Electron tubes

Book T16 1987

Monochrome tubes and deflection units

Black and white TV picture tubes

Monochrome data graphic display tubes

Deflection units
# MONOCHROME TUBES AND DEFLECTION UNITS

## Selection guide

<table>
<thead>
<tr>
<th>Black &amp; white TV picture tubes</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection units for black &amp; white TV picture tubes</td>
<td>3</td>
</tr>
<tr>
<td>Monochrome data graphic display tubes</td>
<td>4</td>
</tr>
<tr>
<td>Deflection units for monochrome data graphic display tubes</td>
<td>6</td>
</tr>
</tbody>
</table>

## General

<table>
<thead>
<tr>
<th>List of symbols</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>General operational recommendations</td>
<td>13</td>
</tr>
<tr>
<td>General data on monochrome display tubes</td>
<td>19</td>
</tr>
<tr>
<td>Type designation</td>
<td>26</td>
</tr>
<tr>
<td>Reference line gauges</td>
<td>27</td>
</tr>
<tr>
<td>Bases</td>
<td>29</td>
</tr>
</tbody>
</table>

## Device specifications

<table>
<thead>
<tr>
<th>Black &amp; white TV picture tubes</th>
<th>31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection units for black &amp; white TV picture tubes</td>
<td>111</td>
</tr>
<tr>
<td>Monochrome data graphic display tubes</td>
<td>133</td>
</tr>
<tr>
<td>Deflection units for monochrome data graphic display tubes</td>
<td>379</td>
</tr>
</tbody>
</table>

## Conversion list (catalogue number-to-type number)          | 511|
DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

ELECTRON TUBES

SEMICONDUCTORS

INTEGRATED CIRCUITS

COMPONENTS AND MATERIALS

The contents of each series are listed on pages iv to vii.

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

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application information is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Electronic Components and Materials Division is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.

Product specialists are at your service and enquiries will be answered promptly.
ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks comprises:

T1  Tubes for r.f. heating
T2a Transmitting tubes for communications, glass types
T2b Transmitting tubes for communications, ceramic types
T3  Klystrons
T4  Magnetrons for microwave heating
T5  Cathode-ray tubes
     Instrument tubes, monitor and display tubes, C.R. tubes for special applications
T6  Geiger-Müller tubes
T8  Colour display systems
     Colour TV picture tubes, colour data graphic display tube assemblies, deflection units
T9  Photo and electron multipliers
T10 Plumbicon camera tubes and accessories
T11 Microwave semiconductors and components
T12 Vidicon and Newvicon camera tubes
T13 Image intensifiers and infrared detectors
T15 Dry reed switches
T16 Monochrome tubes and deflection units
     Black and white TV picture tubes, monochrome data graphic display tubes, deflection units
SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

S1 Diodes
Small-signal silicon diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2a Power diodes

S2b Thyristors and triacs

S3 Small-signal transistors

S4a Low-frequency power transistors and hybrid modules

S4b High-voltage and switching power transistors

S5 Field-effect transistors

S6 R.F. power transistors and modules

S7 Surface mounted semiconductors

S8a Light-emitting diodes

S8b Devices for optoelectronics
Optocouplers, photosensitive diodes and transistors, infrared light-emitting diodes and infrared sensitive devices, laser and fibre-optic components

S9 Power MOS transistors

S10 Wideband transistors and wideband hybrid IC modules

S11 Microwave transistors

S12 Surface acoustic wave devices

S13 Semiconductor sensors
INTEGRATED CIRCUITS (PURPLE SERIES)

The NEW SERIES of handbooks is now completed. With effect from the publication date of this handbook the "N" in the handbook code number will be deleted.
Handbooks to be replaced during 1986 are shown below.
The purple series of handbooks comprises:

IC01  Radio, audio and associated systems
      Bipolar, MOS
      IC01N 1985

IC02a/b Video and associated systems
       Bipolar, MOS
      new issue 1986
      IC02Na/b 1985

IC03  Integrated circuits for telephony
      Bipolar, MOS
      new issue 1986
      IC03N 1985

IC04  HE4000B logic family
      CMOS
      new issue 1986
      IC4 1983

IC05N HE4000B logic family — uncased ICs
      CMOS
      published 1984

IC06N High-speed CMOS; PC74HC/HCT/HCU
      Logic family
      published 1986

IC08  ECL 10K and 100K logic families
      New issue 1986
      IC08N 1984

IC09N TTL logic series
      published 1986

IC10  Memories
      MOS, TTL, ECL
      new issue 1986
      IC7 1982

IC11N Linear LSI
      published 1985
Supplement
to IC11N

IC12  I²C-bus compatible ICs
      not yet issued

IC13  Semi-custom
      Programmable Logic Devices (PLD)
      new issue 1986
      IC13N 1985

IC14N Microprocessors, microcontrollers and peripherals
      Bipolar, MOS
      published 1985

IC15  FAST TTL logic series
      new issue 1986
      IC15N 1985

IC16  CMOS integrated circuits for clocks and watches
      first issue 1986

IC17  Integrated Services Digital Networks (ISDN)
      not yet issued

IC18  Microprocessors and peripherals
      new issue 1986*

* The Microprocessors were included in handbook IC14N 1985, so IC18 will replace that part of IC14N.
COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

C2  Television tuners, coaxial aerial input assemblies, surface acoustic wave filters
C3  Loudspeakers
C4  Ferroxcube potcores, square cores and cross cores
C5  Ferroxcube for power, audio/video and accelerators
C6  Synchronous motors and gearboxes
C7  Variable capacitors
C8  Variable mains transformers
C9  Piezoelectric quartz devices
C11 Varistors, thermistors and sensors
C12 Potentiometers, encoders and switches
C13 Fixed resistors
C14 Electrolytic and solid capacitors
C15 Ceramic capacitors
C16 Permanent magnet materials
C17 Stepping motors and associated electronics
C18 Direct current motors
C19 Piezoelectric ceramics
C20 Wire-wound components for TVs and monitors
C22 Film capacitors
## BLACK & WHITE TV PICTURE TUBES

<table>
<thead>
<tr>
<th>Face diagonal</th>
<th>Type</th>
<th>Deflection angle</th>
<th>Neck diameter</th>
<th>Max. overall length</th>
<th>$V_f/I_f$</th>
<th>$V_a$</th>
<th>$V_{g4}$</th>
<th>$V_{g2}$</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 cm (12 in)</td>
<td>A31-322W</td>
<td>90°</td>
<td>20</td>
<td>280</td>
<td>11/140</td>
<td>12</td>
<td>0-130</td>
<td>130</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>A31-410W</td>
<td>110°</td>
<td>20</td>
<td>233</td>
<td>11/140</td>
<td>12</td>
<td>0-350</td>
<td>250</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>A31-510W</td>
<td>110°</td>
<td>20</td>
<td>233</td>
<td>11/140</td>
<td>12</td>
<td>0-130</td>
<td>130</td>
<td>55</td>
</tr>
<tr>
<td>34 cm (14 in)</td>
<td>A34-111W</td>
<td>90°</td>
<td>20</td>
<td>287</td>
<td>11/140</td>
<td>12</td>
<td>0-130</td>
<td>130</td>
<td>65</td>
</tr>
<tr>
<td>44 cm (17 in)</td>
<td>A44-510W</td>
<td>110°</td>
<td>20</td>
<td>288</td>
<td>11/140</td>
<td>15</td>
<td>0-130</td>
<td>130</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>A44-520W</td>
<td>110°</td>
<td>28,6</td>
<td>291</td>
<td>6,3/240</td>
<td>20</td>
<td>0-130</td>
<td>130</td>
<td>87</td>
</tr>
<tr>
<td>50 cm (20 in)</td>
<td>A50-520W</td>
<td>110°</td>
<td>28,6</td>
<td>319</td>
<td>6,3/240</td>
<td>20</td>
<td>0-130</td>
<td>130</td>
<td>99</td>
</tr>
</tbody>
</table>
### DEFLECTION UNITS FOR BLACK & WHITE TV PICTURE TUBES

