001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power (W)</th>
<th>( G_p ) (dB)</th>
<th>( d_3 ) (dB)</th>
<th>( I_C ) (A)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8 (PEP)</td>
<td>&gt; 18</td>
<td>&lt; -40</td>
<td>&lt; 1.2</td>
<td>A</td>
</tr>
</tbody>
</table>

Test circuit:

**S.S.B. class A**

![Circuit Diagram](image)

L1 = 3 turns enameled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 7 mm leads 50 mm totally
L2 = 7 turns enameled Cu wire (0.7 mm) on 3H1 toroid; 60 \( \mu \text{H} \)
(code number of 3H1: 4322 020 36620)
L3 = 4 turns enameled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 10 mm
L4 = 7 turns enameled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 12 mm

---

Detailed information for a wide band application
1.6 to 28 MHz available on request

---

1) Stated figures are maxima encountered at any driving level between the specified values of PEP and are referred to the according level of either of the equal ampl. tones. Relative to the according peak envelope power these figures should be increased by 6 dB.
$V_{CE} = 26V$
$T_h = 70^\circ C$
$R_{th mb-h} = 0.3^\circ C/W$
$I_C = 0.8A - 1.0A - 1.2A$
APPLICATION INFORMATION

R.F. performance in S.S.B. operation (linear power amplifier)

\[ V_{CC} = 28 \text{ V}; T_h \text{ up to } 25 \text{ °C} \]
\[ f_1 = 28.000 \text{ MHz}; f_2 = 28.001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power (W)</th>
<th>( G_p ) (dB)</th>
<th>( \text{dt} ) (%)</th>
<th>( d_3 ) (dB) (^1)</th>
<th>ICZS (mA)</th>
<th>IC (A)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 PEP</td>
<td>&gt; 18</td>
<td>typ. 35</td>
<td>typ. -35</td>
<td>25</td>
<td>typ. 1.28</td>
<td>AB</td>
</tr>
</tbody>
</table>

Test circuit:

**S.S.B. class AB**

\( D1 = AYY10/120 \)
\( L1 = 3 \text{ turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 7 mm leads 50 mm totally} \)
\( L2 = 7 \text{ turns enamelled Cu wire (0.7 mm) on 3H1 toroid; 60 \mu H} \)
\( \text{ (code number of 3H1: 4322 020 36620)} \)
\( L3 = 4 \text{ turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 10 mm} \)
\( L4 = 7 \text{ turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 12 mm} \)

\(^1\) Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
Conditions:

- $P_L = 25$ W PEP
- $V_{CC} = 28$ V
- $I_{CZS} = 25$ mA
- $Z_L = 12.5 \, \Omega$
- $T_h = 25 \, ^\circ C$
Conditions:

- $P_L = 25 \text{ W PEP}$
- $V_{CC} = 28 \text{ V}$
- $I_{CZS} = 25 \text{ mA}$
- $Z_L = 12.5 \Omega$
- $T_h = 25 \degree \text{C}$
APPLICATION INFORMATION

R.F. performance in c.w. operation (class B)

\[ V_{CC} = 28 \text{ V}; T_h \text{ up to } 25^\circ \text{C} \]

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>I_C (A)</th>
<th>( G_D ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( z_1 ) (Ω)</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>typ. 0.5</td>
<td>25</td>
<td>typ. 1.49</td>
<td>typ. 17</td>
<td>typ. 60</td>
<td>0.53-j1.4</td>
<td>42.5-j54</td>
</tr>
</tbody>
</table>

Test circuit:

C.W. class B

```
L1 = 93 nH; 3 turns enamelled Cu wire (1.5 mm); int. diam. 10 mm; length 8 mm; leads 2 x 5 mm
L2 = 147 nH; 5 turns enamelled Cu wire (1.5 mm); int. diam. 9 mm; length 14 mm; leads 2 x 5 mm
L3 = 118 nH; 4 turns enamelled Cu wire (1.5 mm); int. diam. 9 mm; length 10.5 mm; leads 2 x 5 mm
L4 = FXC choke (code number 4312 020 36640)
```
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heatsink temperature as parameter.
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor for use in transmitting amplifiers operating in the h.f. and v.h.f. bands, with a nominal supply voltage of 28 V. The transistor is specified for s.s.b. applications as linear amplifier in class-A and AB. The device is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

Matched $h_{FE}$ groups are available on request.

It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta_{dt}$</th>
<th>$I_C$ A</th>
<th>$d_3$ dB</th>
<th>$T_h$ °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-A)</td>
<td>26</td>
<td>1.6–28</td>
<td>0–8 (P.E.P.)</td>
<td>&gt; 20</td>
<td>–</td>
<td>1.25</td>
<td>&lt; -40</td>
<td>70</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>1.6–28</td>
<td>3–25 (P.E.P.)</td>
<td>typ. 21</td>
<td>typ. 45</td>
<td>typ. 1.0</td>
<td>typ. -30</td>
<td>25</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Dimensions in mm

<table>
<thead>
<tr>
<th>Torque on nut: min. 0.75 Nm (7.5 kg cm)</th>
<th>max. 0.85 Nm (8.5 kg cm)</th>
<th>Diameter of clearance hole in heatsink: max. 4.2 mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting hole to have no burrs at either end.</td>
<td>De-burring must leave surface flat; do not chamfer or countersink either end of hole.</td>
<td></td>
</tr>
</tbody>
</table>

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \((V_{BE} = 0)\)
  peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open-collector)

Collector current (average)

Collector current (peak value); \(f > 1\) MHz

R.F. power dissipation \((f > 1\) MHz\); \(T_{mb} = 25\) °C

Storage temperature

Operating junction temperature

\[
\begin{align*}
V_{CESM} & \quad \text{max.} \quad 65 \text{ V} \\
V_{CEO} & \quad \text{max.} \quad 36 \text{ V} \\
V_{EBO} & \quad \text{max.} \quad 4 \text{ V} \\
I_{C(AV)} & \quad \text{max.} \quad 3 \text{ A} \\
I_{CM} & \quad \text{max.} \quad 9 \text{ A} \\
P_{rf} & \quad \text{max.} \quad 73 \text{ W} \\
T_{stg} & \quad -65 \text{ to } +150 \text{ °C} \\
T_{j} & \quad \text{max.} \quad 200 \text{ °C}
\end{align*}
\]

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; \(V_{CE} \leq 28\) V;
\(f > 1\) MHz.

I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operating during mismatch

THERMAL RESISTANCE (dissipation = 32,5 W; \(T_{mb} = 85\) °C, i.e. \(T_{h} = 70\) °C)

From junction to mounting base (d.c. dissipation)
\[
R_{th\ j-mb(dc)} = 3,55 \text{ °C/W}
\]

From junction to mounting base (r.f. dissipation)
\[
R_{th\ j-mb(rf)} = 2,65 \text{ °C/W}
\]

From mounting base to heatsink
\[
R_{th\ mb-h} = 0,45 \text{ °C/W}
\]
CHARACTERISTICS

$T_j = 25 \, ^\circ\text{C}$ unless otherwise specified

Collector-emitter breakdown voltage

$V_{BE} = 0; \, I_C = 10 \, \text{mA}$

Collector-emitter breakdown voltage

open base; $I_C = 50 \, \text{mA}$

Emitter-base breakdown voltage

open collector; $I_E = 10 \, \text{mA}$

Collector cut-off current

$V_{BE} = 0; \, V_{CE} = 36 \, \text{V}$

Second breakdown energy; $L = 25 \, \text{mH}; \, f = 50 \, \text{Hz}$

open base

$R_{BE} = 10 \, \Omega$

D.C. current gain *

$I_C = 1,25 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

D.C. current gain ratio of matched devices *

$I_C = 1,25 \, \text{A}; \, V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage *

$I_C = 3,75 \, \text{A}; \, I_B = 0,75 \, \text{A}$

Transition frequency at $f = 100 \, \text{MHz}$ *

$-I_E = 1,25 \, \text{A}; \, V_{CB} = 28 \, \text{V}$

$-I_E = 3,75 \, \text{A}; \, V_{CB} = 28 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$

$I_E = I_b = 0; \, V_{CB} = 28 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$

$I_C = 100 \, \text{mA}; \, V_{CE} = 28 \, \text{V}$

Collector-stud capacitance

$V_{(BR)CES} > 65 \, \text{V}$

$V_{(BR)CEO} > 36 \, \text{V}$

$V_{(BR)EBO} > 4 \, \text{V}$

$I_{CES} < 4 \, \text{mA}$

$E_{SB0} > 8 \, \text{mJ}$

$E_{SBR} > 8 \, \text{mJ}$

$h_{FE} \text{ typ.} = 50$

$10 \text{ to } 100$

$h_{FE1}/h_{FE2} < 1,2$

$V_{CEsat} \text{ typ.} = 1,5 \, \text{V}$

$f_T \text{ typ.} = 530 \, \text{MHz}$

$f_T \text{ typ.} = 530 \, \text{MHz}$

$C_c \text{ typ.} = 50 \, \text{pF}$

$C_{re} \text{ typ.} = 31 \, \text{pF}$

$C_{cs} \text{ typ.} = 2 \, \text{pF}$

Fig. 4 Typical values; $V_{CE} = 28 \, \text{V}$.

* Measured under pulse conditions: $t_p < 200 \, \mu\text{s}; \, \delta < 0,02$. 

July 1978
Fig. 5 Typical values; $T_j = 25 \degree C$.

Fig. 6 $I_E = I_e = 0; f = 1 \text{ MHz}; T_j = 25 \degree C$.

Fig. 7 Typical values; $f = 100 \text{ MHz}; T_j = 25 \degree C$. 

July 1978
APPLICATION INFORMATION

R.F. performance in s.s.b. class-A operation (linear power amplifier)

\[ V_{CE} = 26 \, \text{V}; \quad f_1 = 28,000 \, \text{MHz}; \quad f_2 = 28,001 \, \text{MHz} \]

<table>
<thead>
<tr>
<th>output power ( W )</th>
<th>( G_p ) dB</th>
<th>( I_c ) A</th>
<th>( d_3 ) dB*</th>
<th>( d_5 ) dB*</th>
<th>( T_h ) ( ^\circ \text{C} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 8 (P.E.P.)</td>
<td>&gt; 20</td>
<td>1.25</td>
<td>-40</td>
<td>&lt; -40</td>
<td>70</td>
</tr>
<tr>
<td>typ. 10 (P.E.P.)</td>
<td>typ. 24</td>
<td>1.25</td>
<td>-40</td>
<td>&lt; -40</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 8 Test circuit; s.s.b. class-A.

List of components on page 6.

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
List of components in Fig. 8:

C1 = C2 = 10 to 780 pF film dielectric trimmer
C3 = 22 nF ceramic capacitor (63 V)
C4 = 47 µF/10 V electrolytic capacitor
C5 = 56 pF ceramic capacitor (500 V)
C6 = 47 µF/35 V electrolytic capacitor
C7 = C8 = 220 nF polyester capacitor
C9 = 10 µF/35 V electrolytic capacitor
C10 = 10 to 210 pF film dielectric trimmer
C11 = 15 to 575 film dielectric trimmer

L1 = 3 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
L2 = L3 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 11 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 11,0 mm
L5 = 14 turns closely enamelled Cu wire (1,6 mm); int. dia. 11,0 mm

R1 = 600 Ω; parallel connection of 2 x 1,2 kΩ carbon resistors (± 5%; 0,5 W each)
R2 = 15 Ω carbon resistor (± 5%; 0,25 W)
R3 = 1,2 Ω parallel connection of 4 x 4,7 Ω carbon resistors (± 5%; 0,125 W each)
R4 = 33 Ω carbon resistor (± 5%; 0,25 W)
R5 = 18 Ω carbon resistor (± 5%; 0,25 W)
R6 = 120 Ω wirewound resistor (± 5%; 5,5 W)
R7 = 1 Ω carbon resistor (± 5%; 0,125 W)
R8 = 47 Ω wirewound potentiometer (3 W)
R9 = 1,57 Ω; parallel connection of 3 x 4,7 Ω wirewound resistors (± 5%; 5,5 W each)

Fig. 9 Intermodulation distortion as a function of output power. Typical values; VCE = 26 V; f1 = 28,000 MHz; f2 = 28,001 MHz; Th = 70 °C; — — — Th = 25 °C.
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

\[ V_{CE} = 28 \text{ V}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power</th>
<th>( G_p ) dB</th>
<th>( \eta_{dt} (%) ) at 25 W P.E.P.</th>
<th>( I_C ) (A)</th>
<th>( d_3 ) dB*</th>
<th>( d_5 ) dB*</th>
<th>( I_C(ZS) ) mA</th>
<th>( T_h ) °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 25 (P.E.P.)</td>
<td>typ. 21</td>
<td>typ. 45</td>
<td>typ. 1,0</td>
<td>typ. −30</td>
<td>&lt;−30</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>3 to 22 (P.E.P.)</td>
<td>typ. 21</td>
<td>−</td>
<td>−</td>
<td>typ. −30</td>
<td>&lt;−30</td>
<td>25</td>
<td>70</td>
</tr>
</tbody>
</table>

List of components:

- \( C_1 = C_2 = 10 \) to 780 \( \mu \)F film dielectric trimmer
- \( C_3 = C_5 = C_6 = 220 \) nF polyester capacitor
- \( C_4 = 56 \) pF ceramic capacitor (500 V)
- \( C_7 = C_8 = 15 \) to 575 \( \mu \)F film dielectric trimmer

- \( L_1 = 4 \) turns closely wound enamelled Cu wire (1,6 mm); int. dia. 7,0 mm; leads 2 x 5 mm
- \( L_2 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L_3 = 4 \) turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 9,4 mm; leads 2 x 5 mm
- \( L_4 = 7 \) turns enamelled Cu wire (1,6 mm); int. dia. 12 mm; length 17,2 mm; leads 2 x 5 mm

- \( R_1 = 1,2 \Omega \); parallel connection of 4 x 4,7 \( \Omega \) carbon resistors
- \( R_2 = 39 \Omega \) carbon resistor

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
Fig. 11  Intermodulation distortion as a function of output power. *

Conditions for Fig. 11:
$V_{CE} = 28 \, \text{V}; I_{C(ZS)} = 25 \, \text{mA}; f_1 = 28,000 \, \text{MHz}; f_2 = 28,001 \, \text{MHz}$; typical values.

Fig. 12  Double-tone efficiency and power gain as a function of output power.

Conditions for Fig. 12:
$V_{CE} = 28 \, \text{V}; I_{C(ZS)} = 25 \, \text{mA}; f_1 = 28,000 \, \text{MHz}; f_2 = 28,001 \, \text{MHz}; T_h = 25 \, ^\circ\text{C}$; typical values.

* See note on page 7.
Fig. 13 Power gain as a function of frequency.

Fig. 14 Input impedance (series components) as a function of frequency.

Figs 13 and 14 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
\[ V_{CE} = 28 \text{ V; } I_{C(ZS)} = 25 \text{ mA; } P_L = 25 \text{ W; } T_h = 25 \text{ °C; } Z_L = 12 \Omega. \]

Ruggedness in s.s.b. operation

The BLX13C is capable of withstanding a load mismatch (VSWR = 50) under the following conditions:
\[ f_1 = 28,000 \text{ MHz; } f_2 = 28,001 \text{ MHz; } V_{CE} = 28 \text{ V; } T_h = 70 \text{ °C and } P_{L_{nom}} = 30 \text{ W (P.E.P.).} \]
H.F./V.H.F. POWER TRANSISTOR

Silicon n-p-n power transistor for use in industrial and military s.s.b. and c.w. equipment operating in the h.f. and v.h.f. band:

- rated for 50 W P.E.P. at 1,6 MHz to 28 MHz (intermodulation distortion better than 30 dB down); full load mismatch permissible at stud temperatures up to 70 °C
- rated at 50 W for frequencies up to 70 MHz in c.w. operation
- supply voltage 28 V
- plastic stripline package

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$d_3$ dB</th>
<th>$I_C(ZS)$ A</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-A)</td>
<td>28</td>
<td>1,6 to 28</td>
<td>15 (P.E.P.)</td>
<td>&gt; 13</td>
<td>typ. -40</td>
<td>2,0</td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>1,6 to 28</td>
<td>7,5-50 (P.E.P.)</td>
<td>&gt; 13</td>
<td>&lt; -30</td>
<td>0,1</td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>70</td>
<td>50</td>
<td>&gt; 7,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>30</td>
<td>50</td>
<td>typ. 16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-55.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 2,3 Nm  
(23 kg cm)  
max. 2,7 Nm  
(27 kg cm)

Diameter of clearance hole in heatsink: max. 6,5 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134)

**Voltages**
- Collector-base voltage (open emitter) peak value
- Collector-emitter voltage ($R_{BE} = 10 \Omega$) peak value
- Collector-emitter voltage (open base)
- Emitter-base voltage (open collector)

**Currents**
- Collector current (average)
- Collector current (peak value) $f > 1 \text{ MHz}$

**Power dissipation**
- Total power dissipation up to $T_h = 25 \text{ °C}$ $f > 1 \text{ MHz}$

**Temperature**
- Storage temperature
- Operating junction temperature

**THERMAL RESISTANCE**
- From junction to mounting base
- From mounting base to heatsink

---

### Graphs

- **Power Dissipation Graph**
- **Temperature vs. Power Dissipation**
- **Collector Current vs. Collector Voltage**

---

### Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CBOM}$</td>
<td>max. 85 V</td>
</tr>
<tr>
<td>$V_{CERM}$</td>
<td>max. 85 V</td>
</tr>
<tr>
<td>$V_{CEO}$</td>
<td>max. 36 V</td>
</tr>
<tr>
<td>$V_{EBO}$</td>
<td>max. 4.0 V</td>
</tr>
<tr>
<td>$I_{CAV}$</td>
<td>max. 4.0 A</td>
</tr>
<tr>
<td>$I_{CM}$</td>
<td>max. 12 A</td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>max. 88 W</td>
</tr>
</tbody>
</table>

---

### Formulas

- $R_{th \ j-mb} = 1.8 \text{ °C/W}$
- $R_{th \ mb-h} = 0.2 \text{ °C/W}$

---

May 1971
**CHARACTERISTICS**

**Breakdown voltages**

- Collector-base voltage
  - open emitter; $I_C = 25 \text{ mA}$
  - Collector-emitter voltage
    - $R_{BE} = 10 \Omega$; $I_C = 25 \text{ mA}$
  - Collector-emitter voltage
    - open base; $I_C = 50 \text{ mA}$
- Emitter-base voltage
  - open collector; $I_E = 10 \text{ mA}$

**Collector-emitter saturation voltage**

- $I_C = 0.7 \text{ A}; I_B = 0.14 \text{ A}$

**Transient energy**

- $L = 25 \text{ mH}; f = 50 \text{ Hz}$
  - open base
  - $-V_{BE} = 1.5 \text{ V}; R_{BE} = 33 \Omega$

**D.C. current gain**

- $I_C = 1.4 \text{ A}; V_{CE} = 6 \text{ V}$

**Transition frequency**

- $I_C = 3.0 \text{ A}; V_{CE} = 10 \text{ V}$

**Collector capacitance at f = 1 MHz**

- $I_E = I_e = 0; V_{CB} = 30 \text{ V}$

**Feedback capacitance at f = 1 MHz**

- $I_C = 100 \text{ mA}; V_{CE} = 30 \text{ V}$

**Collector-stud capacitance**

- $I_C = 100 \text{ mA}; V_{CE} = 30 \text{ V}$

---

$T_j = 25 \degree C$ unless otherwise specified

$V_{(BR)CBO} > 85 \text{ V}$

$V_{(BR)CER} > 85 \text{ V}$

$V_{(BR)CEO} > 36 \text{ V}$

$V_{(BR)EBO} > 4.0 \text{ V}$

$V_{CE_{sat}} < 1.0 \text{ V}$

$h_{FE} 15 \text{ to } 100$

$f_T \text{ typ. } 250 \text{ MHz}$

$C_{c} \text{ typ. } 115 \text{ pF}$

$C_{re} \text{ typ. } 90 \text{ pF}$

$C_{cs} \text{ typ. } 3.5 \text{ pF}$
APPLICATION INFORMATION

R.F. performance in S.S.B. operation (linear power amplifier)

\[ V_{CC} = 28 \, \text{V}; \, T_h \text{ up to } 25 \, ^\circ\text{C} \]

\[ f_1 = 28.000 \, \text{MHz}; \, f_2 = 28.001 \, \text{MHz} \]

<table>
<thead>
<tr>
<th>output power (W)</th>
<th>( G_B ) (dB)</th>
<th>( \eta_{dt} ) (%)</th>
<th>( d_3 ) (dB)</th>
<th>( d_5 ) (dB)</th>
<th>( I_{CZS} ) (A)</th>
<th>( I_C ) (A)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5 to 50 (PEP)</td>
<td>&gt;13</td>
<td>&gt;35</td>
<td>&lt; -30</td>
<td>&lt; -30</td>
<td>0.1</td>
<td>&lt;2.55</td>
<td>AB</td>
</tr>
</tbody>
</table>

At temperatures up to 90 °C the output power relative to that at 25 °C is diminished by a factor -40 mW/°C

The transistor is designed to withstand a full load mismatch operating under 50 W PEP at \( V_{CC} = 28 \, \text{V} \) and \( T_h = 70 \, ^\circ\text{C} \)

Test circuit:

**S.S.B. class A-B**

![Test Circuit Diagram]

D1 = AYY10/120

\( L_1 = 3 \) turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 7 mm leads 50 mm totally

\( L_2 = 7 \) turns enamelled Cu wire (0.7 mm) on 3H1 toroid; 60 \( \mu \text{H} \)

(code number of 3H1: 4322 020 36620)

\( L_3 = 4 \) turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 10 mm

\( L_4 = 7 \) turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; int. diam. 12 mm

---

1) Stated figures are maxima encountered at any driving level between the specified values of PEP and are referred to the according level of either of the equal ampl. tones. Relative to the according peak envelope power these figures should be increased by 6 dB.
typical values
V_{CC} = 28V
f_1 = 28.000 MHz
f_2 = 28.001 MHz
T_h = 25°C
I_{CZS} = 100 mA

V_{CC} = 28V
f_1 = 28.000 MHz
f_2 = 28.001 MHz
I_{CZS} = 0.1 A
T_h = 25°C

typical values
f_1 = 28.000 MHz
f_2 = 28.001 MHz
I_{CZS} = 0.1 A
V_{CC} = 28V

P.E.P. (W)

P.E.P.
S.S.B. class AB operation

\[
\begin{align*}
P_L &= 50 \text{ W PEP} \\
V_{CC} &= 28 \text{ V} \\
I_C &= 100 \text{ mA} \\
Z_L &= 6.25 \Omega \\
T_h &= 25 \degree \text{C}
\end{align*}
\]

The drawn curve holds for an unneutralized amplifier.

The dashed curve holds for a push-pull amplifier with cross neutralization.

Collector-base neutralizing capacitor: 82 pF
S.S.B. class AB operation

\[ P_L = 50 \text{ W PEP} \]
\[ V_{CC} = 28 \text{ V} \]
\[ I_C = 100 \text{ mA} \]
\[ Z_L = 6.25 \text{ }\]
\[ T_h = 25 \text{ }\]

The upper graph holds for a push-pull amplifier with cross neutralization. Collector-base neutralizing capacitor: 82 pF

The lower graph holds for an unneutralized amplifier.
APPLICATION INFORMATION (continued)

R.F. performance in s.s.b. operation (linear power amplifier)

V_{CC} = 28 V; T_{h} up to 25 °C
f_{1} = 28,000 MHz; f_{2} = 28,001 MHz

<table>
<thead>
<tr>
<th>output power (W)</th>
<th>( G_{p} ) (dB)</th>
<th>( d_{3} ) (dB)</th>
<th>( d_{5} ) (dB)</th>
<th>( I_{C} ) (A)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 PEP</td>
<td>&gt; 13</td>
<td>typ. -40</td>
<td>typ. -45</td>
<td>2.0</td>
<td>A</td>
</tr>
</tbody>
</table>

Test circuit:

S.S.B. class-A

L1 = 3 turns enamelled Cu wire (1,5 mm); winding pitch 2,5 mm; int. dia. 7 mm leads 50 mm totally
L2 = 7 turns enamelled Cu wire (0,7 mm) on 3H1 toroid; 60 \( \mu \)H (code number of 3H1: 4322 020 36620)
L3 = 4 turns enamelled Cu wire (1,5 mm); winding pitch 2,5 mm; int. dia. 10 mm
L4 = 7 turns enamelled Cu wire (1,5 mm); winding pitch 2,5 mm; int. dia. 12 mm

---

June 1976
APPLICATION INFORMATION

R.F. performance in c.w. operation (class B)

VCC = 28 V; TH up to 25 °C

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>PS (W)</th>
<th>PL (W)</th>
<th>IC (A)</th>
<th>Gp (dB)</th>
<th>(%)</th>
<th>Z1 (Ω)</th>
<th>YL (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>&lt; 8.9</td>
<td>50</td>
<td>&lt; 3.25</td>
<td>&gt; 7.5</td>
<td>55</td>
<td>1.0+j0.2</td>
<td>120-j75</td>
</tr>
<tr>
<td>50</td>
<td>typ. 4</td>
<td>50</td>
<td>typ. 3.25</td>
<td>typ. 11</td>
<td>typ. 55</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30</td>
<td>typ. 1.2</td>
<td>50</td>
<td>typ. 3.25</td>
<td>typ. 16</td>
<td>typ. 55</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

At temperatures up to 90 °C the output power relative to that at 25 °C is diminished by a factor -40 mW/°C.

Test circuit:

C.W.
70 MHz

L1 = 60 mm straight enamelled Cu wire (1.5 mm); 9 mm above chassis
L2 = FXC choke coil (code number 4322 020 36640)
L3 = 2 turns enamelled Cu wire (1.5 mm); winding pitch 2 mm; internal diam. 10 mm; leads 55 mm totally
L4 = 3 turns enamelled Cu wire (1.5 mm); winding pitch 2.5 mm; internal diam. 10 mm; leads 50 mm totally
APPLICATION INFORMATION (continued)

Test circuit:

- **L1 = 1 turn** enamelled Cu wire (1.5 mm); int. diam. 10 mm; leads 40 mm totally
- **L2 = 4 turns** enamelled Cu wire (1.5 mm); int. diam. 12 mm; leads 40 mm totally winding pitch 2 mm
- **L3 = FXC choke coil** (code number 4322 020 36640)
- **L4 = 3 turns** enamelled Cu wire (1.5 mm); int. diam. 10 mm; leads 40 mm totally winding pitch 2 mm

![Diagram](image-url)
APPLICATION INFORMATION (continued)

Test circuit:

C.W.
30 MHz

L1 = 2 turns enameled Cu wire (1.5 mm); winding pitch 2 mm; int. diam. 10 mm leads 60 mm totally
L2 = 7 turns enameled Cu wire (0.7 mm) on 3H1 toroid; 60 μH
(code number of 3H1: 4322 020 36620)
L3 = 4 turns enameled Cu wire (1.5 mm); winding pitch 2 mm; int. diam. 10 mm leads 50 mm totally
L4 = 6 turns enameled Cu wire (1.5 mm); winding pitch 2 mm; int. diam. 12 mm leads 50 mm totally
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heatsink temperature as parameter.
OPERATING NOTE  Below 50 MHz a base-emitter resistor of 6.8 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

- Power gain versus frequency (class B operation)
  - VCC = 28 V
  - PL = 50 W
  - Th = 25 °C
  - typ. values

- Input impedance (series components) versus frequency (class B operation)
  - VCC = 28 V
  - PL = 50 W
  - Th = 25 °C
  - typ. values

- Load impedance (parallel components) versus frequency (class B operation)
  - VCC = 28 V
  - PL = 50 W
  - Th = 25 °C
  - typ. values
H.F./V.H.F. POWER TRANSISTOR

Silicon n-p-n power transistor for use in industrial and military s.s.b. and c.w. equipment operating in the h.f. and v.h.f. band:

- rated for 150 W P.E.P. at 1,6 MHz to 28 MHz (intermodulation distortion better than 30 dB down)
- rated at 150 W output power for frequencies up to 108 MHz in c.w. operation
- supply voltage up to 50 V
- plastic encapsulated stripline package
- delivered in matched hFE groups

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>VCE V</th>
<th>f MHz</th>
<th>PL W</th>
<th>GP dB</th>
<th>d3 dB</th>
<th>IC(ZS) A</th>
</tr>
</thead>
<tbody>
<tr>
<td>s.s.b. (class-AB)</td>
<td>50</td>
<td>1,6 to 28</td>
<td>20 to 150 (P.E.P.)</td>
<td>&gt; 14</td>
<td>&lt; -30</td>
<td>0,10</td>
</tr>
<tr>
<td>s.s.b. (class-A)</td>
<td>40</td>
<td>1,6 to 28</td>
<td>typ. 30 (P.E.P.)</td>
<td>&gt; 14</td>
<td>&lt; -40</td>
<td>2,5</td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>50</td>
<td>70</td>
<td>150</td>
<td>&gt; 10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w. (class-B)</td>
<td>50</td>
<td>108</td>
<td>150</td>
<td>typ. 7,5</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-55.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 2,3 Nm
(23 kg cm)
max. 2,7 Nm
(27 kg cm)

Diameter of clearance hole in heatsink: max. 6,5 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

- Collector-base voltage (open emitter) peak value
  - VCBOM max. 110 V

- Collector-emitter voltage (RBE = 10Ω) peak value
  - VCERM max. 110 V

- Collector-emitter voltage (open base)

- Emitter-base voltage (open collector)

Currents

- Collector current (average)
  - IC(AV) max. 6.5 A

- Collector current (peak value) f > 1 MHz
  - IC(M) max. 20 A

Power dissipation

Temperatures

- Storage temperature
  - Tstg -65 to +200 °C

- Junction temperature
  - Tj max. 200 °C

THERMAL RESISTANCE

- From junction to mounting base
  - Rth j-mb = 0.75 °C/W

- From mounting base to heatsink
  - Rth mb-h = 0.15 °C/W

August 1973
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter ; \( I_C = 100 \text{ mA} \)

Collector-emitter voltage
\( R_{BE} = 5 \Omega \) ; \( I_C = 100 \text{ mA} \)

Collector-emitter voltage
open base ; \( I_C = 100 \text{ mA} \)

Emitter-base voltage
open collector; \( I_E = 20 \text{ mA} \)

\( V_{(BR)CBO} > 110 \text{ V} \)

\( V_{(BR)CER} > 110 \text{ V} \)

\( V_{(BR)CEO} > 53 \text{ V} \)

\( V_{(BR)EBO} > 4.0 \text{ V} \)

Transient energy
\( L = 25 \text{ mH}; f = 50 \text{ Hz} \)

\( V_{(BR)}EBO \)

\( E > 12,5 \text{ mWs} \)

D.C. current gain
\( I_C = 1,4 \text{ A} ; V_{CE} = 6 \text{ V} \)

\( h_{FE} \)

15 to 50

D.C. current gain ratio of matched devices
\( I_C = 1,4 \text{ A} ; V_{CE} = 6 \text{ V} \)

\( h_{FE1}/h_{FE2} < 1,2 \)

Transition frequency
\( I_C = 6,0 \text{ A} ; V_{CE} = 35 \text{ V} \)

\( f_T \)

typ. 275 MHz

Collector capacitance at \( f = 1 \text{ MHz} \)
\( I_E = I_e = 0 ; V_{CB} = 50 \text{ V} \)

\( C_c \)

typ. 185 pF

Feedback capacitance at \( f = 1 \text{ MHz} \)
\( I_C = 150 \text{ mA}; V_{CE} = 50 \text{ V} \)

\( C_{re} \)

typ. 115 pF

Collector-stud capacitance
\( C_{cs} \)

typ. 3,5 pF

\( T_j = 25 ^\circ \text{C} \) unless otherwise specified
typ. values

\( V_{CE} = 35 \text{ V} \)

\( 25 \text{ V} \)

\( 15 \text{ V} \)

\( 10 \text{ V} \)

\( 5 \text{ V} \)

\( 2 \text{ V} \)

\( f = 1 \text{ MHz} \)

\( I_{E} = I_{E} = 0 \)

\( V_{CE} = 40 \text{ V} \)

\( T_{h} = 25 \text{ °C} \)
APPLICATION INFORMATION

R.F. performance in s.s.b. operation (linear power amplifier)

Th up to 25 °C
f1 = 28,000 MHz; f2 = 28,001 MHz

<table>
<thead>
<tr>
<th>Output Power (W)</th>
<th>Gp (dB)</th>
<th>ηdt (%)</th>
<th>d3 (dB) 1)</th>
<th>d5 (dB) 1)</th>
<th>ICZS (A)</th>
<th>IC (A)</th>
<th>VCE (V)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 to 150 (PEP)</td>
<td>&gt; 14</td>
<td>&gt; 37,5</td>
<td>&lt; -30</td>
<td>&lt; -30</td>
<td>0,10</td>
<td>&lt; 4</td>
<td>50</td>
<td>AB</td>
</tr>
<tr>
<td>typ. 30 (PEP)</td>
<td>&gt; 14</td>
<td>typ. 15</td>
<td>&lt; -40</td>
<td>&lt; -40</td>
<td>2,5</td>
<td>-</td>
<td>40</td>
<td>A</td>
</tr>
</tbody>
</table>

S.S.B. test circuit class AB; f = 28 MHz

List of components: see page 6.

1) Stated figures are maxima encountered at any driving level between the specified values of PEP and are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope power these figures should be increased by 6dB.
APPLICATION INFORMATION (continued)

List of components:

**Tr1 = BD135**

**Tr2 = BD228**

- **C1 = C10 =** 100 pF air dielectric capacitor (single insulated rotor type)
- **C2 = C6 =** 27 pF ceramic capacitor
- **C3 =** 180 pF ceramic capacitor
- **C4 = C13 =** 100 pF air dielectric capacitor (single non-insulated rotor)
- **C5 = C7 =** 3.9 nF polyester capacitor (±10%)
- **C8 = C14 = C15 =** 100 nF polyester capacitor (±10%)
- **C9 =** 2.2 μF moulded metallized polyester capacitor
- **C11 =** 68 pF ceramic capacitor
- **C12 =** 220 pF ceramic capacitor

**L1 = 88 nH; 3 turns Cu wire (1.0 mm); internal diameter 9 mm; coil length 6.1 mm; leads 2 x 5 mm**

**L2 = L5 =** Ferroxcube bead, grade 3B (code number 4312 020 36640)

**L3 = 180 nH; 4 turns enamelled Cu wire (1.5 mm); internal diameter 12 mm; coil length 9.9 mm; leads 2 x 10 mm**

**L4 = 350 nH; 7 turns enamelled Cu wire (1.5 mm); internal diameter 12 mm; coil length 19.1 mm; leads 2 x 10 mm**

- **R1 = 0.66 Ω parallel connection of 5 x 3.3 Ω carbon resistors (±5%; 0.5 W each)**
- **R2 = 27 Ω carbon resistor (±5%; 0.5 W)**
- **R3 = 4.7 Ω carbon resistor (±5%; 0.5 W)**
- **R4 = 5.6 kΩ carbon resistor (±5%; 1 W)**
- **R5 = 15 Ω wire-wound potentiometer (3W)**
- **R6 = 157 Ω parallel connection of 3 x 470 Ω wire-wound resistors (5.5 W each)**
- **R7 = 68 Ω carbon resistor (±5%; 0.5 W)**

-20

<table>
<thead>
<tr>
<th>d_{im} (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CC} = 50 V</td>
</tr>
<tr>
<td>f_1 = 28,000 MHz</td>
</tr>
<tr>
<td>f_2 = 28,001 MHz</td>
</tr>
<tr>
<td>I_{CZS} = 100 mA</td>
</tr>
</tbody>
</table>

intermodulation distortion versus heatsink temp.
intermodulation distortion
versus P.E.P.

Typical values
- $V_{CC} = 50 \text{ V}$
- $f_1 = 28,000 \text{ MHz}$
- $f_2 = 28,001 \text{ MHz}$
- $T_h = 25 \text{ °C}$
- $I_{CZS} = 100 \text{ mA}$

$\text{dim} (\text{dB})$

$0 \quad 100 \quad 200$
P.E.P. (W)

double-tone efficiency
versus P.E.P.

