Bipolar ICs for radio and audio equipment
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 four series of handbooks each comprising several parts.

ELECTRON TUBES
SEMICONDUCTORS
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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Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1  February 1980  T1 02-80  Tubes for r.f. heating
          (ET1a 12-75)

Part 2  April 1980  T2 04-80  Transmitting tubes for communications
          (ET1b 08-77)

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 5a October 1979  ET5a 10-79  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
Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes

Part 7b May 1979  ET7b 05-79  Gas-filled tubes
Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units

Part 8 July 1979  ET8 07-79  Picture tubes and components
Colour TV picture tubes, black and white TV picture tubes, monitor tubes, components for colour television, components for black and white television

Part 9 March 1978  ET9 03-78  Photomultiplier tubes; phototubes
## SEMICONDUCTORS (RED SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

<table>
<thead>
<tr>
<th>Part</th>
<th>Release Date</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1</td>
<td>March 1980</td>
<td>S1 03-80</td>
<td>Diodes (SC1b 05-77) Small-signal germanium diodes, small-signal silicon diodes, special diodes, voltage regulator diodes (&lt; 1.5 W), voltage reference diodes, tuner diodes, rectifier diodes</td>
</tr>
<tr>
<td>Part 2</td>
<td>May 1980</td>
<td>S2 05-80</td>
<td>Power diodes, thyristors, triacs (SC1a 08-78) Rectifier diodes, voltage regulator diodes (&gt; 1.5 W), rectifier stacks, thyristors, triacs</td>
</tr>
<tr>
<td>Part 2</td>
<td>June 1979</td>
<td>SC2 06-79</td>
<td>Low-frequency power transistors</td>
</tr>
<tr>
<td>Part 3</td>
<td>January 1978</td>
<td>SC3 01-78</td>
<td>High-frequency, switching and field-effect transistors *</td>
</tr>
<tr>
<td>Part 3</td>
<td>April 1980</td>
<td>S3 04-80</td>
<td>Small-signal transistors (SC2 11-77, partly) (SC3 01-78, partly)</td>
</tr>
<tr>
<td>Part 4a</td>
<td>December 1978</td>
<td>SC4a 12-78</td>
<td>Transmitting transistors and modules</td>
</tr>
<tr>
<td>Part 4b</td>
<td>September 1978</td>
<td>SC4b 09-78</td>
<td>Devices for optoelectronics Photosensitive diodes and transistors, light-emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices</td>
</tr>
<tr>
<td>Part 4c</td>
<td>July 1978</td>
<td>SC4c 07-78</td>
<td>Discrete semiconductors for hybrid thick and thin-film circuits</td>
</tr>
</tbody>
</table>

* Field-effect transistors and wideband transistors will be transferred to S5 and SC3c respectively. The old book SC3 01-78 should be kept until then.
INTEGRATED CIRCUITS (PURPLE SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code. Books with the purple cover will replace existing red covered editions as each is revised.

Part 1  May 1980  IC1  04-80  Bipolar ICs for radio and audio equipment  
(SC5b 03-77)

Part 2  May 1980  IC2  04-80  Bipolar ICs for video equipment  
(SC5b 03-77)

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

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

Part 6b  August 1979  SC6b 08-79  ICs for digital systems in radio and television receivers

Signetics integrated circuits  
Bipolar and MOS memories 1979  
Bipolar and MOS microprocessors 1978  
Analogue circuits 1979  
Logic - TTL 1978
# COMPONENTS AND MATERIALS (GREEN SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

<table>
<thead>
<tr>
<th>Part</th>
<th>Issue Date</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>July 1979</td>
<td>CM1 07-79</td>
<td>Assemblies for industrial use&lt;br&gt;PLC modules, high noise immunity logic FZ/30 series, NORbits 60-series, 61-series, 90-series, input devices, hybrid integrated circuits, peripheral devices</td>
</tr>
<tr>
<td>3a</td>
<td>September 1978</td>
<td>CM3a 09-78</td>
<td>FM tuners, television tuners, surface acoustic wave filters</td>
</tr>
<tr>
<td>3b</td>
<td>October 1978</td>
<td>CM3b 10-78</td>
<td>Loudspeakers</td>
</tr>
<tr>
<td>4a</td>
<td>November 1978</td>
<td>CM4a 11-78</td>
<td>Soft Ferrites&lt;br&gt;Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores</td>
</tr>
<tr>
<td>4b</td>
<td>February 1979</td>
<td>CM4b 02-79</td>
<td>Piezoelectric ceramics, permanent magnet materials</td>
</tr>
<tr>
<td>6</td>
<td>April 1977</td>
<td>CM6 04-77</td>
<td>Electric motors and accessories&lt;br&gt;Small synchronous motors, stepper motors, miniature direct current motors</td>
</tr>
<tr>
<td>7</td>
<td>September 1971</td>
<td>CM7 09-71</td>
<td>Circuit blocks&lt;br&gt;Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive</td>
</tr>
<tr>
<td>7a</td>
<td>January 1979</td>
<td>CM7a 01-79</td>
<td>Assemblies&lt;br&gt;Circuit blocks 40-series and CSA70 (L), counter modules 50-series, input/output devices</td>
</tr>
<tr>
<td>8</td>
<td>June 1979</td>
<td>CM8 06-79</td>
<td>Variable mains transformers</td>
</tr>
<tr>
<td>9</td>
<td>August 1979</td>
<td>CM9 08-79</td>
<td>Piezoelectric quartz devices&lt;br&gt;Quartz crystal units, temperature compensated crystal oscillators</td>
</tr>
<tr>
<td>10</td>
<td>April 1978</td>
<td>CM10 04-78</td>
<td>Connectors</td>
</tr>
<tr>
<td>11</td>
<td>December 1979</td>
<td>CM11 12-79</td>
<td>Non-linear resistors&lt;br&gt;Voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)</td>
</tr>
<tr>
<td>12</td>
<td>November 1979</td>
<td>CM12 11-79</td>
<td>Variable resistors and test switches</td>
</tr>
<tr>
<td>13</td>
<td>December 1979</td>
<td>CM13 12-79</td>
<td>Fixed resistors</td>
</tr>
<tr>
<td>14</td>
<td>April 1980</td>
<td>CM14 04-80&lt;br&gt;(CM2b 02-78)</td>
<td>Electrolytic and solid capacitors</td>
</tr>
<tr>
<td>15</td>
<td>May 1980</td>
<td>CM15 05-80&lt;br&gt;(CM2b 02-78)</td>
<td>Film capacitors, ceramic capacitors, variable capacitors</td>
</tr>
</tbody>
</table>

May 1980
FUNCTIONAL AND NUMERICAL INDEX
MAINTENANCE TYPE LIST
## SELECTION GUIDE BY FUNCTION

### AM CHANNELS
- **TDA1072** AM receiver circuit
- **TEA5550** AM car radio receiver circuit

### FM CHANNELS
- **TCA420A** hi-fi FM/IF amplifier
- **TEA5560** FM/IF system for car radios and hi-fi

### AM/FM COMBINED CHANNELS
- **TBA570A; AQ** AM/FM radio receiver circuit
- **TBA700** AM/FM radio receiver circuit
- **TDA5700; Q** AM/FM radio receiver circuit

### STEREO DECODERS
- **TDA1005A; AT** frequency multiplex PLL stereo decoder

### INTERFERENCE SUPPRESSORS
- **TDA1001A; AT** interference absorption circuit

### D.C. CONTROLLED AUDIO CIRCUITS
- **TCA730A** d.c. volume and balance stereo control circuit
- **TCA740A** d.c. treble and bass stereo control circuit
- **TDA1028** signal-sources switch (2 x four channels)
- **TDA1029** signal-sources switch (4 x two channels)
- **TDA1074** dual electronic stereo potentiometer circuit

### VOLTAGE STABILIZERS
- **TCA530** voltage stabilizer for electronic tuning
- **TCA750** multi-stabilizer for electronic tuning

### AUDIO POWER AMPLIFIERS
- **TCA760B** 1,5 W audio amplifier
- **TDA1004A** 10 W audio power amplifier with thermal shut-down
- **TDA1010** 6 W audio power amplifier
- **TDA1011** 2 to 6 W audio power amplifier
- **TDA1011A** 2 to 6 W audio power amplifier with inverted input/output
- **TDA1013** 4 W audio power amplifier with d.c. volume control
- **TDA1512** 12 to 20 W hi-fi audio power amplifier
- **TDA2611A** 5 W audio power amplifier

### RECORDER AMPLIFIERS
- **TDA1002A** recording and playback amplifier
- **TDA1012** recording/playback and 2 W audio power amplifier

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March 1980
SELECTION GUIDE BY FUNCTION (continued)

MOTOR SPEED CONTROL ICs

- TDA1003A: motor regulator and bias/erase oscillator circuit
- TDA1006A: motor regulator with automatic tape-end indicator
- TDA1059B: motor speed regulator with thermal shut-down
- TDA1059C: motor speed regulator
- TDA1533: PLL motor speed control circuit for hi-fi applications

MISCELLANEOUS

- OM200/S2: integrated amplifier for use in ear hearing aids
- TAA263: low-level amplifier
- TAA320: integrated MOST amplifier
- TAA320A: integrated MOST level sensor
- TDA1008: gating/frequency divider for electronic musical instruments
NUMERICAL INDEX

OM200/S2 integrated amplifier for use in ear hearing aids
TAA263 low-level amplifier
TAA320 integrated MOST amplifier
TAA320A integrated MOST level sensor
TBA570A; AQ AM/FM radio receiver circuit
TBA700 AM/FM radio receiver circuit
TCA420A hi-fi FM/IF amplifier
TCA530 voltage stabilizer for electronic tuning
TCA730A d.c. volume and balance stereo control circuit
TCA740A d.c. treble and bass stereo control circuit
TCA750 multi-stabilizer for electronic tuning
TCA760B 1,5 W audio amplifier
TDA1001A; AT interference absorption circuit
TDA1002A recording and playback amplifier
TDA1003A motor regulator and bias/erase oscillator circuit
TDA1004A 10 W audio power amplifier with thermal shut-down
TDA1005A; AT frequency multiplex PLL stereo decoder
TDA1006A motor regulator with automatic tape-end indicator
TDA1008 gating/frequency divider for electronic musical instruments
TDA1010 6 W audio power amplifier
TDA1011 2 to 6 W audio power amplifier
TDA1011A 2 to 6 W audio power amplifier with inverted input/output
TDA1012 recording/play-back and 2 W audio power amplifier
TDA1013 4 W audio power amplifier with d.c. volume control
TDA1028 signal-sources switch (2 x four channels)
TDA1029 signal-sources switch (4 x two channels)
TDA1059B motor speed regulator with thermal shut-down
TDA1059C motor speed regulator
TDA1072 AM receiver circuit
TDA1074 dual electronic stereo potentiometer circuit
TDA1512 12 to 20 W hi-fi audio power amplifier
TDA1533 PLL motor speed control circuit for hi-fi applications
TDA2611A 5 W audio power amplifier
TDA5700; Q AM/FM radio receiver circuit
TEA5550 AM car radio receiver circuit
TEA5560 FM/IF system for car radios and hi-fi
MAINTENANCE TYPE LIST

The types listed below are not included in this handbook. Detailed information will be supplied on request.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAJ110</td>
<td></td>
</tr>
<tr>
<td>TCA290A</td>
<td></td>
</tr>
<tr>
<td>TCA450</td>
<td></td>
</tr>
<tr>
<td>TCA730</td>
<td>(successor type: TCA730A)</td>
</tr>
<tr>
<td>TCA740</td>
<td>(successor type: TCA740A)</td>
</tr>
<tr>
<td>TDA1002</td>
<td>(successor type: TDA1002A)</td>
</tr>
<tr>
<td>TDA1005</td>
<td>(successor type: TDA1005A; AT)</td>
</tr>
<tr>
<td>TDA1006</td>
<td>(successor type: TDA1006A)</td>
</tr>
<tr>
<td>TDA1009</td>
<td></td>
</tr>
<tr>
<td>TDA2611</td>
<td>(successor type: TDA2611A)</td>
</tr>
</tbody>
</table>
GENERAL

Preface to data of ICs
Type designation
Rating systems
Letter symbols
PREFACE TO DATA OF INTEGRATED CIRCUITS

1. General

The published data comprise particulars needed by designers of equipment in which integrated circuits are to be incorporated, and criteria on which to base acceptance testing of such circuits. For ease of reference, the data on each circuit are grouped according to the several headings discussed below.

The limiting values quoted under the headings Characteristics and Package Outline may be taken as references for acceptance testing.

Values cited as typical are given for information only.

For an explanation of the type designation code, see the section Type Designation.

For an explanation of the letter symbols used in designating terminals and performance of integrated circuits, and the electrical and logic quantities pertaining to them, see the section Letter Symbols.

2. Quick Reference Data

The main properties of the integrated circuit summarized for quick reference

3. Ratings

Ratings are limits beyond which the serviceability of the integrated circuit may be impaired. The ratings given here are in accordance with the Absolute Maximum System as defined in publication no. 134 of the International Electrical Commission; for further details see item 2 of the section Rating Systems.

If a circuit is used under the conditions set forth in the sections Characteristics and Additional System Design Data, its operation within the ratings is ensured.

4. Circuit diagram

Circuit diagrams and logic symbols are given to illustrate the circuit function. The diagrams show only essential elements, parasitic elements due to the method of manufacture normally being omitted. The manufacturer reserves the right to make minor changes to improve manufacturability.

5. System Design Data and Additional System Design Data

System Design Data normally derived from the Characteristics and based on worst-case assumptions as to temperature, loading and supply voltage, are quoted for the guidance of equipment designers. Supplementary information derived from measurements on large production samples may be given under Additional System Design Data.
6. Application information
   Under this heading, practical circuit connections and the resulting performance are described. Care has been taken to ensure the accuracy and completeness of the information given, but no liability therefor is assumed, nor is license under any patent implied.

7. Characteristics
   Characteristics are measurable properties of the integrated circuit described. Under a specific set of test conditions compliance with limit values given under this heading establishes the specified performance of the circuit; this can be used as a criterion for acceptance testing. Values cited as typical are given for information only and are not subject to any form of guarantee.

8. Logic symbols (digital circuits)
   Graphical logic symbols accord with MIL standard 806B. Supplementary drawings correlate logic functions with pin locations as a help to laying out printed circuit boards.

9. Outline drawing and pin 1 identification
   Dimensional drawings indicate the pin numbering of circuit packages. Dual in-line packages have a notch at one end to identify pin 1. Take care not to mistake adventitious moulding marks for the pin 1 identification. Flat packs identify pin 1 by a small projection on the pin itself and/or by a dot on the body of the package. Metal can encapsulations identify pin 1 by a tab on the rim of the can.
This type nomenclature applies to semiconductor monolithic, semiconductor multi-chip, thin-film, thick-film and hybrid integrated circuits.

A basic number consists of:

THREE LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST AND SECOND LETTER

1. DIGITAL FAMILY CIRCUITS
   The FIRST TWO LETTERS identify the FAMILY (see note 1).

2. SOLITARY CIRCUITS
   The FIRST LETTER divides the solitary circuits into:
   - S: Solitary digital circuits
   - T: Analogue circuits
   - U: Mixed analogue/digital circuits
   The SECOND LETTER is a serial letter without any further significance except ‘H’ which stands for hybrid circuits.

3. MICROPROCESSORS
   The FIRST TWO LETTERS identify microprocessors and correlated circuits as follows:
   - MA: Microcomputer
   - MB: Central processing unit
   - MD: Slice processor (see note 2)
   - ME: Correlated memories
   - Other correlated circuits (interface, clock, peripheral controller, etc.)

THIRD LETTER

It indicates the operating ambient temperature range.
The letters A to G give information about the temperature:
   - A: temperature range not specified
   - B: 0 to + 70 °C
   - C: −55 to + 125 °C
   - D: −25 to + 70 °C
   - E: −25 to + 85 °C
   - F: −40 to + 85 °C
   - G: −55 to + 85 °C

If a circuit is published for another temperature range, the letter indicating a narrower temperature range may be used or the letter ‘A’.

Example: the range 0 to + 75 °C can be indicated by ‘B’ or ‘A’.
TYPE DESIGNATION

SERIAL NUMBER
This may be either a 4-digit number assigned by Pro Electron, or the serial number (which may be a combination of figures and letters) of an existing company type designation of the manufacturer.

To the basic type number may be added:

A VERSION LETTER
Indicates a minor variant of the basic type or the package. Except for 'Z', which means customized wiring, the letter has no fixed meaning. The following letters are recommended for package variants:

C : for cylindrical
D : for ceramic DIL
F : for flat pack
P : for plastic DIL
Q : for QIL
U : for uncased chip

Alternatively a TWO LETTER SUFFIX may be used instead of a single package version letter, if the manufacturer (sponsor) wishes to give more information.

FIRST LETTER: General shape
C : Cylindrical
D : Dual-in-line (DIL)
E : Power DIL (with external heatsink)
F : Flat (leads on 2 sides)
G : Flat (leads on 4 sides)
K : Diamond (TO-3 family)
M : Multiple-in-line (except Dual-, Triple-, Quadruple-in-line)
Q : Quadruple-in-line (QIL)
R : Power QIL (with external heatsink)
S : Single-in-line
T : Triple-in-line

A hyphen precedes the suffix to avoid confusion with a version letter.

SECOND LETTER: Material
C : Metal-ceramic
G : Glass-ceramic (cerdip)
M : Metal
P : Plastic

Notes
1. A logic family is an assembly of digital circuits designed to be interconnected and defined by its basic electrical characteristics (such as: supply voltage, power consumption, propagation delay, noise immunity).
2. By 'slice processor' is meant: a functional slice of microprocessor.
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 LINEAR INTEGRATED CIRCUITS

General
The voltages and currents are normally related to the terminals to which they are applied or at which they appear. Each terminal is indicated by a number. In appropriate cases voltages, currents etc., pertinent to one or more of the circuit elements (transistors, diodes) are given in which case symbols are based on the recommendations as published in I.E.C. Publication 148.

Quantity symbols
1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.
   Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.
   Examples: I, V, P

Polarity of current and voltage
A current is defined to be positive when its conventional direction of flow is into the device.
A voltage is measured with respect to the reference terminal, which is indicated by the subscripts. Its polarity is defined to be positive when the potential is higher than that of the reference terminal.

Subscripts
For currents the number behind the quantity symbol indicates the terminal carrying the current.
   Examples: i₂, i₁₄
For voltages normally two number subscripts are used, connected by a hyphen. The first number indicates the terminal at which the voltage is measured and the second subscript the reference terminal. Where there is no possibility of confusion the second subscript may be omitted.
   Examples: V₂₋₁₂, v₁₄₋₂, V₅, v₈
LETTER SYMBOLS

To distinguish between maximum (peak), average, d.c. and root-mean-square values the following subscripts are added:

For maximum (peak) values: M or m
For average values: AV or av
For root-mean-square values: (RMS) or (rms)
For d.c. values: no additional subscripts

The upper case subscripts indicate total values.
The lower case subscripts indicate values of varying components:

Examples: \( I_2, I_{2AV}, I_{2(rms)}, I_{2(RMS)} \)

If in appropriate cases quantity symbols are pertinent to single elements of a circuit (transistors or diodes), the normal subscripts for semiconductor devices can be used.

Examples: \( V_{CBO}, V_{be}, V_{CES}, I_C \)
\( V_{DSS}, V_{GS}, I_D \)

List of subscripts:

\[ \begin{align*}
E, e & \quad = \quad \text{Emitter terminal} \\
B, b & \quad = \quad \text{Base terminal for bipolar transistors,} \\
& \quad \text{Substrate for MOS devices} \\
C, c & \quad = \quad \text{Collector terminal} \\
D, d & \quad = \quad \text{Drain terminal} \\
G, g & \quad = \quad \text{Gate terminal} \\
S, s & \quad = \quad \text{Source terminal for MOS devices} \\
& \quad \text{Substrate for bipolar transistor circuits} \\
(BR) & \quad = \quad \text{Break-down} \\
M, m & \quad = \quad \text{Maximum (peak) value} \\
AV, av & \quad = \quad \text{Average value} \\
(RMS), (rms) & \quad = \quad \text{R.M.S. value}
\end{align*} \]

Electrical Parameter Symbols

1. The values of four pole matrix parameters or other resistances, impedances, admittances, etc., inherent in the device, are represented by the lower case symbol with appropriate subscript.

Examples: \( h_i, z_f, y_o, k_r \)

Subscripts for Parameter Symbols

1. The static values of parameters are indicated by upper case subscripts.

Examples: \( h_{FE}, h_I \)

2. The small signal values of parameters are indicated by lower case subscripts.

Examples: \( h_i, z_o \)
3. The first subscript, in matrix notation identifies the element of the four pole matrix.

i (for 11) = input
o (for 22) = output
f (for 21) = forward transfer
r (for 12) = reverse transfer

Examples: \( V_1 = h_i i_1 + h_f v_2 \)
\( I_2 = h_f i_1 + h_o v_2 \)

The voltage and current symbols in matrix notation are indicated by a single digit subscript.
The subscript 1 = input; the subscript 2 = output.
The voltages and currents in these equations may be complex quantities.

4. A second subscript is used only for separate circuit elements (e.g. transistors) to identify the circuit configuration:

\( e = \) common emitter
\( b = \) common base
\( c = \) common collector

5. If it is necessary to distinguish between real and imaginary parts of the four pole parameters, the following notation may be used:

\( R_e (h_i) \) etc. ... for the real part
\( I_m (h_i) \) etc. ... for the imaginary part
METAL TO-72 (SOT-18/13)

METAL TO-72 (SOT-18/17)

PLASTIC (SOT-20)
PLASTIC TO-126 (SOT-32)

2.7 max

3.2
3.0

11.1 max

15.3 min

0.88 max

2.29

2.54 max

1.2

4.58

0.5

7.8 max

3.75

March 1980
16-LEAD DUAL IN-LINE; PLASTIC (SOT-38)

Dimensions in mm

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between
300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in
contact with the joint for more than 5 seconds. The total contact time of successive solder waves
must not exceed 5 seconds.
The device may be mounted up to the seating plane, but the temperature of the plastic body must
not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced
cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.
16-LEAD DUAL IN-LINE; PLASTIC POWER (SOT-38M and N)

Dimensions in mm

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds. The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.
16-LEAD QUADRUPLE IN-LINE; PLASTIC (SOT-58)

Dimensions in mm

\[ \begin{align*}
&2.2 \text{ max} \\
&3.65 \\
&3.20 \\
&5.08 \\
&10.16 \\
&0.32 \text{ max} \\
&8.25 \text{ max} \\
&0.53 \text{ max} \\
&1.4 \text{ max} \\
&2.54 \\
&14 \times \\
&1.4 \text{ min} \\
&0.7 \text{ max} \\
&4.7 \text{ max} \\
&0.76 \text{ min} \\
&0.254 \text{ max} \\
&0.254 \text{ min} \\
&3,65 \\
&3,20 \\
&1.4 \text{ max} \\
&2.2 \text{ max} \\
&16 \text{ max} \\
&15 \text{ max} \\
&14 \text{ max} \\
&13 \text{ max} \\
&12 \text{ max} \\
&11 \text{ max} \\
&10 \text{ max} \\
&9 \text{ max} \\
&1 \text{ max} \\
&2 \text{ max} \\
&3 \text{ max} \\
&4 \text{ max} \\
&5 \text{ max} \\
&6 \text{ max} \\
&7 \text{ max} \\
&8 \text{ max} \\
\end{align*} \]

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.
The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.
PACKAGE OUTLINES

16-LEAD DUAL IN-LINE; PLASTIC POWER (SOT-69B, D)

Dimensions in mm

SOLDERING

1. By hand
   Apply the soldering iron below the seating plane (or not more than 2 mm above it).
   If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between
   300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave
   The maximum permissible temperature of the solder is 260 °C; this temperature must not be in
   contact with the joint for more than 5 seconds. The total contact time of successive solder waves
   must not exceed 5 seconds.
   The device may be mounted up to the seating plane, but the temperature of the plastic body must
   not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced
   cooling may be necessary immediately after soldering to keep the temperature within the permissi­
   ble limit.

3. Repairing soldered joints
   The same precautions and limits apply as in (1) above.
18-LEAD DUAL IN-LINE; PLASTIC (SOT-102C)

Dimensions in mm

SOLDERING
See SOT-69B, D, for example.
16-LEAD FLAT PACK; PLASTIC (SO-16; SOT-109A)

Dimensions in mm

- Positional accuracy.
- Maximum Material Condition.

SOLDERING
See next page.
SOLDERING

The reflow solder technique

The preferred technique for mounting miniature components on hybrid thick or thin-film circuits is reflow soldering. Solder is applied to the required areas on the substrate by dipping in a solder bath or, more usually, by screen printing a solder paste. Components are put in place and the solder is reflowed by heating.

Solder pastes consist of very finely powdered solder and flux suspended in an organic liquid binder. They are available in various forms depending on the specification of the solder and the type of binder used. For hybrid circuit use, a tin-lead solder with 2 to 4% silver is recommended. The working temperature of this paste is about 220 to 230 °C when a mild flux is used.

For printing the paste onto the substrate a stainless steel screen with a mesh of 80 to 105 µm is used for which the emulsion thickness should be about 50 µm. To ensure that sufficient solder paste is applied to the substrate, the screen aperture should be slightly larger than the corresponding contact area.

The contact pins are positioned on the substrate, the slight adhesive force of the solder paste being sufficient to keep them in place. The substrate is heated to the solder working temperature preferably by means of a controlled hot plate. The soldering process should be kept as short as possible: 10 to 15 seconds is sufficient to ensure good solder joints and evaporation of the binder fluid.

After soldering, the substrate must be cleaned of any remaining flux.
Package outlines

9-Lead Single In-Line; Plastic (SOT-110A)

Dimensions in mm

- Positional accuracy.
- Maximum Material Condition.

A Centre-lines of all leads are within ±0.127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0.254 mm.

B Lead spacing tolerances apply from seating plane to the line indicated.

March 1980
Dimensions in mm

\(\oplus\) Positional accuracy.

\(\otimes\) Maximum Material Condition.

(1) Centre-lines of all leads are within \(\pm 0,127\) mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by \(\pm 0,254\) mm.
Dimensions in mm

- Positional accuracy.
- Maximum Material Condition.

(1) Centre-lines of all leads are within ±0.127 mm of the nominal position shown; in the worst case, the spacing between any two leads may deviate from nominal by ±0.254 mm.

(2) Lead spacing tolerances apply from seating plane to the line indicated.
INTRODUCTION
INTRODUCTION TO BIPOLAR ICs FOR RADIO AND AUDIO EQUIPMENT

Three main fields of application are shown in the following block diagram concepts. These are:

- portable radio recorder,
- hi-fi,
- car radio player.

'Concept' here means: a total IC programme is available for a system, in which the ICs are perfectly matched to each other during the design phase. All ICs can also be used as solitary types in combination with other components.

The various concept types are chosen as a function of the required compromise between performance and cost.

Two concepts are given for portable radio recorders:

- high performance,
- economical.

Some types in the IC programme are still in the development stage at the date of publication of this data handbook. These type numbers are given in brackets in the block diagrams (some of them still have the 'in-house' development number).
PORTABLE RADIO RECORDER CONCEPT

HIGH PERFORMANCE

- TDA1003A
  - MOTOR CONTROL + BIAS/ERASE OSC.

ECONOMICAL

- TDA1059
  - MOTOR CONTROL
- PRE-AMP
- TDA1012
  - PRE-AMP + STABILIZED LEVEL CONTROL + REC. AMP OR POWER AMP.
CAR RADIO PLAYER CONCEPT

- AM CHANNEL
- TDA5700 or TDA1072 or TEA5550
- FM CHANNEL
- TDA1576 (TEA5560)
- INTERFERENCE SUPPRESSION
- TDA1001A
- STEREO INDI.
- TDA1576 TDA1006A (N1830)
- STEREO DECODER
- NE645B NE646B
- DOLBY
- NE645B NE646B
- TDA1010 (N1780)
- STABILISER
- (V5010) FM FRONT-END
- FM CHANNEL
- RADIO/REC TDA1006A (R0710)
- NE542
- END TAPE INDC.
- MOTOR CONTROL + ELECTRONIC SWITCH
- PRE-AMPL.
INTEGRATED AMPLIFIER
for use in ear hearing aids

Monolithic integrated circuit amplifier in a plastic envelope, primarily intended for use in ear hearing aids.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_{1-3}$ max. 5 V</td>
</tr>
<tr>
<td>Supply current</td>
<td>$I_2$ max. 5 mA</td>
</tr>
<tr>
<td>Total power dissipation up to $T_{amb} = 25^\circ C$</td>
<td>$P_{tot}$ max. 25 mW</td>
</tr>
</tbody>
</table>

The following data are measured in test circuit on page 3:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total supply current</td>
<td>$I_{tot}$ typ. 1 mA</td>
</tr>
<tr>
<td>Transducer gain</td>
<td>$G_{tr}$ $&gt; 77$ dB</td>
</tr>
<tr>
<td>Output power at $d_{tot} = 10%$</td>
<td>$P_o$ $&gt; 0,2$ mW</td>
</tr>
<tr>
<td>Cut-off frequency ($-3$ dB)</td>
<td>$f_c$ $&gt; 20$ kHz</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE (Dimensions in mm)

SOT-20

CIRCUIT DIAGRAM

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)
For meaning of symbols test circuit on page 3.

Voltages
Supply voltage
Output voltage
Input voltage

Currents
Output current
Input current

Power dissipation
Power derating curve

\[
\begin{align*}
\text{V}_{1-3} & \text{ max.} & 5 \text{ V} \\
\text{V}_{2-3} & \text{ max.} & 5 \text{ V} \\
-\text{V}_{4-3} & \text{ max.} & 5 \text{ V}
\end{align*}
\]

\[
\begin{align*}
\text{I}_2 & \text{ max.} & 5 \text{ mA} \\
\text{I}_4 & \text{ max.} & 5 \text{ mA}
\end{align*}
\]

Temperatures
Storage temperature
Ambient temperature (see derating curve above)

\[
\begin{align*}
\text{T}_{\text{stg}} & \text{ -20 to +80 } \text{°C} \\
\text{T}_{\text{amb}} & \text{ -20 to +80 } \text{°C}
\end{align*}
\]

1) This value may be exceeded during inductive switch-off for transient energies < 10 \(\mu\)Ws.
CHARACTERISTICS at $V_{1-3} = 1.3$ V; $I_2 = 0.7$ mA and $T_{amb} = 25$ °C unless otherwise specified

Supply currents (no signal)

<table>
<thead>
<tr>
<th>Current</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{tot}$</td>
<td>$&lt; 1.1$ mA</td>
</tr>
<tr>
<td>$I_1$ typ.</td>
<td>$0.30$ mA</td>
</tr>
<tr>
<td>$C_{tr}$ typ.</td>
<td>$77$ dB</td>
</tr>
<tr>
<td>$C_{tr}$</td>
<td>$85$ dB</td>
</tr>
</tbody>
</table>

Transducer gain at $f = 1$ kHz

<table>
<thead>
<tr>
<th>Gain</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$G_{tr}$ typ.</td>
<td>$85$ dB</td>
</tr>
</tbody>
</table>

Total distortion at $f = 1$ kHz

<table>
<thead>
<tr>
<th>Distortion</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d_{tot}$ typ.</td>
<td>$4$ %</td>
</tr>
<tr>
<td>$d_{tot}$</td>
<td>$6$ %</td>
</tr>
</tbody>
</table>

Noise figure at $R_S = 5$ kΩ

<table>
<thead>
<tr>
<th>Noise</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F$ typ.</td>
<td>$2.5$ dB</td>
</tr>
<tr>
<td>$F$</td>
<td>$6$ dB</td>
</tr>
</tbody>
</table>

Cut-off frequency (-3 dB)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f_c$</td>
<td>$20$ kHz</td>
</tr>
</tbody>
</table>

Value of $R_F$ to adjust $I_2$ at $0.7$ mA

<table>
<thead>
<tr>
<th>Resistance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_F$ typ.</td>
<td>$400$ kΩ</td>
</tr>
<tr>
<td>$R_F$</td>
<td>$170$ to $1000$ kΩ</td>
</tr>
</tbody>
</table>

Test circuit

![Test Circuit Diagram]

Note

$I_2 = 0.7$ mA; adjusted by means of $R_F$

1) The transducer gain is defined as the ratio of the output power in the load $|Z| = 1.5$ kΩ and the available input power of the source with $R_S = 5$ kΩ.

$$G_{tr} = \frac{P_0}{V_1^2 / 4 R_S}$$

2) Due to special processing and pre-measuring, the flutter-noise level is extremely low.

April 1973
SOLDERING RECOMMENDATIONS

1. Iron soldering
At a maximum iron temperature of 300 °C the maximum permissible soldering time is 3 seconds, provided the solder spot is at least 0.5 mm from the seal and the leads are not soldered at the same time. Soldering in immediate subsequence is allowed.

2. Dipsoldering
At a maximum solder temperature of 250 °C the maximum permissible soldering time is 3 seconds, provided the soldered spot is at least 0.5 mm from the seal.

CHARACTERISTICS

The graph applies to test circuit on page 3
LOW-LEVEL AMPLIFIER

The TAA263 is a semiconductor integrated amplifier in a 4-lead TO-72 metal envelope. It comprises a three-stage, direct coupled low-level amplifier for use from d.c. up to frequencies of 600 kHz.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_B$ max. 8 V</td>
</tr>
<tr>
<td>Output voltage</td>
<td>$V_{3-4}$ max. 7 V</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_3$ max. 25 mA</td>
</tr>
<tr>
<td>Transducer gain at $P_o = 10$ mW</td>
<td>$G_{tr}$ typ. 77 dB</td>
</tr>
<tr>
<td>$R_L = 150 , \Omega$; $f = 1$ kHz</td>
<td>$T_{amb}$ -20 to +100 °C</td>
</tr>
</tbody>
</table>

OPERATING AMBIENT TEMPERATURE

PACKAGE OUTLINE

TO-72 (SOT-18/17)

Dimensions in mm
CIRCUIT DIAGRAM

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages
Supply voltage \( V_B \) max. 8 V
Output voltage \( V_{3-4} \) max. 7 V
Input voltage \( -V_{1-4} \) max. 5 V

Currents
Output current \( I_3 \) max. 25 mA
Input current \( I_1 \) max. 10 mA

Power dissipation
Total power dissipation up to \( T_{amb} = 65 \text{°C} \)
\[ P_{tot} \text{ max. } 70 \text{ mW} \]

Temperatures
Storage temperature \( T_{stg} \) -55 to +125 °C
Operating ambient temperature (see derating curve above) \( T_{amb} \) -20 to +100 °C
CHARACTERISTICS

Test circuit:

Currents
Output current
Total current drain (no signal)

Over-all small signal current gain

Transducer gain

Output power at f = 1 kHz; \( d_{\text{tot}} = 10\% \)

Noise figure

\[ f = 400 \text{ Hz to } 6 \text{ kHz} \]

\[ f = 450 \text{ kHz; } \Delta f = 5 \text{ kHz} \]

Noise figure

1) \( Z \leq 10 \Omega \) at \( f = 1 \text{ kHz} \)
CHARACTERISTICS  (continued)  

\( V_B = 6 \, \text{V}; I_3 = 3 \, \text{mA}; V_{3-4} = 4.2 \, \text{V} \)

\( f = 1 \, \text{kHz} \)

- Input admittance: \( y_i = g_i \)  typ. 20 \( \mu\Omega^{-1} \)
- Transfer admittance: \( y_f = g_f \)  typ. 11 \( \Omega^{-1} \)
- Output admittance: \( y_o = g_o \)  typ. 60 \( \mu\Omega^{-1} \)

\( f = 450 \, \text{kHz} \)

- Input conductance: \( g_i \)  typ. 15 \( \mu\Omega^{-1} \)
- Input capacitance: \( C_i \)  typ. 14 pF
- Transfer admittance: \( |y_f| \)  typ. 9.4 \( \Omega^{-1} \)
- Phase angle of transfer admittance: \( \phi_f \)  typ. 125°
- Output conductance: \( g_o \)  typ. 20 \( \mu\Omega^{-1} \)
- Output capacitance: \( C_o \)  typ. 13 pF

\( T_{amb} = 25 \, \text{°C} \)

- \( y \) parameters (point 4 common connection)
INTEGRATED MOST AMPLIFIER

The TAA320 is a silicon monolithic integrated circuit, consisting of a MOS transistor and an n-p-n transistor in a TO-18 metal envelope. The device is primarily intended for audio amplifiers with a very high input resistance (e.g., for crystal pick-ups). Besides this application, the TAA320 is also suitable for other applications where a high input resistance is required, like impedance converters, timing circuits, microphone-amplifiers, etc.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source voltage ($V_{GS} = 0$)</td>
<td>$-V_{DSS}$ max. 20 V</td>
</tr>
<tr>
<td>Drain current</td>
<td>$-I_D$ max. 25 mA</td>
</tr>
<tr>
<td>Gate-source voltage</td>
<td>$-V_{GS}$ typ. 11 V</td>
</tr>
<tr>
<td>$-I_D = 10$ mA; $-V_{DS} = 10$ V</td>
<td></td>
</tr>
<tr>
<td>Gate-source resistance</td>
<td>$r_{GS}$ &gt; 100 GΩ</td>
</tr>
<tr>
<td>$-V_{GS}$ up to 20 V; $T_J$ up to 125 °C</td>
<td></td>
</tr>
<tr>
<td>Transfer admittance at $f = 1$ kHz</td>
<td>$</td>
</tr>
<tr>
<td>$-I_D = 10$ mA; $-V_{DS} = 10$ V</td>
<td></td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

TO-18 (SOT-18/13)

Dimensions in mm

Source connected to the case

Accessories supplied on request: 56246, 56263

February 1980
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC134)

**Voltages**
- Drain-source voltage \((V_{GS} = 0)\) \(-V_{DSS}\) max. 20 V
- Gate-source voltage \((I_D = 0)\) \(-V_{GSO}\) max. 20 V
- Non repetitive peak gate-source voltage \((t \leq 10 \text{ ms})\) \(-V_{GSM}\) max. 100 V

**Current**
- Drain current \(-I_D\) max. 25 mA

**Power dissipation**
- Total power dissipation up to \(T_{amb} = 25^\circ\text{C}\) \(P_{tot}\) max. 200 mW

**Temperatures**
- Storage temperature \(T_{stg}\) -55 to +125 °C
- Operating ambient temperature \(T_{amb}\) -20 to +125 °C

**THERMAL RESISTANCE**
- From junction to ambient in free air \(R_{th\ j-a}\) = 0.5 °C/mW
CHARACTERISTICS

Drain current
\(-V_{DS} = 20\,\text{V};\, V_{GS} = 0\)

\(-I_D = 10\,\text{mA}; -V_{DS} = 10\,\text{V}\)

Gate-source voltage

\(-V_{GS} \leq 10\,\text{V}\)

Gate-source resistance

\(r_{GS} > 100\,\text{G}\Omega\)

Equivalent noise voltage

\(-R_{n} = 5\,\text{mV}\sqrt{\text{Hz}}\)

\(B = 50\,\text{Hz to 15 kHz}\)

\(y\) parameters at \(f = 1\,\text{kHz}\)

\(-I_D = 10\,\text{mA}; -V_{DS} = 10\,\text{V}\)

Transfer admittance

\(|y_{fs}| = 75\,\text{mV/Hz}^{-1}\)

Input capacitance

\(C_{IS} = 8\,\text{pF}\)

Feedback capacitance

\(-C_{RS} = 1.5\,\text{pF}\)

Output conductance

\(g_{OS} = 0.65\,\text{mV/Hz}^{-1}\)

NOTE

To exclude the possibility of damage to the gate oxide layer by an electrostatic charge building up on the high resistance gate electrode, the leads of the device have been short circuited by a clip. The clip has been arranged so that it need not be removed until the device has been mounted in the circuit.

1) \(-V_{GS}\) decreases about 6 mV/°C with increasing ambient temperature at a constant \(-I_D\).
The voltage dependent resistor (2322 552 03381) suppresses voltage transients that might otherwise exceed the safe operating limits of the BD115.

Supply voltage

Collector current of BD115

Drain current of TAA320

Primary d.c. resistance of output transformer

Primary inductance of output transformer

A.C. collector load for BD115

Performance at f = 1 kHz; feedback = 16 dB

Output power at \( d_{\text{tot}} = 10\% \)

(on primary of the output transformer)

Input voltage for \( P_o = 50 \text{ mW} \)

Input voltage for \( P_o = 2 \text{ W} \)

Total distortion at \( P_o = 2 \text{ W} \)

Minimum frequency response (-3 dB)

Signal-noise ratio at \( P_o = 2 \text{ W} \)

Mounting instruction for BD115

Proper continuous operation is ensured up to \( T_{\text{amb}} = 50 \text{ °C} \), provided the BD115 is directly mounted on a 1.5 mm blackened Al. heatsink of 30 cm\(^2\) with a clamping washer of type 56218.

If the transistor is mounted on a heatsink with a mica washer, the heatsink should have an area of 50 cm\(^2\).

Recommended diameter of hole in heatsink: 7.7 mm.
APPLICATION INFORMATION (continued)

4 W audio amplifier with TAA320 and 2 transistors of type BD115.

Supply voltage

Collector current of a BD115

Drain current of TAA320

Performance at f = 1 kHz; feedback = 12 dB

Output power at d_{tot} = 10%

Input voltage for P_{o} = 50 mW

Input voltage for P_{o} = 4 W

Total distortion at P_{o} = 4 W

Minimum frequency response (-3 dB)

Signal-noise ratio at P_{o} = 4 W

Mounting instruction for BD115 see page 4

\[
\begin{align*}
V_B &= 200 \text{ V} \\
I_C \text{ typ.} &= 52 \text{ mA} \\
-I_D \text{ typ.} &= 8.6 \text{ mA} \\
P_o \text{ typ.} &= 4.5 \text{ W} \\
V_{i(rms)} \text{ typ.} &= 7.5 \text{ mV} \\
V_{i(rms)} \text{ typ.} &= 67 \text{ mV} \\
d_{tot} \text{ typ.} &= 6 \% \\
50 \text{ Hz to } 20 \text{ kHz} \\
73 \text{ dB}
\end{align*}
\]
**Typical Values**

- **Tamb = 25°C**

**Graph 1:**
- Typical values for $b_{is}$ vs. $g_{is}$
- $V_{DS} = 10V$
- $f = 1kHz$
- Curves for different $I_D$ values:
  - $2mA$
  - $5mA$
  - $10mA$

**Graph 2:**
- Typical values for $|Y_{FS}|$ vs. $V_{DS}$
- $f = 1kHz$
- Curves for different $I_D$ values:
  - $2mA$
  - $5mA$
  - $10mA$
Typical values

$T_{amb} = 25\, ^\circ C$

$f = 1\, kHz$

$I_D = 10\, mA$

$I_D = 8\, mA$

$I_D = 6\, mA$

$I_D = 4\, mA$

$I_D = 2\, mA$

$10^{-3} \cdot V_{DS}\,(V)$

$0$ $5$ $10$ $15$

$g_{os}$

$(m\Omega^{-1})$

$0$ $0.5$ $1$ $1.5$ $2$

$R_{th\, j-a} = 0.3\, ^\circ C/mW$ (with cooling clip 56263)

$R_{th\, j-a} = 0.5\, ^\circ C/mW$ (in free air)

$P_{tot}$

$(mW)$

$0$ $100$ $200$ $300$

$-50$ $0$ $50$ $100$ $150$

$T_{amb}$ $(^\circ C)$

April 1973
Noise (μV/√Hz)

- $I_D = 10$ mA
- $V_{DS} = 10$ V

Typical noise performance graph with frequency (kHz) on the x-axis and noise (μV/√Hz) on the y-axis.
The TAA320A is a silicon monolithic integrated circuit, consisting of a p-channel enhancement type MOS transistor and an n-p-n transistor, in a TO-18 metal envelope. The device is intended for level sensors with a very high input resistance (e.g. timing circuits, thermostats, liquid level sensors, flame control circuits).

### QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source voltage ($V_{GS} = 0$)</td>
<td>$-V_{DSS}$</td>
</tr>
<tr>
<td>Drain current</td>
<td>$-I_D$</td>
</tr>
<tr>
<td>Gate-source voltage $^1$)</td>
<td></td>
</tr>
<tr>
<td>$-I_D = 10 \text{ mA}; -V_{DS} = 10 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Group 1:</td>
<td></td>
</tr>
<tr>
<td>$V_{GS}$ typ.</td>
<td>10.6 V</td>
</tr>
<tr>
<td>$10,0 \text{ to } 11.2 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Group 2:</td>
<td></td>
</tr>
<tr>
<td>$V_{GS}$ typ.</td>
<td>11.3 V</td>
</tr>
<tr>
<td>$10.7 \text{ to } 11.9 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Group 3:</td>
<td></td>
</tr>
<tr>
<td>$V_{GS}$ typ.</td>
<td>12.0 V</td>
</tr>
<tr>
<td>$11.4 \text{ to } 12.6 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Group 4:</td>
<td></td>
</tr>
<tr>
<td>$V_{GS}$ typ.</td>
<td>12.7 V</td>
</tr>
<tr>
<td>$12.1 \text{ to } 13.3 \text{ V}$</td>
<td></td>
</tr>
<tr>
<td>Gate cut-off current at $T_{amb} = 25 \text{ °C}$</td>
<td>$-I_{GSO}$</td>
</tr>
<tr>
<td>$V_{GS} = 20 \text{ V}; I_D = 0$</td>
<td>1 pA</td>
</tr>
<tr>
<td>$V_{GS} = 20 \text{ V}; V_{DS} = 0$</td>
<td>1 pA</td>
</tr>
</tbody>
</table>

### PACKAGE OUTLINE

**TO-18 (SOT-18/13)**

Dimensions in mm

Accessories supplied on request: 56246; 56263

$^1$) For explanation of the group codeification see note b on page 3.
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

**Voltages**
- Drain-source voltage \( (V_{GS} = 0) \): \(-V_{DSS}\) max. 20 V
- Gate-source voltage \( (I_D = 0) \): \(-V_{GSO}\) max. 20 V
- Non-repetitive peak gate-source voltage \( (t \leq 10 \text{ ms}) \): \(\pm V_{GSM}\) max. 100 V

**Current**
- Drain current: \(-I_D\) max. 60 mA
- Peak drain current \( (t < 200 \text{ ms}; I_D < 0.001) \): \(-I_{DM}\) max. 100 mA

**Temperatures**
- Storage temperature: \(T_{stg}\) -65 to +125 °C
- Operating ambient temperature (see curve below): \(T_{amb}\) -20 to +125 °C
CHARACTERISTICS

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

Drain current

\[ -V_{DS} = 20 \text{ V}; V_{GS} = 0 \]

\[ -I_{DSS} \quad \text{typ.} \quad 5 \quad \text{nA} \]

Drain-source voltage \(^1\)

\[ -I_{D} = 10 \text{ mA}; -V_{GS} = 20 \text{ V} \]

\[ -V_{DS} < 1 \quad \text{V} \]

\[ -I_{D} = 60 \text{ mA}; -V_{GS} = 20 \text{ V} \]

\[ -V_{DS} < 1,5 \quad \text{V} \]

Gate-source voltage (see note b)

\[ -I_{D} = 10 \text{ mA}; -V_{DS} = 10 \text{ V} \]

\[ \text{group 1: } -V_{GS} \quad \text{typ.} \quad 10,6 \quad \text{V} \]

\[ \text{10,0 to 11,2} \quad \text{V} \]

\[ \text{group 2: } -V_{GS} \quad \text{typ.} \quad 11,3 \quad \text{V} \]

\[ 10,7 \text{ to } 11,9 \quad \text{V} \]

\[ \text{group 3: } -V_{GS} \quad \text{typ.} \quad 12,0 \quad \text{V} \]

\[ 11,4 \text{ to } 12,6 \quad \text{V} \]

\[ \text{group 4: } -V_{GS} \quad \text{typ.} \quad 12,7 \quad \text{V} \]

\[ 12,1 \text{ to } 13,3 \quad \text{V} \]

Gate cut-off current

\[ -V_{GS} = 20 \text{ V}; I_D = 0 \]

\[ -I_{GSO} \quad \text{typ.} \quad 1 \quad \text{pA} \]

\[ 2) \]

\[ -I_{GSS} \quad \text{typ.} \quad 1 \quad \text{pA} \]

NOTES

a. The leads are short-circuited by a clip to protect the oxide layer against damage due to accumulation (or build-up) of electrostatic charge on the high resistance gate electrode. The clip should not be removed until after the device is mounted.

b. As a service to the customer the \(-V_{GS}\) group to which a device belongs is identified by a numerical suffix (1, 2, 3 or 4), however, individual groups cannot be ordered separately.

---

1. See also upper graph on page 4.

2. Being dependent on handling and ambient humidity, the quoted value applies only up to the time of shipping. Efficient drying treatment is advised before the device is mounted, provided the application requires this low current.
$T_{amb} = 25 \degree C$

$V_{GS} = 20 V$

$-V_{DS}$ (V)

$I_{DS}$ (mA)

Typo values

$V_{GS}$ (V)

$V_{DS}$ (V)

$T_{amb}$ (°C)

Typo values

April 1973
typ. values

\[ T_{\text{amb}} = 25 \, ^\circ\text{C} \]

- \( -V_{GS} = 11.65 \, \text{V} \)
- \( -V_{GS} = 11.60 \, \text{V} \)
- \( -V_{GS} = 11.55 \, \text{V} \)
- \( -V_{GS} = 11.50 \, \text{V} \)
- \( -V_{GS} = 11.45 \, \text{V} \)
- \( -V_{GS} = 11.40 \, \text{V} \)
- \( -V_{GS} = 11.35 \, \text{V} \)
- \( -V_{GS} = 11.30 \, \text{V} \)
INTEGRATED AM/FM RADIO RECEIVER CIRCUIT

The TBA570A is for use in small low-cost a.m. portable receivers as well as in high quality battery or mains-fed a.m. and a.m./f.m. receivers. The IC incorporates: a.m. mixer, oscillator, i.f. amplifier, a.g.c. amplifier, a.m. detector and capacitor, f.m./i.f. limiting amplifier and stable base bias for f.m. front-end, and an audio preamplifier and driver. The unique integrated audio part has an internally limited bandwidth (18 kHz) and negligible h.f. radiation back to the ferrite rod. This makes the TBA570A ideally suitable for small size a.m. receivers because print layout is not critical. The driver stage can directly drive complementary output stages ($P_o = 6$ W max.), or operate as a post amplifier ($V_o = 500$ mV). In its standard applications, the TBA570A can replace the TBA570.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable supply voltage range of receiver</td>
</tr>
<tr>
<td>Ambient temperature</td>
</tr>
<tr>
<td>Supply voltage at pin 8</td>
</tr>
<tr>
<td>Total quiescent current</td>
</tr>
<tr>
<td>A.M. performance (at pin 2)</td>
</tr>
<tr>
<td>R.F. input voltage; $S/N = 26$ dB</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>A.G.C. range; change of r.f. input voltage</td>
</tr>
<tr>
<td>for 10 dB expansion in audio range</td>
</tr>
<tr>
<td>R.F. signal handling; $d_{tot} = 10%$; $m = 0,8$</td>
</tr>
<tr>
<td>F.M. performance (at pin 2)</td>
</tr>
<tr>
<td>R.F. input voltage; 3 dB before limiting</td>
</tr>
<tr>
<td>Audio performance</td>
</tr>
<tr>
<td>Output driver current (peak value)</td>
</tr>
<tr>
<td>Input impedance (at pin 12)</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINES
TBA570A: 16-lead DIL; plastic (SOT-38).
TBA570AQ: 16-lead QIL; plastic (SOT-58).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Pin 11 voltage
Pin 8 voltage
Pin 11 current (peak value)
Total power dissipation
Storage temperature
Operating ambient temperature: \( V_{8;4;7;1-16} = 8 \text{ V} \);
\( I_{11M} = 100 \text{ mA} \); see also derating curve below

<table>
<thead>
<tr>
<th>Pin</th>
<th>Voltage Limitation</th>
<th>Current Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>max. 18 V</td>
<td>max. 100 mA</td>
</tr>
<tr>
<td>8</td>
<td>max. 8 V</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>max. 100 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DESIGN DATA

Characteristics of integrated components are determined by process and layout data.
Pins not under measuring condition should not be connected.

Voltages with respect to pin 9 and 16 (tolerated minimum: 0 V)

<table>
<thead>
<tr>
<th>Pins</th>
<th>Voltage Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-9(16)</td>
<td>max. 18 V</td>
</tr>
<tr>
<td>7-9(16)</td>
<td></td>
</tr>
<tr>
<td>4-9(16)</td>
<td>max. 8 V</td>
</tr>
<tr>
<td>8-9(16)</td>
<td>max. 8 V</td>
</tr>
<tr>
<td>3-9(16)</td>
<td>max. 3 V</td>
</tr>
<tr>
<td>5-9(16)</td>
<td>max. 4 V</td>
</tr>
<tr>
<td>14-9(16)</td>
<td>max. 1 V</td>
</tr>
</tbody>
</table>

Currents (tolerated minimum: 0 mA)

<table>
<thead>
<tr>
<th>Pins</th>
<th>Current Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12;16;12</td>
<td>max. 80 \text{ \mu A}</td>
</tr>
<tr>
<td>13;15</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>max. 5 \text{ mA}</td>
</tr>
</tbody>
</table>

January 1977
D.C. CHARACTERISTICS at $T_{\text{amb}} = 25 \degree C$

Saturation voltage of driver stage
$I_C = 50 \text{ mA}; I_B = 2,5 \text{ mA}$

Collector breakdown voltage of driver stage
$I_C = 25 \text{ mA}; R_{BE} = 7 \text{ k}\Omega$

D.C. current gain of driver stage
$I_C = 50 \text{ mA}$

Total quiescent current
except driver stage collector current;
from m. front-end;
discrete output stages; $V_{8-16} = 5,3 \text{ V}$
$V_{8-16} = 4,2 \text{ V}$

Applicable supply voltage range of receiver

Base bias voltage for f.m. front-end

A.C. CHARACTERISTICS at $T_{\text{amb}} = 25 \degree C$; $V_{8-16} = 5,3 \text{ V}$; $I_E (TR9) = 1 \text{ mA}$

<table>
<thead>
<tr>
<th></th>
<th>0.45</th>
<th>1</th>
<th>10,7 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input conductance at pin 2</td>
<td>$g_{ie}$ typ.</td>
<td>-</td>
<td>0.4</td>
</tr>
<tr>
<td>Output conductance at pin 1</td>
<td>$g_{oe}$ typ.</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>Input conductance at pin 15</td>
<td>$g_{ie}$ typ.</td>
<td>0,35</td>
<td>-</td>
</tr>
</tbody>
</table>

1) Adjustable by a dropping resistor in the $V_p$-line; see also maximum tolerated voltages for pins 1, 4, 7 and 8 in design data on page 3.
H.F. part of a high quality FM/AM (LW; MW; SW) receiver.
Fig. 1 Output stage for $V_p = 9\, \text{V}$ or $6\, \text{V}$ (resistor values between parentheses).

<table>
<thead>
<tr>
<th>$V_p$</th>
<th>$R_L$</th>
<th>$P_o$ at $\delta_{\text{tot}} = 10%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>9, \text{V}</td>
<td>4, \Omega</td>
<td>1.8, \text{W}</td>
</tr>
<tr>
<td>6, \text{V}</td>
<td>4, \Omega</td>
<td>0.6, \text{W}</td>
</tr>
</tbody>
</table>

Fig. 2 Output stage for $V_p = 14.4\, \text{V}$; especially used in car radios.

<table>
<thead>
<tr>
<th>$V_p$</th>
<th>$R_L$</th>
<th>$P_o$ at $\delta_{\text{tot}} = 10%$</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.4, \text{V}</td>
<td>4, \Omega</td>
<td>5.5, \text{W}</td>
</tr>
</tbody>
</table>
Fig. 3 Output stage for $V_p = 16$ V.

$V_p$ $R_L$ $P_o$ at $d_{tot} = 10\%$

16V 4Ω 6, 8 W

Fig. 4 Post amplifier for $V_o = 500$ mV and $V_p = 6$ V.

*In circuit on page 5 volume control resistor (100 kΩ) and capacitor (100 nF) on pin 12 should be omitted.

**Capacitor value depends on load.
COIL DATA (in circuit on page 5)

High quality AM/FM receiver (for portable and mains-fed applications)

A.M. - I.F. coils ($f_0 = 455$ kHz)

I.F. bandpass filter:

<table>
<thead>
<tr>
<th>L9</th>
<th>N1 = 284,5 μH</th>
<th>L10</th>
<th>N1 = 680 μH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q0</td>
<td>100</td>
<td>Q0</td>
<td>100</td>
</tr>
<tr>
<td>N1/N2</td>
<td>40</td>
<td>N2/N1</td>
<td>74</td>
</tr>
<tr>
<td>N2/N3</td>
<td>1</td>
<td>(N2 + N1)/N3</td>
<td>10.7</td>
</tr>
<tr>
<td>$</td>
<td>Z_T</td>
<td>$</td>
<td>= 3 kΩ</td>
</tr>
</tbody>
</table>

F.M. - I.F. coils ($f_0 = 10,7$ MHz)

Second i.f. bandpass filter:

<table>
<thead>
<tr>
<th>L7</th>
<th>N1 + N2 = 2,7 μH</th>
<th>L8</th>
<th>N1 = 2,7 μH</th>
<th>L11</th>
<th>N1 = 2,7 μH</th>
<th>L12</th>
<th>N2 + N3 = 3, 25 μH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q0</td>
<td>100</td>
<td>Q0</td>
<td>90</td>
<td>Q0</td>
<td>85</td>
<td>Q0</td>
<td>85</td>
</tr>
<tr>
<td>$kQ_{L6-L7}$</td>
<td>= 1,2</td>
<td>$kQ_{L11-L12}$</td>
<td>= 0,7</td>
<td>$kQ_{L6-L7}$</td>
<td>= 1,2</td>
<td>$kQ_{L11-L12}$</td>
<td>= 0,7</td>
</tr>
<tr>
<td>N1/N2</td>
<td>5,5</td>
<td>N1/N2</td>
<td>2,2</td>
<td>N1/N2</td>
<td>2,2</td>
<td>N1/N2</td>
<td>2,2</td>
</tr>
</tbody>
</table>

Low-cost 2-band AM portable receiver (see page 9)

<table>
<thead>
<tr>
<th>L1</th>
<th>N1 = 11</th>
<th>L2</th>
<th>N1 = 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2</td>
<td>2</td>
<td>N2</td>
<td>4</td>
</tr>
<tr>
<td>wire: 1,1 Ø</td>
<td>wire: 20 x 0,03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

L3

| N = 284,5 μH | $f_m = 452$ kHz |
| Cl = 430 pF | $Q_o = 100$ |
| wire: 0,1 Ø |        |

core material: 7 MN(C)

L4

| Np = 284,5 μH | $f_m = 452$ kHz |
| Np/Np | = 16,7  |
| Cl = 430 pF | $Q_o = 100$ |
| wire: 0,1 Ø |        |

core material: 7 MN(C)

L5

| N1+N2 = 127 μH | $f_m = 1$ MHz |
| (N1+N2)/N2 = 58  | $Q_o = 100$ |
| (N1+N2)/N3 = 4.8 | $C_p = 200$ pF |
| wire: 0,1 Ø |        |

core material: 7 BR

L6

| N1+N2 = 13 μH | $f_m = 7$ MHz |
| (N1+N2)/N2 = 20  | $Q_o = 90$ |
| (N1+N2)/N3 = 4  | $C_p = 40$ pF |
| wire: 0,1 Ø |        |

core material: 119 AM(C)

Note

In the circuit on page 9 for L3 and L4 a similar coil to L9 in the circuit on page 5 can be used with the following exceptions:

L3: secondary windings N2 and N3 are not used.
L4: secondary windings N2 and N3 are connected in series.

When using a resistor between pins 2 and 15 (see dashed resistor in circuit on page 9), signal handling is improved.
Low-cost 2-band (SW-MW) AM portable receiver \((P_o = 250 \text{ mW})\)

Note: \(C1\) and \(C6\) max. 385 pF.
APPLICATION INFORMATION at $T_{amb} = 25$ °C

### A.M. performance

<table>
<thead>
<tr>
<th></th>
<th>$V_{8-16}$</th>
<th>5, 3 V 1)</th>
<th>4, 2 V 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.F. input voltage: S/N = 26 dB (notes 3 and 4) for $P_0 = 50$ mW (adjustable); notes 3, 4 and 5</td>
<td>$V_1$ typ. 18</td>
<td>10 µV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$V_1$ typ. 2</td>
<td>2 µV</td>
<td></td>
</tr>
<tr>
<td>R.F. input voltage for 10 mV (a.f.) across volume control (notes 3 and 4)</td>
<td>$V_1$ typ. 2,7</td>
<td>4,5 µV</td>
<td></td>
</tr>
<tr>
<td>A.F. voltage across volume control at 100 µV (r.f.) input voltage (notes 3 and 4)</td>
<td>$V_0$ typ. 70</td>
<td>70 mV</td>
<td></td>
</tr>
<tr>
<td>Signal-to-noise ratio at 1 mV (r.f.) input voltage (notes 3 and 4)</td>
<td>S/N typ. 46</td>
<td>47 dB</td>
<td></td>
</tr>
<tr>
<td>A.G.C. range (change in r.f. input voltage for 10 dB expansion in audio range); notes 3 and 4</td>
<td>typ. 60</td>
<td>60 dB</td>
<td></td>
</tr>
<tr>
<td>R.F. signal handling capability at 80% modulation: $d_{tot} &lt; 10%$ (note 3)</td>
<td>$V_1$ typ. 150</td>
<td>7 mV</td>
<td></td>
</tr>
<tr>
<td>Harmonic distortion of h.f. part over most of a.g.c. range; $m = 0.3$; $f_m = 1$ kHz (note 6)</td>
<td>$d_{tot}$ typ. 1</td>
<td>1 %</td>
<td></td>
</tr>
<tr>
<td>I.F. selectivity</td>
<td>$S_9$ typ. 33</td>
<td>16 dB</td>
<td></td>
</tr>
<tr>
<td>I.F. bandwidth (3 dB)</td>
<td>$B$ typ. 5</td>
<td>5,5 kHz</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

1. See circuits on pages 5, 6 and 7 (high quality AM/FM receiver).
2. See circuit on page 9 (low-cost 2-band AM portable receiver).
   b. R.F. signal: measured at pin 2 with the aerial circuit connected (source resistance about 1 kΩ).
   c. $f_0 = 1$ MHz; $f_m = 1$ kHz.
4. $m = 0.3$.
5. A.M. sensitivity for $P_0 = 50$ mW can be adjusted by means of the a.c. feedback network in the audio part e.g.: $V_1 = 1.5$ µV for $P_0 = 50$ mW (S/N ≈ 4 dB).
6. Distortion can be decreased to 0.7% by connecting a resistor of 270 kΩ between pins 2 and 15.
APPLICATION INFORMATION (continued) at $T_{\text{amb}} = 25 \, ^\circ\text{C}; V_{8-16} = 5,3 \, \text{V}$

Measured in the circuit on page 5

F.M. performance

Sensitivity for an f.m. signal 3 dB before limiting
at 75 $\Omega$ aerial input of f.m. front-end (note 1)
at pin 2; first i.f. (notes 2 and 6)

\[
V_i \quad \text{typ.} \quad 3,5 \, \mu\text{V}
\]
\[
V_i \quad \text{typ.} \quad 50 \, \mu\text{V}
\]

Sensitivity for 26 dB S/N ratio
at 75 $\Omega$ aerial input of f.m. front-end (note 1)

\[
V_i \quad \text{typ.} \quad 2,5 \, \mu\text{V}
\]

A.F. output voltage across volume control
at an i.f. signal beyond limiting (note 2)

\[
V_o \quad \text{typ.} \quad 120 \, \text{mV}
\]

Signal-to-noise ratio
over most of signal range (note 2)

\[
S/N \quad \text{typ.} \quad 65 \, \text{dB}
\]

A.M. suppression over most of signal range (note 3)

\[
\text{typ.} \quad 60 \, \text{dB}
\]

I.F. selectivity (note 4)

\[
S_{300} \quad \text{typ.} \quad 43 \, \text{dB}
\]

I.F. bandwidth (3 dB; note 4)

\[
B \quad \text{typ.} \quad 150 \, \text{kHz}
\]

A.F. signal distortion
3 dB before i.f. limiting (note 5)

\[
d_{\text{tot}} \quad \text{typ.} \quad 0,8 \, \% 
\]

Notes

1. Aerial e.m.f. ($V_i$) at $f_0 = 98 \, \text{MHz}; R_S = 50 \, \Omega; \Delta f = \pm 22, 5 \, \text{kHz}; f_m = 1 \, \text{kHz}$.

2. $f_0 = 10,7 \, \text{MHz}; \Delta f = \pm 22, 5 \, \text{kHz}; f_m = 1 \, \text{kHz}$.

3. A.M. signal: $m = 0,3; f_m = 1000 \, \text{Hz}$.
   F.M. signal: $f_0 = 10,7 \, \text{MHz}; \Delta f = \pm 75 \, \text{kHz}; f_m = 400 \, \text{Hz}$.
   Carrier simultaneously modulated with a.m. and f.m.

4. Including ratio detector.

5. $f_0 = 98 \, \text{MHz}; \Delta f = \pm 40 \, \text{kHz}; f_m = 1 \, \text{kHz}$.

6. Pin 3 by-passed to ground with a capacitor of 220 nF.
AUDIO PERFORMANCE

Distortion before clipping (note 1) \( d_{\text{tot}} \) typ. 0.5 \(% \)

Input impedance (note 2) \( |Z_1| \) typ. 90 kΩ

Noise output power; volume control at min. (note 3) \( P_n \) typ. 10 nW

Overall fidelity; flat within 3 dB (obtainable values) 35 Hz to 15 kHz

Open loop voltage gain \( G_v \) typ. 62 dB

<table>
<thead>
<tr>
<th>( V_p )</th>
<th>( V )</th>
<th>4.5</th>
<th>6</th>
<th>9</th>
<th>14, 4</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_L )</td>
<td>( \Omega )</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

\( P_o \) at \( d_{\text{tot}} = 10\% \) W 0.22 0.6 1.8 5.5 6.8

\( P_o \) at onset of clipping; \( d_{\text{tot}} = 1\% \) W 0.15 0.4 1.2 4 4.8

\( V_i \) for \( d_{\text{tot}} = 10\% \) (pin 12) mV 14 16 25 50 45

\( V_i \) for \( P_o = 50 \) mW (pin 12) mV 5.5 4.5 4 3.5 3.5

Output transistors BC327 BC368 BC368 BD329 BD329

BC337 BC369 BC369 BD330 BD330

Circuit diagrams on page 6, 7 or 9 page 9 Fig. 1 Fig. 1 Fig. 2 Fig. 3

Post-amplifier (see Fig. 4 on page 7)

Output voltage : 500 mV

Audio gain (adjustable): 5

Distortion : 0.2%

Notes

1. Measured at 1 kHz and a negative feedback of 16 dB.

2. At the maximum tolerated value of resistance-tap/bleeder at pin 12.

3. Measured at a bandwidth of 60 Hz to 15 kHz, pin 12 being connected via a capacitor of 32 μF to pin 9; \( R_L = 4 \Omega \).
APPLICATION INFORMATION (continued)

Typical a.g.c. curves for AM reception (circuit diagram on page 5)

A.F. voltage across volume control as a function of r.f. voltage at pin 2.

*) Slider at lower end.
APPLICATION INFORMATION (continued)

Typical S/N curves for FM reception (circuit diagram on page 5)

A.F. voltage across volume control as a function of aerial e.m.f. from a source with $R_S = 50\, \Omega$ to the $75\, \Omega$ input of the f.m. front-end.

*) Slider at lower end.
INTEGRATED A.M./F.M. RADIO RECEIVER CIRCUIT

The TBA700 is a monolithic integrated circuit for use in a.m. (including the short-wave band), a.m./f.m. receivers. It incorporates the class-B audio output stage (1 W), stabilization circuit for quiescent current, driver, pre-amplifier, 2-stage i.f. amplifier, a.g.c. and stabilized bias circuit. The discrete input stage (for a.m.: mixer-oscillator; for f.m.: 1st i.f.) enables a high flexibility in circuit lay-out with conventional or lumped selectivity. The internal stabilization ensures negligible loss of sensitivity and cross-over distortion over a wide supply voltage range from 2.7 V to 12 V.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable supply voltage range of receiver</td>
</tr>
<tr>
<td>Ambient temperature</td>
</tr>
<tr>
<td>Supply voltage</td>
</tr>
<tr>
<td>Total quiescent current (inclusive discrete input transistor, exclusive f.m. front end)</td>
</tr>
<tr>
<td>A.F. output power at dₜot = 10 %, Rₗ = 8 Ω</td>
</tr>
<tr>
<td>R.F. input voltage (S/N = 26 dB) (at base of external mixer-oscillator)</td>
</tr>
<tr>
<td>A.G.C. range (change of r.f. input voltage for 10 dB expansion in audio range)</td>
</tr>
<tr>
<td>F.M. performance</td>
</tr>
<tr>
<td>R.F. input voltage (at base of external i.f. stage) 3 dB before limiting</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic with internal copper slug (SOT-38).

1) The data given in this sheet are based on a receiver with Vₚ = 9 V; P₀ = 1000 mW.
### RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

#### Voltages

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Voltage</th>
<th>Max. Voltage</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 10</td>
<td>$V_{10-8}$</td>
<td>12</td>
<td>V</td>
</tr>
<tr>
<td>No. 15, 9, 2</td>
<td>$V_{15-8}, V_{9-8}, V_{2-8}$</td>
<td>11.4</td>
<td>V</td>
</tr>
<tr>
<td>No. 16</td>
<td>$V_{16-8}$</td>
<td>0</td>
<td>V</td>
</tr>
<tr>
<td>No. 7</td>
<td>$\pm V_{7-8}$</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>No. 4, 3, 1</td>
<td>$-V_{4-16}, -V_{3-16}, -V_{1-16}$</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>No. 5</td>
<td>$\pm V_{5-13}$</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td>No. 10</td>
<td>$V_{10-9}$</td>
<td>11.4</td>
<td>V</td>
</tr>
</tbody>
</table>

#### Currents

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Currents</th>
<th>Max. Current</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 14, 12, 11, 6</td>
<td>$I_{14}, I_{12}, I_{11}, I_{6}$</td>
<td>5</td>
<td>mA</td>
</tr>
<tr>
<td>No. 13, 5, 4, 3, 1</td>
<td>$I_{13}, I_{5}, I_{4}, I_{3}, I_{1}$</td>
<td>0.5</td>
<td>mA</td>
</tr>
<tr>
<td>No. 15, 2</td>
<td>$I_{15}, I_{2}$</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td>No. 8</td>
<td>$I_{8RM}$</td>
<td>0.8</td>
<td>A</td>
</tr>
<tr>
<td>No. 9</td>
<td>$I_{9RM}$</td>
<td>0.8</td>
<td>A</td>
</tr>
<tr>
<td>No. 10</td>
<td>$I_{10RM}$</td>
<td>0.8</td>
<td>A</td>
</tr>
</tbody>
</table>

#### Dissipation

<table>
<thead>
<tr>
<th>Total Power Dissipation</th>
<th>Max. Power</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{\text{tot}}$ at $T_{\text{Amb}} = 45$ °C</td>
<td>800</td>
<td>mW</td>
</tr>
<tr>
<td>$P_{\text{tot}}$ at $T_{\text{Amb}} = 25$ °C</td>
<td>1000</td>
<td>mW</td>
</tr>
</tbody>
</table>

#### Temperatures

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Max. Temperature</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>$T_{\text{stg}}$</td>
<td>-55 to +125</td>
</tr>
<tr>
<td>Operating Ambient</td>
<td>$T_{\text{Amb}}$</td>
<td>-20 to +125</td>
</tr>
</tbody>
</table>

1) Substrate connected to pin 16.
2) Repetitive peak value; internally limited.
CHARACTERISTICS

D.C. characteristics at Tamb = 25 °C; Vp = 9 V

I.F. amplifier

Collector current of i.f. transistor TR2  
(a.g.c. transistor "off")

\[ I_C \text{ typ.} = 0.55 \text{ to } 1.6 \text{ mA} \]

Collector current of i.f. transistor TR3  
(a.g.c. transistor "off")

\[ I_C \text{ typ.} = 2.5 \text{ mA} \]

Saturation voltage of i.f. transistor TR2  
at \[ I_C \leq 2 \text{ mA} \]

\[ V_{CEsat} < 150 \text{ mV} \]

Saturation voltage of i.f. transistor TR3  
at \[ I_C \leq 5 \text{ mA} \]

\[ V_{CEsat} < 200 \text{ mV} \]

Bias voltage for mixer and tuner

\[ V_{14-16} \text{ typ.} = 1.4 \text{ to } 4.2 \text{ mA} \]

Temperature dependency of bias voltage \( V_{14-16} \)

\[ T_c \text{ typ.} = -3.6 \text{ mV/°C} \]

Bias current (available)

\[ I_{14} < 100 \mu A \]

A.F. amplifier

Input common mode voltage range

\[ V_{5-8}, V_{13-8} = 1.0 \text{ to } 8.5 \text{ V} \]

Input base bias current

\[ I_5, I_{13} < 25 \mu A \]

Complete circuit

Total quiescent current with 3,3 kΩ  
between pins 7 and 8 (inclusive discrete  
input transistor, exclusive f.m. front end)

\[ I_{tot} \text{ typ.} = 24.5 \text{ mA} \]

\[ < 30.5 \text{ mA} \]

---

1) Maximum input common mode voltage; \( V_{5-8}, V_{13-8} < (V_p - 0.5) \text{ V} \).

2) In those cases where a lower supply current is required the resistor between pins 7 and 8 (3,3 kΩ) can be avoided, resulting in a total current of 17 mA. In this case however some devices may show a marginal increase of the distortion level.
**CHARACTERISTICS (continued)**

A.C. characteristics of i.f. part

<table>
<thead>
<tr>
<th>Parameters at f = 450 kHz</th>
<th>i.f. transistors: TR2</th>
<th>TR3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input conductance</strong></td>
<td>g&lt;sub&gt;ie&lt;/sub&gt; typ.</td>
<td>0,45</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;ie&lt;/sub&gt; typ.</td>
<td>23</td>
</tr>
<tr>
<td><strong>Output conductance</strong></td>
<td>g&lt;sub&gt;oe&lt;/sub&gt; typ.</td>
<td>6,0</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;oe&lt;/sub&gt; typ.</td>
<td>4,0</td>
</tr>
<tr>
<td><strong>Transfer admittance</strong></td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>Phase angle of transfer admittance</td>
<td>φ&lt;sub&gt;fe&lt;/sub&gt; typ.</td>
<td>1°</td>
</tr>
<tr>
<td><strong>Feedback admittance</strong></td>
<td></td>
<td>2,5</td>
</tr>
<tr>
<td>Phase angle of feedback admittance</td>
<td>φ&lt;sub&gt;re&lt;/sub&gt; typ.</td>
<td>90°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameters at f = 10,7 MHz</th>
<th>i.f. transistors: TR2</th>
<th>TR3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input conductance</strong></td>
<td>g&lt;sub&gt;ie&lt;/sub&gt; typ.</td>
<td>0,6</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;ie&lt;/sub&gt; typ.</td>
<td>22</td>
</tr>
<tr>
<td><strong>Output conductance</strong></td>
<td>g&lt;sub&gt;oe&lt;/sub&gt; typ.</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>C&lt;sub&gt;oe&lt;/sub&gt; typ.</td>
<td>4,3</td>
</tr>
<tr>
<td><strong>Transfer admittance</strong></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Phase angle of transfer admittance</td>
<td>φ&lt;sub&gt;fe&lt;/sub&gt; typ.</td>
<td>22°</td>
</tr>
<tr>
<td><strong>Feedback admittance</strong></td>
<td></td>
<td>64</td>
</tr>
<tr>
<td>Phase angle of feedback admittance</td>
<td>φ&lt;sub&gt;re&lt;/sub&gt; typ.</td>
<td>90°</td>
</tr>
</tbody>
</table>

1) At typical values for h<sub>fe</sub> and I<sub>c</sub>.

March 1973
Notes to the circuit on this page
1. The dashed components in the i.f. circuits can be omitted if signal handling of
   6 mV (m = 80%) at the base of TR26 is accepted. In that case the cold ends of
   coils L17 and L14 have to be connected directly to +2.
2. For correct operation on f.m. it is essential that the polarity of the windings
   of L16 is such that input (N1) and output (N2) are in phase opposition.

Notes to the circuit on page 7
   a) For equal a.f. sensitivity:
      at \( R_L = 4 \, \Omega \), \( V_p = 6 \, V \): \( R_{36} = 150 \, \Omega \)
      at \( R_L = 8 \, \Omega \), \( V_p = 9 \, V \): \( R_{36} = 68 \, \Omega \)
   b) The dashed capacitors (C61; C62) are only necessary when the ferrite aerial
      rod is too near to the a.f. output components or the IC. If C61 and C62
      are used the value of R42 must be decreased to 2.2 \( \Omega \).
   c) Can be omitted if degraded cross-over distortion can be tolerated.
Reference numbers L9 and L11 are not used in this circuit.
APPLICATION INFORMATION (continued) at $T_{\text{amb}} = 25 \, ^\circ\text{C}$; $V_P = 9 \, \text{V}$

See also circuit diagram on pages 6 and 7.

A.M. performance

R.F. input voltage for signal to noise ratio of 26 dB $V_l$ typ. 15 $\mu\text{V}$ $1)^2)$

R.F. input voltage for 10 mV (a.f.) across volume control $V_i$ typ. 3 $\mu\text{V}$ $1)^2)$

A.F. voltage across volume control at 100 $\mu\text{V}$ (r.f.) input voltage $V_o$ typ. 100 mV $1)^2)$

Signal to noise ratio at 1 mV (r.f.) input voltage $S/N$ typ. 53, 4 dB $1)^2)$

A.G.C. range (change in r.f. input voltage for 10 dB expansion in audio range) without a.g.c. diode typ. 42 dB $1)^2)^3)$
with a.g.c. diode typ. 72 dB $1)^2)$

R.F. signal handling capability on base of TR26 80% modulation ($d_{\text{tot}} \leq 10\%$) without a.g.c. diode $V_l$ typ. 6 mV $3)$
with a.g.c. diode $V_l$ typ. 80 mV

Harmonic distortion of h.f. part (over most of a.g.c. range) $d_{\text{tot}}$ typ. 1 % $1)^2)$

I.F. selectivity $S_9$ typ. 30 dB

I.F. bandwidth $B_{3\text{dB}}$ typ. 4, 5 kHz

1) a. Negligible influence of supply voltage variations in a range of 2, 7 V to 12 V
c. R.F. signal: measured at base of external mixer-oscillator with the antenna-circuit connected (source resistance $R_S$ of about 1 k\ohm).
d. $f_0 = 1 \, \text{MHz}$, $f_m = 1 \, \text{kHz}$
2) $m = 0, 3$
3) Dashed parts of circuit diagram on pages 6 and 7 are omitted.

March 1973
APPLICATION INFORMATION (continued) See also circuit on pages 6 and 7.

F.M. performance

Sensitivity for an f.m. signal 3 dB before limiting
- at 75Ω aerial input of f.m. front end
- at base of external (first i.f.) stage
- at pin 3

\[ V_i \text{ typ. } 12 \mu V^1 \]
\[ V_i \text{ typ. } 150 \mu V^2 \]
\[ V_i \text{ typ. } 2,2 \text{ mV}^2 \]

Sensitivity for 26 dB S/N ratio
- at 75Ω aerial input of f.m. front end

\[ V_i \text{ typ. } 4 \mu V^1 \]

A.F. output voltage across volume control at an i.f. signal beyond limiting

\[ V_o \text{ typ. } 140 \text{ mV}^2 \]

S/N ratio over most of signal range

\[ S/N \text{ typ. } 55 \text{ dB}^2 \]

A.M. suppression over most of signal range

\[ > 40 \text{ dB}^2 \]

I.F. selectivity

\[ S_{300} \text{ typ. } 40 \text{ dB}^4 \]

I.F. bandwidth

\[ B_{3dB} \text{ typ. } 180 \text{ kHz}^4 \]

A.F. signal distortion, 3 dB before i.f. limiting

\[ d_{tot} < 2 \%^5 \]

Audio performance

A.F. output power at \( d_{tot} = 10 \% \)
- at onset of clipping

\[ P_o \text{ typ. } 1 \text{ W}^6 \]
\[ P_o \text{ typ. } 0,7 \text{ W}^6 \]

Distortion before clipping

\[ d_{tot} \text{ typ. } 1 \%^6 \]

A.F. input signal (at pin 13)
- at \( P_o = 50 \text{ mW} \)
- at \( P_o = 700 \text{ mW} \)

\[ V_i \text{ typ. } 6 \text{ mV}^6 \]
\[ V_i \text{ typ. } 17 \text{ mV}^6 \]

Noise output power (volume control at minimum)

\[ P_N \text{ typ. } 20 \text{ nW}^7 \]

Typical overall fidelity (flat within 3 dB)

\[ 200 \text{ Hz to } 6 \text{ kHz}^8 \]

Open loop voltage gain

\[ G_V \text{ typ. } 60 \text{ dB} \]

---

1) Aerial e.m.f. \((V_i)\) at \(f_o = 100 \text{ MHz}; R_S = 50 \Omega \) (source resistance; see page 12)
\[ \Delta f = \pm 15 \text{ kHz}; f_m = 1 \text{ kHz}. \]

2) \(f_o = 10,7 \text{ MHz}; \Delta f = \pm 15 \text{ kHz}; f_m = 1 \text{ kHz}. \)

3) A.M. signal: \(m = 0,3; f_m = 400 \text{ Hz (carrier simultaneously modulated with a.m. and f.m.)}. \)

4) Including ratio detector.

5) \(f_o = 100 \text{ MHz}; \Delta f = \pm 40 \text{ kHz}; f_m = 1 \text{ kHz}. \)

6) Measured at 1 kHz, a negative feedback of 15 dB and a loudspeaker of 8 Ω; \(V_p = 9 \text{ V}. \)

7) Measured at a bandwidth of 200 Hz to 6 kHz, pin 13 being connected via a capacitor of 32 μF to pin 16; loudspeaker impedance 8 Ω.

8) Depending on values of capacitors C51 and C55, 50 Hz to 15 kHz is possible.
COIL DATA  See also circuit on pages 6 and 7.

1.  A.M.-I.F. coils \( f_0 = 452 \text{ kHz} \)

<table>
<thead>
<tr>
<th>First i.f. bandpass filter</th>
<th>Single tuned coil</th>
<th>Detector coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>L17 ((N_1) = 125 \mu \text{H})</td>
<td>L13 ((N_1+N_2) = 0, 84 \text{ mH})</td>
</tr>
<tr>
<td>( L14 = 38 \mu \text{H} )</td>
<td>( C_p = 1000 \text{ pF} )</td>
<td>( C_p = 150 \text{ pF} )</td>
</tr>
<tr>
<td>( C_p = 3300 \text{ pF} )</td>
<td>( Q_0 = 90 )</td>
<td>( Q_0 = 130 )</td>
</tr>
<tr>
<td>Secondary</td>
<td>L15 ((N_1) = 125 \mu \text{H})</td>
<td>( N_1/N_2 = 3, 1 )</td>
</tr>
<tr>
<td>( L15 (N_1) = 125 \mu \text{H} )</td>
<td>( C_p = 1000 \text{ pF} )</td>
<td>( (N_1+N_2)/N_3 = 4 )</td>
</tr>
<tr>
<td>( Q_0 = 80 )</td>
<td>( N_1/N_2 = 18 )</td>
<td></td>
</tr>
<tr>
<td>( N_1/N_2 = 18 )</td>
<td>( kQ_{L14-L15} = 1 )</td>
<td></td>
</tr>
</tbody>
</table>

2.  F.M.-I.F. coils \( f_0 = 10, 7 \text{ MHz} \)

<table>
<thead>
<tr>
<th>First i.f. bandpass filter</th>
<th>First single tuned filter</th>
<th>Second single tuned filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>L8 ((N_1) = 1, 44 \mu \text{H})</td>
<td>L16 ((N_1) = 1, 44 \mu \text{H})</td>
</tr>
<tr>
<td>( L4 (N_1) = 2, 6 \mu \text{H} )</td>
<td>( C_p = 150 \text{ pF} )</td>
<td>( C_p = 150 \text{ pF} )</td>
</tr>
<tr>
<td>( C_p = 82 \text{ pF} )</td>
<td>( Q_0 = 90 )</td>
<td>( Q_0 = 45 )</td>
</tr>
<tr>
<td>( Q_0 = 90 )</td>
<td>( N_1/N_2 = 10 )</td>
<td>( N_1/N_2 = 5, 7 )</td>
</tr>
<tr>
<td>Secondary</td>
<td>L5 ((N_1) = 1, 44 \mu \text{H})</td>
<td>( N_1/N_2 = 5, 7 )</td>
</tr>
<tr>
<td>( L5 (N_1) = 1, 44 \mu \text{H} )</td>
<td>( C_p = 150 \text{ pF} )</td>
<td>( N_1/N_2 = 5, 7 )</td>
</tr>
<tr>
<td>( C_p = 82 \text{ pF} )</td>
<td>( Q_0 = 55 )</td>
<td>( N_1/N_2 = 1 )</td>
</tr>
<tr>
<td>( Q_0 = 55 )</td>
<td>( N_1/N_2 = 5, 7 )</td>
<td>( (N_1+N_2)/N_3 = 5, 4 )</td>
</tr>
<tr>
<td>( kQ_{L4-L5} = 1, 2 )</td>
<td>( (N_1+N_2)/N_3 = 5, 4 )</td>
<td>( kQ_{L10-L12} = 0, 7 )</td>
</tr>
</tbody>
</table>

Ratio detector

<table>
<thead>
<tr>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>( L10 (N_1) = 1, 44 \mu \text{H} )</td>
<td>( L12 (N_1+N_2) = 2, 6 \mu \text{H} )</td>
</tr>
<tr>
<td>( C_p = 150 \text{ pF} )</td>
<td>( C_p = 82 \text{ pF} )</td>
</tr>
<tr>
<td>( Q_0 = 95 )</td>
<td>( Q_0 = 110 )</td>
</tr>
<tr>
<td>( N_1/N_2 = 2 )</td>
<td>( N_1/N_2 = 1 )</td>
</tr>
<tr>
<td>( (N_1+N_2)/N_3 = 5, 4 )</td>
<td>( (N_1+N_2)/N_3 = 5, 4 )</td>
</tr>
<tr>
<td>( kQ_{L10-L12} = 0, 7 )</td>
<td>( kQ_{L10-L12} = 0, 7 )</td>
</tr>
</tbody>
</table>
APPLICATION INFORMATION (continued)

a.f. voltage across volume control 1)

\[ V_p = 2.7 \text{ to } 9 \text{ V} \]
\[ f_0 = 1 \text{ MHz} \]
\[ m = 30\% \]
\[ f_m = 1 \text{ kHz} \]
\[ R_S \approx 1 \text{ k}\Omega \]

Typical values

- Without diode D19
- With diode D19

\[ 26 \text{ dB} \]
\[ 53 \text{ dB} \]

Typical a.g.c. curves at a.m. reception

A.F. voltages across volume control versus r.f. voltage at base of mixer-oscillator.

1) Slider at lower end.
APPLICATION INFORMATION (continued)

Typical S/N curves at f.m. reception

A.F. voltage across volume control versus aerial e.m.f. represented by the generator voltage $V_i$ (e.m.f.) connected to the 75 $\Omega$ input of the f.m. front-end.

Test circuit

1) Slider at lower end.
HI-FI F.M./I.F. AMPLIFIER

The TCA420A is a monolithic integrated f.m./i.f. amplifier for car and hi-fi equipment provided with the following functions:

- limiter amplifier
- symmetrical quadrature detector
- symmetrical a.f.c. output
- field-strength indication output
- stereo decoder switching voltage
- adjustable side response suppression
- muting

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 11)</td>
<td>( V_p )</td>
<td>15 V</td>
</tr>
<tr>
<td>Supply current (pin 11)</td>
<td>( I_p )</td>
<td>26 mA</td>
</tr>
<tr>
<td>Input limiting voltage (-3 dB); ( f_o = 10.7 ) MHz</td>
<td>( V_{ilim} )</td>
<td>20 ( \mu V )</td>
</tr>
<tr>
<td>A.F. output voltage (pin 5); ( \Delta f = \pm 15 ) kHz; r.m.s. value</td>
<td>( V_{o(rms)} )</td>
<td>115 mV</td>
</tr>
<tr>
<td>Signal plus noise-to-noise ratio; ( V_i &gt; 1 ) mV; ( \Delta f = \pm 15 ) kHz</td>
<td>( S+N/N )</td>
<td>72 dB</td>
</tr>
<tr>
<td>I.F. input voltage; ( \Delta f = \pm 15 ) kHz</td>
<td>( V_i )</td>
<td>15 ( \mu V )</td>
</tr>
<tr>
<td>( S + N/N = 26 ) dB</td>
<td>( V_i )</td>
<td>45 ( \mu V )</td>
</tr>
<tr>
<td>( S + N/N = 46 ) dB</td>
<td>( \alpha )</td>
<td>50 dB</td>
</tr>
<tr>
<td>A.M. rejection; ( V_i = 10 ) mV; ( f_m = 1 ) kHz (f.m.); ( \Delta f = \pm 15 ) kHz</td>
<td>( d_{tot} )</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Total distortion (single tuned circuit); ( \Delta f = \pm 15 ) kHz</td>
<td>( \Delta f =</td>
<td>f_{o1} - f_{o2}</td>
</tr>
<tr>
<td>Centre shift of f.m. detector curve</td>
<td>( \Delta V_i )</td>
<td>70 dB</td>
</tr>
<tr>
<td>Field-strength indication range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage range (pin 11)</td>
<td>( V_p )</td>
<td>6 to 18 V</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>( T_{amb} )</td>
<td>-30 to +80 °C</td>
</tr>
</tbody>
</table>

**PACKAGE OUTLINE**

16-lead DIL; plastic (SOT-38).
Fig. 1a Part of circuit diagram; other part continued in Fig. 1b.
Fig. 1b Part of circuit diagram; continued from Fig. 1a.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Supply voltage (pin 11) \( V_{p} = V_{11-16} \) max. 18 V
Total power dissipation \( P_{\text{tot}} \) max. 720 mW
Storage temperature \( T_{\text{stg}} \) -55 to +150 °C
Operating ambient temperature \( T_{\text{amb}} \) -30 to +80 °C

CHARACTERISTICS
\( V_{p} = 8 \) or 15 V; \( T_{\text{amb}} = 25 \) °C; \( f_{0} = 10,7 \) MHz; \( \Delta f = \pm 15 \) kHz; \( f_{m} = 1 \) kHz; \( R_{G} = 30 \) Ω; with de-emphasis (C5-6 = 10 nF); adjustment conforms to adjustment procedure unless otherwise specified; the characteristics are valid for a TCA420A mounted on a printed-circuit board (see Figs 2, 3 and 4).