<table>
<thead>
<tr>
<th>tube face diagonal</th>
<th>type</th>
<th>deflection angle</th>
<th>tube neck diameter (mm)</th>
<th>line coils</th>
<th>field coils</th>
<th>sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inductance</td>
<td>resistance</td>
<td>at e.h.t.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>µH</td>
<td>Ω</td>
<td>kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inductance</td>
<td>resistance</td>
<td>full-scan current</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mH</td>
<td>Ω</td>
<td>line A (p-p)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>field A (p-p)</td>
</tr>
<tr>
<td>24 cm (9 in)</td>
<td>AT1077/01</td>
<td>90°</td>
<td>20</td>
<td>475</td>
<td>0,80</td>
<td>72</td>
</tr>
<tr>
<td>31/34 cm (12/14 in)</td>
<td>AT1077/02</td>
<td>90°</td>
<td>20</td>
<td>436</td>
<td>0,80</td>
<td>68</td>
</tr>
<tr>
<td>44/50 cm (17/20 in)</td>
<td>AT1040/04</td>
<td>110°</td>
<td>28,6</td>
<td>2090</td>
<td>3,55</td>
<td>17,0</td>
</tr>
<tr>
<td></td>
<td>AT1040/15</td>
<td>110°</td>
<td>28,6</td>
<td>3320</td>
<td>6,10</td>
<td>17,0</td>
</tr>
<tr>
<td></td>
<td>AT1040/17</td>
<td>110°</td>
<td>28,6</td>
<td>8360</td>
<td>14,2</td>
<td>17,0</td>
</tr>
</tbody>
</table>
### MONOCHROME DATA GRAPHIC DISPLAY TUBES

<table>
<thead>
<tr>
<th>face diagonal</th>
<th>type</th>
<th>deflection angle</th>
<th>useful screen diagonal mm</th>
<th>neck diameter mm</th>
<th>max. overall length mm</th>
<th>$V_f/l_f$ V/mA</th>
<th>$V_a$ kV</th>
<th>$V_{g2}$ V</th>
<th>resolution (approx.) (number of lines)</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 cm (9 in)</td>
<td>M24-306, M24-308, M24-310, M24-328</td>
<td>90°</td>
<td>222,5</td>
<td>20</td>
<td>227</td>
<td>12/130</td>
<td>12</td>
<td>400</td>
<td>1300</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>M24-322, M24-326</td>
<td>90°</td>
<td>222,5</td>
<td>20</td>
<td>227</td>
<td>12/75</td>
<td>12</td>
<td>400</td>
<td>1000</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>M24-511W, M24-512W, M24-514W</td>
<td>90°</td>
<td>222,5</td>
<td>20</td>
<td>227</td>
<td>11/140</td>
<td>12</td>
<td>130</td>
<td>800</td>
<td>161</td>
</tr>
<tr>
<td>31 cm (12 in)</td>
<td>M31-340, M31-342, M31-344, M31-346, M31-348</td>
<td>90°</td>
<td>295</td>
<td>20</td>
<td>277</td>
<td>12/130</td>
<td>12</td>
<td>400</td>
<td>1300</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>M31-362, M31-364, M31-366</td>
<td>90°</td>
<td>295</td>
<td>20</td>
<td>277</td>
<td>12/75</td>
<td>12</td>
<td>400</td>
<td>1000</td>
<td>263</td>
</tr>
<tr>
<td></td>
<td>M31-336, M31-338, M31-350</td>
<td>90°</td>
<td>292</td>
<td>20</td>
<td>280</td>
<td>12/130</td>
<td>12</td>
<td>400</td>
<td>1300</td>
<td>221</td>
</tr>
<tr>
<td></td>
<td>M31-354, M31-326, M31-370</td>
<td>90°, 110°</td>
<td>295, 28,6</td>
<td>241</td>
<td>6,3/240</td>
<td>17</td>
<td>400</td>
<td>1500</td>
<td>197</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M31-328</td>
<td>110°</td>
<td>295</td>
<td>28,6</td>
<td>241</td>
<td>12/130</td>
<td>17</td>
<td>400</td>
<td>1500</td>
<td>209</td>
</tr>
<tr>
<td>34 cm (14 in)</td>
<td>M32EAA, M32EBF</td>
<td>90°</td>
<td>322</td>
<td>20</td>
<td>287</td>
<td>12/130</td>
<td>14</td>
<td>400</td>
<td>1300</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>M32EAB, M32EAK</td>
<td>90°</td>
<td>322</td>
<td>20</td>
<td>287</td>
<td>12/75</td>
<td>14</td>
<td>400</td>
<td>1000</td>
<td>289</td>
</tr>
<tr>
<td>face diagonal</td>
<td>type</td>
<td>deflection angle</td>
<td>useful screen diagonal mm</td>
<td>neck diameter mm</td>
<td>max. overall length mm</td>
<td>$V_f/I_f$</td>
<td>$V_a$</td>
<td>$V_g2$</td>
<td>resolution (approx.)</td>
<td>page</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------</td>
<td>------------------</td>
<td>---------------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
<td>----------------------</td>
<td>------</td>
</tr>
<tr>
<td>38 cm (15 in)</td>
<td>M38-328</td>
<td>110°</td>
<td>352</td>
<td>28,6</td>
<td>279</td>
<td>6,3/240</td>
<td>17</td>
<td>400</td>
<td>1500</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>M38-330</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-332</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-334</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-336</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-338</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-342</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-344</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M38-346</td>
<td>110°</td>
<td>352</td>
<td>28,6</td>
<td>279</td>
<td>12/130</td>
<td>17</td>
<td>400</td>
<td>1500</td>
<td>343</td>
</tr>
<tr>
<td></td>
<td>M38-348</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44 cm (17 in)</td>
<td>M41EAA0</td>
<td>114°</td>
<td>413</td>
<td>28,6</td>
<td>291</td>
<td>6,3/240</td>
<td>20</td>
<td>400</td>
<td>1500</td>
<td>355</td>
</tr>
<tr>
<td>50 cm (20 in)</td>
<td>M47EAA0</td>
<td>114°</td>
<td>473</td>
<td>28,6</td>
<td>319</td>
<td>6,3/240</td>
<td>20</td>
<td>400</td>
<td>1400</td>
<td>367</td>
</tr>
</tbody>
</table>

**FLAT SQUARE MONOCHROME DISPLAY TUBES**

<table>
<thead>
<tr>
<th>face diagonal</th>
<th>type</th>
<th>deflection angle</th>
<th>useful screen diagonal mm</th>
<th>neck diameter mm</th>
<th>max. overall length mm</th>
<th>$V_f/I_f$</th>
<th>$V_a$</th>
<th>$V_g2$</th>
<th>resolution (approx.)</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 cm (12 in)</td>
<td>M29EAA</td>
<td>90°</td>
<td>294</td>
<td>20</td>
<td>275</td>
<td>12/130</td>
<td>12</td>
<td>400</td>
<td>1300</td>
<td>173</td>
</tr>
<tr>
<td></td>
<td>M29EAB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>M29ECA</td>
<td>90°</td>
<td>294</td>
<td>20</td>
<td>275</td>
<td>12/75</td>
<td>12</td>
<td>400</td>
<td>1000</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td>M29ECB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34 cm (14 in)</td>
<td>M33EAA</td>
<td>90°</td>
<td>333</td>
<td>20</td>
<td>295</td>
<td>12/130</td>
<td>14</td>
<td>400</td>
<td>1300</td>
<td>301</td>
</tr>
<tr>
<td></td>
<td>M33EAB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 cm (15 in)</td>
<td>M36EAB</td>
<td>110°</td>
<td>363</td>
<td>28,6</td>
<td>276</td>
<td>6,3/240</td>
<td>17</td>
<td>400</td>
<td>1500</td>
<td>313</td>
</tr>
</tbody>
</table>

**NOTE**
For recommended combinations for monochrome data graphic displays, see Data Handbook C20, section “Selection guide”.
# Deflection Units for Monochrome Data Graphic Display Tubes