Typical values
- $V_{CC} = 40 \text{ V}$
- $f_1 = 28,000 \text{ MHz}$
- $f_2 = 28,001 \text{ MHz}$
- $T_h = 25 \text{ °C}$
- $I_{CZS} = 100 \text{ mA}$

$\eta_{dt} (%)$

$0 \quad 100 \quad 200$
P.E.P. (W)
S.S.B. class AB operation

\[ P_L = 150 \text{ W (PEP)} \]

\[ V_{CC} = 50 \text{ V} \]

\[ I_{CZS} = 100 \text{ mA} \]

\[ T_h = 25 \text{ °C} \]

\[ Z_L = 6.25 \Omega \text{ in series with } 10.4 \text{ nH (in parallel with } -267 \text{ pF)} \]

The graphs hold for one transistor of a push-pull amplifier with cross neutralization; collector (Tr1) - base (Tr2), neutralizing capacitor: 82 pF.
S.S.B. class AB operation

\[ P_L = 150 \text{ W (PEP)} \]
\[ V_{CC} = 50 \text{ V} \]
\[ I_{CS} = 100 \text{ mA} \]
\[ T_h = 25 \text{ °C} \]
\[ Z_L = 6.25 \Omega \text{ in series with 7.3 nH (in parallel with } -188 \text{ pF)} \]

The graphs hold for an unneutralized amplifier.
APPLICATION INFORMATION (continued)

S.S.B. test circuit class-A; f = 28 MHz

List of components: (see also page 11)

D1 = BY206
TR1 = BD204

C1 = C10 = 100 pF air dielectric capacitor (single insulated rotor type)
C2 = C6 = 27 pF ceramic capacitor
C3 = 180 pF ceramic capacitor
C4 = C13 = 100 pF air dielectric capacitor (single non-insulated rotor)
C5 = C7 = 3.9 nF polyester capacitor (±10%)
C8 = 100 nF polyester capacitor (±10%)
C9 = 2.2 μF moulded metallized polyester capacitor
C11 = 68 pF ceramic capacitor
C12 = 220 pF ceramic capacitor
APPLICATION INFORMATION (continued)

List of components: (continued)

L1 = 88 nH; 3 turns Cu wire (1,0 mm); internal diameter 9 mm; coil length 6,1 mm; leads 2 x 5 mm
L2 = L5 = ferroxcube bead, grade 3B (code number 4312 020 36440)
L3 = 180 nH; 4 turns enamelled Cu wire (1,5 mm); internal diameter 12 mm; coil length 9,9 mm; leads 2 x 10 mm
L4 = 350 nH; 7 turns enamelled Cu wire (1,5 mm); internal diameter 12 mm; coil length 19,1 mm; leads 2 x 10 mm

R1 = 0,66 Ω parallel connection of 5 x 3,3 Ω carbon resistors (±5%; 0,5 W each)
R2 = 27 Ω carbon resistor (±5%; 0,5 W)
R3 = 4,7 Ω carbon resistor (±5%; 0,5 W)
R4 = 50 Ω wire-wound potentiometer (1 W)
R5 = 10 Ω carbon resistor (±5%; 1 W)
R6 = 560 Ω enamelled wire-wound resistor (5,5 W)
R7 = 270 Ω carbon resistor (±5%; 1 W)
R8 = 0,6 Ω parallel connection of 3 x 1,8 Ω wire-wound resistors (8 W each)
R9 = 90 Ω parallel connection of 3 x 270 Ω enamelled wire-wound resistor (5,5 W each)
R10 = 12 Ω carbon resistor (±5%; 1 W)

![Graph showing third order intermodulation distortion versus P.E.P. (class A operation)](image-url)
APPLICATION INFORMATION (continued)

R.F. performance in c.w. operation (class-B circuit)

$V_{CE} = 50 \text{ V}; T_h \text{ up to } 25 \text{ } ^\circ\text{C}$

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>$P_s$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>&lt; 15</td>
<td>150</td>
<td>&lt; 4,6</td>
<td>&gt; 10</td>
<td>&gt; 65</td>
</tr>
<tr>
<td>108</td>
<td>typ. 30</td>
<td>150</td>
<td>typ. 4,0</td>
<td>typ. 7,5</td>
<td>typ. 75</td>
</tr>
</tbody>
</table>

Test circuit: 70 MHz; c.w. class-B.

List of components:

- $L1 = 60 \text{ mm straight enamelled Cu wire (1,6 mm); 9 mm above chassis}$
- $L2 = \text{ Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)}$
- $L3 = 18 \text{ turns enamelled Cu wire (1,6 mm); internal diameter 10 mm; pitch 2 mm; leads 55 mm totally}$
- $L4 = 3 \text{ turns enamelled Cu wire (1,6 mm); internal diameter 10 mm; pitch 2,5 mm; leads 50 mm totally}$
- $C1 = 4 \text{ to 29 pF concentric air trimmer in parallel with 10 pF ceramic capacitor}$
- $C2 = 4 \text{ to 104 pF film dielectric trimmer in parallel with 56 pF ceramic capacitor}$
- $C3 = 4 \text{ to 104 pF film dielectric trimmer}$
- $C4 = 4 \text{ to 104 pF film dielectric trimmer in parallel with 47 pF ceramic capacitor}$
- $C5 = 100 \text{ nF polyester capacitor (± 10%)}$
- $C6 = 1 \text{ nF ceramic feed-through capacitor}$
- $R = 10 \Omega \text{ carbon resistor (0,5 W)}$

At $P_L = 150 \text{ W and } V_{CE} = 50 \text{ V, the output power at heatsink temperatures between 25 } ^\circ\text{C and 75 } ^\circ\text{C relative to that at 25 } ^\circ\text{C is diminished by 100 mW/}^\circ\text{C.}$
Indicated load power as a function of overload.

The graph has been derived from an evaluation of the performance of transistors matched up to 180W load power in the test amplifier on page 12 and subsequently subjected to various mismatch conditions at 50V with VSWR up to 50 and elevated heatsink temperatures. This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.
APPLICATION INFORMATION (continued)

Test circuit:

List of components:

C1 = C2 = 40 pF film dielectric trimmer
C3 = 400 pF parallel connection of 4 x 100 pF ceramic capacitors
C4 = 270 pF ceramic capacitor
C5 = 100 nF polyester capacitor (±10%)
C6 = 20 pF parallel connection of 2 x 10 pF ceramic capacitors
C7 = C8 = 60 pF film dielectric trimmer
L1 = 49 nH; 2 turns enamelled Cu wire (1,5 mm); internal diameter 9 mm; coil length 4.8 mm; leads 2 x 5 mm
L2 = strip-line (7.7 mm x 6 mm); tap for C3 is 7.5 mm from transistor edge
L3 = L6 = ferroxcube bead, grade 3B (code number 4312 020 36640)
L4 = 67 nH; 3 turns enamelled Cu wire (1,5 mm); internal diameter 8 mm; coil length 8.3 mm; leads 2 x 5 mm
L5 = 57 nH; 2 turns enamelled Cu wire (1,5 mm); internal diameter 10 mm; coil length 4.5 mm; leads 2 x 5 mm
R = 10 Ω carbon resistor (0.5 W)

Component lay-out for 108 MHz test circuit see page 15.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 108 MHz test circuit.

Dimensions of printed circuit board 123 mm x 55 mm.

The circuit has been built on epoxy fibre-glass double copper clad printed circuit board (thickness 1/16”). To minimize the dielectric losses, the ground plane under the inter-connection of L5, C6 and C7 has been removed.
**Load Power and Efficiency Versus Source Power (Class B Operation)**

- **f = 108 MHz**
- **$T_h = 25 \, ^\circ C$**
- **typ. values**

**Power Gain Versus Frequency (Class B Operation)**

- **$V_{CC} = 50 \, V$**
- **$P_L = 150 \, W$**
- **$T_h = 25 \, ^\circ C$**

**Input Impedance (Series Components) Versus Frequency (Class B Operation)**

- **typ. values**
- **$V_{CC} = 50 \, V$**
- **$P_L = 150 \, W$**

**Load Impedance (Parallel Components) Versus Frequency (Class B Operation)**

- **typ. values**
- **$V_{CC} = 50 \, V$**
- **$P_L = 150 \, W$**

---

August 1973
H.F./V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions. Matched $h_{FE}$ groups are available on request.

It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25^\circ C$

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$\overline{z}_L$ Ω</th>
<th>$Y_L$ mA/V</th>
<th>$d_3$ dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w. (class-B)</td>
<td>28</td>
<td>175</td>
<td>45</td>
<td>&gt; 7,5</td>
<td>&gt; 70</td>
<td>0,7 + j1,3</td>
<td>110 – j62</td>
<td></td>
</tr>
<tr>
<td>s.s.b. (class-AB)</td>
<td>28</td>
<td>1,6–28</td>
<td>5–42,5(P.E.P)</td>
<td>typ. 19</td>
<td>typ. 50</td>
<td>–</td>
<td>–</td>
<td>typ. –30</td>
</tr>
<tr>
<td>s.s.b. (class-A)</td>
<td>26</td>
<td>1,6–28</td>
<td>15 (P.E.P)</td>
<td>typ. 20</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>typ. –42</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Dimensions in mm

Torque on nut: min. 0,75 Nm (7,5 kg cm) max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage (V_{BE} = 0)</td>
<td></td>
</tr>
<tr>
<td>peak value</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td></td>
</tr>
<tr>
<td>Emitter-base voltage (open-collector)</td>
<td></td>
</tr>
<tr>
<td>Collector current (average)</td>
<td></td>
</tr>
<tr>
<td>Collector current (peak value); f &gt; 1 MHz</td>
<td></td>
</tr>
<tr>
<td>R.F. power dissipation (f &gt; 1 MHz); T_{mb} = 25 °C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td></td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V; f > 1 MHz.
I  Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 40 W; T_{mb} = 88 °C, i.e. T_{h} = 70 °C)
From junction to mounting base (d.c. dissipation)  \( R_{th j-mb(dc)} = 2.8 \ °C/W \)
From junction to mounting base (r.f. dissipation)  \( R_{th j-mb(rf)} = 2.05 \ °C/W \)
From mounting base to heatsink                    \( R_{th mb-h} = 0.45 \ °C/W \)
CHARACTERISTICS

T<sub>j</sub> = 25°C unless otherwise specified

Collector-emitter breakdown voltage
V<sub>BE</sub> = 0; I<sub>C</sub> = 25 mA

Collector-emitter breakdown voltage
open base; I<sub>C</sub> = 100 mA

Emitter-base breakdown voltage
open collector; I<sub>E</sub> = 10 mA

Collector cut-off current
V<sub>BE</sub> = 0; V<sub>CE</sub> = 36 V

Second breakdown energy; L = 25 mH; f = 50 Hz
open base
R<sub>BE</sub> = 10 Ω

D.C. current gain *
I<sub>C</sub> = 2,5 A; V<sub>CE</sub> = 5 V

D.C. current gain ratio of matched devices *
I<sub>C</sub> = 2,5 A; V<sub>CE</sub> = 5 V

Collector-emitter saturation voltage *
I<sub>C</sub> = 7,5 A; I<sub>B</sub> = 1,5 A

Transition frequency at f = 100 MHz *
I<sub>E</sub> = 2,5 A; V<sub>C</sub>B = 28 V
I<sub>E</sub> = 7,5 A; V<sub>C</sub>B = 28 V

Collector capacitance at f = 1 MHz
I<sub>E</sub> = I<sub>e</sub> = 0; V<sub>C</sub>B = 28 V

Feedback capacitance at f = 1 MHz
I<sub>C</sub> = 100 mA; V<sub>CE</sub> = 28 V

Collector-stud capacitance

---

V<sub>(BR)CES</sub> > 65 V
V<sub>(BR)CEO</sub> > 36 V
V<sub>(BR)EBO</sub> > 4 V
I<sub>CES</sub> < 10 mA
ESBO > 8 mJ
ESBR > 8 mJ
h<sub>FE</sub> typ. 45
h<sub>FE1/hFE2</sub> < 1,2
V<sub>CEsat</sub> typ. 1,5 V
f<sub>T</sub> typ. 570 MHz
f<sub>T</sub> typ. 570 MHz
C<sub>C</sub> typ. 82 pF
C<sub>re</sub> typ. 54 pF
C<sub>cs</sub> typ. 2 pF

---

* Measured under pulse conditions: t<sub>p</sub> < 200 μs; δ < 0,02.
Fig. 5 Typical values; $T_j = 25^\circ C$.

Fig. 6 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

Fig. 7 Typical values; $f = 100$ MHz; $T_j = 25^\circ C$.  

July 1978
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( \overline{z}_i ) (( \Omega ))</th>
<th>( \overline{V}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>45</td>
<td>&lt; 8</td>
<td>&gt; 7,5</td>
<td>&lt; 2,47</td>
<td>&gt; 70</td>
<td>0,7 + j1,3</td>
<td>110 – j62</td>
</tr>
</tbody>
</table>

![Test circuit; c.w. class-B.](image)

List of components:

C1 = C7 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3a = C3b = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor (500 V)
C5 = 100 nF polyester capacitor
C6a = 2,2 pF ceramic capacitor (500 V)
C6b = 1,8 pF ceramic capacitor (500 V)
C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)

L1 = 14 nH; 1 turn Cu wire (1,6 mm); int. dia. 7,7 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
L6 = 80 nH; 3 turns Cu wire (1,6 mm); int. dia. 9,0 mm; length 8,0 mm; leads 2 x 5 mm
L7 = 62 nH; 3 turns Cu wire (1,6 mm); int. dia. 7,5 mm; length 8,1 mm; leads 2 x 5 mm
L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

R1 = R2 = 10 \( \Omega \) carbon resistor.

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 9.
Fig. 9 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.
**H.F./V.H.F. power transistor**

**Fig. 10** Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

![Graph 10](image1.png)

**Fig. 11** Typical values; $V_{CE} = 28$ V; $f = 175$ MHz; $-- T_h = 25$ °C; $-- T_h = 70$ °C.

![Graph 11](image2.png)

**Fig. 12** R.F. SOAR; c.w. class-B operation; $f = 175$ MHz; $V_{CE} = 28$ V; $R_{th \ mb-h} = 0.45$ °C/W.

The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.

![Graph 12](image3.png)
Fig. 13 Input impedance (series components).

Fig. 14 Load impedance (parallel components).

Fig. 15 Power gain versus frequency.

OPERATING NOTE
Below 75 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Conditions for Figs 13; 14 and 15.
Typical values; VCE = 28 V; P_L = 45 W; T_h = 25 °C.
### R.F. performance in s.s.b. class-AB operation (linear power amplifier)

\[ V_{CE} = 28 \text{ V}; f_1 = 28,000 \text{ MHz}; f_2 = 28,001 \text{ MHz} \]

<table>
<thead>
<tr>
<th>output power</th>
<th>( G_p )</th>
<th>( \eta_{dt}(%) )</th>
<th>( I_C (A) )</th>
<th>( d_3 )</th>
<th>( d_5 )</th>
<th>( I_C(ZS) )</th>
<th>( T_h )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 42,5(P.E.P)</td>
<td>typ. 19</td>
<td>typ. 50</td>
<td>typ. 1,52</td>
<td>typ. -30</td>
<td>&lt; -30</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>5 to 37,5(P.E.P)</td>
<td>typ. 19</td>
<td>-</td>
<td>typ. -30</td>
<td>&lt; -30</td>
<td>50</td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

![Test circuit; s.s.b. class-AB.](image)

**Fig. 16 Test circuit; s.s.b. class-AB.**

**List of components:**

- \( C_1 = C_2 = 10 \) to 780 pF film dielectric trimmer
- \( C_3 = C_5 = C_6 = 220 \) nF polyester capacitor
- \( C_4 = 56 \) pF ceramic capacitor (500 V)
- \( C_7 = C_8 = 15 \) to 575 pF film dielectric capacitor
- \( L_1 = 4 \) turns closely wound enamelled Cu wire (1,6 mm); int. dia. 7,0 mm; leads 2 x 5 mm
- \( L_2 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- \( L_3 = 4 \) turns enamelled Cu wire (1,6 mm); int. dia. 10 mm; length 9,4 mm; leads 2 x 5 mm
- \( L_4 = 7 \) turns enamelled Cu wire (1,6 mm); int. dia. 12 mm; length 17,2 mm; leads 2 x 5 mm
- \( R_1 = 1,2 \Omega \); parallel connection of 4 x 4,7 \( \Omega \) carbon resistors
- \( R_2 = 39 \Omega \) carbon resistor

*Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.*
Fig. 17 Intermodulation distortion as a function of output power.*

Conditions for Fig. 17:
\[ V_{CE} = 28 \, V; \, I_{C(ZS)} = 50 \, mA; \, f_1 = 28,000 \, MHz; \, f_2 = 28,001 \, MHz; \, \text{typical values.} \]

Fig. 18 Double-tone efficiency and power gain as a function of output power.

Conditions for Fig. 18:
\[ V_{CE} = 28 \, V; \, I_{C(ZS)} = 50 \, mA; \, f_1 = 28,000 \, MHz; \, f_2 = 28,001 \, MHz; \, T_h = 70 \, ^oC; \, \text{typical values.} \]

* See note on page 9.
Fig. 19 Power gain as a function of frequency.

Fig. 20 Input impedance (series components) as a function of frequency.

Figs 19 and 20 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.

Conditions:
\[ V_{CE} = 28 \text{ V}; \quad I_C(ZS) = 50 \text{ mA}; \quad P_L = 42.5 \text{ W}; \quad T_h = 25 \text{ °C}; \quad Z_L = 7.4 \text{ Ω}. \]

Ruggedness in s.s.b. operation

The BLX39 is capable of withstanding a load mismatch (VSWR = 50) under the following conditions:
Class-AB operation; \( f_1 = 28,000 \text{ MHz}; \quad f_2 = 28,001 \text{ MHz}; \quad V_{CE} = 28 \text{ V}; \quad T_h = 70 \text{ °C} \) and \( P_{Lnom} = 45 \text{ W P.E.P.} \).
R.F. performance in s.s.b. class-A operation (linear power amplifier)

$V_{CE} = 26 \text{ V}$; $T_h = 70 \degree \text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

<table>
<thead>
<tr>
<th>output power</th>
<th>$G_p$ dB</th>
<th>$I_C$ A</th>
<th>$d_3$ dB *</th>
<th>$d_5$ dB *</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 (P.E.P)</td>
<td>typ. 20</td>
<td>1.55</td>
<td>typ. -42</td>
<td>&lt; -40</td>
</tr>
</tbody>
</table>

* Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.
List of components in Fig. 21:

- **C1** = **C2** = 10 to 780 pF film dielectric trimmer
- **C3** = 22 nF ceramic capacitor (63 V)
- **C4** = 47 μF/10 V electrolytic capacitor
- **C5** = 56 pF ceramic capacitor (500 V)
- **C6** = 47 μF/35 V electrolytic capacitor
- **C7** = **C8** = 220 nF polyester capacitor
- **C9** = 10 μF/35 V electrolytic capacitor
- **C10** = 10 to 210 pF film dielectric trimmer
- **C11** = 15 to 575 pF film dielectric trimmer
- **L1** = 3 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
- **L2** = **L3** = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- **L4** = 11 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 11,0 mm
- **L5** = 14 turns closely wound enamelled Cu wire (1,6 mm); int. dia. 11,0 mm
- **R1** = 600 Ω; parallel connection of 2 x 1,2 kΩ carbon resistors (± 5%; 0,5 W each)
- **R2** = 15 Ω; carbon resistor (± 5%; 0,25 W)
- **R3** = 1,2 kΩ; parallel connection of 4 x 4,7 Ω carbon resistors (± 5%; 0,125 W each)
- **R4** = 33 Ω; carbon resistor (± 5%; 0,25 W)
- **R5** = 18 Ω; carbon resistor (± 5%; 0,25 W)
- **R6** = 120 Ω; wirewound resistor (± 5%; 5,5 W)
- **R7** = 1 Ω; carbon resistor (± 5%; 0,125 W)
- **R8** = 47 Ω; wirewound potentiometer (3 W)
- **R9** = 1,57 Ω; parallel connection of 3 x 4,7 Ω wirewound resistors (± 5%; 5,5 W each)

![Graph](image)

**Fig. 22** Intermodulation distortion as a function of output power. Typical values; V<sub>CE</sub> = 26 V; T<sub>h</sub> = 70 °C; f<sub>1</sub> = 28,000 MHz; f<sub>2</sub> = 28,001 MHz.
U.H.F./V.H.F. TRANSMITTING TRANSISTOR

N-P-N transistor intended for use in class-B and C operated mobile, industrial and military transmitters with a supply voltage of 13,8 V. It has a TO-39 metal envelope with the collector connected to the case.

QUICK REFERENCE DATA

R.F. performance up to $T_{\text{case}} = 25 \, ^{\circ}\text{C}$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{\text{CE}} , \text{V}$</th>
<th>$f , \text{MHz}$</th>
<th>$P_{\text{S}} , \text{W}$</th>
<th>$P_{\text{L}} , \text{W}$</th>
<th>$I_{\text{C}} , \text{A}$</th>
<th>$G_{\text{P}} , \text{dB}$</th>
<th>$\eta , %$</th>
<th>$\bar{z}_{i} , \Omega$</th>
<th>$\bar{V}_{L} , \text{mA/V}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,8</td>
<td>470</td>
<td>typ. 0,4</td>
<td>2,0</td>
<td>typ. 0,22</td>
<td>typ. 7</td>
<td>typ. 66</td>
<td>5 + j11</td>
<td>17 – j19</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>470</td>
<td>&lt; 0,5</td>
<td>2,0</td>
<td>&lt; 0,25</td>
<td>6</td>
<td>&gt; 65</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>typ. 0,12</td>
<td>2,0</td>
<td>typ. 0,21</td>
<td>typ. 12</td>
<td>&lt; 75</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories: 56218 (package); 56245 (distance disc).
BLX65

\[ P_{\text{tot}} \text{ (W)} \]

- Short time operation
  - V.S.W.R. > 3

- Normal operation
  - V.S.W.R. < 3

\[ V_{CE} \leq 16.5 \text{V} \]
\[ f \geq 10 \text{MHz} \]

\[ D.C. \text{ SOAR} \]

- \[ T_{\text{case}} = 25^\circ \text{C} \]
- \[ T_{\text{case}} = 125^\circ \text{C} \]
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-base voltage (open emitter)
peak value
\( V_{CBOM} \)  max. 36 V

Collector-emitter voltage \((V_{BE} = 0)\)
peak value
\( V_{CESM} \)  max. 36 V

Collector-emitter voltage (open base)
\( V_{CEO} \)  max. 18 V

Emitter-base voltage (open collector)
\( V_{EBO} \)  max. 4 V

Currents
Collector current (average)
\( I_{C(AV)} \)  max. 0.7 A

Collector current (peak value) \(f > 1 \text{ MHz}\)
\( I_{CM} \)  max. 2.0 A

Power dissipation
Total power dissipation up to \( T_{case} = 90 \degree C\)
\( P_{tot} \)  max. 3.0 W

\( f > 10 \text{ MHz}\)

Temperatures
Storage temperature
\( T_{stg} \)  \(-65 \) to \(+150 \degree C\)

Operating junction temperature
\( T_{j} \)  max 165 \degree C

THERMAL RESISTANCE
From junction to case
\( R_{th \ j-c} = 25 \degree C/W \)

From mounting base to heatsink
with a boron nitride washer for electrical insulation
\( R_{th \ mb-h} = 2.5 \degree C/W \)

December 1971
### CHARACTERISTICS

**Breakdown voltages**

<table>
<thead>
<tr>
<th>Voltage Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage open emitter, IC = 10 mA</td>
<td>V(BR)CBO</td>
<td>&gt; 36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage V_{BE} = 0; IC = 10 mA</td>
<td>V(BR)CES</td>
<td>&gt; 36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage open base, IC = 25 mA</td>
<td>V(BR)CEO</td>
<td>&gt; 18 V</td>
</tr>
<tr>
<td>Emitter-base voltage open collector, IE = 1.0 mA</td>
<td>V(BR)EBO</td>
<td>&gt; 4 V</td>
</tr>
</tbody>
</table>

**Collector-emitter saturation voltage**

<table>
<thead>
<tr>
<th>Voltage Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 100 mA; IB = 20 mA</td>
<td>V_{CE}sat</td>
<td>typ. 0.1 V</td>
</tr>
</tbody>
</table>

**D.C. current gain**

<table>
<thead>
<tr>
<th>Current Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 100 mA; V_{CE} = 5 V</td>
<td>hFE</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>

**Transition frequency**

<table>
<thead>
<tr>
<th>Current Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 200 mA; V_{CE} = 5 V; f = 500 MHz</td>
<td>f_T</td>
<td>typ. 1400 MHz</td>
</tr>
</tbody>
</table>

**Collector capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Current Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE = IE = 0; V_{CB} = 10 V</td>
<td>C_C</td>
<td>typ. 6.5 pF</td>
</tr>
</tbody>
</table>

**Feedback capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Current Description</th>
<th>Symbol</th>
<th>Min Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 20 mA; V_{CB} = 10 V</td>
<td>C_{re}</td>
<td>typ. 4.8 pF</td>
</tr>
</tbody>
</table>

**Tj = 25 °C unless otherwise specified**
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class B circuit)

<table>
<thead>
<tr>
<th>$f$ (MHz)</th>
<th>$V_{CC}$ (V)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_i$ (Ω)</th>
<th>$\overline{V_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>13.8</td>
<td>typ. 0.4</td>
<td>2.0</td>
<td>typ. 0.22</td>
<td>typ. 7</td>
<td>typ. 66</td>
<td>5 + j11</td>
<td>17 - j19</td>
</tr>
<tr>
<td>470</td>
<td>12.5</td>
<td>&lt; 0.5</td>
<td>2.0</td>
<td>&lt; 0.25</td>
<td>&lt; 6</td>
<td>&gt; 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>typ. 0.12</td>
<td>2.0</td>
<td>typ. 0.21</td>
<td>typ. 12</td>
<td>typ. 75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit:

![Test Circuit Diagram](image)

To obtain optimum gain performance the emitter lead length should not exceed 1.6 mm

- $C_1 = C_2 = C_4 = C_5 = 1.8$ to 18 pF film dielectric trimmer
- $C_3 = 22$ pF disc ceramic capacitor
- $C_6 = 10$ nF ceramic capacitor
- $C_7 = 0.1 \mu F$ polyester capacitor
- $C_8 = 4$ nF feed-through capacitor

- $L_1 = 1$ turn Cu wire (1 mm); int. diam. 5 mm, max. lead length 1 mm
- $L_2 = 0.22$ µH choke
- $L_3 = 1$ turn Cu wire (1 mm); int. diam. 7 mm; lead length 2 mm
- $L_4 = 1$ turn Cu wire (1 mm); int. diam. 5 mm; lead length 2 mm
- $R = 10$ Ω carbon

At $P_L = 2.0$ W and $V_{CC} = 12.5$ V the output power at case temperatures between 25 °C and 90 °C relative to that at 25 °C is diminished by typ. $5$ mW/°C.

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: $V_{CC} = 16.5$ V; $f = 470$ MHz; $T_{case} = 70$ °C

V.S.W.R. = 50 : 1 through all phases; $P_S = P_{S_{nom}} + 20$ %

where $P_{S_{nom}} = P_S$ for 1.4 W transistor output into 50 Ω load at $V_{CC} = 13.8$ V.

Component lay-out for 470 MHz see page 7.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 470 MHz test circuit.

Shaded area copper
Back area not metalized
Material of printed circuit board: 1.5 mm epoxy fibre-glass
BLX65

- **Typical values**
  - **Frequency (f)**: 470 MHz
  - **Case Temperature (T_{case})**: 25 °C

- **Power Supply (V_{CC})**
  - 6.9V
  - 12.5V
  - 13.8V

- **Efficiency (η)** as a function of input power (P_{s}) and output power (P_{L})

May 1974
Conditions for R.F. SOAR

\[ P_{S\text{nom}} = P_S \text{ at } VCC = V_{CC\text{nom}} \text{ and } V.S.W.R. = 1 \]

\[ f = 470 \text{ MHz} \]
\[ T_{\text{case}} = 70 \text{ °C} \]
\[ V_{CC\text{nom}} = 13.8 \text{ V} \]

The transistor was developed for use with unstabilized supply voltage \( V_{CC} \).
The above graph is based on its measured performance in the circuit given on page 6. Supply voltage was varied from \( V_{CC\text{nom}} \) to 1.2 \( V_{CC\text{nom}} \), and V.S.W.R. from 1 to 50. It shows the maximum allowable output power under nominal conditions in order not to exceed the maximum allowable power dissipation under conditions of supply overvoltage (\( VCC > V_{CC\text{nom}} \)) and load mismatch (V.S.W.R. > 1).
It is assumed that the drive power increases linearly with the supply voltage; i.e.
\[ P_S/P_{S\text{nom}} = VCC/V_{CC\text{nom}} \].
APPLICATION INFORMATION (continued)

Test circuit for 175 MHz

To obtain optimum gain performance the emitter lead length should not exceed 1.6 mm

C1 = C4 = 60 pF concentric air trimmer
C2 = C3 = 30 pF concentric air trimmer
C5 = 0.25 µF polyester capacitor
C6 = 4 nF feed-through capacitor

L1 = 25 mm straight Cu wire (1.2 mm); height above print 3 mm
L2 = 3 turns Cu wire (0.5 mm) on ferrite FX1115, d = 2 mm, D = 4 mm, l = 5 mm, material 3B (code number 311399116740)
L3 = 5 turns closely wound Cu wire (1.2 mm); int. diam. 10 mm; lead length 5 mm
L4 = 3 turns closely wound Cu wire (1.2 mm); int. diam. 10 mm; lead length 5 mm
R = 10 Ω carbon

Graphs (PL versus P and η versus Ps) for 175 MHz on page 8.
Component lay-out for 175 MHz on page 11.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit:

Shaded area copper
Back area not metallized
Material of printed circuit board: 1.5 mm epoxy fibre-glass

November 1973
OPERATING NOTE Below 200 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
U.H.F./V.H.F. TRANSMITTING TRANSISTOR

N-P-N transistor intended for use in class-B and C operated mobile, industrial and military transmitters with a supply voltage of 13.8 V. It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_{mb} = 25 \, ^{\circ}C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_{S}$ W</th>
<th>$P_{L}$ W</th>
<th>$I_{C}$ A</th>
<th>$G_{D}$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}$ Ω</th>
<th>$\overline{V}_{L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,8</td>
<td>typ. 0,15</td>
<td>1,5</td>
<td>typ. 0,17</td>
<td>typ. 10</td>
<td>typ. 65</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>c.w.</td>
<td>13,8</td>
<td>typ. 0,28</td>
<td>2,5</td>
<td>typ. 0,24</td>
<td>typ. 9,5</td>
<td>typ. 75</td>
<td>2,6 + j4,8</td>
<td>23 – j23</td>
<td></td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>&lt; 0,35</td>
<td>2,5</td>
<td>&lt; 0,31</td>
<td>&gt; 8,5</td>
<td>&gt; 65</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>typ. 0,03</td>
<td>3,0</td>
<td>typ. 0,29</td>
<td>typ. 20</td>
<td>typ. 84</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-48 (without stud).
BLX66

P_{tot} (W)

V_{CE} \leq 18.5 \text{V}
\quad f \geq 10 \text{MHz}

shorttime
operation
V.S.W.R. \geq 3

normal operation
V.S.W.R. \leq 3

T_{mb} = 25^\circ \text{C}

T_{mb} = 125^\circ \text{C}

D.C. SOAR

I_{C} (A)

V_{CE} (V)

10^{-2} - 10^{2}

10

1

November 1971
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter) peak value

Collector-emitter voltage (R_{BE} = 0) peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Currents

Collector current (average)

Collector current (peak value) f > 1 MHz

Power dissipation

Total power dissipation up to T_{mb} = 90 °C f > 10 MHz

Temperatures

Storage temperature

Junction temperature

THERMAL RESISTANCE

From junction to mounting base

\[
R_{th \: j-mb} = 12 \: °C/W
\]
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, \( I_C = 10 \text{ mA} \)
\[ V_{(BR)CBO} > 36 \text{ V} \]

Collector-emitter voltage
\( V_{BE} = 0; I_C = 10 \text{ mA} \)
\[ V_{(BR)CES} > 36 \text{ V} \]

Collector-emitter voltage
open base, \( I_C = 25 \text{ mA} \)
\[ V_{(BR)CEO} > 18 \text{ V} \]

Emitter-base voltage
open collector, \( I_E = 10 \text{ mA} \)
\[ V_{(BR)EBO} > 4 \text{ V} \]

Collector-emitter saturation voltage
\( I_C = 100 \text{ mA}; I_B = 20 \text{ mA} \)
\[ V_{CESat} \text{ typ.} 0.1 \text{ V} \]

D.C. current gain
\( I_C = 100 \text{ mA}; V_{CE} = 5 \text{ V} \)
\[ h_{FE} \text{ typ.} 40 \]

Transition frequency
\( I_C = 200 \text{ mA}; V_{CE} = 5 \text{ V}; f = 500 \text{ MHz} \)
\[ f_T \text{ typ.} 1400 \text{ MHz} \]

Collector capacitance at \( f = 1 \text{ MHz} \)
\( I_E = I_e = 0; V_{CB} = 10 \text{ V} \)
\[ C_c \text{ typ.} 6.5 \text{ pF} \]

Feedback capacitance at \( f = 1 \text{ MHz} \)
\( I_C = 20 \text{ mA}; V_{CE} = 10 \text{ V} \)
\[ C_{re} \text{ typ.} 4.8 \text{ pF} \]

Collector-stud capacitance
\[ C_{cs} \text{ typ.} 2 \text{ pF} \]

\( T_j = 25 \text{ °C} \) unless otherwise specified
APPLICATION INFORMATION

R. F. performance in c. w. operation (unneutralized common-emitter class B circuit)

\[ T_{mb} = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CC} ) (V)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_D ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( \bar{Z}_1 ) (( \Omega ))</th>
<th>( \bar{Y}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>13.8</td>
<td>typ. 0.15</td>
<td>1.5</td>
<td>typ. 0.17</td>
<td>typ. 10</td>
<td>typ. 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>470</td>
<td>13.8</td>
<td>typ. 0.28</td>
<td>2.5</td>
<td>typ. 0.24</td>
<td>typ. 9.5</td>
<td>typ. 75</td>
<td>2.6+j4.8</td>
<td>23-j23</td>
</tr>
<tr>
<td>470</td>
<td>12.5</td>
<td>&lt; 0.35</td>
<td>2.5</td>
<td>&lt; 0.31</td>
<td>&gt; 8.5</td>
<td>&gt; 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>typ. 0.03</td>
<td>3.0</td>
<td>typ. 0.29</td>
<td>typ. 20</td>
<td>typ. 84</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz:

\[ \text{C1} = \text{C2} = \text{C6} = \text{C7} = 1.8 \text{ to } 18 \, \text{pF film dielectric trimmer} \]
\[ \text{C3} = \text{C4} = 18 \, \text{pF disc ceramic capacitor} \]
\[ \text{C5} = 4 \, \text{nF feed-through capacitor} \]
\[ \text{C8} = 0.1 \, \text{pF polyester capacitor} \]

\[ \text{L1} = 1 \, \text{turn Cu wire (1.2 mm); int. diam. 6 mm; max. lead length 1 mm.} \]
\[ \text{L2} = 1 \, \mu H \text{ choke} \]
\[ \text{L3} = 30 \, \text{mm straight Cu wire (2 mm); height above print 2 mm.} \]
\[ \text{L4} = 2 \, \text{turns closely wound Cu wire (0.5 mm); int. diam. 3 mm; max. lead length 8 mm.} \]

\[ \text{R} = 10 \, \Omega \text{ carbon} \]

At \( P_L = 2.5 \, \text{W and} \, V_{CC} = 12.5 \, \text{V} \) the output power at mounting-base temperatures between 25 \( ^\circ \text{C} \) and 90 \( ^\circ \text{C} \) relative to that at 25 \( ^\circ \text{C} \) is diminished by typ. \( 5 \, \text{mW/}^\circ \text{C} \)

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: \( V_{CC} = 16.5 \, \text{V; } f = 470 \, \text{MHz; } T_{mb} = 70 \, ^\circ \text{C; } V.S.W.R. = 50 : 1 \text{ through all phases; } P_S = P_{S\text{nom}} + 20 \% \)

where \( P_{S\text{nom}} = P_S \) for 2.5 \( \text{W transistor output into 50} \, \Omega \text{ load at } V_{CC} = 13.8 \, \text{V} \)

Component lay-out for 470 MHz see page 7
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 470 MHz test circuit.

Shaded area copper
Back area completely copper clad
Material of printed circuit board: 1.5 mm epoxy fibre glass
Conditions for R.F. SOAR

\[ f = 470 \text{ MHz} \quad \Rightarrow \quad \frac{P_{\text{Snom}}}{P_{\text{Snom}}} = P_S \text{ at } VCC = VCC_{\text{nom}} \text{ and V.S.W.R.} = 1 \]

\[ T_{\text{mb}} = 70 \text{ °C} \]

\[ VCC_{\text{nom}} = 13.8 \text{ V} \quad \text{see also page 6} \]

The transistor was developed for use with unstabilized supply voltage \( VCC \).

The above graph is based on its measured performance in the circuit given on page 6. Supply voltage was varied from \( VCC_{\text{nom}} \) to \( 1.2VCC_{\text{nom}} \), and V.S.W.R. from 1 to 50.

It shows the max. allowable output power under nominal conditions in order not to exceed the max. allowable power dissipation under conditions of supply overvoltage (\( VCC > VCC_{\text{nom}} \)) and load mismatch (V.S.W.R. > 1).