Supply voltage range (pin 11) \( V_{p} \) 6 to 18 V
\( V_{p} = 8 \) V \( V_{p} = 15 \) V
Supply current; \( R_{7-16} = 5 \) kΩ; pin 11 \( I_{p} \) typ. 21 26 mA
\(< 35 \) mA

I.F. amplifier/detector
Input voltages (d.c. value) \( V_{13-16}; V_{14-16}; V_{15-16} \) typ. 2.6 2.8 V
Input limiting voltage (−3 dB) \( V_{i \text{lim}} \) typ. 20 20 µV
\(< 50 \) µV

I.F. output voltage (peak-to-peak value) \( V_{1-16}(p-p) \) typ. 300 320 mV
\( V_{2-16}(p-p) \) typ. 350 375 mV

Output voltages (d.c. value) \( V_{5-16} \) typ. 4.7 8.3 V
\( V_{6-16} \) typ. 5.0 9.5 V

Output voltage difference (d.c. value) \( V_{i} = 1 \) mV; \( \Delta f = \pm 75 \) kHz \( \pm V_{5-6} \) typ. 180 350 mV

A.F. output voltage; \( V_{i} = 1 \) mV (pins 5 and 6) \( V_{o} \) typ. 95 mV
\( \Delta f = \pm 15 \) kHz
\( \Delta f = \pm 40 \) kHz
\( \Delta f = \pm 75 \) kHz
\( V_{o} \) typ. 115 mV
\( V_{o} \) typ. 307 mV
\( V_{o} \) typ. 575 mV

Total distortion; \( V_{i} = 1 \) mV; single tuned circuit; \( Q_{L} = 20 \)
\( \Delta f = \pm 15 \) kHz \( d_{\text{tot}} \) typ. 0.1 0.1 %
\( \Delta f = \pm 40 \) kHz
\( \Delta f = \pm 75 \) kHz

without de-emphasis; C5-6 = 220 pF \( \Delta f = \pm 15 \) kHz \( d_{\text{tot}} \) typ. 0.1 0.1 %
\( \Delta f = \pm 40 \) kHz
\( \Delta f = \pm 75 \) kHz
### Hi-fi f.m./i.f. amplifier

<table>
<thead>
<tr>
<th>Vp (V)</th>
<th>( V_i ) (typ.)</th>
<th>( V_i ) (typ.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>15 µV</td>
<td>5 µV</td>
</tr>
<tr>
<td>15</td>
<td>20 µV</td>
<td>8 µV</td>
</tr>
</tbody>
</table>

**I.F. input voltage; with filter:**
- \( B = 250 \text{ Hz to } 16 \text{ kHz} \)
- \( S+N/N = 26 \text{ dB; with de-emphasis; } C_{5-6} = 10 \text{ nF} \)
  - \( \Delta f = \pm 15 \text{ kHz} \)
  - \( \Delta f = \pm 75 \text{ kHz} \)
- \( S+N/N = 26 \text{ dB; without de-emphasis; } C_{5-6} = 220 \text{ pF} \)
  - \( \Delta f = \pm 15 \text{ kHz} \)
  - \( \Delta f = \pm 75 \text{ kHz} \)

**S+N/N = 46 dB; with de-emphasis; \( C_{5-6} = 10 \text{ nF} \)
- \( \Delta f = \pm 15 \text{ kHz} \)
- \( \Delta f = \pm 75 \text{ kHz} \)

**S+N/N = 46 dB; without de-emphasis; \( C_{5-6} = 220 \text{ pF} \)
- \( \Delta f = \pm 15 \text{ kHz} \)
- \( \Delta f = \pm 75 \text{ kHz} \)

**Signal plus noise-to-noise ratio; with filter:**
- \( B = 250 \text{ Hz to } 16 \text{ kHz; } V_i = 1 \text{ mV} \)
- \( \text{with de-emphasis} \)
  - \( \Delta f = \pm 15 \text{ kHz} \)
  - \( \Delta f = \pm 75 \text{ kHz} \)
- \( \text{without de-emphasis} \)
  - \( \Delta f = \pm 15 \text{ kHz} \)
  - \( \Delta f = \pm 75 \text{ kHz} \)

**Noise output voltage; weighted conform DIN45405**
- \( \text{with de-emphasis} \)
  - \( V_i = 0 \)
  - \( V_i = 1 \text{ mV} \)
- \( \text{A.M. rejection; with filter: } B = 700 \text{ Hz to } 5 \text{ kHz} \)
  - \( f_m = 70 \text{ Hz; } \Delta f = \pm 15 \text{ kHz (for f.m.)} \)
  - \( f_m = 1 \text{ kHz; } m = 0,3 \text{ (for a.m.)} \); simultaneously modulated
  - \( V_i = 0,3 \text{ mV} \)
  - \( V_i = 1 \text{ mV} \)
  - \( V_i = 10 \text{ mV} \)
  - \( V_i = 100 \text{ mV} \)
- \( \text{Detectors input impedance} \)
  - \( Z_{3-4} = 4,4 \text{ kΩ/2,25 pF} \)
- \( \text{Output resistance} \)
  - \( R_{5-11}; R_{6-11} = 3,3 \Omega \)

**Note**
Zero crossing shift is defined as the difference between frequencies \( f_{o1} \) at \( V_i = 1 \text{ mV} \) and \( f_{o2} \) at \( V_i = 30 \mu V \).
CHARACTERISTICS (continued)

### Side response suppression

<table>
<thead>
<tr>
<th></th>
<th>$V_p = 8$ V</th>
<th>$V_p = 15$ V</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{i(rms)}$ (typ.)</td>
<td>35</td>
<td>30 $\mu$V</td>
</tr>
</tbody>
</table>

Input voltage for 10 dB side response suppression at $S1 = 'on'$ adjust $R1$, so $V_{10-16} = 1,3$ V at $V_i = 0$;
$S1 = 'off'$; $R4 = 3,9$ k$\Omega$

| $V_{12-16}$ (typ.)  | 0,7        | 0,7 V       |
| $V_{12-16}$ (typ.)  | 1,1        | 1,1 V       |

Side response suppression level

$\Delta f = \pm 15$ kHz; $V_{1i(rms)} = 1$ mV
control voltage for $\Delta V_o = -1$ dB
control voltage for $\Delta V_o = -10$ dB

### Muting

Output signal muting at $S2 = 'on'$;
reference signal at $S2 = 'off'$;
$V_{i(rms)} = 1$ mV; $\Delta f = \pm 75$ kHz; $R4 = 3,9$ k$\Omega$

$\Delta V_o$ (typ.) $-80$ $-80$ dB

### Field-strength indication

Output voltages (d.c. value)

| $V_{9-16}$ (typ.)  | 1,75        | 1,85 V      |
| $V_{8-16}$ (typ.)  | 1,90        | 2,00 V      |

Field-strength indicator current

$R_{indicator} = 2$ k$\Omega$;
adjust $R2$ so $I_{8-9} = 0$ at $V_i = 0$ and $R3 = 0$
measured at $V_{i(rms)} = 120$ mV

$I_{8-9}$ (typ.) $> 130$ 140 $\mu$A

Output resistance

| $R_o$ (typ.)      | 810        | 850 $\Omega$ |
| $R_{9-16}$ (typ.) | 3,7        | 3,7 k$\Omega$ |

### Stereo decoder switching voltage

Reference voltage; without load: $I_7 = 0$

| $V_{7-16}$ (typ.)  | 2,05        | 2,25 V      |
| $V_{10-16}$ (typ.) | 1,70        | 1,90 V      |

Available output current

$-I_{10\ max}$ (typ.) 0,45 0,85 mA

Output voltage as a function of the

| $\Delta V_{10-16}$ (typ.) | $-0,9$ | $-1,2$ V/20 dB |

### Input voltage

- $V_{10-16} = 0,8$ V
  - adjust $R1$ so $V_{10-16} = 1,3$ V at $V_{i(rms)} = 0$
    - $V_{i(rms)}$ (typ.) $< 98$ 100 $\mu$V
    - $V_{i(rms)}$ (typ.) $> 150$ 200 $\mu$V
- $V_{10-16} = 1,3$ V
  - adjust $R1$ so $V_{10-16} = 0,8$ V at $V_{i(rms)} = 3$ mV
    - $V_{i(rms)}$ (typ.) $< 1,3$ 1,3 mV
    - $V_{i(rms)}$ (typ.) $< 1,75$ 1,75 mV

Input resistance (pin 7)

| $R_{7-16}$ (typ.)  | 4          | 4,7 k$\Omega$ |
Fig. 2 Test circuit; for pc-board see Figs 3 and 4.

(1) Detector coil: see Fig. 18.
(2) De-emphasis:
  mono: $C_{5-6} = 10 \, \text{nF}$
  stereo: $C_{5-6} = 220 \, \text{pF}$
(3) Capacitor should be connected as short as possible to pin 11 and pc-board ground.

R1 = preset potentiometer for adjusting output voltage $V_{10-16}$ for mono/stereo switching of stereo decoder. $S1$ = side response suppression switch.
R2 = preset potentiometer for adjusting the zero level of the field-strength indicator current.
R3 = preset potentiometer for adjusting the maximum level of the field-strength indicator current. $S2$ = output signal muting switch.
R4 = preset potentiometer for adjusting the side response suppression.
Fig. 3 Circuit diagram showing components arrangement for printed-circuit board (Fig. 4). The circuit is similar to the test circuit of Fig. 2.

(1) \( C_8 = C_5,6 \) (see Fig. 2).
For mono: \( C_8 = 10 \, \text{nF} \).
For stereo: \( C_8 = 220 \, \text{pF} \).
Fig. 4 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 3.
Fig. 5 $V_p = 15 \, V; f_m = 1 \, kHz; B = 250 \, Hz$ to $16 \, kHz$; typical values.

Fig. 6 A.M. rejection; f.m.: $\Delta f = \pm 15 \, kHz; f_m = 70 \, Hz.$

a.m.: $m = 30\%; f_m = 1 \, kHz; simultaneously$ modulated.
Fig. 7 Total distortion as a function of frequency deviation; single tuned circuit with $Q_L = 20$; $f_m = 1$ kHz; $C_{5-6} = 220$ pF.

Fig. 8 Total distortion as a function of detuning; single tuned circuit with $Q_L = 20$; $f_m = 1$ kHz; $C_{5-6} = 220$ pF.
Fig. 9 Field-strength indication output voltages as a function of i.f. input voltage; R2 adjusted so \( V_{g,9} = 0 \) at \( V_i = 0 \); \( R_{\text{indicator}} + R2 = 2 \text{ k\(\Omega\)} \); for \( V_{g,16}^* \) definition see Fig. 11.
Fig. 9 Scale division of indicator as a function of i.f. input voltage; R2 adjusted so $V_{8,9} = 0$ at $V_i = 0$; $R_{\text{indicator}} = 2 \, \text{k}\Omega$; R3 adjusted at indication 100%; indicator current = 140 $\mu\text{A}$; see Fig. 11.

Fig. 11 Circuit diagram showing field-strength indicator adjustment components.
Fig. 12 Stereo decoder switching voltage as a function of i.f. input voltage; $R_4 = 3.9 \, \text{k}\Omega$; $R_1$ adjusted so $V_{10-16} = 0 \text{ at } V_i = 0$; see Fig. 13.

Fig. 13 Circuit diagram showing stereo decoder switching voltage adjustment.
Hi-fi f.m./i.f. amplifier

**Fig. 14** Supply current consumption.

**Fig. 15** Output voltage range.

**Fig. 16** A.F. output voltage; $\Delta f = \pm 15$ kHz; $f_m = 1$ kHz; $V_i = 1$ mV.

**Fig. 17** Total distortion; $f_m = 1$ kHz; $V_i = 1$ mV; $C_{5-6} = 220$ pF.
Fig. 18 Example of the TCA420A when using a detector with two tuned circuits; \( f_0 = 10.7 \text{ MHz} \); \( L_1 = L_2 \approx 0.4 \mu \text{H} \); \( Q_0 = 70 \).

Adjustment of the detector:
When having an i.f. input signal on top of the limiter capability, \( L_2 \) should be detuned, \( L_1 \) should be adjusted to minimum distortion, and then \( L_2 \) to minimum distortion.

Fig. 19 Total distortion as a function of detuning; circuit as Fig. 18; \( f_m = 1 \text{ kHz} \); \( C_5-6 = 220 \text{ pF} \). \( V_o = 500 \text{ mV} \) for a frequency deviation \( \Delta f = \pm 75 \text{ kHz} \) and \( d_{\text{tot}} < 0.1\% \).
APPLICATION INFORMATION

Fig. 20 I.F. coupling circuit, using LC filter; L1 = L2 = 7 + 7 turns h.f. litz wire (5 x 0.04); L3 = 3 turns h.f. litz wire wound on L2 (5 x 0.04).

Fig. 21 I.F. coupling circuit, using ceramic filter; L1 = 14 turns h.f. litz wire (5 x 0.04), tab at 3 turns.
APPLICATION INFORMATION (continued)

(1) For mono: C5-6 = 10 nF.
For stereo: C5-6 = 220 pF.

Fig. 22 Application example of using TCA420A.
The TCA530 is an adjustable 30 V integrated circuit voltage stabilizer for use with variable capacitance diodes. The circuit features: continuous short-circuit protected output, a.f.c. control voltage input, internal switch-on delay (can be adjusted externally), pre-stabilization and crystal temperature control (temperature sensor and heater).

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input (supply) voltage range</td>
<td>$V_I = V_P$ 50 to 68 V</td>
</tr>
<tr>
<td>Output voltage</td>
<td>$V_O = V_{6-16}$ typ. 30 V</td>
</tr>
<tr>
<td>Amplitude range of output voltage for a.f.c.</td>
<td>$\Delta V_{6-16}$ typ. ± 0.75 V</td>
</tr>
<tr>
<td>Variation of output voltage as a function of:</td>
<td></td>
</tr>
<tr>
<td>input (supply) voltage variations</td>
<td>$\Delta V_{6-12}/\Delta V_I$ typ. -0.2 mV/V</td>
</tr>
<tr>
<td>output current variations</td>
<td>$\Delta V_{6-12}/\Delta I_6$ typ. 0.5 mV/mA</td>
</tr>
<tr>
<td>temperature variations</td>
<td>$\Delta V_{6-12}/\Delta T_{amb}$ typ. 0.1 mV/K</td>
</tr>
<tr>
<td>heater voltage variations</td>
<td>$\Delta V_{6-12}/\Delta V_{1-16}$ typ. 0.2 mV/V</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_6 - I_Q$ typ. 3.0 mA</td>
</tr>
<tr>
<td>Allowable output voltage range</td>
<td>$V_O = V_{6-16}$ 25 to 30 ± 0.75 V</td>
</tr>
<tr>
<td>Allowable output current range</td>
<td>$I_6$ 0 to 4.6 mA</td>
</tr>
</tbody>
</table>

![Block diagram](image)

**Fig. 1 Block diagram.**

**PACKAGE OUTLINE**

16-lead DIL; plastic (SOT-38).
RATINGS

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

Volatges: pin 1 (heater voltage)
   pin 3 (muting switch supply)
   pins 10 and 11 (a.f.c. input control voltage)

Currents: pin 3
   pin 4
   pin 5
   pin 6
   pin 8
   pin 10
   pin 11
   pin 14

Total power dissipation (excluding heater power)
   at Tamb = 60 °C

Storage temperature
   -55 to +150 °C

Operating ambient temperature
   -20 to +80 °C

CHARACTERISTICS

V6-12 = 30 V; V10-12 = V11-12 = 10 V; V1-16 = 15 V; Tamb = 25 °C; measured in Fig. 3.

Voltage control

Input (supply) voltage range*
   R1 = 3,3 kΩ; I6 = 3,5 mA

Current consumption

Regulator voltage drop
   within operating range of the pre-stabilizer

   outside operating range of the pre-stabilizer**

Output current (start of current limiting)

Internal reference voltage

\[ V1 = Vp \]
\[ 50 \text{ to } 68 \text{ V} \]
\[ I_p \text{ typ.} \]
\[ 8,1 \text{ mA} \]
\[ I_5 \text{ typ.} \]
\[ 5,2 \text{ to } 11,0 \text{ mA} \]
\[ I_6 \text{ typ.} \]
\[ 1,1 \pm 0,3 \text{ mA} \]
\[ V5-6 \text{ typ.} \]
\[ 2,7 \text{ V} \]
\[ 2 \text{ to } 3,5 \text{ V} \]
\[ V5-6 < \]
\[ 6 \text{ V} \]
\[ V6 > \]
\[ 8 \text{ mA} \]
\[ V8-12 \text{ typ.} \]
\[ 18,2 \text{ to } 21,8 \text{ V} \]

* For other input (supply) voltage ranges and output currents, the series resistor R1 has to be altered (see also Fig. 2).

** The specified output voltage dependency of the input (supply) voltage is not guaranteed outside the operating range of the pre-stabilizer.
## Integrated voltage stabilizer

### Input current of control amplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input current of control amplifier</td>
<td>$I_B$</td>
</tr>
</tbody>
</table>

### Variation of output voltage as a function of *

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>input (supply) voltage variations</td>
<td>$\Delta V_{6-12}/\Delta V_I$</td>
</tr>
<tr>
<td>output current variations</td>
<td>$\Delta V_{6-12}/\Delta I_6$</td>
</tr>
<tr>
<td>temperature variations</td>
<td>$\Delta V_{6-12}/\Delta T_{\text{amb}}$</td>
</tr>
<tr>
<td>heater voltage variations</td>
<td>$\Delta V_{6-12}/\Delta V_{1-16}$</td>
</tr>
</tbody>
</table>

### Hum suppression at $f = 50$ Hz

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>between input (supply) voltage and pin 6</td>
<td>typ. $80 , dB$</td>
</tr>
<tr>
<td>between pins 5 and 6</td>
<td>typ. $60 , dB$</td>
</tr>
<tr>
<td>between pins 1 and 6</td>
<td>typ. $80 , dB$</td>
</tr>
</tbody>
</table>

### Output noise voltage at $f = 10 \, Hz$ to $15 \, kHz$ (r.m.s. value)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_n$ (rms)</td>
<td>$&lt; 50 , \mu V$</td>
</tr>
</tbody>
</table>

### A.F.C. control amplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common mode input voltage range</td>
<td>$V_{10-12} = V_{11-12}$</td>
</tr>
<tr>
<td>Common mode rejection ratio</td>
<td>CMRR</td>
</tr>
<tr>
<td>Input current</td>
<td>$I_{10} = I_{11}$</td>
</tr>
<tr>
<td>Input resistance</td>
<td>$R_i(10-11)$</td>
</tr>
<tr>
<td>Ratio between output voltage variation</td>
<td>$\Delta V_{6-12}/\Delta V_{10-11}$</td>
</tr>
<tr>
<td>Amplitude range of output voltage</td>
<td>$\Delta V_{6-12}$</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Muting switch

When the crystal temperature has reached approximately its stationary final value, the output of the muting switch (pin 3) becomes high-ohmic. The switching of pin 3 can be delayed by an external RC-circuit at pin 4 or by a switching voltage.

#### Muting switch ON (pin 3 low-ohmic)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>$V_{4-16}$</td>
</tr>
<tr>
<td>Input current</td>
<td>$I_4$</td>
</tr>
<tr>
<td>Output saturation voltage at $I_3 = 1$ mA</td>
<td>$V_{3-16 \text{sat}}$</td>
</tr>
</tbody>
</table>

#### Muting switch OFF (pin 3 high-ohmic)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage</td>
<td>$V_{4-16}$</td>
</tr>
<tr>
<td>Input current</td>
<td>$I_4$</td>
</tr>
<tr>
<td>Output voltage</td>
<td>$V_{3-16}$</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_3$</td>
</tr>
<tr>
<td>Internal switch-on delay</td>
<td>$t_d$</td>
</tr>
</tbody>
</table>

* External component value changes are not taken into account.
CHARACTERISTICS (continued)

Crystal temperature control

Heater voltage range

<table>
<thead>
<tr>
<th>V1-16</th>
<th>8 to 20 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1M</td>
<td>typ. 230 mA</td>
</tr>
<tr>
<td></td>
<td>&lt; 300 mA</td>
</tr>
<tr>
<td>I1</td>
<td>typ. 40 mA</td>
</tr>
<tr>
<td></td>
<td>&lt; 55 mA</td>
</tr>
<tr>
<td>P_h</td>
<td>typ. 600 mW</td>
</tr>
</tbody>
</table>

Heater peak current at switching on

Continuous heater current at V1-16 = 15 V

Continuous heater power

Fig. 2 Curves to obtain R1-values for various input (supply) voltages and/or output currents.
Conditions: V6-12 = 30 V; tolerance of I6 = ± 20%; R5-14 = 3,6 kΩ; tolerance of R1 = ± 2%.
Above the dotted curve a tolerance of V1 (Vp) of ± 15% is allowed.
(1) It is recommended that fixed resistors of the same kind be used for the voltage divider. The voltage divider of Fig. 4 can be used when a narrow temperature dependency is required.

(2) This capacitor can be applied to increase the internal delay.

(3) This resistor is recommended when the IC is not soldered on a printed-circuit board.

(4) Can be connected to pin 6, for example.

Fig. 3 Test circuit.
The following table gives some resistor value examples for various output voltages with $\Delta R/R \leq \pm 2\%$ and $\Delta R_p/R_p \leq \pm 20\%$.

<table>
<thead>
<tr>
<th>$V_{O\text{stab}}$ (V)</th>
<th>$R_{P2}$ (kΩ)</th>
<th>$R_{21}$ (kΩ)</th>
<th>$R_{22}$ (kΩ)</th>
<th>$R_{23}$ (kΩ)</th>
<th>$R_{P1}$ (kΩ)</th>
<th>$R_1$ (kΩ)</th>
<th>$R_2$ (kΩ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>100</td>
<td>200</td>
<td>82</td>
<td>300</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>47</td>
<td>180</td>
<td>82</td>
<td>300</td>
<td>47</td>
<td>100</td>
<td>47</td>
</tr>
<tr>
<td>29</td>
<td>100</td>
<td>220</td>
<td>75</td>
<td>300</td>
<td>22</td>
<td>39</td>
<td>18</td>
</tr>
<tr>
<td>28</td>
<td>47</td>
<td>300</td>
<td>100</td>
<td>430</td>
<td>22</td>
<td>39</td>
<td>15</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td>47</td>
<td>68</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>27</td>
<td>8,2</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>560</td>
<td>91</td>
<td>390</td>
<td>47</td>
<td>47</td>
<td>12</td>
</tr>
<tr>
<td>25</td>
<td>47</td>
<td>620</td>
<td>100</td>
<td>430</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The series resistors $R_1$ and $R_1'$ (see Fig. 3), as well as the input (supply) voltage $V_I (V_p)$, have to be adapted to the chosen output voltages $V_{O\text{stab}}$. 

Fig. 6 Application example; f.m. receiver with TCA530 and TCA420A.
D.C. VOLUME AND BALANCE STEREO CONTROL CIRCUIT

The TCA730A is a monolithic integrated circuit for controlling volume and balance in stereo amplifiers by means of a d.c. voltage.

Features:
- physiological volume control
- balance control
- internal amplifier
- high-ohmic signals inputs
- internal supply voltage stabilization
- converter for the control voltage

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 8)</td>
<td>Vp</td>
<td>typ. 15 V</td>
</tr>
<tr>
<td>Supply current (pin 8)</td>
<td>Ip</td>
<td>typ. 35 mA</td>
</tr>
<tr>
<td>Input voltage range (r.m.s. value)</td>
<td>Vi(rms)</td>
<td>0.1 to 1.7 V</td>
</tr>
<tr>
<td>Nominal input voltage; m = 1 (r.m.s. value)</td>
<td>Vn(rms)</td>
<td>typ. 0.5 V</td>
</tr>
<tr>
<td>Input resistance</td>
<td>Ri</td>
<td>typ. 250 kΩ</td>
</tr>
<tr>
<td>Output voltage at nominal output power (r.m.s. value)</td>
<td>Vo(rms)</td>
<td>typ. 1 V</td>
</tr>
<tr>
<td>Volume control range</td>
<td>Gv</td>
<td>+20 to -80 dB</td>
</tr>
<tr>
<td>Channel balance</td>
<td>ΔGv</td>
<td>typ. 1 dB</td>
</tr>
<tr>
<td>Balance control range</td>
<td>Gv</td>
<td>+5 to -7 dB</td>
</tr>
<tr>
<td>Total distortion at Vo(rms) = 1 V</td>
<td>Δdt</td>
<td>typ. 0.1 %</td>
</tr>
<tr>
<td>Channel separation</td>
<td>α</td>
<td>typ. 55 dB</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>S/N</td>
<td>typ. 67 dB</td>
</tr>
<tr>
<td>Frequency response (−1 dB)</td>
<td></td>
<td>20 Hz to 20 kHz</td>
</tr>
<tr>
<td>Volume control voltage range</td>
<td>V13-15</td>
<td>2 to 9.5 V</td>
</tr>
<tr>
<td>Balance control voltage range</td>
<td>V12-15</td>
<td>2.5 to 9.0 V</td>
</tr>
<tr>
<td>Supply voltage range (pin 8)</td>
<td>Vp</td>
<td>13.5 to 16.5 V</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>Tamb</td>
<td>-30 to +80 °C</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
(1) $6,6 \, V_{BE}; \, V_1 = 4,6 \, V$

(2) $0,35 \, V_P + 0,65 \, V_{BE}; \, V_2 = 5,7 \, V$.

Fig. 1 Block diagram with external circuitry.
D.C. volume and balance stereo control circuit

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

Supply voltage (pin 8) \( V_p \) max. 18 V

Input voltages \( V_{11-15}; V_{14-15} \) min. 0 V max. \( V_p \) V

Control voltages \( V_{12-15}; V_{13-15} \) min. -5 V max. 12 V

Total power dissipation \( P_{tot} \) max. 900 mW

Storage temperature range \( T_{stg} \) -55 to +150 °C

Operating ambient temperature range \( T_{amb} \) -30 to +80 °C

CHARACTERISTICS

\( V_p = 15 \) V; \( T_{amb} = 25 \) °C; measured in Fig. 1; balance control in mid-position \( (V_{12-10} = 0) \); physiology switch off; \( f = 1 \) kHz; \( R_G = 22 \) kΩ; \( R_L = 5,6 \) kΩ; unless otherwise specified.

Supply voltage range (pin 8) \( V_p \) 13,5 to 16,5 V

Supply current \( I_p \) typ. 35 mA 25 to 43 mA

Control range

Voltage gain range \( G_v \) 0 to 20 dB typ. 20 dB

Voltage gain at \( V_{13-15} = 9,5 \) V \( (0,63 \) \( V_p \)) \( G_v \) 18 to 22 dB

Voltage attenuation range \( G_v \) 0 to -80 dB typ. -75 dB

Voltage attenuation at \( V_{13-15} = 3 \) V \( (0,2 \) \( V_p \)) \( G_v \) > +5 to -7 dB

Balance control range at \( G_v = -10 \) dB

Control inputs

Recommended control voltage range

volume \( V_{13-15} \) 2 to 9,5 V

balance \( V_{12-15} \) 2,5 to 9,0 V

Control voltage for \( G_v = -10 \) dB; \( V_{12-10} = 0 \) \( V_{13-15} \) 6,7 to 7,1 V*

Control voltage for balance 0 dB; \( V_{13-15} = 6,9 \) V \( V_{12-10} \) typ. 0 ± 0,2 V typ. 5,9 V

Internal supply voltage \( (0,35 \) \( V_p + 0,65 \) \( V_{BE} \) \( V_{10-15} \) typ. 5,9 V

Output resistance (pin 10) \( R_{o10} \) typ. 3 kΩ

Control current

volume (\( V_{13-15} = 6,9 \) V) \( I_{13} \) typ. 15 \( \mu A \)< 50 \( \mu A \)

balance (\( V_{12-15} = 5,9 \) V) \( I_{12} \) typ. 8 \( \mu A \)< 25 \( \mu A \)

Input resistance

pin 13 (volume) \( R_{i13} \) typ. 500 kΩ

pin 12 (balance) \( R_{i12} \) typ. 600 kΩ

* Typical value 6,9 V.
TCA730A

CHARACTERISTICS (continued)

Signal processing

Frequency response (-1 dB)

Input resistance; \( R_{11;10} = R_{14;10} = 270 \, k\Omega \) (pins 11; 14)

Output resistance (pins 3; 5)

Maximum input voltage; \( V_{o(rms)} < 1 \, V \); \( d_{tot} = 0.7 \% \) (r.m.s. value)

Maximum output voltage; \( V_{i(rms)} < 1 \, V \); \( d_{tot} = 0.7 \% \) (r.m.s. value)

Nominal input voltage; \( m = 1 \) (r.m.s. value)

Nominal output voltage at nominal output power (r.m.s. value)

Total distortion

\[ V_{o(rms)} = 1 \, V; \quad G_{v} = \text{maximum} \]

\[ V_{o(rms)} = 1 \, V; \quad V_{i(rms)} = 1 \, V \]

\[ V_{o(rms)} = 50 \, mV; \quad V_{i(rms)} = 150 \, mV \]

Output noise voltage; \( f = 20 \, Hz \) to 20 \, kHz

signal plus noise voltage (r.m.s. value)

\( G_{v} = -60 \, dB \)

\( G_{v} = -10 \, dB \)

\( G_{v} = \text{maximum} \, (+20 \, dB) \)

noise voltage; weighted conform DIN45405 (peak value)

\( G_{v} = -60 \, dB \)

\( G_{v} = -10 \, dB \)

\( G_{v} = \text{maximum} \, (+20 \, dB) \)

Channel separation; \( G_{v} = \pm20 \, dB; \quad V_{i} = V_{o} < 1 \, V \)

\( f = 250 \, Hz \) to 12.5 \, kHz

\( f = 40 \, Hz \) to 16 \, kHz

Channel balance

\( G_{v} = +15 \) to \(-50 \, dB \)

\( G_{v} < 50 \, dB \)

\( \alpha > \)

\( \alpha \quad \text{typ.} \quad 52 \, dB \)

\( \alpha \quad \text{typ.} \quad 46 \, dB \)

\( \Delta G_{v} \quad \text{typ.} \quad 1 \, dB \)

\( \Delta G_{v} \quad \text{typ.} \quad 2 \, dB \)
**D.C. volume and balance stereo control circuit**

**Amplifier characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input resistance (pins 11 and 14)</td>
<td>Ri11;14</td>
<td>&gt; 3 MΩ</td>
</tr>
<tr>
<td>D.C. output voltages</td>
<td>V3-15; V16-15</td>
<td>typ. 4.2 V</td>
</tr>
<tr>
<td></td>
<td>V3-15; V16-15</td>
<td>typ. 4.6 V</td>
</tr>
<tr>
<td>Quiescent input currents (pins 1,2,6,7,11,14)</td>
<td>I1; I2; I6; I7; I11; I14</td>
<td>typ. 0.5 μA &lt; 2 μA</td>
</tr>
<tr>
<td>Input resistance (pins 1,2,6 and 7)</td>
<td>Ri1;2;6;7</td>
<td>&gt; 1 MΩ</td>
</tr>
<tr>
<td>of physiology; without external circuitry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal load resistance at outputs</td>
<td>R3-15; R5-15; R9-15; R10-15</td>
<td>typ. 2 kΩ</td>
</tr>
<tr>
<td>(pins 3,5,9,16)</td>
<td>G3-1; G3-2; G5-6; G5-7</td>
<td>&gt; 40 dB</td>
</tr>
<tr>
<td>Maximum gain; no load</td>
<td></td>
<td>typ. 43 dB</td>
</tr>
</tbody>
</table>

**Fig. 2** Frequency response volume control with physiology.

February 1980
Fig. 3 Volume control curves; without physiology; balance = 0; $V_{12-10} = 0$.

- $G_v \text{tot}; G_v \text{5-11}; G_v \text{3-14}$
- $G_v \text{9-11}; G_v \text{16-14}$

Fig. 4 Volume adjustment curve; balance = 0; $V_{12-10} = 0$. 
D.C. volume and balance stereo control circuit

Fig. 5 Balance control curves; \( G_{\text{v tot}} = -10 \) dB \( (V_{13-15} = 6.9 \text{ V}) \); for balance = 0.

Fig. 6 Balance control range; \( V_{12-15} = 2.5 \) to 9.0 V.
Fig. 7 Frequency response of the physiology part.

(1) $G_v = R_2/R_1$
(2) $G_v = R_{42}/R_{31}$
(3) $G_v = 1/2\pi \cdot R_{42} \cdot C_{42}$
(4) $G_v = 1/2\pi \cdot R_{41} \cdot C_{31} = 1/2\pi \cdot R_{31} \cdot C_{31}$
(5) $G_v \approx R_{41}/R_{32}$
(6) $G_v \approx R_{41}/R_{32}$
(7) $G_v = 1/2\pi \cdot R_{32} \cdot C_{31}$
Fig. 8 Physiology control curve; $f = 1$ kHz; balance = 0; $V_{12-15} = 0$. 
Fig. 9 Total distortion as a function of r.m.s. input voltage; \(f = 1 \text{ kHz} \); \(R_L = 5.6 \text{ k}\Omega\).

Fig. 10 Total distortion as a function of r.m.s. output voltage; \(f = 1 \text{ kHz} \); \(R_L = 5.6 \text{ k}\Omega\).
Fig. 11 The r.m.s. output voltage as a function of voltage gain; \( P_0(\text{nom}) \) relative to \( V_o(\text{rms}) = 1 \text{ V} \):

- without physiological volume control;
- with physiological volume control.

For example:
- \( V_I = 2 \text{ V} \)
- \( V_I = 1 \text{ V} \)
- \( V_I(\text{nom}) = 0.5 \text{ V} \)
- \( 0.25 \text{ V} \)
- \( 0.15 \text{ V} \)
- \( 0.1 \text{ V} \)

Frequency range: \( f = 20 \text{ Hz} \) to \( 20 \text{ kHz} \).
APPLICATION INFORMATION

(1) RC network for limiting treble boost (linear: f_3 dB = 100 kHz).

Fig. 12 Application diagram for TCA730A and TCA740A. For printed-circuit board see Fig. 13.
Fig. 13 Printed-circuit board component side, showing component layout; for circuit diagram see Fig. 12.
(1) \( C_{13-15} = C_{12-15} = 1 \mu F \) are intended for suppression of the noise when adjusting the mechanical potentiometers.

(2) For rejecting noise, caused by switching on or off, corresponding muting switches can be used before or in the output power stage.

Fig. 14  Application example of TCA730A used for volume and balance control.
D.C. TREBLE AND BASS STEREO CONTROL CIRCUIT

The TCA740A is a monolithic integrated circuit for controlling treble and bass in stereo amplifiers by means of a d.c. voltage.

Features:
- two double potentiometer circuits
- feedback control
- internal amplifier
- high-ohmic signal inputs
- converter for the control voltages
- low-ohmic and short-circuit protected signal outputs

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 8)</td>
<td>V_p</td>
<td>15 V</td>
</tr>
<tr>
<td>Supply current (pin 8)</td>
<td>I_p</td>
<td>35 mA</td>
</tr>
<tr>
<td>Bass boost and cut at 40 Hz (ref. 1 kHz)</td>
<td>V_i(o)</td>
<td>± 16 dB</td>
</tr>
<tr>
<td>Treble boost and cut at 16 kHz (ref. 1 kHz)</td>
<td>d_tot</td>
<td>± 16 dB</td>
</tr>
<tr>
<td>Input/output voltage at d_tot = 0,7% (r.m.s. value)</td>
<td>V_i,o(rms)</td>
<td>2 V</td>
</tr>
<tr>
<td>Total distortion at V_o(rms) = 1 V; linear frequency response</td>
<td>d_tot</td>
<td>0,1 %</td>
</tr>
<tr>
<td>Channel separation</td>
<td>α</td>
<td>70 dB</td>
</tr>
<tr>
<td>Output signal plus noise voltage (r.m.s. value)</td>
<td>V_no(rms)</td>
<td>45 μV</td>
</tr>
<tr>
<td>Frequency response (—1 dB)</td>
<td>f</td>
<td>20 Hz to 20 kHz</td>
</tr>
<tr>
<td>Treble/bass control voltage range</td>
<td>V_{12-16}; V_{4-16}</td>
<td>1,8 to 9,5 V</td>
</tr>
<tr>
<td>Supply voltage range (pin 8)</td>
<td>V_p</td>
<td>13,5 to 16,5 V</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>T_amb</td>
<td>—30 to + 80 °C</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE
16-lead DIL; plastic (SOT-38).
Fig. 1 Block diagram with external circuitry.

(1) 6.6 \text{V}_{\text{BE}}; V_1 = 4.6 \text{V}
(2) 0.31 V_P + 1.4 \text{V}_{\text{BE}}; V_2 = 5.6 \text{V}
D.C. treble and bass stereo control circuit

**RATINGS**

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Specified Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 8)</td>
<td>$V_p$</td>
<td>max. 18 V</td>
</tr>
<tr>
<td>Control voltages (pins 4 and 12)</td>
<td>$V_{4-16}$</td>
<td>max. 12 V</td>
</tr>
<tr>
<td></td>
<td>$-V_{4-16}$</td>
<td>max. 5 V</td>
</tr>
<tr>
<td></td>
<td>$V_{12-16}$</td>
<td>max. 12 V</td>
</tr>
<tr>
<td></td>
<td>$-V_{12-16}$</td>
<td>max. 5 V</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>max. 900 mW</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>$T_{stg}$</td>
<td>-55 to +150 °C</td>
</tr>
<tr>
<td>Operating ambient temperature range</td>
<td>$T_{amb}$</td>
<td>-30 to +80 °C</td>
</tr>
</tbody>
</table>

**CHARACTERISTICS**

$V_p = 15$ V; $T_{amb} = 25$ °C; measured in Fig.1; in position 'linear' ($V_{4-16} = V_{12-16} = 5.6$ V);
$R_G = 60$ Ω; $R_L = 5.6$ kΩ; $f = 1$ kHz; unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Specified Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range (pin 8)</td>
<td>$V_p$</td>
<td>13.5 to 16.5 V</td>
</tr>
<tr>
<td>Supply current (pin 8)</td>
<td>$I_p$</td>
<td>typ. 34 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 to 45 mA</td>
</tr>
<tr>
<td>Signal processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage gain at linear frequency response</td>
<td>$G_v$</td>
<td>typ. 0 dB</td>
</tr>
<tr>
<td>Frequency response ($-1$ dB)</td>
<td>$f$</td>
<td>20 Hz to 20 kHz</td>
</tr>
<tr>
<td>Maximum gain variation at $f = 1$ kHz at maximum bass/treble boost or cut</td>
<td>$\Delta G_v$</td>
<td>&lt; ±1.5 dB</td>
</tr>
<tr>
<td>Bass boost at 40 Hz (ref. 1 kHz)</td>
<td>$V_{4-16}$ = 9.2 V</td>
<td>&gt; 15 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 16 dB</td>
</tr>
<tr>
<td>Bass cut at 40 Hz (ref. 1 kHz)</td>
<td>$V_{4-16}$ = 2 V</td>
<td>&gt; 15 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 16 dB</td>
</tr>
<tr>
<td>Treble boost at 16 kHz (ref. 1 kHz)</td>
<td>$V_{12-16}$ = 9.2 V</td>
<td>&gt; 15 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 16 dB</td>
</tr>
<tr>
<td>Treble cut at 16 kHz (ref. 1 kHz)</td>
<td>$V_{12-16}$ = 2 V</td>
<td>&gt; 15 dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 16 dB</td>
</tr>
<tr>
<td>Total distortion</td>
<td>$d_{tot}$</td>
<td>typ. 0.03 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 0.1 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 0.07 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 0.2 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 0.2 %</td>
</tr>
<tr>
<td>Input/output voltage at $d_{tot} = 0.7 %$ (r.m.s. value)</td>
<td>$V_i(rms) = V_o(rms)$</td>
<td>&gt; 1.6 V</td>
</tr>
<tr>
<td>Output signal plus noise voltage (r.m.s. value)</td>
<td>$V_{no(rms)}$</td>
<td>typ. 2 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>typ. 40 μV</td>
</tr>
<tr>
<td>Output noise voltage; weighted conform DIN45405; peak value</td>
<td>$V_{no(m)}$</td>
<td>&lt; 90 μV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 160 μV</td>
</tr>
</tbody>
</table>

February 1980
CHARACTERISTICS (continued)

Channel separation
- \( f = 1 \text{ kHz} \)
- \( f = 250 \text{ Hz to 12,5 kHz} \)
- \( f = 40 \text{ Hz to 16 kHz} \)

Control voltages

Control voltage at linear frequency response
- \( V_{4-16} = V_{12-16} \) (0,31 \( V_p \) to 1,4 \( V_{BE} \))

Quiescent input current
- \( V_{4-16} = V_{12-16} = 2 \text{ to 9,2 V} \)
- \( I_4 = I_{12} \) typ. 6 \( \mu A \)

Input resistance (pins 4 and 12)
- \( V_{4-16} = V_{12-16} = 5,6 \text{ V} \)
- \( R_{i4;12} \) typ. 800 k\( \Omega \)

Amplifier characteristics

Quiescent input currents; \( V_i = 4,6 \text{ V} \)
- \( I_1;I_2;I_6;I_7;I_9;I_{10};I_{14};I_{15} \) typ. 0,6 \( \mu A \)
- \( I_{11} \) typ. 2 \( \mu A \)

Input resistance (pins 1,2,6,7,9,10,14 and 15)
- \( R_{i1;2;6;7;9;10;14;15} \) typ. 1 M\( \Omega \)

Internal emitter resistance at outputs
- \( R_{3-16; R_5-16; R_{11-16}; R_{13-16}} \) typ. 2 k\( \Omega \)

Output resistance (pins 3,5,11 and 13)
- \( R_{o3;5;11;13-16} \) typ. 10 \( \Omega \)
- \( G_V \) typ. 40 dB

Maximum gain; no load
- \( G_V \) typ. 43 dB

D.C. output voltages
- \( V_{4-16} = V_{12-16} = 5,6 \text{ V (pins 3,5,11 and 13)} \)
- \( V_{3-16; V_5-16; V_{11-16}; V_{13-16}} \) typ. 4,6 \( \text{ V (6,6 \( V_{BE} \))} \)

Control voltages

Recommended control voltage range
treble/bass
- \( V_{4-16} = V_{12-16} \)
- \( V_{4-16} = V_{12-16} \) typ. 2 to 9,2 V

Control voltage at linear frequency response
- \( V_{4-16} = V_{12-16} \)
- \( V_{4-16} = V_{12-16} \) typ. 5,6 V

D.C. output voltages
- \( V_{3-16; V_5-16; V_{11-16}; V_{13-16}} \) typ. 4,3 to 4,9 V

Note: \( \alpha \) typ. 72 dB
\( \alpha \) typ. 68 dB
\( \alpha \) typ. 50 dB
\( \alpha \) typ. 58 dB

February 1980
D.C. treble and bass stereo control circuit

Fig. 2 Frequency response.

Fig. 3 Bass control curve at f = 40 Hz.

Fig. 4 Treble control curve at f = 16 kHz.

February 1980
Fig. 5 Total distortion as a function of output voltage; $V_{4.16} = V_{12.16} = 5.6$ V (linear, $G_{v\text{tot}} = 1$);

--- $f = 1$ kHz; --- $f = 40$ Hz to $16$ kHz.
APPLICATION INFORMATION

(1) RC network for limiting treble boost (linear: $f_{-3\,\text{dB}} = 100$ kHz).
(2) Capacitors are intended for suppression of the noise when adjusting the mechanical potentiometers.

Fig. 6 Application example of TCA740A used for treble and bass control.

February 1980
(1) RC network for limiting treble boost (linear: $f_{-3\text{ dB}} = 100$ kHz).

Fig. 7 Application diagram for TCA730A and TCA740A. For printed-circuit board see Fig. 8.
Fig. 8 Printed-circuit board component side, showing component layout; for circuit diagram see Fig. 7.
MULTI-STABILIZER FOR ELECTRONIC TUNING

The TCA750 is basically a stabilizer for use in electronic tuning systems. The circuit is combined with an external reference diode which entirely determines the thermal stability of the system and can be adapted to the stability requirements of AM, FM or TV receivers.

The reference diode BZV38 used in conjunction with the TCA750 form an ideal pair for FM tuners in radio or TV receivers.

Additional to a stabilized voltage (V_o1) for the electronic tuning system, the TCA750 incorporates two other output voltages (V_o2 and V_o3) for stabilized supply of the entire receiver combination as well as the following attractive features:

- The output current of any of the three stabilizers can be increased by a discrete power transistor without affecting circuit stability.
- For mute control at switching on, V_o2 can be delayed by external components.
- An a.f.c. coupling circuit provides a constant correction factor by superimposing an a.f.c. voltage on V_o1.
- Adjustable a.f.c. amplification factor (<5).
- Pulse or touch contact operation switches off the a.f.c. whilst changing stations.
- Delayed switching on of the a.f.c., externally adjustable (t_d < 2 s).
- Search tuning becomes very simple when using the a.f.c. current source (pin 10).
- All three stabilized outputs are protected against short-circuit and are individually adjustable.