<table>
<thead>
<tr>
<th>Tube Face Diagonal</th>
<th>Type</th>
<th>Deflection Angle</th>
<th>Tube Neck Diameter (mm)</th>
<th>Line Coils (μH, Ω)</th>
<th>Field Coils (mH, Ω)</th>
<th>Sensitivity at Full-Scan Current (kV, A(p-p))</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 cm (7 in)</td>
<td>AT1071/07</td>
<td>90°</td>
<td>28.6</td>
<td>84.5, 0.14</td>
<td>41.6, 16.8</td>
<td>15, 6.85, 0.35</td>
<td>437</td>
</tr>
<tr>
<td>24 cm (9 in)</td>
<td>AT1077/01(A)</td>
<td>90°</td>
<td>20</td>
<td>475, 0.80</td>
<td>72, 40</td>
<td>10, 2.7, 0.24</td>
<td>441(445)</td>
</tr>
<tr>
<td></td>
<td>AT1077/09</td>
<td>90°</td>
<td>20</td>
<td>475, 0.80</td>
<td>18, 10</td>
<td>12, 2.91, 0.50</td>
<td>461</td>
</tr>
<tr>
<td></td>
<td>AT1077/10</td>
<td>90°</td>
<td>20</td>
<td>475, 0.80</td>
<td>72, 40</td>
<td>12, 2.91, 0.25</td>
<td>465</td>
</tr>
<tr>
<td>29 cm (12 in)</td>
<td>AT1078/10**</td>
<td>90°</td>
<td>20</td>
<td>310, 0.66</td>
<td>23.8, 13.6</td>
<td>12, 3.33, 0.44</td>
<td>501</td>
</tr>
<tr>
<td>31 cm (12 in)</td>
<td>AT1038/41</td>
<td>110°</td>
<td>28.6</td>
<td>700, 1.03</td>
<td>56.4*, 30.4*</td>
<td>17, 4.46, 0.98</td>
<td>381</td>
</tr>
<tr>
<td></td>
<td>AT1071/05</td>
<td>90°</td>
<td>28.6</td>
<td>91.5, 0.15</td>
<td>13, 7.0</td>
<td>17, 9.2, 0.91</td>
<td>433</td>
</tr>
<tr>
<td></td>
<td>AT1077/05</td>
<td>90°</td>
<td>20</td>
<td>475, 0.80</td>
<td>18, 10</td>
<td>12, 2.9, 0.48</td>
<td>449</td>
</tr>
<tr>
<td></td>
<td>AT1077/06</td>
<td>90°</td>
<td>20</td>
<td>475, 0.80</td>
<td>72, 40</td>
<td>12, 2.9, 0.24</td>
<td>453</td>
</tr>
<tr>
<td></td>
<td>AT1077/07</td>
<td>90°</td>
<td>20</td>
<td>118, 0.22</td>
<td>18, 10</td>
<td>12, 5.8, 0.48</td>
<td>457</td>
</tr>
<tr>
<td></td>
<td>AT1077/15</td>
<td>90°</td>
<td>20</td>
<td>240, 0.42</td>
<td>12.5, 7.25</td>
<td>12, 4.2, 0.60</td>
<td>469</td>
</tr>
<tr>
<td></td>
<td>AT1077/16</td>
<td>90°</td>
<td>20</td>
<td>170, 0.35</td>
<td>6.6, 4.35</td>
<td>12, 4.92, 0.80</td>
<td>473</td>
</tr>
<tr>
<td></td>
<td>AT1077/20</td>
<td>90°</td>
<td>20</td>
<td>145, 0.25</td>
<td>18, 10</td>
<td>12, 5.3, 0.50</td>
<td>477</td>
</tr>
<tr>
<td></td>
<td>AT1077/22</td>
<td>90°</td>
<td>20</td>
<td>112, 0.20</td>
<td>7.7, 4.15</td>
<td>12, 6.1, 0.74</td>
<td>481</td>
</tr>
<tr>
<td></td>
<td>AT1077/23</td>
<td>90°</td>
<td>20</td>
<td>240, 0.42</td>
<td>31, 16.6</td>
<td>12, 4.2, 0.37</td>
<td>485</td>
</tr>
<tr>
<td></td>
<td>AT1078/01</td>
<td>90°</td>
<td>20</td>
<td>310, 0.66</td>
<td>23.8, 13.6</td>
<td>12, 3.4, 0.48</td>
<td>489</td>
</tr>
<tr>
<td></td>
<td>AT1078/02</td>
<td>90°</td>
<td>20</td>
<td>480, 0.90</td>
<td>18, 11.5</td>
<td>12, 2.96, 0.52</td>
<td>493</td>
</tr>
<tr>
<td></td>
<td>AT1078/19</td>
<td>90°</td>
<td>20</td>
<td>245, 0.53</td>
<td>6.85, 4.10</td>
<td>12, 3.9, 0.85</td>
<td>505</td>
</tr>
</tbody>
</table>

* Coils can be connected in series or parallel. The indicated values apply to parallel-connected line coils, and series connected field coils.

** For flat square application.
<table>
<thead>
<tr>
<th>tube face diagonal</th>
<th>type</th>
<th>deflection angle</th>
<th>tube neck diameter</th>
<th>line coils</th>
<th>field coils</th>
<th>sensitivity</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inductance</td>
<td>resistance</td>
<td>inductance</td>
<td>resistance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>µH</td>
<td>Ω</td>
<td>µH</td>
<td>Ω</td>
</tr>
<tr>
<td>31 cm (12 in)</td>
<td>AT1039/03</td>
<td>110°</td>
<td>28,6</td>
<td>228*</td>
<td>0,41*</td>
<td>9,18*</td>
<td>10,2*</td>
</tr>
<tr>
<td>landscape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 cm (14 in)</td>
<td>AT1078/04</td>
<td>90°</td>
<td>20</td>
<td>310</td>
<td>0,66</td>
<td>23,8</td>
<td>13,6</td>
</tr>
<tr>
<td>landscape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 cm (15 in)</td>
<td>AT1039/21**</td>
<td>110°</td>
<td>28,6</td>
<td>205*</td>
<td>0,33*</td>
<td>9,5*</td>
<td>10,4*</td>
</tr>
<tr>
<td>landscape</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 cm (15 in)</td>
<td>AT1039/00</td>
<td>110°</td>
<td>28,6</td>
<td>225*</td>
<td>0,39*</td>
<td>9,18*</td>
<td>10,2*</td>
</tr>
<tr>
<td>portrait</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 cm (15 in)</td>
<td>AT1038/42</td>
<td>110°</td>
<td>28,6</td>
<td>206*</td>
<td>0,36*</td>
<td>9,5*</td>
<td>10,5*</td>
</tr>
<tr>
<td>landscape</td>
<td>AT1039/01</td>
<td>110°</td>
<td>28,6</td>
<td>700</td>
<td>1,03</td>
<td>56,4*</td>
<td>30,4*</td>
</tr>
</tbody>
</table>

NOTE
For recommended combinations for monochrome data graphic displays, see Data Handbook C20, section "Selection guide".

* Coils can be connected in series or parallel. The indicated values apply to parallel-connected line coils, and series connected field coils.
** For flat square application.
LIST OF SYMBOLS

Symbols denoting electrodes/elements and electrode/element connections

- f: Heater
- k: Cathode
- g: Grid: Grids are distinguished by means of an additional numeral; the electrode nearest to the cathode having the lowest number.
- a: Anode
- m: External conductive coating
- m': Rimband or tension band (T-band)
- : Fluorescent screen
- i.c.: Tube pin which must not be connected externally
- n.c.: Tube pin which may be connected externally

Symbols denoting voltages

Unless otherwise stated, the reference point for electrode voltages is the cathode.

- V: Symbol for voltage, followed by a subscript denoting the relevant electrode/element
- V_f: Heater voltage
- V_{(p-p)}: Peak-to-peak value of a voltage
- V_p: Peak value of a voltage
- V_{GR}: Grid 1 voltage for visual extinction of focused raster (grid drive service)
- V_{KR}: Cathode voltage for visual extinction of focused raster (cathode drive service)

Symbols denoting currents

- I: Symbol for current, followed by a subscript denoting the relevant electrode
- I_f: Heater current (r.m.s. value)

Note: The symbols quoted represent the average value of the current, unless otherwise stated.

Symbols denoting powers

- P_g: Dissipation of the fluorescent screen
- P_{g^*}: Grid dissipation

Symbols denoting capacitances

See IEC publication 100

Symbols denoting resistances and impedances

- R: Symbol for resistance, followed by a subscript for the relevant electrode pair. When only one subscript is given, the second electrode is the cathode.
- Z: Symbol for impedance, followed by a subscript for the relevant electrode pair. When only one subscript is given, the second electrode is the cathode.

Symbols denoting various quantities

- L: Luminance
- f: Frequency
- H: Magnetic field strength
GENERAL OPERATIONAL RECOMMENDATIONS

INTRODUCTION
Equipment design should be based on the characteristics as stated in the data sheets. Where deviations from these general recommendations are permissible or necessary, statements to that effect will be made.

If applications are considered which are not referred to in the data sheets of the relevant tube type extra care should be taken with circuit design to prevent the tube being overloaded due to unfavourable operating conditions.

SPREAD IN TUBE CHARACTERISTICS
The spread in tube characteristics is the difference between maximum and minimum values. Values not qualified as maximum or minimum are nominal ones. It is evident that average or nominal values, as well as spread figures, may differ according to the number of tubes of a certain type that are being checked. No guarantee is given for values of characteristics in settings substantially differing from those specified in the data sheets.

SPREAD AND VARIATION IN OPERATING CONDITIONS
The operating conditions of a tube are subject to spread and/or variation.