It is assumed that the drive power increases linearly with the supply voltage; i.e.

\[ \frac{P_S}{P_{\text{Snom}}} = \frac{VCC}{VCC_{\text{nom}}} \]
APPLICATION INFORMATION (continued)

Test circuit for 175 MHz:

\[ \text{Component lay-out for 175 MHz see page 11.} \]
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

Shaded area copper
Back area not metallized
Material of printed circuit board: 1.5 mm epoxy fibre glass
OPERATING NOTE Below 280 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

**Power Gain Versus Frequency**

- $V_{CC} = 13.8$ V
- $P_L = 2.5$ W
- $T_{mb} = 25$ °C
- typ. values

**Input Impedance (Series Components) Versus Frequency**

**Load Impedance (Parallel Components) Versus Frequency**

- $V_{CC} = 13.8$ V
- $P_L = 2.5$ W
- $T_{mb} = 25$ °C
- typ. values
**U.H.F./V.H.F. TRANSMITTING TRANSISTOR**

N-P-N transistor intended for use in class B and C operated mobile, industrial and military transmitters with a supply voltage of 13.8 V. It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

### QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class B circuit

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>$V_{CC}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_1$ ($\Omega$)</th>
<th>$\bar{V}_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.8</td>
<td>470</td>
<td>typ. 0.15</td>
<td>1.5</td>
<td>typ. 0.17</td>
<td>10</td>
<td>typ. 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>13.8</td>
<td>470</td>
<td>typ. 0.35</td>
<td>3.0</td>
<td>typ. 0.28</td>
<td>9.3</td>
<td>typ. 79</td>
<td>2.9 + j5.1</td>
<td>127 - j21</td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>470</td>
<td>&lt; 0.35</td>
<td>2.5</td>
<td>&lt; 0.31</td>
<td>8.5</td>
<td>&gt; 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>175</td>
<td>typ. 0.03</td>
<td>3.0</td>
<td>typ. 0.29</td>
<td>typ. 20</td>
<td>typ. 84</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### MECHANICAL DATA

**Dimensions in mm**

SOT-48

When locking is required an adhesive instead of a lock washer is preferred

Torque on nut: min. 7.5 kg cm (0.75 Newton metres)  
max. 8.5 kg cm (0.85 Newton metres)

Diameter of clearance hole in heatsink: max. 4.17 mm.

Mounting hole to have no burrs at either end

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

May 1974
P_{tot} (W)

short time operation
V.S.W.R. > 3

normal operation
V.S.W.R. < 3

V_{CE} \leq 16.5 V
f \geq 10 MHz

T_h = 25°C
125°C
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
- Collector-base voltage (open emitter) peak value
  \( V_{CBOM} \max. \ 36 \ V \)
- Collector-emitter voltage \((R_{BE} = 0)\) peak value
  \( V_{CESM} \max. \ 36 \ V \)
- Collector-emitter voltage (open base)
  \( V_{CEO} \max. \ 18 \ V \)
- Emitter-base voltage (open collector)
  \( V_{EBO} \max. \ 4 \ V \)

Currents
- Collector current (average) \( I_{C(AV)} \max. \ 0.7 \ A \)
- Collector current (peak value) \( f > 1 \ MHz \)
  \( I_{CM} \max. \ 2.0 \ A \)

Power dissipation
- Total power dissipation up to \( T_h = 90 ^\circ C \), \( f > 10 \ MHz \)
  \( P_{tot} \max. \ 4.5 \ W \)

Temperature
- Storage temperature
  \( T_{stg} \ -65 \ to \ +150 ^\circ C \)
- Junction temperature
  \( T_j \max. \ 150 ^\circ C \)

Thermal Resistance
- From junction to mounting base
  \( R_{th\ j-mb} = 12 ^\circ C/W \)
- From mounting base to heatsink
  \( R_{th\ mb-h} = 0.6 ^\circ C/W \)
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, $I_C = 10 \text{ mA}$

Collector-emitter voltage
$V_{BE} = 0; I_C = 10 \text{ mA}$

Collector-emitter voltage
open base, $I_C = 25 \text{ mA}$

Emitter-base voltage
open collector, $I_E = 1,0 \text{ mA}$

Collector-emitter saturation voltage
$I_C = 100 \text{ mA}; I_B = 20 \text{ mA}$

D.C. current gain
$I_C = 100 \text{ mA}; V_C E = 5 \text{ V}$

Transition frequency
$I_C = 0,2 \text{ A}; V_C E = 5 \text{ V}; f = 500 \text{ MHz}$

Collector capacitance at $f = 1 \text{ MHz}$
$I_E = I_e = 0; V_{CB} = 10 \text{ V}$

Feedback capacitance at $f = 1 \text{ MHz}$
$I_C = 20 \text{ mA}; V_C E = 10 \text{ V}$

Collector-stud capacitance

$T_j = 25 \text{ °C unless otherwise specified}$

$V_{(BR)CBO} > 36 \text{ V}$

$V_{(BR)CES} > 36 \text{ V}$

$V_{(BR)CEO} > 18 \text{ V}$

$V_{(BR)EBO} > 4 \text{ V}$

$V_{CEsat} \text{ typ. } 0,1 \text{ V}$

$h_{FE} > 10$

$10$

$t_{T} \text{ typ. } 1400 \text{ MHz}$

$C_c \text{ typ. } 6,5 \text{ pF}$

$9,0 \text{ pF}$

$C_{re} \text{ typ. } 4,8 \text{ pF}$

$2 \text{ pF}$
APPLICATION INFORMATION

**T**<sub>j</sub> = 25 °C unless otherwise specified

R. F. performance in c.w. operation (unneutralized common-emitter class B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V&lt;sub&gt;CC&lt;/sub&gt; (V)</th>
<th>P&lt;sub&gt;S&lt;/sub&gt; (W)</th>
<th>P&lt;sub&gt;L&lt;/sub&gt; (W)</th>
<th>I&lt;sub&gt;C&lt;/sub&gt; (A)</th>
<th>G&lt;sub&gt;P&lt;/sub&gt; (dB)</th>
<th>η (%)</th>
<th>Z&lt;sub&gt;i&lt;/sub&gt; (Ω)</th>
<th>Y&lt;sub&gt;L&lt;/sub&gt; (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>13.8</td>
<td>typ. 0.15</td>
<td>1.5</td>
<td>typ. 0.17</td>
<td>typ. 10</td>
<td>typ. 65</td>
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<tr>
<td>470</td>
<td>13.8</td>
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<td>3.0</td>
<td>typ. 0.28</td>
<td>typ. 9.3</td>
<td>typ. 79</td>
<td>2.9 + j5.1</td>
<td>27 - j21</td>
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<tr>
<td>470</td>
<td>12.5</td>
<td>&lt; 0.35</td>
<td>2.5</td>
<td>&lt; 0.31</td>
<td>&gt; 8.5</td>
<td>&gt; 65</td>
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<tr>
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<td>3.0</td>
<td>typ. 0.29</td>
<td>typ. 20</td>
<td>typ. 84</td>
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</tbody>
</table>

Test circuit for 470 MHz:

![Test Circuit Diagram](image)

1. **C1** = **C2** = **C6** = **C7** = 1.8 to 18 pF film dielectric trimmer
2. **C3** = **C4** = 18 pF disc ceramic capacitor
3. **C5** = 4 nF feed-through capacitor
4. **C8** = 0.1 μF polyester capacitor

- **L1** = 1 turn Cu wire (1.2 mm); int. diam. 6 mm; max. lead length 1 mm
- **L2** = 1 μH choke
- **L3** = 30 mm straight Cu wire (2 mm); height above print 2 mm
- **L4** = 2 turns closely wound Cu wire (0.5 mm); int. diam. 3 mm; max. lead length 8 mm
- **R** = 10 Ω carbon

At P<sub>L</sub> = 2.5 W and V<sub>CC</sub> = 12.5 V, the output power at heatsink temperatures between 25 °C and 90 °C relative to that at 25 °C is diminished by typ. 5 mW/°C.

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: V<sub>CC</sub> = 16.5 V; f = 470 MHz; T<sub>h</sub> = 70 °C; V.S.W.R. = 50 : 1 through all phases; P<sub>S</sub> = P<sub>Snom</sub> + 20 %

where P<sub>Snom</sub> = P<sub>S</sub> for 2.5 W transistor output into 50 Ω load and V<sub>CC</sub> = 13.8 V

Component lay-out for 470 MHz see page 7
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 470 MHz test circuit.

Shaded area copper
Back area completely copper clad.
Material of printed circuit board: 1.5 mm epoxy fibre glass.

May 1974
**I- typical values**

- **f = 470 MHz**
- **T_h = 25°C**

**VI/1/4**

- **V_{CC} = 13.8 V**
- **V_{CC} = 12.5 V**
Conditions for R.F. SOAR

\[ f = 470 \text{ MHz} \]
\[ T_h = 70 \, \text{°C} \]
\[ V_{CC\text{nom}} = 13.8 \, \text{V} \]

\[ P_{\text{Snom}} = P_S \text{ at } V_{CC} = V_{CC\text{nom}} \text{ and } \text{VSWR} = 1 \]
\[ R_{\text{th\,mb-h}} = 0.6 \, \text{°C/W} \]

See also page 6

The transistor was developed for use with unstabilized supply voltage \( V_{CC} \).
The above graph is based on its measured performance in the circuit given on page 6. Supply voltage was varied from \( V_{CC\text{nom}} \) to 1.2 \( V_{CC\text{nom}} \), and \( V_{SWR} \) from 1 to 50. It shows the max. permissible output power under nominal conditions in order not to exceed the max. permissible power dissipation under conditions of supply over-voltage (\( V_{CC} > V_{CC\text{nom}} \)) and load mismatch (\( \text{VSWR} > 1 \)). It is assumed that the drive power increases linearly with the supply voltage; i.e.

\[ \frac{P_S}{P_{\text{Snom}}} = \frac{V_{CC}}{V_{CC\text{nom}}} \]
APPLICATION INFORMATION (continued)

Test circuit for 175 MHz:

```
C1 = C3 = C4 = 30 pF concentric air trimmer
C2 = 60 pF concentric air trimmer
C5 = 0.25 µF ceramic capacitor
C6 = 4 nF polyester capacitor

L1 = 25 mm straight Cu wire (1.2 mm); height above print max. 3 mm
L2 = 3 turns closely wound Cu wire (1.2 mm); int. diam. 10 mm; lead length 5 mm
L3 = 2 turns closely wound Cu wire (1.7 mm); int. diam. 12 mm; lead length 5 mm
R1 = 50 Ω carbon
R2 = 1.2 kΩ carbon
R3 = 5 Ω carbon

Component lay-out for 175 MHz see page 11.
```
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175MHz test circuit.

Shaded area copper
Back area not metalized
Material of pcb : 1.5 mm epoxy fibre glass
OPERATING NOTE Below 200 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
U.H.F./ V.H.F. POWER TRANSISTOR

N-P-N- transistor intended for use in class B and C operated mobile, industrial and military transmitters with a supply voltage of 13.8 V. It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>VCC (V)</th>
<th>f (MHz)</th>
<th>PS (W)</th>
<th>PL (W)</th>
<th>IC (A)</th>
<th>Gp (dB)</th>
<th>η (%)</th>
<th>Z1 (Ω)</th>
<th>YL (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.8</td>
<td>470</td>
<td>&lt; 2.0</td>
<td>7.0</td>
<td>&lt; 0.78</td>
<td>&gt; 5.4</td>
<td>&gt; 65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.w.</td>
<td>13.8</td>
<td>470</td>
<td>typ. 2.0</td>
<td>7.8</td>
<td>typ. 0.81</td>
<td>typ. 5.9</td>
<td>typ. 70</td>
<td>2.4+j6.7</td>
<td>60−j20</td>
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<tr>
<td>c.w.</td>
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<td>470</td>
<td>&lt; 2.2</td>
<td>7.0</td>
<td>&lt; 0.86</td>
<td>&gt; 5.0</td>
<td>&gt; 65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>175</td>
<td>typ. 0.4</td>
<td>7.2</td>
<td>typ. 0.87</td>
<td>typ.12.6</td>
<td>typ. 66</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-48

Dimensions in mm

When locking is required an adhesive instead of a lock washer is preferred.

- Torque on nut: min. 7.5 kg cm (0.75 Newton metres) max. 8.5 kg cm (0.85 Newton metres)
- Diameter of clearance hole in heatsink: max. 4.17 mm.
- Mounting hole to have no burrs at either end.
- De-burring must leave surface flat; do not chamfer or countersink either end of hole.

May 1974
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134)

### Voltages

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Max. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter), peak value</td>
<td>$V_{CBOM}$</td>
<td>36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage ($R_{BE} = 0$), peak value</td>
<td>$V_{CESM}$</td>
<td>36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$</td>
<td>18 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>$V_{EBO}$</td>
<td>4 V</td>
</tr>
</tbody>
</table>

### Currents

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Max. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector current (average)</td>
<td>$I_{C(AV)}$</td>
<td>1.0 A</td>
</tr>
<tr>
<td>Collector current (peak value) f &gt; 1 MHz</td>
<td>$I_{CM}$</td>
<td>4.0 A</td>
</tr>
</tbody>
</table>

### Power dissipation

- Total power dissipation up to $T_h = 70 ^\circ C$  
  $P_{tot}$ max. 10 W 

### Temperatures

- Storage temperature  
  $T_{stg}$ -65 to +150 $^\circ C$
- Junction temperature  
  $T_j$ max. 150 $^\circ C$

### THERMAL RESISTANCE

- From junction to mounting base  
  $R_{th \, j-mb}$ = 7.0 $^\circ C/W$
- From mounting base to heatsink  
  $R_{th \, mb-h}$ = 0.6 $^\circ C/W$

---

November 1971
$P_{\text{tot}}$ (W) vs. $T_h$ (°C) graph:
- Short time operation: $V_{CE} \leq 16.5\, \text{V}$, $f \geq 10\, \text{MHz}$
- Normal operation: $V_{SWR} < 3$

$I_C$ (A) vs. $V_{CE}$ (V) graph:
- $T_h = 25\, \text{°C}$
- $T_h = 125\, \text{°C}$
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, $I_C = 10 \, \text{mA}$

$$V(\text{BR})_{CBO} > 36 \, \text{V}$$

Collector-emitter voltage
$V_{BE} = 0; \, I_C = 10 \, \text{mA}$.

$$V(\text{BR})_{CES} > 36 \, \text{V}$$

Collector-emitter voltage
open base, $I_C = 25 \, \text{mA}$

$$V(\text{BR})_{CEO} > 18 \, \text{V}$$

Emitter-base voltage
open collector, $I_E = 1.0 \, \text{mA}$

$$V(\text{BR})_{EBO} > 4 \, \text{V}$$

Collector-emitter saturation voltage

$I_C = 500 \, \text{mA}; \, I_B = 100 \, \text{mA}$

$$V_{C Eb} \text{ sat} \, \text{typ}. \, 0.2 \, \text{V}$$

D.C. current gain

$I_C = 500 \, \text{mA}; \, V_{CE} = 5 \, \text{V}$

$$h_{FE} \, \text{typ}. \, 40$$

Transition frequency

$I_C = 500 \, \text{mA}; \, V_{CE} = 5 \, \text{V}; \, f = 500 \, \text{MHz}$

$$f_T \, \text{typ}. \, 1300 \, \text{MHz}$$

Collector capacitance at $f = 1 \, \text{MHz}$

$I_E = I_e = 0; \, V_{CB} = 10 \, \text{V}$

$$C_C \, \text{typ}. \, 14 \, \text{pF} \, < \, 20 \, \text{pF}$$

Emitter capacitance at $f = 1 \, \text{MHz}$

$I_C = I_c = 0; \, V_{EB} = 0$

$$C_e \, \text{typ}. \, 65 \, \text{pF}$$

Feedback capacitance at $f = 1 \, \text{MHz}$

$I_C = 50 \, \text{mA}; \, V_{CE} = 10 \, \text{V}$

$$C_{re} \, \text{typ}. \, 10.5 \, \text{pF}$$

Collector-stud capacitance

$$C_{cs} \, \text{typ}. \, 2 \, \text{pF}$$

\[ T_j = 25 \, ^\circ\text{C} \, \text{unless otherwise specified} \]
APPLICATION INFORMATION

R. F. performance in c. w. operation (unneutralized common-emitter class B circuit)

$T_h$ up to 25 °C

<table>
<thead>
<tr>
<th>$f$ (MHz)</th>
<th>$V_{CC}$ (V)</th>
<th>$P_s$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$\overline{Z_L}$ ($\Omega$)</th>
<th>$\overline{V}_{IL}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>13.8</td>
<td>&lt; 2.0</td>
<td>7.0</td>
<td>&lt; 0.78</td>
<td>&gt; 5.4</td>
<td>&gt; 65</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>470</td>
<td>13.8</td>
<td>typ. 2.0</td>
<td>7.8</td>
<td>typ. 0.81</td>
<td>typ. 5.9</td>
<td>typ. 70</td>
<td>2.4+j6.7</td>
<td>60 – j20</td>
</tr>
<tr>
<td>470</td>
<td>12.5</td>
<td>&lt; 2.2</td>
<td>7.0</td>
<td>&lt; 0.86</td>
<td>&gt; 5.0</td>
<td>&gt; 65</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>typ. 0.4</td>
<td>7.2</td>
<td>typ. 0.87</td>
<td>typ. 12.6</td>
<td>typ. 66</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz:

C1 = C2 = C4 = C5 = 1.8 to 18 pF film dielectric trimmer
C3 = 6.8 pF ceramic capacitor
C6 = 0.1 μF polyester capacitor
C7 = 4 nF feed-through capacitor
C8 = 10 pF ceramic capacitor

L1 = L4 = L5 = 20 mm straight Cu wire (1.2 mm); height above print 12 mm
L2 = 0.47 μH choke
L3 = 1 turn Cu wire (1.7 mm); int. diam. 10 mm; max. lead length 5 mm
R = 10 Ω carbon

At $P_L = 7.0$ W and $V_{CC} = 12.5$ V the output power at heatsink temperatures between 25 °C and 90 °C relative to that at 25 °C is diminished by typ. 10 mW/°C

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: $V_{CC} = 16.5$ V; $f = 470$ MHz; $T_h = 70$ °C;
V.S.W.R. = 50 : 1 through all phases; $P_S = P_{S_{nom}} + 20\%$
where $P_{S_{nom}} = P_S$ for 7.0 W transistor output into 50 Ω load at $V_{CC} = 13.8$ V

Component lay-out for 470 MHz see page 7
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 470 MHz test circuit.

Shaded area copper
Back area completely copper clad
Material of printed circuit board: 1.5 mm epoxy fibre glass
May 1974
Conditions for R. F. SOAR:

\[ f = 470 \text{ MHz} \]
\[ T_h = 70 \text{ °C} \]
\[ V_{CC_{nom}} = 13.8 \text{ V} \]

\[ P_{S_{nom}} = P_S \text{ at } V_{CC} = V_{CC_{nom}} \text{ and } V_{SWR} = 1 \]

The transistor was developed for use with unstabilized supply voltage \( V_{CC} \).

The above graph is based on its measured performance in the circuit given on page 6. Supply voltage was varied from \( V_{CC_{nom}} \) to 1.2 \( V_{CC_{nom}} \), and \( V_{SWR} \) from 1 to 50.

It shows the max. permissible output power under nominal conditions in order not to exceed the max. permissible power dissipation under conditions of supply over-voltage (\( V_{CC} > V_{CC_{nom}} \)) and load mismatch (\( V_{SWR} > 1 \)).

It is assumed that the drive power increases linearly with the supply voltage; i.e.

\[ P_S/P_{S_{nom}} = V_{CC}/V_{CC_{nom}} \].
APPLICATION INFORMATION (continued)

Test circuit for 175 MHz:

![Circuit Diagram]

C1 = C3 = C4 = 30 pF concentric air trimmer
C2 = 60 pF concentric air trimmer
C5 = 0.25 μF polyester capacitor
C6 = 4.0 nF feed-through capacitor

L1 = 25 mm straight Cu wire (1.2 mm); height above print 3 mm
L2 = 3 turns Cu wire (0.5 mm) on Ferrite FX1115, d = 2 mm, D = 4 mm, l = 5 mm
material 3B (code number 311399116740)
L3 = 5 turns closely wound Cu wire (1.2 mm); int. diam. 10 mm; lead length 5 mm
L4 = 3 turns closely wound Cu wire (1.2 mm); int. diam. 10 mm; lead length 5 mm
R = 10 Ω carbon

Graphs (P_L versus P_S and η versus P_S) for 175 MHz on page 8.
Component lay-out for 175 MHz on page 11.
APPLICATION INFORMATION  (continued)

Component lay-out and printed circuit board for 175 MHz test circuit

Shaded area copper
Back area not metalized
Material of printed circuit board: 1.5 mm epoxy fibre glass
power gain versus frequency (class B operation)

VCC = 13.8 V
P_L = 7.8 W
T_h = 25 °C

typ

input impedance (series components) versus frequency (class B operation)

VCC = 13.8 V
P_L = 7.8 W
T_h = 25 °C
typ. values

load impedance (parallel components) versus frequency (class B operation)

VCC = 13.8 V
P_L = 7.8 W
T_h = 25 °C
typ. values

May 1974
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class A, B and C operated mobile, industrial and military transmitters with a supply voltage of 13.5 V. The transistor is resistance stabilized. Gold metallization ensures extremely high reliability. Every transistor is tested under severe load mismatch conditions with a supply overvoltage to 16.5 V. It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.F. performance up to T&lt;sub&gt;mb&lt;/sub&gt; = 25 °C in an unneutralised common-emitter class B circuit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>V&lt;sub&gt;CC&lt;/sub&gt; (V)</th>
<th>f (MHz)</th>
<th>P&lt;sub&gt;S&lt;/sub&gt; (W)</th>
<th>P&lt;sub&gt;L&lt;/sub&gt; (W)</th>
<th>I&lt;sub&gt;C&lt;/sub&gt; (A)</th>
<th>G&lt;sub&gt;p&lt;/sub&gt; (dB)</th>
<th>η (%)</th>
<th>z&lt;sub&gt;1&lt;/sub&gt; (Ω)</th>
<th>Y&lt;sub&gt;L&lt;/sub&gt; (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.5</td>
<td>470</td>
<td>&lt;8.0</td>
<td>20</td>
<td>&lt;2.28</td>
<td>&gt;4</td>
<td>&gt;65</td>
<td>1.2 + j4.5</td>
<td>163 - j35</td>
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<tr>
<td>c.w.</td>
<td>12.5</td>
<td>470</td>
<td>&lt;6.8</td>
<td>17</td>
<td>&lt;2.09</td>
<td>&gt;4</td>
<td>&gt;65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required, an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0.75 Nm (7.5 kg cm) max. 0.85 Nm (8.5 kg cm)

Diameter of clearance hole in heatsink: max. 4.17 mm.

Mounting hole to have no burrs at either end. De-burring must leave surface flat; do not chamfer or countersink either end of hole.

February 1975
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to $T_h = 25 \degree C$
f $\geq 1 \text{ MHz}$

$$P_{tot} \leq 50 \text{ W}$$

Temperatures
Storage temperature
Junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

$$T_{stg} = -65 \text{ to } +200 \degree C$$
$$T_j \text{ max. } = 200 \degree C$$
$$R_{th j-mb} = 2.9 \degree C/W$$
$$R_{th mb-h} = 0.6 \degree C/W$$

February 1975
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter ; $I_C = 25$ mA

Collector-emitter voltage
open base ; $I_C = 25$ mA

Emitter-base voltage
open collector ; $I_E = 10$ mA

V (BR)CBO $> 36$ V

V (BR)CEO $> 18$ V

V (BR)EBO $> 4$ V

$T_J = 25$ °C unless otherwise specified

Breakdown voltages

Collector-base voltage
open emitter ; $I_C = 25$ mA

Collector-emitter voltage
open base ; $I_C = 25$ mA

Emitter-base voltage
open collector ; $I_E = 10$ mA

$T_J = 25$ °C unless otherwise specified

Breakdown voltages

Collector-base voltage
open emitter ; $I_C = 25$ mA

Collector-emitter voltage
open base ; $I_C = 25$ mA

Emitter-base voltage
open collector ; $I_E = 10$ mA

$T_J = 25$ °C unless otherwise specified

$T_J = 25$ °C unless otherwise specified

Transient energy

$L = 25$ mH; $f = 50$ Hz

open base

$-V_{BE} = 1.5$ V; $R_{BE} = 33$ Ω

$E > 3.1$ mWs

$E > 3.1$ mWs

D.C. current gain

$I_C = 1$ A; $V_{CE} = 5$ V

$h_{FE} > 10$

$typ. 30$

Transition frequency

$I_C = 2$ A; $V_{CE} = 10$ V

$f_T typ. 1.0$ GHz

Collector capacitance at $f = 1$ MHz

$I_E = I_e = 0$; $V_{CB} = 15$ V

$C_C typ. 55$ pF

$< 70$ pF

Feedback capacitance

$I_C = 100$ mA; $V_{CE} = 15$ V

$C_{re} typ. 32$ pF

Collector-stud capacitance

$C_{cs} typ. 2$ pF

February 1975
**f_t (MHz)**

**VCE = 10 V**

**Tj = 25°C**

<table>
<thead>
<tr>
<th>Ic (A)</th>
<th>Cc (pF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**February 1975**
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

$T_{\text{mb}}$ up to $25 \degree C$

<table>
<thead>
<tr>
<th>$f$ (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_p$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_i$ ($\Omega$)</th>
<th>$\overline{Y_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>13,5</td>
<td>&lt; 8,00</td>
<td>20</td>
<td>&lt; 2,28</td>
<td>&gt; 4</td>
<td>&gt; 65</td>
<td>1,2 + j4,5</td>
<td>163 - j35</td>
</tr>
<tr>
<td>470</td>
<td>12,5</td>
<td>&lt; 6,80</td>
<td>17</td>
<td>&lt; 2,09</td>
<td>&gt; 4</td>
<td>&gt; 65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>typ. 1,35</td>
<td>17</td>
<td>typ. 2,30</td>
<td>typ. 11</td>
<td>typ. 60</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit: 470 MHz; c.w. class-B.

![Diagram of the test circuit](image)

List of components:

- $C_1 = C_2 = C_7 = C_8 = 2,0 \text{ to } 9,0 \mu F$ film dielectric trimmer (cat. no. 2222 809 09002)
- $C_3 = C_4 = 15 \mu F$ chip capacitor
- $C_5 = 100 \mu F$ feed-through capacitor
- $C_6 = 33 \mu F$ polyester capacitor
- $R_1 = 1 \Omega$ carbon resistor
- $R_2 = 10 \Omega$ carbon resistor
- $L_1$ = stripline (41,1 mm x 5,0 mm)
- $L_2$ = 13 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 4,0 mm (0,32 $\mu$H)
- $L_3$ = 2 turns Cu wire (1 mm); winding pitch 1,5 mm; int. dia. 4 mm; leads 2 x 5 mm
- $L_4$ = stripline (52,7 mm x 5,0 mm)
- $L_5 = \text{Ferroxcube choke coil. } Z \text{ (at } f = 50 \text{ MHz) } = 750 \Omega \pm 20\% \text{ (cat. no. 4312 020 36640)₴}
- $L_1$ and $L_4$ are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric. ($\varepsilon_r = 2,74$); thickness 1,45 mm.

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph above for safe operation at supply voltages other than the nominal. The graph shows the allowable output power, under nominal conditions, as a function of the supply overvoltage ratio, with VSWR as parameter. The graph applies to the situation in which the drive \( (P_S/P_{S\text{nom}}) \) increases linearly with the supply overvoltage ratio.

The horizontal line at 20 W applies at \( V_{CC\text{nom}} = 13.5 \) V. For \( V_{CC\text{nom}} = 12.5 \) V, \( P_L \) should be derated to 17 W.
power gain versus frequency
(class B operation)

\[ V_{CC} = 13.5 \text{ V} \]
\[ P_L = 20 \text{ W} \]
\[ T_{mb} = 25 \text{ °C} \]

input impedance (series components) versus frequency
(class B operation)

\[ V_{CC} = 13.5 \text{ V} \]
\[ P_L = 20 \text{ W} \]
\[ T_{mb} = 25 \text{ °C} \]

typ. values

load impedance (parallel components) versus frequency
(class B operation)

\[ V_{CC} = 13.5 \text{ V} \]
\[ P_L = 20 \text{ W} \]
\[ T_{mb} = 25 \text{ °C} \]

typ. values
U.H.F. TRANSMITTING TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C with a supply voltage up to 28 V. The transistor is resistance stabilized and is tested under severe load mismatch conditions. Gold metallization ensures extremely high reliability. It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>V_{CC} (V)</th>
<th>f (MHz)</th>
<th>P_{S} (mW)</th>
<th>P_{L} (W)</th>
<th>I_{C} (mA)</th>
<th>G_{P} (dB)</th>
<th>\eta (%)</th>
<th>\overline{z}_{i} (\Omega)</th>
<th>\overline{Y}_{L} (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>24</td>
<td>470</td>
<td>typ. 50</td>
<td>typ. 67</td>
<td>typ. 12.3</td>
<td>typ. 53</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>&lt; 80</td>
<td>&lt; 71 &gt; 11,0 &gt; 50</td>
<td>2,5 + j0,2</td>
<td>3,4 - j16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>typ. 80</td>
<td>typ. 86</td>
<td>typ. 12.6</td>
<td>typ. 60</td>
<td>2,5 + j0,2</td>
<td>3,4 - j16</td>
<td></td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>1000</td>
<td>typ. 400</td>
<td>typ. 100</td>
<td>typ. 5,4</td>
<td>typ. 50</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0,75 Nm (7,5 kg cm)
max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,17 mm.

Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

- Collector-base voltage (open emitter) peak value
  \( V_{CBOM} \) max. 65 V

- Collector-emitter voltage \((V_{BE} = 0)\) peak value
  \( V_{CESM} \) max. 65 V

- Collector-emitter voltage (open base)
  \( V_{CEO} \) max. 33 V

- Emitter-base voltage (open collector)
  \( V_{EBO} \) max. 4,0 V

Currents

- Collector current (d.c.) \( I_C \) max. 400 mA
- Collector current (peak value); \( f \geq 10 \text{ MHz} \) \( I_{CM} \) max. 800 mA

Power dissipation

- Total power dissipation up to \( T_h = 70 \text{ °C} \)
  \( f \geq 10 \text{ MHz} \) (see also page 3)
  \( P_{tot} \) max. 4,0 W

Temperatures

- Storage temperature
  \( T_{stg} \) -65 to +150 °C

- Operating junction temperature
  \( T_j \) max. 200 °C

THERMAL RESISTANCE

- From junction to mounting base
  \( R_{th \text{ j-mb}} = 32.5 \text{ °C/W} \)

- From mounting base to heatsink
  \( R_{th \text{ mb-h}} = 0.6 \text{ °C/W} \)
$P_{\text{tot}}$ (W)

- Short time operation
- VSWR ≥ 3
- Normal operation
- VSWR ≤ 3

$\text{VCE} \leq 28 \text{ V}$
$f \geq 10 \text{ MHz}$

$\text{R}_{\text{th,d}} = (325 + 0.6) \text{ °C/W}$

$\text{R}_{\text{th,jn}} = (335 + 0.6) \text{ °C/W}$

$\text{D.C. SOAR}$

$T_h = 70 \text{ °C}$

$P_{\text{tot max (d.c.)}}$

- Derate by 33 °C/W for $70 \text{ °C} < T_h < 125 \text{ °C}$

June 1976
CHARACTERISTICS

Breakdown voltages

V(BR)CBO > 65 V

V(BR)CES > 65 V

V(BR)CEO > 33 V

V(BR)EBO > 4.0 V

D.C. current gain

hFE > 10 typ. 35

Transition frequency

fT typ. 1.2 GHz

Collector capacitance at f = 1 MHz

Cc typ. 3.5 pF

Emitter capacitance at f = 1 MHz

Ce typ. 11 pF

Feedback capacitance at f = 1 MHz

Cce typ. 2.5 pF

Collector-stud capacitance

Ccs typ. 2.0 pF

Tj = 25°C unless otherwise specified
APPLICATION INFORMATION

R.F. performance in c.w. operation (Unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ\text{C} \]

<table>
<thead>
<tr>
<th>( V_{CC} (V) )</th>
<th>( f ) (MHz)</th>
<th>( P_S ) (mW)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (mA)</th>
<th>( G_P ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( Z_L ) (( \Omega ))</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>470</td>
<td>typ. 50</td>
<td>typ. 67</td>
<td>typ. 12,3</td>
<td>typ. 53</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>470</td>
<td>&lt; 80</td>
<td>1,0</td>
<td>&lt; 71</td>
<td>&gt; 11,0</td>
<td>&gt; 50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>28</td>
<td>470</td>
<td>typ. 80</td>
<td>1,45</td>
<td>typ. 86</td>
<td>typ. 12,6</td>
<td>typ. 60</td>
<td>2,5 + j0,2</td>
<td>3,4 - j16</td>
</tr>
<tr>
<td>28</td>
<td>1000</td>
<td>typ. 400</td>
<td>1,4</td>
<td>typ. 100</td>
<td>typ. 5,4</td>
<td>typ. 50</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz:

\[ \text{C1} = \text{C2} = \text{C7} = 1,8 \text{ to } 18 \, \text{pF film dielectric trimmer} \]
\[ \text{C3} = \text{C4} = 18 \, \text{pF disc ceramic capacitor} \]
\[ \text{C5} = 1 \, \text{nF feed-through capacitor} \]
\[ \text{C6} = 1,0 \text{ to } 9,0 \, \text{pF film dielectric trimmer} \]
\[ \text{C8} = 0,1 \, \text{\mu F polyester capacitor} \]

\[ L_1 = 1 \text{ turn Cu wire (1,2 mm); int. dia. 5 mm; lead length = 2 mm} \]
\[ L_2 = 0,47 \, \mu \text{H choke} \]
\[ L_3 = 4 \text{ turns closely wound enamelled Cu wire (1,2 mm); int. dia. 6,5 mm; lead length = 4 mm} \]
\[ L_4 = 5 \text{ turns closely wound enamelled Cu wire (0,5 mm); int. dia. 4 mm; lead length = 5 mm} \]
\[ R = 10 \, \Omega \text{ carbon} \]

At \( P_L = 1,0 \, \text{W and } V_{CC} = 28 \, \text{V}, \) the output power at heatsink temperatures between 25 \( ^\circ\text{C} \) and 90 \( ^\circ\text{C} \) relative to that at 25 \( ^\circ\text{C} \) is diminished by typ. 2 mW/\( ^\circ\text{C} \).

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: \( V_{CC} = 28 \, \text{V; } f = 470 \, \text{MHz; } T_h = 90 \, ^\circ\text{C}. \)
\[ \text{VSWR} = 50 : 1 \text{ through all phases; } P_L = 1,2 \, \text{W}. \]

Component layout for 470 MHz test circuit see page 8.
APPLICATION INFORMATION (continued)

Component layout and printed-circuit board for 470 MHz test circuit.

Shaded area copper
Back area completely copper clad
Material of printed-circuit board: 1.5 mm epoxy fibre-glass
Indicated load power as a function of overload

The graph has been derived from an evaluation of the performance of transistors matched up to 1.6 W load power in the test amplifier on page 7 and subsequently subjected to various mismatch conditions at 28 V with VSWR up to 50 and elevated heatsink temperatures. This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.
OPERATING NOTE Below 350 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

**Power Gain Versus Frequency (Class-B Operation)**

- $V_{CC} = 28 \text{ V}$
- $P_L = 1.45 \text{ W}$
- $T_h = 25 \degree \text{C}$
- Typ. values

**Input Impedance (Series Components) Versus Frequency (Class-B Operation)**

- $r_i$
- $x_i$

**Load Impedance (Parallel Components) Versus Frequency (Class-B Operation)**

- $R_L$
- $C_L$
- Typ. values

---

June 1976
U.H.F. TRANSMITTING TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C with a supply voltage up to 28 V.

The transistor is resistance stabilized and is tested under severe load mismatch conditions.

Gold metallization ensures extremely high reliability.

It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

### QUICK REFERENCE DATA

R.F. performance up to $T_h = 25^\circ C$ in an unneutralized common-emitter class-B circuit.