QUICK REFERENCE DATA see page 2

PACKAGE OUTLINE
16-lead DIL; plastic (SOT-38).

May 1979
## QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Input voltage range</th>
<th>( V_{13-16} )</th>
<th>26.5 to 54 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>( T_{\text{amb}} )</td>
<td>typ. 25 °C</td>
</tr>
<tr>
<td>Input voltage</td>
<td>( V_{13-16} )</td>
<td>typ. 45 V</td>
</tr>
</tbody>
</table>

- **Tuning voltage \( (V_{O1})^* \)**
  - \( V_{12-16} \) 21 to 34 V
  - \( I_{12} \) < 14.5 mA
  - \( t_{\text{stab}} \) typ. 0.8 s

- **Temperature coefficient \( (V_{O1})^* \)**
  - \( \Delta V_{O1}/\Delta T \) typ. 1 ppm/°C
  - \( \Delta V_{O1}/\Delta V_{\text{in}} \) typ. 10 ppm/V

- **Line regulation**
  - \( V_{14-16} \) 8 to 21 V
  - \( I_{14} \) < 6 mA

- **Output voltage \( (V_{O2})^* \)**
  - \( V_{2-16} \) 8 to 29 V
  - \( I_2 \) < 6 mA

* Symbols used in test circuit Fig. 3.
Fig. 1 Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Input voltage (supply)  \( V_{13-16} \) max. 54 V
A.F.C. input voltages (pins 8 and 9)  \( V_{8-16}, V_{9-16} \) max. 17 V
\( \pm V_{8-9} \) max. 6 V
Output current
- pin 12  \( I_{12} \) max. 55 mA
- pin 14  \( I_{14} \) max. 20 mA
- pin 2  \( I_{2} \) max. 25 mA
Input current (pin 11)  \( \pm I_{11} \) max. 6 mA
Storage temperature
- \( T_{stg} \) -55 to +150 °C
- \( T_{amb} \) -25 to +150 °C *
Total power dissipation

![Fig. 2 Power derating curve.](image)

* See derating curve Fig. 2.
Multi-stabilizer for electronic tuning

* $V_{afc}$ is superimposed on a common-mode voltage ($V_{com}$) of 5 V to 17 V.

Fig. 3 Test circuit and multi-stabilizer peripheral components.

**Note to power reduction resistor RD**

For worst case conditions (maximum output currents of the three stabilizers and a high supply voltage $V_{in}$) the power dissipation ($P_{tot}$) must be reduced by the use of the external resistor RD.

$$\text{Power reduction} = \frac{(V_{in} - V_{o1})^2}{\text{RD}}$$

The minimum permissible value of RD is derived by the formula

$$\text{RD}_{min} = \frac{V_{in\ max} - V_{o1} - V_{afc\ out}}{I_{12} - I_{13\ min}}$$

where,

- $I_{13\ min} = 4.5$ mA (stand-by current $I_8$)
- $I_{12} = I_Z + I_{RA1} + I_{1\ min}$
CHARACTERISTICS and APPLICATION INFORMATION

Tamb = 25 °C; see test circuit Fig. 3.

### Supplies

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage ( V_{in} )</td>
<td>V</td>
<td>1</td>
<td>26,5</td>
<td>54</td>
</tr>
<tr>
<td>Input current ( I_{tot} )</td>
<td>mA</td>
<td>2</td>
<td>—</td>
<td>31</td>
</tr>
</tbody>
</table>

### Output characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D.C. output resistance</td>
<td>( \Omega )</td>
<td>25</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Permissible output short-circuit duration stabilizer 1</td>
<td>( t_{short} )</td>
<td>continuous</td>
<td>—</td>
<td>10</td>
</tr>
</tbody>
</table>

### Stabilizer 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage range</td>
<td>V</td>
<td>3</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Output current</td>
<td>mA</td>
<td>4, 5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Stabilizing time</td>
<td>s</td>
<td>6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Output voltage temp. coefficient</td>
<td>ppm/°C</td>
<td>7,8</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Line regulation</td>
<td>ppm/V</td>
<td>8</td>
<td>—</td>
<td>10</td>
</tr>
</tbody>
</table>

### A.F.C. coupling circuit

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A.F.C. input voltage (( % V_{afc} ) swing)</td>
<td>V</td>
<td>abc</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td>A.F.C. output voltage (( % V_{afc} )lim swing)</td>
<td>V</td>
<td>abc</td>
<td>15, 16</td>
<td>0,9</td>
</tr>
<tr>
<td>A.F.C. output current threshold</td>
<td>mA</td>
<td>10</td>
<td>15, 16</td>
<td>1,5</td>
</tr>
<tr>
<td>A.F.C. output current swing</td>
<td>mA</td>
<td>10</td>
<td>15, 16</td>
<td>3,0</td>
</tr>
<tr>
<td>A.F.C. off delay</td>
<td>s</td>
<td>—</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>Amplification factor</td>
<td>mA/V</td>
<td>S</td>
<td>14</td>
<td>—</td>
</tr>
<tr>
<td>Common-mode voltage</td>
<td>V</td>
<td>9</td>
<td>17</td>
<td>—</td>
</tr>
<tr>
<td>( \Delta V_{o1}/\Delta T )</td>
<td>V</td>
<td>8</td>
<td>—</td>
<td>10</td>
</tr>
<tr>
<td>Asymmetry of a.f.c. input</td>
<td>( \mu ) A</td>
<td>±(( \mu ) A)</td>
<td>—</td>
<td>0,5</td>
</tr>
</tbody>
</table>

### A.F.C. switch operated by manual switch

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage (a.f.c. on)</td>
<td>V</td>
<td>0,5</td>
<td>—</td>
<td>+0,5</td>
</tr>
<tr>
<td>Positive input voltage (a.f.c. off)</td>
<td>V</td>
<td>0,8</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>Negative input voltage (a.f.c. off)</td>
<td>V</td>
<td>0,8</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Positive input current (a.f.c. off)</td>
<td>mA</td>
<td>0,004</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>Negative input current (a.f.c. off)</td>
<td>mA</td>
<td>0,8</td>
<td>—</td>
<td>2</td>
</tr>
</tbody>
</table>

### A.F.C. switch operated by pulse

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive trigger pulse peak current</td>
<td>mA</td>
<td>13</td>
<td>800</td>
<td>3000</td>
</tr>
<tr>
<td>Negative trigger pulse peak current</td>
<td>mA</td>
<td>10</td>
<td>0,8</td>
<td>2</td>
</tr>
</tbody>
</table>

### Positive trigger pulse peak current

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pulse width = 10 ( \mu s )</td>
<td>( \mu A )</td>
<td>—</td>
<td>800</td>
<td>3000</td>
</tr>
<tr>
<td>100 ( \mu s )</td>
<td>( \mu A )</td>
<td>—</td>
<td>80</td>
<td>3000</td>
</tr>
<tr>
<td>10 ms</td>
<td>( \mu A )</td>
<td>—</td>
<td>4</td>
<td>3000</td>
</tr>
<tr>
<td>Negative trigger pulse peak current</td>
<td>mA</td>
<td>—</td>
<td>0,8</td>
<td>2</td>
</tr>
<tr>
<td>Negative trigger pulse width</td>
<td>( \mu s )</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
</tbody>
</table>
### Stabilizer 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage range (adjustable)</td>
<td>$V_{O2}$</td>
<td>10</td>
<td>8</td>
<td>21</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_2$</td>
<td>5</td>
<td>0</td>
<td>5,5</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage temp. coefficient</td>
<td>$\Delta V_{O2}/\Delta T$</td>
<td>7, 8</td>
<td>-</td>
<td>45</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Switch-on delay time</td>
<td>$t_{don}$</td>
<td>11</td>
<td>0</td>
<td>6</td>
<td>s</td>
</tr>
<tr>
<td>Switching voltage</td>
<td>$V_{1-16}$</td>
<td>-</td>
<td>0,8</td>
<td>1</td>
<td>V</td>
</tr>
</tbody>
</table>

### Stabilizer 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage range (adjustable)</td>
<td>$V_{O3}$</td>
<td>12</td>
<td>8</td>
<td>29</td>
<td>V</td>
</tr>
<tr>
<td>Output current</td>
<td>$I_3$</td>
<td>5</td>
<td>0</td>
<td>5,5</td>
<td>mA</td>
</tr>
<tr>
<td>Output voltage temp. coefficient</td>
<td>$\Delta V_{O3}/\Delta T$</td>
<td>7, 8</td>
<td>-</td>
<td>45</td>
<td>ppm/°C</td>
</tr>
</tbody>
</table>

**Notes**

1. The $V_{in}$ range depends on the value of $V_{O1}$ (see Fig. 4).
2. At $I_1 = 5$ mA, $I_2 = I_3 = 5,5$ mA, $I_{10} = 0$.
3. Adjustable by means of RA1, RB1 and RP.
4. If a higher level is required from the output of stabilizer 1, the reference diode supply may be obtained from the emitter of a power transistor connected to the output from stabilizer 3 (see Fig. 8). In this case, the current available from stabilizer 1 is increased to 12,5 mA (bleeder current $I_{RA1} = 2$ mA).
5. At $T_{amb} = 60$ °C maximum with all stabilizers at rated currents.
6. With $V_{O1}$ within 0,05% of its steady value.
7. Temperature coefficient at $T_{amb}$ from 10 °C to 60 °C with $V_{in}$ constant, and using metal film bleed resistors having a temperature coefficient of $\leq 50$ ppm/°C.
8. With all stabilizer output currents constant and within the specified limits.
9. Common-mode voltage = voltage between pins 8 and 16, and 9 and 16 of the I.C.
10. $V_{O2}$ depends on the value of $V_{O1}$ (see Fig. 6); adjustable with RA2.
11. Adjustable by means of RT and $C_T1$. The delay time is limited by the leakage current of $C_T1$.
12. $V_{O3}$ depends on the value of $V_{O1}$ (see Fig. 7); adjustable with RA3.
13. The delay time after triggering depends on the value of $C_T2$.
14. With $RE = 10$ kΩ and $T_{amb} = 25$ °C.
15. $V_{afc}$ out at $V_{afc}$ in after limiting.
16. With $RE = 10$ kΩ; $RA1 = 12$ kΩ.
Fig. 4 Range of values for $V_{o1}$.

Fig. 5 Determination of $I_{10}$ and S-factor ($S = \frac{\Delta I_{a/fc}}{\Delta V_{a/fc}}$) from $R_{E}$.

Fig. 6 Range of values for $V_{o2}$.

Fig. 7 Range of values for $V_{o3}$.
Fig. 8 Hi-fi radio receiver with electronic tuning using TCA750.
INTEGRATED AUDIO AMPLIFIER

The TCA760B is a monolithic integrated audio amplifier incorporating high flexibility for applications in battery and mains-fed equipment.

Due to special internal circuitry (stabilization, temperature correction, high a.c. feedback of 20 dB) the cross-over distortion is negligible over the entire supply voltage range (5 to 14 V). Presetting is not required for the quiescent current (5 to 15.7 mA), it is internally adjusted.

Additional features are:
- low noise output voltage;
- high peak current (1 A);
- high unloaded supply voltage (15 V);
- high gain (closed loop 15 dB at a feedback of 20 dB);
- safe operation regarding second breakdown;
- high ripple rejection.

The device will withstand repetitive short circuits across the speaker load if the absolute maximum junction temperature is not exceeded.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
</tr>
<tr>
<td>Total quiescent current</td>
</tr>
<tr>
<td>Supply voltage (peak value)</td>
</tr>
<tr>
<td>Output power at $d_{tot} = 10%$</td>
</tr>
<tr>
<td>at $V_p = 9$ V; $R_L = 8 \Omega$</td>
</tr>
<tr>
<td>at $V_p = 12$ V; $R_L = 8 \Omega$</td>
</tr>
<tr>
<td>Total distortion before clipping</td>
</tr>
<tr>
<td>Input impedance</td>
</tr>
<tr>
<td>Sensitivity for $P_0$ at $d_{tot} = 10%$</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Supply voltage (pin 11) V_{11-16} \text{ max.} 14 \text{ V}
Unloaded supply voltage (pin 11; peak value) (no-signal condition) V_{11-16M} \text{ max.} 15 \text{ V}

Currents
Output current (pin 13, 11, 4) I_O \text{ max.} 1 \text{ A}
Non-repetitive peak output current (pin 13, 11, 4) I_{OSM} \text{ max.} 2 \text{ A}

Power dissipation 1)
Total power dissipation at T_{amb} = 25 \degree \text{C.} P_{tot} \text{ max.} 1.4 \text{ W}

Temperatures
Storage temperature T_{stg} -55 \text{ to } +125 \degree \text{C}
Operating ambient temperature T_{amb} -25 \text{ to } +125 \degree \text{C}

1) See derating curve on page 3.
Design data

Pin 6 to 4 voltage
Pin 13 to 16 voltage
Pin 11 to 13 voltage

\[ P_{\text{tot}} (W) \]

\[ T_{\text{amb}} (°C) \]

\[ \pm V_{6-4} \text{ max.} 6 \text{ V} \]
\[ V_{13-16} \text{ max.} 14 \text{ V} \]
\[ V_{11-13} \text{ max.} 14 \text{ V} \]

October 1976
CHARACTERISTICS at $T_{\text{amb}} = 25^\circ C$; $V_P = 9$ V; $R_L = 8$ $\Omega$ unless otherwise specified

**D.C. characteristics**

- **Supply voltage range**
  - $V_{11-16}$
  - 5 to 14 V

- **Total quiescent current**
  - $I_{11 \text{ tot}}$
  - (typ.) 10 mA
  - (5 to 15,7 mA)

- **Saturation voltages of output stages at $I_o = 0,5$ A**
  - $V_{CE\text{sat}}$
  - < 0,9 V

**A.C. characteristics**

- **A.F. output power at onset of clipping**
  - at $d_{\text{tot}} = 10\%$
  - $P_o$
  - (typ.) 0,8 W
  - 1,1 W

- **Open loop voltage gain**
  - $G_v$
  - (typ.) 70 dB

- **Total harmonic distortion at $P_o = 0,7$ W**
  - $d_{\text{tot}}$
  - (typ.) 0,7 \%
  - (<) 3 \%

- **Noise output power at $R_S = 0$**
  - $P_n$
  - (typ.) 2 nW

- **Input sensitivity at $P_o = 0,7$ W**
  - $V_i$
  - 4 to 8,5 mV

- **Input impedance**
  - $|Z_i|$
  - (typ.) 15 k$\Omega$

- **Equivalent input noise voltage at $R_S = 7$ k$\Omega$**
  - $V_n$
  - (typ.) 1,5 $\mu$V
  - (<) 3,0 $\mu$V

1) Measured without signal.

2) Measured at a frequency ranging from 30 Hz to 15 kHz.

3) Measured across $R_L$. 

---

October 1976
APPLICATION INFORMATION

<table>
<thead>
<tr>
<th>Supply voltage V</th>
<th>11-16</th>
<th>6</th>
<th>6</th>
<th>7,5</th>
<th>7,5</th>
<th>9</th>
<th>9</th>
<th>10</th>
<th>12</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load resistance R_L</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>Ω</td>
</tr>
<tr>
<td>A. F. output power at onset of clipping</td>
<td>0,45</td>
<td>0,35</td>
<td>0,8</td>
<td>0,6</td>
<td>1,1</td>
<td>0,9</td>
<td>1,2</td>
<td>1,4</td>
<td>W 1)</td>
<td></td>
</tr>
<tr>
<td>A. F. output power at d_tot = 10%</td>
<td>0,42</td>
<td>0,33</td>
<td>0,7</td>
<td>0,57</td>
<td>1,0</td>
<td>0,8</td>
<td>1,1</td>
<td>1,3</td>
<td>W 2)</td>
<td></td>
</tr>
<tr>
<td>Sensitivity for P_0 = 50 mW V_i</td>
<td>1,4</td>
<td>2,0</td>
<td>1,4</td>
<td>2,0</td>
<td>1,4</td>
<td>2,0</td>
<td>2,0</td>
<td>2,0</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>for d_tot = 10% V_i</td>
<td>4,8</td>
<td>7,0</td>
<td>8,0</td>
<td>9,0</td>
<td>10</td>
<td>10</td>
<td>11,0</td>
<td>12,0</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>T_amb (maximum)</td>
<td>93</td>
<td>107</td>
<td>78</td>
<td>99</td>
<td>45</td>
<td>87</td>
<td>81</td>
<td>45</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Supply current for full output power</td>
<td>185</td>
<td>125</td>
<td>225</td>
<td>165</td>
<td>300</td>
<td>190</td>
<td>215</td>
<td>250</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Quiescent current I_{tot}</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>10,0</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Value of R_1</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>R_2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>R_3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>C_1</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>1,6</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>C_2</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>C_3</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>C_4</td>
<td>470</td>
<td>220</td>
<td>470</td>
<td>220</td>
<td>470</td>
<td>220</td>
<td>470</td>
<td>220</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>C_5</td>
<td>1000</td>
<td>470</td>
<td>1000</td>
<td>470</td>
<td>1000</td>
<td>470</td>
<td>470</td>
<td>470</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>C_6</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>nF</td>
<td></td>
</tr>
<tr>
<td>C_7</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
<td>μF</td>
<td></td>
</tr>
<tr>
<td>Input impedance</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>kΩ</td>
<td></td>
</tr>
<tr>
<td>Closed loop voltage gain G_v</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>dB 3)</td>
<td></td>
</tr>
<tr>
<td>Open loop voltage gain G_v</td>
<td>66</td>
<td>68</td>
<td>70</td>
<td>71</td>
<td>70</td>
<td>74</td>
<td>76</td>
<td>78</td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>

1) Measured before output capacitor (C5).
2) Measured across R_L.
3) At R_1 = 47 Ω. The gain can be increased by decreasing the value of R_1; at decreasing the gain level however the maximum tolerated value of R_1 amounts to 100 Ω; at further decrease of the gain an attenuator at the input is preferred.
4) R_S = 0 Ω; frequency range 30 Hz to 15 kHz.
5) R_S = 7 kΩ; frequency range 30 Hz to 15 kHz.
**APPLICATION INFORMATION** (continued)

**General notes**

1. Prescription for print lay-out:
   - Pin 1 must be used as a ground connection for the input circuit.
   - Pin 16 must be used for the output circuit and for connection of the negative supply voltage.
   - The pins 16 and 1 have to be interconnected as close to the package as possible to prevent a common impedance in the ground line.

2. The smoothing capacitor across the supply must be connected close to the pins.

3. To prevent radio signals in the low frequency amplifier a small capacitor of about 560 pF between pins 6 and 1 is preferred.

**Basic power amplifier**
APPLICATION INFORMATION  (continued)

Power amplifier for mains-fed supply

When using a mains-fed power supply with high ripple it is advantageous to connect the speaker to ground by bootstrapping pin 9.
Pin 7 is available for extra hum suppression (see graphs on page 9).
$R_L = 8 \, \Omega; \, V_p = 9 \, V$
APPLICATION INFORMATION (continued)

The influence on the hum suppression when a capacitor of 10 μF is connected between pins 7 and 1 is shown in the graph below. An increase of the capacitor value gives no further improvement in hum suppression.
$\Delta G_v$ (dB)

$C_2 = 47 \mu F; 22 \mu F$

-4
-3
-2
-1
0

10
$10^2$
$10^3$
$10^4$
$10^5$

$V_p = 9 \, V; R_1 = 8 \, \Omega; R_S = \infty$

$C = 560 \, pF \text{ between pins 6 and 1}$

October 1976
INTERFERENCE ABSORPTION CIRCUIT

The TDA1001A is a monolithic integrated circuit for very effectively suppressing interference which, especially in FM mono and stereo receivers, disturbs the quality of reception. The operation is based on the use of a high-pass filter separating the interference from the a.f. signal. The interference pulses are amplified to trigger a one shot. In this way gating pulses are obtained interrupting the audio signal, which is delayed by a low-pass filter, during the interference periods, the output being kept constant for that time. A 19 kHz filter can be externally connected to sustain the stereo pilot signal during suppression for improved performance as described below. An integrating network decreases the trigger sensitivity for interference of high duty factor, so that the receiver remains operative even during periods of continuous interference.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>( V_P = V_{9-16} )</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>typ. 25°C</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>nom. 12 V</td>
</tr>
<tr>
<td>Total quiescent current</td>
<td>typ. 15 mA</td>
</tr>
<tr>
<td>A.F. input signal handling (peak-to-peak value)</td>
<td></td>
</tr>
<tr>
<td>( d_{tot} \leq 1% ); ( f = 1 \text{kHz} )</td>
<td>( V_{1-16(p-p)} &lt; 1.5 \text{ V} )</td>
</tr>
<tr>
<td>Input impedance at ( f = 40 \text{kHz} ) (pin 1)</td>
<td>(</td>
</tr>
<tr>
<td>Audio voltage gain</td>
<td>( V_{6-16} )</td>
</tr>
<tr>
<td>Total distortion</td>
<td>( d_{tot} ) typ. 0,35%</td>
</tr>
<tr>
<td>Residual gate pulse in output signal (pin 6)</td>
<td>( V_{r6-16(p-p)} &lt; 4 \text{ mV} )</td>
</tr>
<tr>
<td>(peak-to-peak value)</td>
<td></td>
</tr>
<tr>
<td>Interference trigger sensitivity (adjustable)</td>
<td>( V_{1-16M} ) typ. 50 mV</td>
</tr>
<tr>
<td>( R_{13} = 3.3 \text{k}\Omega; \text{peak value} )</td>
<td>( V_{1-16M} ) typ. 42 mV</td>
</tr>
<tr>
<td>( R_{13} = 2.5 \text{k}\Omega; \text{peak value} )</td>
<td></td>
</tr>
<tr>
<td>Suppression pulse duration (pin 10)</td>
<td>( t_s ) 20 to 35 \mu s</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINES

TDA1001A: 16-lead DIL; plastic (SOT-38)
TDA1001AT: 16-lead flat pack; plastic (SO-16; SOT-109A).
The interference trigger sensitivity is predetermined by R13 (see also Fig. 3) and is defined by:

\[ V_{tr} = \left(1 + \frac{R_{13}}{R_S}\right) V_{tr0} \]

in which \( V_{tr} \) = trigger voltage, \( V_{tr0} \) = trigger voltage at 0 \( \Omega \), \( R_S = 2.2 \, \text{k}\Omega \) (internal source resistance).

Fig. 1 Block diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 9) V_\text{P}</td>
<td>max. 18 V</td>
</tr>
<tr>
<td>D.C. input voltage (pin 1) V_{1-16}</td>
<td>max. V_\text{P}</td>
</tr>
<tr>
<td>D.C. output current (pin 6) I_6</td>
<td>max. 15 mA</td>
</tr>
<tr>
<td></td>
<td>max. 1 mA</td>
</tr>
<tr>
<td>Storage temperature</td>
<td></td>
</tr>
<tr>
<td>Operating ambient temperature*</td>
<td></td>
</tr>
<tr>
<td>T_{\text{stg}}</td>
<td>-65 to +150 °C</td>
</tr>
<tr>
<td>T_{\text{amb}}</td>
<td>-30 to +80 °C</td>
</tr>
</tbody>
</table>

* Based on nominal application, Fig. 3; for deviating periphery see power derating curve Fig. 2.

Fig. 2 Power derating curves; —— SOT-38; —— SO-16, SOT-109A mounted on a ceramic substrate of 50 x 15 x 0.7 mm.
CHARACTERISTICS measured in Fig. 3

D.C. characteristics at $T_{amb} = 25\, ^\circ\text{C}$

Supply voltage $V_p$ typ. 12 V
8 to 15 V

Total quiescent current at $V_p = 12\, V$ $I_{tot}$ typ. 15 mA
< 25 mA

A.C. characteristics at $T_{amb} = 25\, ^\circ\text{C}; V_p = 12\, V$

Preamplifier; delay and gating circuit; output stage
(input: pin 1; output: pin 6)

A.F. input signal handling (peak-to-peak value)
for $d_{tot} < 1\%$ at pin 6; $f = 1\, \text{kHz}$ $V_{1-16(p-p)} < 1,5\, V$

Input impedance (pin 1)
$f = 40\, \text{kHz}$ $|Z_1| > 30\, \text{k}\Omega$

Input impedance (pin 3)
$f = 1\, \text{kHz}$ $|Z_1| > 230\, \text{k}\Omega$

Input impedance (pin 5)
$f = 1\, \text{kHz}$, during suppression
(gating circuit non-conducting) $|Z_1| > 4\, \text{M}\Omega$

Audio voltage gain
$\frac{V_{6-16}}{V_{1-16}}$ typ. 0,8 dB

Residual gate pulse in output signal (pin 6)
(peak-to-peak value)
see note 1 $V_{r6-16(p-p)} < 4\, \text{mV}$

Discharge current at pin 5 $I_{d5} < 250\, \text{nA}$

Total distortion; no-interference condition (pin 6)
$f = 1\, \text{kHz}$; $V_{i(rms)} < 0,5\, V$
$|d_{tot}| < 0,35\%$

Preamplifier; interference separator; pulse converter; one shot
(input: pin 1; output: pin 10)

Input signal: sine-wave of 120 kHz (high-pass filter characteristic is $V_{14-16}/V_{1-16} = -2\, \text{dB at 120 kHz}$)

Interference trigger sensitivity at 120 kHz (pin 1)
(r.m.s. values); see note 2 $V_{1-16(rms)}$ typ. 30 mV
20 to 42 mV

control function OFF (pin 12 connected to pin 9)

at $R13 = 3,3\, \text{k}\Omega$ $V_{1-16(rms)}$ typ. 25 mV
18 to 36 mV

at $R13 = 2,5\, \text{k}\Omega$

control function ON

at $R13 = 3,3\, \text{k}\Omega$ $V_{1-16(rms)}$ typ. 170 mV

at $R13 = 2,5\, \text{k}\Omega$ $V_{1-16(rms)}$ typ. 145 mV

For notes see next page.
**Interference absorption circuit**

Input signal: pulse signal with \( t_p = 10 \mu s \); repetition frequency \( f_r = 1 \text{ kHz} \); pulse rise and fall times \( t_r = t_f = 6 \text{ ns} \)

Pulse trigger sensitivity (pulse peak value); see note 2

control function OFF (pin 12 connected to pin 9)

\[ V_{1-16M} \text{ typ.} \]
\[ V_{1-16M} \text{ typ.} \]

\( t_s \) 20 to 35 \( \mu s \)

**Noise threshold circuit**

(input: pin 1; output: pin 12 with respect to pin 9)

Input signal: sine-wave of 120 kHz (high-pass filter characteristic is \( V_{14-16}/V_{1-16} = -2 \text{ dB at 120 kHz} \))

Input voltage (r.m.s. value)

\( V_{12-9} = 100 \text{ mV} \)

for \( V_{12-9} \)

at \( R_{13} = 3,3 \text{ k}\Omega \)

at \( R_{13} = 2,5 \text{ k}\Omega \)

for \( V_{12-9} = 600 \text{ mV} \) (pin 10 short-circuited to pin 9)

at \( R_{13} = 3,3 \text{ k}\Omega \)

at \( R_{13} = 2,5 \text{ k}\Omega \)

Minimum interference repetition rate to cause defeat action (pin 12); see note 4

\( f_r \text{ min} > 20 \text{ kHz} \)

Amplification control by interference intensity

\( V_{i} = 50 \text{ mV} \); \( f = 19 \text{ kHz} \); \( V_{1-16M} = 300 \text{ mV} \)

pulse duration \( t_p = 10 \mu s \)

repetition frequency \( f_r = 1 \text{ kHz} \)

repetition frequency \( f_r = 16 \text{ kHz} \)

**19 kHz filter** (input: pin 7; output: pin 8)

\( \Delta I_7 \) typ. 3

\( \Delta I_8 \) typ. 2,8 to 3,2

**Notes**

1. See Fig. 4 for the output pulse description; with the 19 kHz filter switched off (pin 7 connected to pin 16).
2. The interference trigger sensitivity is predetermined by \( R_{13} \) and is defined by the formula

\[ V_{TR} = (1 + R_{13}/R_S) \times V_{TR0} \text{ in which } R_S = 2,2 \text{ k}\Omega \text{ (see also note in Fig. 1).} \]
3. Adjustable with \( R_{11} \) or \( C_{11} \); for 20 to 35 \( \mu s \): \( R_{11} = 6,8 \text{ k}\Omega \text{ and } C_{11} = 2,2 \text{ nF} \).
4. Adjustable with \( R_{10} \); at \( R_{10} = 1,5 \text{ k}\Omega \): \( f_r = 20 \text{ kHz} \).

Defeat action starts if \( V_{12-16} \) has reacted a control voltage of \( V_{BE} (0,6 \text{ V}) \).
5. 19 kHz adjustable with \( R_{19kHz} \) (see Fig. 3).
6. The IC may also be used, if desired, without 19 kHz filter by connecting the 1,5 k\Omega \text{ resistor and 6,6 nF capacitor of pin 5 to pin 16, and by leaving pins 7 and 8 unused (see Fig. 3).}
APPLICATION INFORMATION

T_{amb} = 25 \, ^\circ\text{C}; \, V_p = 12 \, V; \, measured \, in \, Fig. \, 3

SIGNAL PATH

Input amplifier

Input impedance at f = 40 \, kHz (pin 1)
- pin 2 unloaded: |Z_i| \text{ typ.} 500 \, k\Omega
- pin 2 loaded: |Z_i| \text{ typ.} 40 \, k\Omega

D.C. input voltage adjustment

\[ V_{1-16} \text{ typ.} 0,4 \, V_p \, V \]

Output impedance (pin 2)

- pin 2 unloaded; pin 1 loaded: |Z_o| \text{ typ.} 480 \, \Omega

Low-pass filter

Input impedance at f = 1 \, kHz (pin 3)

\[ |Z_i| \text{ typ.} 1 \, M\Omega \]

D.C. input current at V_{3-16} = 3,4 \, V

\[ I_3 \text{ typ.} 2 \, \mu\text{A} \]

Output impedance (pin 4)

\[ |Z_o| \text{ typ.} 500 \, \Omega \]

-3 dB point of low-pass filter

\[ f(-3 \, \text{dB}) \text{ typ.} 75 \, \text{kHz} \]

Gate circuit with output stage

Leakage current (pin 5)

\[ I_5 \text{ typ.} 100 \, \text{nA} \]

Pilot regeneration 19 kHz filter

Current amplification

\[ \frac{\Delta I_7}{\Delta I_8} \text{ typ.} 3, \quad 2,8 \, \text{to} \, 3,2 \]

INTERFERENCE PATH

High-pass filter

Input impedance at f = 1 \, kHz (pin 15)

\[ |Z_i| \text{ typ.} 1 \, M\Omega \]

D.C. input current

- at V_{15-16} = 0,19 \, V; \, V_{9-16} = 2,0 \, V

\[ I_{15} \text{ typ.} 1 \, \mu\text{A} \]

Output impedance (pin 14)

\[ \frac{V_{14-16}}{V_{15-16}} \text{ typ.} 1,4 \]

-3 dB point of high-pass filter

\[ f(-3 \, \text{dB}) \text{ typ.} 140 \, \text{kHz} \]

Pulse amplifier; converter and gain control

Peak output current

- (noise controlled feedback in ON position)

\[ I_{12M} \text{ typ.} 0,4 \, \text{mA} \]

Input voltage

- (noise controlled feedback in ON position)

\[ -V_{12-9} \text{ typ.} 0,65 \, \text{V} \]

March 1980
Interference absorption circuit

One shot

Gate circuit conducting; no-interference condition
required input voltage level
output leakage current

Gate circuit non-conducting; interference condition
required input voltage level
output current

Offset voltage; backlash

<table>
<thead>
<tr>
<th>$V_{11-16}$</th>
<th>$&lt; 1 \text{ V}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{10}$</td>
<td>typ. 15 $\mu\text{A}$</td>
</tr>
<tr>
<td>$V_{11-16}$</td>
<td>$&gt; 2 \text{ V}$</td>
</tr>
<tr>
<td>$I_{10}$</td>
<td>$&gt; 1 \text{ mA}$</td>
</tr>
<tr>
<td>$\Delta V_{11-16}$</td>
<td>typ. 0.4 V</td>
</tr>
</tbody>
</table>
Fig. 3 Test/application circuit.
Fig. 4 Residual gate pulse in output signal at $V_I = 80$ mV; pulse duration $t_p = 10 \mu$s; repetition frequency $f_r = 1$ kHz.
16-LEAD DUAL IN-LINE; PLASTIC (SOT-38)

Dimensions in mm

SOLDERING

1. By hand

Apply the soldering iron below the seating plane (or not more than 2 mm above it).
If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave

The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.
The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints

The same precautions and limits apply as in (1) above.
16-LEAD FLAT PACK; PLASTIC (SO-16; SOT-109A)

Dimensions in mm

- Positional accuracy.
- Maximum Material Condition.

SOLDERING
See next page.
SOLDERING

The reflow solder technique

The preferred technique for mounting miniature components on hybrid thick or thin-film circuits is reflow soldering. Solder is applied to the required areas on the substrate by dipping in a solder bath or, more usually, by screen printing a solder paste. Components are put in place and the solder is reflowed by heating.

Solder pastes consist of very finely powdered solder and flux suspended in an organic liquid binder. They are available in various forms depending on the specification of the solder and the type of binder used. For hybrid circuit use, a tin-lead solder with 2 to 4% silver is recommended. The working temperature of this paste is about 220 to 230 °C when a mild flux is used.

For printing the paste onto the substrate a stainless steel screen with a mesh of 80 to 105 μm is used for which the emulsion thickness should be about 50 μm. To ensure that sufficient solder paste is applied to the substrate, the screen aperture should be slightly larger than the corresponding contact area.

The contact pins are positioned on the substrate, the slight adhesive force of the solder paste being sufficient to keep them in place. The substrate is heated to the solder working temperature preferably by means of a controlled hot plate. The soldering process should be kept as short as possible: 10 to 15 seconds is sufficient to ensure good solder joints and evaporation of the binder fluid. After soldering, the substrate must be cleaned of any remaining flux.
RECORDING AND PLAYBACK AMPLIFIER

This integrated circuit incorporates all amplifier circuits necessary for the record/playback functions, with the exception of the audio power output amplifier. It comprises:
— a preamplifier for microphone or playback,
— a recording amplifier with automatic level control,
— a dynamic limiter with a short limiting time.

Compared to its predecessor TDA1002, this type features an improved automatic level control circuit; the control range has been enlarged from 40 to 55 dB and the spread in control characteristic has been reduced to less than 2 dB.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>4 to 12 V</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>T_{amb}</td>
</tr>
<tr>
<td>Total quiescent current (V_p = 9 V)</td>
<td>I_{tot}</td>
</tr>
<tr>
<td>Preamp</td>
<td></td>
</tr>
<tr>
<td>Input impedance (pin 1)</td>
<td></td>
</tr>
<tr>
<td>Open loop gain</td>
<td>G_o</td>
</tr>
<tr>
<td>Clipping level (pin 4); V_p = 9 V; r.m.s. value</td>
<td>V4-5 (rms)</td>
</tr>
<tr>
<td>Equivalent noise input voltage</td>
<td>V_n (rms)</td>
</tr>
<tr>
<td>Recording amplifier</td>
<td></td>
</tr>
<tr>
<td>Input impedance (pin 8)</td>
<td></td>
</tr>
<tr>
<td>Open loop gain</td>
<td>G_o</td>
</tr>
<tr>
<td>Clipping level (pin 9); V_p = 9 V; r.m.s. value</td>
<td>V9-10 (rms)</td>
</tr>
<tr>
<td>Automatic Level Control (A.L.C.)</td>
<td></td>
</tr>
<tr>
<td>Input impedance (pin 6) at low signal level at pin 8</td>
<td></td>
</tr>
<tr>
<td>at high signal level pin 8</td>
<td></td>
</tr>
<tr>
<td>Control voltage</td>
<td></td>
</tr>
<tr>
<td>V_{4-5} = 10 mV; f = 1 kHz; V_p = 9 V</td>
<td>V9-10</td>
</tr>
<tr>
<td>V_{4-5} = 1000 mV; f = 1 kHz; V_p = 9 V</td>
<td>V9-10</td>
</tr>
<tr>
<td>Limiting time (Fig. 12)</td>
<td>t_l</td>
</tr>
<tr>
<td>Level setting time (Fig. 12)</td>
<td>t_s</td>
</tr>
<tr>
<td>Recovery time (Fig. 13)</td>
<td>t_r</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
Fig. 1 Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Supply voltage preamplifier
Supply voltage recording amplifier
Total power dissipation
Storage temperature
Operating ambient temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage preamplifier</td>
<td>$V_{15-10}$ max. 12 V</td>
</tr>
<tr>
<td>Supply voltage recording amplifier</td>
<td>$V_{16-5}$ max. 12 V</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>see derating curve Fig. 2</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$ -65 to +125 °C</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>$T_{amb}$ -25 to +125 °C</td>
</tr>
</tbody>
</table>

D.C. CHARACTERISTICS
$T_{amb} = 25$ °C unless otherwise specified.
Supply voltage recording amplifier
Supply voltage preamplifier
Quiescent current rec. amplifier; $V_p = 9$ V
Quiescent current preamplifier; $V_p = 9$ V
Output voltage recording amplifier
Output voltage preamplifier

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage recording amplifier</td>
<td>$V_{15-10}$ 4 to 12 V</td>
</tr>
<tr>
<td>Supply voltage preamplifier</td>
<td>$V_{16-5}$ 4 to 12 V</td>
</tr>
<tr>
<td>Quiescent current rec. amplifier; $V_p = 9$ V</td>
<td>$I_{15}$ typ. 10 mA</td>
</tr>
<tr>
<td>Quiescent current preamplifier; $V_p = 9$ V</td>
<td>$I_{16}$ typ. 5 mA</td>
</tr>
<tr>
<td>Output voltage recording amplifier</td>
<td>$V_{9-10}$ typ. $\frac{1}{2} V_p$ V</td>
</tr>
<tr>
<td>Output voltage preamplifier</td>
<td>$V_{4-5}$ typ. $\frac{1}{2} V_p -0.35$ V</td>
</tr>
</tbody>
</table>

Fig. 2 Power dissipation derating curve.
A.C. CHARACTERISTICS

$T_{\text{amb}} = 25 ^\circ \text{C}; \ V_p = 9 \text{ V}$ unless otherwise specified.

Preamplifier (note 1)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Type</th>
<th>Recording</th>
<th>Playback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open loop voltage gain</td>
<td>$G_o$</td>
<td>typ.</td>
<td>70 dB</td>
<td>70 dB</td>
</tr>
<tr>
<td>Closed loop voltage gain at $f = 1$ kHz</td>
<td>$G_c$</td>
<td>typ.</td>
<td>38 dB</td>
<td>45 dB</td>
</tr>
<tr>
<td>Output voltage (clipping level); r.m.s. value</td>
<td>$V_{4-5}(\text{rms})$</td>
<td>typ.</td>
<td>2 V</td>
<td>2 V</td>
</tr>
<tr>
<td>Equivalent noise input voltage; r.m.s. value (note 2)</td>
<td>$V_n$</td>
<td>&lt;</td>
<td>0.75 $\mu$V</td>
<td>0.75 $\mu$V</td>
</tr>
<tr>
<td>Input impedance (pin 1)</td>
<td>$</td>
<td>Z_i</td>
<td>$</td>
<td>typ.</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$f = 1$ kHz; $V_{4-5} = 150$ mV</td>
<td>$d_t$</td>
<td>typ.</td>
<td></td>
<td>0.12 %</td>
</tr>
<tr>
<td>$f = 1$ kHz; $V_{4-5} = 500$ mV</td>
<td>$d_t$</td>
<td>&lt;</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Amplitude response</td>
<td></td>
<td></td>
<td>flat: 20 Hz to 20 kHz</td>
<td>see Fig. 7</td>
</tr>
</tbody>
</table>

Recording amplifier (Fig. 9)

with A.L.C.; unless otherwise specified.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Type</th>
<th>Recording</th>
<th>Playback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open loop gain</td>
<td>$G_o$</td>
<td>typ.</td>
<td>80 dB</td>
<td></td>
</tr>
<tr>
<td>Closed loop voltage gain at $f = 1$ kHz (note 3)</td>
<td>$G_c$</td>
<td>typ.</td>
<td>49 dB</td>
<td></td>
</tr>
<tr>
<td>Output voltage (clipping level); r.m.s. value</td>
<td>$V_{9-10}(\text{rms})$</td>
<td>typ.</td>
<td>2 V</td>
<td></td>
</tr>
<tr>
<td>Input impedance pin 8</td>
<td>$</td>
<td>Z_i</td>
<td>$</td>
<td>typ.</td>
</tr>
<tr>
<td>Input impedance pin 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low signal levels</td>
<td>$</td>
<td>Z_i</td>
<td>$</td>
<td>typ.</td>
</tr>
<tr>
<td>high signal levels</td>
<td>$</td>
<td>Z_i</td>
<td>$</td>
<td>typ.</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
<td></td>
<td></td>
<td>see Fig. 11</td>
<td></td>
</tr>
<tr>
<td>Amplitude response (note 3)</td>
<td></td>
<td></td>
<td>see Fig. 10</td>
<td></td>
</tr>
</tbody>
</table>

Automatic level control (see Fig. 8)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Type</th>
<th>Recording</th>
<th>Playback</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{4-5} = 10$ mV; $f = 1$ kHz</td>
<td>$V_{9-10}$</td>
<td>typ.</td>
<td>250 mV</td>
<td></td>
</tr>
<tr>
<td>$V_{4-5} = 100$ mV; $f = 1$ kHz</td>
<td>$V_{9-10}$</td>
<td>typ.</td>
<td>450 mV</td>
<td></td>
</tr>
<tr>
<td>$V_{4-5} = 1000$ mV; $f = 1$ kHz</td>
<td>$V_{9-10}$</td>
<td>typ.</td>
<td>750 mV</td>
<td></td>
</tr>
<tr>
<td>$V_{4-5} = 2000$ mV; $f = 1$ kHz</td>
<td>$V_{9-10}$</td>
<td>typ.</td>
<td>880 mV</td>
<td></td>
</tr>
<tr>
<td>Limiting time (see Fig. 12)</td>
<td>$t_l$</td>
<td>typ.</td>
<td>10 ms</td>
<td></td>
</tr>
<tr>
<td>Level setting time (see Fig. 12)</td>
<td>$t_s$</td>
<td>typ.</td>
<td>4 s</td>
<td></td>
</tr>
<tr>
<td>Recovery time (see Fig. 13)</td>
<td>$t_r$</td>
<td>typ.</td>
<td>35 s</td>
<td></td>
</tr>
</tbody>
</table>

Notes

1. For recording see Fig. 3; for playback see Fig. 5.
2. $R_S = 500 \Omega$; bandwidth = 300 Hz to 15 kHz.
3. Pin 6 not connected to pin 8.

November 1979
Recording and playback amplifier

Fig. 3 Preamplifier used as microphone amplifier.

Fig. 4 Total harmonic distortion of preamplifier used for recording.
Fig. 5 Preamplifier used for playback.

Fig. 6 Total harmonic distortion of preamplifier used for playback at $V_{4.5} = 150$ mV.
Fig. 7 Amplitude response of preamplifier used for playback; typical values. 
0 dB = input voltage of 0.3 mV at f = 333 Hz. Dotted line according to DIN 45513.

Fig. 8 Automatic level control; for circuitry see Fig. 9; f = 1 kHz.
Fig. 9 Application of TDA1002A (recording position).
Fig. 10 Amplitude response of recording amplifier (A.L.C. not connected).

Fig. 11 Total harmonic distortion recording amplifier with A.L.C.; f = 1 kHz.
**Fig. 12** Output response at input level jumps.

**Fig. 13** Output response at input level jumps.
MOTOR REGULATOR
AND BIAS/ERASE OSCILLATOR CIRCUIT

The TDA1003A is pin for pin compatible with the TDA1003 with an extension of features. The TDA1003A is for use in recording/playback systems. It incorporates capstan motor speed control, an automatic stop circuit, and a bias/erase oscillator.

The motor circuit controls the back e.m.f. and delivers a stabilized voltage to the capstan motor. The motor voltage is corrected for line voltage and torque variations, and temperature variations of the magnetic material and windings. The motor speed control is operative as long as a pulse train, derived from the tape wind spool mechanism via an interrupter, is applied to the automatic stop circuit. The TDA1003A can also be used without stop circuit by connecting pin 16 to ground. An output is available for a "stop" indicator lamp.