Spread in an operating condition is a permanent deviation from an average condition due to, e.g., component value deviations. The average condition is found from such a number individual cases taken at random that an increase of the number will have a negligible influence.

Variation in an operating condition is non-permanent (occurs as a function of time), e.g., due to supply voltage fluctuations. The average value is calculated over a period such that a prolongation of that period will have negligible influence.

LIMITING VALUES
Limiting values are in accordance with the applicable rating system as defined by IEC publication 134. Reference may be made to one of the following 3 rating systems.

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, 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 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 components spread and variation, equipment control adjustment, load variations, signal variation, environmental conditions, and spread or variations in characteristics of the device under considerations 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.
GENERAL

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 average 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 spread and variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations or spread 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.

If the tube data specify limiting values according to more than one rating system the circuit has to be designed so that none of these limiting values is exceeded under the relevant conditions.

In addition to the limiting values given in the individual data sheets the directives in the following paragraphs should be observed.

HEATER SUPPLY

For maximum cathode life it is recommended that the heater supply be stabilized at the nominal heater voltage, +0%, −5%. Any deviation from this heater voltage has a detrimental effect on tube performance and life, and should therefore be kept to a minimum. Such deviations may be caused by:

- mains voltage fluctuations;
- spread in the characteristics of components such as transformers, resistors, capacitors, etc.;
- spread in circuit adjustments;
- operational variations.

Supply from mains transformer

The maximum deviation of the heater voltage must not exceed ± 10% (Design Maximum Value).

Supply from line output transformer

A deviation from the nominal heater voltage due to spread in component characteristics and adjustments should not exceed ± 7,5%. Considering all other possible deviations, due to mains voltage variations, beam current variations, VCR-operation, etc., the total spread in heater voltage must not exceed ± 10%.

* A bogey tube is a tube whose characteristics have the published nominal values for the type. A bogey tube for any particular application can be obtained by considering only those characteristics which are directly related to the application.
General operational recommendations

Standby (instant-on circuits)
The majority of tubes employ quick-heating cathodes and therefore an instant-on circuit is superfluous. If used, it is recommended to that the heater voltage of the tubes be reduced during standby operation to 75% of the nominal value.

Notes: If series connection of the heater circuit has to be used, and only parallel connection is quoted in the data sheet, please contact your local supplier.

Picture tubes with quick-heating cathodes should not be used in series with receiving tubes.

Cathode to heater voltage
The voltage between cathode and heater should be as low as possible and never exceed the limiting values given in the data sheets of the individual tubes. The limiting values relate to that side of the heater where the voltage between cathode and heater is greatest. The voltage between cathode and heater may be d.c., a.c., or a combination of both. Unless otherwise stated, the maximum values quoted indicate the maximum permissible d.c. voltage. If a combination of d.c. and a.c. voltages is applied, the peak value may be twice the rated $V_{KF}$; however, unless otherwise stated, this peak value shall never exceed 315 V. Unless otherwise stated, the $V_{KF max}$ holds for both polarities of the voltage; however, a positive cathode is usually the most favourable in view of insulation during life.

In order to avoid excessive hum the a.c. component of the heater to cathode voltage should be as low as possible and never exceed 20 V r.m.s. (mains frequency). A d.c. connection should always be present between heater and cathode. Unless otherwise specified the maximum resistance should not exceed 1 MΩ; the maximum impedance at mains frequency should be less than 100 kΩ.

Intermediate electrodes (between cathode and final accelerator)
In no circumstances should the tube be operated without a d.c. connection between each electrode and the cathode. The total effective impedance between each electrode and the cathode should never exceed the published maximum value. However, no electrode should be connected directly to a high energy source. When such a connection is required, it should be made via a series resistor of not less than 1 kΩ.

Cut-off voltage
Curves showing the limits of the cut-off voltage as a function of grid 2 voltage are generally included in the data. The brightness control should be so dimensioned that it can handle any tube within the limits shown, at the appropriate grid 2 voltage.

The published limits are determined at an ambient illumination level of 10 lux. Because the brightness of a spot is in general greater than that of a raster of the same current, the cut-off voltage determined with the aid of a focused spot will be more negative by about 5 V as compared with that of a focused raster.

Focusing electrode voltage
Individual tubes will have satisfactory focus over the entire screen at some value within the published range of the focusing voltage.

Due to their flat focus characteristics, black and white picture tubes can generally be operated at a fixed focusing voltage within the published range. Monochrome data graphic display tubes should have adjustable focus.
LUMINESCENT SCREEN
To prevent permanent screen damage, care should be taken:
— not to operate the tube with a stationary picture at high beam currents for extended periods;
— not to operate the tube with a stationary or slowly moving spot except at extremely low beam currents;
— if no e.h.t. bleeder is used, to choose the time constants of the cathode, grid 1, grid 2, and deflection circuits, such that sufficient beam current is maintained to discharge the e.h.t. capacitance before deflection has ceased after equipment has been switched off.

EXTERNAL CONDUCTIVE COATING
The external conductive coating must be connected to the chassis. The capacitance of this coating to the final accelerating electrode may be used to provide smoothing for the e.h.t. supply.

The coating is not a perfect conductor and in order to reduce electromagnetic radiation caused by the line time base and the picture content it may be necessary to make multiple connections to the coating. See also ‘Flashover’.

METAL RIMBAND
An appreciable capacitance exists between the metal rimband and the internal conductive coating of the tube; its value is quoted in the individual data sheets. To avoid electric shock, a d.c. connection should be provided between the metal band and the external conductive coating. In receivers where the chassis can be connected directly to the mains there is a risk of electric shock if access is made to the metal band. To reduce the shock to the safe limit, it is suggested that a 2 MΩ resistor capable of handling the peak voltages be inserted between the metal band and the point of contact with the external conductive coating. In receivers where the chassis can be connected directly to the mains there is a risk of electric shock if access is made to the metal band. To reduce the shock to the safe limit, it is suggested that a 2 MΩ resistor capable of handling the peak voltages be inserted between the metal band and the point of contact with the external conductive coating. This safety arrangement will provide the necessary insulation from the mains but in the event of flashover high voltages will be induced on the metal band. It is therefore recommended that the 2 MΩ resistor be bypassed by a 4,7 nF capacitor capable of withstanding the peak voltage determined by the voltage divider formed by this capacitor and the capacitance of the metal rimband to the internal conductive coating, and the anode voltage. The 4,7 nF capacitor also serves to improve e.h.t. smoothing by adding the rimband capacitance to the capacitance of the outer conductive coating.

FLASHOVER
High electric field strengths are present between the gun electrodes of picture tubes. Voltages between gun electrodes may reach values of 20 kV over approx. 1 mm. Although the utmost precautions are taken in the design and manufacture of the tubes, there is always a chance that flashover will occur. The resulting transient currents and voltages may be of sufficient magnitude to cause damage to the tube itself and to various components on the chassis. Arcing terminates when the e.h.t. capacitor is discharged. Therefore it is of vital importance to provide protective circuits with spark gaps and series resistors, which should be connected according to Fig. 1. No other connections between the outer conductive coating and the chassis are permissible.
IMPLOSION PROTECTION

All picture tubes employ integral implosion protection and must be replaced with a tube of the same type number or recommended replacement to assure continued safety.

HANDLING

Although all picture tubes are provided with integral implosion protection, which meets the intrinsic protection requirements stipulated in the relevant part of IEC 65, care should be taken not to scratch or knock any part of the tube. Stress on the tube neck must be avoided.

When lifting a tube from the edge-down position, one hand should be placed around the parabola section of the cone and the other hand should be placed under the rim band (Fig. 2).

When placing a tube face downwards ensure that the screen rests on a soft pad of suitable material, kept free from abrasive substances. When lifting from the face-down position the hand should be placed under the areas of the faceplate close to the mounting lugs at diagonally opposite corners of the faceplate (Fig. 3).

When lifting from the face-up position the hands should be placed under the areas of the cone close to the mounting lugs at diagonally opposite corners of the cone (Fig. 4).
In all handling procedures prior to insertion in the receiver cabinet there is a risk of personal injury as a result of severe accidental damage to the tube. It is therefore recommended that protective clothing should be worn, particularly eye shielding.

If suspending the tube from the mounting lugs ensure that a minimum of 2 are used; UNDER NO CIRCUMSTANCES HANG THE TUBE FROM ONE LUG.

Remember when replacing or servicing the picture tube that a residual electrical charge may be carried by the anode contact and also the external coating if not earthed. Before removing the tube from the equipment, earth the external coating and short the anode contact to the coating.