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>$V_{CC}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_s$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (mA)</th>
<th>$G_P$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_I$ (\Omega)</th>
<th>$Y_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>24</td>
<td>470</td>
<td>typ. 0,2</td>
<td>2,4</td>
<td>typ. 143</td>
<td>typ. 10,8</td>
<td>typ. 70</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>&lt; 0,2</td>
<td>2,5</td>
<td>&lt; 149</td>
<td>&gt; 11,0</td>
<td>&gt; 60</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>typ. 0,2</td>
<td>3,0</td>
<td>typ. 162</td>
<td>typ. 11,7</td>
<td>typ. 66</td>
<td>1,8 + j2,8</td>
<td>7,2 - j24</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>1000</td>
<td>typ. 0,7</td>
<td>2,5</td>
<td>typ. 179</td>
<td>typ. 5,5</td>
<td>typ. 50</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### MECHANICAL DATA

**SOT-48**

Dimensions in mm

When locking is required an adhesive instead of a lock washer is preferred.
Torque on nut: min. 0,75 Nm

(7,5 kg cm)

max. 0,85 Nm

(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,17 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter) peak value</td>
<td>$V_{CBOM}$</td>
<td>65</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter voltage ($V_{BE} = 0$) peak value</td>
<td>$V_{CESM}$</td>
<td>65</td>
<td>V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$</td>
<td>33</td>
<td>V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>$V_{EBO}$</td>
<td>4.0</td>
<td>V</td>
</tr>
</tbody>
</table>

Currents

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector current (d.c.)</td>
<td>$I_C$</td>
<td>0.7</td>
<td>A</td>
</tr>
<tr>
<td>Collector current (peak value) $f \leq 10$ MHz</td>
<td>$I_{CM}$</td>
<td>2.0</td>
<td>A</td>
</tr>
</tbody>
</table>

Power dissipation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total power dissipation up to $T_h = 70$ °C $f \geq 10$ MHz (see also page 3)</td>
<td>$P_{tot}$</td>
<td>6.0</td>
<td>W</td>
</tr>
</tbody>
</table>

Temperatures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td>-65</td>
<td>+150</td>
<td>°C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>$T_j$</td>
<td>max.</td>
<td>200</td>
<td>°C</td>
</tr>
</tbody>
</table>

THERMAL RESISTANCE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>From junction to mounting base</td>
<td>$R_{th\ j-mb}$</td>
<td>21.4</td>
<td>°C/W</td>
</tr>
<tr>
<td>From mounting base to heatsink</td>
<td>$R_{th\ mb-h}$</td>
<td>0.6</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
CHARACTERISTICS

Breakdown voltages

- Collector-base voltage
  - open emitter, $I_C = 10$ mA
  - $V_{BR}CBO > 65$ V

- Collector-emitter voltage
  - $V_{BE} = 0, I_C = 10$ mA
  - $V_{BR}CES > 65$ V

- Collector-emitter voltage
  - open base, $I_C = 25$ mA
  - $V_{BR}CEO > 33$ V

- Emitter-base voltage
  - open collector, $I_E = 1.0$ mA
  - $V_{BR}EBO > 4.0$ V

- Collector-emitter saturation voltage
  - $I_C = 100$ mA; $I_B = 20$ mA
  - $V_{CEsat}$ typ. 0.17 V

- D.C. current gain
  - $I_C = 100$ mA; $V_{CE} = 5.0$ V
  - $hFE > 10$
  - typ. 40

Transition frequency

- $I_C = 100$ mA; $V_{CE} = 5.0$ V
  - $f_T$ typ. 1.2 GHz

Collector capacitance at $f = 1$ MHz

- $I_E = I_c = 0; V_{CB} = 10$ V
  - $C_C$ typ. 6.5 pF

Emitter capacitance at $f = 1$ MHz

- $I_C = I_e = 0; V_{EB} = 0$
  - $C_e$ typ. 25 pF

Feedback capacitance at $f = 1$ MHz

- $I_C = 10$ mA; $V_{CE} = 10$ V
  - $C_{re}$ typ. 4.8 pF

Collector-stud capacitance

- $C_{cs}$ typ. 2.0 pF

$T_j = 25$ °C unless otherwise specified
$|s_{le}|$ (dB)

$\arg s_{le}$

$|s_{re}|$ (dB)

$\arg s_{re}$

$|s_{fe}|$ (dB)

$\arg s_{fe}$

$|s_{oe}|$ (dB)

$\arg s_{oe}$

$I_E = 100 \ mA$

$V_{CE} = 28 \ V$

typ. values

June 1976
APPLICATION INFORMATION

R.F. performance in c.w. operation (Unneutralized common-emitter class-B circuit)

\[ T_h = 25^\circ C \]

<table>
<thead>
<tr>
<th>( V_{CC} ) (V)</th>
<th>( f ) (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (mA)</th>
<th>( G_P ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( Z_I ) (( \Omega ))</th>
<th>( \bar{V}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>470</td>
<td>typ. 0,2</td>
<td>2,4</td>
<td>typ. 143</td>
<td>typ. 10,8</td>
<td>typ. 70</td>
<td>-</td>
<td>-</td>
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<tr>
<td>28</td>
<td>470</td>
<td>&lt; 0,2</td>
<td>2,5</td>
<td>&lt; 149</td>
<td>&gt; 11,0</td>
<td>&gt; 60</td>
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<td>-</td>
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<tr>
<td>28</td>
<td>470</td>
<td>typ. 0,2</td>
<td>3,0</td>
<td>typ. 162</td>
<td>typ. 11,7</td>
<td>typ. 66</td>
<td>1,8 + j2,8</td>
<td>7,2 - j24</td>
</tr>
<tr>
<td>28</td>
<td>1000</td>
<td>typ. 0,7</td>
<td>2,5</td>
<td>typ. 179</td>
<td>typ. 5,5</td>
<td>typ. 50</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz:

C1 = C2 = 1,8 to 18 pF film dielectric trimmer
C3 = C4 = 18 pF disc ceramic capacitor
C5 = 1 nF feed-through capacitor
C6 = C7 = 1,0 to 9,0 pF film dielectric trimmer
C8 = 0,1 \( \mu F \) polyester capacitor

L1 = 1 turn Cu wire (1,2 mm); int. dia. 5 mm; lead length = 2 mm
L2 = 0,47 \( \mu H \) choke
L3 = 2 turns closely wound enamelled Cu wire (1,2 mm); int. dia. 6,5 mm; lead length = 4 mm
L4 = 3 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 4,0 mm; lead length = 5 mm
R = 10 \( \Omega \) carbon

At \( P_L = 2,5 \) W and \( V_{CC} = 28 \) V, the output power at heatsink temperatures between 25 \( ^\circ C \) and 90 \( ^\circ C \) relative to that at 25 \( ^\circ C \) is diminished by typ. 5 mW/\( ^\circ C \).

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: \( V_{CC} = 28 \) V; \( f = 470 \) MHz; \( T_h = 90 \) \( ^\circ C \).

VSWR = 50 : 1 through all phases; \( P_L = 2,5 \) W.

Component layout for 470 MHz test circuit see page 8.
APPLICATION INFORMATION (continued)

Component layout and printed-circuit board for 470 MHz test circuit.

Shade area copper
Back area completely copper clad
Material of printed-circuit board: 1.5 mm epoxy fibre-glass
Indicated load power as a function of overload

The graph has been derived from an evaluation of the performance of transistors matched up to 3.8 W load power in the test amplifier on page 7 and subsequently subjected to various mismatch conditions at 28 V with VSWR up to 50 and elevated heatsink temperatures. This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.
OPERATING NOTE Below 350 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
U.H.F. TRANSMITTING TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C with a supply voltage up to 28 V.

The transistor is resistance stabilized and is tested under severe load mismatch conditions. Gold metallization ensures extremely high reliability.

It has a capstan envelope with a moulded cap. All leads are isolated from the stud.

### QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ\text{C}$ in an unneutralized common-emitter class-B circuit.

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>$V_{CC}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_P$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$\bar{z}_i$ (Ω)</th>
<th>$\bar{Y}_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>24</td>
<td>470</td>
<td>typ. 1,0</td>
<td>7,0</td>
<td>typ. 0,42</td>
<td>typ. 8,5</td>
<td>typ. 70</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>&lt; 1,0</td>
<td>7,0</td>
<td>&lt; 0,42</td>
<td>&gt; 8,5</td>
<td>&gt; 60</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>typ. 1,0</td>
<td>8,0</td>
<td>typ. 0,38</td>
<td>typ. 9,0</td>
<td>typ. 75</td>
<td>1,8 + j5,3</td>
<td>19 – j32</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>1000</td>
<td>typ. 1,5</td>
<td>5,0</td>
<td>typ. 0,40</td>
<td>typ. 5,2</td>
<td>typ. 45</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0,75 Nm

(7,5 kg cm)

max. 0,85 Nm

(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,17 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

June 1976
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

**Voltages**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter) peak value</td>
<td>V_CBOM</td>
<td>max. 65 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (V_{BE} = 0) peak value</td>
<td>V_CESM</td>
<td>max. 65 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_CEO</td>
<td>max. 33 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>V_EBO</td>
<td>max. 4,0 V</td>
</tr>
</tbody>
</table>

**Currents**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector current (d.c.)</td>
<td>I_C</td>
<td>max. 1,0 A</td>
</tr>
<tr>
<td>Collector current (peak value) f ≥ 10 MHz</td>
<td>I_CM</td>
<td>max. 3,0 A</td>
</tr>
</tbody>
</table>

**Power dissipation**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total power dissipation up to T_{j} = 70 °C f ≥ 10 MHz (see also page 3)</td>
<td>P_{tot}</td>
<td>max. 12,5 W</td>
</tr>
</tbody>
</table>

**Temperatures**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>T_STG</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>T_J</td>
<td>max. 200 °C</td>
</tr>
</tbody>
</table>

**THERMAL RESISTANCE**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>From junction to mounting base</td>
<td>R_{th j-mb}</td>
<td>= 9,8 °C/W</td>
</tr>
<tr>
<td>From mounting base to heatsink</td>
<td>R_{th mb-h}</td>
<td>= 0,6 °C/W</td>
</tr>
</tbody>
</table>

June 1976
D.C. SOAR

\[ P_{\text{tot max}} \text{ (d.c.)} \]
- derate by 10.4 °C/W for
- 70 °C < \( T_h \) < 125 °C

Second breakdown (d.c.)

\( T_h = 25 \) °C
125 °C

- \( T_h \) ≤ 28 V
- \( f \) ≥ 10 MHz

- \( V_{CE} \) ≤ 28 V
- \( f \) ≥ 10 MHz

- short time operation
- VSWR ≥ 3

- \( R_{th} - h = (9.8 \pm 0.6) \) °C/W

- normal operation
- VSWR ≤ 3

- \( R_{th} - h = (9.8 \pm 0.6) \) °C/W

June 1976
### CHARACTERISTICS

**Breakdown voltages**

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>Minimum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage, open emitter, $I_C = 10 \text{ mA}$</td>
<td>$V_{(BR)CBO} &gt; 65 \text{ V}$</td>
</tr>
<tr>
<td>Collector-emitter voltage, open base, $I_C = 10 \text{ mA}$</td>
<td>$V_{(BR)CES} &gt; 65 \text{ V}$</td>
</tr>
<tr>
<td>Collector-emitter voltage, open base, $I_C = 25 \text{ mA}$</td>
<td>$V_{(BR)CEO} &gt; 33 \text{ V}$</td>
</tr>
<tr>
<td>Emitter-base voltage, open collector, $I_E = 1.0 \text{ mA}$</td>
<td>$V_{(BR)EBO} &gt; 4.0 \text{ V}$</td>
</tr>
</tbody>
</table>

**D.C. current gain**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$h_{FE}$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 100 \text{ mA}; V_{CE} = 5.0 \text{ V}$</td>
<td>$10$</td>
</tr>
</tbody>
</table>

**Transition frequency**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$f_T$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 200 \text{ mA}; V_{CE} = 5.0 \text{ V}$</td>
<td>$1.2 \text{ GHz}$</td>
</tr>
</tbody>
</table>

**Collector capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$C_C$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_E = I_e = 0; V_{CB} = 10 \text{ V}$</td>
<td>$14 \text{ pF}$</td>
</tr>
</tbody>
</table>

**Emitter capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$C_e$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = I_c = 0; V_{EB} = 0$</td>
<td>$60 \text{ pF}$</td>
</tr>
</tbody>
</table>

**Feedback capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$C_{re}$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 20 \text{ mA}; V_{CE} = 10 \text{ V}$</td>
<td>$10 \text{ pF}$</td>
</tr>
</tbody>
</table>

**Collector-stud capacitance**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$C_{CS}$ Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 25 \text{ °C}$ unless otherwise specified</td>
<td>$2.0 \text{ pF}$</td>
</tr>
</tbody>
</table>
APPLICATION INFORMATION

R.F. performance in c.w. operation (Unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( V_{CC} (V) )</th>
<th>( f ) (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( z_i ) (( \Omega ))</th>
<th>( \overline{V_L} ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>470</td>
<td>typ. 1,0</td>
<td>7,0</td>
<td>typ. 0,42</td>
<td>typ. 8,5</td>
<td>typ. 70</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>28</td>
<td>470</td>
<td>&lt; 1,0</td>
<td>7,0</td>
<td>&lt; 0,42</td>
<td>&gt; 8,5</td>
<td>&gt; 60</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>28</td>
<td>470</td>
<td>typ. 1,0</td>
<td>8,0</td>
<td>typ. 0,38</td>
<td>typ. 9,0</td>
<td>typ. 75</td>
<td>1,8 + j5,3</td>
<td>19 – j32</td>
</tr>
<tr>
<td>28</td>
<td>1000</td>
<td>typ. 1,5</td>
<td>5,0</td>
<td>typ. 0,40</td>
<td>typ. 5,2</td>
<td>typ. 45</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Test circuit for 470 MHz:

![Circuit Diagram]

- \( C1 = C2 = 1,8 \) to 18 pF film dielectric trimmer
- \( C3 = C4 = 18 \) pF disc ceramic capacitor
- \( C5 = 1 \) nF feed-through capacitor
- \( C6 = C7 = 1,0 \) to 9,0 pF film dielectric trimmer
- \( C8 = 0,1 \) μF polyester capacitor

\( L1 = 1 \) turn Cu wire (1,2 mm); int. dia. 5 mm; lead length = 2 mm
\( L2 = 0,47 \) μH choke
\( L3 = 2 \) turns closely wound enamelled Cu wire (1,2 mm); int. dia. 6,5 mm; lead length = 4 mm
\( L4 = 3 \) turns closely wound enamelled Cu wire (0,5 mm); int. dia. 4,0 mm; lead length = 5 mm
\( R = 10\Omega \) carbon

At \( P_L = 7,0 \) W and \( V_{CC} = 28 \) V, the output power at heatsink temperatures between 25 \( ^\circ C \) and 90 \( ^\circ C \) relative to that at 25 \( ^\circ C \) is diminished by typ. 10 mW/\( ^\circ C \).

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: \( V_{CC} = 28 \) V; \( f = 470 \) MHz; \( T_h = 90 \) \( ^\circ C \).

\( V_{SWR} = 50 : 1 \) through all phases; \( P_L = 7,0 \) W.

Component layout for 470 MHz test circuit see page 8.
APPLICATION INFORMATION  (continued)
Component layout and printed-circuit board for 470 MHz test circuit.

Shaded area copper
Back area completely copper clad
Material of printed-circuit board: 1.5 mm epoxy fibre-glass
Indicated load power as a function of overload

The graph has been derived from an evaluation of the performance of transistors matched up to 8 W load power in the test amplifier on page 7 and subsequently subjected to various mismatch conditions at 28 V with VSWR up to 50 and elevated heatsink temperatures. This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.
OPERATING NOTE Below 250 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor for use in class A, B or C amplifiers in U.H.F. transmitters with supply voltages up to 28 V. The transistor is resistance stabilized and tested under conditions of severe load mismatch. Gold metallization ensures extremely high reliability. The transistor is housed in a plastic encapsulated stripline package. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>VCC (V)</th>
<th>f (MHz)</th>
<th>PS (W)</th>
<th>PL (W)</th>
<th>IC (A)</th>
<th>GP (dB)</th>
<th>η (%)</th>
<th>Zj (Ω)</th>
<th>YL (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>&lt; 6,25</td>
<td>25</td>
<td>&lt; 1,62</td>
<td>&gt; 6</td>
<td>&gt; 55</td>
<td>0,8 + j4,3</td>
<td>62 - j64</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required, an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0,75 Nm

max. 0,85 Nm

Diameter of clearance hole in heatsink: max. 4,17 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1974
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to T_h = 25 °C f > 1 MHz

Temperatures
Storage temperature
Junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

\[ V_{CBOM} \text{ max. } 65 \text{ V} \]
\[ V_{CEO} \text{ max. } 30 \text{ V} \]
\[ V_{EBO} \text{ max. } 4 \text{ V} \]
\[ I_{C(AV)} \text{ max. } 2,0 \text{ A} \]
\[ I_{CM} \text{ max. } 6,0 \text{ A} \]

\[ P_{tot} \text{ max. } 50 \text{ W} \]

\[ T_{stg} \text{ -65 to +200 °C} \]
\[ T_{j} \text{ max. } 200 \text{ °C} \]

\[ R_{thj-mb} = 2,9 \text{ °C/W} \]
\[ R_{thmb-h} = 0,6 \text{ °C/W} \]
CHARACTERISTICS

Collector cut-off current

\[ I_B = 0; \ V_{CE} = 28 \ V \]

\[ I_{CEO} < 10 \ mA \]

Breakdown voltages

Collector-base voltage

open emitter, \( I_C = 25 \ mA \)

\[ V_{(BR)CBO} > 65 \ V \]

Collector-emitter voltage

open base, \( I_C = 25 \ mA \)

\[ V_{(BR)CEO} > 30 \ V \]

Emitter-base voltage

open collector, \( I_E = 10 \ mA \)

\[ V_{(BR)EBO} > 4 \ V \]

Transient energy

\[ L = 25 \ mH; f = 50 \ Hz \]

open base

\[ -V_{BE} = 1.5 \ V; R_{BE} = 33 \Omega \]

\[ E \geq 3 \ mWs \]

D.C. current gain

\[ I_C = 1 \ A; V_{CE} = 5 \ V \]

\[ h_{FE} \geq 15 \]

typ. 50

Transition frequency

\[ I_C = 2 \ A; V_{CE} = 20 \ V \]

\[ f_T \text{ typ.} 1.0 \ GHz \]

Collector capacitance at \( f = 1 \ MHz \)

\[ I_E = I_e = 0; V_{CB} = 30 \ V \]

\[ C_C \text{ typ.} 32 \ pF \]

\[ < 50 \ pF \]

Feedback capacitance at \( f = 1 \ MHz \)

\[ I_C = 100 \ mA; V_{CE} = 30 \ V \]

\[ C_{re} \text{ typ.} 18 \ pF \]

\[ C_{cs} \text{ typ.} 2 \ pF \]
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[
\begin{array}{ccccccc}
V_{CE} (V) & P_{S} (W) & P_{L} (W) & I_{C} (A) & G_{p} (dB) & \eta (%) & Z_{i} (\Omega) \\
28 & <6,25 & 25 & <1,62 & >6 & >55 & 0,8 + j4,3 \\
\end{array}
\]

Test circuit: 470 MHz; c.w. class-B.

Test circuit:

\[
\begin{array}{cccc}
R_{1} = 1 \Omega & \text{carbon resistor} \\
R_{2} = 10 \Omega & \text{carbon resistor} \\
L_{1} = \text{stripline (40,8 mm x 5,0 mm)} \\
L_{2} = 13 \text{ turns closely wound enamelled Cu wire (0,5 mm); int. dia. 4,0 mm} \\
L_{3} = 2 \text{ turns Cu wire (1 mm); winding pitch 1,5 mm; int. dia. 4 mm; leads 2 x 5 mm} \\
L_{4} = \text{stripline (52,4 mm x 5,0 mm)} \\
L_{5} = \text{Ferroxcube choke coil. Z (at f = 50 MHz) = 750 \Omega \pm 20\% (cat. no. 4312 020 36640)} \\
\end{array}
\]

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the VSWR, with heatsink temperature as parameter.
Power gain versus frequency (class B operation)

$G_p$ (dB)

$V_{CC} = 28$ V
$P_L = 25$ W
$T_{mb} = 25 ^\circ C$

Input impedance (series components) versus frequency (class B operation)

$R_i$ (Ω)
$x_i$ (Ω)

$V_{CC} = 28$ V
$P_L = 25$ W
$T_{mb} = 25 ^\circ C$

Load impedance (parallel components) versus frequency (class B operation)

$R_L$ (Ω)
$C_L$ (pF)

$V_{CC} = 28$ V
$P_L = 25$ W
$T_{mb} = 25 ^\circ C$

September 1974
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for transmitting applications in class-A, B or C in the u.h.f. frequency range for supply voltages up to 28 V. The transistor is resistance stabilized and is tested under severe load mismatch conditions. Due to a gold metallization excellent reliability properties have been obtained. The transistor is housed in a capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ \text{C}$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_S$ W</th>
<th>$P_L$ W</th>
<th>$I_C$ A</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>470</td>
<td>&lt; 14,2</td>
<td>40</td>
<td>&lt; 2,4</td>
<td>&lt; 4,5</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>typ. 3,2</td>
<td>40</td>
<td>typ. 1,9</td>
<td>typ. 11</td>
<td>typ. 75</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-56.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 1,5 Nm
(15 kg cm)
max. 1,7 Nm
(17 kg cm)

Diameter of clearance hole in heatsink: max. 5,0 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter) peak value

Collector-emitter voltage (RBE = 10Ω) peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Currents

Collector current (average)

Collector current (peak value) f > 1 MHz

Power dissipation

\[
\begin{align*}
V_{CBOM} & \text{ max. } 65 \, V \\
V_{CERM} & \text{ max. } 65 \, V \\
V_{CEO} & \text{ max. } 30 \, V \\
V_{EBO} & \text{ max. } 4 \, V \\
I_{C(AV)} & \text{ max. } 3,0 \, A \\
I_{CM} & \text{ max. } 10,0 \, A
\end{align*}
\]

Temperatures

Storage temperature

Junction temperature

THERMAL RESISTANCE

From junction to mounting base

From mounting base to heatsink

\[
\begin{align*}
T_{Stg} & \text{ -65 to } +200 \, ^\circ C \\
T_{J} & \text{ max. } 200 \, ^\circ C \\
R_{th \, j-mb} & = 2,0 \, ^\circ C/W \\
R_{th \, mb-h} & = 0,3 \, ^\circ C/W
\end{align*}
\]
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, $I_C = 50$ mA

Collector-emitter voltage
$R_{BE} = 10\Omega$, $I_C = 50$ mA

Collector-emitter voltage
open base, $I_C = 50$ mA

Emitter-base voltage
open collector, $I_E = 10$ mA

$T_j = 25^\circ C$ unless otherwise specified

$V_{(BR)CBO} > 65$ V

$V_{(BR)CER} > 65$ V

$V_{(BR)CEO} > 30$ V

$V_{(BR)EBO} > 4$ V

Transient energy

$L = 25$ mH; $f = 50$ Hz

open base $E > 4,5$ mWs

$-V_{BE} = 1,5$ V; $R_{BE} = 33\ \Omega$

$E > 4,5$ mWs

D.C. current gain

$I_C = 1,0$ A; $V_{CE} = 5$ V

$h_{FE} = 25$ to 100

Transition frequency

$I_C = 4$ A; $V_{CE} = 25$ V

$f_T$ typ. 900 MHz

Collector capacitance at $f = 1$ MHz

$I_E = I_C = 0$; $V_{CB} = 30$ V

$C_C$ typ. 68 pF

$< 80$ pF

Feedback capacitance at $f = 1$ MHz

$I_C = 200$ mA; $V_{CE} = 30$ V

$C_{re}$ typ. 39 pF

$C_{cs}$ typ. 2 pF

Collector-stud capacitance

November 1975
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ V_{CE} = 28 \, \text{V}; \, T_h \text{ up to } 25 \, ^\circ\text{C} \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>&lt; 14,2 typ.</td>
<td>40</td>
<td>&lt; 2,4 typ. 1,9</td>
<td>&gt; 4,5 typ. 11</td>
<td>&gt; 60 typ. 75</td>
</tr>
<tr>
<td>175</td>
<td>typ. 3,2</td>
<td>40</td>
<td>typ. 1,9</td>
<td>typ. 11</td>
<td>typ. 75</td>
</tr>
</tbody>
</table>

Test circuit: 470 MHz; c.w. class-B.

List of components:

- \( C1 = C7 = C8 = 2 \) to 18 pF film dielectric trimmer (cat. no. 2222 809 09003)
- \( C2 = 1,8 \) to 9 pF film dielectric trimmer (cat. no. 2222 809 09002)
- \( C3 = C4 = 18 \) pF chip capacitor
- \( C5 = 100 \) pF feed-through capacitor
- \( C6 = 33 \) nF polyester capacitor
- \( C9 = 2 \times 3,3 \) pF miniature ceramic plate capacitors (in parallel)
- \( R1 = 1 \) \( \Omega \) carbon resistor (0,25 W)
- \( R2 = 10 \) \( \Omega \) carbon resistor (0,25 W)
- \( L1 = \) stripline (21,4 mm x 5,3 mm)
- \( L2 = 13 \) turns closely wound enamelled Cu wire (0,5 mm); internal diameter 4,0 mm
- \( L3 = \) stripline (43,8 mm x 3,0 mm)
- \( L4 = \) stripline (45,5 mm x 5,3 mm)
- \( L5 = \) Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)

\( L1; L3; L4 \) are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric. \((\varepsilon_r = 2,74); \) thickness 1/32".

At \( P_L = 40 \) W and \( V_{CE} = 28 \) V, the output power at heatsink temperatures between 25 \( ^\circ\)C and 70 \( ^\circ\)C relative to that at 25 \( ^\circ\)C is diminished by typ. 50 mW/\(^\circ\)C.

The transistor is designed to withstand full load mismatch in the test circuit under the following conditions: \( V_{CE} = 28 \) V; \( f = 470 \) MHz; \( T_h = 70 \) \(^\circ\)C.

\( \text{VSWR} = 50 \) through all phases; \( P_L = 36 \) W.

Component layout and printed-circuit board for 470 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)

Component layout and printed-circuit board for 470 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
Indicated load power as a function of overload.

The graph has been derived from an evaluation of the performance of transistors matched up to 46 W load power in the test amplifier on page 5 and subsequently subjected to various mismatch conditions at 28 V with VSWR up to 50 and elevated heatsink temperatures.

This indicates a restriction to the load power matched under nominal conditions in the recommended test configuration.
APPLICATION INFORMATION (continued)

Test circuit for 175 MHz:

List of components:

C1 = 2.5 to 20 pF film dielectric trimmer (code number 2222 809 07004)
C2 = 4 to 40 pF film dielectric trimmer (code number 2222 809 07008)
C3 = C4 = 47 pF ceramic capacitor
C5 = 100 pF ceramic capacitor
C6 = 100 nF polyester capacitor
C7 = 6.8 pF ceramic capacitor
C8 = 4 to 60 pF film dielectric trimmer (code number 2222 809 07011)
C9 = 4 to 100 pF film dielectric trimmer (code number 2222 809 07015)
L1 = 0.5 turn enamelled Cu wire (1.5 mm); int. diam. 6 mm;
      lead length 2 x 6 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0.5 mm); int. diam. 3 mm;
      lead length 2 x 5 mm
L3 = L4 = ferroxcube choke coil (code number 4312 020 36640)
L5 = 53 nH; 2 turns enamelled Cu wire (1.5 mm); int. diam. 10 mm;
      coil length 5.2 mm; lead length 2 x 5 mm
L6 = 46 nH; 2 turns enamelled Cu wire (1.5 mm); int. diam. 9 mm;
      coil length 5.4 mm; lead length 2 x 5 mm
R1 = R2 = 10 Ω carbon resistor (0.25 W)

Component lay-out for 175 MHz test circuit see page 9.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

Dimensions of printed circuit board 123 mm x 55 mm.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
load power and efficiency versus source power (class B operation)

Typical values:
- $V_{CC} = 28V$
- $f = 175MHz$
- $T_h = 25 \, ^\circ C$

Power gain versus frequency (class B operation)

- $V_{CC} = 28V$
- $P_L = 40W$
- $T_h = 25 \, ^\circ C$

Input impedance (series components) versus frequency (class B operation)

Typical values:
- $V_{CC} = 28V$
- $P_L = 40W$
- $T_h = 25 \, ^\circ C$

Load impedance (parallel components) versus frequency (class B operation)

Typical values:
- $V_{CC} = 28V$
- $P_L = 40W$
- $T_h = 25 \, ^\circ C$
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N multi-emitter silicon transistor in a capstan envelope. It has extremely good inter-modulation properties and high power gain. The device is primarily intended for pre-amplifiers in television transmitters and transposers.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter; peak value)</td>
<td>V_{CBOM} max. 40 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_{CEO} max. 27 V</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>I_{CM} max. 1 A</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>T_j max. 200 °C</td>
</tr>
<tr>
<td>Thermal resistance from junction to mounting base</td>
<td>R_{th j-mb} = 15 °C/W</td>
</tr>
<tr>
<td>Transition frequency</td>
<td>f_T &gt; 1,2 GHz</td>
</tr>
<tr>
<td>IC = 200 mA; V_{CE} = 20 V</td>
<td>P_0 sync &gt; 0,5 W</td>
</tr>
<tr>
<td>Output power at f_{vision} = 860 MHz *)</td>
<td>G_p &gt; 6 dB</td>
</tr>
<tr>
<td>IC = 250 mA; V_{CE} = 25 V; T_h = 25 °C; d_{im} = -60 dB</td>
<td></td>
</tr>
<tr>
<td>Power gain at f_{vision} = 860 MHz</td>
<td></td>
</tr>
<tr>
<td>IC = 250 mA; V_{CE} = 25 V; T_h = 25 °C</td>
<td></td>
</tr>
</tbody>
</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, side band signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0,75 Nm
(7,5 kg cm)
max. 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,17 mm.
Mountinghole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC134)

**Voltages**
- Collector-base voltage (open emitter; peak value) \( V_{CBOM} \) max. 40 V
- Collector-emitter voltage (RBE = 10 \( \Omega \); peak value) \( V_{CERM} \) max. 40 V
- Collector-emitter voltage (open base) \( V_{CEO} \) max. 27 V
- Emitter-base voltage (open collector) \( V_{EBO} \) max. 3,5 V

**Currents**
- Collector current (d.c.) \( I_C \) max. 0,4 A
- Collector current (peak value) \( f > 1 \) MHz \( I_{CM} \) max. 1 A

**Power dissipation**
- Total power dissipation up to \( T_h = 100 \) °C \( P_{tot} \) max. 6,25 W

---

**Temperatures**
- Storage temperature \( T_{stg} \) -65 to +200 °C
- Junction temperature \( T_j \) max. 200 °C

**THERMAL RESISTANCE**
- From junction to mounting base \( R_{th j-mb} = 15 \) °C/W
- From mounting base to heatsink \( R_{th mb-h} = 0,6 \) °C/W

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September 1974
CHARACTERISTICS

**Collector cut-off current**

\[ I_E = 0; \quad V_{CB} = 20 \, \text{V} \]

**Breakdown voltages**

**Collector-base voltage**

open emitter; \( I_C = 1 \, \text{mA} \)

\[ V_{(BR)CBO} > 40 \, \text{V} \]

**Collector-emitter voltage**

\( R_{BB} = 10 \, \Omega; \quad I_C = 5 \, \text{mA} \)

open base; \( I_C = 5 \, \text{mA} \)

\[ V_{(BR)CER} > 40 \, \text{V} \]

\[ V_{(BR)CEO} > 27 \, \text{V} \]

**Emitter-base voltage**

open collector; \( I_E = 1 \, \text{mA} \)

\[ V_{(BR)EBO} > 3.5 \, \text{V} \]

**Saturation voltage**

\[ I_C = 200 \, \text{mA}; \quad I_B = 20 \, \text{mA} \]

\[ V_{CESat} < 0.75 \, \text{V} \]

**D.C. current gain**

\[ I_C = 200 \, \text{mA}; \quad V_{CE} = 20 \, \text{V} \]

\[ h_{FE} > 30 \]

\[ I_C = 400 \, \text{mA}; \quad V_{CE} = 20 \, \text{V} \]

\[ h_{FE} > 20 \]

**Transition frequency**

\[ I_C = 200 \, \text{mA}; \quad V_{CE} = 20 \, \text{V} \]

\[ f_T > 1.2 \, \text{GHz} \]

\[ I_C = 350 \, \text{mA}; \quad V_{CE} = 20 \, \text{V} \]

\[ f_T > 1.0 \, \text{GHz} \]

**Collector capacitance at \( f = 1 \, \text{MHz} \)**

\[ I_E = I_e = 0; \quad V_{CB} = 20 \, \text{V} \]

\[ C_C < 10 \, \text{pF} \]

**Feedback capacitance at \( f = 1 \, \text{MHz} \)**

\[ I_C = 10 \, \text{mA}; \quad V_{CE} = 20 \, \text{V}; \quad T_{mb} = 25 \, ^\circ\text{C} \]

\[ C_{re} \text{ typ.} \quad 3.5 \, \text{pF} \]

**Collector-stud capacitance**

\[ C_{cs} \text{ typ.} \quad 2 \, \text{pF} \]

\( T_J = 25 \, ^\circ\text{C} \) unless otherwise specified
**APPLICATION INFORMATION**

<table>
<thead>
<tr>
<th>dim(dB)</th>
<th>$f_{\text{vision}}$ (MHz)</th>
<th>$V_{\text{GE}}$ (V)</th>
<th>$I_{\text{C}}$ (mA)</th>
<th>$G_{p}$ (dB)</th>
<th>$P_{\text{o sync}}$ (W)</th>
<th>$T_{\text{h}}$ (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60</td>
<td>860</td>
<td>25</td>
<td>250</td>
<td>&gt; 6</td>
<td>&gt; 0,5</td>
<td>25</td>
</tr>
<tr>
<td>-60</td>
<td>860</td>
<td>25</td>
<td>250</td>
<td>typ. 7</td>
<td>typ. 0.6</td>
<td>25</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

Test circuit at $f_{\text{vision}}$ = 860 MHz.

**List of components:** (see also page 6)

C1 = C2 = C10 = 2 to 9 pF film dielectric trimmers
C3 = C4 = C12 = 100 nF polyester capacitors
C5 = C7 = C8 = 100 pF feed-through capacitors
C6 = 2 x 2.7 pF in parallel, chip capacitors
C9 = 2 to 18 pF film dielectric trimmer
C11 = 10 μF/40 V solid aluminium electrolytic capacitor

R1 = 220 Ω
R2 = 4.7 kΩ
R3 = 100 Ω
R4 = 10 Ω
R5 = 470 Ω (1 W)
R6 = 3 x 22 Ω in parallel; (1 W)
R7 = 12 kΩ
R8 = 1 kΩ
APPLICATION INFORMATION (continued)
List of components: (continued)

L1 = stripline (14.8 mm x 4.3 mm)
L2 = 7 turns closely wound enamelled Cu wire (0.5 mm); int. dia. 3 mm
L3 = 2 turns Cu wire (1 mm); winding pitch 1.5 mm; int. dia. 4.5 mm; leads 2 x 5 mm
L4 = stripline (29.5 mm x 4.3 mm)

L1 and L4 are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric ($\varepsilon_r = 2.74$); thickness 1.45 mm.

Layout of printed-circuit board for 860 MHz test circuit.

---

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.

Layout of printed board bias circuit.
Intermodulation distortion versus output power
three-tone test method (vision carrier -8 dB,
sound carrier -7 dB, sideband signal -16 dB),
zero dB corresponds to peak sync level.

\[ I_C = 250 \text{ mA} \]
\[ V_{CE} = 25 \text{ V} \]
\[ T_h = 25 \text{ °C} \]
\[ f = 860 \text{ MHz} \]

Power gain versus frequency

\[ I_C = 250 \text{ mA} \]
\[ V_{CE} = 25 \text{ V} \]
\[ T_h = 25 \text{ °C} \]

Input impedance (series components) versus frequency

\[ I_C = 250 \text{ mA} \]
\[ V_{CE} = 25 \text{ V} \]
\[ T_h = 25 \text{ °C} \]

Load impedance (parallel components) versus frequency

\[ I_C = 250 \text{ mA} \]
\[ V_{CE} = 25 \text{ V} \]
\[ T_h = 25 \text{ °C} \]
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N multi-emitter silicon transistor in a capstan envelope. It has extremely good inter-modulation properties and high power gain. The device is primarily intended for pre-amplifiers in television transmitters and transposers.

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<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$ max. 27 V</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>$I_{CM}$ max. 2 A</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_j$ max. 200 °C</td>
</tr>
<tr>
<td>Thermal resistance from junction to mounting base</td>
<td>$R_{th j-mb}$ = 7,5 °C/W</td>
</tr>
<tr>
<td>Transition frequency</td>
<td>$f_T$ &gt; 1,2 GHz</td>
</tr>
<tr>
<td>Output power at $f_{vision} = 860$ MHz *)</td>
<td>$P_{o sync}$ &gt; 1,0 W</td>
</tr>
<tr>
<td>Power gain at $f_{vision} = 860$ MHz</td>
<td>$G_p$ &gt; 5,5 dB</td>
</tr>
</tbody>
</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, side band signal -16 dB), zero dB corresponds to peak sync level.