The oscillator section contains a temperature-independent voltage reference source and an a.g.c. circuit controlling the transconductance of a balanced oscillator circuit incorporating the erase head. Any Q variations of the erase head winding are fed back to maintain the oscillator output as a constant undistorted sine-wave so that harmonic products do not cause interference during radio recording.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>Vp</td>
</tr>
<tr>
<td>3.5 to 18 V</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>Tamb typ. 25 °C</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>Vp typ. 9 V</td>
</tr>
<tr>
<td>Motor regulator</td>
<td>I4 typ. 1.8 mA</td>
</tr>
<tr>
<td>Current consumption</td>
<td>I3 &lt; 1000 mA</td>
</tr>
<tr>
<td>Motor starting current</td>
<td>I3 &lt; 250 mA</td>
</tr>
<tr>
<td>Operating motor current</td>
<td>V3-2min typ. 0.9 V</td>
</tr>
<tr>
<td>Minimum operating voltage at I3 = 600 mA</td>
<td>ΔV3-2/ΔV4-2 typ. 1 mV/V</td>
</tr>
<tr>
<td>Supply voltage rejection</td>
<td></td>
</tr>
<tr>
<td>Stop circuit</td>
<td></td>
</tr>
<tr>
<td>Output current for &quot;stop&quot; indicator lamp</td>
<td>I1 &lt; 100 mA</td>
</tr>
<tr>
<td>Knee voltage at I1 = 100 mA</td>
<td>V1-2 typ. 0.6 V</td>
</tr>
<tr>
<td>Input current for I1 = 100 mA</td>
<td>I16 &gt; 4 µA</td>
</tr>
<tr>
<td>Bias and erase oscillator</td>
<td></td>
</tr>
<tr>
<td>Current consumption at Q = 40</td>
<td>I8 typ. 25 mA</td>
</tr>
<tr>
<td>Erase head voltage at Q = 40 (r.m.s. value)</td>
<td>V erase(rms) typ. 16 V</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic power (SOT-38N).
RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages
Supply voltage on: pin 4
pin 8
pin 14

$V_{4-2} \quad \text{max.} \quad 18 \ \text{V}$
$V_{8-2} \quad \text{max.} \quad 18 \ \text{V}$
$V_{14-2} \quad \text{max.} \quad 18 \ \text{V}$

Currents
Motor current (pin 3; peak-value)
"Stop" indicator lamp current (d.c.; pin 1)
Maximum input current (pin 15)

$I_{3M} \quad \text{max.} \quad 1000 \ \text{mA}$
$I_{1} \quad \text{max.} \quad 100 \ \text{mA}$
$\pm I_{15\text{max}} \quad \text{max.} \quad 20 \ \text{mA}$

Temperatures
Storage temperature
Operating ambient temperature
see also power derating curve below

$T_{\text{stg}} \quad -65 \text{ to } +150 \ \text{°C}$
$T_{\text{amb}} \quad -20 \text{ to } +150 \ \text{°C}$

Power dissipation
Total power dissipation
see derating curve below

![Power dissipation graph](image-url)
CHARACTERISTICS at \( V_p = 9 \, \text{V} \); \( T_{amb} = 25 \, \text{°C} \) unless otherwise specified; see test circuit on page 6

Supply voltage range (pins 4, 8 and 14) \( V_p \) 3.5 to 18 V 1)

Motor regulator

Current consumption \( I_4 \) typ. 1.8 mA 1 to 3 mA

Operating motor current \( I_3 \) < 250 mA

Motor starting current (peak-value) \( I_{3M} \) < 1000 mA

Input offset voltage at \( I_3 = 3 \, \text{mA} \) \( |V_{7-6}| \) typ. 2 mV < 8 mV

Input offset current at \( I_3 = 3 \, \text{mA} \) \( |I_{7-6}| \) typ. 0.2 \( \mu \text{A} \)

Input voltage range (common mode) \( V_{6-2} \) 2.4 to \((V_p-0.25)\) V
\( V_{7-2} \) 2.4 to \((V_p-0.25)\) V

Input bias current \( I_{16;17} \) typ. 0.1 \( \mu \text{A} \) < 1.0 \( \mu \text{A} \)

Input sensitivity (for \( \Delta I_3 = 100 \, \text{mA} \) \( \Delta V_{7-6} \) typ. 1 mV < 10 mV

Minimum operating voltage at \( I_3 = 600 \, \text{mA} \) \( V_{3-2 \, \text{min}} \) typ. 0.9 V < 1.8 V 2)

Automatic motor "stop" circuit

"Stop" indicator lamp current \( I_1 \) < 100 mA

Knee voltage at \( I_1 = 100 \, \text{mA} \) \( V_{15-2} \) = low \( V_{1-2} \) typ. 0.6 V < 1.0 V

Input current for \( I_1 = 100 \, \text{mA} \) \( I_{16} \) > 4 \( \mu \text{A} \)

Voltage at pin 1 without external load (\( V_{16} \) = low) \( V_{1-2} \) typ. 4.1 V 3 to 5.0 V

Maximum input current (pin 15) \( \pm I_{15 \, \text{max}} \) < 20 mA

1) To guarantee proper functioning with \( V_p = 3.5 \, \text{V} \) to 18 V, the external component values as shown in test circuit on page 6 should be modified.

2) The minimum operating voltage is defined as the voltage (\( V_{3-2} \)) at which the motor still operates at correct speed.
CHARACTERISTICS (continued)

Bias and erase oscillator

Current consumption at \( Q = 40 \)
\[
I_8 \quad \text{typ.} \quad 25 \ \text{mA}
\]
\[
I_8 \quad \text{typ.} \quad 38 \ \text{mA}
\]
\[
I_8 \quad \text{typ.} \quad 46 \ \text{mA}
\]

Internal current limiting
\[
I_8 \quad < \quad 95 \ \text{mA} \]

Peak output current
\[
\pm I_9 \quad > \quad 100 \ \text{mA}
\]

Output voltage swing (peak-to-peak value)
\[
V_{9-2(p-p)} \quad \text{typ.} \quad V_{p-2} \quad \text{V}
\]

Current consumption of reference source
\[
I_{14} \quad \text{typ.} \quad 1,8 \ \text{mA}
\]
\[
I_{14} \quad < \quad 2,4 \ \text{mA}
\]

Reference voltage (temperature compensated)
\[
V_{13-2} \quad \text{typ.} \quad 1,7 \ \text{V}
\]
\[
1,55 \text{ to } 1,9 \ \text{V}
\]

Erase head voltage; \( Q = 40; L = 620 \mu\text{H} \) (r.m.s. value)
\[
V_{\text{erase(rms)}} \quad \text{typ.} \quad 16 \ \text{V}
\]

Change of \( V_{\text{erase}} \) when \( Q \) changes from 20 to 60
\[
\Delta V_{\text{erase}} \quad \text{typ.} \quad 1 \ \text{V}
\]
\[
< \quad 1,8 \ \text{V}
\]

APPLICATION INFORMATION measured in circuit on page 7

Motor regulator

Supply voltage rejection
\[
\frac{\Delta V_{3-2}}{\Delta V_{4-2}} \quad \text{typ.} \quad 1 \ \text{mV/V}
\]

Motor speed variation over \( T_{\text{amb}} = -5 \) to \( +55 \ \text{°C} \)
\[
\pm \Delta n \quad \text{typ.} \quad 2 \ \% 
\]

Automatic motor "stop" circuit

Input voltage from wind spool supplied via
\[
10 \ \text{k}\Omega \ \text{to pin 15 (peak-to-peak value)}
\]
\[
V_{W(p-p)} \quad \text{typ.} \quad 1,2 \ \text{V}
\]

Input current (pin 15)
\[
\pm I_{15} \quad < \quad 20 \ \text{mA}
\]

Bias and erase oscillator

Erase head voltage for \( Q = 40; \)
\[
L = 620 \mu\text{H} \ (\text{r.m.s. value})
\]
\[
V_{\text{erase(rms)}} \quad \text{typ.} \quad 16 \ \text{V}
\]

Change of \( V_{\text{erase}} \) when \( Q \) changes from 20 to 60
\[
\Delta V_{\text{erase}} \quad \text{typ.} \quad 1 \ \text{V}
\]

Harmonic distortion
(unsaturated erase head)
\[
-\alpha_{2\text{nd harm}} \quad \text{typ.} \quad 55 \ \text{dB} \]
\[
-\alpha_{3\text{rd harm}} \quad \text{typ.} \quad 40 \ \text{dB}
\]
\[
-\alpha_{>6\text{th harm}} \quad > \quad 80 \ \text{dB}
\]

---

1) If erase head is defective.

2) Typical value of temperature coefficient \( 0 \ \text{mV/°C} \).

3) At unsaturated erase head, with respect to 45 kHz.
APPLICATION INFORMATION (continued)

Indicator lamp: 9 V; 40 mA
Motor (M): \( R_\text{M} = 14 \Omega \)
\( E_\text{M} = 2.3 \text{ V at 1500 r.p.m.} \)

Erase head: \( L = 620 \mu\text{H} \)
\( Q = 40 \)
\( f_0 = 45 \text{ kHz} \)

*) Capacitor with low losses required; especially for \( \text{CrO}_2 \) tape and low battery voltage.

**) Switch closed: suitable for \( \text{CrO}_2 \) tape
open: suitable for \( \text{Fe}_2\text{O}_3 \) tape.
The TDA1004A is a monolithic integrated circuit in a plastic 16-lead power dual in-line package, intended for use as a low-frequency class-B amplifier.

This circuit can also be used in car radios, even when 2 Ω load is required.

The device provides 10 W output power at 20 V/4 Ω; 6 W at 14 V/4 Ω and 7.5 W at 14 V/2 Ω. The supply voltage ranges from 9 to 20 V.

The TDA1004A is pin for pin compatible with the TDA1004.

The d.c. and a.c. gain are equal, which means an external feedback network is not necessary.

The circuit comprises two separate amplifiers with the following features:

- low-cost and small number of external components;
- thermal limiting circuit, the gain of the circuit decreases when the crystal temperature exceeds 150 °C;
- continuous short-circuit protection of the load for supply voltages up to 16 V;
- very good ripple rejection;
- low input impedance;
- low thermal resistance of the package thus requiring relatively small heatsinks;
- filtered but not stabilized supply (pin 6) available for other electronic functions.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
</tr>
<tr>
<td>( V_P )</td>
</tr>
<tr>
<td>D.C. output current (peak value)</td>
</tr>
<tr>
<td>( I_{OM} )</td>
</tr>
<tr>
<td>Output power at ( d_{tot} = 10% )</td>
</tr>
<tr>
<td>at ( V_P = 14 \text{ V}; R_L = 4 \Omega )</td>
</tr>
<tr>
<td>( P_O ) typ. 6.2 W</td>
</tr>
<tr>
<td>at ( V_P = 14 \text{ V}; R_L = 2 \Omega )</td>
</tr>
<tr>
<td>( P_O ) typ. 7.0 W</td>
</tr>
<tr>
<td>at ( V_P = 20 \text{ V}; R_L = 8 \Omega )</td>
</tr>
<tr>
<td>( P_O ) typ. 7.0 W</td>
</tr>
<tr>
<td>at ( V_P = 20 \text{ V}; R_L = 4 \Omega )</td>
</tr>
<tr>
<td>( P_O ) typ. 11.0 W</td>
</tr>
<tr>
<td>Total harmonic distortion at ( P_O &lt; 1 \text{ W}; R_L = 4 \Omega )</td>
</tr>
<tr>
<td>( d_{tot} ) typ. 0.2 %</td>
</tr>
<tr>
<td>Input impedance</td>
</tr>
<tr>
<td>(</td>
</tr>
<tr>
<td>Total quiescent current at ( V_P = 14 \text{ V} )</td>
</tr>
<tr>
<td>( I_{tot} ) typ. 30 mA</td>
</tr>
<tr>
<td>Sensitivity at ( P_O = 1 \text{ W}; R_L = 4 \Omega )</td>
</tr>
<tr>
<td>( V_i ) typ. 6.6 mV</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
</tr>
<tr>
<td>( T_{amb} ) -25 to +150 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
</tr>
<tr>
<td>( T_{stg} ) -55 to +150 °C</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic power (SOT-69B).

January 1977
**RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134)

**Voltage**
Supply voltage

\[ V_p \max. = 24 \text{ V} \]

**Currents**

Repetitive peak output current (pins 11, 12, 14)
\[ I_{ORM} \max. = 2.5 \text{ A} \]

Non-repetitive peak output current (pins 11, 12, 14)
\[ I_{OSM} \max. = 5.0 \text{ A} \]

Supply current from pin 6
\[ I_6 \max. = 30 \text{ mA} \]

**Power dissipation**

Total power dissipation
see derating curve below

**Temperatures**

Storage temperature
\[ T_{stg} = -55 \text{ to } +150 \text{ °C} \]

Operating ambient temperature
\[ T_{amb} = -25 \text{ to } +150 \text{ °C} \]

**Short-circuiting**

A.C. short-circuit duration of load impedance during sine-wave signal drive;
without heatsink at \( V_p = 14 \text{ V} \)
\[ t_{SC} \max. = 100 \text{ hours} \]

![Derating curve](image)

1. Infinite heatsink
2. External heatsink of 100 cm\(^2\)
3. External heatsink of 30 cm\(^2\)
4. External heatsink of 12 cm\(^2\)
5. In free air; without external heatsink

Heatsink: blackened aluminium area.
THERMAL RESISTANCE (The power derating curve on page 3 is based on the following data)

From junction to case  \( R_{th \ j-c} = 3.3 \degree C/W \)
From junction to ambient  \( R_{th \ j-a} = 45 \degree C/W \)

CHARACTERISTICS

D.C. characteristics

Supply voltage range (pin 11)  \( V_P \) 9 to 20 V
Supply voltage (pin 6) at \( I_6 = 0 \) mA
at \( I_6 = 20 \) mA  \( V_{6-1} > 11.0 \) V  \( V_{6-1} > 10.8 \) V
Output current (peak value)  \( I_{OM} < 2.5 \) A
Output current at pin 6 (peak value)  \( I_{6M} < 30 \) mA
Total quiescent current at \( V_P = 14 \) V  \( I_{tot} < 90 \) mA

A.C. characteristics at \( T_{amb} = 25 \degree C; V_P = 14 \) V; \( R_L = 4 \) \( \Omega \); \( f = 1 \) kHz unless otherwise specified; see also test circuit on page 5.

A.F. output power at \( d_{tot} = 10\% \) 1)

at \( V_P = 14 \) V; \( R_L = 4 \) \( \Omega \); without bootstrap 2)
\( P_0 > 4.8 \) W
\( P_0 < 5.5 \) W
\( P_0 < 6.2 \) W
\( P_0 < 7.0 \) W
\( P_0 < 7.0 \) W
\( P_0 < 11.0 \) W

Voltage gain
preamplifier  \( G_{V1} \) typ. 20 dB
power amplifier  \( G_{V2} \) typ. 30 dB
total amplifier  \( G_{V_{tot}} \) typ. 50 dB

Total harmonic distortion at \( P_0 = 1 \) W  \( d_{tot} < 0.2 \) %
Frequency response (-3 dB)  \( \beta \) 60 Hz to 17 kHz

Input impedance: preamplifier  \( |Z_1| \) typ. 15 k\( \Omega \)
power amplifier  \( |Z_1| \) typ. 20 k\( \Omega \)

Output impedance of preamplifier (pin 4)  \( |Z_0| \) > 10 k\( \Omega \) 3)

1) Output power is always measured at the d.c. output of the amplifier, so losses in coupling capacitor are not taken into account.
2) See circuit on page 7. With this circuit 4.8 W is guaranteed.
3) At this impedance value from pin 4 to ground, the maximum output power can be delivered.
CHARACTERISTICS (continued)

Output voltage preamplifier
at $d_{tot} = 5\%$ (r.m.s. value)

Noise output voltage at $R_S = 0 \Omega$
at $R_S = 2 \text{ k}\Omega$

Sensitivity at $P_o = 1 \text{ W}$

Ripple rejection at $f = 100 \text{ Hz}$
at $f = 1 \text{ kHz}$

Test circuit

---

1) Measured with a $30 \text{ k}\Omega$ a.c. load impedance at pin 4 (disconnected from pin 5).

2) Measured at a bandwidth of 60 Hz to 15 kHz.

3) See ripple rejection on page 6.
 Typical ripple rejection measured with nominal load impedance ($R_L = 4 \, \Omega$) and input a.c. short-circuited.

$$V_{O_{\text{max}}} = 4 \, \text{mV} \text{ at } f = 10^3 \, \text{Hz}.$$
APPLICATION INFORMATION

Without bootstrap

With bootstrap

January 1977
APPLICATION INFORMATION (continued)

<table>
<thead>
<tr>
<th>Supply voltage (V_{11-14})</th>
<th>V_P</th>
<th>14</th>
<th>8</th>
<th>20</th>
<th>V</th>
<th>Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load resistance</td>
<td>R_L</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Total quiescent current</td>
<td>I_{tot}</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Output power at d_{tot} = 10%</td>
<td>P_O</td>
<td>7.0</td>
<td>6</td>
<td>3.5</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>with bootstrap</td>
<td></td>
<td>7.5</td>
<td>5</td>
<td>3.0</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>without bootstrap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distortion at P_O = 2 W</td>
<td>d_{tot}</td>
<td>1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Input sensitivity for P_O = 1 W</td>
<td>V_i</td>
<td>4.8</td>
<td>6.6</td>
<td>9.1</td>
<td>6.6</td>
<td>9.1</td>
</tr>
<tr>
<td>Ripple rejection at f = 100 Hz</td>
<td>RR</td>
<td>32.5</td>
<td>32.5</td>
<td>32.5</td>
<td>32.5</td>
<td>32.5</td>
</tr>
<tr>
<td>at f = 1 kHz</td>
<td></td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Noise output voltage at</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B = 60 Hz to 15 kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS = 0 Ω</td>
<td>V_n</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>RS = 2 kΩ</td>
<td>V_n</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
</tr>
<tr>
<td>Input impedance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum power dissipation</td>
<td>P_{tot}</td>
<td>5.2</td>
<td>2.8</td>
<td>1.6</td>
<td>5.5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

1) P_O = 9 W, when a resistor of 220 Ω is connected between pins 9 and 11.
APPLICATION INFORMATION (continued)

Without bootstrap

With bootstrap

January 1977
MOUNTING INSTRUCTIONS

When using an external heatsink, connected to the heat spreader of the IC, the thermal power in the circuit can be reduced to a negligible value.

The optimum heatsink dimensions (blackened aluminium) for a given operating ambient temperature, can be found from the derating curves on page 3.

The fact that the thermal resistance of the encapsulation is very good, results in a relatively small heatsink for thermal power reduction; e.g. $P_0 = 2 \text{ W}$ at $T_{amb} = 50 \degree \text{C}$ can be obtained without an external heatsink.

Two mounting methods are shown below.

By using these methods, no extra copper area is required on the printed-circuit board, so a saving in printed-wiring area is obtained.

Mounting the external heatsink can be done by screwing or clipping.

Mechanical stresses do not damage the IC.

It is recommended that a heatsink-compound be used between IC heat spreader and heatsink.

Method 1

![Diagram of Method 1]

Method 2

![Diagram of Method 2]
The TDA1005A is a high quality PLL stereo decoder based on the frequency-division multiplex (f.d.m.) principle, performing:

- excellent ACI (Adjacent Channel Interference) and SCA (Storecast) rejection
- very low BFC (Beat-Frequency Components) distortion in the higher frequency region.

The circuit incorporates the following features:

- with simplified peripheral circuitry the circuit can perform as a time-division multiplex (t.d.m.) decoder, for use in economic medium and low-class apparatus
- for car radios: operation at a supply voltage of 8 V
- extra pin for smooth mono/stereo take-over without “clicks”
- automatic mono/stereo switching (minimum switching level is 16 mV), controlled by both pilot signal and field strength level.
- low distortion in the loop resonance frequency region (~300 Hz; THD = 0.2% typ.)
- external adjustment for obtaining optimum channel separation in the complete receiver
- internal amplification: t.d.m., 7 dB; f.d.m., 10 dB
- driver for stereo indicator lamp
- externally switchable: VCO-off or mono condition
- guaranteed VCO capture range (> 3.5% or 2.7 kHz)

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Supplier voltage range</th>
<th>V8-16</th>
<th>8 to 18 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>V8-16</td>
<td>typ.</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>Tamb</td>
<td>typ. 15 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25 °C</td>
</tr>
</tbody>
</table>

Measured at Vi(p-p) = 1 V (MUX signal with 8% pilot)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>t.d.m.</th>
<th>f.d.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel separation at f = 1 kHz</td>
<td>α</td>
<td>50</td>
</tr>
<tr>
<td>Carrier suppression</td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>at f = 19 kHz</td>
<td>α19</td>
<td>typ.</td>
</tr>
<tr>
<td>at f = 38 kHz</td>
<td>α38</td>
<td>typ.</td>
</tr>
<tr>
<td>at f = 76 kHz</td>
<td>α76</td>
<td>typ.</td>
</tr>
<tr>
<td>ACI rejection at f = 114 kHz</td>
<td>α114</td>
<td>typ.</td>
</tr>
<tr>
<td>SCA rejection at f = 67 kHz</td>
<td>α67</td>
<td>typ.</td>
</tr>
<tr>
<td>VCO capture range</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>f_m = 1 kHz</td>
<td>THD</td>
<td>0.2</td>
</tr>
<tr>
<td>f_m = 300 Hz to 10 kHz</td>
<td>THD</td>
<td>0.2</td>
</tr>
<tr>
<td>BFC suppression</td>
<td>dBFC</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINES

TDA1005A: 16-lead DIL; plastic (SOT-38).
TDA1005AT: 16-lead flat pack; plastic (SO-16; SOT-109A).
Fig. 1 Block diagram.
Frequency multiplex PLL stereo decoder

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>Supply voltage</td>
<td>V8:16 max. 18 V</td>
</tr>
<tr>
<td>Indicator lamp voltage</td>
<td>V15-16 max. 22 V</td>
</tr>
<tr>
<td>Mono/stereo switching voltage</td>
<td>V14-16 max. 4 V</td>
</tr>
<tr>
<td>Indicator lamp current</td>
<td>I15 max. 100 mA</td>
</tr>
<tr>
<td>Indicator lamp turn-on current (peak value)</td>
<td>I15max. 200 mA</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>see derating curve Fig. 2</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg -55 to +150 °C</td>
</tr>
<tr>
<td>Operating ambient temperature (see also Fig. 2)</td>
<td>Tamb -25 to +150 °C</td>
</tr>
</tbody>
</table>

Fig. 2 Power derating curve.
A.C. CHARACTERISTICS and APPLICATION INFORMATION

\( T_{\text{amb}} = 25 \, ^\circ\text{C}; \ V_{8-16} = 15 \, \text{V} \) (unless otherwise specified); see also Fig. 7 and Fig. 10.

<table>
<thead>
<tr>
<th>note</th>
<th>pin</th>
<th>parameter</th>
<th>t.d.m.</th>
<th>f.d.m.</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Channel separation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>see Figs 23 and 24</td>
<td>1, 2</td>
<td>2, 3</td>
<td>( \alpha )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F.M.—I.F. roll-off correction</td>
<td>1, 2</td>
<td></td>
<td>range</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input MUX-voltage; ( L = 1; \ R = 1 )</td>
<td>1, 2</td>
<td>11</td>
<td>( V_{\text{p-p}} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input impedance</td>
<td>11</td>
<td>(</td>
<td>Z_1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage gain per channel</td>
<td>1, 2</td>
<td>( G_v )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Channel balance</td>
<td>1, 2</td>
<td>( \pm \Delta G_v )</td>
<td>&lt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output voltage (r.m.s. value)</td>
<td>1, 2</td>
<td>2</td>
<td>( V_{2-16 \text{ (rms)}} )</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output impedance</td>
<td>2, 3</td>
<td>(</td>
<td>Z_0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total harmonic distortion;</td>
<td>see Figs 25 and 26</td>
<td>1</td>
<td>THD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f_m = 1 , \text{kHz} ) (all conditions)</td>
<td>2, 3</td>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f_m = 1 , \text{kHz}; \ L = 1; \ R = 1 )</td>
<td>1</td>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f_m = 300 , \text{Hz} ) to 10 kHz</td>
<td>1, 2</td>
<td></td>
<td>&lt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carrier suppression</td>
<td>2, 3</td>
<td>( \alpha_{19} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 19 , \text{kHz} ); without notch filter</td>
<td>1</td>
<td>( \alpha_{19} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 19 , \text{kHz} ); with notch filter</td>
<td>1, 9</td>
<td></td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 38 , \text{kHz} ); without notch filter</td>
<td>1</td>
<td>( \alpha_{38} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 38 , \text{kHz} ); with notch filter</td>
<td>1, 9</td>
<td></td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 57 , \text{kHz} ); without notch filter</td>
<td>1</td>
<td>( \alpha_{57} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 57 , \text{kHz} ); with notch filter</td>
<td>1, 9</td>
<td></td>
<td>&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( f = 76 , \text{kHz} ); without notch filter</td>
<td>1</td>
<td>( \alpha_{76} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACI rejection</td>
<td>2, 3</td>
<td>( \alpha_{114} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>at ( f = 114 , \text{kHz} )</td>
<td>4</td>
<td>( \alpha_{114} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>at ( f = 190 , \text{kHz} )</td>
<td>4</td>
<td>( \alpha_{190} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SCA rejection at ( f = 67 , \text{kHz} )</td>
<td>5</td>
<td>( \alpha_{67} )</td>
<td>typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ripple rejection; ( f = 100 , \text{Hz} ); ( V_{8-16 \text{ (rms)}} = 200 , \text{mV} )</td>
<td>2, 3</td>
<td>( \text{RR} )</td>
<td>typ.</td>
</tr>
</tbody>
</table>

February 1980
Frequency multiplex PLL stereo decoder

<table>
<thead>
<tr>
<th>note</th>
<th>pin</th>
<th>parameter</th>
<th>t.d.m.</th>
<th>f.d.m.</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCO; adjustable with R7-16</td>
<td>6</td>
<td>fVCO</td>
<td>typ.</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>nominal frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capture range (deviation from 76 kHz centre frequency)</td>
<td>6</td>
<td>&gt;</td>
<td>3.5</td>
<td>3.5</td>
<td>%</td>
</tr>
<tr>
<td>19 kHz pilot signal of 32 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>temperature coefficient</td>
<td>6</td>
<td>−TC</td>
<td>typ.</td>
<td>450.10^{-6}</td>
<td>450.10^{-6}</td>
</tr>
<tr>
<td>uncompensated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>compensated</td>
<td>6</td>
<td>± TC</td>
<td>typ.</td>
<td>200.10^{-6}</td>
<td>200.10^{-6}</td>
</tr>
<tr>
<td>Stereo/mono switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when equal to 19 kHz pilot-tone threshold voltage; adjustable with R13-8</td>
<td>7</td>
<td>V_i</td>
<td>10 to 100</td>
<td>10 to 100</td>
<td>mV</td>
</tr>
<tr>
<td>when equal to threshold voltage at R13-8 = 620 kΩ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for switching to stereo</td>
<td>11</td>
<td>V_i</td>
<td>7 to 16</td>
<td>7 to 16</td>
<td>mV</td>
</tr>
<tr>
<td>for switching to mono</td>
<td>11</td>
<td>V_i</td>
<td>&lt;</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>hysteresis</td>
<td>8</td>
<td>ΔV_i</td>
<td>typ.</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Smooth take-over circuit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>full mono</td>
<td>8</td>
<td>V6-16</td>
<td>&lt;</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>full stereo</td>
<td>8</td>
<td>V6-16</td>
<td>&gt;</td>
<td>1.3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Notes
1. \( V_i \) (p-p) = 1 V (MUX signal with 8% pilot level).
2. \( f_m = 1 \) kHz.
3. At supply voltages of 8 to 11 V, resistors of 5.6 kΩ have to be connected from ground to pins 2 and 3.
4. Measured with a composite input signal: \( L = R \); \( f_m = 1 \) kHz; 90% M-signal; 9% pilot signal; 1% spurious signal of 110 kHz (for \( \alpha_{11} \)) or 186 kHz (for \( \alpha_{190} \)).

\[
V_o (at \ 4 \ kHz) = 20 \log \frac{V_o (at \ 1 \ kHz)}{V_o (at \ 4 \ kHz)}
\]

ACI suppression is defined as: 20 log \( \frac{V_o (at \ 1 \ kHz)}{V_o (at \ 1 \ kHz)} \).
5. Measured with a composite input signal: \( L = R \); \( f_m = 1 \) kHz; 80% S-signal; 9% pilot signal; 10% SCA carrier (67 kHz); \( d_{13} = 20 \log \frac{V_o (at \ 9 \ kHz)}{V_o (at \ 1 \ kHz)} \).

6. See also Figs 7 and 10; compensated with RC network on pin 7.
7. Adjustable with R13-8; see also Fig. 28; for field strength dependent input (pin 14) see next page.
8. \( V_{11-16} \) (mono/stereo) = 20 log \( \frac{V_{11-16} (at \ 1 \ kHz)}{V_{11-16} (at \ 9 \ kHz)} \).

9. For example of notch filter see Fig. 6.
TDA1005A
TDA1005AT

D.C. CHARACTERISTICS

$\text{T}_{\text{amb}} = 25 \, ^{\circ}\text{C}; \ V_{8\text{-}16} = 15 \, \text{V}$ (unless otherwise specified)

Supply voltage range

<table>
<thead>
<tr>
<th>$V_{8\text{-}16}$</th>
<th>8 to 18 , \text{V} *</th>
</tr>
</thead>
</table>

Total current (except indicator lamp)

| $I_{8}$ | typ. | 21 mA |

Power dissipation (operating)

| $P_{\text{tot}}$ | < | 570 \, \text{mW} |

Saturation voltage of lamp driver

| $V_{15\text{-}16}$ | typ. | 0.9 \, \text{V} |

Maximum lamp driver voltage

| $V_{15\text{-}16}$ | < | 22 \, \text{V} |

Switching voltage

| $V_{14\text{-}16}$ | > | 1.2 \, \text{V} ** |
| $V_{14\text{-}16}$ | < | 0.65 \, \text{V} |
| $V_{14\text{-}16}$ | typ. | 0.2 \, \text{V} |

APPLICATION NOTES

1. Switching-off the VCO

If the internal gain is used with A.M. reception, the VCO can be switched off by connecting pin 9 via a 100 \, \text{k}\Omega resistor to ground (no h.f. signal on the leads), or connecting pin 7 to ground.

2. Mono button

The decoder can be switched to the mono position by connecting pin 12 to ground. The VCO then remains operational so this possibility cannot be used with A.M. reception.

3. Economic periphery

a. For a fixed stereo switching level of $\leq 16 \, \text{mV}$ a resistor of 620 \, \text{k}\Omega can be connected between pin 13 and positive supply (+) instead of a potentiometer in series with a resistor.

b. The 10 \, \text{k}\Omega resistor connected in parallel with the stereo indicator lamp can be omitted, however, some TDA1005A circuits will switch to mono during lamp failure.

c. The 10 \, \mu\text{F} capacitor in series with a 1 \, \text{k}\Omega resistor at pin 9 can be decreased to a 1 \, \mu\text{F} capacitor, bearing in mind that the distortion will increase, especially around loop resonance.

d. A MUX-input filter is not needed, if i.f. roll-off starts at a frequency of 62 \, \text{kHz}.

4. Printed-circuit boards

For both the f.d.m. and t.d.m. stereo decoder circuits a printed-circuit board layout is given as an example (Figs 8 and 11). Also for an active filter, which is mainly used with a t.d.m. decoder, a printed-circuit board layout is given in Fig. 4.

5. Notch filter

If attention has to be paid for suppression of the 57 \, \text{kHz} signal (T.W.S. = Traffic Warning System) and the 19 \, \text{kHz} signal, an input filter can be used as given in Fig. 6.

* At supply voltages of 8 to 11 \, \text{V}, resistors of 5.6 \, \text{k}\Omega have to be connected from ground to pins 2 and 3.

** Maximum voltage for safe operation: $V_{14\text{-}16} < 4 \, \text{V}$.
Frequency multiplex PLL stereo decoder

APPLICATION INFORMATION

Fig. 3 Active filter circuit diagram.

Fig. 4 Printed-circuit board component side, showing component layout.

Fig. 5 Printed-circuit board showing track side.

(1) Transistor to achieve low impedance driving of notch filter.
(2) 33 nF will give common mode suppression of 19 kHz.
(3) Coil: TOKO 10 PA, 700 turns, φ0.07 mm Cu; case type: P06-0114; drumcore: AN01-0021; base 5 pins type: 07-0084-02; core type CAN02-0029.

Fig. 6 Example of using a 19 kHz tuned notch filter; for other input structures see Figs 13 to 21.
Notes
1. For other input structures see Figs 13 to 21; shown here is with RC-filter (Fig. 15).
2. The micropoco capacitor has a temperature coefficient of $125 \times 10^{-6} \pm 60 \times 10^{-6}$ K$^{-1}$.
3. In simplified circuits a fixed resistor (e.g. 620 k$\Omega$) can be used for a guaranteed switching level of $\leq 16$ mV.
4. Either the LED circuit or an external stereo indicator can be used.

Fig. 7 Basic application circuit of a frequency-division multiplex (f.d.m.) stereo decoder.
Frequency multiplex PLL stereo decoder

1. Positive supply (+15 V).
2. Left output.
4. Right output.
5. Mono/stereo switch.
6. MUX input.
7. External stereo indicator.

Fig. 8 Printed-circuit board component side of an f.d.m. decoder, showing component layout. For circuit diagram see Fig. 7.

Fig. 9 Printed-circuit board showing track side.
Notes
1. For other input structures see Figs 13 to 21; shown here is with RC-filter (Fig. 15).
2. The micropoco capacitor has a temperature coefficient of $125 \times 10^{-6} \pm 60 \times 10^{-6} \, ^\circ \text{C}^{-1}$.
3. In simplified circuits a fixed resistor (e.g. 620 kΩ) can be used for a guaranteed switching level of $\leq 16 \, \text{mV}$.
4. Either the LED circuit or an external stereo indicator can be used.

Fig. 10 Basic application circuit of a time-division multiplex (t.d.m.) stereo decoder.
Frequency multiplex PLL stereo decoder

1. Positive supply (+15 V).
2. Left output.
4. Right output.
5. Mono/stereo switch.
6. MUX input.
7. External stereo indicator.

Fig. 11 Printed-circuit board component side of a t.d.m. decoder, showing component layout. For circuit diagram see Fig. 10.

Fig. 12 Printed-circuit board showing track side.
INPUT STRUCTURES (see also Figs 7 and 10)

Fig. 13 Without filtering.

Fig. 15 With RC-filter for achieving i.f. roll-off (typ. 62 kHz).

Fig. 14 Printed-circuit board component side, showing component layout of Fig. 13.

Fig. 16 Printed-circuit board component side, showing component layout of Fig. 15.

Fig. 17 With 19 kHz notch filter.

Fig. 18 Printed-circuit board component side, showing component layout of Fig. 17.
Frequency multiplex PLL stereo decoder

Fig. 19 With buffer stage (to achieve low impedance driving of notch filter; see Fig. 6) and 19 kHz notch filter.

Fig. 20 Printed-circuit board component side, showing component layout of Fig. 19.

Fig. 21 With RC-filter, buffer stage and 19 kHz notch filter.

Fig. 22 Printed-circuit board component side, showing component layout of Fig. 21.
Fig. 23 Channel separation as a function of frequency.

- - - time-division multiplex system; adjusted at 1 kHz (R4 in Fig. 10)
- - - frequency-division multiplex system; adjusted at 1 and 5 kHz (R4 and R10 in Fig. 7)

Conditions: $V_{G16} = 15 \text{ V}; V_{i(p-p)} = 1 \text{ V}$.

Note: RC-filter for simulating the i.f. roll-off (typ. 62 kHz).

---

**Figure 23** Channel separation as a function of frequency.
Fig. 24 Channel separation at $f = 1$ kHz as a function of resistance between pins 5 and 10 for a t.d.m. system. For test circuit see Fig. 23.

Fig. 25 Distortion as a function of audio frequency; $R = 1$; $L = 0$; $V_{8-16} = 15$ V; $V_{2-16} = V_{3-16} = 1$ V (r.m.s.). --- t.d.m. system; ----- f.d.m. system.
(1) Audible interferences (BFC-distortion) and desired 12 kHz signal.

(2) \[ dB_{BFC} = 20 \log \frac{V_{BFC}}{V \text{ (at 12 kHz)}} \]

Fig. 26 Spectrum at the decoder outputs; A for t.d.m.; B for f.d.m. \( V_{i(p-p)} = 1 \) V; \( R = 1; L = 0 \); \( m = 90\% \) for \( f = 12 \) kHz; \( m = 10\% \) for \( f = 19 \) kHz.
Fig. 27 Typical values of the capture range of the oscillator as a function of the pilot threshold voltage at MUX-input.

\( V_{8-16} = 15 \text{ V}; \Delta f_{\text{VCO}} = f_{\text{VCO}} - 76 \text{ kHz} \) where: \( f_{\text{VCO}} \) = modulated, free-running oscillator frequency; \( \Delta f_{\text{VCO}} \) = maximum \( f_{\text{VCO}} \) deviation which will be captured if pilot signal (pin 11) is switched-on.
Fig. 28 Pilot input voltage switching level (stereo ‘on’) as a function of resistance between pins 8 and 13.
Fig. 29 Channel separation as a function of $V_{6-16}$ at 1 kHz (smooth take-over).
MOTOR REGULATOR WITH AUTOMATIC TAPE-END INDICATOR

The TDA1006A is for use in car radio tape-decks

The circuit incorporates the following functions:
- capstan motor speed control;
- an electronic motor stop in conjunction with hysteresis slip-coupling or commutator pulses;
- an automatic switch from playback to radio at tape-end;
- playback indication with lamp;
- tape-end indication with intermittent light.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Supply voltage range</th>
<th>$V_p$</th>
<th>6 to 22 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>$T_{amb}$</td>
<td>typ. 25°C</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>$V_p$</td>
<td>typ. 14 V</td>
</tr>
</tbody>
</table>

Motor regulator

Current consumption ($R_{3,4} = 7.5 \text{k} \Omega$)
- radio: $I_4$ typ. 9 mA
- playback ($I_1 = 0$): $I_4$ typ. 12 mA
- playback tape-end: $I_4$ typ. 52 mA
- tape-end: $I_4$ typ. 32 mA

Operating motor current
- $I_3$ typ. 200 mA

Supply voltage rejection
- $\Delta V_{3-2}/\Delta V_{4-2}$ typ. 1 mV/V

Automatic stop circuit

Input current
- $I_{14}$ > 25 μA

Input voltage at commutator
- $V_{11-2}$ -6 to +6 V

PACKAGE OUTLINE

16-lead DIL; plastic power (SOT-38N2).

November 1979
Fig. 1a Circuit diagram (continued in Fig. 1b).
Fig. 1b Circuit diagram (continued from Fig. 1a).

Motor regulator with automatic tape-end indicator


R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36

Components and connections labeled with terminals 1 to 10, 16, 6, 7, 2, 4, 5, 3.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage
- pin 4
  - $V_{4-2}$ max. 24 V
- pin 9
  - $V_{9-2}$ max. 24 V
  - $V_{4-2} \geq V_{9-2}$

Output current
- pin 1 (d.c. value)
  - $I_1$ max. 40 mA
  - $I_{1M}$ max. 100 mA
- pin 3 (d.c. value)
  - $I_3$ max. 250 mA
  - $I_{3SM}$ max. 600 mA
- pin 8 (d.c. value)
  - $I_8$ max. 45 mA
  - $I_{8M}$ max. 80 mA
- pin 10 (d.c. value)
  - $I_{10}$ max. 20 mA
  - $I_{10M}$ max. 20 mA

Storage temperature
- $T_{stg}$ -65 to +150 °C

Operating ambient temperature
- $T_{amb}$ -25 to +150 °C

Fig. 2 Power derating curve; derating factor: 14.3 mW/°C.
CHARACTERISTICS

$V_p = 14 \, \text{V}$; $T_{\text{amb}} = 25 \, ^{\circ} \text{C}$ unless otherwise specified (see test circuit Fig. 3).

Supply voltage range (pins 4 and 9)

<table>
<thead>
<tr>
<th>$V_p$</th>
<th>6 to 22 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{4-2}$</td>
<td>$\geq V_{9-2}$</td>
</tr>
</tbody>
</table>

Motor regulator

Current consumption ($R_{3.4} = 7.5 \, \text{k}\Omega$)

- radio $I_4$ typ. 9 mA
- playback ($I_1 = 0$) $I_4$ typ. 12 mA
- playback $I_4$ typ. 9.5 to 17 mA
- tape-end $I_4$ typ. 52 mA

Input offset voltage at $I_3 = 3 \, \text{mA}$ $|V_{7-6}|$ typ. 2 mV

Input voltage range (common mode) $V_{6-2}$; $V_{7-2}$ 2.4 to $V_p - 0.2 \, \text{V}$

Input bias current $I_6$; $I_7$ typ. 80 nA

Input sensitivity (for $I_{3SM} = 100 \, \text{mA}$) $\Delta V_{7-6}$ $< 13 \, \text{mV}$

Operating voltage of TR38 at $I_{3SM} = 600 \, \text{mA}$ $V_{3-2}$ typ. 900 mV

Supply voltage rejection $\Delta V_{3-2}/\Delta V_{4-2}$ typ. 1 mV/V

Operating motor current $I_3$ typ. 200 mA

Automatic motor ‘stop’ circuit

Input current $I_{14}$ $> 25 \, \mu\text{A}$

Voltage when TR20 is not conducting (pin 16; peak-to-peak value) $V_{16-2(p-p)}$ 0.9 to 1.4 V

Voltage when TR20 is conducting (pin 16) $V_{16-2}$ $< 250 \, \text{mV}$

Input voltage at commutator (pin 11) $V_{11-2}$ $-6$ to $+6 \, \text{V}$

Stop signal amplifier

Differential input voltage $V_{12-13}$ typ. 3.5 mV

Voltage without input signal $V_{11-2}$ 85 to 170 mV

Input voltage (r.m.s. value) $V_{12-13(rms)}$ $> 10 \, \text{mV}$
### CHARACTERISTICS (continued)

#### Radio and preamplifier supply

Radio supply current (d.c.)
- $I_8 \leq 45 \text{ mA}$
- $V_{8-9} \leq 1.35 \text{ V}$

Saturation voltage at $-I_{8M} = 80 \text{ mA}$
- $V_{10-9} \leq 1.2 \text{ V}$

Preamplifier supply current (d.c.)
- $I_{10} \leq 20 \text{ mA}$

Saturation voltage at $-I_{10} = 20 \text{ mA}$
- $V_{4-1} \leq 1.85 \text{ V}$

#### Lamp driver

Output current (d.c.)
- $I_1 \leq 40 \text{ mA}$

Saturation voltage at $-I_{1M} = 100 \text{ mA}$
- $V_{15-2} \leq 0.75 \text{ to } 1.2 \text{ V}$

D.C. voltage level
- $V_{4-1} \leq 1.85 \text{ V}$
Fig. 3 Test circuit.
APPLICATION INFORMATION

(1) Radio: lamp off
    Playback: lamp on
    Tape-end: intermittent light

(2) D.C. motor
    E3000 = 7,2 to 8,3 V
    \( R_m = 27 \Omega \)

Fig. 4 Application circuit diagram.
The TDA1008 is a monolithic bipolar integrated circuit based on I²L (integrated injection logic), with frequency dividers directly coupled to the gating system.

The outputs of the dividers, together with the input signal, are applied internally to nine gate inputs. By activating a key input, five successive signals out of the nine are selected and transferred to the outputs. Five key inputs are available, each selecting a different combination; e.g. 16', 8', 4', 2' and 1'. The output signal level is proportional to the voltage applied to the key inputs. By connecting RC combinations to the key inputs, sustain of the output signal is easily obtained. The duration of the sustained signal can be adjusted by connecting a variable voltage to the appropriate terminal (pin 7).

In electronic organs using a top octave synthesizer directly coupled to twelve TDA1008 circuits, only one busbar per manual is needed to obtain five octave-related tones per key.

The tone output signals are symmetrical around a fixed d.c. voltage, thereby avoiding key clicks.

### QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 1)</td>
<td>V_{P1-16}</td>
<td>typ. 12 V</td>
</tr>
<tr>
<td>Supply voltage divider (pin 13)</td>
<td>V_{P13-16}</td>
<td>typ. 6 V</td>
</tr>
<tr>
<td>Supply voltage tone outputs (pins 2, 3, 4, 5, 6)</td>
<td>V_{Ptone}</td>
<td>typ. 9 V</td>
</tr>
<tr>
<td>Input voltage; HIGH</td>
<td>V_{IH}</td>
<td>&gt; 1,5 V</td>
</tr>
<tr>
<td>Input voltage; LOW</td>
<td>V_{IL}</td>
<td>&lt; 0,4 V</td>
</tr>
<tr>
<td>Required key voltage (pins 8, 9, 10, 11, 12)</td>
<td>V_{K1 to VK5}</td>
<td>typ. V_{P13-16}</td>
</tr>
<tr>
<td>Key input impedance (see note)</td>
<td>Z_{K1 to ZK5}</td>
<td>&gt; 8 MΩ</td>
</tr>
<tr>
<td>Supply current (pin 1) all keys activated</td>
<td>I_{1}</td>
<td>typ. 13 mA</td>
</tr>
<tr>
<td>Supply current (pin 1) no activated keys</td>
<td>I_{1}</td>
<td>typ. 0 mA</td>
</tr>
<tr>
<td>Supply current (pin 13)</td>
<td>I_{13}</td>
<td>typ. 11 mA</td>
</tr>
<tr>
<td>Sustaining voltage range (pin 7)</td>
<td>V_{7sust}</td>
<td>0 to 2 V</td>
</tr>
<tr>
<td>Input frequency</td>
<td>f_{i}</td>
<td>&lt; 100 kHz</td>
</tr>
<tr>
<td>Tone output signal voltage with one key activated</td>
<td>V_{Q(p-p)}</td>
<td>typ. 600 mV</td>
</tr>
<tr>
<td>Operating ambient temperature range</td>
<td>T_{amb}</td>
<td>0 to + 70 °C</td>
</tr>
</tbody>
</table>

Note
Key input impedance is determined by the voltage applied to pin 7. This impedance is stated at zero volt on pin 7.

### PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
Fig. 1 Circuit diagram.
Gating/frequency divider for electronic musical instruments

Fig. 2 Block diagram.

Fig. 3 Logic diagram of the $l^2 L$ 2-divider.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltages
- pin 1
- pin 13
- pin 14

Input voltages
- K inputs (pins 8, 9, 10, 11, 12)
- f_i input (pin 15)
- S input (pin 7)

Output voltages
- O_1 to O_5 (pins 2, 3, 4, 5, 6)

Operating ambient temperature
Storage temperature
Total power dissipation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP_1-16</td>
<td>max. 13 V</td>
</tr>
<tr>
<td>VP_13-16</td>
<td>max. 6,5 V</td>
</tr>
<tr>
<td>VP_14-16</td>
<td>max. 6,5 V</td>
</tr>
<tr>
<td>VK_1 to VK_5</td>
<td>max. VP_13-16</td>
</tr>
<tr>
<td>V_fi</td>
<td>max. 15 V</td>
</tr>
<tr>
<td>V_S</td>
<td>max. 2,5 V</td>
</tr>
<tr>
<td>VO_1 to VO_5</td>
<td>max. 12 V</td>
</tr>
</tbody>
</table>

See derating curve Fig. 4

Fig. 4 Power derating curve.
CHARACTERISTICS

All voltages with reference to pin 16; all currents positive into the IC.

Supply voltage range

- \( \text{VP}_{13-16} = 5 \text{ to } 6.5 \text{ V} \)
- \( \text{VP}_{1-16} = 10 \text{ to } 13 \text{ V} \)
- \( \text{VP}_{9-16} \) see note 1

Characteristics at \( T_{\text{amb}} = 25^\circ \text{C}; \text{VP}_{13-16} = 6 \text{ V}; \text{VP}_{1-16} = 12 \text{ V}; \) see Fig. 6.

Supply current (pin 13)
- \( \text{K-inputs at 6 V} \)
- \( I_{13} \) typ. 11 mA

Supply current (pin 1)
- \( \text{K-inputs at 6 V} \)
- \( I_{1} \) typ. 12.7 mA

Input current at \( f_1 \) (pin 15)
- \( \text{V}_{f_1} = 6 \text{ V} \)
- \( I_{15} \) typ. 150 \( \mu \text{A} \)

Input current \( \text{K-inputs} \) (pins 8, 9, 10, 11, 12)
- \( \text{V}_{K} = 6 \text{ V} \)
- \( I_{K} \) typ. 150 nA

S-input connected to 0 V
- \( I_{K} \) typ. < 750 nA

S-input connected to 2.0 V
- \( I_{K} \) typ. 80 to 150 \( \mu \text{A} \)

Input current S-input (pin 7)
- \( \text{no key inputs activated} \)
- \( I_{S} \) typ. 500 \( \mu \text{A} \)

- \( \text{all key inputs activated} \)
- \( I_{S} \) typ. 10 \( \mu \text{A} \)

Output current Q-output (pins 2, 3, 4, 5, 6)
- \( \text{V}_{Q} = \text{LOW} \) (note 2)
- \( +I_{Q} \) typ. 230 to 450 \( \mu \text{A} \)
- \( -I_{Q} \) typ. 230 to 450 \( \mu \text{A} \)

Output current pin 14
- \( I_{14} \) typ. < 20 \( \mu \text{A} \)

Peak output voltage (pins 2, 3, 4, 5, 6)
- by activating one K-input only (Fig. 5)
- \( \text{V}_{QM} \) typ. 300 mV

Input frequency at pin 15
- \( \text{V}_{15\text{HIGH}} > 1.5 \text{ V}; \text{V}_{15\text{LOW}} < 0.4 \text{ V} \)
- \( f_1 \) typ. < 100 kHz

Notes
1. This voltage has to be in the middle of \( \text{VP}_{1-16} \) and \( \text{VP}_{13-16}. \)
2. To be multiplied by the number of activated K-inputs.
TRUTH TABLE

<table>
<thead>
<tr>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K4</th>
<th>K5</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_1</td>
<td>f_2/8</td>
<td>f_4/8</td>
<td>f_16/32</td>
<td>f_1/32</td>
</tr>
<tr>
<td>f_2</td>
<td>f_4/8</td>
<td>f_16/32</td>
<td>f_32/64</td>
<td>f_1/64</td>
</tr>
<tr>
<td>f_4</td>
<td>f_8/16</td>
<td>f_32/64</td>
<td>f_64/128</td>
<td>f_1/256</td>
</tr>
<tr>
<td>f_8</td>
<td>f_16/64</td>
<td>f_64/128</td>
<td>f_128/256</td>
<td></td>
</tr>
</tbody>
</table>

Activating 'one' key input only gives the notified output frequency.

By activating more key inputs at a time, the output amplitude will be the sum signal of the notified frequencies.

APPLICATION INFORMATION

(1) If required contact-current limiting resistors.
(2) a. Factory test point; ungated output from the final divider.
    b. Can be used for obtaining very low frequencies (pedals). It should be connected to pin 13 (+6 V) via a resistor of minimum 300 kΩ to deliver the current I_{14}.

Fig. 6 Basic application diagram.
6 W AUDIO POWER AMPLIFIER

The TDA1010 is a monolithic integrated class-B audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is primarily developed as a 6 W car radio amplifier for use with 4 Ω and 2 Ω load impedances. The wide supply voltage range and the flexibility of the IC make it an attractive proposition for record players and tape recorders with output powers up to 8 W.

Special features are:
- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- low-cost external components
- good ripple rejection
- thermal protection

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>6 to 24 V</td>
</tr>
<tr>
<td>Repetitive peak output current</td>
<td>3 A</td>
</tr>
<tr>
<td>Output power at pin 2; ( \eta \text{tot} = 10% )</td>
<td></td>
</tr>
<tr>
<td>( V_P = 14,4 \text{ V} ); ( R_L = 2 \Omega )</td>
<td>( P_O ) typ. 6,4 W</td>
</tr>
<tr>
<td>( V_P = 14,4 \text{ V} ); ( R_L = 4 \Omega )</td>
<td>( P_O ) typ. 6,2 W</td>
</tr>
<tr>
<td>( V_P = 14,4 \text{ V} ); ( R_L = 8 \Omega )</td>
<td>( P_O ) typ. 3,4 W</td>
</tr>
<tr>
<td>( V_P = 14,4 \text{ V} ); ( R_L = 2 \Omega ); with additional bootstrap resistor of 220 Ω between pins 3 and 4</td>
<td>( P_O ) typ. 9 W</td>
</tr>
<tr>
<td>Total harmonic distortion at ( P_O = 1 \text{ W} ); ( R_L = 4 \Omega )</td>
<td>( \eta \text{tot} ) typ. 0,2 %</td>
</tr>
<tr>
<td>Input impedance</td>
<td>(</td>
</tr>
<tr>
<td>preamplifier (pin 8)</td>
<td>(</td>
</tr>
<tr>
<td>power amplifier (pin 6)</td>
<td>( I_{tot} ) typ. 31 mA</td>
</tr>
<tr>
<td>Total quiescent current at ( V_P = 14,4 \text{ V} )</td>
<td>( V_i ) typ. 10 mV</td>
</tr>
<tr>
<td>Sensitivity for ( P_O = 5,8 \text{ W} ); ( R_L = 4 \Omega )</td>
<td>( T_{\text{amb}} ) -25 to +150 °C</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>( T_{\text{stg}} ) -55 to +150 °C</td>
</tr>
</tbody>
</table>

**PACKAGE OUTLINE**

9-lead SIL; plastic (SOT-110A).
Fig. 1 Circuit diagram.
### RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Spec.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>( V_p )</td>
<td>max.</td>
<td>24 V</td>
</tr>
<tr>
<td>Peak output current</td>
<td>( I_{OM} )</td>
<td>max.</td>
<td>5 A</td>
</tr>
<tr>
<td>Repetitive peak output current</td>
<td>( I_{ORM} )</td>
<td>max.</td>
<td>3 A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td></td>
<td>-55 to +150 °C</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>( T_{amb} )</td>
<td></td>
<td>-25 to +150 °C</td>
</tr>
<tr>
<td>A.C. short-circuit duration of load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>during sine-wave drive; without heatsink at ( V_p = 14.4 ) V</td>
<td>( t_{sc} )</td>
<td>max.</td>
<td>100 hours</td>
</tr>
</tbody>
</table>

### HEATSINK DESIGN
Assume \( V_p = 14.4 \) V; \( R_L = 2 \) \( \Omega \); \( T_{amb} = 60 \) °C maximum; thermal shut-down starts at \( T_j = 150 \) °C.

The maximum sine-wave dissipation in a 2 \( \Omega \) load is about 5.2 W. The maximum dissipation for music drive will be about 75% of the worst-case sine-wave dissipation, so this will be 3.9 W. Consequently, the total resistance from junction to ambient

\[
R_{th \ j-a} = R_{th \ j-tab} + R_{th \ tab-h} + R_{th \ h-a} = \frac{150 - 60}{3.9} = 23 \text{ °C/W.}
\]

Since \( R_{th \ j-tab} = 12 \text{ °C/W} \) and \( R_{th \ tab-h} = 1 \text{ °C/W} \),

\[
R_{th \ h-a} = 23 - (12 + 1) = 10 \text{ °C/W.}
\]
### D.C. CHARACTERISTICS

- **Supply voltage range**
  
### A.C. CHARACTERISTICS

- **Tamb = 25 °C; VP = 14,4 V; RL = 4 Ω; f = 1 kHz unless otherwise specified; see also Fig. 3.**

#### A.F. output power (see Fig. 4) at d tot = 10%; measured at pin 2; with bootstrap

| VP = 14,4 V; RL = 2 Ω (note 1) | PO | typ. | 6,4 W |
| VP = 14,4 V; RL = 4 Ω (note 1 and 2) | PO | typ. | 6,2 W |
| VP = 14,4 V; RL = 8 Ω (note 1) | PO | typ. | 3,4 W |
| VP = 14,4 V; RL = 4 Ω; without bootstrap | PO | typ. | 5,7 W |
| VP = 14,4 V; RL = 2 Ω; with additional bootstrap resistor of 220 Ω between pins 3 and 4 | PO | typ. | 9 W |

#### Voltage gain

- **preamplifier (note 3)**
  
#### Power amplifier

- **total amplifier**

#### Total harmonic distortion at PO = 1 W

- **Efficiency at PO = 6 W**

#### Frequency response (–3 dB)

- **Input impedance**

#### Output impedance of preamplifier; pin 7 (note 5)

#### Output voltage preamplifier (r.m.s. value)

- **d tot < 1% (pin 7) (note 3)**

#### Noise output voltage (r.m.s. value; note 6)

- **RS = 0 Ω**

- **RS = 8,2 kΩ**

#### Ripple rejection at f = 1 kHz to 10 kHz (note 7)

- **at f = 100 Hz; C2 = 1 μF**

#### Sensitivity for PO = 5,8 W

#### Bootstrap current at onset of clipping; pin 4 (r.m.s. value)
**Notes**

1. Measured with an ideal coupling capacitor to the speaker load.
2. Up to $P_o \leq 3\, \text{W}$: $\eta_{\text{tot}} \leq 1\%$.
3. Measured with a load impedance of 20 kΩ.
5. Output impedance of preamplifier ($|Z_o|$) is correlated (within 10%) with the input impedance ($|Z_i|$) of the power amplifier.
6. Unweighted r.m.s. noise voltage measured at a bandwidth of 60 Hz to 15 kHz (12 dB/octave).
7. Ripple rejection measured with a source impedance between 0 and 2 kΩ (maximum ripple amplitude: 2 V).

---

**Fig. 3 Test circuit.**
Fig. 4 Output power of the circuit of Fig. 3 as a function of the supply voltage with the load impedance as a parameter; typical values. Solid lines indicate the power across the load, dashed lines that available at pin 2 of the TDA1010. $R_L = 2 \Omega \,(1)$ has been measured with an additional 220 $\Omega$ bootstrap resistor between pins 3 and 4. Measurements were made at $f = 1$ kHz, $d_{tot} = 10\%$, $T_{amb} = 25$ °C.

Fig. 5 See next page.
Total harmonic distortion in the circuit of Fig. 3 as a function of the output power with the load impedance as a parameter; typical values. Solid lines indicate the power across the load, dashed lines that available at pin 2 of the TDA1010. $R_L = 2 \Omega \,(1)$ has been measured with an additional 220 $\Omega$ bootstrap resistor between pins 3 and 4. Measurements were made at $f = 1$ kHz, $V_p = 14,4$ V.
Fig. 5 For caption see page 6.

Fig. 6 Frequency characteristics of the circuit of Fig. 3 for three values of load impedance; typical values. $P_o$ relative to 0 dB = 1 W; $V_p = 14.4$ V.
Fig. 7 Total power dissipation (solid lines) and the efficiency (dashed lines) of the circuit of Fig. 3 as a function of the output power with the load impedance as a parameter (for $R_L = 2\,\Omega$ an external bootstrap resistor of 220 $\Omega$ has been used); typical values. $V_p = 14.4\,V; f = 1\,kHz$. 
Fig. 8 Thermal resistance from heatsink to ambient of a 1,5 mm thick bright aluminium heatsink as a function of the single-sided area of the heatsink with the total power dissipation as a parameter.
APPLICATION INFORMATION

Fig. 9 Complete mono audio amplifier of a car radio.
6 W audio power amplifier

Fig. 10 Track side of printed-circuit board used for the circuit of Fig. 9; p.c. board dimensions 92 mm x 52 mm.

Fig. 11 Component side of printed-circuit board showing component layout used for the circuit of Fig. 9.
Fig. 12 Complete stereo car radio amplifier.
Fig. 13 Track side of printed-circuit board used for the circuit of Fig. 12; p.c. board dimensions 83 mm x 65 mm.

Fig. 14 Component side of printed-circuit board showing component layout used for the circuit of Fig. 12. Balance control is not on the p.c. board.
Fig. 15  Channel separation of the circuit of Fig. 12 as a function of the frequency.

Fig. 16  Power supply of circuit of Fig. 17.
Fig. 17 Complete mains-fed ceramic stereo pick-up amplifier; for power supply see Fig. 16.
Fig. 18  Track side of printed-circuit board used for the circuit of Fig. 17 (Fig. 16 partly); p.c. board dimensions 169 mm x 118 mm.
Fig. 19 Component side of printed-circuit board showing component layout used for the circuit of Fig. 17 (Fig. 16 partly).
Fig. 20 Channel separation of the circuit of Fig. 17 as a function of frequency.
The TDA1011 is a monolithic integrated audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is especially designed for portable radio and recorder applications and delivers up to 4 W in a 4 Ω load impedance. The device can deliver up to 6 W into 4 Ω at 16 V loaded supply in mains-fed applications. The maximum permissible supply voltage of 24 V makes this circuit very suitable for d.c. and a.c. apparatus, while the very low applicable supply voltage of 3.6 V permits 6 V applications. Special features are:

- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- thermal protection
- high input impedance
- low current drain
- limited noise behaviour at radio frequencies

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Supply voltage range</th>
<th>V p</th>
<th>3.6 to 24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak output current</td>
<td>I OM</td>
<td>max. 3 A</td>
</tr>
<tr>
<td>Output power at $d_{tot} = 10%$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_p = 16 \text{ V}; R_L = 4 \Omega$</td>
<td>$P_o$</td>
<td>typ. 6.5 W</td>
</tr>
<tr>
<td>$V_p = 12 \text{ V}; R_L = 4 \Omega$</td>
<td>$P_o$</td>
<td>typ. 4.2 W</td>
</tr>
<tr>
<td>$V_p = 9 \text{ V}; R_L = 4 \Omega$</td>
<td>$P_o$</td>
<td>typ. 2.3 W</td>
</tr>
<tr>
<td>$V_p = 6 \text{ V}; R_L = 4 \Omega$</td>
<td>$P_o$</td>
<td>typ. 1.0 W</td>
</tr>
<tr>
<td>Total harmonic distortion at $P_o = 1 \text{ W}; R_L = 4 \Omega$</td>
<td>$d_{tot}$</td>
<td>typ. 0.2 %</td>
</tr>
</tbody>
</table>

Input impedance

- preamplifier (pin 8) $|Z_i| > 100 \text{ kΩ}$
- power amplifier (pin 6) $|Z_i| \text{ typ. } 20 \text{ kΩ}$

Total quiescent current $I_{tot} \text{ typ. } 14 \text{ mA}$

Operating ambient temperature $T_{amb} \text{ -25 to } +150 \text{ °C}$

Storage temperature $T_{stg} \text{ -55 to } +150 \text{ °C}$

PACKAGE OUTLINE

9-lead SIL; plastic (SOT-110A).
Fig. 1 Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage
Peak output current
Total power dissipation
Storage temperature
Operating ambient temperature
A.C. short-circuit duration of load during sine-wave drive; \( V_p = 12 \text{ V} \)

Supply voltage
Peak output current
Total power dissipation
Storage temperature
Operating ambient temperature
A.C. short-circuit duration of load during sine-wave drive; \( V_p = 12 \text{ V} \)

\[ \begin{align*}
V_p \text{ max.} & = 24 \text{ V} \\
I_{OM} \text{ max.} & = 3 \text{ A} \\
\text{see derating curve Fig. 2} & \\
T_{stg} & = -55 \text{ to } +150 \text{ °C} \\
T_{amb} & = -25 \text{ to } +150 \text{ °C} \\
t_{sc} \text{ max.} & = 100 \text{ hours}
\end{align*} \]

Fig. 2 Power derating curve.
### D.C. CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>$V_p \text{ 3,6 to 24 V}$</td>
</tr>
<tr>
<td>Repetitive peak output current</td>
<td>$I_{ORM} &lt; 2 \text{ A}$</td>
</tr>
<tr>
<td>Total quiescent current at $V_p = 12 \text{ V}$</td>
<td>$I_{tot} \text{ typ. 14 mA}$</td>
</tr>
</tbody>
</table>

### A.C. CHARACTERISTICS

$T_{amb} = 25^\circ \text{C}$; $V_p = 12 \text{ V}$; $R_L = 4 \Omega$; $f = 1 \text{ kHz}$ unless otherwise specified; see also Fig. 3.

**A.F. output power at $d_{tot} = 10\%$ (note 1)**

<table>
<thead>
<tr>
<th>$V_p$</th>
<th>$P_o$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 V</td>
<td>6,5 W</td>
</tr>
<tr>
<td>12 V</td>
<td>&gt; 3,6 W</td>
</tr>
<tr>
<td>9 V</td>
<td>&gt; 4,2 W</td>
</tr>
<tr>
<td>6 V</td>
<td>&gt; 2,3 W</td>
</tr>
<tr>
<td></td>
<td>&gt; 1,0 W</td>
</tr>
</tbody>
</table>

**without bootstrap:**

<table>
<thead>
<tr>
<th>$V_p$</th>
<th>$P_o$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V</td>
<td>3,0 W</td>
</tr>
</tbody>
</table>

**Voltage gain:**

- **preamplifier (note 2)**
  - $G_{V1}$ typ. 23 dB
  - $G_{V2}$ typ. 29 dB
  - $G_{V tot}$ typ. 52 dB

- **power amplifier**
  - $G_{V1}$ typ. 21 to 25 dB
  - $G_{V2}$ typ. 27 to 31 dB
  - $G_{V tot}$ typ. 50 to 54 dB

**Total harmonic distortion at $P_o = 1,5 \text{ W}$**

<table>
<thead>
<tr>
<th>$d_{tot}$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 %</td>
</tr>
</tbody>
</table>

**Frequency response; $-3 \text{ dB}$ (note 3)**

- $B = 60 \text{ Hz to 15 kHz}$

**Input impedance:**

- **preamplifier (note 4)**
  - $|Z_{i1}|$ typ. $100 \text{ k}\Omega$
  - $|Z_{i2}|$ typ. $200 \text{ k}\Omega$

- **power amplifier**
  - $|Z_{o1}|$ typ. $1 \text{ k}\Omega$

**Output impedance preamplifier**

<table>
<thead>
<tr>
<th>$V_o(rms)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0,7 V</td>
</tr>
</tbody>
</table>

**Noise output voltage (r.m.s. value; note 5)**

- $R_S = 0 \Omega$
- $R_S = 10 \text{ k}\Omega$

<table>
<thead>
<tr>
<th>$V_{n(rms)}$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0,2 mV</td>
</tr>
<tr>
<td>&lt; 0,6 mV</td>
</tr>
<tr>
<td>&lt; 1,4 mV</td>
</tr>
</tbody>
</table>

**Noise output voltage at $f = 500 \text{ kHz}$ (r.m.s. value)**

- $B = 5 \text{ kHz}$; $R_S = 0 \Omega$

<table>
<thead>
<tr>
<th>$V_{n(rms)}$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 8 \text{ mV}</td>
</tr>
</tbody>
</table>

**Ripple rejection (note 6)**

- $f = 1 \text{ to 10 kHz}$
- $f = 100 \text{ Hz}$; $C2 = 1 \mu\text{F}$

<table>
<thead>
<tr>
<th>$RR$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 42 dB</td>
</tr>
<tr>
<td>&gt; 35 dB</td>
</tr>
</tbody>
</table>

**Bootstrap current at onset of clipping; pin 4 (r.m.s. value)**

<table>
<thead>
<tr>
<th>$I_{4(rms)}$ typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 35 mA</td>
</tr>
</tbody>
</table>
Notes
1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 20 kΩ.
3. Measured at $P_o = 1$ W; the frequency response is mainly determined by C1 and C3 for the low frequencies and by C4 for the high frequencies.
5. Unweighted r.m.s. noise voltage measured at a bandwidth of 60 Hz to 15 kHz (12 dB/octave).
6. Ripple rejection measured with a source impedance between 0 and 2 kΩ (maximum ripple amplitude: 2 V).

Fig. 3 Test circuit.
APPLICATION INFORMATION

Fig. 4 Circuit diagram of a 4 W amplifier.

Fig. 5 Total quiescent current as a function of supply voltage.
Fig. 6 Track side of printed-circuit board used for the circuit of Fig. 4; p.c. board dimensions 62 mm x 48 mm.

Fig. 7 Component side of printed-circuit board showing component layout used for the circuit of Fig. 4.
Fig. 8  Total harmonic distortion as a function of output power across $R_L$; —— with bootstrap; —— without bootstrap; $f = 1$ kHz; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).

Fig. 9  Output power across $R_L$ as a function of supply voltage with bootstrap; $d_{\text{tot}} = 10\%$; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).
Fig. 10 Voltage gain as a function of frequency; $P_o$ relative to 0 dB = 1 W; $V_p$ = 12 V; $R_L = 4 \Omega$.

Fig. 11 Total harmonic distortion as a function of frequency; $P_o = 1$ W; $V_p = 12$ V; $R_L = 4 \Omega$. 
Fig. 12 Ripple rejection as a function of R2 (see Fig. 4); Rs = 0; typical values.

Fig. 13 Noise output voltage as a function of R2 (see Fig. 4); measured according to A-curve; capacitor C5 is adapted for obtaining a constant bandwidth.
Fig. 14 Noise output voltage as a function of frequency; curve a: total amplifier; curve b: power amplifier; B = 5 kHz; R_S = 0; typical values.

Fig. 15 Voltage gain as a function of R2 (see Fig. 4).
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

2 TO 6 W AUDIO POWER AMPLIFIER

The TDA1011A is a monolithic integrated audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is especially designed for portable radio and recorder applications and delivers up to 4 W in a 4 Ω load impedance. The device can deliver up to 6 W into 4 Ω at 16 V loaded supply in mains-fed applications. The maximum permissible supply voltage of 24 V makes this circuit very suitable for d.c. and a.c. apparatus, while the low applicable supply voltage of 5,4 V permits 9 V applications. The power amplifier has an inverted input/output which makes the circuit optimal for applications with active tone control and spatial stereo. Special features are:

- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- thermal protection
- high input impedance
- low current drain
- limited noise behaviour at radio frequencies

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Supply voltage range</th>
<th>V_p</th>
<th>5.4 to 24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak output current</td>
<td>I_Om</td>
<td>max. 3 A</td>
</tr>
<tr>
<td>Output power at d_tot = 10%</td>
<td>P_o</td>
<td>typ. 6.5 W</td>
</tr>
<tr>
<td>V_p = 16 V; R_L = 4 Ω</td>
<td>P_o</td>
<td>typ. 4.2 W</td>
</tr>
<tr>
<td>V_p = 12 V; R_L = 4 Ω</td>
<td>P_o</td>
<td>typ. 2.3 W</td>
</tr>
<tr>
<td>V_p = 9 V; R_L = 4 Ω</td>
<td>P_o</td>
<td>typ. 1.0 W</td>
</tr>
<tr>
<td>V_p = 6 V; R_L = 4 Ω</td>
<td>d_tot</td>
<td>typ. 0.2 %</td>
</tr>
<tr>
<td>Total harmonic distortion at P_o = 1 W; R_L = 4 Ω</td>
<td>Z_i</td>
<td>&gt; 100 kΩ</td>
</tr>
<tr>
<td>Input impedance</td>
<td>I_tot</td>
<td>typ. 14 mA</td>
</tr>
<tr>
<td>preamplifier (pin 8)</td>
<td>T_amb</td>
<td>-25 to +150 °C</td>
</tr>
<tr>
<td>Total quiescent current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>T_stg</td>
<td>-55 to +150 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE
9-lead SIL; plastic (SOT-110A).

January 1980
Fig. 1 Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage
Peak output current
Total power dissipation
Storage temperature
Operating ambient temperature
A.C. short-circuit duration of load
during sine-wave drive; \( V_p = 12 \text{ V} \)

\[
\begin{align*}
V_p & \quad \text{max.} \quad 24 \text{ V} \\
I_{\text{OM}} & \quad \text{max.} \quad 3 \text{ A} \\
T_{\text{stg}} & \quad -55 \text{ to } +150 \text{ °C} \\
T_{\text{amb}} & \quad -25 \text{ to } +150 \text{ °C} \\
t_{\text{sc}} & \quad \text{max.} \quad 100 \text{ hours}
\end{align*}
\]

Fig. 2 Power derating curve.
TDA1011A

D.C. CHARACTERISTICS

Supply voltage range

Repetitive peak output current

Total quiescent current at \( V_p = 12 \) V

A.C. CHARACTERISTICS

\( T_{amb} = 25^\circ \text{C}; \ V_p = 12 \) V; \( R_L = 4 \) Ω; \( f = 1 \) kHz unless otherwise specified; see also Fig. 3.

A.F. output power at \( d_{tot} = 10\% \) (note 1)

with bootstrap:

\[ \begin{align*}
V_p & = 16 \text{ V}; \ R_L = 4 \text{ Ω} \\
V_p & = 12 \text{ V}; \ R_L = 4 \text{ Ω} \\
V_p & = 9 \text{ V}; \ R_L = 4 \text{ Ω} \\
V_p & = 6 \text{ V}; \ R_L = 4 \text{ Ω}
\end{align*} \]

without bootstrap:

\[ \begin{align*}
V_p & = 12 \text{ V}; \ R_L = 4 \text{ Ω}
\end{align*} \]

Voltage gain:

\[ \begin{align*}
preamplifier & (\text{note 2}) \\
power \text{ amplifier} & (\text{note 3}) \\
total \text{ amplifier} & (\text{note 3})
\end{align*} \]

Total harmonic distortion at \( P_o = 1,5 \) W

Frequency response; \(-3\) dB (note 4)

Input impedance:

\[ \begin{align*}
preamplifier & (\text{note 5})
\end{align*} \]

Output impedance preamplifier

Output voltage preamplifier (r.m.s. value)

\( d_{tot} < 1\% \) (note 2)

Noise output voltage (r.m.s. value; note 6)

\[ \begin{align*}
R_S & = 0 \text{ Ω} \\
R_S & = 10 \text{ kΩ}
\end{align*} \]

Noise output voltage at \( f = 500 \) kHz (r.m.s. value)

\[ \begin{align*}
B & = 5 \text{ kHz}; \ R_S = 0 \text{ Ω} \\
f & = 1 \text{ to 10 kHz} \\
f & = 100 \text{ Hz}; \ C_2 = 1 \mu \text{F}
\end{align*} \]

Bootstrap current at onset of clipping; pin 4 (r.m.s. value)
Notes
1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 20 kΩ.
3. Measured with R2 = 20 kΩ.
4. Measured at P₀ = 1 W; the frequency response is mainly determined by C1 and C3 for the low frequencies and by C4 for the high frequencies.
5. Independent of load impedance of preamplifier.
6. Unweighted r.m.s. noise voltage measured at a bandwidth of 60 Hz to 15 kHz (12 dB/octave).
7. Ripple rejection measured with a source impedance between 0 and 2 kΩ (maximum ripple amplitude: 2 V).

Fig. 3 Test circuit.
APPLICATION INFORMATION

Fig. 4 Circuit diagram of a 4 W amplifier.

Fig. 5 Total quiescent current as a function of supply voltage.
Fig. 6 Total harmonic distortion as a function of output power across $R_L$: —— with bootstrap; —— without bootstrap; $f = 1$ kHz; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).

Fig. 7 Output power across $R_L$ as a function of supply voltage with bootstrap; $d_{tot} = 10\%$; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).
Fig. 8 Noise output voltage as a function of frequency; curve a: total amplifier; curve b: power amplifier; $B = 5$ kHz; $R_S = 0$; typical values.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

RECORDING / PLAY-BACK AND 2 W AUDIO POWER AMPLIFIER

The TDA1012 is a monolithic integrated audio power amplifier, preamplifier and A.L.C. circuit designed for applications in radio-recorders and recorders. The wide supply voltage range makes this circuit very suitable for d.c. and a.c. apparatus. The circuit is thermal protected and contains the following functions:

- Power amplifier
- Preamplifier
- Automatic Level Control (A.L.C.) circuit
- Voltage stabilizer

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specified Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>3.6 to 18 V</td>
</tr>
<tr>
<td>Total quiescent current at ( V_p = 9 ) V</td>
<td>( I_{tot} ) 14 mA</td>
</tr>
<tr>
<td>Power amplifier Output power at ( d_{tot} = 10 % )</td>
<td>( P_0 ) 2 W</td>
</tr>
<tr>
<td>( V_p = 9 ) V; ( R_L = 4 ) ( \Omega )</td>
<td>( G_C ) 36 dB</td>
</tr>
<tr>
<td>Closed loop voltage gain</td>
<td></td>
</tr>
<tr>
<td>Preamplifier Open loop voltage gain</td>
<td>( G_O ) &gt; 66 dB</td>
</tr>
<tr>
<td>Minimum closed loop voltage gain</td>
<td>( G_{C min} ) 31 dB</td>
</tr>
<tr>
<td>Output voltage at ( d_{tot} = 1 % )</td>
<td>( V_O ) &gt; 2 V</td>
</tr>
<tr>
<td>Automatic Level Control (A.L.C.)</td>
<td></td>
</tr>
<tr>
<td>Gain variation for ( \Delta V_I = 40 ) dB</td>
<td>( \Delta G_V ) typ. 2 dB</td>
</tr>
<tr>
<td>Stabilized supply voltage</td>
<td>Output voltage</td>
</tr>
<tr>
<td></td>
<td>( V_{11-15} ) typ. 4.2 V</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic medium power (with internal heat spreader).
Fig. 1 Block diagram with external components; also used as test circuit.
RATINGS

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

Supply voltage (pin 4)
\[ V_p = V_{4-1} \text{ max.} \quad 18 \, \text{V} \]

Non-repetitive peak output current (pin 2)
\[ I_{OSM} \text{ max.} \quad 2 \, \text{A} \]

Storage temperature
\[ T_{stg} \quad -55 \text{ to } + 150 \, ^\circ\text{C} \]

Crystal temperature
\[ T_c \text{ max.} \quad 150 \, ^\circ\text{C} \]

Total power dissipation
see derating curve Fig. 2

A.C. short-circuit duration of load
during sine-wave drive; \( V_p = 12 \, \text{V} \)
\[ t_{sc} \text{ max.} \quad 100 \, \text{hours} \]

---

**Fig. 2 Power derating curve.**
CHARACTERISTICS

$V_P = 9 \text{ V}; R_L = 4 \Omega; f = 1 \text{ kHz}; T_{\text{amb}} = 25 \text{ }^\circ\text{C}$; measured in test circuit of Fig. 1; unless otherwise specified.

**Power amplifier**

- Output power at $d_{\text{tot}} = 10\%$ $P_o$ typ. $2$ W
- Closed loop voltage gain $G_c$ typ. $36$ dB
- Total harmonic distortion at $P_o = 1$ W $d_{\text{tot}}$ $< 1$ %
- Input impedance $|Z_i|$ $> 1$ M$\Omega$
- Ripple rejection at $f = 100$ Hz $RR$ $> 40$ dB
- Noise output voltage (r.m.s. value) $R_S = 0 \Omega$; $B = 60 \text{ Hz to } 15 \text{ kHz}$ $V_{n(rms)}$ typ. $150$ $\mu$V

**Preamplifier**

- Open loop voltage gain $G_o$ $> 66$ dB
- Closed loop voltage gain $G_c$ typ. $48$ dB
- Minimum closed loop voltage gain $G_{c\text{ min}}$ $31$ dB
- Output voltage at $d_{\text{tot}} = 1$ % $V_o$ $> 2$ V
- Total harmonic distortion with A.L.C.
  - $V_i = 4.8$ mV $d_{\text{tot}}$ $< 1$ %
  - $V_i = 480$ mV $d_{\text{tot}}$ $< 3$ %
- Signal-to-noise ratio related to $V_i = 1.2$ mV; $R_S = 0 \Omega$; $B = 60 \text{ Hz to } 15 \text{ kHz}$ $S/N$ typ. $60$ dB
- Input impedance $|Z_i|$ $> 100$ k$\Omega$
- Ripple rejection at $f = 100$ Hz $RR$ $> 52$ dB
- Output impedance $Z_o$ $< 50$ $\Omega$

**Automatic Level Control (A.L.C.)**

- Gain variation for $\Delta V_i = 40$ dB $\Delta G_v$ typ. $2$ dB
- Limiting time at $\Delta V_i = 40$ dB $t_l$ $< 50$ ms
- Level setting time at $\Delta V_i = 40$ dB $t_s$ $< 50$ ms
- Recovery time at $\Delta V_i = 40$ dB $t_r$ typ. $100$ s

**Voltage stabilizer**

- Output voltage $V_{11-15}$ typ. $4.2$ V
- Load current $I_{11}$ $< 1$ mA
- Ripple rejection at $f = 100$ Hz $RR$ $> 40$ dB
16-LEAD DUAL IN-LINE; PLASTIC MEDIUM POWER

Dimensions in mm

SOLDERING

1. By hand
   Apply the soldering iron below the seating plane (or not more than 2 mm above it).
   If its temperature is below 300 °C it must not be in contact for more than 10 seconds; if between 300 °C and 400 °C, for not more than 5 seconds.

2. By dip or wave
   The maximum permissible temperature of the solder is 260 °C; this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.
   The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified storage maximum. If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

3. Repairing soldered joints
   The same precautions and limits apply as in (1) above.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

4 W AUDIO POWER AMPLIFIER WITH D.C. VOLUME CONTROL

The TDA1013 is a monolithic integrated audio amplifier circuit with d.c. volume control in a 9-lead single in-line (SIL) plastic package. The wide supply voltage range makes this circuit very suitable for applications in mains-fed apparatus such as: television receivers and record players. The d.c. volume control stage has a good control characteristic with a range of more than 80 dB; control can be obtained by means of a variable d.c. voltage between 4 and 8 V. The audio amplifier has a well defined open loop gain and a fixed integrated closed loop gain. This offers an optimum in number of external components, performance and stability. The SIL package (SOT-110A) offers a simple and low-cost heatsink connection.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Supply voltage range</td>
<td>Vp</td>
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<tr>
<td>Repetitive peak output current</td>
<td>IORM max.</td>
</tr>
<tr>
<td>Total sensitivity (d.c. control at max. gain)</td>
<td>Vi typ.</td>
</tr>
<tr>
<td>for P₀ = 2,5 W</td>
<td></td>
</tr>
<tr>
<td>Audio amplifier</td>
<td></td>
</tr>
<tr>
<td>Output power at dₜot = 10 %</td>
<td>Po typ.</td>
</tr>
<tr>
<td>Vp = 18 V; Rₗ = 8 Ω</td>
<td></td>
</tr>
<tr>
<td>Total harmonic distortion at P₀ = 2,5 W; Rₗ = 8 Ω</td>
<td>dtot typ.</td>
</tr>
<tr>
<td>Sensitivity for P₀ = 2,5 W</td>
<td>Vi typ.</td>
</tr>
<tr>
<td>D.C. volume control unit</td>
<td></td>
</tr>
<tr>
<td>Gain control range</td>
<td>φ</td>
</tr>
<tr>
<td>Signal handling at dₜot &lt; 1% (d.c. control at 0 dB)</td>
<td>Vi &gt;</td>
</tr>
<tr>
<td>Sensitivity for V₀ = 125 mV at max. voltage gain</td>
<td>Vi typ.</td>
</tr>
<tr>
<td>Input impedance (pin 9)</td>
<td>Zᵢ typ.</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

9-lead SIL; plastic (SOT-110A).
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage \( V_p \) max. 35 V
Non-repetitive peak output current \( I_{OM} \) max. 3 A
Repetitive peak output current \( I_{ORM} \) max. 1.5 A
Storage temperature \( T_{stg} \) -55 to + 150 °C
Crystal temperature \( T_j \) -25 to + 150 °C
Total power dissipation see derating curve Fig. 2

HEATSINK DESIGN
Assume \( V_p = 18 \) V; \( R_L = 8 \) Ω; \( T_{amb} = 60 \) °C (max.); \( T_j = 150 \) °C (max.); for a 4 W application into an 8 Ω load, the maximum dissipation is about 2.5 W.
The thermal resistance from junction to ambient can be expressed as:

\[
R_{th \ j-a} = R_{th \ j-tab} + R_{th \ tab-h} + R_{th \ h-a} = \frac{T_j \max - T_{amb \ max}}{P_{max}} = \frac{150 - 60}{2.5} = 36 \text{ K/W.}
\]

Since \( R_{th \ j-tab} = 12 \) K/W and \( R_{th \ tab-h} = 1 \) K/W, \( R_{th \ h-a} = 36 - (12 + 1) = 23 \) K/W.
4 W audio power amplifier with d.c. volume control

Fig. 2 Power derating curve.
- infinite heatsink;
- --- without heatsink.

CHARACTERISTICS

Supply voltage
\( V_p = 18 \text{ V} \); \( R_L = 8 \Omega \); \( f = 1 \text{ kHz} \); \( T_{amb} = 25 \text{ °C} \); unless otherwise specified

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>( V_p )</td>
</tr>
<tr>
<td>Total quiescent current</td>
<td>( I_{tot} )</td>
</tr>
<tr>
<td>Ripple rejection at ( f = 100 \text{ Hz} ); ( R_S = 0 )</td>
<td>( R_R )</td>
</tr>
<tr>
<td>Signal-to-noise ratio (d.c. control at minimum gain)</td>
<td>( S/N )</td>
</tr>
<tr>
<td>Total sensitivity (d.c. control at maximum gain)</td>
<td>( V_i )</td>
</tr>
<tr>
<td>for ( P_O = 2.5 \text{ W} )</td>
<td>typ. ( 55 \text{ mV} )</td>
</tr>
</tbody>
</table>

Audio amplifier

Repetitive peak output current
\( I_{ORM} \) < \( 1.5 \text{ A} \)

Output power at \( d_{tot} = 10\% \)
\( P_O \) > \( 4 \text{ W} \)

Total harmonic distortion at \( P_O = 2.5 \text{ W} \)
\( d_{tot} \) typ. \( 0.5 \% \)

Voltage gain
\( G_v \) typ. \( 30 \text{ dB} \)

Sensitivity for \( P_O = 2.5 \text{ W} \)
\( V_i \) typ. \( 125 \text{ mV} \)

Input impedance (pin 5)
\( |Z_i| \) typ. \( 200 \text{ k} \Omega \)

Frequency response
\( f \) > \( 15 \text{ kHz} \)

Note

Measured in a bandwidth according to IEC-curve ‘A’, related to \( P_O = 2.5 \text{ W} \); \( R_S = 5 \text{ k} \Omega \).
CHARACTERISTICS (continued)

D.C. volume control unit

Gain control range (see also Fig. 3)
\( \phi \) > 80 dB

Signal handling at \( d_{\text{tot}} < 1 \% \)
(d.c. control at 0 dB)
\( V_i \) > 1,2 V

Sensitivity for \( V_o = 125 \text{ mV} \) at max. voltage gain
\( V_i \) typ. 55 mV
1 typ. 200 k\( \Omega \)
100 to 500 k\( \Omega \)

Input impedance (pin 9)
\( |Z_i| \) typ. 200 k\( \Omega \)

Output impedance (pin 7)
\( |Z_o| \) typ. 1 k\( \Omega \)

Fig. 3 Gain control curve; \( V_i \) at pin 8.
SIGNAL-SOURCES SWITCH

The TDA1028 is a quadruple operational amplifier connected as an impedance converter. Each amplifier has 2 switchable inputs which are protected by clamping diodes. The input currents are independent of the switch position and the outputs are short-circuit protected.

The device is intended as an electronic four-channel signal-sources switch in a.f. amplifiers.

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range (pin 9)</td>
<td>$V_p$ 6 to 23 V</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>$T_{amb}$ -30 to +80 °C</td>
</tr>
<tr>
<td>Supply voltage (pin 9)</td>
<td>$V_p$ typ. 20 V</td>
</tr>
<tr>
<td>Current consumption (pins 4, 5, 12, 13 unloaded)</td>
<td>$I_g$ typ. 2,9 mA</td>
</tr>
<tr>
<td>Maximum input signal handling (r.m.s. value)</td>
<td>$V_{i(rms)}$ typ. 6 V</td>
</tr>
<tr>
<td>Voltage gain</td>
<td>$G_v$ typ. 1</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
<td>$d_{tot}$ typ. 0,01 %</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>$\alpha$ typ. 70 dB</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>$S/N$ typ. 120 dB</td>
</tr>
</tbody>
</table>

**PACKAGE OUTLINE**

16-lead DIL; plastic (SOT-38).
Fig. 1 Block diagram.
RATINGS

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

- Supply voltage (pin 9) \( V_p \) max. 23 V
- Input voltages (pins 2, 3, 6, 7, 10, 11, 14, 15) \( V_I \) max. \( V_p \)
- Switch control voltage (pin 1 and 8) \( V_S \) max. 0 to 23 V
- Input current \( \pm I_I \) max. 20 mA
- Switch control current \( -I_S \) max. 50 mA
- Total power dissipation \( P_{tot} \) max. 800 mW
- Storage temperature \( T_{stg} \) -55 to +150 °C
- Operating ambient temperature \( T_{amb} \) -30 to +80 °C

CHARACTERISTICS

- Supply voltage range \( V_p = 20 \) V; \( T_{amb} = 25 \) °C; unless otherwise specified
- Current consumption
  - without load: \( I_9 = 1,6 \) to 4,2 mA
- Supply voltage range
  - \( V_p \) 6 to 23 V
- Signal inputs
  - Input offset voltage of switched-on inputs \( (R_S < 1 \, \text{k} \Omega) \) \( V_{io} \) typ. 2 mV
  - Input offset current of switched-on inputs \( I_{io} \) typ. 20 nA
  - Input offset current of a switched-on input with respect to a non-switched-on input \( I_{io} \) typ. 20 nA
  - Input bias current
    - independent of switch position \( I_I \) typ. 250 nA
    - \( < 950 \) nA
  - Capacitance between adjacent inputs \( C \) typ. 0,5 pF
  - D.C. input voltage range \( V_I \) 3 to 19 V
  - Supply voltage rejection ratio; \( R_S < 10 \, \text{k} \Omega \) \( SVRR \) typ. 100 \( \mu \text{V/V} \)
  - Equivalent input noise voltage \( R_S < 1 \, \text{k} \Omega; f = 20 \, \text{Hz to} 20 \, \text{kHz} \) (r.m.s. value) \( V_{n(rms)} \) typ. 3,5 \( \mu \text{V} \)
  - Equivalent input noise current
    - \( f = 20 \, \text{Hz to} 20 \, \text{kHz} \) (r.m.s. value) \( I_{n(rms)} \) typ. 0,05 nA
  - Crosstalk between a switched-on input and a non-switched-on input; measured at the output at \( R_S < 1 \, \text{k} \Omega; f = 1 \, \text{kHz} \) \( \alpha \) typ. 100 dB
- Signal amplifier
  - Voltage gain of a switched-on input
    - at \( I_4; 5; 12; 13 = 0; R_L = \infty \) \( G_V \) typ. 1
  - Current gain of a switched-on amplifier \( G_I \) typ. 10^5

January 1980
CHARACTERISTICS (continued)

Signal outputs

Output resistance \( R_o \) typ. 400 Ω
Output current capability (pins 4, 5, 12 and 13) \( \pm I_o \) > 5 mA
Frequency limit of the output voltage at \( V_{ip}=1 \) V; \( R_S < 1 \) kΩ; \( R_L = 10 \) MΩ; \( C_L = 10 \) pF
Slew rate (unity gain) \( \Delta V_{4; 5; 12; 13-16}/\Delta t \) at \( R_L = 10 \) MΩ; \( C_L = 10 \) pF

Switch control

<table>
<thead>
<tr>
<th>switched-on inputs</th>
<th>interconnected pins</th>
<th>control voltages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( V_{1-16} )</td>
</tr>
<tr>
<td>I-1, II-1</td>
<td>2-4, 15-13</td>
<td>H</td>
</tr>
<tr>
<td>I-2, II-2</td>
<td>3-4, 14-13</td>
<td>L</td>
</tr>
<tr>
<td>III-1, IV-1</td>
<td>7-5, 10-12</td>
<td>–</td>
</tr>
<tr>
<td>III-2, IV-2</td>
<td>6-5, 11-12</td>
<td>–</td>
</tr>
</tbody>
</table>

Control inputs (pins 1 and 8)

Required voltage

HIGH \( V_{SH} > 3,3 \) V *
LOW \( V_{SL} < 2,1 \) V

Input current

HIGH (leakage current) \( I_{SH} < 1 \) μA
LOW (control current) \( I_{SL} < 200 \) μA

* Or control inputs open; \( R_{1-16}, R_{8-16} > 33 \) MΩ.
APPLICATION INFORMATION

Vp = 20 V; Tamb = 25 °C; measured in Fig. 1; RS = 47 kΩ; Ci = 0,1 µF; Rbias = 470 kΩ; RL = 4,7 kΩ; CL = 100 pF (unless otherwise specified)

Voltage gain

\[ G_v \text{ typ. } -1,5 \text{ dB} \]

D.C. output voltage variation when switching the inputs (pins 4, 5, 12 and 13)

\[ \Delta V_o \text{ typ. } < 10 \text{ mV} \]

Total harmonic distortion

over most of signal range (see Fig. 4)

\[ d_{tot} \text{ typ. } 0,01 \% \]

\[ d_{tot} \text{ typ. } 0,02 \% \]

\[ d_{tot} \text{ typ. } 0,03 \% \]

Output signal handling

\[ d_{tot} = 0,1\%; f = 1 \text{ kHz (r.m.s. value)} \]

\[ V_o(\text{rms}) \text{ typ. } > 5,0 \text{ V} \]

\[ V_o(\text{rms}) \text{ typ. } 5,3 \text{ V} \]

Noise output voltage (unweighted)

\[ f = 20 \text{ Hz to 20 kHz (r.m.s. value)} \]

\[ V_n(\text{rms}) \text{ typ. } 5 \mu V \]

Noise output voltage (weighted)

\[ f = 20 \text{ Hz to 20 kHz (in accordance with DIN 45405)} \]

\[ V_n \text{ typ. } 12 \mu V \]

Amplitude response (pins 4, 5, 12 and 13)

\[ V_i = 5 \text{ V; } f = 20 \text{ Hz to 20 kHz} \]

\[ \Delta V_o \text{ typ. } 0,1 \text{ dB *} \]

Crosstalk between a switched-on input and a non-switched-on input;

measured at the output at f = 1 kHz

\[ \alpha \text{ typ. } 75 \text{ dB **} \]

Crosstalk between switched-on inputs and the outputs of the other channels; at f = 1 kHz

\[ \alpha \text{ typ. } 90 \text{ dB **} \]

* The lower cut-off frequency depends on values of Rbias and Ci.