PACKING
The packing provides protection against tube damage under normal conditions of shipment or handling. Observe any instructions given on the packing and handle accordingly. The tube should under no circumstances be subjected to accelerations greater than 35g.

MOUNTING
Unless otherwise specified on the data sheets for individual tubes there are no restrictions on the position of mounting.

The tube socket should not be rigidly mounted but should have flexible leads and be allowed to move freely.

The mass of the socket and additional circuitry should not be more than 150 g. The socket of tubes with a 7-pin miniature base may not be used for mounting components.

It is very desirable that tubes should not be exposed to strong electrostatic and magnetic fields.

DIMENSIONS
In designing the equipment the tolerances given on the dimensional drawings should be considered. Under no circumstances should the equipment be designed around dimensions taken from individual tubes.

REFERENCE LINE
Where a reference line is indicated on the tube outline drawing, it is determined by means of a gauge. Drawings of the gauges are given in this section under “Reference line gauges”
GENERAL DATA ON MONOCHROME DISPLAY TUBES

Glass transmission
Two types of screen glass are available:
  – normal tinted glass,
  – dark tinted glass, for improved contrast.
The light transmission at the screen centre of both types is shown in the table below.

<table>
<thead>
<tr>
<th>tube</th>
<th>normal tinted glass</th>
<th>dark tinted glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 cm (9 in), 90°</td>
<td>approx. 53%</td>
<td>approx. 42%</td>
</tr>
<tr>
<td>29 cm (12 in), 90°*</td>
<td>approx. 43%</td>
<td>approx. 30%</td>
</tr>
<tr>
<td>31 cm (12 in), 90°; 3 x 4</td>
<td>approx. 46%</td>
<td>approx. 34%</td>
</tr>
<tr>
<td>31 cm (12 in), 90°; 4 x 5</td>
<td>approx. 50%</td>
<td>approx. 34%</td>
</tr>
<tr>
<td>31 cm (12 in), 110°</td>
<td>approx. 46%</td>
<td>approx. 34%</td>
</tr>
<tr>
<td>34 cm (14 in), 90°</td>
<td>approx. 48%</td>
<td>approx. 34%</td>
</tr>
<tr>
<td>38 cm (15 in), 110°</td>
<td>approx. 46%</td>
<td>approx. 34%</td>
</tr>
<tr>
<td>41 cm (17 in), 114°</td>
<td>approx. 48%</td>
<td>–</td>
</tr>
<tr>
<td>47 cm (20 in), 114°</td>
<td>approx. 46%</td>
<td>–</td>
</tr>
</tbody>
</table>

Screen surface treatments
Two types of anti-glare treatments are available:
  – direct grind, i.e. the screen is ground to an ultrafine finish that minimizes reflection without blurring the image or decreasing resolution,
  – direct etch, i.e. the screen is etched to a finish that diffuses specular reflection.

* Flat square high resolution monochrome display tube.
### Survey of screen phosphors

<table>
<thead>
<tr>
<th>type</th>
<th>designation</th>
<th>fluorescent colour</th>
<th>phosphorescent colour</th>
<th>persistence*</th>
<th>colour co-ordinates x</th>
<th>y</th>
<th>relative brightness (%) with respect to type WW</th>
</tr>
</thead>
<tbody>
<tr>
<td>WW</td>
<td>P4</td>
<td>white</td>
<td>white</td>
<td>medium short</td>
<td>0,265</td>
<td>0,295</td>
<td>100</td>
</tr>
<tr>
<td>GA</td>
<td>P40</td>
<td>white</td>
<td>yellowish-green</td>
<td>medium</td>
<td>0,250</td>
<td>0,300</td>
<td>approx. 80</td>
</tr>
<tr>
<td>GH</td>
<td>P31</td>
<td>green</td>
<td>green</td>
<td>medium short</td>
<td>0,265</td>
<td>0,550</td>
<td>approx. 150</td>
</tr>
<tr>
<td>GR</td>
<td>P39</td>
<td>yellowish-green</td>
<td>yellowish-green</td>
<td>long</td>
<td>0,205</td>
<td>0,715</td>
<td>approx. 75</td>
</tr>
<tr>
<td>GW</td>
<td>P42</td>
<td>yellowish-green</td>
<td>yellowish-green</td>
<td>medium</td>
<td>0,238</td>
<td>0,568</td>
<td>approx. 120</td>
</tr>
<tr>
<td>HA</td>
<td>—</td>
<td>yellowish-green</td>
<td>yellowish-green</td>
<td>medium</td>
<td>0,220</td>
<td>0,660</td>
<td>approx. 85</td>
</tr>
<tr>
<td>HC</td>
<td>—</td>
<td>yellow-green</td>
<td>yellow-green</td>
<td>long</td>
<td>0,205</td>
<td>0,715</td>
<td>approx. 75</td>
</tr>
<tr>
<td>KC</td>
<td>—</td>
<td>yellow-green</td>
<td>yellow-green</td>
<td>medium-short</td>
<td>0,425</td>
<td>0,550</td>
<td>approx. 170</td>
</tr>
<tr>
<td>LA</td>
<td>—</td>
<td>orange</td>
<td>orange</td>
<td>medium</td>
<td>0,557</td>
<td>0,442</td>
<td>approx. 60</td>
</tr>
<tr>
<td>LM</td>
<td>—</td>
<td>orange</td>
<td>orange</td>
<td>medium short</td>
<td>0,547</td>
<td>0,446</td>
<td>approx. 85</td>
</tr>
<tr>
<td>LQ</td>
<td>—</td>
<td>orange</td>
<td>orange</td>
<td>medium</td>
<td>0,557</td>
<td>0,442</td>
<td>approx. 60</td>
</tr>
<tr>
<td>WD</td>
<td>—</td>
<td>white</td>
<td>white</td>
<td>medium</td>
<td>0,355</td>
<td>0,395</td>
<td>approx. 65</td>
</tr>
</tbody>
</table>

* medium short: 10 to 1000 µs  
medium: 1 to 100 ms  
long: 100 ms to 1 s.
Fig. 1 Kelly chart.
Resolution characteristics

The following graphs (Figs 2 to 7) represent the line width as a function of the cathode cut-off voltage at constant anode current (shrinking raster method), at screen centre for different display tubes.

Fig. 2 Tubes M24-511W, M24-512W, M24-514W; $V_{a} = 12$ kV; raster dimensions 168 mm x 126 mm; 292 active lines at 50 Hz repetition frequency.
Fig. 3 Tubes M24-306, M24-308, M24-310, M24-328; $V_a = 12$ kV; raster dimensions 168 mm x 126 mm; 292 active lines at 50 Hz repetition frequency.

Fig. 4 Tubes M31-326, M31-328; $V_a = 17$ kV; raster dimensions 216 mm x 162 mm; 292 active lines at 50 Hz repetition frequency.
Fig. 5 Tubes M31-336/338/340/342/344/346/348/350; $V_a = 12$ kV; raster dimensions 216 mm x 162 mm; 292 active lines at 50 Hz repetition frequency.

Fig. 6 Tubes M32EAA; $V_a = 14$ kV; raster dimensions 237 mm x 178 mm; 292 active lines at 50 Hz repetition frequency.
Fig. 7 Tubes M38-320/330/340 series; $V_a = 17 \text{kV}$; raster dimensions 259 mm x 194 mm; 292 active lines at 50 Hz repetition frequency.
Screen glass, screen surface treatment and phosphor are identified by the complete type designation. In the **old system**, used for type numbers M24-306, M31-340, etc., surface treatment and type of screen glass are identified by a type number suffix, as shown in the table below.

<table>
<thead>
<tr>
<th>surface treatment</th>
<th>screen glass</th>
<th>suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal glare</td>
<td>normal tinted</td>
<td>no</td>
</tr>
<tr>
<td>direct grind</td>
<td>normal tinted</td>
<td>/P</td>
</tr>
<tr>
<td>direct etch</td>
<td>normal tinted</td>
<td>/E</td>
</tr>
<tr>
<td>direct grind</td>
<td>dark tinted</td>
<td>/PD</td>
</tr>
<tr>
<td>direct etch</td>
<td>dark tinted</td>
<td>/ED</td>
</tr>
</tbody>
</table>

For tubes without contact strip between external coating and mounting hardware the suffix is: /.. 3. For tubes with an internal surge limiter the suffix is: /.. 4.

**Example:**

- monitor application: M31-340GH/ PD3
- face diagonal in cm: no contact strip
- series number: direct grind
- screen phosphor: dark tinted glass

In the **new system**, used for type numbers M29EAA, M32EAA, etc., surface treatment and type of screen glass are identified as shown in the example below.