**MECHANICAL DATA**

Dimensions in mm

SOT-48

When locking is required an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0, 75 Nm (7, 5 kg cm)  
max. 0, 85 Nm (8, 5 kg cm)

Diameter of clearance hole in heatsink: max. 4, 17 mm.

Mounting hole to have no burrs at either end.  
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

**Voltages**
- Collector-base voltage (open emitter; peak value) \( V_{CBOM} \) max. 40 V
- Collector-emitter voltage (\( R_{BE} = 10 \Omega \); peak value) \( V_{CERM} \) max. 40 V
- Collector-emitter voltage (open base) \( V_{CEO} \) max. 27 V
- Emitter-base voltage (open collector) \( V_{EBO} \) max. 3.5 V

**Currents**
- Collector current (d.c.) \( I_C \) max. 0.8 A
- Collector current (peak value) \( f > 1 \text{ MHz} \) \( I_{CM} \) max. 2 A

**Power dissipation**
- Total power dissipation up to \( T_h = 100 \, ^\circ \text{C} \) \( P_{\text{tot}} \) max. 12.5 W

**Temperatures**
- Storage temperature \( T_{\text{stg}} \) -65 to +200 \( ^\circ \text{C} \)
- Junction temperature \( T_j \) max. 200 \( ^\circ \text{C} \)

**THERMAL RESISTANCE**
- From junction to mounting base \( R_{th \, j-\text{mb}} = 7.5 \, ^\circ \text{C} / \text{W} \)
- From mounting base to heatsink \( R_{th \, \text{mb-h}} = 0.6 \, ^\circ \text{C} / \text{W} \)

September 1974
CHARACTERISTICS

Collector cut-off current

\[ I_E = 0; \quad V_{CB} = 20 \text{ V} \]

Breakdown voltages

Collector-base voltage

open emitter; \( I_C = 2 \text{ mA} \)

Collector-emitter voltage

\( R_{BE} = 10 \text{ } \Omega; \quad I_C = 10 \text{ mA} \)

open base; \( I_C = 10 \text{ mA} \)

Emitter-base voltage

open collector; \( I_E = 2 \text{ mA} \)

Saturation voltage

\( I_C = 400 \text{ mA}; \quad I_B = 40 \text{ mA} \)

D.C. current gain

\( I_C = 400 \text{ mA}; \quad V_{CE} = 20 \text{ V} \)
\( I_C = 800 \text{ mA}; \quad V_{CE} = 20 \text{ V} \)

Transition frequency

\( I_C = 400 \text{ mA}; \quad V_{CE} = 20 \text{ V} \)
\( I_C = 700 \text{ mA}; \quad V_{CE} = 20 \text{ V} \)

Collector capacitance at \( f = 1 \text{ MHz} \)

\( I_E = I_e = 0; \quad V_{CB} = 20 \text{ V} \)

Feedback capacitance at \( f = 1 \text{ MHz} \)

\( I_C = 20 \text{ mA}; \quad V_{CE} = 20 \text{ V}; \quad T_{mb} = 25 ^\circ \text{C} \)

Collector-stud capacitance

\( T_j = 25 ^\circ \text{C} \) unless otherwise specified

\[ I_{CBO} < 200 \mu\text{A} \]

\[ V_{(BR)CBO} > 40 \text{ V} \]

\[ V_{(BR)CER} > 40 \text{ V} \]
\[ V_{(BR)CEO} > 27 \text{ V} \]

\[ V_{(BR)EBO} > 3,5 \text{ V} \]

\[ V_{CEsat} < 0,75 \text{ V} \]

\[ h_F E > 30 \]
\[ h_F E > 20 \]

\[ f_T > 1,2 \text{ GHz} \]
\[ f_T > 1,0 \text{ GHz} \]

\[ C_c < 20 \text{ pF} \]

\[ C_{re} \text{ typ. } 7 \text{ pF} \]

\[ C_{cs} \text{ typ. } 2 \text{ pF} \]
APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>$d_{im} \text{ (dB)}$</th>
<th>$f_{vision} \text{ (MHz)}$</th>
<th>$V_{CE}$ (V)</th>
<th>$I_{C}$ (mA)</th>
<th>$G_{p} \text{ (dB)}$</th>
<th>$P_{o \text{ sync}} \text{ (W)}$</th>
<th>$T_{h} \text{ (°C)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60</td>
<td>860</td>
<td>25</td>
<td>500</td>
<td>&gt; 5,5</td>
<td>&gt; 1,0</td>
<td>25</td>
</tr>
<tr>
<td>-60</td>
<td>860</td>
<td>25</td>
<td>500</td>
<td>typ. 6,5</td>
<td>typ. 1,1</td>
<td>25</td>
</tr>
</tbody>
</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

Test circuit at $f_{vision} = 860 \text{ MHz}$

List of components: (see also page 6)

C1 = C2 = C10 = 2 to 9 pF film dielectric trimmers
C3 = C4 = C12 = 100 nF polyester capacitors
C5 = C7 = C8 = 100 pF feed-through capacitors
C6 = 2 x 2,7 pF in parallel, chip capacitors
C9 = 2 to 18 pF film dielectric trimmer
C11 = 10 μF/40 V solid aluminium electrolytic capacitor

R1 = 220 Ω
R2 = 4,7 kΩ
R3 = 100 Ω
R4 = 10 Ω
R5 = 470 Ω (1 W)
R6 = 3 x 22 Ω in parallel; (1 W)
R7 = 12 kΩ
R8 = 1 kΩ

June 1976
APPLICATION INFORMATION (continued)

List of components: (continued)

L1 = stripline (14.8 mm x 4.3 mm)
L2 = 7 turns closely wound enamelled Cu wire (0.5 mm); int. dia. 3 mm
L3 = 2 turns Cu wire (1 mm); winding pitch 1.5 mm; int. dia. 4.5 mm; leads 2 x 5 mm
L4 = stripline (29.5 mm x 4.3 mm)

L1 and L4 are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric (\( \varepsilon_r = 2.74 \)); thickness 1.45 mm.

Layout of printed-circuit board for 860 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.

Layout of printed board bias circuit.
Intermodulation distortion versus output power
three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB),
zero dB corresponds to peak sync level.

-70
-65
-60
-55
-50

0 1 2 3 Po (W)

Power gain versus frequency

IC = 500 mA
VCE = 25 V
Th = 25 °C

Input impedance (series components) versus frequency
IC = 500 mA
VCE = 25 V
Th = 25 °C

Load impedance (parallel components) versus frequency
IC = 500 mA
VCE = 25 V
Th = 25 °C
U.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor assembled in a plastic encapsulated stripline package all leads of which are isolated from the stud. Excellent d.c. dissipation properties have been obtained by means of internal emitter-ballasting resistors and gold metallization. Detailed information is presented for application of this device in preamplifiers for television transposers and transmitters in band IV - V.

<table>
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<tr>
<td>Output power at f_{vision} = 860 MHz *)</td>
</tr>
<tr>
<td>Power gain at f_{vision} = 860 MHz</td>
</tr>
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</table>

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

MECHANICAL DATA

SOT-48

Dimensions in mm

When locking is required an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0,75 Nm (7,5 kg cm) max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,17 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

March 1976
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-base voltage (open emitter; peak value)  $V_{CBOM}$  max.  50 V
Collector-emitter voltage (open base)  $V_{CEO}$  max.  27 V
Emitter-base voltage (open collector)  $V_{EBO}$  max.  3.5 V

Currents
Collector current (d.c.)  $I_C$  max.  2 A
Collector current (peak value) $f > 1$ MHz  $I_{CM}$  max.  4 A

Power dissipation
Total power dissipation at $T_h = 70$ °C  $P_{tot}$  max.  21.5 W

Temperatures
Storage temperature  $T_{stg}$  -65 to +200 °C
Junction temperature  $T_j$  max.  200 °C

THERMAL RESISTANCE
From junction to mounting base  $R_{th j-mb}$  =  5.5 °C/W
From mounting base to heatsink  $R_{th mb-h}$  =  0.6 °C/W
### CHARACTERISTICS

**Breakdown voltages**

- Collector-base voltage
  - open emitter; $I_C = 10\ mA$
  - $V_{(BR)CBO} > 50\ V$
- Collector-emitter voltage
  - open base; $I_C = 25\ mA$
  - $V_{(BR)CEO} > 27\ V$
- Emitter-base voltage
  - open collector; $I_E = 5\ mA$
  - $V_{(BR)EBO} > 3.5\ V$

**Saturation voltage**

- $I_C = 500\ mA; I_B = 100\ mA$
  - $V_{CE_{sat}} < 0.75\ V$

**D.C. current gain**

- $I_C = 1\ A; V_{CE} = 25\ V$
  - $h_{FE} > 15\ typ.$
  - $h_{FE} \leq 40\ typ.$

**Transition frequency**

- $I_C = 1\ A; V_{CE} = 25\ V$
  - $f_T \leq 2.5\ GHz$

**Collector capacitance at $f = 1\ MHz$**

- $I_E = I_C = 0; V_{CB} = 25\ V$
  - $C_C \leq 30\ pf$

**Feedback capacitance at $f = 1\ MHz$**

- $I_C = 50\ mA; V_{CE} = 25\ V; T_{mb} = 25\ ^\circ C$
  - $C_{re} \leq 15\ pf$

**Collector-stud capacitance**

- $C_{cs} \leq 2\ pf$

---

$T_j = 25\ ^\circ C$ unless otherwise specified.
### APPLICATION INFORMATION

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<tr>
<th>$d_{im}$ (dB)</th>
<th>$f_{vision}$ (MHz)</th>
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<th>$I_C$ (mA)</th>
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<td>-60</td>
<td>860</td>
<td>25</td>
<td>850</td>
<td>$&gt; 5.0$</td>
<td>$&gt; 3.5$</td>
<td>70</td>
</tr>
<tr>
<td>-60</td>
<td>860</td>
<td>25</td>
<td>850</td>
<td>typ. 5.5</td>
<td>typ. 4.0</td>
<td>70</td>
</tr>
</tbody>
</table>

* Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.

Test circuit at $f_{vision} = 860$ MHz

![Test circuit diagram](image)

**List of components:** (see also page 6)

- $C_1 = C_2 = 1,4$ to 5,5 pF film dielectric trimmers (2222 809 09001)
- $C_3 = C_4 = 100$ nF polyester capacitors
- $C_5 = C_6 = 1$ nF feed-through capacitors
- $C_7 = 5,6$ pF ceramic capacitor
- $C_8 = 2$ to 18 pF film dielectric trimmer (2222 809 09003)
- $C_9 = 2$ to 9 pF film dielectric trimmer (2222 809 09002)
- $C_{10} = 10$ μF/40 V solid aluminium electrolytic capacitor
- $C_{11} = 470$ nF polyester capacitor
- $C_{12} = 2 \times 3,3$ pF chip capacitors (in parallel)
APPLICATION INFORMATION (continued)

List of components: (continued)

- R1 = 150 Ω
- R2 = 1.8 kΩ
- R3 = 33 Ω
- R4 = 220 Ω (1 W)
- R5 = 4 x 12 Ω in parallel (4 x 1 W)
- R6 = 1 kΩ
- R7 = 220 Ω (potentiometer)

- L1 = stripline (13.6 mm x 6.9 mm)
- L2 = micro choke 0.47 μH (cat. no. 4322 057 04770)
- L3 = 1 turn Cu wire (1 mm); internal diameter 5.5 mm; leads 2 x 5 mm
- L4 = stripline (40.8 mm x 6.9 mm)
- L5 = 1 turn Cu wire (1 mm); internal diameter 5.5 mm; leads 2 x 5 mm

L1 and L4 are striplines on a double Cu-clad print plate with PTFE fibre-glass dielectric ($\varepsilon_r = 2.74$); thickness 1.45 mm.

Component layout and printed-circuit board for 860 MHz test circuit.

The circuit and the components are situated on one side of the PTFE fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
Measured in a TV band IV circuit.

Measured in a TV band V circuit.

Detailed information concerning these circuits, available on request.

*) Three-tone test method (vision carrier -8 dB, sound carrier -7 dB, sideband signal -16 dB), zero dB corresponds to peak sync level.
Intermodulation distortion of input signal ≤ -75 dB.
Input impedance (series components) versus frequency

Typical values

\( V_{CE} = 25 \text{ V} \)
\( I_C = 850 \text{ mA} \)
\( T_H = 70 \text{ °C} \)

Load impedance (parallel components) versus frequency

Typical values

\( V_{CE} = 25 \text{ V} \)
\( I_C = 850 \text{ mA} \)
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class A, B and C operated mobile, industrial and military transmitters with a supply voltage of 13.5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply overvoltage to 16.5 V. It has a ¼" capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R. F. performance up to $T_{mb} = 25^\circ C$ in an unneutralised common-emitter class B circuit.

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>$V_{CC}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_D$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_1$ ($\Omega$)</th>
<th>$\bar{Y}_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.5</td>
<td>175</td>
<td>&lt; 1.0</td>
<td>8</td>
<td>&lt; 0.85</td>
<td>&gt; 9</td>
<td>&gt; 70</td>
<td>2.8 + j1.2</td>
<td>76 – j16</td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>175</td>
<td>typ. 1.0</td>
<td>8</td>
<td>typ. 0.91</td>
<td>typ. 9</td>
<td>typ. 70</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-48

Dimensions in mm

Diameter of clearance hole in heatsink: max. 4.17 mm.
Mounting hole to have no burrs at either end. De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required, an adhesive instead of a lock washer is preferred.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Collector-base voltage (open emitter)  
peak value  
Collector-emitter voltage (open base)  
Emitter-base voltage (open collector)

Currents

Collector current (average)  
Collector current (peak value) \( f > 1 \text{ MHz} \)

Power dissipation

Total power dissipation up to \( T_h = 25 \, ^\circ\text{C} \)  
\( f > 1 \text{ MHz} \)

D.C. SOAR

\[
P_{tot} \quad \max. \quad 17.5 \quad \text{W}
\]

Temperature

Storage temperature  
Operating junction temperature

THERMAL RESISTANCE

From junction to mounting base
From mounting base to heatsink

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CBOM} ) max.</td>
<td>36 V</td>
</tr>
<tr>
<td>( V_{CEO} ) max.</td>
<td>18 V</td>
</tr>
<tr>
<td>( V_{EBO} ) max.</td>
<td>4 V</td>
</tr>
<tr>
<td>( I_{CAV} ) max.</td>
<td>1.25 A</td>
</tr>
<tr>
<td>( I_{CM} ) max.</td>
<td>3.75 A</td>
</tr>
<tr>
<td>( P_{tot} ) max.</td>
<td>17.5 W</td>
</tr>
<tr>
<td>( R_{th , j-mb} )</td>
<td>9.4 , ^\circ\text{C}/\text{W}</td>
</tr>
<tr>
<td>( R_{th , mb-h} )</td>
<td>0.6 , ^\circ\text{C}/\text{W}</td>
</tr>
</tbody>
</table>

T \( _{stg} \) -30 to +200 \, ^\circ\text{C} 
T \( _{j} \) \quad \text{max.} \quad 200 \, ^\circ\text{C}
CHARACTERISTICS

Collector cut-off current

\[ I_B = 0; \ V_{CE} = 14 \ V \]

\[ I_{CEO} < 5 \ mA \]

Breakdown voltages

Collector-base voltage

open emitter, \( I_C = 1 \ mA \)

\[ V(\text{BR})CBO > 36 \ V \]

Collector-emitter voltage

open base, \( I_C = 10 \ mA \)

\[ V(\text{BR})CEO > 18 \ V \]

Emitter-base voltage

open collector, \( I_E = 1 \ mA \)

\[ V(\text{BR})EBO > 4 \ V \]

Transient energy

\[ L = 25 \ mH; \ f = 50 \ Hz \]

\[ E > 0.5 \ mWs \]

D.C. current gain

\[ I_C = 500 \ mA; \ V_{CE} = 5 \ V \]

\[ h_{FE} > 5 \]

Transition frequency

\[ I_C = 500 \ mA; \ V_{CE} = 10 \ V \]

\[ f_T \ \text{typ.} \ 700 \ MHz \]

Collector capacitance at \( f = 1 \ MHz \)

\[ I_E = I_e = 0; \ V_{CB} = 15 \ V \]

\[ C_c \ \text{typ.} \ 15 \ pF \]

Feedback capacitance at \( f = 1 \ MHz \)

\[ I_C = 100 \ mA; \ V_{CE} = 15 \ V \]

\[ C_{re} \ \text{typ.} \ 11 \ pF \]

Collector-stud capacitance

\[ C_{cs} \ \text{typ.} \ 2 \ pF \]

\( T_j = 25^\circ C \) unless otherwise specified
APPLICATION INFORMATION

R. F. performance in c. w. operation (unneutralised common-emitter class B circuit)

\( f = 175 \text{ MHz}; \ T_{mb} \text{ up to } 25^\circ \text{C} \)

<table>
<thead>
<tr>
<th>( V_{CC}(V) )</th>
<th>( P_S(W) )</th>
<th>( P_L(W) )</th>
<th>( I_C(A) )</th>
<th>( G_p(dB) )</th>
<th>( \eta(%) )</th>
<th>( Z_i(\Omega) )</th>
<th>( V_L(mA/V) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5</td>
<td>&lt; 1.0</td>
<td>8</td>
<td>&lt; 0.85</td>
<td>&gt; 9</td>
<td>&gt; 70</td>
<td>2.8 + j1.2</td>
<td>76 - j16</td>
</tr>
<tr>
<td>12.5</td>
<td>typ. 1.0</td>
<td>8</td>
<td>typ. 0.91</td>
<td>typ. 9</td>
<td>typ. 70</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit

C1 = 2.5 to 20 pF film dielectric trimmer (code number 2222 809 07004)
C2 = C6 = C7 = 4 to 40 pF film dielectric trimmer (code number 2222 809 07008)
C3 = 47 pF ceramic
C4 = 100 pF ceramic
C5 = 150 nF polyester
L1 = 0.5 turn enamelled Cu wire (1.5 mm); int. diam. 6 mm; leads 2 x 10 mm
L2 = L5 = ferroxcube choke (code number 4312 020 36640)
L3 = 2.5 turns closely wound enamelled Cu wire (1.5 mm); int. diam. 6 mm; leads 2 x 10 mm
L4 = 4.5 turns enamelled Cu wire (1.5 mm); int. diam. 6 mm; leads 2 x 10 mm
R = 10 \( \Omega \) carbon

Component lay-out for 175 MHz test circuit see page 6
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
OPERATING NOTE Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
Conditions for R.F. SOAR:

$$f = 175 \text{ MHz} \quad P_{\text{Snom}} = P_s \text{ at } V_{CC} = V_{CC\text{nom}} \quad \text{and } V.S.W.R. = 1$$

$$T_h = 70 \degree C \quad R_{th \text{ mb-h}} = 0.6 \quad \text{W/C/W}$$

$$V_{CC\text{nom}} = 12.5 \text{ or } 13.5 \text{ V} \quad \text{see also page 5}$$

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graphs above for safe operation at supply voltages other than the nominal. The graphs show the allowable output power under nominal conditions, as a function of the supply overvoltage ratio, with V.S.W.R. as parameter.

The left hand graph applies to the situation in which the drive ($P_s/P_{\text{Snom}}$) increases linearly with supply overvoltage ratio.

The right hand graph shows the derating factor to be applied when the drive ($P_s/P_{\text{Snom}}$) increases as the square of the supply overvoltage ratio ($V_{CC}/V_{CC\text{nom}}$).

Depending on the operating conditions, the appropriate derating factor may lie in the region between the linear and the square-law functions.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, h.f. and v.h.f. transmitters with a nominal supply voltage of 13,5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16,5 V. It has a 3/8” capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_H = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$z_I$ $\Omega$</th>
<th>$\nabla_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>8</td>
<td>$&gt; 12,0$</td>
<td>$&gt; 60$</td>
<td>$2,2 + j0,4$</td>
<td>96 – j28</td>
</tr>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>8 typ. 11,5</td>
<td>typ. 65</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-120.

Torque on nut: min. 0,75 Nm (7,5 kg cm)  
max. 0,85 Nm (8,5 kg cm)  

Diameter of clearance hole in heatsink: max. 4,2 mm.  
Mounting hole to have no burrs at either end.  
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

CAUTION  This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

May 1978
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage ($V_{BE} = 0$)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); $f > 1$ MHz

R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25\,^\circ$C.

- $V_{CEL}$ max. 36 V
- $V_{CEO}$ max. 18 V
- $V_{EBO}$ max. 4 V
- $I_C(\text{AV})$ max. 1.5 A
- $I_{CM}$ max. 4.0 A
- $P_{rf}$ max. 20 W

Storage temperature

Operating junction temperature

THERMAL RESISTANCE (dissipation = 8 W; $T_{mb} = 73,5\,^\circ$C, i.e. $T_{th} = 70\,^\circ$C)

- From junction to mounting base (d.c. dissipation)
  - $R_{th \ j-mb(d)} = 10,7\,^\circ$C/W
- From junction to mounting base (r.f. dissipation)
  - $R_{th \ j-mb(rf)} = 8,6\,^\circ$C/W
- From mounting base to heatsink
  - $R_{th \ mb-h} = 0,45\,^\circ$C/W

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; $V_{CE} \leq 16,5$ V; $f > 1$ MHz.

I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

$T_{stg}$ -65 to + 150 $^\circ$C
$T_{j}$ max. 200 $^\circ$C
CHARACTERISTICS

$T_j = 25 \, ^\circ\text{C}$

Collector-emitter breakdown voltage
$V_{BE} = 0; \; I_C = 5 \, \text{mA}$

Collector-emitter breakdown voltage
open base; $I_C = 25 \, \text{mA}$

Emitter-base breakdown voltage
open collector; $I_E = 1 \, \text{mA}$

Collector cut-off current
$V_{BE} = 0; \; V_{CE} = 18 \, \text{V}$

Second breakdown energy; $L = 25 \, \text{mH}; \; f = 50 \, \text{Hz}$
open base
$R_{BE} = 10 \, \Omega$

D.C. current gain *
$I_C = 0,75 \, \text{A}; \; V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage *
$I_C = 2 \, \text{A}; \; I_B = 0,4 \, \text{A}$

Transition frequency at $f = 100 \, \text{MHz}$ *
$-I_E = 0,75 \, \text{A}; \; V_{CB} = 13,5 \, \text{V}$
$-I_E = 2 \, \text{A}; \; V_{CB} = 13,5 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$
$I_E = I_e = 0; \; V_{CB} = 13,5 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$
$I_C = 100 \, \text{mA}; \; V_{CE} = 13,5 \, \text{V}$

Collector-stud capacitance

$V_{(BR)CES} > 36 \, \text{V}$

$V_{(BR)CEO} > 18 \, \text{V}$

$V_{(BR)EBO} > 4 \, \text{V}$

$I_{CES} < 2 \, \text{mA}$

$E_{SBO} > 0,5 \, \text{mJ}$

$E_{SBR} > 0,5 \, \text{mJ}$

$h_{FE} \quad \text{typ.} \quad 40 \quad \text{10 to 100}$

$V_{CEsat} \quad \text{typ.} \quad 0,85 \, \text{V}$

$f_T \quad \text{typ.} \quad 950 \, \text{MHz}$

$f_T \quad \text{typ.} \quad 850 \, \text{MHz}$

$C_{c} \quad \text{typ.} \quad 16,5 \, \text{pF}$

$C_{re} \quad \text{typ.} \quad 12 \, \text{pF}$

$C_{cs} \quad \text{typ.} \quad 2 \, \text{pF}$

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \; \delta \leq 0,02$.  

May 1978
Fig. 4 Typical values; \( T_j = 25 \, ^\circ\text{C} \).

Fig. 5 \( I_E = I_e = 0; f = 1 \, \text{MHz}; T_j = 25 \, ^\circ\text{C} \).

Fig. 6 Typical values; \( f = 100 \, \text{MHz}; T_j = 25 \, ^\circ\text{C} \).
**APPLICATION INFORMATION**

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_r = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_f ) (Ω)</th>
<th>( \overline{V_L} ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13.5</td>
<td>8</td>
<td>&lt;0.5</td>
<td>&gt;12.0</td>
<td>&lt;0.99</td>
<td>&gt;60</td>
<td>2.2 + j0.4</td>
<td>96 - j28</td>
</tr>
<tr>
<td>175</td>
<td>12.5</td>
<td>8</td>
<td>–</td>
<td>typ. 11.5</td>
<td>–</td>
<td>typ. 65</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

![Test Circuit](image)

**Fig. 7** Test circuit; c.w. class-B.

List of components:

- **C1** = 2.5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- **C2** = **C7** = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- **C3a** = **C3b** = 47 pF ceramic capacitor (500 V)
- **C4** = 120 pF ceramic capacitor
- **C5** = 100 nF polyester capacitor
- **C6** = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- **L1** = 2 turns Cu wire (1.6 mm); int. dia. 4.5 mm; length 5.7 mm; leads 2 x 5 mm
- **L2** = 100 nH; 7 turns closely wound enamelled Cu wire (0.5 mm); int. dia. 3 mm
- **L3** = **L8** = Ferroxcube choke coil (cat. no. 4312 020 36640)
- **L4** = **L5** = strip (12 mm x 6 mm); taps for **C3a** and **C3b** at 5 mm from transistor
- **L6** = 3 turns Cu wire (1.6 mm); int. dia. 7.5 mm; length 7.5 mm; leads 2 x 5 mm
- **L7** = 3 turns Cu wire (1.6 mm); int. dia. 6.5 mm; length 7.4 mm; leads 2 x 5 mm
- **L4** and **L5** are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16”.
- **R1** = 10 Ω carbon resistor
- **R2** = 4.7 Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
V.H.F. power transistor

Fig. 9 Typical values; \( f = 175 \text{ MHz} \);
- - - \( V_{CE} = 13,5 \text{ V} \);
- - - \( V_{CE} = 12,5 \text{ V} \).

Fig. 10 Typical values; \( f = 175 \text{ MHz} \);
- - - \( V_{CE} = 13,5 \text{ V} \);
- - - \( V_{CE} = 12,5 \text{ V} \).

Fig. 11 R.F. SOAR (short-time operation during mismatch); \( f = 175 \text{ MHz} \); \( T_h = 70 \text{ °C} \);
\( R_{th \, mb-h} = 0,45 \text{ °C/W} \); \( V_{CENom} = 13,5 \text{ V} \) or \( 12,5 \text{ V} \);
\( P_S = P_{Snom} \) at \( V_{CENom} \) and \( VSWR = 1 \).

Note to Fig. 11:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive \( (P_S/P_{Snom}) \) increases linearly with supply over-voltage ratio.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13 and 14:
Typical values; $V_{CE} = 13.5$ V; $P_L = 8$ W; $T_h = 25^\circ$C.

OPERATING NOTE
Below 100 MHz a base-emitter resistor of 10 $\Omega$ is recommended to avoid oscillation.
This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class A, B and C operated mobile, industrial and military transmitters with a supply voltage of 13.5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply overvoltage to 16.5 V. It has a 1/4" capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>$V_{CC}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_P$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$Z_i$ ($\Omega$)</th>
<th>$\bar{Y}_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.5</td>
<td>175</td>
<td>&lt; 2.65</td>
<td>15</td>
<td>&lt; 1.71</td>
<td>&gt; 7.5</td>
<td>&gt; 65</td>
<td>2.3+j2.2</td>
<td>128–j4.4</td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>175</td>
<td>typ. 2.65</td>
<td>15</td>
<td>typ. 1.85</td>
<td>typ. 7.5</td>
<td>typ. 65</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-48

Dimensions in mm

Torque on nut: min. 7.5 kg cm (0.75 Newton metres) max. 8.5 kg cm (0.85 Newton metres)

Diameter of clearance hole in heatsink: max. 4.17 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required, an adhesive instead of a lock washer is preferred.

May 1974
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

**Voltages**

Collector-base voltage (open emitter) peak value  
Collector-emitter voltage (open base)  
Emitter-base voltage (open collector)

**Currents**

Collector current (average)  
Collector (peak value) f > 1 MHz

**Power dissipation**

Total power dissipation up to $T_h = 25\, ^\circ C$  
f > 1 MHz

$P_{tot}$ max. 32 W

**Temperature**

Storage temperature  
Operating junction temperature

$T_{stg}$ -30 to +200 $^\circ C$  
$T_j$ max. 200 $^\circ C$

**THERMAL RESISTANCE**

From junction to mounting base  
From mounting base to heatsink

$R_{thj-mb} = 4.9 \, ^\circ C/W$  
$R_{mb-h} = 0.6 \, ^\circ C/W$

April 1971
CHARACTERISTICS

Collector cut-off current

\[ I_B = 0; \ V_{CE} = 14 \ V \]

\[ I_{CEO} < 10 \ mA \]

Breakdown voltages

Collector-base voltage

open emitter, \( I_C = 3 \ mA \)

\[ V_{(BR)CBO} > 36 \ V \]

Collector-emitter voltage

open base, \( I_C = 25 \ mA \)

\[ V_{(BR)CEO} > 18 \ V \]

Emitter-base voltage

open collector; \( I_E = 3 \ mA \)

\[ V_{(BR)EBO} > 4 \ V \]

Transient energy

\[ L = 25 \ mH; \ f = 50 \ Hz \]

open base

\[ -V_{BE} = 1.5 \ V; \ R_{BE} = 33 \ \Omega \]

\[ E > 2.0 \ \text{mWs} \]

\[ E > 4.5 \ \text{mWs} \]

D.C. current gain

\[ I_C = 500 \ mA; \ V_{CE} = 5 \ V \]

\[ h_{FE} > 5 \]

Transition frequency

\[ I_C = 1 \ A; \ V_{CE} = 10 \ V \]

\[ f_T \text{ typ.} 700 \ \text{MHz} \]

Collector capacitance at \( f = 1 \ \text{MHz} \)

\[ I_B = I_E = 0; \ V_{CB} = 15 \ V \]

\[ C_c \text{ typ.} 34 \ \text{pF} \]

\[ C_c < 40 \ \text{pF} \]

Feedback capacitance at \( f = 1 \ \text{MHz} \)

\[ I_C = 100 \ mA; \ V_{CE} = 15 \ V \]

\[ C_{re} \text{ typ.} 25 \ \text{pF} \]

Collector-stud capacitance

\[ C_{cs} \text{ typ.} 2 \ \text{pF} \]
BLY88A

1000
750
500
250
0

0
1
2
3
4
5
6

$f_t$ (MHz)

$I_C$ (A)

$V_{CE}=10$V

$C_c$ (pF)

$I_E=I_E=0$

$f=1$MHz

April 1971
APPLICATION INFORMATION

R. F. performance in c. w. operation (unneutralised common-emitter class B circuit)

\( f = 175 \text{ MHz}; T_{mb} \text{ up to } 25^\circ\text{C} \)

<table>
<thead>
<tr>
<th>( V_{CC}(V) )</th>
<th>( P_S(W) )</th>
<th>( P_L(W) )</th>
<th>( I_C(A) )</th>
<th>( G_p(\text{dB}) )</th>
<th>( \eta(%) )</th>
<th>( Z_i(\Omega) )</th>
<th>( Y_L(\text{mA/V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5</td>
<td>&lt; 2.65</td>
<td>15</td>
<td>&lt; 1.71</td>
<td>&gt; 7.5</td>
<td>&gt; 65</td>
<td>2.3+j2.2</td>
<td>128-j4.4</td>
</tr>
<tr>
<td>12.5</td>
<td>typ. 2.65</td>
<td>15</td>
<td>typ. 1.85</td>
<td>typ. 7.5</td>
<td>typ. 65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test circuit

\[ \text{Component lay-out for 175 MHz test circuit see page 6.} \]
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
OPERATING NOTE Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

- \( V_{CC} = 13.5 \text{ V} \)
- \( P_L = 15 \text{ W} \)
- \( T_{mb} = 25 ^\circ \text{C} \)

Typical values:
- \( f = 175 \text{ MHz} \)
- \( T_h = 25 ^\circ \text{C} \)

See page 5.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graphs above for safe operation at supply voltages other than the nominal. The graphs show the allowable output power under nominal conditions, as a function of the supply overvoltage ratio, with V.S.W.R. as parameter.

The left hand graph applies to the situation in which the drive \( \frac{P_S}{P_{Snom}} \) increases linearly with supply overvoltage ratio.

The right hand graph shows the derating factor to be applied when the drive \( \frac{P_S}{P_{Snom}} \) increases as the square of the supply overvoltage ratio \( \frac{V_{CC}}{V_{CCnom}} \).

Depending on the operating conditions, the appropriate derating factor may lie in the region between the linear and the square-law functions.

Conditions for R.F. SOAR:

\[
\begin{align*}
\text{f} & = 175 \text{ MHz} \\
T_h & = 70 \degree \text{C} \\
V_{CCnom} & = 12.5 \text{ or } 13.5 \text{ V}
\end{align*}
\]

\[P_{Snom} = P_s \text{ at } V_{CC} = V_{CCnom} \text{ and V.S.W.R. } = 1\]

\[T_{th} \text{ mb-h} = 0.6 \degree \text{C/W}\]
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, h.f. and v.h.f. transmitters with a nominal supply voltage of 13.5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16.5 V. It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_B$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_1$ $\Omega$</th>
<th>$\bar{V}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13.5</td>
<td>175</td>
<td>15</td>
<td>$&gt;3.0$</td>
<td>$&gt;60$</td>
<td>$2.3 + j2.2$</td>
<td>$130 - j4.4$</td>
</tr>
<tr>
<td>c.w.</td>
<td>12.5</td>
<td>175</td>
<td>15</td>
<td>typ. 7.5</td>
<td>typ. 67</td>
<td>$-$</td>
<td>$-$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Torque on nut: min. 0.75 Nm
(7.5 kg cm)
max. 0.85 Nm
(8.5 kg cm)

Diameter of clearance hole in heatsink: max. 4.2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

May 1978
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Collector-emitter voltage \( V_{BE} = 0 \)
   peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)
Collector current (average)
Collector current (peak value); \( f > 1 \) MHz
R.F. power dissipation (\( f > 1 \) MHz); \( T_{mb} = 25 ^\circ C \)
Storage temperature
Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{CESM} ) max.</td>
<td>36 V</td>
</tr>
<tr>
<td>( V_{CEO} ) max.</td>
<td>18 V</td>
</tr>
<tr>
<td>( V_{EBO} ) max.</td>
<td>4 V</td>
</tr>
<tr>
<td>( I_{C(AV)} ) max.</td>
<td>3 A</td>
</tr>
<tr>
<td>( I_{CM} ) max.</td>
<td>8 A</td>
</tr>
<tr>
<td>( P_{rf} ) max.</td>
<td>36 W</td>
</tr>
<tr>
<td>( T_{stg} )</td>
<td>-65 to +150 ^\circ C</td>
</tr>
<tr>
<td>( T_{j} ) max.</td>
<td>200 ^\circ C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; \( V_{CE} \leq 16.5 \) V;
\( f > 1 \) MHz.
I Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 15 W; \( T_{mb} = 77 ^\circ C \), i.e. \( T_{h} = 70 ^\circ C \))
From junction to mounting base (d.c. dissipation)
From junction to mounting base (r.f. dissipation)
From mounting base to heatsink

\[
\begin{align*}
R_{th \ j-mb(d)} &= 6.55 ^\circ C/W \\
R_{th \ j-mb(rf)} &= 4.95 ^\circ C/W \\
R_{th \ mb-h} &= 0.45 ^\circ C/W 
\end{align*}
\]
CHARACTERISTICS

$T_j = 25 \, ^\circ\text{C}$

Collector-emitter breakdown voltage
$V_{BE} = 0; I_C = 10 \, \text{mA}$

Collector-emitter breakdown voltage
open base; $I_C = 50 \, \text{mA}$

Emitter-base breakdown voltage
open collector; $I_E = 4 \, \text{mA}$

Collector cut-off current
$V_{BE} = 0; V_{CE} = 18 \, \text{V}$

Second breakdown energy; $L = 25 \, \text{mH}; f = 50 \, \text{Hz}$
open base
$R_{BE} = 10 \, \Omega$

D.C. current gain*
$I_C = 1,5 \, \text{A}; V_{CE} = 5 \, \text{V}$

Collector-emitter saturation voltage*
$I_C = 4,5 \, \text{A}; I_B = 0,9 \, \text{A}$

Transition frequency at $f = 100 \, \text{MHz}$*
$-I_E = 1,5 \, \text{A}; V_{CB} = 13,5 \, \text{V}$
$-I_E = 4,5 \, \text{A}; V_{CB} = 13,5 \, \text{V}$

Collector capacitance at $f = 1 \, \text{MHz}$
$I_E = I_e = 0; V_{CB} = 13,5 \, \text{V}$

Feedback capacitance at $f = 1 \, \text{MHz}$
$I_C = 200 \, \text{mA}; V_{CE} = 13,5 \, \text{V}$

Collector-stud capacitance

$V(\text{BR})CES > 36 \, \text{V}$

$V(\text{BR})CEO > 18 \, \text{V}$

$V(\text{BR})EBO > 4 \, \text{V}$

$I_{CES} < 4 \, \text{mA}$

$E_{SBO} > 2,5 \, \text{mJ}$

$E_{SBR} > 2,5 \, \text{mJ}$

$h_{FE}$ typ. 40

10 to 100

$V_{CE}\text{sat}$ typ. 1,0 V

$f_T$ typ. 850 MHz

$f_T$ typ. 800 MHz

$C_C$ typ. 32 pF

$C_{re}$ typ. 23 pF

$C_{cs}$ typ. 2 pF

* Measured under pulse conditions: $t_p < 200 \, \mu\text{s}; \delta < 0,02.$
Fig. 4 Typical values; $T_j = 25^\circ C$.