** Depends on external circuitry and RS. The value will be fixed mostly by capacitive crosstalk of the external components.
Fig. 2 Equivalent input noise current.

Fig. 3 Equivalent input noise voltage.
Fig. 4 Total harmonic distortion as a function of r.m.s. output voltage.

--- f = 1 kHz; --- f = 20 kHz.

\[ Z_L = 1 \text{ M} \Omega // 100 \text{ pF} \]
\[ Z_L = 4.7 \text{ k} \Omega // 100 \text{ pF} \]
Fig. 5 Output voltage as a function of supply voltage.

Fig. 6 Noise output voltage as a function of input resistance; $G_v = 1$; $f = 20$ Hz to 20 kHz.

--- $V_n$ (output); --- $V_n$ (RS).
APPLICATION NOTES
Input protection circuit and indication

![Circuit diagram showing input protection and indication.](image)

Fig. 7 Circuit diagram showing input protection and indication.

Unused signal inputs
Any unused inputs must be connected to a d.c. (bias) voltage, which is within the d.c. input voltage range.

Circuits with standby operation
The control inputs (pins 1 and 8) are high-ohmic at \( V_{SH} \leq 20 \text{ V} \) \( (I_{SH} \leq 1 \mu\text{A}) \), as well as, when the supply voltage (pin 9) is switched off.
Fig. 8 Typical application diagram for a switchable scratch/rumble filter.
Fig. 9 Frequency response curves for scratch/rumble filters in Fig. 8.
Fig. 10 Half of TDA1028 used as a mono/stereo switch.
SIGNAL-SOURCES SWITCH

The TDA1029 is a dual operational amplifier (connected as an impedance converter) each amplifier having 4 mutually switchable inputs which are protected by clamping diodes. The input currents are independent of switch position and the outputs are short-circuit protected.

The device is intended as an electronic two-channel signal-source switch in a.f. amplifiers.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range (pin 14)</td>
<td>$V_P$</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>$T_{amb}$</td>
</tr>
<tr>
<td></td>
<td>6 to 23 V</td>
</tr>
<tr>
<td>-30 to + 80 °C</td>
<td></td>
</tr>
<tr>
<td>Supply voltage (pin 14)</td>
<td>$V_P$</td>
</tr>
<tr>
<td>Current consumption</td>
<td>$I_{14}$</td>
</tr>
<tr>
<td></td>
<td>typ. 20 V</td>
</tr>
<tr>
<td></td>
<td>typ. 3.5 mA</td>
</tr>
<tr>
<td>Maximum input signal handling (r.m.s. value)</td>
<td>$V_{i(rms)}$</td>
</tr>
<tr>
<td>Voltage gain</td>
<td>$G_V$</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
<td>$d_{tot}$</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>$\alpha$</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>$S/N$</td>
</tr>
<tr>
<td></td>
<td>typ. 6 V</td>
</tr>
<tr>
<td></td>
<td>typ. 1</td>
</tr>
<tr>
<td></td>
<td>typ. 0.01 %</td>
</tr>
<tr>
<td></td>
<td>typ. 70 dB</td>
</tr>
<tr>
<td></td>
<td>typ. 120 dB</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
Fig. 1 Block diagram.
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>Supply voltage (pin 14)</td>
<td>( V_P )</td>
<td>max.</td>
<td>23 V</td>
</tr>
<tr>
<td>Input voltage (pins 1 to 8)</td>
<td>( V_I )</td>
<td>max.</td>
<td>( V_P )</td>
</tr>
<tr>
<td></td>
<td>(-V_I)</td>
<td>max.</td>
<td>0,5 V</td>
</tr>
<tr>
<td>Switch control voltage (pins 11, 12 and 13)</td>
<td>( V_S )</td>
<td>0 to 23 V</td>
<td></td>
</tr>
<tr>
<td>Input current</td>
<td>( I_I )</td>
<td>max.</td>
<td>20 mA</td>
</tr>
<tr>
<td></td>
<td>(-I_S)</td>
<td>max.</td>
<td>50 mA</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>( P_{tot} )</td>
<td>max.</td>
<td>800 mW</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td>-55 to +150 °C</td>
<td></td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>( T_{amb} )</td>
<td>-30 to +80 °C</td>
<td></td>
</tr>
</tbody>
</table>

CHARACTERISTICS

- \( V_P = 20 \) V; \( T_{amb} = 25 \) °C; unless otherwise specified
- Current consumption
  - without load; \( I_g = I_{15} = 0 \)
  - \( I_{14} \) typ. 3,5 mA
  - \( V_P \) typ. 2 to 5 mA
- Supply voltage range (pin 14)

**Signal inputs**

- Input offset voltage
  - of switched-on inputs
    - \( R_S \ll 1 \) kΩ
    - \( V_{io} \) typ. < 10 mV
- Input offset current
  - of switched-on inputs
    - \( I_{io} \) typ. < 200 nA
  - of a switched-on input with respect to a non-switched-on input of a channel
    - \( I_{io} \) typ. < 200 nA
- Input bias current
  - independent of switch position
    - \( I_i \) typ. < 250 nA
    - < 950 nA
- Capacitance between adjacent inputs
  - \( C \) typ. 0,5 pF
- D.C. input voltage range
  - \( V_I \) typ. 3 to 19 V
- Supply voltage rejection ratio; \( R_S \ll 10 \) kΩ
  - \( SVRR \) typ. 100 µV/V
- Equivalent input noise voltage
  - \( R_S \ll 0; f = 20 \) Hz to 20 kHz (r.m.s. value)
    - \( V_{n(rms)} \) typ. 3,5 µV
- Equivalent input noise current
  - \( f = 20 \) Hz to 20 kHz (r.m.s. value)
    - \( I_{n(rms)} \) typ. 0,05 nA
- Crosstalk between a switched-on input and a non-switched-on input;
  - measured at the output at \( R_S = 1 \) kΩ; \( f = 1 \) kHz
    - \( \alpha \) typ. 100 dB
CHARACTERISTICS (continued)

Signal amplifier

Voltage gain of a switched-on input
at \( Gv = G_{15} = 0; \) \( RL = \infty \)

Current gain of a switched-on amplifier

Gv typ. 1
Gl typ. \( 10^6 \)

Signal outputs

Output resistance (pins 9 and 15)

Output current capability at \( V_p = 6 \text{ to } 23 \text{ V} \)

Frequency limit of the output voltage

Slew rate (unity gain); \( \Delta V_{9-16} / \Delta t; \Delta V_{15-16} / \Delta t \)

Bias voltage

D.C. output voltage

Output resistance

Switch control

<table>
<thead>
<tr>
<th>switched-on inputs</th>
<th>interconnected pins</th>
<th>control voltages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( V_{11-16} )</td>
</tr>
<tr>
<td>I-1, II-1</td>
<td>1-15, 5-9</td>
<td>H</td>
</tr>
<tr>
<td>I-2, II-2</td>
<td>2-15, 6-9</td>
<td>H</td>
</tr>
<tr>
<td>I-3, II-3</td>
<td>3-15, 7-9</td>
<td>H</td>
</tr>
<tr>
<td>I-4, II-4</td>
<td>4-15, 8-9</td>
<td>L</td>
</tr>
<tr>
<td>I-4, II-4</td>
<td>4-15, 8-9</td>
<td>L</td>
</tr>
<tr>
<td>I-4, II-4</td>
<td>4-15, 8-9</td>
<td>L</td>
</tr>
<tr>
<td>I-3, II-3</td>
<td>3-15, 7-9</td>
<td>H</td>
</tr>
</tbody>
</table>

In the case of offset control, an internal blocking circuit of the switch control ensures that not more than one input will be switched on at a time. In that case safe switching-through is obtained at \( V_{SL} \leq 1.5 \text{ V} \).

Control inputs (pins 11, 12 and 13)

Required voltage

\( V_{SH} > 3.3 \text{ V} \)
\( V_{SL} < 2.1 \text{ V} \)

Input current

\( I_{SH} < 1 \mu\text{A} \)
\( -I_{SL} < 250 \mu\text{A} \)

* \( V_{10-16} \) is typically \( 0.5 \cdot V_{14-16} + 1.5 \cdot V_{BE} \).
** Or control inputs open \( (R_{11,12,13-16} > 33 \text{ M\Omega}) \).
**APPLICATION INFORMATION**

$V_p = 20\,V$; $T_{amb} = 25\,^\circ C$; measured in Fig. 1; $R_S = 47\,k\Omega$; $C_i = 0,1\,\mu F$; $R_{bias} = 470\,k\Omega$; $R_L = 4,7\,k\Omega$; $C_L = 100\,pF$ (unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage gain</td>
<td>$G_v$</td>
<td>typ. $-1,5,dB$</td>
</tr>
<tr>
<td>Output voltage variation when switching the inputs</td>
<td>$\Delta V_{9-16}$</td>
<td>typ. $10,mV$</td>
</tr>
<tr>
<td></td>
<td>$\Delta V_{15-16}$</td>
<td>$&lt; 100,mV$</td>
</tr>
<tr>
<td>Total harmonic distortion over most of signal range (see Fig. 4)</td>
<td>$d_{tot}$</td>
<td>typ. $0,01,%$</td>
</tr>
<tr>
<td>$V_i = 5,V$; $f = 1,kHZ$</td>
<td>$d_{tot}$</td>
<td>typ. $0,02,%$</td>
</tr>
<tr>
<td>$V_i = 5,V$; $f = 20,Hz$ to $20,kHz$</td>
<td>$d_{tot}$</td>
<td>typ. $0,03,%$</td>
</tr>
<tr>
<td>Output signal handling</td>
<td>$d_{tot} = 0,1,%$; $f = 1,kHz$ (r.m.s. value)</td>
<td>$V_o(rms)$</td>
</tr>
<tr>
<td>Noise output voltage (unweighted)</td>
<td>$f = 20,Hz$ to $20,kHz$ (r.m.s. value)</td>
<td>$V_n(rms)$</td>
</tr>
<tr>
<td>Noise output voltage (weighted)</td>
<td>$f = 20,Hz$ to $20,kHz$ (in accordance with DIN 45405)</td>
<td>$V_n$</td>
</tr>
<tr>
<td>Amplitude response</td>
<td>$V_i = 5,V$; $f = 20,Hz$ to $20,kHz$; $C_i = 0,22,\mu F$</td>
<td>$\Delta V_{9-16}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\Delta V_{15-16}$</td>
</tr>
<tr>
<td>Crosstalk between a switched-on input and a non-switched-on input; measured at the output at $f = 1,kHz$</td>
<td>$\alpha$</td>
<td>typ. $75,dB$ **</td>
</tr>
<tr>
<td>Crosstalk between switched-on inputs and the outputs of the other channels</td>
<td>$\alpha$</td>
<td>typ. $90,dB$ **</td>
</tr>
</tbody>
</table>

* The lower cut-off frequency depends on values of $R_{bias}$ and $C_i$.

** Depends on external circuitry and $R_S$. The value will be fixed mostly by capacitive crosstalk of the external components.
In/iff (pA/√Hz)

Fig. 2 Equivalent input noise current.

\( I_n/\sqrt{f} \) (pA/√Hz)

Fig. 3 Equivalent input noise voltage.

\( V_n/\sqrt{f} \) (nV/√Hz)
Fig. 4 Total harmonic distortion as a function of r.m.s. output voltage.

- - - f = 1 kHz; - - - - - - f = 20 kHz.
Fig. 5 Output voltage as a function of supply voltage.

Fig. 6 Noise output voltage as a function of input resistance; $G_v = 1$; $f = 20$ Hz to 20 kHz.
--- $V_n$ (output); — — $V_n$ (Rs).
APPLICATION NOTES

Input protection circuit and indication

Fig. 7 Circuit diagram showing input protection and indication.

Unused signal inputs
Any unused inputs must be connected to a d.c. (bias) voltage, which is within the d.c. input voltage range; e.g. unused inputs can be connected directly to pin 10.

Circuits with standby operation
The control inputs (pins 11, 12 and 13) are high-ohmic at $V_{SH} \leq 20$ V ($I_{SH} \leq 1$ μA), as well as, when the supply voltage (pin 14) is switched off.
Fig. 8 TDA1029 connected as a four input stereo source selector.
Fig. 9 TDA1029 and TDA1028 connected as a five input stereo source selector with monitoring facilities.
Fig. 10 TDA1029 connected as a third-order active high-pass filter with Butterworth response and component values chosen according to the method proposed by Fjällbrant. It is a four-function circuit which can select mute, rumble filter, subsonic filter and linear response.

Switch control

<table>
<thead>
<tr>
<th>function</th>
<th>V11-16</th>
<th>V12-16</th>
<th>V13-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>linear</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>subsonic filter ‘on’</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>rumble filter ‘on’</td>
<td>H</td>
<td>L</td>
<td>X</td>
</tr>
<tr>
<td>mute ‘on’</td>
<td>L</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Fig. 11 Frequency response curves for the circuit of Fig. 10.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

MOTOR SPEED REGULATOR WITH THERMAL SHUT-DOWN

The TDA1059B is a monolithic integrated circuit with a current limiter and with good thermal characteristics in a TO-126 plastic package for easy mounting. It is intended to regulate the speed of d.c. motors in record players, cassette recorders and car cassette recorders.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_P$</td>
<td>V</td>
</tr>
<tr>
<td>Internal reference voltage</td>
<td>$V_{ref}$</td>
<td>V</td>
</tr>
<tr>
<td>Drop-out voltage</td>
<td>$V_{3.1}$</td>
<td>V</td>
</tr>
<tr>
<td>Limited output current</td>
<td>$I_{3\text{lim}}$</td>
<td>A</td>
</tr>
<tr>
<td>Multiplication coefficient</td>
<td>$k$</td>
<td>-</td>
</tr>
</tbody>
</table>

Supplier voltage $V_P = V_{2.1}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_P$</td>
<td>9 V</td>
</tr>
<tr>
<td>$V_{ref}$</td>
<td>1,3 V</td>
</tr>
<tr>
<td>$V_{3.1}$</td>
<td>1,8 V</td>
</tr>
<tr>
<td>$I_{3\text{lim}}$</td>
<td>0,6 A</td>
</tr>
<tr>
<td>$k$</td>
<td>9</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

Fig. 1 TO-126 (SOT-32).
Pin 1 connected to metal part of mounting surface.

(1) Within this region the cross-section of the leads is uncontrolled.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Supply voltage $V_p = V_{2.1}$ max. 16 V
Storage temperature $T_{stg}$ -55 to +150 °C
Operating ambient temperature (see Fig. 3 and note) $T_{amb}$ -25 to +130 °C

THERMAL RESISTANCE
From junction to case $R_{thj-c} = 10^4$ K/W
From junction to ambient $R_{thj-a} = 100$ K/W

Note
At ambient temperatures above 130 °C, the crystal temperature limiter decreases the internal power consumption.
### CHARACTERISTICS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_p = V_{2-1}$</td>
<td>3,3</td>
<td>9</td>
<td>16 V</td>
</tr>
<tr>
<td>Internal reference voltage</td>
<td>$V_p = 3,3$ V; $I_3 = 80$ mA</td>
<td>1,24</td>
<td>1,3</td>
<td>1,36 V</td>
</tr>
<tr>
<td>Drop-out voltage</td>
<td>$V_{3-1} = 80$ mA; $\Delta V_{\text{ref}} = 5%$</td>
<td>–</td>
<td>1,8</td>
<td>2,06 V</td>
</tr>
<tr>
<td>Quiescent current; $I_3 = 0$</td>
<td>$I_q$</td>
<td>1,8</td>
<td>2,3</td>
<td>2,3 mA</td>
</tr>
<tr>
<td>Limited output current*</td>
<td>$I_{3\text{lim}}$</td>
<td>0,3</td>
<td>0,6</td>
<td>1 A</td>
</tr>
<tr>
<td>Multiplication coefficient</td>
<td>$k = \frac{\Delta I_3}{\Delta I_2}$</td>
<td>8,5</td>
<td>9</td>
<td>9,5</td>
</tr>
</tbody>
</table>

#### Line regulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_p = 3,3$ to 16 V at $I_3 = 50$ mA</td>
<td>$\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}} / \Delta V_p$</td>
<td>–0,115</td>
<td>0</td>
<td>+0,115 %/V</td>
</tr>
<tr>
<td>Multiplication coefficient variation</td>
<td>$\frac{\Delta k}{k} / \Delta V_p$</td>
<td>–</td>
<td>0,86</td>
<td>– %/V</td>
</tr>
<tr>
<td>Input current variation; $I_3 = 50$ mA</td>
<td>$\frac{\Delta I_2}{V_p}$</td>
<td>–15</td>
<td>0</td>
<td>+15 µA/V</td>
</tr>
</tbody>
</table>

#### Load regulation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_3 = 20$ to 80 mA</td>
<td>$\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}} / \Delta I_3$</td>
<td>0</td>
<td>19</td>
<td>38,5 %/A</td>
</tr>
<tr>
<td>Multiplication coefficient variation</td>
<td>$\frac{\Delta k}{k} / \Delta I_3$</td>
<td>–0,075</td>
<td>0</td>
<td>+0,075 %/mA</td>
</tr>
</tbody>
</table>

#### Temperature coefficient

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_3 = 50$ mA; $T_{\text{amb}} = -15$ to +65 °C</td>
<td>$\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}} / \Delta T_{\text{amb}}$</td>
<td>–0,03</td>
<td>0</td>
<td>+0,03 %/K</td>
</tr>
<tr>
<td>Multiplication coefficient variation</td>
<td>$\frac{\Delta k}{k} / \Delta T_{\text{amb}}$</td>
<td>–</td>
<td>0,008</td>
<td>– %/K</td>
</tr>
<tr>
<td>Input current variation</td>
<td>$\frac{\Delta I_2}{\Delta T_{\text{amb}}}$</td>
<td>–2</td>
<td>0</td>
<td>+2 µA/K</td>
</tr>
</tbody>
</table>

* If the motor is stopped by a mechanical brake, the current limitation is effective in the supply voltage range. If the motor is short-circuited, the TDA1059B will be damaged if the supply voltage is higher than 10 V due to parasitic oscillations.
APPLICATION INFORMATION

For start operation: \( V_{\text{ref}} \) must start with final \( V_p = 6.7 \) V and a time constant of \( 3 \tau = 100 \) ms in which \( \tau = R.C; R = \) source impedance, \( C = \) by-pass capacitor.

(1) Inclusion of D(BA220) is arbitrary; it permits compensation of variation of the motor resistance as function of temperature.

(2) Motor example (without diode D):
Catalogue no. 9904 120 01806; \( n = 2000 \) rev/min; \( R_20 = 180 \Omega (\pm 2\%); R_{32} = 100 \Omega + 100 \Omega \) (variable).

Fig. 5 Example of using the TDA1059B in a d.c. motor speed regulation circuit.
Motor equations

\[ E_m = \alpha_1 n \]

where: \( \alpha_1, \alpha_2 = \) motor constant

\[ I_m = \alpha_2 r \]

\( n = \) number of revolutions

\( r = \) motor torque

\[ V_m = E_m + R_m I_m \]

\( E_m = \) back electromotive force

\( R_m = \) motor resistance

The back electromotive force (\( E_m \)) in Fig. 5 can be expressed (excluding diode D) as:

\[
E_m = \left( \frac{R_{20}}{k} - R_m \right) I_m + V_{\text{ref}} \left\{ 1 + \frac{R_{20}}{R_{32}} \left( 1 + \frac{1}{k} \right) \right\} + R_{20} I_o
\]

and including diode D, as:

\[
E_m = \left( \frac{R_{20}}{k} - R_m \right) I_m + \left( V_{\text{ref}} + V_D \right) \left\{ 1 + \frac{R_{20}}{R_{32}} \left( 1 + \frac{1}{k} \right) \right\} + R_{20} I_o
\]

Speed regulation is constant when \( E_m \) is independent of \( I_m \) variations; this will be obtained when \( R_{20} = k R_m \).

\( E_m \), and therefore the motor speed, is regulated by \( R_{32} \). A practical condition for stability is \( R_{20} < k R_m \).
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

MOTOR SPEED REGULATOR

The TDA1059C is a monolithic integrated circuit with a current limiter and with good thermal characteristics in a TO-126 plastic package for easy mounting. It is intended to regulate the speed of d.c. motors in record players, cassette recorders and car cassette recorders.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_p = V_{2-1}$ typ. 9 V 2,5 to 15 V</td>
</tr>
<tr>
<td>Internal reference voltage</td>
<td>$V_{ref}$ typ. 1,1 V</td>
</tr>
<tr>
<td>Drop-out voltage</td>
<td>$V_{3-1}$ typ. 1,0 V</td>
</tr>
<tr>
<td>Limited output current</td>
<td>$I_{lim}$ typ. 0,6 A</td>
</tr>
<tr>
<td>Multiplication coefficient</td>
<td>$k$ typ. 9</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

Fig. 1 TO-126 (SOT-32).
Pin 1 connected to metal part of mounting surface.

Dimensions in mm

(1) Within this region the cross-section of the leads is uncontrolled.
CURRENT LIMITER

REFERENCE VOLTAGE

Ratings

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

Supply voltage

\[ V_p = V_{2.1} \max \quad 16 \text{ V} \]

Storage temperature

\[ T_{stg} \quad -55 \text{ to } +150 \text{ °C} \]

Operating ambient temperature (see Fig. 3)

\[ T_{amb} \quad -25 \text{ to } +150 \text{ °C} \]

Thermal Resistance

From junction to case

\[ R_{th \ j-c} = 10 \text{ K/W} \]

From junction to ambient

\[ R_{th \ j-a} = 100 \text{ K/W} \]

Fig. 2 Functional diagram.

Fig. 3 Power derating curve.
CHARACTERISTICS

$V_p = 9 \text{ V}$; $T_{\text{amb}} = 25 \degree \text{C}$; $R_{20} = 0$; heatsink with $R_{\text{th}} = 100 \text{ K/W}$ and after thermal stabilization; unless otherwise specified; see test circuit Fig. 4

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_p = V_{2-1}$</td>
<td>2,5</td>
<td>9</td>
</tr>
<tr>
<td>Internal reference voltage</td>
<td>$V_{\text{ref}}$</td>
<td>1,05</td>
<td>1,1</td>
</tr>
<tr>
<td>Drop-out voltage</td>
<td>$I_3 = 80 \text{ mA}; \Delta V_{\text{ref}} = 5%$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiescent current; $I_3 = 0$</td>
<td>$V_{3-1}$</td>
<td></td>
<td>1,0</td>
</tr>
<tr>
<td>Limited output current *</td>
<td>$I_{3\text{lim}}$</td>
<td>0,3</td>
<td>0,6</td>
</tr>
<tr>
<td>Multiplication coefficient</td>
<td>$I_3 = 50 \text{ mA} \pm 10 \text{ mA}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$k = \frac{\Delta I_3}{\Delta I_2}$</td>
<td>8,5</td>
<td>9</td>
<td>9,5</td>
</tr>
</tbody>
</table>

Line regulation

$V_p = 2,5 \text{ to } 15 \text{ V at } I_3 = 50 \text{ mA}$

| Characteristic                      |       |      |      |
| reference voltage variation         | $\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}}$ | 0,04  | 0,13 | 0,22 \%/V |
| multiplication coefficient variation| $\frac{\Delta k}{k} / \Delta V_p$ |       | 0,86 | - \%/V |
| input current variation; $I_3 = 50 \text{ mA}$ | $\frac{\Delta I_2}{\Delta V_p}$ | 0     | 15   | 30 \mu A/V |

Load regulation

$V_p = 2,5 \text{ to } 15 \text{ V at } I_3 = 50 \text{ mA}$

| Characteristic                      |       |      |      |
| reference voltage variation         | $\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}}$ |       | 23   | 45,5 \%/A |
| multiplication coefficient variation| $\frac{\Delta k}{k} / \Delta I_3$ |       | 0    | - \%/mA |

Temperature coefficient

$I_3 = 50 \text{ mA}; T_{\text{amb}} = -15 \text{ to } +65 \degree \text{C}$

| Characteristic                      |       |      |      |
| reference voltage variation         | $\frac{\Delta V_{\text{ref}}}{V_{\text{ref}}}$ |       | 0,036 | 0 + 0,036 \%/K |
| multiplication coefficient variation| $\frac{\Delta k}{k} / \Delta T_{\text{amb}}$ |       | 0,008 | - \%/K |
| input current variation             | $\frac{\Delta I_2}{\Delta T_{\text{amb}}}$ |       | 0    | - \mu A/K |

* If the motor is stopped by a mechanical brake, the current limitation is effective in the supply voltage range. If the motor is short-circuited, the TDA1059C will be damaged if the supply voltage is higher than 10 V due to parasitic oscillations.
APPLICATION INFORMATION

For start operation: \( V_{\text{ref}} \) must start with final \( V_P = 6.7 \) V and a time constant of \( 3 \tau = 100 \) ms in which \( \tau = R.C. \); \( R \) = source impedance, \( C \) = by-pass capacitor.

(1) Inclusion of D(BA220) is arbitrary; it permits compensation of variation of the motor resistance as function of temperature.

(2) Motor example (without diode D):
Catalogue no. 9904 120 01806; \( n = 2000 \) rev/min; \( R20 = 180 \, \Omega \) (\( \pm 2\% \)); \( R32 = 39 \, \Omega + 47 \, \Omega \) (variable).

Fig. 5 Example of using the TDA1059C in a d.c. motor speed regulation circuit.
Motor equations

\[ E_m = \alpha_1 n \quad \text{where:} \quad \alpha_1, \alpha_2 = \text{motor constant} \]
\[ I_m = \alpha_2 r \quad \text{n = number of revolutions} \]
\[ V_m = E_m + R_m I_m \quad \text{r = motor torque} \]
\[ R_m = \text{motor resistance} \]

The back electromotive force \( (E_m) \) in Fig. 5 can be expressed (excluding diode D) as:

\[ E_m = \left( \frac{R_20}{k} - R_m \right) I_m + V_{\text{ref}} \left[ 1 + \frac{R_20}{R_32} \left( 1 + \frac{1}{k} \right) \right] + R_20 I_0 \]

and including diode D, as:

\[ E_m = \left( \frac{R_20}{k} - R_m \right) I_m + \left( V_{\text{ref}} + V_D \right) \left[ 1 + \frac{R_20}{R_32} \left( 1 + \frac{1}{k} \right) \right] + R_20 I_0 \]

Speed regulation is constant when \( E_m \) is independent of \( I_m \) variations; this will be obtained when \( R_20 = k R_m \).

\( E_m \), and therefore the motor speed, is regulated by \( R_32 \). A practical condition for stability is \( R_20 \leq k R_m \).
The TDA1072 is a monolithic integrated AM receiver circuit provided with the following functions:

- controlled h.f. preamplifier
- multiplicative balanced mixer
- separate oscillator with amplitude control
- i.f. amplifier with gain control
- balanced full-wave detector
- a.f. preamplifier
- internal a.g.c. voltage
- amplifier for field-strength indication
- electronic stand-by on/off switch

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 13)</td>
<td>V&lt;p&gt;</td>
<td>15 V</td>
</tr>
<tr>
<td>Supply current</td>
<td>I&lt;p&gt;</td>
<td>22 mA</td>
</tr>
<tr>
<td>H.F. input voltage</td>
<td>V&lt;i&gt;</td>
<td>2.2 µV</td>
</tr>
<tr>
<td>S + N/N = 6 dB</td>
<td>V&lt;i&gt;</td>
<td>30 µV</td>
</tr>
<tr>
<td>S + N/N = 26 dB</td>
<td>V&lt;i&gt;</td>
<td>650 mV</td>
</tr>
<tr>
<td>H.F. input voltage; d_tot = 3%; m = 80%</td>
<td>V&lt;i&gt;</td>
<td>340 mV</td>
</tr>
<tr>
<td>A.F. output voltage; Vi = 2 mV</td>
<td>V&lt;i&gt;</td>
<td></td>
</tr>
<tr>
<td>Total distortion</td>
<td>d_tot</td>
<td>0.5 %</td>
</tr>
<tr>
<td>Input voltage range for ∆V_o = 6 dB</td>
<td>∆V_i</td>
<td>91 dB</td>
</tr>
<tr>
<td>Oscillator frequency range</td>
<td>f&lt;osc&gt;</td>
<td>0.6 to 31 MHz</td>
</tr>
<tr>
<td>Oscillator voltage amplitude</td>
<td>V&lt;osc&gt;</td>
<td>140 mV</td>
</tr>
<tr>
<td>Field-strength indication range</td>
<td>∆V_i</td>
<td>100 dB</td>
</tr>
<tr>
<td>Supply voltage range</td>
<td>V&lt;p&gt;</td>
<td>7.5 to 18 V</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>T&lt;amb&gt;</td>
<td>-30 to +80 °C</td>
</tr>
</tbody>
</table>

**PACKAGE OUTLINE**

16-lead DIL; plastic (SOT-38).
(1) T1 : N1/N2 = 34/9; Q₀ = 65; Qₙ = 60; Z₂₁ = 700 Ω at RL(3) = 3 kΩ; Z₁₁ = 5.2 kΩ.

Fig. 1 Block diagram with external components; used as test circuit.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage (pin 13) \( V_p = V_{13-16} \) max. 23 V

Voltage on pin 2 \( V_{2-16} \) 0 to 23 V

H.F. inputs

Voltages between:

- pins 14 and 15 \( \pm V_{14-15} \) max. 12 V
- pins 14 and 16 \( V_{14-16} \) max. \( V_p \) V
- pins 15 and 16 \( V_{15-16} \) max. \( V_p \) V

Or currents:

- pin 14 \( \pm I_{14} \) max. 10 mA
- pin 15 \( \pm I_{15} \) max. 10 mA

Storage temperature range \( T_{stg} \) -55 to +150 °C

Operating ambient temperature range \( T_{amb} \) -30 to +80 °C

CHARACTERISTICS

\( V_p = 15 \) V; \( T_{amb} = 25 \) °C; \( f_i = 1 \) MHz (I.F.), \( R_G = 50 \) Ω; \( f_m = 0,4 \) kHz; \( m = 30\% \);

i.f. frequency = 460 kHz; unless otherwise specified

Supply voltage range (pin 13) \( V_p \) typ. 7,5 to 18 V

Supply current; without load (\( I_{L(11)} = 0 \)) \( I_p \) typ. 22 mA

H.F. preamplifier and mixer

D.C. input voltages \( V_{14-16}; V_{15-16} \) typ. 2,75 (4VBE) V

Input impedance

\( V_i \) < 300 μV

\( V_i > 10 \) mV

\( Z_{i(14-16)}; Z_{i(15-16)} \) typ. 6 kΩ
typ. 6 pF

Output impedance

\( Z_{o(1-16)} \) typ. 2,5 pF
typ. > 200 kΩ

Maximum conversion conductance \( S_M \) typ. 5,5 mA/V*

Maximum i.f. output voltage (peak-to-peak value) \( V_{o(1)(p-p)} \) typ. 2,8 V

Output current capability \( I_o(1) \) typ. 1 mA

Control range of preamplifier \( \Delta S_M \) typ. 30 dB

Maximum h.f. input voltage (peak-to-peak value) \( V_{i(14-15)(p-p)} \) typ. 2,8 V

\* \( S_M \) is defined as \( I_o(1)/V_i \)

January 1980 3
<table>
<thead>
<tr>
<th>CHARACTERISTICS (continued)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscillator</td>
<td></td>
</tr>
<tr>
<td>Frequency range</td>
<td>f_{osc}(12) 0,6 to 31 MHz</td>
</tr>
<tr>
<td>Oscillator impedance range</td>
<td>Z_{L}(12) 1 to 200 k\Omega</td>
</tr>
<tr>
<td>Controlled oscillator amplitude</td>
<td>V_{osc}(12) typ. 140 mV</td>
</tr>
<tr>
<td>D.C. output voltage (I_{L}(11) = 0)</td>
<td>V_{11-16} typ. V_{p}-1,3 V</td>
</tr>
<tr>
<td>Output load current range</td>
<td>-I_{L}(11) 0 to 15 mA</td>
</tr>
<tr>
<td>Output resistance; I_{L}(11) = 5 ± 0,5 mA</td>
<td>R_{o}(11) typ. 7 \Omega</td>
</tr>
</tbody>
</table>

**Oscillator frequency output (pin 10)**

<table>
<thead>
<tr>
<th>Output voltage (peak-to-peak value)</th>
<th>V_{o}(10) typ. 200 mV</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{10-16} = 15 k\Omega (R_{L}(10))</td>
<td>R_{o}(10) typ. 150 \Omega</td>
</tr>
<tr>
<td>Output resistance</td>
<td>I_{o}(10)M typ. &lt; 2 mA</td>
</tr>
</tbody>
</table>

**I.F. amplifier and a.f. stage**

<table>
<thead>
<tr>
<th>D.C. input voltages</th>
<th>V_{3-16}; V_{4-16} typ. 2 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input impedance</td>
<td>Z_{i}(3) typ. 3 \kappa \Omega</td>
</tr>
<tr>
<td>Max. i.f. input voltage; m = 80%; d_{tot} = 3%</td>
<td>V_{i}(3) typ. 75 mV</td>
</tr>
<tr>
<td>Control range; V_{o} = -6 dB</td>
<td>\Delta V_{i} typ. 62 dB</td>
</tr>
<tr>
<td>A.F. output voltage; V_{i}(3) = 2 mV; without load</td>
<td>V_{o}(6) typ. 350 mV</td>
</tr>
<tr>
<td>A.F. output resistance</td>
<td>R_{o}(6) typ. 3,5 \kappa \Omega</td>
</tr>
</tbody>
</table>

**Field-strength indication**

<table>
<thead>
<tr>
<th>D.C. indicator voltage</th>
<th>V_{9-16} typ. &lt; 140 mV</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{i} = 0; R_{L}(9) = 2,7 \kappa \Omega</td>
<td>V_{9-16} typ. 2,8 \V</td>
</tr>
<tr>
<td>V_{i} = 500 mV; R_{L}(9) = 2,7 \kappa \Omega</td>
<td>&gt; 1,2 mA</td>
</tr>
<tr>
<td>Output current capability</td>
<td>R_{o}(9) typ. 250 \Omega</td>
</tr>
<tr>
<td>Output resistance; -I_{g} = 0,5 mA</td>
<td>V_{9-16} typ. 6 \V</td>
</tr>
<tr>
<td>Leakage voltage at the output; ± I_{g} &lt; 1 \mu A; at AM switch off (V_{2-16} &gt; 3,5 V)</td>
<td></td>
</tr>
</tbody>
</table>
Stand-by switch
Switching voltage $V_{2-16}$ typ. 2,6 V

Required control voltage*
AM on $V_{2-16}$ < 2 V
AM off $V_{2-16}$ > 3,5 V**

Input current
AM on; switching current $-I_2$ < 100 μA
AM off; leakage current ($V_{2-16} = V_{3-16}$) $± I_2$ < 1 μA

APPLICATION INFORMATION
$V_p = 15$ V; $T_{amb} = 25$ °C; measured in Fig. 1; $f_i = 1$ MHz (h.f.); $f_m = 0,4$ kHz; $m = 30$%; unless otherwise specified

H.F. input voltage
$S + N/N = 6$ dB
$S + N/N = 10$ dB
$S + N/N = 26$ dB
$S + N/N = 46$ dB
$V_i$ typ. 2,2 μV
$V_i$ typ. 3,5 μV
$V_i$ typ. 30 μV
$V_i$ typ. 550 μV

H.F. input voltage for a.g.c. operation
$V_i$ typ. 14 μV

Control range for $\Delta V_o = 6$ dB
reference value $V_i = 500$ mV $\Delta V_i$ typ. 91 dB

Maximum h.f. input voltage
$d_{tot} = 3$%; $m = 80$%
$d_{tot} = 3$%; $m = 30$%
$d_{tot} = 10$%; $m = 30$%
$V_i$ typ. 0,65 V
$V_i$ typ. 0,9 V
$V_i$ typ. 1,3 V

A.F. output voltage; $V_i = 2$ mV
$V_o$ typ. 340 mV

Change of a.f. output voltage; $V_i = 2$ mV
$\Delta V_o$ typ. ± 2 dB

H.F. input voltage; $V_o = 60$ mV
$V_i$ typ. 4 μV

Total distortion of a.f. output voltage
$V_i = 2$ mV; $m = 80$%
$V_i = 500$ mV; $m = 80$%
$d_{tot}$ typ. 0,5 %
$d_{tot}$ typ. 1,8 %

Signal plus noise-to-noise ratio of a.f. output voltage
$V_i = 2$ mV
$S + N/N$ typ. 50 dB

I.F. bandwidth (−3 dB)
$B$ typ. 4,6 kHz

I.F. selectivity
$\Delta f = ± 9$ kHz
$\Delta f = ± 36$ kHz
$S(9)$ typ. 30 dB
$S(36)$ typ. 60 dB

* At allowable ambient temperature range and supply voltage range.
** Also achieved at open input.
Fig. 2 A.F. output voltage as a function of h.f. input voltage; \( f_i = 1 \) MHz (h.f.); \( R_G = 50 \) \( \Omega \); \( f_m = 0.4 \) kHz.

Fig. 3 Indication voltage as a function of h.f. input voltage; \( R_{g.16} = 2.7 \) k\( \Omega \).
AM receiver circuit

Fig. 4 Total distortion and signal plus noise-to-noise ratio as a function of h.f. input voltage; for $d_{tot}: f_m = 0.4$ kHz; $m = 80\%$.

$C_{7-16} = 0$

$C_{7-16} = 2.2 \mu F$

Fig. 5 Total distortion as a function of the modulation frequency; $V_i = 10$ mV; $f_i = 1$ MHz; $m = 80\%$. $C_{8-16} = 22 \mu F$. 

January 1980
Fig. 6 Frequency responses (wobbled) for various conditions:

- - - - with a.f. and i.f. filter
- - - with i.f. filter
- - - with a.f. filter
(1) T1 : N1/N2 = 34/9; Q_o = 65; Q_L = 60; Z_{21} = 700 \ \Omega \text{ at } R_L(3) = 3 \ \text{k}\Omega; Z_{11} = 5.2 \ \text{k}\Omega.

(2) T2 : N1/N2/N3 = 14/67/17; L = 175 \ \mu\text{H}; Q_o = 145; Q_L = 50 (f = 1 MHz); V_i/V_G = -6 \ \text{dB}.

Fig. 7 Application circuit diagram of an AM-MW receiver with two double variable tuning capacitors; f_i = 510 to 1620 kHz (h.f.); f_i = 460 kHz (i.f.).
Fig. 8  A.F. output voltage as a function of the h.f. generator input voltage; $f_i = 1 \text{ MHz (h.f.)};$
$f_m = 0.4 \text{ kHz}.$
Fig. 9 Total distortion and signal plus noise-to-noise ratio as a function of h.f. generator input voltage; for $d_{tot}$: $f_m = 0.4$ kHz; $m = 80\%$. 
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.

DUAL ELECTRONIC STEREO POTentiOMETER CIRCUIT

The TDA1074 is a monolithic integrated circuit designed for use as adjustment circuit in stereo amplifiers. The circuit contains the following functions:

- internal amplifier
- two high-ohmic inputs for each adjuster
- electronic supply voltage filter
- feedback output stages with short-circuit protected current limitation

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typical Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage (pin 11)</td>
<td>V_P</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Supply current (pin 11)</td>
<td>I_P</td>
<td>20</td>
<td>mA</td>
</tr>
<tr>
<td>Input signal voltage (r.m.s. value)</td>
<td>V_i(rms)</td>
<td>&lt;</td>
<td>6 V</td>
</tr>
<tr>
<td>Output signal voltage (r.m.s. value)</td>
<td>V_o(rms)</td>
<td>&lt;</td>
<td>6 V</td>
</tr>
<tr>
<td>Total distortion</td>
<td>d_tot</td>
<td>0.05</td>
<td>%</td>
</tr>
<tr>
<td>Output noise voltage (r.m.s. value)</td>
<td>V_no(rms)</td>
<td>50</td>
<td>µV</td>
</tr>
<tr>
<td>Adjustment range</td>
<td>Δα</td>
<td>110</td>
<td>dB</td>
</tr>
<tr>
<td>Channel separation</td>
<td>α</td>
<td>80</td>
<td>dB</td>
</tr>
<tr>
<td>Hum suppression</td>
<td>α100</td>
<td>46</td>
<td>dB</td>
</tr>
<tr>
<td>Channel balance</td>
<td>ΔG</td>
<td>0.5</td>
<td>dB</td>
</tr>
<tr>
<td>Supply voltage range</td>
<td>V_P</td>
<td>7.5 to 23</td>
<td>V</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>T_amb</td>
<td>-30 to +80</td>
<td>°C</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE
18-lead DIL; plastic (SOT-102C).
Fig. 1 Block diagram and external components; $I_{c(I)}$, $I_{c(II)}$, $V_{c(I)} = V_{9-8}$, $V_{c(II)} = V_{10-8}$ are control input currents and voltages; $Z_1 = Z_2 = Z_3 = Z_4 = 22 \text{ k}\Omega$; $R_G = 60 \text{ k}\Omega$; $R_L = 4.7 \text{ k}\Omega$; $C_1 = 2.2 \text{ mF}$; $C_0 = 10 \mu\text{F}$. 
Application notes

When one or more adjusters of an IC are not used, the following is recommended:
1. Unused signal inputs of an adjuster should be connected to the associated output, e.g. pins 3 and 4 to pin 2.
2. Unused control voltage inputs should be connected directly to pin 8.
3. Where more than one TDA1074 circuit is used in an application, pins 1 can be connected together; however, pins 8 may not be connected together directly.