**Example:**

- monitor application: M32EAA0WW
- minimum viewable screen diagonal in cm: screen phosphor
- family code: code for a.o. glass and screen surface treatment
REFERENCE LINE GAUGES

REFERENCE LINE GAUGE C (JEDEC 126) (IEC 67-IV-3)

Fig. 1 Reference line gauge for 110° deflection angle.

The millimetre dimensions are derived from the original inch dimensions.

<table>
<thead>
<tr>
<th>ref.</th>
<th>inches</th>
<th></th>
<th>millimetres</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>nom.</td>
<td>max.</td>
<td>min.</td>
<td>nom.</td>
</tr>
<tr>
<td>A</td>
<td>—</td>
<td>5,000</td>
<td>—</td>
<td>—</td>
<td>127,00</td>
</tr>
<tr>
<td>B</td>
<td>—</td>
<td>4,500</td>
<td>—</td>
<td>—</td>
<td>114,30</td>
</tr>
<tr>
<td>C</td>
<td>—</td>
<td>2,000</td>
<td>—</td>
<td>—</td>
<td>50,80</td>
</tr>
<tr>
<td>D</td>
<td>1,168</td>
<td>1,168</td>
<td>1,171</td>
<td>29,668</td>
<td>29,668</td>
</tr>
<tr>
<td>E</td>
<td>1,241</td>
<td>1,242</td>
<td>1,243</td>
<td>31,522</td>
<td>31,547</td>
</tr>
<tr>
<td>F</td>
<td>4,248</td>
<td>4,250</td>
<td>4,252</td>
<td>107,900</td>
<td>107,950</td>
</tr>
<tr>
<td>G</td>
<td>—</td>
<td>0,279</td>
<td>—</td>
<td>—</td>
<td>7,09</td>
</tr>
<tr>
<td>H</td>
<td>—</td>
<td>0,250</td>
<td>—</td>
<td>—</td>
<td>6,35</td>
</tr>
<tr>
<td>L</td>
<td>1,165</td>
<td>1,170</td>
<td>1,175</td>
<td>29,60</td>
<td>29,72</td>
</tr>
<tr>
<td>M</td>
<td>—</td>
<td>1,634</td>
<td>—</td>
<td>—</td>
<td>41,50</td>
</tr>
<tr>
<td>N</td>
<td>—</td>
<td>0,920</td>
<td>—</td>
<td>—</td>
<td>23,37</td>
</tr>
<tr>
<td>P</td>
<td>—</td>
<td>0,250</td>
<td>—</td>
<td>—</td>
<td>6,35</td>
</tr>
<tr>
<td>R</td>
<td>—</td>
<td>1,000r</td>
<td>—</td>
<td>—</td>
<td>25,40r</td>
</tr>
<tr>
<td>S</td>
<td>0,712</td>
<td>0,714</td>
<td>0,716</td>
<td>18,085</td>
<td>18,136</td>
</tr>
<tr>
<td>T</td>
<td>—</td>
<td>3,214</td>
<td>—</td>
<td>—</td>
<td>81,64</td>
</tr>
<tr>
<td>V</td>
<td>2,490</td>
<td>2,500</td>
<td>2,510</td>
<td>63,25</td>
<td>63,50</td>
</tr>
</tbody>
</table>

Notes
1. \( y = 0.58 x^2 + 0.576 \) inches \((0.0228 x^2 + 14.630 \text{ mm})\) 'y' values must be held to \( \pm 0.002'' \) (0.05 mm).
   The Y-axis is 0.920” (23.368 mm) below the X-X' reference plane.
2. 4° ± 30’ taper between planes G and L.
Fig. 2 Reference line gauge for 90° deflection angle.

Fig. 3 Reference line gauge for 110° deflection angle.
Bases

Small-button neo eightar base  
IEC 67-1-31  
JEDEC B7-208

Dimensions in mm

Fig. 1.

Notes

1. Base-pin positions are held to tolerances such that the base will fit a flat-plate gauge having a thickness of 9.53 and eight equally spaced holes of 1.40 ± 0.01 diameter located on a 15.24 ± 0.01 diameter circle. The gauge is also provided with a centre hole to provide 0.25 diametrical clearance for the lug and key. Pin fit in the gauge shall be such that the entire length of pins will, without undue force, pass into and disengage from the gauge.

2. This dimension may vary within the limits shown around the periphery of any individual pin.
7-PIN MINIATURE BASE WITH PUMPING STEM
Dimensions of this base are within the JEDEC E7-91 dimensions

Notes
1. Base-pin and pumping stem positions are held to tolerances such that entire length of pins and stem will without undue force pass into and disengage from a flat-plate gauge having a thickness of 6,35 mm and eight holes with diameters of 1,27 ± 0,013 mm so located on a 9,525 ± 0,013 mm diameter circle that the distance along the chord between any two adjacent hole centres is 3,645 ± 0,013 mm and a centre hole of 5,97 + 0,025 mm being chamfered at the top over 1,52 mm with an angle of 45 degrees.
2. This dimension around the periphery of any individual pin may vary within the limits shown.
BLACK & WHITE TV PICTURE TUBES
### TV PICTURE TUBE

31 cm (12 in), 90°, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

#### QUICK REFERENCE DATA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 280 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>11 V, 140 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>130 V</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
</tbody>
</table>

#### SCREEN

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal-backed phosphor</td>
<td>P4</td>
</tr>
<tr>
<td>Luminescence</td>
<td>white</td>
</tr>
<tr>
<td>Light transmission of face glass</td>
<td>50 %</td>
</tr>
<tr>
<td>Useful diagonal</td>
<td>min. 292,2 mm</td>
</tr>
<tr>
<td>Useful width</td>
<td>min. 254,1 mm</td>
</tr>
<tr>
<td>Useful height</td>
<td>min. 201,7 mm</td>
</tr>
</tbody>
</table>

#### HEATING

Indirect by a.c. or d.c.; parallel supply

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater voltage</td>
<td>$V_f$ 11 V</td>
</tr>
<tr>
<td>Heater current</td>
<td>$I_f$ 140 mA</td>
</tr>
<tr>
<td>Limits (Absolute max. rating system) of r.m.s. heater voltage, measured in any 20 ms</td>
<td>$V_f$ max. 12,7 V *</td>
</tr>
</tbody>
</table>

For heating time as a function of source impedance see last page of this data sheet.

* This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.
MECHANICAL DATA

Notes are given after the drawings.

Dimensions in mm
TV picture tube

227 max

65°

40 ± 4

Ø 100 min

254.1 min

201.7 min

R 788.3
R 875.4
R 31.3
R 715.7
R 571.7
R 22.85

bulb and screen dimensions

November 1978

A31-322W
Mounting position any
Net mass approx. 2.9 kg
Base designation JEDEC E7-91

The socket for the base should not be rigidly mounted; it should have flexible leads and be allowed to move freely.

Notes to outline drawings
1. The reference line is determined by the plane of the upper edge of the reference line gauge when the gauge is resting on the cone (gauge D).
2. The configuration of the external conductive coating may be different but contains the contact area shown in the drawing. The external conductive coating must be earthed.
3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge D.
4. This area must be kept clean.
5. Recessed cavity contact IEC 67-III-2; JEDEC J1-21.
6. The metal band must be earthed.
7. Distance from reference point Z to any hardware.
8. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
9. The mounting screws in the cabinet must be situated inside a circle of 7 mm drawn around the true geometrical positions i.e. at the corners of a rectangle of 273.3 mm x 190.2 mm.
MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. distance from section 1</th>
<th>Distance from centre (max. values)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>13</td>
<td>105,9</td>
<td>48,4</td>
</tr>
<tr>
<td>12</td>
<td>99</td>
<td>55,3</td>
</tr>
<tr>
<td>11</td>
<td>90</td>
<td>66,1</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
<td>79,7</td>
</tr>
<tr>
<td>9</td>
<td>70</td>
<td>91,8</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>102,3</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td>111,8</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
<td>120,4</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>128,2</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>135,0</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>140,0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>140,9</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>141,3</td>
</tr>
</tbody>
</table>

November 1978
CAPACITANCES
Final accelerator to external conductive coating\[C_{a, g3, g5/m} < 900 \text{ pF}\]
Final accelerator to metal band\[C_{a, g3, g5/m'} = 150 \text{ pF}\]
Cathode to all\[C_k = 3 \text{ pF}\]
Grid 1 to all\[C_{q1} = 7 \text{ pF}\]

FOCUSING
electrostatic

DEFLECTION
Diagonal deflection angle\[90^\circ\]
Horizontal deflection angle\[83^\circ\]
Vertical deflection angle\[65^\circ\]

PICTURE CENTRING MAGNET
Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 55 mm.