Fig. 5 $I_E = I_C = 0$; $f = 1$ MHz; $T_j = 25^\circ C$.

Fig. 6 Typical values; $f = 100$ MHz; $T_j = 25^\circ C$. 
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_H = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_p ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( Z_l ) (( \Omega ))</th>
<th>( \overline{V_L} ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>15</td>
<td>&lt; 2,4</td>
<td>&gt; 8,0</td>
<td>&lt; 1,85</td>
<td>&gt; 60</td>
<td>2,3 + j2,2</td>
<td>130 – j4,4</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>15</td>
<td>–</td>
<td>typ. 7,5</td>
<td>–</td>
<td>typ. 67</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

![Test Circuit Diagram](image)

Fig. 7 Test circuit; c.w. class-B.

List of components:

- **C1**: 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- **C2 = C7**: 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- **C3a = C3b**: 47 pF ceramic capacitor (500 V)
- **C4**: 120 pF ceramic capacitor
- **C5**: 100 nF polyester capacitor
- **C6**: 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
- **L1**: 2 turns Cu wire (1,6 mm); int. dia. 4,5 mm; length 5,7 mm; leads 2 x 5 mm
- **L2**: 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm
- **L3**: 120 \( \mu \)H; 3 turns Cu wire (1,6 mm); int. dia. 6,5 mm; length 7,4 mm; leads 2 x 5 mm
- **L4**: 10 \( \Omega \) carbon resistor
- **L5**: 4,7 \( \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; f = 175 MHz;
--- VCE = 13.5 V; ---- VCE = 12.5 V.

Fig. 10 Typical values; f = 175 MHz;
--- VCE = 13.5 V; ---- VCE = 12.5 V.

Fig. 11 R.F. SOAR (short-time operation during mismatch); f = 175 MHz; T_h = 70 °C;
R_{th mb-h} = 0.45 °C/W; V_{CEnom} = 13.5 V or 12.5 V; P_S = P_{Snom} at V_{CEnom} and VSWR = 1.

Note to Fig. 11:
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive (P_S/P_{Snom}) increases linearly with supply over-voltage ratio.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Fig. 14.

Conditions for Figs 12, 13 and 14:
Typical values: \( V_{CE} = 13.5 \text{ V} \); \( P_L = 15 \text{ W} \);
\( T_h = 25 \text{ °C} \).

**OPERATING NOTE**
Below 50 MHz a base-emitter resistor of 10 \( \Omega \) is recommended to avoid oscillation. This resistor must be effective for r.f. only.
**V.H.F. POWER TRANSISTOR**

N-P-N epitaxial planar transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 13,5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply over-voltage to 16,5 V. It has a ¾" capstan envelope with a moulded cap. All leads are isolated from the stud.

**QUICK REFERENCE DATA**

R.F. performance up to $T_{mb} = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$</th>
<th>$f$ MHz</th>
<th>$P_S$</th>
<th>$P_L$</th>
<th>$I_C$ A</th>
<th>$G_p$ dB</th>
<th>$\eta$</th>
<th>$\bar{Z}_i$ Ω</th>
<th>$\bar{V}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>&lt;6,25</td>
<td>25</td>
<td>&lt;2,64</td>
<td>&gt;6</td>
<td>&gt;70</td>
<td>1,6 + j1,4</td>
<td>213 + j5,5</td>
</tr>
</tbody>
</table>

**MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-56.

When locking is required an adhesive is preferred instead of a lock washer.

- Torque on nut: min. 1,5 Nm  
  (15 kg cm)  
  max. 1,7 Nm  
  (17 kg cm)

- Diameter of clearance hole in heatsink: max. 5,0 mm.
- Mounting hole to have no burrs at either end.
- De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to $T_{mb} = 25$ °C

Temperature
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

---

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter) peak value</td>
<td>$V_{CBOM}$ max. 36 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$ max. 18 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>$V_{EBO}$ max. 4 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>$I_{C(AV)}$ max. 5 A</td>
</tr>
<tr>
<td>Collector current (peak value) f &gt; 1 MHz</td>
<td>$I_{CM}$ max. 10 A</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P_{tot}$ max. 70 W</td>
</tr>
</tbody>
</table>

---

Temperature
- Storage temperature: $T_{stg} = -30$ to $+200$ °C
- Operating junction temperature: $T_j$ max. 200 °C

THERMAL RESISTANCE
- From junction to mounting base: $R_{th j-mb} = 2.5$ °C/W
- From mounting base to heatsink: $R_{th mb-h} = 0.3$ °C/W

---

March 1971
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, $I_C = 50$ mA

Collector-emitter voltage
open base, $I_C = 50$ mA

Emitter-base voltage
open collector; $I_E = 10$ mA

$T_j = 25^\circ C$ unless otherwise specified

$V_{(BR)CBO} > 36$ V

$V_{(BR)CEO} > 18$ V

$V_{(BR)EBO} > 4$ V

Transient energy

$L = 25$ mH; $f = 50$ Hz

open base

$E > 8$ mWs

$V_{BE} = 1.5$ V; $R_{BE} = 33\Omega$

$E > 8$ mWs

D.C. current gain

$I_C = 1$ A; $V_{CE} = 5$ V

$h_{FE}$ typ. 50

$10$ to $120$

Transition frequency

$I_C = 4$ A; $V_{CE} = 10$ V

$f_T$ typ. $650$ MHz

Collector capacitance at $f = 1$ MHz

$I_E = I_e = 0$; $V_{CB} = 15$ V

$C_c$ typ. $65$ pF

$< 90$ pF

Feedback capacitance at $f = 1$ MHz

$I_C = 100$ mA; $V_{CE} = 15$ V

$C_{re}$ typ. $41$ pF

Collector-stud capacitance

$C_{cs}$ typ. $2$ pF

March 1971
APPLICATION INFORMATION

R. F. performance in c.w. operation (unneutralised common-emitter class B circuit)

\[ V_{CC} = 13.5 \text{ V}; \ T_{mb} \text{ up to } 25^\circ \text{C} \]

<table>
<thead>
<tr>
<th>f(MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( z_1 ) (( \Omega ))</th>
<th>( Y_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>&lt; 6.25</td>
<td>25</td>
<td>&lt; 2.64</td>
<td>&gt; 6</td>
<td>&gt; 70</td>
<td>1.6+j1.4</td>
<td>213 +j5.5</td>
</tr>
</tbody>
</table>

Test circuit

\[ \text{C1} = 4 \text{ to } 44 \text{ pF} \text{ film dielectric trimmer (code number 2222 809 07008)} \]
\[ \text{C2} = 2 \text{ to } 22 \text{ pF} \text{ film dielectric trimmer (code number 2222 809 07004)} \]
\[ \text{C3} = \text{C4} = 47 \text{ pF} \text{ ceramic} \]
\[ \text{C5} = 100 \text{ pF} \text{ ceramic} \]
\[ \text{C6} = 150 \text{ nF} \text{ polyester} \]
\[ \text{C7} = 4 \text{ to } 104 \text{ pF} \text{ film dielectric trimmer (code number 2222 809 07015)} \]
\[ \text{C8} = 4 \text{ to } 64 \text{ pF} \text{ film dielectric trimmer (code number 2222 809 07011)} \]
\[ \text{L1} = 0.5 \text{ turn enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2x6 mm} \]
\[ \text{L2} = \text{L3} = \text{ferroxcube choke (code number 4312 020 36640)} \]
\[ \text{L4} = 3.5 \text{ turns closely wound enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2x6 mm} \]
\[ \text{L5} = 1 \text{ turn enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2x6 mm} \]
\[ \text{R1} = 10 \text{ \( \Omega \) carbon} \]

Component lay-out for 175 MHz see page 6.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graphs on page 3 for safe operation at supply voltages other than the nominal. The graphs show the allowable output power under nominal conditions, as a function of the supply overvoltage ratio, with V.S.W.R. as parameter.

The upper graph applies to the situation in which the drive \( \frac{P_S}{P_{S\text{nom}}} \) increases linearly with supply overvoltage ratio.

The lower graph shows the derating factor to be applied when the drive \( \frac{P_S}{P_{S\text{nom}}} \) increases as the square of the supply overvoltage ratio \( \frac{V_{CC}}{V_{CC\text{nom}}} \).

Depending on the operating conditions, the appropriate derating factor may lie in the region between the linear and the square-law functions.
f = 175 MHz
T_h = 70°C
R_{th mb-h} = 0.3 °C/W
V_{CC nom} = 13.5 V
P_{Snom} = P_S at V_{CC} = 13.5 V and V.S.W.R. = 1
see page 5

V.S.W.R. = 10

V.S.W.R. = 50

P_S

P_{Snom}

\frac{V_{CC}}{V_{CC nom}}

f = 175 MHz
T_h = 70°C
R_{th mb-h} = 0.3 °C/W
V_{CC nom} = 13.5 V
P_{Snom} = P_S at V_{CC} = 13.5 V and V.S.W.R. = 1
see page 5

V.S.W.R. = 10

V.S.W.R. = 50

P_S

P_{Snom}

\frac{V_{CC}}{V_{CC nom}}
OPERATING NOTE  Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a nominal supply voltage of 13.5 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions with a supply over-voltage to 16.5 V. It has a 3/8'' capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \degree C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CC}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\overline{z}_1$ $\Omega$</th>
<th>$\overline{Y_L}$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>13,5</td>
<td>175</td>
<td>25</td>
<td>&gt; 6</td>
<td>&gt; 70</td>
<td>1,6 + j1,4</td>
<td>210 + j5,5</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

SOT-120

Dimensions in mm

Torque on nut: min 0,75 Nm (7,5 kg cm)  
max 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink:  
min 4,2 mm.
max 4,2 mm.

Mounting hole to have no burrs at either end.  
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-emitter voltage ($V_{BE} = 0$)
- peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value); $f > 1$ MHz

Power dissipation
R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25^\circ C$

\[ \begin{align*}
V_{CESM} & \quad \text{max} \quad 36 \text{ V} \\
V_{CEO} & \quad \text{max} \quad 18 \text{ V} \\
V_{EBO} & \quad \text{max} \quad 4 \text{ V} \\
I_{C(AV)} & \quad \text{max} \quad 6 \text{ A} \\
I_{CM} & \quad \text{max} \quad 12 \text{ A} \\
\end{align*} \]

---

THERMAL RESISTANCE (dissipation 20 W; $T_{mb} = 79^\circ C$, i.e. $T_h = 70^\circ C$)

From junction to mounting base (d.c. dissipation)
From junction to mounting base (r.f. dissipation)
From mounting base to heatsink

\[ \begin{align*}
R_{th \ j-mb (dc)} & = 3,1 \text{ }^\circ \text{C/W} \\
R_{th \ j-mb (rf)} & = 2,3 \text{ }^\circ \text{C/W} \\
R_{th \ mb-h} & = 0,45 \text{ }^\circ \text{C/W} \\
\end{align*} \]
V.H.F. power transistor

CHARACTERISTICS

Tj = 25 °C

Breakdown voltage

Collector-emitter voltage

\[ V_{BE} = 0; \; I_C = 25 \; \text{mA} \]

Collector-emitter voltage

open base; \( I_C = 50 \; \text{mA} \)

Emitter-base voltage

open collector; \( I_E = 10 \; \text{mA} \)

Collector cut-off current

\[ V_{BE} = 0; \; V_{CE} = 18 \; \text{V} \]

\[ I_{CES} < 10 \; \text{mA} \]

Transient energy

\[ L = 25 \; \text{mH}; \; f = 50 \; \text{Hz} \]
open base

\[ V_{BE} = 1,5 \; \text{V}; \; R_{BE} = 33 \; \Omega \]

\[ E > 8 \; \text{mWs} \]

\[ E > 8 \; \text{mWs} \]

D.C. current gain*

\[ I_C = 2,5 \; \text{A}; \; V_{CE} = 5 \; \text{V} \]

\[ h_{FE} \; \text{typ} \; 50 \; \text{to} \; 80 \]

Collector-emitter saturation voltage*

\[ I_C = 7,5 \; \text{A}; \; I_B = 1,5 \; \text{A} \]

\[ V_{CEsat} \; \text{typ} \; 1,7 \; \text{V} \]

Transition frequency at \( f = 100 \; \text{MHz}^* \)

\[ I_C = 2,5 \; \text{A}; \; V_{CE} = 13,5 \; \text{V} \]

\[ I_C = 7,5 \; \text{A}; \; V_{CE} = 13,5 \; \text{V} \]

\[ f_T \; \text{typ} \; 800 \; \text{MHz} \]

\[ f_T \; \text{typ} \; 750 \; \text{MHz} \]

Collector capacitance at \( f = 1 \; \text{MHz} \)

\[ I_E = I_e = 0; \; V_{CB} = 15 \; \text{V} \]

\[ C_c \; \text{typ} \; 65 \; \text{pF} \]

\[ C_c \; < 90 \; \text{pF} \]

Feedback capacitance at \( f = 1 \; \text{MHz} \)

\[ I_C = 100 \; \text{mA}; \; V_{CE} = 15 \; \text{V} \]

\[ C_{re} \; \text{typ} \; 41 \; \text{pF} \]

Collector-stud capacitance

\[ C_{cs} \; \text{typ} \; 2 \; \text{pF} \]

* Measured under pulse conditions: \( t_p < 200 \; \mu s; \; \delta < 0,02. \)
BLY89C

**Graph 1:**
- **Typ values**
- **$T_J = 25 \, ^\circ C$**
- **$V_{CE} = 13.5 \, V$**
- **$V_{CE} = 5 \, V$**

**Graph 2:**
- **$I_E = I_e = 0$**
- **$f = 1 \, MHz$**

**Graph 3:**
- **$V_{CE} = 13.5 \, V$**
- **$f = 100 \, MHz$**
- **$T_J = 25 \, ^\circ C$**
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ C \]

<table>
<thead>
<tr>
<th>( f (\text{MHz}) )</th>
<th>( V_{CC} (\text{V}) )</th>
<th>( P_L (\text{W}) )</th>
<th>( P_S (\text{W}) )</th>
<th>( G_p (\text{dB}) )</th>
<th>( I_C (\text{A}) )</th>
<th>( \eta (%) )</th>
<th>( z_l (\Omega) )</th>
<th>( Y_L (\text{mA/V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>13,5</td>
<td>25</td>
<td>&lt;6,25</td>
<td>&gt; 6</td>
<td>&lt;2,64</td>
<td>&gt; 70</td>
<td>1,6 + j1,4</td>
<td>210 + j5,5</td>
</tr>
<tr>
<td>175</td>
<td>12,5</td>
<td>25</td>
<td>-</td>
<td>typ 6,6</td>
<td>-</td>
<td>typ 75</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Test circuit for 175 MHz

![Test circuit diagram](image)

List of components:

- C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
- C2 = C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
- C3a = C3b = 47 pF ceramic capacitor (500 V)
- C4 = 120 pF ceramic capacitor
- C5 = 100 nF polyester capacitor
- C6a = C6b = 8,2 pF ceramic capacitor (500 V)
- C7 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)

- L1 = 1 turn enameiled Cu wire (1,6 mm); int. dia. 9,0 mm; leads 2 x 5 mm
- L2 = 100 nH; 7 turns closely wound enameled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
- L3 = L8 = Ferroxcube choke coil (cat. no. 4312 020 36640)
- L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
- L6 = 2 turns enameled Cu wire (1,6 mm); int. dia. 5,0 mm; length 6,0 mm; leads 2 x 5 mm
- L7 = 2 turns enameled Cu wire (1,6 mm); int. dia. 4,5 mm; length 6,0 mm; leads 2 x 5 mm

L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".

- R1 = 10 \( \Omega \) (±10%) carbon resistor
- R2 = 4,7 \( \Omega \) (±5%) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit on page 6.

May 1977
APPLICATION INFORMATION (continued)
Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Conditions for R.F. SOAR

\[ f = 175 \text{ MHz} \]
\[ T_h = 70 \text{ °C} \]
\[ R_{th \, mb-h} = 0,45 \text{ °C/W} \]
\[ V_{CCnom} = 13,5 \text{ V} \]
\[ P_S = P_{Snom} \text{ at } V_{CCnom} = 13,5 \text{ V and VSWR = 1} \]

see page 5

The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power must be derated in accordance with the graph for safe operation at supply voltages other than the nominal. The graph shows the permissible output power under nominal conditions (VSWR = 1), as a function of the expected supply over-voltage ratio with VSWR as parameter.

The graph applies to the situation in which the drive \( \frac{P_S}{P_{Snom}} \) increases linearly with supply over-voltage ratio.
OPERATING NOTE  Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Measuring conditions for the graphs on this page

$V_{CC} = 13.5$ V
$P_L = 25$ W
$T_h = 25$ °C

Typical values
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 12.5 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions with a supply over-voltage to 15 V. It has a plastic encapsulated stripline package. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \degree C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_S$ W</th>
<th>$P_L$ W</th>
<th>$I_C$ A</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{Z}_i$ $\Omega$</th>
<th>$\bar{Y}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>12,5</td>
<td>175</td>
<td>&lt; 15,8</td>
<td>50</td>
<td>&lt; 5,33</td>
<td>&gt; 5,0</td>
<td>&gt; 75</td>
<td>1,3 + j1,6</td>
<td>270 + j170</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-55.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 2,3 Nm

$($23 kg cm$)$

max. 2,7 Nm

$($27 kg cm$)$

Diameter of clearance hole in heatsink: max. 6,5 mm.

Mounting hole to have no burrs at either end.

De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134)

**Voltages**
- Collector-base voltage (open emitter) peak value
- Collector-emitter voltage (open base)
- Emitter-base voltage (open collector)

**Currents**
- Collector current (average)
- Collector current (peak value) $f > 1$ MHz

**Power dissipation**
Total power dissipation up to $T_{mb} = 25^\circ C$ $f > 1$ MHz

**Temperature**
- Storage temperature
- Operating junction temperature

**THERMAL RESISTANCE**
- From junction to mounting base
- From mounting base to heatsink

---

**Graphs and Tables**

- Graph showing power dissipation ($P_{tot}$) vs. $T_h$ (°C) for different SWR conditions.
- Graph showing collector current ($I_c$) vs. collector-emitter voltage ($V_{CE}$) and temperature ($T_h$).

---

June 1971
CHARACTERISTICS

T_j = 25°C unless otherwise specified

Breakdown voltages

Collector-base voltage
open emitter, I_C = 100 mA
V(BR)CEO > 36 V

Collector-emitter voltage
open base, I_C = 100 mA
V(BR)CEO > 18 V

Emitter-base voltage
open collector, I_E = 25 mA
V(BR)EBO > 4 V

Transient energy

L = 25 mH; f = 50 Hz
-\( V_{BE} = 1.5 \) V; RBE = 33 \( \Omega \)
E > 8 mWs

D.C. current gain

I_C = 1 A; VCE = 5 V
hFE > 10 typ. 50

Transition frequency

I_C = 6 A; VCE = 10 V
f_T typ. 550 MHz

Collector capacitance at f = 1 MHz

I_E = 1_e = 0; VCB = 15 V
C_c typ. 130 pF
< 160 pF

Feedback capacitance

I_C = 200 mA; VCE = 15 V
C_re typ. 82 pF

Collector-stud capacitance

C_cs typ. 3.5 pF
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ f = 175 \text{ MHz}; \ T_h \text{ up to } 25 \text{ } ^\circ \text{C} \]

<table>
<thead>
<tr>
<th>( V_{CC} (V) )</th>
<th>( P_S (W) )</th>
<th>( P_L (W) )</th>
<th>( I_C (A) )</th>
<th>( G_p (dB) )</th>
<th>( \eta (%) )</th>
<th>( \overline{Z}_L (\Omega) )</th>
<th>( \overline{V}_L (mA/V) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.5</td>
<td>&lt; 15.8</td>
<td>50</td>
<td>&lt; 5.33</td>
<td>&gt; 5.0</td>
<td>&gt; 75</td>
<td>1.3 + j 1.6</td>
<td>270 + j 170</td>
</tr>
</tbody>
</table>

Test circuit for 175 MHz:

\[ \text{Component layout and printed-circuit board for 175 MHz test circuit see page 6.} \]
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets.
The transistor has been developed for use with unstabilized supply voltages. As the output power and drive power increase with the supply voltage, the nominal output power ($P_{Lnom}$) must be derated in accordance with the adjacent graph for safe operation at supply voltage other than the nominal. The graph shows the allowable output power under nominal conditions, as a function of the supply overvoltage ratio with V.S.W.R. as parameter. The graph applies to the situation in which the drive ($P_S/P_{Snom}$) increases linearly with supply overvoltage ratio ($V_{CC}/V_{CCnom}$).
power gain versus frequency (class B operation)

\[ V_{CC} = 12.5 \text{ V} \]
\[ P_L = 50 \text{ W} \]
\[ T_h = 25 \text{ °C} \]

Input impedance (series components) versus frequency (class B operation)

\[ V_{CC} = 12.5 \text{ V} \]
\[ P_L = 50 \text{ W} \]
\[ T_h = 25 \text{ °C} \]

typ. values

Load impedance (parallel components) versus frequency (class B operation)

\[ V_{CC} = 12.5 \text{ V} \]
\[ P_L = 50 \text{ W} \]
\[ T_h = 25 \text{ °C} \]

typ. values
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class A, B and C operated mobile, industrial and military transmitters with a supply voltage of 28 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions. It has a 1/4" capstan envelope with a moulded cap. All leads are isolated from the stud.

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>VCC (V)</th>
<th>f (MHz)</th>
<th>PS (W)</th>
<th>PL (W)</th>
<th>IC (A)</th>
<th>GP (dB)</th>
<th>( \eta ) (%)</th>
<th>( \bar{Z}_I ) (Ω)</th>
<th>( \bar{V}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>&lt; 0.50</td>
<td>8</td>
<td>&lt; 0.44</td>
<td>&gt; 12</td>
<td>&gt; 65</td>
<td>1.8+j0.7</td>
<td>18–j20</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

SOT-48

Diameter of clearance hole in heatsink: max. 4.17 mm
Mounting hole to have no burrs at either end
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required, an adhesive instead of a lock washer is preferred.
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Collector-base voltage (open emitter)  
peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to $T_h = 25^\circ C$
$f > 1$ MHz

Temperatures
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink
**CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector cut-off current</td>
<td>$I_B = 0$; $V_{CE} = 28 \text{ V}$</td>
<td>$I_{CEO} &lt; 5 \text{ mA}$</td>
</tr>
<tr>
<td><strong>Breakdown voltages</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-base voltage</td>
<td>$V_{(BR)CBO} &gt; 65 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>open emitter; $I_C = 1 \text{ mA}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>$V_{(BR)CEO} &gt; 36 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>open base, $I_C = 10 \text{ mA}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>$V_{(BR)EBO} &gt; 4 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>open collector; $I_E = 1 \text{ mA}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transient energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$L = 25 \text{ mH}$; $f = 50 \text{ Hz}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>open base</td>
<td>$E &gt; 0.5 \text{ mWs}$</td>
<td></td>
</tr>
<tr>
<td>$-V_{BE} = 1.5 \text{ V}; R_{BE} = 33 \text{ \Omega}$</td>
<td>$E &gt; 0.5 \text{ mWs}$</td>
<td></td>
</tr>
<tr>
<td><strong>D.C. current gain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_C = 500 \text{ mA}; V_{CE} = 5 \text{ V}$</td>
<td>$h_{FE} &gt; 5$</td>
<td></td>
</tr>
<tr>
<td><strong>Transition frequency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_C = 400 \text{ mA}; V_{CE} = 20 \text{ V}$</td>
<td>$f_T \text{ typ. } 500 \text{ MHz}$</td>
<td></td>
</tr>
<tr>
<td>**Collector capacitance at } f = 1 \text{ MHz}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_E = I_e = 0; V_{CB} = 30 \text{ V}$</td>
<td>$C_c \text{ typ. } 10 \text{ pF}$</td>
<td></td>
</tr>
<tr>
<td>**Feedback capacitance at } f = 1 \text{ MHz}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_C = 50 \text{ mA}; V_{CE} = 30 \text{ V}$</td>
<td>$C_{re} \text{ typ. } 7.5 \text{ pF}$</td>
<td></td>
</tr>
<tr>
<td><strong>Collector-stud capacitance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_{cs} \text{ typ. } 2 \text{ pF}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$T_j = 25^\circ \text{C unless otherwise specified}$
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralised common-emitter class B circuit)

\[ V_{CC} = 28 \text{ V}; \quad T_{mb} \text{ up to } 25 \degree \text{C} \]

<table>
<thead>
<tr>
<th>f(MHz)</th>
<th>( P_s ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( \overline{Z}_L ) (( \Omega ))</th>
<th>( \overline{V_L} ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>&lt; 0.50</td>
<td>8</td>
<td>&lt; 0.44</td>
<td>&gt; 12</td>
<td>&gt; 65</td>
<td>1.8+j0.7</td>
<td>18-j20</td>
</tr>
</tbody>
</table>

Test circuit

- **C1 =** 2.5 to 20 \( \mu \text{F} \) film dielectric trimmer (code number 2222 809 07004)
- **C2 = C6 = C7 =** 4 to 40 \( \mu \text{F} \) film dielectric trimmer (code number 2222 809 07008)
- **C3 =** 47 \( \mu \text{F} \) ceramic
- **C4 =** 100 \( \mu \text{F} \) ceramic
- **C5 =** 150 nF polyester

- **L1 =** 0.5 turn enameled \( \text{Cu} \) wire (1.5 mm); int. diam. 6 mm; leads 2 x 10 mm
- **L2 =** 6.5 turns closely wound enameled \( \text{Cu} \) wire (0.7 mm); int. diam. 4 mm; leads 2 x 5 mm
- **L3 = L6 =** ferroxcube choke (code number 4312 020 36640)
- **L4 =** 7.5 turns enameled \( \text{Cu} \) wire (0.7 mm); int. diam. 4 mm; leads 2 x 5 mm
- **L5 =** 4.5 turns enameled \( \text{Cu} \) wire (0.7 mm); int. diam. 6 mm; leads 2 x 7 mm
- **L7 =** 3.5 turns enameled \( \text{Cu} \) wire (0.7 mm); int. diam. 6 mm; leads 2 x 7 mm

- **R1 = R2 =** 10 \( \Omega \) carbon

Component lay-out for 175 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heatsink temperature as parameter.
OPERATING NOTE Below 100 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

**Power Gain versus Frequency (class B operation)**

- $V_{CC} = 28$ V
- $P_L = 8$ W
- $T_{mb} = 25$ °C
- Typ. values

**Input Impedance (series components) versus frequency (class B operation)**

- $V_{CC} = 28$ V
- $P_L = 8$ W
- $T_{mb} = 25$ °C
- Typ. values

**Load Impedance (parallel components) versus frequency (class B operation)**

- $V_{CC} = 28$ V
- $P_L = 8$ W
- $T_{mb} = 25$ °C
- Typ. values
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8” capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ\text{C}$ in an unneutralized common-emitter class-B circuit.

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$z_i$ $\Omega$</th>
<th>$V_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>8</td>
<td>&gt;12</td>
<td>&gt;65</td>
<td>1,8 + j0,7</td>
<td>18 – j20</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-120.

Torque on nut: min. 0,75 Nm (7,5 kg cm)
max. 0,85 Nm (8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage (V_{BE} = 0) peak value</td>
<td>V_{CESM}</td>
<td>65 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_{CEO}</td>
<td>36 V</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>V_{EBO}</td>
<td>4 V</td>
</tr>
<tr>
<td>Collector current (average)</td>
<td>I_{C(AV)}</td>
<td>2,5 A</td>
</tr>
<tr>
<td>Collector current (peak value); f &gt; 1 MHz</td>
<td>I_{CM}</td>
<td>0,9 A</td>
</tr>
<tr>
<td>R.F. power dissipation (f &gt; 1 MHz); T_{mb} = 25 °C</td>
<td>P_{rf}</td>
<td>20 W</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg}</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>T_{j}</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V; f > 1 MHz.
I Continuous d.c operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 8 W; T_{mb} = 73,6 °C, i.e. T_{h} = 70 °C)

From junction to mounting base (d.c. dissipation)
R_{th j-mb(dc)} = 10,7 °C/W

From junction to mounting base (r.f. dissipation)
R_{th j-mb(rf)} = 8,6 °C/W

From mounting base to heatsink
R_{th mb-h} = 0,45 °C/W

May 1978
CHARACTERISTICS

$T_J = 25 \degree C$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{BE} = 0; I_C = 2 \text{ mA}$</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{(BR)CES} &gt; 65 \text{ V}$</td>
</tr>
<tr>
<td>open base; $I_C = 10 \text{ mA}$</td>
<td>$V_{(BR)CEO} &gt; 36 \text{ V}$</td>
</tr>
<tr>
<td>Emitter-base breakdown voltage</td>
<td>$V_{(BR)EBO} &gt; 4 \text{ V}$</td>
</tr>
<tr>
<td>open collector; $I_E = 1 \text{ mA}$</td>
<td>$I_{CES} &lt; 1 \text{ mA}$</td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td>$V_{BE} = 0; V_{CE} = 36 \text{ V}$</td>
</tr>
<tr>
<td>Second breakdown energy; $L = 25 \text{ mH}; f = 50 \text{ Hz}$</td>
<td>$E_{SBO} &gt; 0.5 \text{ mJ}$</td>
</tr>
<tr>
<td>open base</td>
<td>$E_{SBR} &gt; 0.5 \text{ mJ}$</td>
</tr>
<tr>
<td>$R_{BE} = 10 \Omega$</td>
<td>$h_{FE}$ typ. 50</td>
</tr>
<tr>
<td>D.C. current gain*</td>
<td>10 to 100</td>
</tr>
<tr>
<td>$I_C = 0.4 \text{ A}; V_{CE} = 5 \text{ V}$</td>
<td>$V_{CEsat}$ typ. 0.8 V</td>
</tr>
<tr>
<td>Collector-emitter saturation voltage*</td>
<td>$f_T$ typ. 600 MHz</td>
</tr>
<tr>
<td>$I_C = 1.25 \text{ A}; I_B = 0.25 \text{ A}$</td>
<td>$f_T$ typ. 525 MHz</td>
</tr>
<tr>
<td>Transition frequency at $f = 100 \text{ MHz}$*</td>
<td>$C_{c}$ typ. 10 pF</td>
</tr>
<tr>
<td>$-I_E = 0.4 \text{ A}; V_{CB} = 28 \text{ V}$</td>
<td>$C_{re}$ typ. 7.1 pF</td>
</tr>
<tr>
<td>$-I_E = 1.25 \text{ A}; V_{CB} = 28 \text{ V}$</td>
<td>$C_{cs}$ typ. 2 pF</td>
</tr>
<tr>
<td>Collector capacitance at $f = 1 \text{ MHz}$</td>
<td>$I_E = I_e = 0; V_{CB} = 28 \text{ V}$</td>
</tr>
<tr>
<td>$I_E = I_e = 0.5 \text{ mA}; V_{CE} = 28 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Collector-stud capacitance</td>
<td>$f_T$ typ. 600 MHz</td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p < 200 \mu s; \delta < 0.02.$
Fig. 4 Typical values; $T_j = 25\, ^\circ\text{C}$.

Fig. 5 $I_E = I_e = 0$; $f = 1\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$.

Fig. 6 Typical values; $f = 100\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$. 

May 1978
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ T_h = 25 \, ^\circ\text{C} \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( V_{CE} ) (V)</th>
<th>( P_L ) (W)</th>
<th>( P_S ) (W)</th>
<th>( G_P ) (dB)</th>
<th>( I_C ) (A)</th>
<th>( \eta ) (%)</th>
<th>( \frac{Z_j}{\pi} ) (Ω)</th>
<th>( V_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>8</td>
<td>&lt;0,5</td>
<td>&gt;12</td>
<td>&lt;0,44</td>
<td>&gt;65</td>
<td>1,8 + j0,7</td>
<td>18 – j20</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components:

- \( C_1 = C_6 = 2,5 \) to \( 20 \) pF film dielectric trimmer (cat. no. 2222 809 07004)
- \( C_2 = 5 \) to \( 60 \) pF film dielectric trimmer (cat. no. 2222 809 07011)
- \( C_3 = 47 \) pF ceramic capacitor (500 V)
- \( C_4 = 120 \) pF ceramic capacitor
- \( C_5 = 100 \) nF polyester capacitor
- \( C_7 = 4 \) to \( 40 \) pF film dielectric trimmer (cat. no. 2222 809 07008)
- \( L_1 = 1 \) turn Cu wire (1,6 mm); int. dia. 8,4 mm; leads 2 x 5 mm
- \( L_2 = 100 \) nH; \( 7 \) turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm
- \( L_3 = L_8 = \) Ferroxcube choke coil (cat. no. 4312 020 36640)
- \( L_4 = L_5 = \) strip (12 mm x 6 mm); tap for \( C_3 \) at 5 mm from transistor
- \( L_6 = 6 \) turns enamelled Cu wire (1,0 mm); int. dia. 9,0 mm; length 9,2 mm; leads 2 x 5 mm
- \( L_7 = 4 \) turns enamelled Cu wire (1,0 mm); int. dia. 8,2 mm; length 5,0 mm; leads 2 x 5 mm

\( L_4 \) and \( L_5 \) are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness \( 1/16\)".

- \( R_1 = 10 \) Ω carbon resistor
- \( R_2 = 4,7 \) Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

Fig. 10 Typical values; $V_{CE} = 28$ V; $f = 175$ MHz.

Fig. 11 R.F. SOAR; c.w. class-B operation; $f = 175$ MHz; $V_{CE} = 28$ V; $R_{th mb-h} = 0.45$ $^\circ$C/W. The graph shows the permissible output power under nominal conditions (VSWR = 1) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Conditions for Figs 12, 13 and 14.
Typical values; \( V_{CE} = 28 \, \text{V}; \, P_L = 8 \, \text{W}; \, T_H = 25 \, \text{°C}. \)

OPERATING NOTE
Below 100 MHz a base-emitter resistor of 10 \( \Omega \) is recommended to avoid oscillation. This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class A, B and C operated mobile, industrial and military transmitters with a supply voltage of 28 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions. It has a \( \frac{1}{4}'' \) capstan envelope with a moulded cap. All leads are isolated from the stud.

### QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Mode of operation</th>
<th>( V_{CC} ) (V)</th>
<th>( f ) (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( C_P ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( Z_i ) (( \Omega ))</th>
<th>( \bar{N}_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>&lt;1.5</td>
<td>15</td>
<td>&lt;0.83</td>
<td>&gt;10</td>
<td>&gt;65</td>
<td>1.4+j1.85</td>
<td>33-j27.5</td>
</tr>
</tbody>
</table>

### MECHANICAL DATA

Dimensions in mm

SOT-48

When locking is required, an adhesive instead of a lock washer is preferred.

Torque on nut: min. 0.75 Nm (7.5 kg cm)  
max. 0.85 Nm (8.5 kg cm)

Diameter of clearance hole in heatsink: max. 4.17 mm.

Mounting hole to have no burrs at either end.  
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

May 1974
RATINGS  Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) \( f > 1 \text{ MHz} \)

Power dissipation
Total power dissipation up to \( T_h = 25 \degree C \)
\( f > 1 \text{ MHz} \)

Temperatures
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink
CHARACTERISTICS

Collector cut-off current

\[ I_B = 0; \ V_{CE} = 28 \ V \]

\[ I_{CEO} < 10 \ mA \]

Breakdown voltages

Collector-base voltage

open emitter, \( I_C = 3 \ mA \)

\[ V_{(BR)CBO} > 65 \ V \]

Collector-emitter voltage

open base, \( I_C = 25 \ mA \)

\[ V_{(BR)CEO} > 36 \ V \]

Emitter-base voltage

open collector; \( I_E = 3 \ mA \)

\[ V_{(BR)EBO} > 4 \ V \]

Transient energy

\( L = 25 \ mH; f = 50 \ Hz \)

open base

\[ E > 2.0 \ mWs \]

\[ -V_{BE} = 1.5 \ V; R_{BE} = 33 \Omega \]

\[ E > 4.5 \ mWs \]

D.C. current gain

\( I_C = 500 \ mA; V_{CE} = 5 \ V \)

\[ h_{FE} > 5 \]

Transition frequency

\( I_C = 600 \ mA; V_{CE} = 20 \ V \)

\[ f_T \text{ typ.} \ 500 \ MHz \]

Collector capacitance at \( f = 1 \ MHz \)

\( I_E = I_e = 0; V_{CB} = 30 \ V \)

\[ C_c \text{ typ.} \ 20 \ pF \]

\[ < 30 \ pF \]

Feedback capacitance at \( f = 1 \ MHz \)

\( I_C = 100 \ mA; V_{CE} = 30 \ V \)

\[ C_{re} \text{ typ.} \ 15 \ pF \]

\[ C_{cs} \text{ typ.} \ 2 \ pF \]
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

\[ V_{CE} = 28 \text{ V; } T_{mb} \text{ up to } 25 \, ^\circ \text{C} \]

<table>
<thead>
<tr>
<th>( f ) (MHz)</th>
<th>( P_S ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( z_i ) (( \Omega ))</th>
<th>( \sqrt{L} ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>&lt; 1,5</td>
<td>15</td>
<td>&lt; 0,83</td>
<td>&gt; 10</td>
<td>&gt; 65</td>
<td>1,4 + j1,85</td>
<td>33 – j27,5</td>
</tr>
</tbody>
</table>

Test circuit: 175 MHz; c.w. class-B.