RATINGS

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

Supply voltage (pin 11)        $V_p$ max. 23 V
Control voltages ($V_c$)      $V_{9.8}; V_{10.8}$ max. 1 V
                                          $-V_{9.8}; -V_{10.8}$ max. 1 V

Input voltages (with respect to pin 18) at pins 3, 4, 5, 6, 13, 14, 15, 16
                                         0 to $V_p$

Total power dissipation
$P_{tot}$ max. 800 mW

Storage temperature range
$T_{stg}$ -55 to +150 °C

Operating ambient temperature range
$T_{amb}$ -30 to +80 °C

THERMAL RESISTANCE

From crystal to ambient
$R_{th \text{ cr-a}} = 80$ °C/W
Fig. 2 Application diagram for treble and bass control.
APPLICATION INFORMATION

Tone control circuit

\[ V_p = 20 \text{ V}; \ T_{\text{amb}} = 25 \text{ \textdegree C}; \text{ in the application for treble control and bass control Fig. 2; } R_G = 60 \text{ \Omega}; \ R_L \geq 4.7 \text{ k\Omega}; \ C_L \leq 30 \text{ pF}; \ f = 1 \text{ kHz}; \text{ unless otherwise specified.} \]

Supply current; without load

\[ I_p \text{ typ. } 20 \text{ mA} \]

Frequency response \(-1 \text{ dB}\)

\[ V_c = 0 \]

\[ f \text{ typ. } 10 \text{ Hz to } 20 \text{ kHz} \]

Voltage gain at linear frequency response

\[ V_c = 0 \]

\[ G_v \text{ typ. } 0 \text{ dB} \]

Maximum gain variation at \( f = 1 \text{ kHz} \)

\[ \Delta G_v \text{ typ. } \pm 1.5 \text{ dB} \]

Bass boost at 40 Hz (ref. 1 kHz)

\[ V_c(\text{II}) = V_{10-8} = 120 \text{ mV} \]

\[ \text{typ. } 17 \text{ dB} \]

Bass cut at 40 Hz (ref. 1 kHz)

\[ -V_c(\text{II}) = V_{10-8} = 120 \text{ mV} \]

\[ \text{typ. } -17 \text{ dB} \]

Treble boost at 16 kHz (ref. 1 kHz)

\[ V_c(\text{I}) = V_{9-8} = 120 \text{ mV} \]

\[ \text{typ. } 16 \text{ dB} \]

Treble cut at 16 kHz (ref. 1 kHz)

\[ -V_c(\text{I}) = V_{9-8} = 120 \text{ mV} \]

\[ \text{typ. } -16 \text{ dB} \]

Total distortion at \( V_i(\text{rms}) = 5 \text{ V} \)

\[ V_c = 0, \text{ at linear frequency response} \]

\[ d_{\text{tot}} \text{ typ. } 0.03 \% \]

\[ d_{\text{tot}} \text{ typ. } 0.07 \% \]

Channel separation at \( V_i(\text{rms}) = 5 \text{ V} \)

\[ V_c = 0, \text{ at linear frequency response} \]

\[ \alpha \text{ typ. } 80 \text{ dB} \]

Output noise voltages; \( V_c = 0; f = 20 \text{ Hz to } 20 \text{ kHz} \)

\[ V_{\text{no}(\text{rms})} \text{ typ. } 75 \text{ \mu V} \]

\[ V_{\text{no}(\text{m})} \text{ typ. } 170 \text{ \mu V} \]

\[ V_{\text{no}(\text{rms})} \leq 230 \text{ \mu V} \]

\[ V_i(\text{rms}) = V_o(\text{rms}) \text{ typ. } 6 \text{ V} \]

Signal for \( d_{\text{tot}} = 1\%; \ V_c = 0 \)

\[ V_P(\text{rms}) \leq 200 \text{ mV (at } 100 \text{ Hz); } V_c = 0 \]

Hum suppression for \( f = 100 \text{ Hz} \)

\[ \alpha_{100} \text{ typ. } 46 \text{ dB} \]

May 1979
Fig. 3 Frequency response curves; voltage gain (bass and treble) as a function of frequency.

Fig. 4 Control capability; \( V_P = 20 \, V; f = 1 \, kHz, V_c = V_{g-b} = V_{10-b} = 0 \, V \) (linear, \( G_v \, tot = 1 \)); \( R_L = 4.7 \, k\Omega \).
Dual electronic stereo potentiometer circuit

Fig. 5 Control curve; voltage gain (treble) as a function of control voltage; f = 16 kHz.

Fig. 6 Control curve; voltage gain (bass) as a function of control voltage.
APPLICATION INFORMATION (continued)

Fig. 7 Adjustment curves at 40 Hz to 16 kHz as a function of the angle of rotation ($\alpha$) of a linear potentiometer (R); for curves see table below.

<table>
<thead>
<tr>
<th>curve no.</th>
<th>value of R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 kΩ</td>
</tr>
<tr>
<td>2</td>
<td>100 kΩ</td>
</tr>
<tr>
<td>3</td>
<td>220 kΩ</td>
</tr>
<tr>
<td>4</td>
<td>470 kΩ</td>
</tr>
<tr>
<td>5</td>
<td>1 MΩ</td>
</tr>
</tbody>
</table>

Fig. 8 Circuit diagram showing measurement of curves in Fig. 7.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

12 TO 20 W HI-FI AUDIO POWER AMPLIFIER

The TDA1512 is a monolithic integrated hi-fi audio power amplifier designed for asymmetrical or symmetrical power supplies for mains-fed apparatus. Special features are:
- Thermal protection
- Low intermodulation distortion
- Low transient intermodulation distortion
- Built-in output current limiter
- Low input offset voltage
- Output stage with low cross-over distortion
- Single in-line (SIL) power package

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Supply voltage range</th>
<th>$V_p$</th>
<th>15 to 35 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total quiescent current at $V_p = 25$ V</td>
<td>$I_{tot}$</td>
<td>typ.</td>
</tr>
</tbody>
</table>

Output power at $d_{tot} = 0.7\%$
- Sine-wave power
  - $V_p = 25$ V; $R_L = 4 \Omega$; $P_0$ typ. 13 W
  - $V_p = 25$ V; $R_L = 8 \Omega$; $P_0$ typ. 7 W
- Music power
  - $V_p = 32$ V; $R_L = 4 \Omega$; $P_0$ typ. 21 W
  - $V_p = 32$ V; $R_L = 8 \Omega$; $P_0$ typ. 12 W

Closed-loop voltage gain (externally determined)
- $G_c$ typ. 30 dB

Input resistance (externally determined)
- $R_i$ typ. 20 kΩ

Signal-to-noise ratio at $P_o = 50$ mW
- $S/N$ typ. 72 dB

Supply voltage ripple rejection at $f = 100$ Hz
- $R_R$ typ. 50 dB

PACKAGE OUTLINE

9-lead SIL; plastic power (SOT-131B).
Fig. 1 Simplified internal circuit diagram.

PINNING
1. Non-inverting input
2. Input ground (substrate)
3. Compensation
4. Negative supply (ground)
5. Output
6. Positive supply (Vp)
7. Externally connected to pin 6
8. Ripple rejection
9. Inverting input (feedback)
12 to 20 W hi-fi audio power amplifier

RATINGS

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

Supply voltage
Repetitive peak output current
Non-repetitive peak output current
Total power dissipation
Storage temperature
Operating ambient temperature
A.C. short-circuit duration of load during full-load sine-wave drive

\[ R_L = 0; \ V_P = 30 \text{ V} \text{ with } R_i = 4 \Omega \]

- \[ V_P \text{ max. } 35 \text{ V} \]
- \[ I_{ORM} \text{ max. } 3.2 \text{ A} \]
- \[ I_{OSM} \text{ max. } 5 \text{ A} \]

see derating curve Fig. 2

- \[ T_{stg} \text{ } -55 \text{ to } +150 \degree \text{C} \]
- \[ T_{amb} \text{ } -25 \text{ to } +150 \degree \text{C} \]

- \[ t_{sc} \text{ max. } 100 \text{ hours} \]

Fig. 2 Power derating curves.

THERMAL RESISTANCE

From junction to mounting base

\[ R_{th \ j-mb} \leq 4 \text{ K/W} \]
TDA1512

D.C. CHARACTERISTICS

Supply voltage range

| Vp | 15 to 35 V |

Total quiescent current at Vp = 25 V

| Itot | typ. | 65 mA |

A.C. CHARACTERISTICS

Vp = 25 V; R_L = 4 Ω; f = 1 kHz; T_amb = 25 °C; measured in test circuit of Fig. 3; unless otherwise specified

Output power

<table>
<thead>
<tr>
<th>R_L</th>
<th>P_O</th>
<th>typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Ω</td>
<td>13 W</td>
<td></td>
</tr>
<tr>
<td>8 Ω</td>
<td>7 W</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R_L</th>
<th>P_O</th>
<th>typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Ω</td>
<td>21 W</td>
<td></td>
</tr>
<tr>
<td>8 Ω</td>
<td>12 W</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R_L</th>
<th>P_O</th>
<th>typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Ω</td>
<td>15 W</td>
<td></td>
</tr>
<tr>
<td>8 Ω</td>
<td>10%</td>
<td></td>
</tr>
</tbody>
</table>

Power bandwidth; –3 dB; d_tot = 0.7%

| B | 20 Hz to 20 kHz |

Voltage gain

<table>
<thead>
<tr>
<th>G_o</th>
<th>typ.</th>
<th>74 dB</th>
</tr>
</thead>
</table>

| G_c | typ. | 30 dB |

Input resistance (pin 1)

| R_i | typ. | > 100 kΩ |

Input resistance of test circuit (Fig. 3)

| R_i | typ. | 20 kΩ |

Input sensitivity

<table>
<thead>
<tr>
<th>V_i</th>
<th>typ.</th>
<th>16 mV</th>
</tr>
</thead>
</table>

| V_i | typ. | 210 mV |

Signal-to-noise ratio

| S/N | typ. | 72 dB |

at P_O = 50 mW; R_S = 2 kΩ;

| S/N | typ. | 76 dB |

f = 20 Hz to 20 kHz; unweighted weighted; measured according to IEC 173 (A-curve)

Ripple rejection at f = 100 Hz

| RR | typ. | 50 dB |

| RR | typ. | 0.1% |

Total harmonic distortion at P_O = 10 W

| d_tot | < |

| d_tot | < |

Output resistance (pin 5)

| R_o | typ. | 0.1 Ω |
Fig. 3 Test circuit.
Fig. 4  Output power as a function of the supply voltage; \( f = 1 \text{ kHz} \);

\[ d_{\text{tot}} = 0.7\% \quad \text{and} \quad d_{\text{tot}} = 10\%. \]

Fig. 5  Total harmonic distortion as a function of the output power.
PLL MOTOR SPEED CONTROL CIRCUIT FOR HI-FI APPLICATIONS

The TDA1533 is a monolithic integrated circuit intended for PLL motor speed control in several hi-fi applications; e.g. record players, cassette recorders, reel-to-reel, and operates in accordance with the phase-locked-loop (PLL) system.

The circuit incorporates the following functions:

- A quartz reference oscillator
- A synthesizer for adjustment of the phase detector reference frequency
- A programmable scaler for the several applications
- A digital memory phase detector
- A tacho-signal amplifier/limiter
- Two operational amplifiers for the external integration and loop filtering of the phase detector output.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>V_p</td>
</tr>
<tr>
<td>Supply current</td>
<td>I_p</td>
</tr>
<tr>
<td>Crystal oscillator</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>f</td>
</tr>
<tr>
<td>Temperature coefficient</td>
<td>TC</td>
</tr>
<tr>
<td>Tacho input</td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td>V_i</td>
</tr>
<tr>
<td>Input sensitivity (peak-to-peak value)</td>
<td>V_{i(p-p)}</td>
</tr>
<tr>
<td>Operational amplifiers</td>
<td></td>
</tr>
<tr>
<td>Voltage gain</td>
<td>G_v</td>
</tr>
<tr>
<td>Input bias current</td>
<td>I_bias</td>
</tr>
<tr>
<td>Input offset voltage</td>
<td>V_{io}</td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg}</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>T_{amb}</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

18-lead DIL; plastic (SOT-102C).
PINNING
1. Ground
2. Test input/output
3. Output of opamp 1
4. Input of opamp 1
5. Up/down input/output
6. Input of opamp 2
7. Output of opamp 2
8. Positive supply (+ 10 V)
9. Phase detector output
10. Lock indicator output
11. + input tacho limiter
12. – input tacho limiter
13. Output tacho limiter
14. A-input scaler control
15. B-input scaler control
16. Reset input/output
17. Crystal oscillator input
18. Crystal oscillator output

Fig. 1 Block diagram.
GENERAL DESCRIPTION (see also Fig. 1)
The crystal frequency (e.g. 4.8 MHz) is divided by the presettable 901 to 1099 divider. The scaler is used to obtain the reference signal for the digital memory phase detector. The tacho signal is derived from the tacho amplifier/limiter.
The output of the phase detector becomes HIGH on the positive-going edge of the reference signal, and it is floating on the first-coming positive edge of the tacho signal, if the angle between the edges is not more than 360°. The output becomes LOW if the first positive-going edge is the edge of the tacho signal, and it is floating on the first-coming positive edge of the reference signal. This means that the holding range is 720°.
The lock indication output is HIGH, except for the period between the two positive and the two negative-going edges of the tacho and reference signals.
The dividing number of the presettable divider depends on the state of its presets, thus on the position of the up/down counter.
A pull-up to the IC supply voltage of the reset input results into a reset of the up/down counter and dividing by 1000.
The up/down counter can be changed in position by means of the up/down input and the up/down control unit, and therefore the divisors of the presettable divider in a range from 901 to 1099.
The clock of the up/down counter is available at the reset input as a 0.1 Vp to 0.8 Vp pulse.
The timing diagram of the up/down counter is given in Fig. 2.
The up/down input and the scaler control inputs are 3-state inputs. The scaler truth table is given below.
A HIGH level at the up/down input gives an increase, a LOW level a decrease, of the phase detector reference signal frequency.
The information at the up/down input will be internally forced on the state present, over a period of 250 ms. Together with the up/down clock at the reset pin, this offers the possibility of displaying the number of clock pulses used.

SCALER TRUTH TABLE

<table>
<thead>
<tr>
<th>control inputs</th>
<th>A</th>
<th>B</th>
<th>division ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>H</td>
<td></td>
<td>note 1</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td></td>
<td>note 2</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>F</td>
<td>L</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>H</td>
<td>F</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>L</td>
<td>L</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>L</td>
<td>F</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

Notes
1. Test 1; general preset.
2. Test 2; fast clock via test pin (pin 2).
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage \( V_p = V_{B-1} \) max. 12 V
Total power dissipation \( P_{tot} \) max. 1 W
Storage temperature \( T_{stg} \) -25 to +125 °C
Operating ambient temperature \( T_{amb} \) -20 to +80 °C

CHARACTERISTICS

Supply voltage \( V_p \) typ. 10 V
Supply current \( I_p \) typ. 50 mA
Operating ambient temperature \( T_{amb} \) 0 to 60 °C

The following characteristics are measured at \( V_p = 10 \) V; \( T_{amb} = 25 \) °C; unless otherwise specified

Crystal oscillator

Frequency \( f \) typ. 4,8 MHz

Input voltage HIGH \( V_{IH} \) typ. 2,6 to 10 V
Input voltage LOW \( V_{IL} \) typ. -2,0 to +2,0 V
Input resistance \( R_i \) typ. > 50 kΩ
Input capacitance \( C_i \) typ. < 5 pF
Open voltage 1 \( V_{o1} \) typ. 2 V
Open voltage 2 \( V_{o2} \) typ. 1,3 V
Temperature coefficient \( T_{C} \) typ. < 0,1.10^-6 K^-1

Lock indicator output (open collector)

Output voltage HIGH \( V_{OH} \) typ. < 12 V
Output voltage LOW at 10 mA \( V_{OL} \) typ. < 0,25 V
Output sink current \( I_o \) typ. < 10 mA

Phase detector output

Output voltage HIGH at 20 µA \( V_{OH} \) typ. > 9,5 V
Output voltage LOW at 20 µA \( V_{OL} \) typ. > 0,3 V

Output current source \( I_o \) typ. > 30 µA

sink \( I_o \) typ. > 30 µA
### Motor speed control circuit

**Tacho input**

- **Input voltage**
  - $V_I\quad -0.3\text{ to } +10\text{ V}$

- **Input biasing current**
  - $I_{bias}\quad \text{typ. } 0.5\text{ µA}$
  - $I_{bias}\quad <\quad 5.0\text{ µA}$

- **Input sensitivity (peak-to-peak value)**
  - $V_{i(p-p)}\quad >\quad 10\text{ mV}$

- **Offset voltage over temperature range**
  - $V_{io}\quad \text{typ. } 0.1\text{ mV}$
  - $V_{io}\quad <\quad 2.0\text{ mV}$

- **Offset current over temperature range**
  - $I_{io}\quad \text{typ. } 50\text{ nA}$
  - $I_{io}\quad <\quad 250\text{ nA}$

**Tacho output** (open collector)

- **Output voltage HIGH**
  - $V_{OH}\quad <\quad 12\text{ V}$

- **Output voltage LOW at 5 mA**
  - $V_{OL}\quad <\quad 0.5\text{ V}$
  - $I_o\quad <\quad 10\text{ mA}$

**Up/down - input/output**

- **Input voltage LOW**
  - $V_{IL}\quad \text{typ. } 0\text{ V}$
  - $V_{IL}\quad < -0.4\text{ to } +0.4\text{ V}$

- **Output voltage HIGH**
  - $V_{OH}\quad < 3\text{ to } 10\text{ V}$

- **Open voltage**
  - $V_o\quad \text{typ. } 0.7\text{ V}$
  - $V_o\quad < 0.6\text{ to } 0.8\text{ V}$

- **Open voltage HIGH at 0.5 mA**
  - $V_{OH}\quad <\quad 8.5\text{ V}$
  - $V_{OH}\quad \text{typ. } 9.0\text{ V}$

- **Open voltage LOW at 0.5 mA**
  - $V_{OL}\quad <\quad 0.5\text{ V}$
  - $I_o\quad <\quad 10\text{ mA}$

- **Output sink current**
  - $|Z_o|\quad <\quad 1.5\text{ kΩ}$

**Scaler inputs**

- **Input voltage LOW**
  - $V_{IL}\quad \text{typ. } 0\text{ V}$
  - $V_{IL}\quad < -0.4\text{ to } +0.4\text{ V}$

- **Input voltage HIGH**
  - $V_{IH}\quad < 4\text{ to } 10\text{ V}$

- **Open voltage**
  - $V_o\quad \text{typ. } 0.7\text{ V}$
  - $V_o\quad < 0.6\text{ to } 0.8\text{ V}$

**Reset input/output**

- **Input voltage HIGH**
  - $V_{IH}\quad <\quad 9.5\text{ V}$
  - $V_{IH}\quad \text{typ. } 10.0\text{ V}$

- **Output voltage LOW**
  - $V_{OL}\quad \text{typ. } 0.3\text{ V}$
  - $V_{OL}\quad <\quad 0.5\text{ V}$

- **Output voltage HIGH**
  - $V_{OH}\quad \text{typ. } 8\text{ V}$
CHARACTERISTICS (continued)

Operational amplifiers

Voltage gain

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage gain</td>
<td>$G_v$</td>
<td>typ. 10000</td>
</tr>
</tbody>
</table>

Input bias current

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input bias current</td>
<td>$I_{bias}$</td>
<td>typ. 30 nA</td>
</tr>
</tbody>
</table>

Output sink current at $V_o = 1 \text{ V}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output sink current</td>
<td>$I_o$</td>
<td>typ. 0.1 mA</td>
</tr>
</tbody>
</table>

Output source current at $V_o = 9 \text{ V}$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output source current</td>
<td>$I_o$</td>
<td>typ. 15 mA</td>
</tr>
</tbody>
</table>

Input offset voltage

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input offset voltage</td>
<td>$V_{io}$</td>
<td>&lt; 15 mV</td>
</tr>
</tbody>
</table>

Input offset voltage drift

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input offset voltage drift</td>
<td>$\Delta V_{io}/\Delta T$</td>
<td>&lt; 0.25 mV/K</td>
</tr>
</tbody>
</table>

Bandwidth (3 dB)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth (3 dB)</td>
<td>$B$</td>
<td>60 Hz</td>
</tr>
</tbody>
</table>

---

(1) Start operation of up/down pin.
(2) 1st clock pulse.
(3) From this point on, restart of cycle by second excitation is possible.
(4) 2nd clock pulse.
(5) 3rd clock pulse.
(6) 4th clock pulse.

Fig. 2 Timing diagram of up/down counter.
5 W AUDIO POWER AMPLIFIER

The TDA2611A is a monolithic integrated circuit in a 9-lead single in-line (SIL) plastic package with a high supply voltage audio amplifier. Special features are:

- possibility for increasing the input impedance
- single in-line (SIL) construction for easy mounting
- very suitable for application in mains-fed apparatus
- extremely low number of external components
- thermal protection
- well defined open loop gain circuitry with simple quiescent current setting and fixed integrated closed loop gain

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range</td>
<td>VP: 6 to 35 V</td>
</tr>
<tr>
<td>Repetitive peak output current</td>
<td>IORM: &lt; 1,5 A</td>
</tr>
<tr>
<td>Output power at d_{tot} = 10%</td>
<td>Po typ. 4,5 W</td>
</tr>
<tr>
<td>V_P = 18 V; R_L = 8 Ω</td>
<td>Po typ. 5 W</td>
</tr>
<tr>
<td>V_P = 25 V; R_L = 15 Ω</td>
<td>d_{tot} typ. 0,3 %</td>
</tr>
<tr>
<td>Total harmonic distortion at P_o &lt; 2 W; R_L = 8 Ω</td>
<td></td>
</tr>
<tr>
<td>Input impedance</td>
<td></td>
</tr>
<tr>
<td>Total quiescent current at V_P = 18 V</td>
<td>I_{tot} typ. 25 mA</td>
</tr>
<tr>
<td>Sensitivity for P_o = 2,5 W; R_L = 8 Ω</td>
<td>V_i typ. 55 mV</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>T_{amb} −25 to +150 °C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T_{stg} −55 to +150 °C</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

9-lead SIL; plastic (SOT-110A).
Fig. 1 Circuit diagram; pin 3 not connected.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage
Non-repetitive peak output current
Repetitive peak output current
Total power dissipation
Storage temperature
Operating ambient temperature

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vp max.</td>
<td>35 V</td>
</tr>
<tr>
<td>IOSM max.</td>
<td>3 A</td>
</tr>
<tr>
<td>IORM max.</td>
<td>1.5 A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>see derating curves Fig. 2</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg -55 to + 150 °C</td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>Tamb -25 to + 150 °C</td>
</tr>
</tbody>
</table>

Fig. 2 Power derating curves.
TDA2611A

D.C. CHARACTERISTICS
Supply voltage range
Repetitive peak output current
Total quiescent current at $V_p = 18\, V$

A.C. CHARACTERISTICS
$T_{amb} = 25\, ^oC; V_p = 18\, V; R_L = 8\, \Omega; f = 1\, kHz$ unless otherwise specified; see also Fig. 3
A.F. output power at $d_{tot} = 10\%$

- $P_o > 4\, W$
- $P_o$ typ. $4.5\, W$
- $P_o$ typ. $1.7\, W$
- $P_o$ typ. $0.65\, W$
- $P_o$ typ. $6\, W$
- $P_o$ typ. $5\, W$

$V_p \leq 18\, V; RL = 8\, \Omega$

- Total harmonic distortion at $P_o = 2\, W$

- Frequency response

- Input impedance $\left| Z_i \right|$ typ. $45\, k\Omega$

- Noise output voltage at $R_S = 5\, k\Omega; B = 60\, Hz$ to $15\, kHz$

- Sensitivity for $P_o = 2.5\, W$

Fig. 3 Test circuit; pin 3 not connected.

* Input impedance can be increased by applying C and R between pins 5 and 9 (see also Figures 6 and 7).
Fig. 4 Total harmonic distortion as a function of output power.

Fig. 5 Output power as a function of supply voltage.

Fig. 6 Input impedance as a function of frequency; curve a for $C = 1 \mu F$, $R = 0 \Omega$; curve b for $C = 1 \mu F$, $R = 1 \text{k} \Omega$; circuit of Fig. 3; $C_2 = 10 \text{ pF}$; typical values.
Fig. 7 Input impedance as a function of R in circuit of Fig. 3; C = 1 μF; f = 1 kHz.

Fig. 8 Total harmonic distortion as a function of R_S in the circuit of Fig. 3; P_o = 3.5 W; f = 1 kHz.
Fig. 9 Total power dissipation and efficiency as a function of output power.
APPLICATION INFORMATION

Fig. 10 Ceramic pickup amplifier circuit.

Fig. 11 Total harmonic distortion as a function of output power; —— with tone control; -- without tone control; in circuit of Fig. 10; typical values.
Fig. 12 Frequency characteristics of the circuit of Fig. 10; — tone control max. high; --- tone control min. high; $P_o$ relative to $0 \, \text{dB} = 3 \, \text{W}$; typical values.

Fig. 13 Frequency characteristic of the circuit of Fig. 10; volume control at the top; tone control max. high.
INTEGRATED AM/FM RADIO RECEIVER CIRCUIT

The TDA5700 is for use in high quality battery or mains-fed a.m. and a.m./f.m. receivers as well as small low-cost a.m. portable receivers. The IC incorporates a.m. mixer, oscillator, i.f. amplifier, a.g.c. amplifier, a.m. detector and capacitor, f.m./i.f. limiting amplifier and stable base bias for f.m. front-end. The TDA5700 is pin compatible, with the h.f. part of the TBA570A. The IC has been designed to improve the distortion characteristics of the a.m. part and is very suitable in combination with ceramic filters, of which application is given.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable supply voltage range of receiver</td>
<td>V_P</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>T_amb</td>
</tr>
<tr>
<td>Supply voltage at pin 8</td>
<td>V8-16</td>
</tr>
<tr>
<td>Total quiescent current</td>
<td>I_tot</td>
</tr>
<tr>
<td>A.M. performance (at pin 2)</td>
<td></td>
</tr>
<tr>
<td>R.F. input voltage</td>
<td>V_i</td>
</tr>
<tr>
<td>S/N = 26 dB</td>
<td></td>
</tr>
<tr>
<td>for V_o = 10 mV</td>
<td></td>
</tr>
<tr>
<td>A.G.C. range; change of r.f. input voltage</td>
<td></td>
</tr>
<tr>
<td>for 10 dB expansion in audio range</td>
<td></td>
</tr>
<tr>
<td>R.F. signal handling</td>
<td>V_i</td>
</tr>
<tr>
<td>d_tot = 10%; m = 0.8</td>
<td></td>
</tr>
<tr>
<td>F.M. performance (at pin 2)</td>
<td></td>
</tr>
<tr>
<td>R.F. input voltage</td>
<td>V_i</td>
</tr>
<tr>
<td>3 dB before limiting</td>
<td></td>
</tr>
</tbody>
</table>

PACKAGE OUTLINES

TDA5700: 16-lead DIL; plastic (SOT-38).
TDA5700Q: 16-lead Q1L; plastic (SOT-58).
Fig. 1 Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage pin 8
V8-16 max. 8 V
Total power dissipation
see derating curve (Fig. 2)
Storage temperature
Tstg -55 to + 150 °C
Operating ambient temperature
V8; 4; 7; 1-16 = 8 V; see also derating curve (Fig. 2)
Tamb -20 to + 85 °C

DESIGN DATA
Characteristics of integrated components are determined by process and layout data.
Pins not under measuring condition should not be connected.

Pins 9, 10, 11, 12 and 13 are not allowed to be connected

Voltage pins 1 and 7 *
V1-16 max. 12 V
V7-16
Voltage pin 4 *
V4-16
Voltage pin 8 *
V8-16 max. 7 V
Voltage pin 3 *
V3-16 max. 3 V
Voltage pin 5 *
V5-16 max. 4 V
Voltage pin 14 *
V14-16 max. 1 V
Current pin 2, 6 and 15 *
l2; l6; l15 max. 80 μA

* Tolerated minimum for voltages 0 V; for currents 0 mA.
**D.C. CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Total quiescent current</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_{amb} = 25,^\circ\mathrm{C}$</td>
<td>$V_{8-16} = 5,4,\mathrm{V}$, $V_{8-16} = 3,4,\mathrm{V}$</td>
</tr>
<tr>
<td>$I_{tot}$ (typ.)</td>
<td>$9,\mathrm{mA}$</td>
</tr>
<tr>
<td>$I_{tot}$ (typ.)</td>
<td>$8,\mathrm{mA}$</td>
</tr>
</tbody>
</table>

Applicable supply voltage range of receiver (note 1)

| $V_p$ | $2,7$ to $12\,\mathrm{V}$ |

Base bias voltage for f.m. front-end

| Total external load current at pin 2: $I_2 = 150\,\mu\mathrm{A}$ |

**A.C. CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Input conductance at pin 2 $g_{ie}$</th>
<th>Output conductance at pin 1 $g_{oe}$</th>
<th>Input conductance at pin 15 $g_{ie}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0,45,\mathrm{MHz}$</td>
<td>$-$</td>
<td>$10$</td>
<td>$0,5$</td>
</tr>
<tr>
<td>$1,\mathrm{MHz}$</td>
<td>$0,3$</td>
<td>$-$</td>
<td>$-$</td>
</tr>
<tr>
<td>$10,7,\mathrm{MHz}$</td>
<td>$0,4$</td>
<td>$40,\mu\mathrm{A/V}$</td>
<td>$1,0,\mathrm{mA/V}$</td>
</tr>
</tbody>
</table>

A.M. performance (in test circuit Fig. 3)

<table>
<thead>
<tr>
<th>$V_{8-16}$</th>
<th>$5,4,\mathrm{V}$</th>
<th>$3,4,\mathrm{V}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i$ (typ.)</td>
<td>$18$</td>
<td>$18,\mu\mathrm{V}$</td>
</tr>
<tr>
<td>$V_i$ (typ.)</td>
<td>$2,5$</td>
<td>$6,0,\mu\mathrm{V}$</td>
</tr>
<tr>
<td>$V_o$ (typ.)</td>
<td>$100$</td>
<td>$100,\mathrm{mV}$</td>
</tr>
<tr>
<td>$S/N$ (typ.)</td>
<td>$46$</td>
<td>$49,\mathrm{dB}$</td>
</tr>
</tbody>
</table>

Notes

1. Adjustable by a dropping resistor in the $V_p$-line; see also maximum tolerated voltages for pins 1, 4, 7 and 8 in design data on page 3.

   b. R.F. signal: measured at pin 2 at source impedance of $50\,\Omega$.
   c. $f_o = 1\,\mathrm{MHz}$; $f_m = 1\,\mathrm{kHz}$.

3. $m = 0,3$. 

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4 May 1979
Integrated a.m./f.m. radio receiver circuit

Fig. 3 A.M. performance test circuit.

Fig. 4 Component side of printed-circuit board (test circuit Fig. 3).

Fig. 5 Track side of printed-circuit board (test circuit Fig. 3).
F.M. performance test circuit (Fig. 6)

$T_{\text{Amb}} = 25 \, ^\circ\text{C}; \, V_{8-16} = 5.4 \, \text{V}; \, f_0 = 10.7 \, \text{MHz}; \, \Delta f = \pm 22.5 \, \text{kHz}; \, f_m = 1 \, \text{kHz}; \, R_S = 50 \, \Omega; \, \text{unless otherwise specified.}$

Sensitivity for an f.m. signal 3 dB before limiting
- at pin 2
- at pin 15

A.F. output voltage across a load of 100 kΩ

Signal-to-noise ratio over most of signal range

A.F. signal distortion 3 dB before i.f. limiting (note 1)

- $V_I$ typ. 125 µV
- $V_I$ typ. 500 µV
- $V_O$ typ. 140 mV
- $S/N$ typ. 65 dB
- $d_{\text{tot}}$ typ. 0.5 %

![Fig. 6 Test circuit f.m. performance.](image)

1. $\Delta f = \pm 40 \, \text{kHz}; \, \text{measured with} \, V_O \, \text{at maximum.}$
Integrated a.m./f.m. radio receiver circuit

Fig. 7 Component side of printed-circuit board (test circuit Fig. 6).

Fig. 8 Track side of printed-circuit board; (test circuit Fig. 6).
Fig. 9 Performance of an f.m. circuit including the f.m. tuner.
APPLICATION INFORMATION (continued)

F.M. performance of the complete f.m. circuit measured at Vp = 6,0 V.

Sensitivity for an f.m. signal 3 dB before limiting

- at 75 Ω aerial input of the f.m. front-end (note 1)
- at pin 2; first i.f. input (notes 2 and 6)

Sensitivity for 26 dB S/N ratio at 75 Ω aerial input of the f.m. front-end (note 1)

A.F. output voltage across a volume control of 100 kΩ

at an i.f. signal beyond limiting

Signal-to-noise over most of the signal range

A.M. suppression over most of the signal range (note 3)

I.F. selectivity (note 4)

I.F. bandwidth (3 dB; note 4)

A.F. distortion at an i.f. signal level 3 dB before limiting (note 5)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vi typ.</td>
<td>12,5 μV</td>
</tr>
<tr>
<td>Vi typ.</td>
<td>125 μV</td>
</tr>
<tr>
<td>Vi typ.</td>
<td>3 μV</td>
</tr>
<tr>
<td>Vo typ.</td>
<td>140 mV</td>
</tr>
<tr>
<td>S/N typ.</td>
<td>65 dB</td>
</tr>
<tr>
<td>S/N typ.</td>
<td>60 dB</td>
</tr>
<tr>
<td>S300 typ.</td>
<td>55 dB</td>
</tr>
<tr>
<td>B typ.</td>
<td>180 kHz</td>
</tr>
<tr>
<td>dtot typ.</td>
<td>0,5 %</td>
</tr>
</tbody>
</table>

Notes

1. Aerial e.m.f. (Vi) at fo = 98 MHz; RG = 75 Ω; Δf = ± 22,5 kHz; fm = 1 kHz.
2. fo = 10,7 MHz; Δf = ± 22,5 kHz; fm = 1 kHz.
3. A.M. signal: m = 0,3; fm = 1 kHz.
   F.M. signal: fo = 10,7 MHz; Δf = ± 75 kHz; fm = 70 Hz.
   Carrier simultaneously modulated with a.m. and f.m.
4. Including the ratio detector, measured at N1 of the secondary coil of the ratio detector.
   Level of measurement: 3 dB before limiting.
5. fo = 98 MHz; Δf = 40 kHz; fm = 1 kHz.
   Measurement carried out selectively to avoid noise influence on meter reading.
6. Pin 3 bypassed to ground with a capacitor of 220 nF.
**COIL DATA**

**A.M. - i.f. coils (Fig. 3)**

N1 = 86 t.
N2 = 60 t.
C = 180 pF.
N3 = 8 t.

Fig. 10 I.F. bandpass filter (L1). TOKO sample no. 7 MCS-A 3544 EK. L = 680 μH at 455 kHz; Q₀ = 110.

N1 = 55 t.
N2 = 2 t.
N3 = 9 t.

Fig. 11 Oscillator coil (L2). TOKO sample no. 7 BOS-A 3498 EK. L = 115 μH at 796 kHz; Q₀ = 110.

**F.M. - i.f. coils (Figs 6 and 9)**

N1 = 11 t.
N2 = 5 t.
C5 = 82 pF.

Fig. 12 Primary ratio detector coil (L3). TOKO sample no. 119 ACS-A 3503 AO. L = 2,7 μH at 10,7 MHz; Q₀ = 90.

N3 = 6 t.
N2 = 6 t.
C7 = 68 pF.
N1 = 2 t.

Fig. 13 Secondary ratio detector coil (L4). TOKO sample no. 119 ACS-A 3258 EK. L = 3,25 μH at 10,7 MHz; Q₀ = 85.

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May 1979
AM CAR RADIO RECEIVER CIRCUIT

The TEA5550 is a monolithic integrated radio circuit, primarily intended for use in car radios. The IC can reduce the costs in a car radio due to the following features:

- minimum periphery
- ceramic filter application
- simple a.m./f.m. switching possibility

The TEA5550 incorporates the following functions:

- a double balanced mixer with large signal handling and common mode rejection properties
- a 'one-pin' oscillator, permitting the application of a variable capacitance diode
- an i.f. amplifier, designed for ceramic filters
- an a.m. envelope detector
- a.g.c. stages
- a voltage stabilizer, for the internal circuit current and an external current up to 20 mA
- a simple d.c. switch for a.m./f.m. radios

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range (pin 8)</td>
<td>10.2 to 16 V</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>T_{amb} typ. 25 °C</td>
</tr>
<tr>
<td>Supply voltage (pin 8)</td>
<td>V_P typ. 14.4 V</td>
</tr>
<tr>
<td>R.F. input voltage (pin 1)</td>
<td>V_i typ. 4 μV</td>
</tr>
<tr>
<td>S/N = 26 dB</td>
<td>V_i typ. 13 μV</td>
</tr>
<tr>
<td>S/N = 46 dB</td>
<td>V_i typ. 160 μV</td>
</tr>
<tr>
<td>A.F. output voltage (pin 10)</td>
<td>V_o typ. 180 mV</td>
</tr>
<tr>
<td>Total harmonic distortion; m = 0.8; V_i = 1 mV</td>
<td>THD &lt; 2.5 %</td>
</tr>
<tr>
<td>R.F. signal handling</td>
<td>V_i typ. 400 mV</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

16-lead DIL; plastic (SOT-38).
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)
Supply voltages
pin 8
pin 3
Non-repetitive peak output current (pin 9)
Total power dissipation
Storage temperature
Operating ambient temperature

D.C. CHARACTERISTICS at \( V_I = 0 \)
\( V_P = 14.4 \text{ V; } T_{\text{amb}} = 25 \text{ }^\circ\text{C}; \text{measured in Fig. 2} \)
Supply voltage range (unstabilized)*
Voltage at pin 9; \(-\lg = 0\)
Voltage at pin 10
Voltage at pins 1 and 2

* A stabilized supply voltage of 7 to 9 V can also be applied at pin 9 instead of \( V_P \) (pin 8).
AM car radio receiver circuit

Total supply current; $-I_g = 0$

Current drain
- pin 3
- pin 15

Current supplied from pin 9

Power dissipation; $-I_g = 0$

A.C. CHARACTERISTICS

$V_p = 14,4$ V; $T_{\text{amb}} = 25$ °C; r.f. condition: $f_i = 1$ MHz, $m = 0,3$, $f_m = 1$ kHz; measured in Fig. 2; unless otherwise specified

R.F. input voltage; $V_o = 30$ mV

H.F. sensitivity for:
- $S/N = 6$ dB
- $S/N = 26$ dB
- $S/N = 46$ dB
- $S/N = 50$ dB

Input conductance at pin 1
- $V_i = 0,1$ mV
- $V_i = 100$ mV

Input conductance at pin 6
- $V_i = 200$ mV

Change in r.f. input voltage for 10 dB change in a.f. output voltage; $V_{i1} = 200$ mV

A.F. output voltage
- $V_o > 160$ mV

A.F. output impedance (pin 10)

Total harmonic distortion at $m = 0,8$
- $V_i = 16$ $\mu$V
- $V_i = 1$ mV
- $V_i = 2,5$ mV

R.F. signal handling
- $\text{THD} < 10\%$; $m = 0,8$

I.F. suppression
- $V_o = 30$ mV; without input selection

Oscillator voltage
- $V_{9-16} = 8$ V; $f_{\text{osc}} = 1468$ kHz

$* \alpha = 20 \log\frac{V_{i1}}{V_{i2}}$, where: $V_{i1}$ is input voltage at $f = 468$ kHz and $V_{i2}$ is input voltage at $f = 1$ MHz.

March 1980
Fig. 2 AM test circuit; for printed-circuit board see Figs 3 and 4.
Fig. 3 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 2.

Fig. 4 Printed-circuit board showing track side.
DEVELOPMENT SAMPLE DATA
This information is derived from development samples made available for evaluation. It does not necessarily imply that the device will go into regular production.

FM/IF SYSTEM

The TEA5560 is a monolithic integrated f.m./i.f. system circuit, intended for car radios and home-receivers equipped with a ratio detector. The system incorporates the following functions:

- a three-stage i.f. limiting amplifier
- a 15 dB field-strength dependent muting circuit
- a field-strength dependent d.c. voltage for e.g.:
  - mono/stereo switching
  - channel separation control of a stereo decoder
  - an indicator (I_max ≤ 1 mA)
- standby ON/OFF switching circuit
- a voltage stabilizer, for the internal circuit current and an external current up to 10 mA
- adjustable gain (ΔG = 15 dB)

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range (pin 6)</td>
<td>V_p</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>T_amb typ.</td>
</tr>
<tr>
<td>Supply voltage (pin 6)</td>
<td>V_p typ.</td>
</tr>
<tr>
<td>Frequency</td>
<td>f_0</td>
</tr>
<tr>
<td>Sensitivity (3 dB limiting)</td>
<td>V_i typ.</td>
</tr>
<tr>
<td>Signal-to-noise ratio for V_i = 10 mV</td>
<td>S/N &gt;</td>
</tr>
<tr>
<td>A.F. output voltage at Δf = ± 22.5 kHz</td>
<td>V_o typ.</td>
</tr>
<tr>
<td>Total harmonic distortion; Δf = ± 22.5 kHz</td>
<td>THD typ.</td>
</tr>
<tr>
<td>A.M. suppression</td>
<td>α typ.</td>
</tr>
<tr>
<td>a.m. signal: m = 0.3; f_m = 1 kHz</td>
<td></td>
</tr>
<tr>
<td>f.m. signal: Δf = ± 22.5 kHz; f_m = 70 Hz</td>
<td></td>
</tr>
</tbody>
</table>

PACKAGE OUTLINE

9-lead S1L; plastic (SOT-142).
Fig. 1 Block diagram.
RATINGS

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Maximum Value</th>
<th>Minimum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pin 6</td>
<td></td>
<td>max. 24 V</td>
<td></td>
</tr>
<tr>
<td>pin 7</td>
<td></td>
<td>max. 24 V</td>
<td></td>
</tr>
<tr>
<td>Voltage at pin 4</td>
<td></td>
<td>max. 7 V</td>
<td></td>
</tr>
<tr>
<td>Voltage at pin 5</td>
<td></td>
<td>max. 9 V</td>
<td></td>
</tr>
<tr>
<td>Non-repetitive peak output current (pin 8)</td>
<td></td>
<td>max. 100 mA</td>
<td></td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>P&lt;sub&gt;tot&lt;/sub&gt;</td>
<td>max. 1000 mW</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td>-65 to +150 °C</td>
<td></td>
</tr>
<tr>
<td>Operating ambient temperature</td>
<td>T&lt;sub&gt;amb&lt;/sub&gt;</td>
<td>-30 to +85 °C</td>
<td></td>
</tr>
</tbody>
</table>

D.C. CHARACTERISTICS at \( V_1 = 0 \)

\( V_P = 14.4 \text{ V}; T_{amb} = 25 \text{ °C}; \) measured in Fig. 2

Supply voltage range (unstabilized, pin 6)*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage at pin 8</td>
<td></td>
<td>10.2 to 16 V</td>
</tr>
<tr>
<td>Voltage at pin 4 (level detector)</td>
<td></td>
<td>8 V</td>
</tr>
<tr>
<td>Voltage at pins 1, 2 and 3</td>
<td></td>
<td>&lt; 100 mV</td>
</tr>
<tr>
<td>Total supply current</td>
<td></td>
<td>2.3 V</td>
</tr>
<tr>
<td>Current supplied from pin 8</td>
<td></td>
<td>&lt; 10 mA</td>
</tr>
<tr>
<td>Current into pin 5</td>
<td></td>
<td>1.5 mA</td>
</tr>
<tr>
<td>Current into pin 7</td>
<td></td>
<td>3.5 mA</td>
</tr>
<tr>
<td>Power dissipation; (-I_8 = 0)</td>
<td></td>
<td>300 mW</td>
</tr>
</tbody>
</table>

* A stabilized supply voltage of 7 to 9 V can also be applied at pins 5 and 6 (linked); in that case pin 8 must be not connected.
A.C. CHARACTERISTICS
V_P = 14,4 V; T_amb = 25 °C; V_i = 1 mV; f_o = 10,7 MHz; Δf = ± 22,5 kHz; f_m = 1 kHz; measured in Fig. 2; unless otherwise specified.

I.F. part and ratio detector
Sensitivity at -3 dB before limiting (pin 1)
V_i typ. 150 μV
V_i 85 to 210 μV

A.F. output voltage
Δf = ± 22,5 kHz
V_o typ. 190 mV
V_o typ. 600 mV

Total harmonic distortion
Δf = ± 22,5 kHz
THD typ. 0,35 %
THD typ. 1,7 %

A.M. suppression
a.m. signal: m = 0,3; f_m = 1 kHz
f.m. signal: Δf = ± 22,5 kHz; f_m = 70 Hz
α typ. 50 dB

H.F. sensitivity at B = 300 Hz to 15 kHz
for a signal-to-noise ratio of:
S/N = 26 dB
V_i typ. 4 μV
S/N = 70 dB
V_i > 1 mV

Level detector circuit
D.C. output voltage at pin 4
V_i = 200 μV
V_i = 500 μV
V_i = 1 mV
V_i = 10 mV
V_4.9 typ. 1,4 V
V_4.9 typ. 2,0 V
V_4.9 typ. 2,6 V
V_4.9 typ. 4,5 V

Muting circuit
Output voltage ratio at V_i = 3 μV
with muting: V_4.9 < 0,3 V and
without muting: V_4.9 = 1 V
α_vo typ. 15 dB

Stabilizer circuit
Voltage at pin 8; -I_G = 0
V_8.9 7,6 to 8,2 V
-I_G < 10 mA

Maximum current supplied from pin 8
Fig. 2 F.M. test circuit; for printed-circuit board see Figs 3 and 4.

Catalogue numbers of detector coils:
- L1: 3122 138 20211
- L2: 3122 138 20221
Fig. 3 Printed-circuit board component side, showing component layout. For circuit diagram see Fig. 2.

Fig. 4 Printed-circuit board showing track side.
BIPOLAR ICs FOR RADIO AND AUDIO EQUIPMENT

FUNCTIONAL AND NUMERICAL INDEX
MAINTENANCE TYPE LIST

GENERAL

PACKAGE OUTLINES

INTRODUCTION

DEVICE DATA