TYPICAL OPERATING CONDITIONS
Cathode drive service
Voltages are specified with respect to grid 1\[
\begin{align*}
V_{a, g3, g5} & = 12 \text{ kV} \\
V_{g4} & = 0 \text{ to } 130 \text{ V}^* \\
V_{g2} & = 130 \text{ V} \\
V_{KR} & = 45 \text{ to } 65 \text{ V}
\end{align*}
\]

* Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps: 0 V and 130 V). The optimum focusing voltage of individual tubes may be between −150 and +150 V.
TV picture tube

LIMITING VALUES (Design maximum rating system)
Voltages are specified with respect to grid 1 unless stated otherwise.

Final accelerator voltage

\[ V_{a,g3,g5} \]

\[ \text{max. } 15 \text{ kV}^* \]

\[ \text{min. } 10 \text{ kV} \]

Grid 4 voltage

positive \[ V_{g4} \]

\[ \text{max. } 500 \text{ V} \]

negative \[ -V_{g4} \]

\[ \text{max. } 200 \text{ V} \]

Grid 2 voltage

\[ V_{g2} \]

\[ \text{min. } 80 \text{ V} \]

Cathode to grid 1 voltage

positive \[ V_k \]

\[ \text{max. } 200 \text{ V} \]

positive peak \[ V_{kp} \]

\[ \text{max. } 400 \text{ V}^{**} \]

negative \[ -V_k \]

\[ \text{max. } 0 \text{ V} \]

negative peak \[ -V_{kp} \]

\[ \text{max. } 2 \text{ V} \]

Cathode-to-heater voltage

\[ V_{k/f} \]

\[ \text{max. } 100 \text{ V} \]

CIRCUIT DESIGN VALUES

Grid 4 current

positive \[ l_{g4} \]

\[ \text{max. } 25 \mu\text{A} \]

negative \[ -l_{g4} \]

\[ \text{max. } 25 \mu\text{A} \]

Grid 2 current

positive \[ l_{g2} \]

\[ \text{max. } 5 \mu\text{A} \]

negative \[ -l_{g2} \]

\[ \text{max. } 5 \mu\text{A} \]

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater

\[ R_{k/f} \]

\[ \text{max. } 1 \text{ M\Omega} \]

Impedance between cathode and heater

\[ Z_{k/f} (50 \text{ Hz}) \]

\[ \text{max. } 0,1 \text{ M\Omega} \]

Grid 1 circuit resistance

\[ R_{g1} \]

\[ \text{max. } 1,5 \text{ M\Omega} \]

Grid 1 circuit impedance

\[ Z_{g1} (50 \text{ Hz}) \]

\[ \text{max. } 0,5 \text{ M\Omega} \]

* The X-ray dose rate remains below the acceptable value of 0,5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

** Maximum pulse duration 22% of a cycle but max. 1,5 ms.
Final accelerator current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.
Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 12$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}$$
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

31 cm (12 in), 110°, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
</tr>
<tr>
<td>Deflection angle</td>
</tr>
<tr>
<td>Overall length</td>
</tr>
<tr>
<td>Neck diameter</td>
</tr>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Grid no. 2 voltage</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
</tr>
<tr>
<td>Quick heating cathode</td>
</tr>
</tbody>
</table>

SCREEN

Metal-backed phosphor

Luminescence white

Light transmission of face glass ≈ 50 %

Useful diagonal ≥ 295 mm

Useful width ≥ 257 mm

Useful height ≥ 195 mm

HEATING

Indirect by a.c. or d.c.; parallel supply

Heater voltage $V_f$ 11 V

Heater current $I_f$ 140 mA

Limits (Absolute max. rating system) of r.m.s. heater voltage, measured in any 20 ms $V_f$ max. 12.7 V $^*$

For heating time as a function of source impedance see last page of this data sheet.

$^*$ This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.
MECHANICAL DATA
Notes are given after the drawings.

Dimensions in mm

[Diagram of mechanical data with dimensions and notes]

November 1978
Mounting position: any

Net mass: approx. 2.8 kg.

Base: JEDEC E7-91

The socket for the base should not be rigidly mounted, it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWINGS

1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone. (Gauge G).

2. The configuration of the external conductive coating may be different but contains the contact area shown in the drawing.
   The external conductive coating must be earthed.

3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.

4. This area must be kept clean.


6. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.

7. The mounting screws in the cabinet must be situated inside a circle of 7 mm diameter drawn around the true geometrical positions, i.e. at the corners of a rectangle of 267.5 mm x 204.4 mm.

8. The metal band must be earthed.
   Electrical contact between the metal band and the mounting lugs is guaranteed.

9. Distance from reference point Z to any hardware.
### MAXIMUM CONE CONTOUR DRAWING

**Dimensions in mm**

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>25°</th>
<th>38°</th>
<th>32°</th>
<th>30°</th>
<th>25°</th>
<th>20°</th>
<th>10°</th>
<th>0°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59.6</td>
<td>72.2</td>
<td>72.0</td>
<td>71.7</td>
<td>71.4</td>
<td>71.2</td>
<td>71.1</td>
<td>71.0</td>
<td>71.0</td>
<td>70.9</td>
<td>70.8</td>
<td>70.6</td>
</tr>
<tr>
<td>12</td>
<td>55</td>
<td>85.9</td>
<td>85.6</td>
<td>84.9</td>
<td>84.4</td>
<td>84.0</td>
<td>83.8</td>
<td>83.5</td>
<td>83.3</td>
<td>83.1</td>
<td>82.7</td>
<td>82.4</td>
</tr>
<tr>
<td>11</td>
<td>50</td>
<td>99.5</td>
<td>99.4</td>
<td>98.9</td>
<td>98.5</td>
<td>97.9</td>
<td>97.5</td>
<td>97.1</td>
<td>96.8</td>
<td>96.3</td>
<td>95.4</td>
<td>94.4</td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td>112.3</td>
<td>112.4</td>
<td>112.2</td>
<td>111.7</td>
<td>110.9</td>
<td>110.4</td>
<td>109.7</td>
<td>109.1</td>
<td>108.3</td>
<td>106.6</td>
<td>104.7</td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>121.3</td>
<td>121.3</td>
<td>122.8</td>
<td>122.9</td>
<td>122.4</td>
<td>121.9</td>
<td>121.2</td>
<td>120.5</td>
<td>119.5</td>
<td>117.1</td>
<td>114.3</td>
</tr>
<tr>
<td>8</td>
<td>35</td>
<td>127.9</td>
<td>128.9</td>
<td>131.2</td>
<td>132.1</td>
<td>140.8</td>
<td>132.3</td>
<td>131.7</td>
<td>130.9</td>
<td>129.7</td>
<td>126.5</td>
<td>122.7</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>132.6</td>
<td>134.0</td>
<td>137.4</td>
<td>139.3</td>
<td>147.2</td>
<td>141.2</td>
<td>140.9</td>
<td>140.2</td>
<td>138.8</td>
<td>134.6</td>
<td>129.5</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>136.0</td>
<td>137.5</td>
<td>141.7</td>
<td>144.4</td>
<td>151.6</td>
<td>148.3</td>
<td>146.5</td>
<td>147.9</td>
<td>146.5</td>
<td>140.9</td>
<td>134.3</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>138.4</td>
<td>140.0</td>
<td>144.5</td>
<td>147.8</td>
<td>154.6</td>
<td>153.2</td>
<td>153.7</td>
<td>153.2</td>
<td>151.7</td>
<td>144.8</td>
<td>137.1</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>140.3</td>
<td>141.9</td>
<td>146.6</td>
<td>150.2</td>
<td>156.5</td>
<td>156.6</td>
<td>157.4</td>
<td>156.9</td>
<td>155.1</td>
<td>147.1</td>
<td>138.5</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>141.6</td>
<td>143.2</td>
<td>148.0</td>
<td>151.8</td>
<td>154.6</td>
<td>158.7</td>
<td>159.5</td>
<td>159.0</td>
<td>157.1</td>
<td>148.5</td>
<td>139.4</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>142.4</td>
<td>143.9</td>
<td>148.8</td>
<td>152.6</td>
<td>157.4</td>
<td>159.5</td>
<td>160.7</td>
<td>160.2</td>
<td>158.2</td>
<td>149.4</td>
<td>140.7</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>142.8</td>
<td>144.4</td>
<td>149.3</td>
<td>153.1</td>
<td>157.9</td>
<td>160.2</td>
<td>161.1</td>
<td>160.6</td>
<td>158.7</td>
<td>149.9</td>
<td>140.6</td>
</tr>
</tbody>
</table>

**Note:**
- The table lists distances from the center in millimeters (max. values).
- The measurements are taken at various sections along the cone contour.
CAPACITANCES

Final accelerator to external conductive coating  \( Ca, g3, g5/m \)  
- \( < 900 \text{ pF} \)
- \( > 450 \text{ pF} \)

Final accelerator to metal band  \( Ca, g3, g5/m' \)  
- \( 150 \text{ pF} \)

Cathode to all  \( C_k \)  
- \( 3 \text{ pF} \)

Grid no. 1 to all  \( C_{g1} \)  
- \( 7 \text{ pF} \)

FOCUSED  electrostatic

DEFLECTION  magnetic

- Diagonal deflection angle  \( 110^\circ \)
- Horizontal deflection angle  \( 99^\circ \)
- Vertical deflection angle  \( 80^\circ \)

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line : 47 mm.