C1 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = C6 = C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
C3 = 47 pF ceramic capacitor
C4 = 100 pF ceramic capacitor
C5 = 150 nF polyester capacitor
L1 = 0,5 turn enameled Cu wire (1,6 mm); int. dia. 6 mm; leads 2 x 10 mm
L2 = 6,5 turns closely wound enameled Cu wire (0,7 mm); int. dia. 4 mm; leads 2 x 5 mm
L3 = L5 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = 2,5 turns enameled Cu wire (0,7 mm); int. dia. 6 mm; leads 2 x 7 mm
L6 = 4,5 turns enameled Cu wire (0,7 mm); int. dia. 6 mm; leads 2 x 7 mm
R1 = R2 = 10 \, \Omega \) carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see page 6.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
For high voltage operation, a stabilized power supply is generally used.
The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heat-sink temperature as parameter.
OPERATING NOTE Below 100 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25$ °C in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$</th>
<th>$f$</th>
<th>$P_L$</th>
<th>$G_p$</th>
<th>$\eta$</th>
<th>$Z_i$</th>
<th>$\frac{V_L}{I}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>15</td>
<td>&gt;10</td>
<td>&gt;65</td>
<td>1,4 + j1,85</td>
<td>33 – j27,5</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-120.

Torque on nut: min. 0,75 Nm
(7,5 kg cm)
max. 0,85 Nm
(8,5 kg cm)

Diameter of clearance hole in heatsink: max. 4,2 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage \( V_{BE} = 0 \)
- peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); \( f > 1 \) MHz

R.F. power dissipation (\( f > 1 \) MHz); \( T_{mb} = 25 \) °C

Storage temperature

Operating junction temperature

---

**Fig. 2** D.C. SOAR.

**Fig. 3** R.F. power dissipation; \( V_{CE} \leq 28 \) V; \( f > 1 \) MHz.
- Continuous d.c. operation
- Continuous r.f. operation
- Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 15 W; \( T_{mb} = 77 \) °C, i.e. \( T_{h} = 70 \) °C)

From junction to mounting base (d.c. dissipation)

From junction to mounting base (r.f. dissipation)

From mounting base to heatsink

\[
\begin{align*}
R_{th\ j-mb}(dc) & = 6.55 \text{ °C/W} \\
R_{th\ j-mb}(rf) & = 4.95 \text{ °C/W} \\
R_{th\ mb-h} & = 0.45 \text{ °C/W}
\end{align*}
\]
**CHARACTERISTICS**

$T_j = 25 \, ^\circ\text{C}$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{BE} = 0; I_C = 5 , \text{mA}$</td>
</tr>
<tr>
<td>Collector-emitter breakdown voltage</td>
<td>$V_{(BR)CES} &gt; 65 , \text{V}$</td>
</tr>
<tr>
<td>open base; $I_C = 25 , \text{mA}$</td>
<td></td>
</tr>
<tr>
<td>Emitter-base breakdown voltage</td>
<td>$V_{(BR)CEO} &gt; 36 , \text{V}$</td>
</tr>
<tr>
<td>open collector; $I_E = 2 , \text{mA}$</td>
<td></td>
</tr>
<tr>
<td>Collector cut-off current</td>
<td>$V_{BE} = 0; V_{CE} = 36 , \text{V}$</td>
</tr>
<tr>
<td>open base</td>
<td></td>
</tr>
<tr>
<td>Second breakdown energy; $L = 25 , \text{mH}; f = 50 , \text{Hz}$</td>
<td>$E_{SBO} &gt; 2.5 , \text{mJ}$</td>
</tr>
<tr>
<td>RBE = 10 $\Omega$</td>
<td>$E_{SBR} &gt; 2.5 , \text{mJ}$</td>
</tr>
<tr>
<td>D.C. current gain*</td>
<td>$I_C = 0.7 , \text{A}; V_{CE} = 5 , \text{V}$</td>
</tr>
<tr>
<td>hFE</td>
<td>typ. 50</td>
</tr>
<tr>
<td>typ. 10 to 100</td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage*</td>
<td>$I_C = 2 , \text{A}; I_B = 0.4 , \text{A}$</td>
</tr>
<tr>
<td>trans. freq. at $f = 100 , \text{MHz}$*</td>
<td></td>
</tr>
<tr>
<td>$I_E = 0.7 , \text{A}; V_{CB} = 28 , \text{V}$</td>
<td>$f_T$</td>
</tr>
<tr>
<td>$I_E = 2 , \text{A}; V_{CB} = 28 , \text{V}$</td>
<td>typ. 650 MHz</td>
</tr>
<tr>
<td>Collector capacitance at $f = 1 , \text{MHz}$</td>
<td></td>
</tr>
<tr>
<td>$I_E = I_e = 0; V_{CB} = 28 , \text{V}$</td>
<td>$f_T$</td>
</tr>
<tr>
<td>Feedback capacitance at $f = 1 , \text{MHz}$</td>
<td>typ. 625 MHz</td>
</tr>
<tr>
<td>$I_C = 100 , \text{mA}; V_{CE} = 28 , \text{V}$</td>
<td></td>
</tr>
<tr>
<td>Collector-stud capacitance</td>
<td></td>
</tr>
<tr>
<td>typ. 18 pF</td>
<td></td>
</tr>
<tr>
<td>typ. 12.8 pF</td>
<td></td>
</tr>
<tr>
<td>typ. 2 pF</td>
<td></td>
</tr>
</tbody>
</table>

* Measured under pulse conditions: $t_p \leq 200 \, \mu\text{s}; \delta \leq 0.02.$
Fig. 4 Typical values; $T_j = 25\, ^\circ\text{C}$.

Fig. 5 $I_E = I_e = 0$; $f = 1\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$.

Fig. 6 Typical values; $f = 100\, \text{MHz}$; $T_j = 25\, ^\circ\text{C}$.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>V_CE (V)</th>
<th>P_L (W)</th>
<th>P_S (W)</th>
<th>G_P (dB)</th>
<th>I_C (A)</th>
<th>η (%)</th>
<th>z_i (Ω)</th>
<th>Y_L (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>15</td>
<td>&lt;1,5</td>
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Fig. 7 Test circuit; c.w. class-B.

List of components:

C1 = C6 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3 = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor
C5 = 100 nF polyester capacitor
C7 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
L1 = 1 turn Cu wire (1,6 mm); int. dia. 8,4 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamed Cu wire (0,5 mm); int. dia. 3 mm
L3 = L8 = Ferroxcube choke coil (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); tap for C3 at 5 mm from transistor
L6 = 6 turns enamed Cu wire (1,0 mm); int. dia. 9,0 mm; length 9,2 mm; leads 2 x 5 mm
L7 = 4 turns enamed Cu wire (1,0 mm); int. dia. 8,2 mm; length 5,0 mm; leads 2 x 5 mm
L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16”.
R1 = 10 Ω carbon resistor
R2 = 4,7 Ω carbon resistor

Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.
Fig. 9 Typical values; $V_{CE} = 28\, \text{V}$; $f = 175\, \text{MHz}$.

Fig. 10 Typical values; $V_{CE} = 28\, \text{V}$; $f = 175\, \text{MHz}$.

Fig. 11 R.F. SOAR; c.w. class-B operation; $f = 175\, \text{MHz}$; $V_{CE} = 28\, \text{V}$; $R_{th\, mb-h} = 0,45\, \degree\text{C/W}$.

The graph shows the permissible output power under nominal conditions ($\text{VSWR} = 1$) as a function of the expected VSWR during short-time mismatch conditions with heatsink temperatures as parameter.
Conditions for Figs 12, 13 and 14.
Typical values: $V_{CE} = 28\, \text{V}$; $P_L = 15\, \text{W}$; $T_h = 25\, ^\circ\text{C}$.

OPERATING NOTE
Below 100 MHz a base-emitter resistor of 10 $\Omega$ is recommended to avoid oscillation. This resistor must be effective for r.f. only.
V.H.F. POWER TRANSISTOR

N-P-N epitaxial planar transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 28 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions. It has a ¼” capstan envelope with a moulded cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_{mb} = 25$ °C in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_S$ W</th>
<th>$P_L$ W</th>
<th>$I_C$ A</th>
<th>$G_p$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{Z}_i$ Ω</th>
<th>$\bar{V}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>&lt; 3,1</td>
<td>25</td>
<td>&lt; 1,5</td>
<td>&gt; 9</td>
<td>&gt; 60</td>
<td>1,0 + j1,2</td>
<td>58.8 – j53.8</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-56.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 1,5 Nm
(15 kg cm)
max. 1,7 Nm
(17 kg cm)

Diameter of clearance hole in heatsink: max. 5,0 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) $f > 1 \text{ MHz}$

Power dissipation
Total power dissipation up to $T_{mb} = 25 \, ^\circ\text{C}$

$P_{tot}$ max. $70 \, \text{W}$

Temperature
Storage temperature
Operating junction temperature

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CBOM}$ max.</td>
<td>65 V</td>
</tr>
<tr>
<td>$V_{CEO}$ max.</td>
<td>36 V</td>
</tr>
<tr>
<td>$V_{EBO}$ max.</td>
<td>4 V</td>
</tr>
<tr>
<td>$I_{C(AV)}$ max.</td>
<td>3 A</td>
</tr>
<tr>
<td>$I_{CM}$ max.</td>
<td>9 A</td>
</tr>
<tr>
<td>$P_{tot}$ max.</td>
<td>70 W</td>
</tr>
<tr>
<td>$T_{stg}$</td>
<td>-30 to +200 $^\circ\text{C}$</td>
</tr>
<tr>
<td>$T_{j}$ max.</td>
<td>200 $^\circ\text{C}$</td>
</tr>
<tr>
<td>$R_{th,j-mb}$</td>
<td>2.5 $^\circ\text{C}/\text{W}$</td>
</tr>
<tr>
<td>$R_{th,mb-h}$</td>
<td>0.3 $^\circ\text{C}/\text{W}$</td>
</tr>
</tbody>
</table>
CHARACTERISTICS

Breakdown voltages

Collector-base voltage
open emitter, \( I_C = 50 \) mA
\( V(BR)CBO \) > 65 V

Collector-emitter voltage
open base, \( I_C = 50 \) mA
\( V(BR)CEO \) > 36 V

Emitter-base voltage
open collector; \( I_E = 10 \) mA
\( V(BR)EBO \) > 4 V

Transient energy
\( L = 25 \) mH; \( f = 50 \) Hz
open base
\( V_{BE} = 1.5 \) V; \( R_{BE} = 33 \) \( \Omega \)
\( E \) > 8 mWs

D.C. current gain
\( I_C = 1 \) A; \( V_{CE} = 5 \) V
\( h_{FE} \) typ. 50

10 to 120

Transition frequency
\( I_C = 3 \) A; \( V_{CE} = 20 \) V
\( f_T \) typ. 500 MHz

Collector capacitance at \( f = 1 \) MHz
\( I_E = I_e = 0; V_{CB} = 30 \) V
\( C_c \) typ. 50 pF

< 65 pF

Feedback capacitance at \( f = 1 \) MHz
\( I_C = 100 \) mA; \( V_{CE} = 30 \) V
\( C_{re} \) typ. 31 pF

Collector-stud capacitance
\( C_{cs} \) typ. 2 pF

February 1971
$f_T$ (MHz)

$I_C$ (A)

$C_C$ (pF)

$V_{CE} = 20V$

$I_E = I_F = 0$

$f = 1MHz$

February 1971
APPLICATION INFORMATION

R. F. performance in c. w. operation (unneutralised common-emitter class B circuit)

\[ V_{CC} = 28 \, V; \quad T_{mb} = 25^\circ C \]

<table>
<thead>
<tr>
<th>f(MHz)</th>
<th>( P_s ) (W)</th>
<th>( P_L ) (W)</th>
<th>( I_C ) (A)</th>
<th>( G_p ) (dB)</th>
<th>( \eta ) (%)</th>
<th>( Z_i ) (( \Omega ))</th>
<th>( \lambda_L ) (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>&lt; 3.1</td>
<td>25</td>
<td>&lt; 1.5</td>
<td>&gt; 9</td>
<td>&gt; 60</td>
<td>1.0+j1.2</td>
<td>58.8–j53.8</td>
</tr>
</tbody>
</table>

Test circuit

\[ C_1 = 4 \text{ to } 44 \, \text{pF} \quad \text{film dielectric trimmer (code number 2222 809 07008)} \]
\[ C_2 = 2 \text{ to } 22 \, \text{pF} \quad \text{film dielectric trimmer (code number 2222 809 07004)} \]
\[ C_3 = C_4 = 47 \, \text{pF} \quad \text{ceramic} \]
\[ C_5 = 100 \, \text{pF} \quad \text{ceramic} \]
\[ C_6 = 150 \, \text{nF} \quad \text{polyester} \]
\[ C_7 = 4 \text{ to } 104 \, \text{pF} \quad \text{film dielectric trimmer (code number 2222 809 07015)} \]
\[ C_8 = 4 \text{ to } 64 \, \text{pF} \quad \text{film dielectric trimmer (code number 2222 809 07011)} \]

\[ L_1 = 0.5 \text{ turn enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2 x 6 mm} \]
\[ L_2 = 6 \text{ turns closely wound enamelled Cu wire (0.7 mm); int.diam. 4 mm; leads 2 x 4 mm} \]
\[ L_3 = L_4 = \text{ferroxcube choke (code number 4312 020 36640)} \]
\[ L_5 = 3.5 \text{ turns enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2 x 6 mm} \]
\[ L_6 = 1.5 \text{ turns enamelled Cu wire (1.5 mm); int.diam. 6 mm; leads 2 x 6 mm} \]
\[ R_1 = R_2 = 10 \, \Omega \quad \text{carbon} \]

Component lay-out for 175 MHz see page 6.
APPLICATION INFORMATION (continued)

Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heat-sink temperature as parameter.
OPERATING NOTE  Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

### Power Gain Versus Frequency (class B operation)

- **VCC** = 28 V
- **P_L** = 25 W
- **Tmb** = 25 °C
- typ. values

### Input Impedance (series components) Versus Frequency (class B operation)

- **VCC** = 28 V
- **P_L** = 25 W
- **Tmb** = 25 °C
- typ. values

### Load Impedance (parallel components) Versus Frequency (class B operation)

- **VCC** = 28 V
- **P_L** = 25 W
- **Tmb** = 25 °C
- typ. values

*December 1973*
V.H.F. POWER TRANSISTOR

N-P-N silicon planar epitaxial transistor intended for use in class-A, B and C operated h.f. and v.h.f. transmitters with a nominal supply voltage of 28 V. The transistor is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 3/8" capstan envelope with a ceramic cap. All leads are isolated from the stud.

QUICK REFERENCE DATA

R.F. performance up to $T_h = 25 \, ^\circ\text{C}$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ V</th>
<th>$f$ MHz</th>
<th>$P_L$ W</th>
<th>$G_P$ dB</th>
<th>$\eta$ %</th>
<th>$\bar{z}_i$ $\Omega$</th>
<th>$\bar{Y}_L$ mA/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>25</td>
<td>$&gt; 9$</td>
<td>$&gt; 60$</td>
<td>$1,0 + j1,2$</td>
<td>$59-554$</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 SOT-120.

Dimensions in mm

Torque on nut: min. 0,75 Nm (7,5 kg cm) max. 0,85 Nm (8,5 kg cm)

When locking is required an adhesive is preferred instead of a lock washer.

CAUTION This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V_{BE} = 0)
  peak value

Collector-emitter voltage (open base)

Emitter-base voltage (open collector)

Collector current (average)

Collector current (peak value); f > 1 MHz

R.F. power dissipation (f > 1 MHz); T_{mb} = 25 °C

Storage temperature

Operating junction temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CESM} max.</td>
<td>65 V</td>
</tr>
<tr>
<td>V_{CEO} max.</td>
<td>36 V</td>
</tr>
<tr>
<td>V_{EBO} max.</td>
<td>4 V</td>
</tr>
<tr>
<td>I_{C(AV)} max.</td>
<td>3 A</td>
</tr>
<tr>
<td>I_{CM} max.</td>
<td>9 A</td>
</tr>
<tr>
<td>P_{rf} max.</td>
<td>70 W</td>
</tr>
<tr>
<td>T_{stg}</td>
<td>-65 to + 150 °C</td>
</tr>
<tr>
<td>T_{j} max.</td>
<td>200 °C</td>
</tr>
</tbody>
</table>

Fig. 2 D.C. SOAR.

Fig. 3 R.F. power dissipation; V_{CE} ≤ 28 V; f > 1 MHz.
I  Continuous d.c. operation
II Continuous r.f. operation
III Short-time operation during mismatch

THERMAL RESISTANCE (dissipation = 20 W; T_{mb} = 79 °C, i.e. T_{h} = 70 °C)

From junction to mounting base (d.c. dissipation)
$$R_{th j-mb} (dc) = 3,1 \, °C/W$$

From junction to mounting base (r.f. dissipation)
$$R_{th j-mb} (rf) = 2,3 \, °C/W$$

From mounting base to heatsink
$$R_{th mb-h} = 0,45 \, °C/W$$
CHARACTERISTICS

$T_j = 25 \, ^\circ C$

Collector-emitter breakdown voltage

$V_{BE} = 0; \, I_C = 10 \, mA$

Collector-emitter breakdown voltage
open base; $I_C = 50 \, mA$

Emitter-base breakdown voltage
open collector; $I_E = 10 \, mA$

Collector cut-off current

$V_{BE} = 0; \, V_{CE} = 36 \, V$

Second breakdown energy; $L = 25 \, mH; \, f = 50 \, Hz$

$R_{BE} = 10 \, \Omega$

D.C. current gain *

$I_C = 1,25 \, A; \, V_{CE} = 5 \, V$

Collector-emitter saturation voltage *

$I_C = 3,75 \, A; \, I_B = 0,75 \, A$

Transition frequency at $f = 100 \, MHz$

$-I_E = 1,25 \, A; \, V_{CE} = 28 \, V$

$f_T$ typ. 625 MHz

$-I_E = 3,75 \, A; \, V_{CE} = 28 \, V$

$f_T$ typ. 625 MHz

Collector capacitance at $f = 1 \, MHz$

$I_E = I_e = 0; \, V_{CE} = 28 \, V$

$C_c$ typ. 45 pF

Feedback capacitance at $f = 1 \, MHz$

$I_C = 100 \, mA; \, V_{CE} = 28 \, V$

$C_{re}$ typ. 28 pF

Collector-stud capacitance

$C_{cs}$ typ. 2 pF

$V_{(BR)CES} > 65 \, V$

$V_{(BR)CEO} > 36 \, V$

$V_{(BR)EBO} > 4 \, V$

$I_{CES} < 4 \, mA$

$E_{SBO} > 8 \, mJ$

$E_{SBR} > 8 \, mJ$

$h_{FE}$ typ. 45

10 to 100

$V_{CE_{sat}}$ typ. 1,5 V

---

* Measured under pulse conditions: $t_p \leq 200 \, \mu s; \, \delta \leq 0,02$. 

July 1978 3
Fig. 4 Typical values; $T_j = 25^\circ$C.

Fig. 5 $I_E = I_e = 0$; $f = 1$ MHz; $T_j = 25^\circ$C.

Fig. 6 Typical values; $f = 100$ MHz; $T_j = 25^\circ$C.
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit)

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_L$ (W)</th>
<th>$P_S$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$I_C$ (A)</th>
<th>$\eta$ (%)</th>
<th>$\bar{Z}_i$ (Ω)</th>
<th>$\bar{Y}_L$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>28</td>
<td>25</td>
<td>&lt;3,15</td>
<td>&gt;9</td>
<td>&lt;1,5</td>
<td>&gt;60</td>
<td>1,0 + j1,2</td>
<td>59–j54</td>
</tr>
</tbody>
</table>

Fig. 7 Test circuit; c.w. class-B.

List of components

C1 = C7 = 2,5 to 20 pF film dielectric trimmer (cat. no. 2222 809 07004)
C2 = 5 to 60 pF film dielectric trimmer (cat. no. 2222 809 07011)
C3a = C3b = 47 pF ceramic capacitor (500 V)
C4 = 120 pF ceramic capacitor
C5 = 100 nF polyester capacitor
C6a = 2,2 pF ceramic capacitor (500 V)
C6b = 1,8 pF ceramic capacitor (500 V)
C8 = 4 to 40 pF film dielectric trimmer (cat. no. 2222 809 07008)
L1 = 14 nH; 1 turn Cu wire (1,6 mm); int. dia. 7,7 mm; leads 2 x 5 mm
L2 = 100 nH; 7 turns closely wound enamelled Cu wire (0,5 mm); int. dia. 3 mm; leads 2 x 5 mm
L3 = L8 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
L4 = L5 = strip (12 mm x 6 mm); taps for C3a and C3b at 5 mm from transistor
L6 = 80 nH; 3 turns Cu wire (1,6 mm); int. dia. 9,0 mm; length 8,0 mm; leads 2 x 5 mm
L7 = 62 nH; 3 turns Cu wire (1,6 mm); int. dia. 7,5 mm; length 8,1 mm; leads 2 x 5 mm
L4 and L5 are strips on a double Cu-clad printed-circuit board with epoxy fibre-glass dielectric, thickness 1/16".
R1 = R2 = 10 Ω carbon resistor (0,25 W)
Component layout and printed-circuit board for 175 MHz test circuit see Fig. 8.
Fig. 8 Component layout and printed-circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallized to serve as earth. Earth connections are made by means of hollow rivets, whilst under the emitter leads Cu straps are used for a direct contact between upper and lower sheets.

To minimize the dielectric losses, the ground plane under the interconnection of L7 and C7 has been removed.
V.H.F. power transistor

**Fig. 9** $V_{CE} = 28$ V; $f = 175$ MHz; typical values.

**Fig. 10** $V_{CE} = 28$ V; $f = 175$ MHz; typical values; $T_h = 25$ °C; $T_h = 70$ °C.

**Fig. 11** R.F. SOAR; c.w. class-B operation; $f = 175$ MHz; $V_{CE} = 28$ V; $R_{th mb-h} = 0.45$ °C/W.

The graph shows the permissible output power under nominal conditions ($VSWR = 1$) as a function of the expected $VSWR$ during short-time mismatch conditions with heatsink temperatures as parameter.
Fig. 12 Input impedance (series components).

Fig. 13 Load impedance (parallel components).

Fig. 14 Power gain versus frequency.

OPERATING NOTE

Below 70 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.

Conditions for Figs 12, 13 and 14:
Typical values; $V_{CE} = 28$ V; $P_L = 25$ W; $T_h = 25^\circ$C.
**V.H.F. POWER TRANSISTOR**

N-P-N planar epitaxial transistor intended for use in class-A, B and C operated mobile, industrial and military transmitters with a supply voltage of 28 V. The transistor is resistance stabilized. Every transistor is tested under severe load mismatch conditions. It has a plastic encapsulated stripline package. All leads are isolated from the stud.

**QUICK REFERENCE DATA**

R.F. performance up to $T_{mb} = 25 \, ^\circ C$ in an unneutralized common-emitter class-B circuit

<table>
<thead>
<tr>
<th>mode of operation</th>
<th>$V_{CE}$ (V)</th>
<th>$f$ (MHz)</th>
<th>$P_S$ (W)</th>
<th>$P_L$ (W)</th>
<th>$I_C$ (A)</th>
<th>$G_P$ (dB)</th>
<th>$\eta$ (%)</th>
<th>$\overline{z_i}$ (Ω)</th>
<th>$\overline{V_L}$ (mA/V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c.w.</td>
<td>28</td>
<td>175</td>
<td>&lt; 10</td>
<td>50</td>
<td>&lt; 2,75</td>
<td>&gt; 7</td>
<td>&gt; 65</td>
<td>0,8 + j1,45</td>
<td>125 – j66</td>
</tr>
</tbody>
</table>

**MECHANICAL DATA**

Fig. 1 SOT-55.

Dimensions in mm

When locking is required an adhesive is preferred instead of a lock washer.

Torque on nut: min. 2,3 Nm (23 kg cm)  
max. 2,7 Nm (27 kg cm)  

Diameter of clearance hole in heatsink: max. 6,5 mm.
Mounting hole to have no burrs at either end.
De-burring must leave surface flat; do not chamfer or countersink either end of hole.

September 1978
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Volatges
Collector-base voltage (open emitter) peak value
Collector-emitter voltage (open base)
Emitter-base voltage (open collector)

Currents
Collector current (average)
Collector current (peak value) f > 1 MHz

Power dissipation
Total power dissipation up to $T_{mb} = 25^\circ C$

f > 1 MHz

P$_{tot}$ max. 130 W

Temperature
Storage temperature
Operating junction temperature

T$_{stg}$ -65 to +200 $^\circ C$
T$_j$ max. 200 $^\circ C$

THERMAL RESISTANCE
From junction to mounting base
From mounting base to heatsink

R$_{thj-mb}$ = 1.35 $^\circ C/W$
R$_{thmb-h}$ = 0.2 $^\circ C/W$
<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>T&lt;sub&gt;j&lt;/sub&gt; = 25°C unless otherwise specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown voltages</td>
<td></td>
</tr>
<tr>
<td>Collector-base voltage</td>
<td>open emitter, I&lt;sub&gt;C&lt;/sub&gt; = 100 mA</td>
</tr>
<tr>
<td>Collector-emitter voltage</td>
<td>open base, I&lt;sub&gt;C&lt;/sub&gt; = 100 mA</td>
</tr>
<tr>
<td>Emitter-base voltage</td>
<td>open collector; I&lt;sub&gt;E&lt;/sub&gt; = 25 mA</td>
</tr>
<tr>
<td>Transient energy</td>
<td>L = 25 mH; f = 50 Hz</td>
</tr>
<tr>
<td>open base</td>
<td>E &gt; 8 mWs</td>
</tr>
<tr>
<td>−V&lt;sub&gt;BB&lt;/sub&gt; = 1.5 V; R&lt;sub&gt;BE&lt;/sub&gt; = 33 Ω</td>
<td>E &gt; 8 mWs</td>
</tr>
<tr>
<td>D.C. current gain</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 1 A; V&lt;sub&gt;CE&lt;/sub&gt; = 5 V</td>
<td></td>
</tr>
<tr>
<td>Transition frequency</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 6 A; V&lt;sub&gt;CE&lt;/sub&gt; = 20 V</td>
<td></td>
</tr>
<tr>
<td>Collector capacitance at f = 1 MHz</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;E&lt;/sub&gt; = I&lt;sub&gt;E&lt;/sub&gt; = 0; V&lt;sub&gt;CB&lt;/sub&gt; = 30 V</td>
<td></td>
</tr>
<tr>
<td>Feedback capacitance</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;C&lt;/sub&gt; = 100 mA; V&lt;sub&gt;CE&lt;/sub&gt; = 30 V</td>
<td></td>
</tr>
<tr>
<td>Collector-stud capacitance</td>
<td></td>
</tr>
</tbody>
</table>

April 1971
APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralised common-emitter class B circuit)

\( f = 175 \text{ MHz}; T_{mb} \text{ up to } 25^\circ C \)

<table>
<thead>
<tr>
<th>( V_{CC} (V) )</th>
<th>( P_s (W) )</th>
<th>( P_L (W) )</th>
<th>( I_C (A) )</th>
<th>( G_p (\text{dB}) )</th>
<th>( \eta (%) )</th>
<th>( Z_I (\Omega) )</th>
<th>( \overline{V_L} (\text{mA/V}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>&lt; 10</td>
<td>50</td>
<td>&lt; 2.75</td>
<td>&gt; 7</td>
<td>&gt; 65</td>
<td>0.8+j1.45</td>
<td>125 - j66</td>
</tr>
</tbody>
</table>

Test circuit for 175 MHz:

List of components:

- \( \text{C1} = 2\text{ to } 20 \text{ pF film dielectric trimmer (code number 2222 809 07004)} \)
- \( \text{C2} = 4\text{ to } 40 \text{ pF film dielectric trimmer (code number 2222 809 07008)} \)
- \( \text{C3} = \text{C4} = 56 \text{ pF ceramic} \)
- \( \text{C5} = 100 \text{ pF ceramic} \)
- \( \text{C6} = 100 \text{ nF polyester} \)
- \( \text{C7} = 4\text{ to } 60 \text{ pF film dielectric trimmer (code number 2222 809 07011)} \)
- \( \text{C8} = 4\text{ to } 100 \text{ pF film dielectric trimmer (code number 2222 809 07015)} \)
- \( \text{C9} = 6.8 \text{ pF ceramic} \)
- \( \text{L1} = 36 \text{ nH; 2 turns enameled Cu wire (1.5 mm); int. diam. 7 mm; length 5 mm; lead length 2 x 5 mm} \)
- \( \text{L2} = \text{formed by the metallization on the p.c. board; see component lay-out} \)
- \( \text{L3} = 100 \text{ nH; 7 turns closely wound enameled Cu wire (0.5 mm); int. diam 3 mm; lead length 2 x 5 mm} \)
- \( \text{L4 = L5 = ferroxcube choke (code number 4312 020 36640)} \)
- \( \text{L6} = 53 \text{ nH; 2 turns enameled Cu wire (1.5 mm); int. diam. 10 mm; length 5.2 mm; lead length 2 x 5 mm} \)
- \( \text{L7} = 46 \text{ nH; 2 turns enameled Cu wire (1.5 mm); int. diam. 9 mm; length 5.4 mm; lead length 2 x 5 mm} \)
- \( \text{R1 = R2 = 10 \Omega carbon} \)

Component lay-out see page 6
APPLICATION INFORMATION (continued)
Component lay-out and printed circuit board for 175 MHz test circuit.

The circuit and the components are situated on one side of the epoxy fibre-glass board, the other side being fully metallised to serve as earth. Earth connections are made by means of hollow rivets.
For high voltage operation, a stabilized power supply is generally used. The graph shows the allowable output power under nominal conditions as a function of the V.S.W.R., with heatsink temperature as parameter.
OPERATING NOTE  Below 50 MHz a base-emitter resistor of 10 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.

- **Power Gain Versus Frequency (Class B Operation)**
  - $V_{CC} = 28 \text{ V}$
  - $P_L = 50 \text{ W}$
  - $T_{mb} = 25 \degree \text{C}$
  - Typ. values

- **Input Impedance (Series Components) Versus Frequency (Class B Operation)**
  - $V_{CC} = 28 \text{ V}$
  - $P_L = 50 \text{ W}$
  - $T_{mb} = 25 \degree \text{C}$
  - Typ. values

- **Load Impedance (Parallel Components) Versus Frequency (Class B Operation)**
  - $V_{CC} = 28 \text{ V}$
  - $P_L = 50 \text{ W}$
  - $T_{mb} = 25 \degree \text{C}$
  - Typ. values

December 1973
SILICON EPITAXIAL PLANAR OVERLAY TRANSISTORS

The 2N3553 is an n-p-n overlay transistor in a TO-39 metal envelope with the collector connected to the case. The 2N3375 and the 2N3632 are n-p-n overlay transistors in TO-60 metal envelopes with the electrodes insulated from the studs.

The 2N3553 and the 2N3375 are intended for v.h.f./u.h.f. and the 2N3632 for v.h.f. transmitting applications.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2N3553</th>
<th>2N3375</th>
<th>2N3632</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage −V_{BE} = 1.5 V</td>
<td>V_{CEX} max.</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V_{CEO} max.</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>I_{CM} max.</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Total power dissipation up to T_{mb} = 25 °C</td>
<td>P_{tot} max.</td>
<td>7</td>
<td>11.6</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>T_{j} max.</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Transition frequency</td>
<td>f_{T} typ.</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>R.F. performance at V_{CE} = 28 V</td>
<td>f_{T} typ.</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>type number</th>
<th>f (MHz)</th>
<th>P_{O} (W)</th>
<th>P_{i} (W)</th>
<th>\eta (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N3553</td>
<td>175</td>
<td>2.5</td>
<td>&lt; 0.25</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>2N3375</td>
<td>100</td>
<td>7.5</td>
<td>&lt; 1</td>
<td>&gt; 65</td>
</tr>
<tr>
<td>2N3375</td>
<td>400</td>
<td>&gt; 3</td>
<td>1</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>2N3632</td>
<td>175</td>
<td>&gt; 13.5</td>
<td>3.5</td>
<td>&gt; 70</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12.7 mm.

Accessories: 56218 (package); 56245 (distance disc).
MECHANICAL DATA (continued)

2N3375
2N3553
2N3632

TO-60
The top pins should not be bent

Dimensions in mm
Torque on nut: min. 8 cm kg
max. 17 cm kg
Diameter of hole in heatsink: 4.8 to 5.2 mm

RATINGS (Limiting values) 1)

Voltages 2)
Collector-base voltage (open emitter) \(V_{CBO}\) max. 65 V
Collector-emitter voltage \(V_{CEX}\) max. 65 V
Collector-emitter voltage (open base) \(V_{CEO}\) max. 40 V
Emitter-base voltage (open collector) \(V_{EBO}\) max. 4 V

Currents 2)
Collector current (d.c.) \(I_C\) max. 0.35 A
Collector current (peak value) \(I_{CM}\) max. 1.0 A

Power dissipation 2)
Total power dissipation \(P_{tot}\) max. 7 W
up to \(T_{mb} = 25\) °C

Temperatures
Storage temperature \(T_{stg}\) -65 to +200 °C
Junction temperature \(T_j\) max. 200 °C

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
2) See also areas of permissible operation at pages 10 and 11.
### THERMAL RESISTANCE

<table>
<thead>
<tr>
<th></th>
<th>2N3553</th>
<th>2N3375</th>
<th>2N3632</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th \ j-mb}$</td>
<td>25</td>
<td>15</td>
<td>7.5</td>
</tr>
<tr>
<td>$R_{th \ mb-h}$</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>$R_{th \ mb-h}$</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{th \ mb-h}$</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**From junction to mounting base**
**From mounting base to heatsink**
**From mounting base to heatsink mounted with top clamping washer of 56218**
**top clamping washer of 56218 and a boron nitride washer for electrical insulation**

### CHARACTERISTICS

**Collector cut-off current**

$I_B = 0; V_{CE} = 30 \, \text{V}$

**Breakdown voltages**

$I_E = 0; I_C = 250 \, \mu\text{A}$

$I_C$ up to 200 mA

$V_{BE} = 1.5 \, \text{V}; R_B = 33 \, \Omega$

$V_{(BR)CBO} > 65$; $65$; $65 \, \text{V}$

$V_{(BR)CEX} > 65$; $65$; $65 \, \text{V}$

$V_{(BR)CEO} > 40$; $40$; $40 \, \text{V}$

$V_{(BR)EBO} > 4$; $4$; $4 \, \text{V}$

**Base-emitter voltage**

$I_C = 250 \, \text{mA}; V_{CE} = 5 \, \text{V}$

$I_C = 500 \, \text{mA}; V_{CE} = 5 \, \text{V}$

$I_C = 1000 \, \text{mA}; V_{CE} = 5 \, \text{V}$

$V_{BE} < 1.5$; $V$

$V_{BE} < 1.5$; $V$

$V_{BE} < 1.5$; $V$

**Saturation voltage**

$I_C = 250 \, \text{mA}; I_B = 50 \, \text{mA}$

$I_C = 500 \, \text{mA}; I_B = 100 \, \text{mA}$

$I_C = 1000 \, \text{mA}; I_B = 200 \, \text{mA}$

$V_{CE\text{sat}} < 1.0$; $V$

$V_{CE\text{sat}} < 1.0$; $V$

$V_{CE\text{sat}} < 1.0$; $V$

$^1$) Pulsed through an inductor of 25 mH; $\delta = 0.5; f = 50 \, \text{Hz}$

$T_j = 25 \, \text{°C}$ unless otherwise specified

<table>
<thead>
<tr>
<th></th>
<th>2N3553</th>
<th>2N3375</th>
<th>2N3632</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{CEO}$</td>
<td>$&lt; 100$</td>
<td>$100$</td>
<td>$250 , \mu\text{A}$</td>
</tr>
</tbody>
</table>
CHARACTERISTICS (continued)  

D.C. current gain

<table>
<thead>
<tr>
<th>IC, mA</th>
<th>VCE, V</th>
<th>hFE, &gt;</th>
<th>hFE, &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>5</td>
<td>15</td>
<td>200</td>
</tr>
<tr>
<td>250</td>
<td>5</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>5</td>
<td>5</td>
<td>110</td>
</tr>
</tbody>
</table>

Collector capacitance at f = 1 MHz

<table>
<thead>
<tr>
<th>IE = Ie = 0; VCB = 28 V</th>
<th>Cc, &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Collector-case capacitance

| < |
| 6 | 6 pF |

Transition frequency

<table>
<thead>
<tr>
<th>IC, mA</th>
<th>VCE, V</th>
<th>fT, typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>28</td>
<td>500 MHz</td>
</tr>
<tr>
<td>250</td>
<td>28</td>
<td>400 MHz</td>
</tr>
</tbody>
</table>

Real part of input impedance at f = 200 MHz

<table>
<thead>
<tr>
<th>IC, mA</th>
<th>VCE, V</th>
<th>Re(hie), &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>28</td>
<td>20 Ω</td>
</tr>
<tr>
<td>250</td>
<td>28</td>
<td>20 Ω</td>
</tr>
</tbody>
</table>

R.F. performance at VCE = 28 V

<table>
<thead>
<tr>
<th>f (MHz)</th>
<th>P0 (W)</th>
<th>P1 (W)</th>
<th>IC (mA)</th>
<th>η %</th>
<th>Test circuit at page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N3553</td>
<td>175</td>
<td>&lt; 0.25</td>
<td>&lt; 180</td>
<td>&gt; 50</td>
<td>5</td>
</tr>
<tr>
<td>2N3375</td>
<td>100</td>
<td>&lt; 1</td>
<td>&lt; 410</td>
<td>&gt; 65</td>
<td>6</td>
</tr>
<tr>
<td>2N3375</td>
<td>400</td>
<td>&gt; 1</td>
<td>270</td>
<td>&gt; 40</td>
<td>7</td>
</tr>
<tr>
<td>2N3632</td>
<td>175</td>
<td>&gt; 3.5</td>
<td>3.5</td>
<td>&gt; 70</td>
<td>5</td>
</tr>
</tbody>
</table>

NOTE

The transistors can withstand an output V.S.W.R. of 3:1 varied through all phases under conditions mentioned in the table above.
CHARACTERISTICS (continued)

Test circuit with the 2N3553 or the 2N3632 at $f = 175$ MHz

*) The length of the external emitter wire of the 2N3553 is 1.6 mm.
The emitter of the 2N3632 should be connected to the case as short as possible.

Components

- $C_1 = C_2 = C_3 = C_4 = 4$ to 29 pF, air trimmer
- $C_5 =$ 10 nF, polyester
- $C_6 =$ 100 pF, ceramic
- $L_1 =$ 1 turn Cu wire (1.0 mm); int. diam. 10 mm; leads 2 x 10 mm
- $L_2 =$ Ferroxcube choke coil. $Z$ (at $f = 175$ MHz) = 550 $\Omega \pm 20\%$ (code number 4312 020 36640)
- $L_3 =$ 15 turns closely wound enamelled Cu wire (0.7 mm); int. diam. 4 mm
- $L_4 =$ 3 turns closely wound enamelled Cu wire (1.5 mm); int. diam. 12 mm; leads 2 x 20 mm
- $R =$ 0 for the 2N3553
- $R =$ 0 to 2 $\Omega$ for the 2N3632

September 1970
CHARACTERISTICS (continued)

Test circuit with the 2N3375 at \( f = 100 \) MHz

\[ \begin{align*}
\text{Components} \\
\text{C1} = \text{C2} & = 3.5 \text{ to } 61.5 \text{ pF} \quad \text{air trimmer} \\
\text{C3} & = 10 \text{ nF} \quad \text{polyester} \\
\text{C4} = \text{C5} & = 4 \text{ to } 29 \text{ pF} \quad \text{air trimmer} \\
\text{C6} & = 330 \text{ pF} \quad \text{ceramic} \\
\text{C7} & = 10 \text{ nF} \quad \text{polyester} \\
\text{L1} & = 2 \text{ turns closely wound enameled } \text{Cu wire (1.5 mm); int. diam. 10 mm; leads } 2 \times 10 \text{ mm} \\
\text{L2} & = \text{Ferroxcube choke coil. } Z (\text{at } f = 100 \text{ MHz}) = 700 \Omega \pm 20\% \quad (\text{code number } 4312 \ 020 \ 36640) \\
\text{L3} & = 23 \text{ turns closely wound enameled } \text{Cu wire (0.7 mm); int. diam. } 6 \text{ mm} \\
\text{L4} & = 5 \text{ turns closely wound enameled } \text{Cu wire (1.5 mm); int. diam. } 12 \text{ mm; leads } 2 \times 10 \text{ mm} \\
\text{R1} & = 1.35 \Omega \quad \text{carbon} \\
\text{R2} & = 10 \Omega \quad \text{carbon}
\end{align*} \]
CHARACTERISTICS (continued)

Test circuit with the 2N3375 at f = 400 MHz

*) The emitter should be connected to the case as short as possible.

Components

C1 = C2 = 0.7 to 6.7 pF    ceramic trimmer
C3 = 0.5 to 3.5 pF    ceramic trimmer
C4 = C5 = 3 to 19 pF    air trimmer
C6 = C7 = 15 pF    ceramic
C8 = 4700 pF    ceramic

L1 = 20 mm straight Cu wire; diam. 1.5 mm; spaced 8 mm from chassis
L2 = 17 turns closely wound enamelled Cu wire (0.5 mm); int. diam. 3 mm
L3 = 7 turns closely wound enamelled Cu wire (0.5 mm); int. diam. 3 mm
L4 = 1 turn Cu wire (1.5 mm); int. diam. 10 mm; leads 2 x 5 mm
R = 0 to 5 Ω
APPLICATION INFORMATION

The 2N3553 used in a frequency doubler circuit 87.5 - 175 MHz

Components

C1 = C2 = C3 = 4 to 29 pF air trimmer
C4 = 3.5 to 61.5 pF air trimmer
C5 = 56 pF ceramic
C6 = 680 pF ceramic
C7 = 150 pF ceramic
C8 = 100 pF ceramic
C9 = 10 nF polyester

L1 = 5 turns Cu wire (1 mm); winding pitch 1.5 mm; int. diam. 6 mm; leads 2 x 12 mm
L2 = Ferroxcube choke coil; Z (at f = 87.5 MHz) = 750 Ω ± 20% (code number 4312 020 36640)
L3 = 15 turns closely wound enamelled Cu wire (0.7 mm); int. diam. 4 mm
L4 = 6 turns Cu wire (1 mm); winding pitch 1.5 mm; int. diam. 6 mm; leads 2 x 12 mm
The 2N3553 used in a parametric frequency tripler 156.7 - 470 MHz

*) C3 tuned to second harmonic frequency

Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 = C2 = C3 = C4</td>
<td>4 to 29 pF</td>
<td>air trimmer</td>
</tr>
<tr>
<td>C5 = C6 = C7</td>
<td>4 to 10.4 pF</td>
<td>air trimmer</td>
</tr>
<tr>
<td>C8</td>
<td>1.0 pF</td>
<td>ceramic</td>
</tr>
<tr>
<td>C9</td>
<td>12 pF</td>
<td>ceramic; feed through</td>
</tr>
<tr>
<td>C10</td>
<td>100 pF</td>
<td>ceramic; feed through</td>
</tr>
<tr>
<td>C11</td>
<td>1000 pF</td>
<td>ceramic</td>
</tr>
<tr>
<td>C12</td>
<td>15 nF</td>
<td>polyester</td>
</tr>
<tr>
<td>L1</td>
<td>35 mm</td>
<td>straight Cu wire; diam. 1 mm; spaced 5.5 mm from chassis</td>
</tr>
<tr>
<td>L2</td>
<td>Ferroxcube</td>
<td>choke coil; Z (at f = 156.7 MHz) = 600 Ω ± 20%</td>
</tr>
<tr>
<td>L3</td>
<td>18 mm</td>
<td>straight Cu wire; diam. 1 mm; spaced 5.5. mm from chassis</td>
</tr>
<tr>
<td>L4</td>
<td>7 turns</td>
<td>closely wound enamelled Cu wire (0.5 mm); int. diam. 3.5 mm</td>
</tr>
<tr>
<td>L5</td>
<td>3 turns</td>
<td>Cu wire (1 mm); winding pitch 1.7 mm; int. diam. 8.5 mm; leads 2 x 10 mm</td>
</tr>
<tr>
<td>L6</td>
<td>2 turns</td>
<td>Cu wire (1 mm); winding pitch 1.7 mm; int. diam. 7 mm; leads 2 x 10 mm</td>
</tr>
<tr>
<td>L7</td>
<td>40 mm</td>
<td>straight Cu wire; diam. 1.5 mm; spaced 5.5 mm from chassis</td>
</tr>
<tr>
<td>L8</td>
<td>1 turn</td>
<td>Cu wire; int. diam. 7 mm; leads 2 x 5 mm</td>
</tr>
</tbody>
</table>

Typical performance at $V_{CC} = 28$ V

<table>
<thead>
<tr>
<th>$P_o$ (W)</th>
<th>$P_i$ (W)</th>
<th>$G_p$ (dB)</th>
<th>$I_C$ (mA)</th>
<th>$\eta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>0.27</td>
<td>7.5</td>
<td>125</td>
<td>43</td>
</tr>
<tr>
<td>2.0</td>
<td>0.39</td>
<td>7.1</td>
<td>156</td>
<td>46</td>
</tr>
</tbody>
</table>

September 1970
maximum allowable total power dissipation versus mounting base temp.

\[ P_{\text{total}} = P_{\text{dc}} + P_{I} - P_{O} \]

\[
\begin{array}{c|c|c|c}
T_{mb} (\degree C) & 0 & 100 & 200 \\
\hline
P_{\text{total}} (W) & 15 & 10 & 5 \\
\end{array}
\]

maximum allowable total power dissipation versus mounting base temp.

\[ P_{\text{total}} = P_{\text{dc}} + P_{I} - P_{O} \]

\[
\begin{array}{c|c|c|c}
T_{mb} (\degree C) & 0 & 100 & 200 \\
\hline
P_{\text{total}} (W) & 10 & 5 & 0 \\
\end{array}
\]
I Region of permissible operation under all base-emitter conditions and at all frequencies, including d.c.

II Additional region of operation at $f \geq 1$ MHz.
Care must be taken to reduce the d.c. adjustment to region I before removing the a.c. signal. This may be achieved by an appropriate bias in class A, B or C.

III Operating during switching off in this region is allowed, provided the transistor is cut-off with $-V_{BB} \leq 1.5$ V and $R_{BE} \geq 33$ $\Omega$, $I_C \leq 200$ mA and the transient energy does not exceed 0.5 mWs.
2N3375
2N3553
2N3632

Typical Values:

$V_{CE} = 28 \text{V}$
$T_{mb} = 25 ^\circ \text{C}$

$P_0$ vs. $f$ (MHz)

- $P_0 = 0.5 \text{W}$
- $P_0 = 1 \text{W}$
- $P_0 = 1.5 \text{W}$
- $P_0 = 2 \text{W}$

$C_C$ vs. $V_{CB}$ (V)

- $f = 1 \text{MHz}$
- $I_F = I_E = 0$
- $T = 25 ^\circ \text{C}$

2N3632

Typical Values:

$V_{CE} = 28 \text{V}$
$T_{mb} = 25 ^\circ \text{C}$

$P_0$ vs. $f$ (MHz)

- $P_0 = 0.5 \text{W}$
- $P_0 = 0.75 \text{W}$
- $P_0 = 1 \text{W}$
- $P_0 = 1.5 \text{W}$

$C_C$ vs. $V_{CB}$ (V)

- $f = 1 \text{MHz}$
- $I_F = I_E = 0$
- $T = 25 ^\circ \text{C}$
base current versus collector current

$V_{CE}=5V$

$T_j=25^\circ C$

June 1968
typical values
\( f = 175 \text{MHz} \)

2N3375
2N3553
2N3632

June 1968
SILICON PLANAR EPITAXIAL OVERLAY TRANSISTORS

N-P-N overlay transistors in TO-39 metal envelopes with the collector connected to the case. The devices are primarily intended for class-A, B or C amplifiers, frequency multiplier and oscillator circuits.

The transistors are suitable in output, driver or pre-driver stages in v.h.f. and u.h.f. equipment.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Collector-emitter voltage</th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{BE} = 10 \Omega$</td>
<td>V$_{CER}$ max. 55</td>
<td>40 V</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V$_{CEO}$ max. 30</td>
<td>20 V</td>
</tr>
<tr>
<td>Collector current (d.c. or averaged over any 20 ms period)</td>
<td>I$_C$ max. 0.4</td>
<td>0.4 A</td>
</tr>
<tr>
<td>Total power dissipation up to $T_{mb} = 25 , ^\circ C$</td>
<td>$P_{tot}$ max. 5</td>
<td>3.5 W</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>$T_j$ max. 200</td>
<td>200 $^\circ C$</td>
</tr>
</tbody>
</table>

Transition frequency

- $I_C = 25 \, mA; \, V_{CE} = 15 \, V; \, f = 100 \, MHz$
- $I_C = 25 \, mA; \, V_{CE} = 10 \, V; \, f = 100 \, MHz$

- $f_T$ typ. 700 MHz
- $f_T$ typ. 700 MHz

R.F. performance

<table>
<thead>
<tr>
<th>type number</th>
<th>f (MHz)</th>
<th>$V_{CE}$ (V)</th>
<th>$P_o$ (W)</th>
<th>$P_i$ (W)</th>
<th>$\eta$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N3866</td>
<td>400</td>
<td>28</td>
<td>1</td>
<td>&lt; 0.1</td>
<td>&gt; 45</td>
</tr>
<tr>
<td>2N4427</td>
<td>175</td>
<td>12</td>
<td>1</td>
<td>&lt; 0.1</td>
<td>&gt; 50</td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12.7 mm.

Accessories: 56218 (package); 56245 (distance disc).
### RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

<table>
<thead>
<tr>
<th>Voltages 1)</th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-base voltage (open emitter)</td>
<td>V\text{CBO}</td>
<td>max. 55</td>
</tr>
<tr>
<td>Collector-emitter voltage ( R_{\text{BE}} = 10 , \Omega )</td>
<td>V\text{CER}</td>
<td>max. 55</td>
</tr>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>V\text{CEO}</td>
<td>max. 30</td>
</tr>
<tr>
<td>Emitter-base voltage (open collector)</td>
<td>V\text{EBO}</td>
<td>max. 3.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Currents 1)</th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector current (d.c. or averaged over any 20 ms period)</td>
<td>I\text{C}</td>
<td>max. 0.4</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>I\text{CM}</td>
<td>max. 0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power dissipation 1)</th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total power dissipation up to ( T_{\text{mb}} = 25 , ^\circ\text{C} )</td>
<td>P\text{tot}</td>
<td>max. 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
</tr>
<tr>
<td>Junction temperature</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>From junction to ambient in free air</td>
</tr>
<tr>
<td>From junction to mounting base</td>
</tr>
<tr>
<td>From mounting base to heatsink mounted with top clamping washer of 56218</td>
</tr>
<tr>
<td>and a boron nitride washer for electrical insulation</td>
</tr>
</tbody>
</table>

---

1) See also areas of permissible operation on page 6.
CHARACTERISTICS

Tj = 25 °C unless otherwise specified

### Collector cut-off current

<table>
<thead>
<tr>
<th></th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB = 0; VCE = 28 V</td>
<td>ICEO &lt; 20 µA</td>
<td></td>
</tr>
<tr>
<td>IB = 0; VCE = 12 V</td>
<td>ICEO &lt; 20 µA</td>
<td></td>
</tr>
</tbody>
</table>

### Breakdown voltages

<table>
<thead>
<tr>
<th></th>
<th>2N3866</th>
<th>2N4427</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE = 0; IC = 100 µA</td>
<td>V(BR)CBO &gt; 55 V</td>
<td>40 V</td>
</tr>
<tr>
<td>IC = 5 mA; RBE = 10 Ω</td>
<td>V(BR)CER &gt; 55 V</td>
<td>40 V</td>
</tr>
<tr>
<td>IB = 0; IC = 5 mA</td>
<td>V(BR)CEO &gt; 30 V</td>
<td>20 V</td>
</tr>
<tr>
<td>IC = 0; IE = 100 µA</td>
<td>V(BR)EBO &gt; 3.5 V</td>
<td>2 V</td>
</tr>
</tbody>
</table>

### Collector-emitter saturation voltage

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2N3866</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 100 mA; IB = 20 mA</td>
<td>VCEsat &lt; 1.0 V</td>
<td>0.5 V</td>
</tr>
</tbody>
</table>

### D.C. current gain

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2N3866</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 50 mA; VCE = 5 V</td>
<td>hFE 10 to 200</td>
<td></td>
</tr>
<tr>
<td>IC = 100 mA; VCE = 5 V</td>
<td>hFE 10 to 200</td>
<td></td>
</tr>
<tr>
<td>IC = 360 mA; VCE = 5 V</td>
<td>hFE &gt; 5</td>
<td>5</td>
</tr>
</tbody>
</table>

### Transition frequency

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2N3866</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC = 25 mA; VCE = 15 V; f = 100 MHz</td>
<td>fT typ. 700 MHz</td>
<td></td>
</tr>
<tr>
<td>IC = 25 mA; VCE = 10 V; f = 100 MHz</td>
<td>fT typ. 700 MHz</td>
<td></td>
</tr>
</tbody>
</table>

### Collector capacitance

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2N3866</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCB = 28 V; IE = Ie = 0; f = 1 MHz</td>
<td>CC &lt; 3 pF</td>
<td></td>
</tr>
<tr>
<td>VCB = 12 V; IE = Ie = 0; f = 1 MHz</td>
<td>CC &lt; 4 pF</td>
<td></td>
</tr>
</tbody>
</table>

### R.F. performance at Tmb = 25 °C

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>f (MHz)</td>
<td>VCE (V)</td>
<td>P0 (W)</td>
<td>P1 (W)</td>
<td>IC (mA)</td>
<td>η (%)</td>
</tr>
<tr>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>2N3866</td>
<td>100</td>
<td>28</td>
<td>1.8</td>
<td>0.05</td>
<td>&lt; 107</td>
</tr>
<tr>
<td>2N3866</td>
<td>250</td>
<td>28</td>
<td>1.5</td>
<td>0.1</td>
<td>&lt; 107</td>
</tr>
<tr>
<td>2N3866</td>
<td>400</td>
<td>28</td>
<td>1.0</td>
<td>&lt; 0.1</td>
<td>&lt; 79</td>
</tr>
<tr>
<td>2N4427</td>
<td>175</td>
<td>12</td>
<td>1.0</td>
<td>&lt; 0.1</td>
<td>&lt; 167</td>
</tr>
<tr>
<td>2N4427</td>
<td>470</td>
<td>12</td>
<td>0.4</td>
<td>0.1</td>
<td>67</td>
</tr>
</tbody>
</table>

*) The transistor can withstand an output V.S.W.R. of 3:1 varied through all phases for conditions, mentioned in the table above.

June 1968
CHARACTERISTICS (continued)

Test circuit with the 2N3866 at \( f = 400 \) MHz

\[
\begin{align*}
C1 &= C2 = C3 = 4 \text{ to } 29 \text{ pF} & \text{air trimmer} \\
C4 &= 4 \text{ to } 14 \text{ pF} & \text{air trimmer} \\
C5 &= 1 \text{ nF} & \text{feed through} \\
C6 &= 12 \text{ pF} \\
C7 &= 12 \text{ nF} \\
R1 &= 5.6 \Omega \\
R2 &= 10 \Omega \\
L1 &= 2 \text{ turns Cu wire (1 mm); int. diam. 6 mm; winding pitch 3 mm} \\
L2 &= \text{Ferroxcube choke coil; } Z \left( \text{at } f = 250 \text{ MHz} \right) = 450 \Omega \text{ (code number 4312 020 36690)} \\
L3 &= L4 = 6 \text{ turns enameled Cu wire (0.5 mm); int. diam. 3.5 mm (100 nH)} \\
L5 &= 2 \text{ turns Cu wire (1 mm); int. diam. 7 mm; winding pitch 2.5 mm; leads 2x15 mm.}
\end{align*}
\]
**CHARACTERISTICS (continued)**

Test circuit with the 2N4427 at \( f = 175 \text{ MHz} \)

![Circuit Diagram]

*) The length of the external emitter wire is 1.6 mm

- \( C_1 = C_2 = C_3 = C_4 = 4 \text{ to } 29 \text{ pF} \) air trimmer
- \( C_5 = 1 \text{ nF} \) feed through
- \( C_6 = 12 \text{ nF} \)
- \( R = 10 \Omega \)

- \( L_1 = 2 \text{ turns Cu wire (1 mm); int. diam. 6 mm; winding pitch 2 mm; leads 2x10 mm} \)
- \( L_2 = \text{ Ferroxcube choke coil; } Z(\text{at } f = 175 \text{ MHz}) = 550 \Omega \) (code number 4312 020 36640)
- \( L_3 = 2 \text{ turns Cu wire (1 mm); int. diam. 5 mm; winding pitch 2 mm; leads 2x10 mm} \)
- \( L_4 = 3 \text{ turns Cu wire (1.5 mm); int. diam. 10 mm; winding pitch 2 mm; leads 2x15 mm} \)
For 2N3866 and 2N4427, the power dissipation, $P_{\text{tot}}$, can be calculated as:

$$P_{\text{tot}} = P_{\text{d.c.}} + P_I - P_0$$

Where:
- $P_{\text{d.c.}}$ is the power dissipation due to the dc components.
- $P_I$ is the power dissipation due to the input signal.
- $P_0$ is the power dissipation due to the output signal.

The diagrams show the relationship between $P_{\text{tot}}$ and $T_{\text{amb}}$, the ambient temperature, in degrees Celsius. The charts also include additional notes and graphs for other parameters, such as $I_C$ vs. $V_{CE}$.
I Region of permissible operation under all base-emitter conditions and at all frequencies, including d.c.

II Additional region of operation at \( f \geq 1 \text{ MHz} \).
Care must be taken to reduce the d.c. adjustment to region I before removing the a.c. signal. This may be achieved by an appropriate bias in class A, B or C.

III Operating during switching off in this region is allowed, provided the transistor is cut-off with \( -V_{BB} \leq 1.5 \text{ V} \) and \( R_{BE} \geq 33 \Omega \), \( I_C \leq 100 \text{ mA} \) and the transient energy does not exceed 0.125 mWs.
OPERATING NOTE  Below 280 MHz a base-emitter resistor of 10 \( \Omega \) is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
OPERATING NOTE Below 100 MHz a base-emitter resistor of 22 Ω is recommended to avoid oscillation. This resistor must be effective for both d.c. and r.f.
SILICON PLANAR EPITAXIAL OVERLAY TRANSISTORS

The 2N3924 is an n-p-n overlay transistor in a TO-39 metal envelope with the collector connected to the case. The 2N3926 and the 2N3927 are n-p-n overlay transistors in TO-60 metal envelopes with the emitter connected to the case. The transistors are intended for v.h.f. transmitting applications.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Collector-emitter voltage $-V_{BE} = 1.5$ V</th>
<th>$V_{CEX}$ max.</th>
<th>36</th>
<th>36</th>
<th>36</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-emitter voltage (open base)</td>
<td>$V_{CEO}$ max.</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>V</td>
</tr>
<tr>
<td>Collector current (peak value)</td>
<td>$I_{CM}$ max.</td>
<td>1,5</td>
<td>3,0</td>
<td>4,5</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$ max.</td>
<td>7</td>
<td>11,6</td>
<td>23</td>
<td>W</td>
</tr>
<tr>
<td>up to $T_{mb} = 25$ °C</td>
<td>$T_{j}$ max.</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>°C</td>
</tr>
<tr>
<td>Transition frequency</td>
<td>$I_{C} = 100$ mA; $V_{CE} = 13.5$ V</td>
<td>$f_{T}$ &gt; 250</td>
<td>250</td>
<td>–</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>$I_{C} = 200$ mA; $V_{CE} = 13.5$ V</td>
<td>$f_{T}$ &gt; –</td>
<td>–</td>
<td>200</td>
<td>MHz</td>
</tr>
<tr>
<td>R.F. performance at $V_{CE} = 13.5$ V; $f = 175$ MHz</td>
<td>type number</td>
<td>$P_{O}$ (W)</td>
<td>$P_{I}$ (W)</td>
<td>$\eta$ (%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2N3924</td>
<td>4</td>
<td>&lt;1</td>
<td>&gt; 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2N3926</td>
<td>7</td>
<td>&lt;2</td>
<td>&gt; 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2N3927</td>
<td>12</td>
<td>&lt;4</td>
<td>&gt; 80</td>
<td></td>
</tr>
</tbody>
</table>

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-39; collector connected to case.

Maximum lead diameter is guaranteed only for 12,7 mm.

Accessories: 56218 (package); 56245 (distance disc).

September 1978
MECHANICAL DATA (continued)

Dimensions in mm

Diameter of hole in heatsink: 4.8 to 5.2 mm
The device is supplied with nut and lock washer
Torque on nut: min. 8 cm kg
max. 17 cm kg

RATINGS (Limiting values) 1)

Voltages 2)

Collector-base voltage (open emitter)
Collector-emitter voltage
IC up to 400 mA; \(V_{BE} = 1.5 \text{ V}\)
Collector-emitter voltage (open base)
IC up to 400 mA
Emitter-base voltage (open collector)

IC
max. 0.5 1.0 1.5 A
ICM
max. 1.5 3.0 4.5 A

P_{tot} max. 7 11.6 23 W

Temperatures

Storage temperature
T_{stg} -65 to +200 °C
Junction temperature
T_{j} max. 200 °C

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
2) See also areas of permissible operation at pages 8 and 9.
### THERMAL RESISTANCE

<table>
<thead>
<tr>
<th></th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>From junction to mounting base</td>
<td>$R_{th , j-mb}$</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>From mounting base to heatsink</td>
<td>$R_{th , mb-h}$</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>From mounting base to heatsink mounted with top clamping washer of 56218</td>
<td>$R_{th , mb-h}$</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>top clamping washer of 56218 and a boron nitride washer for electrical insulation</td>
<td>$R_{th , mb-h}$</td>
<td>2.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

### CHARACTERISTICS

Collector cut-off current

<table>
<thead>
<tr>
<th></th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_E = 0; V_{CB} = 15 , V$</td>
<td>$I_{CBO}$</td>
<td>&lt; 100</td>
<td>100</td>
</tr>
<tr>
<td>$I_E = 0; V_{CB} = 15 , V; T_j = 150 , ^{\circ}C$</td>
<td>$I_{CBO}$</td>
<td>&lt; 5</td>
<td>5</td>
</tr>
</tbody>
</table>

Breakdown voltages

<table>
<thead>
<tr>
<th></th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_E = 0; I_C = 250 , \mu A$</td>
<td>$V_{(BR)CBO}$</td>
<td>&gt; 36</td>
<td>36</td>
</tr>
<tr>
<td>$I_C$ up to 400 mA</td>
<td>$V_{(BR)CEX}$</td>
<td>&gt; 36</td>
<td>36</td>
</tr>
<tr>
<td>$-V_{BE} = 1.5 , V; R_B = 33 , \Omega$</td>
<td>$V_{(BR)CEO}$</td>
<td>&gt; 18</td>
<td>18</td>
</tr>
<tr>
<td>$I_B = 0$</td>
<td>$V_{(BR)EBO}$</td>
<td>&gt; 4</td>
<td>4</td>
</tr>
</tbody>
</table>

Base-emitter voltage

<table>
<thead>
<tr>
<th></th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 250 , mA; V_{CE} = 5 , V$</td>
<td>$V_{BE}$</td>
<td>&lt; 1.5</td>
<td>1.5 V</td>
</tr>
<tr>
<td>$I_C = 500 , mA; V_{CE} = 5 , V$</td>
<td>$V_{BE}$</td>
<td>&lt; 1.5</td>
<td>1.5 V</td>
</tr>
<tr>
<td>$I_C = 1000 , mA; V_{CE} = 5 , V$</td>
<td>$V_{BE}$</td>
<td>&lt; 1.5</td>
<td>1.5 V</td>
</tr>
</tbody>
</table>

Saturation voltage

<table>
<thead>
<tr>
<th></th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_C = 250 , mA; I_B = 50 , mA$</td>
<td>$V_{CEsat}$</td>
<td>&lt; 0.75</td>
<td>0.75 V</td>
</tr>
<tr>
<td>$I_C = 500 , mA; I_B = 100 , mA$</td>
<td>$V_{CEsat}$</td>
<td>&lt; 0.75</td>
<td>0.75 V</td>
</tr>
<tr>
<td>$I_C = 1000 , mA; I_B = 200 , mA$</td>
<td>$V_{CEsat}$</td>
<td>&lt; 0.75</td>
<td>1.0 V</td>
</tr>
</tbody>
</table>

1) Pulsed through an inductor of 25 mH; $\delta = 0.5$; $f = 50 \, Hz$
CHARACTERISTICS (continued)

**D.C. current gain**

<table>
<thead>
<tr>
<th>Current</th>
<th>Collector Voltage</th>
<th>HFE</th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 mA</td>
<td>5 V</td>
<td>&gt;10</td>
<td>&lt;150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 mA</td>
<td>5 V</td>
<td>&gt;5</td>
<td></td>
<td>&lt;150</td>
<td></td>
</tr>
<tr>
<td>1000 mA</td>
<td>5 V</td>
<td>&gt;</td>
<td></td>
<td></td>
<td>&lt;5</td>
</tr>
</tbody>
</table>

**Collector capacitance at f = 1 MHz**

<table>
<thead>
<tr>
<th>Current</th>
<th>Collector Voltage</th>
<th>Cc</th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>13.5 V</td>
<td>&lt;20</td>
<td>20</td>
<td>45 pF</td>
<td></td>
</tr>
</tbody>
</table>

**Transition frequency**

<table>
<thead>
<tr>
<th>Current</th>
<th>Collector Voltage</th>
<th>fT</th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mA</td>
<td>13.5 V</td>
<td>&gt;250</td>
<td>250 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 mA</td>
<td>13.5 V</td>
<td>&gt;</td>
<td>200 MHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Real part of input impedance at f = 200 MHz**

<table>
<thead>
<tr>
<th>Current</th>
<th>Collector Voltage</th>
<th>Re(hie)</th>
<th>2N3924</th>
<th>2N3926</th>
<th>2N3927</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mA</td>
<td>13.5 V</td>
<td>&lt;20</td>
<td>20</td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>200 mA</td>
<td>13.5 V</td>
<td>&lt;</td>
<td></td>
<td></td>
<td>20 Ω</td>
</tr>
</tbody>
</table>

**R.F. performance at VCE = 13.5 V; f = 175 MHz**

<table>
<thead>
<tr>
<th>Transistor</th>
<th>Po (W)</th>
<th>Pi (W)</th>
<th>IC (mA)</th>
<th>η (%)</th>
<th>Test circuit page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2N3924</td>
<td>4</td>
<td>&lt;1</td>
<td>&lt;420</td>
<td>&gt;70</td>
<td>5</td>
</tr>
<tr>
<td>2N3926</td>
<td>7</td>
<td>&lt;2</td>
<td>&lt;740</td>
<td>&gt;70</td>
<td>6</td>
</tr>
<tr>
<td>2N3927</td>
<td>12</td>
<td>&lt;4</td>
<td>&lt;1100</td>
<td>&gt;80</td>
<td>6</td>
</tr>
</tbody>
</table>

**NOTE**

The transistors can withstand an output V.S.W.R. of 3:1 varied through all phases under conditions mentioned in the table above.
CHARACTERISTICS (continued)

Test circuit with the 2N3924 at $f = 175$ MHz

*) The length of the external emitter wire of the 2N3924 is 1.6 mm.

Components

$C_1 = C_2 = C_3 = C_4 = 4$ to $29$ pF  air trimmer
$C_5 = 10$ nF  polyester
$L_1 = 1$ turn Cu wire (1.0 mm); int. diam. 10 mm; leads 2 x 10 mm
$L_2 = \text{Ferroxcube choke coil. } Z (at f = 175$ MHz$) = 550 \Omega \pm 20\%$
\hspace{2cm} (code number 4312 020 36640)
$L_3 = 15$ turns closely wound enamelled Cu wire (0.7 mm); int. diam. 4 mm
$L_4 = 3$ turns closely wound enamelled Cu wire (1.5 mm); int. diam. 12 mm; leads 2 x 20 mm
CHARACTERISTICS (continued)

Test circuit with the 2N3926 or 2N3927 at \( f = 175 \) MHz

Components

\[ \begin{align*}
C1 & = C2 = C3 = C4 = 4 \text{ to } 29 \text{ pF} \quad \text{air trimmer} \\
C5 & = \quad \quad 100 \text{ pF} \quad \text{ceramic} \\
C6 & = \quad \quad 10 \text{ nF} \quad \text{polyester} \\
L1 & = 1 \text{ turn Cu wire (1.0 mm); int. diam. 10 mm; leads } 2 \times 10 \text{ mm} \\
L2 & = \text{Ferroxcube choke coil. } Z \text{ (at } f = 175 \text{ MHz) } = 550 \Omega \pm 20\% \\
& \quad \text{(code number 4312 020 36640)} \\
L3 & = 15 \text{ turns closely wound enamelled Cu wire (0.7 mm); int. diam. 4 mm} \\
L4 & = 2 \text{ turns closely wound enamelled Cu wire (1.5 mm); int. diam. 8.5 mm; leads } 2 \times 20 \text{ mm} \\
R & = 10 \Omega \quad \text{carbon}
\end{align*} \]
Maximum allowable total power dissipation versus mounting base temp.

\[ P_{\text{tot}} = P_{\text{dc}} + P_I - P_0 \]

See also adjacent graph.

July 1969
I Region of permissible operation under all base-emitter conditions and at all frequencies, including d.c.

II Additional region of operation at $f \geq 1 \text{ MHz}$.
   Care must be taken to reduce the d.c. adjustment to region I before removing the a.c. signal. This may be achieved by an appropriate bias in class A, B or C.

III Operating during switching off in this region is allowed, provided the transistor is cut-off with $-V_{BB} \leq 1.5 \text{ V}$ and $R_{BE} \geq 33 \Omega$, $I_C \leq 400 \text{ mA}$ and the transient energy does not exceed 2 mWs.
SILICON EPITAXIAL PLANAR OVERLAY TRANSISTOR

For data of this transistor please refer to type 2N3866
General note on flat heatsinks

All information on thermal resistances of the accessories combined with flat heatsinks is valid for square heatsinks of 1.5 mm blackened aluminium.

For a few variations the thermal resistance may be derived as follows:

- Rectangular heatsinks (sides a and 2a)
  When mounted with long side horizontal, multiply by 0.95.
  When mounted with short side horizontal, multiply by 1.10.

- Unblackened or thinner heatsinks
  Multiply by the factor given in Fig. 1 as a function of the heatsink size A.

Fig. 1 Multiplication factor (B) as a function of heatsink area (A).
(1) 1 mm blackened aluminium.
(2) 1.5 mm unblackened aluminium.
(3) 1 mm unblackened aluminium.
MOUNTING ACCESSORIES

Mounting accessories for TO-5 and TO-39 envelopes; the package consists of:
1 top clamping piece
1 bottom clamping piece
1 mylar insulator

MECHANICAL DATA

Dimensions in mm

Top clamping piece of insulating material.

Bottom clamping piece; material: brass, tin plated.

Mylar insulator.

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56218

TEMPERATURE
Maximum permissible temperature

\[ T_{\text{max}} = 100 \, ^{\circ}\text{C} \]

THERMAL RESISTANCE
From mounting base to heatsink
- direct mounting
- insulated mounting

\[ R_{\text{th mb-h}} = 3 \, ^{\circ}\text{C/W} \]
\[ R_{\text{th mb-h}} = 6 \, ^{\circ}\text{C/W} \]

MOUNTING INSTRUCTIONS
Insulated mounting

1. Top clamping piece
2. Bottom clamping piece
3. Mylar insulator

Direct mounting: without items 2 and 3; item 1 to be mounted upside-down.

56245

DISTANCE DISC

MECHANICAL DATA
Insulating material.

TO-5 or TO-39

Dimensions in mm

[Diagram showing the dimensions]
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GENERAL

TRANSMITTING TRANSISTORS AND MODULES

ACCESSORIES
Argentina: FAPESA S.A., Av. Crovara 2550, Tablada, Prov. de BUENOS AIRES, Tel. 652-7438/7478.
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