TYPICAL OPERATING CONDITIONS

**Grid drive service**

- Final accelerator voltage  \( V_{a, g3, g5} \)  
  - \( 12 \text{ kV} \)
- Focusing electrode voltage  \( V_{g4} \)  
  - \( 0 \text{ to } 350 \text{ V} \)  
- Grid no. 2 voltage  \( V_{g2} \)  
  - \( 250 \text{ V} \)
- Grid no. 1 voltage for visual extinction of focused raster  \( V_{GR} \)  
  - \( -35 \text{ to } -69 \text{ V} \)

**Cathode drive service**

Volatges are specified with respect to grid no. 1

- Final accelerator voltage  \( V_{a, g3, g5} \)  
  - \( 12 \text{ kV} \)
- Focusing electrode voltage  \( V_{g4} \)  
  - \( 0 \text{ to } 350 \text{ V} \)  
- Grid no. 2 voltage  \( V_{g2} \)  
  - \( 250 \text{ V} \)
- Cathode voltage for visual extinction of focused raster  \( V_{KR} \)  
  - \( 32 \text{ to } 58 \text{ V} \)

\(^1\) Individual tubes will have optimum focus within this range. In general an acceptable picture will be obtained with a fixed focus voltage.
**LIMITING VALUES** (Design max. rating system)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final accelerator voltage</td>
<td>$V_{a,g3,g5}$ max. 17 kV*, min. 10 kV</td>
</tr>
<tr>
<td>Grid No. 4 voltage</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>$V_{g4}$ max. 500 V</td>
</tr>
<tr>
<td>negative</td>
<td>$-V_{g4}$ max. 50 V</td>
</tr>
<tr>
<td>Grid No. 2 voltage</td>
<td>$V_{g2}$ max. 350 V, min. 200 V</td>
</tr>
<tr>
<td>Grid No. 2 to grid No. 1 voltage</td>
<td>$V_{g2/g1}$ max. 450 V</td>
</tr>
<tr>
<td>Cathode to grid No. 1 voltage</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>$V_{k/g1}$ max. 200 V</td>
</tr>
<tr>
<td>positive peak</td>
<td>$V_{k/g1p}$ max. 400 V**</td>
</tr>
<tr>
<td>negative</td>
<td>$-V_{k/g1}$ max. 0 V</td>
</tr>
<tr>
<td>negative peak</td>
<td>$-V_{k/g1p}$ max. 2 V</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>$V_{k/f}$ max. 100 V</td>
</tr>
</tbody>
</table>

**CIRCUIT DESIGN VALUES**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No. 4 current</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>$I_{g4}$ max. 25 µA</td>
</tr>
<tr>
<td>negative</td>
<td>$-I_{g4}$ max. 25 µA</td>
</tr>
<tr>
<td>Grid No. 2 current</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>$I_{g2}$ max. 5 µA</td>
</tr>
<tr>
<td>negative</td>
<td>$-I_{g2}$ max. 5 µA</td>
</tr>
</tbody>
</table>

**MAXIMUM CIRCUIT VALUES**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance between cathode and heater</td>
<td>$R_{k/f}$ max. 1 MΩ</td>
</tr>
<tr>
<td>Impedance between cathode and heater</td>
<td>$Z_{k/f}$ (50 Hz) max. 0, 1 MΩ</td>
</tr>
<tr>
<td>Grid No. 1 circuit resistance</td>
<td>$R_{g1}$ max. 1, 5 MΩ</td>
</tr>
<tr>
<td>Grid No. 1 circuit impedance</td>
<td>$Z_{g1}$ (50 Hz) max. 0, 5 MΩ</td>
</tr>
</tbody>
</table>

*) The X-ray dose rate remains below the acceptable value of 0, 5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

**) Maximum pulse duration 22% of a cycle but max. 1, 5 ms.
Final accelerator current as a function of cathode voltage

$I_{a+g3+g5}$

$V_{d,g3,g5} = 12kV$

$V_{g2-g1} = 250V$

Cathode drive

November 1975
Final accelerator voltage as a function of grid no. 1 voltage

$V_{g1} = V_{g3}, V_{g5} = 12\, kV$

$V_{g2} = 250\, V$

Grid No. 1 drive
$\frac{\Delta V_{KR}}{\Delta V_{a, g3, g5}} = 0.3 \times 10^{-3}$

Limits of cathode cut-off voltage as a function of grid no. 2 voltage
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

31 cm (12 in), 110°, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
</tr>
<tr>
<td>Deflection angle</td>
</tr>
<tr>
<td>Overall length</td>
</tr>
<tr>
<td>Neck diameter</td>
</tr>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Grid no. 2 voltage</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
</tr>
<tr>
<td>Quick heating cathode</td>
</tr>
</tbody>
</table>

SCREEN

Metal-backed phosphor
Luminescence white
Light transmission of face glass ≈ 50 %
Useful diagonal ≥ 295 mm
Useful width ≥ 257 mm
Useful height ≥ 195 mm

HEATING

Indirect by a.c. or d.c.; parallel supply
Heater voltage $V_f = 11 V$
Heater current $I_f = 140 mA$

Limits (Absolute max. rating system) of r.m.s. heater voltage $V_f$
max. 12,7 V*)
min. 9,3 V

For heating time as a function of source impedance see last page of this data sheet.

*) This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.

October 1984 55
MECHANICAL DATA
Notes are given after the drawings.

Dimensions in mm
Mounting position: any
Net mass: approx. 2.8 kg
Base: JEDEC E7-91

The socket for this base should not be mounted rigidly, it should have flexible leads and be allowed to move freely.

NOTES TO OUTLINE DRAWINGS
1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (Gauge G).
2. The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing.
   The external conductive coating must be earthed.
3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.
4. This area must be kept clean.
6. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
7. The mounting screws in the cabinet must be situated inside a circle of 7 mm diameter drawn around the true geometrical positions, i.e. at the corners of a rectangle of 267.5 mm x 204.4 mm.
8. Electrical contact between the metal band and the mounting lugs is guaranteed.
9. Distance from reference point Z to any hardware.
### MAXIMUM CONE CONTOUR DRAWINGS

![Diagram](image)

**Dimensions in mm**

#### Table: Nominal distance from centre (max. values)

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>25°</th>
<th>30°</th>
<th>32°30'</th>
<th>diag.</th>
<th>37°30'</th>
<th>40°</th>
<th>45°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>59.6</td>
<td>72.2</td>
<td>72.0</td>
<td>71.7</td>
<td>71.4</td>
<td>71.2</td>
<td>71.1</td>
<td>71.0</td>
<td>70.9</td>
<td>70.8</td>
<td>70.6</td>
<td>70.7</td>
<td>70.8</td>
<td>70.8</td>
<td>70.8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>55</td>
<td>85.9</td>
<td>85.6</td>
<td>84.9</td>
<td>84.4</td>
<td>84.0</td>
<td>83.8</td>
<td>83.5</td>
<td>83.3</td>
<td>83.1</td>
<td>82.7</td>
<td>82.4</td>
<td>81.9</td>
<td>81.6</td>
<td>81.5</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>50</td>
<td>99.5</td>
<td>99.4</td>
<td>98.9</td>
<td>98.5</td>
<td>97.9</td>
<td>97.5</td>
<td>97.1</td>
<td>96.8</td>
<td>96.3</td>
<td>95.4</td>
<td>94.4</td>
<td>92.4</td>
<td>90.7</td>
<td>89.3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>45</td>
<td>112.3</td>
<td>112.4</td>
<td>112.2</td>
<td>111.7</td>
<td>110.9</td>
<td>110.4</td>
<td>109.7</td>
<td>109.1</td>
<td>108.3</td>
<td>106.6</td>
<td>104.7</td>
<td>100.7</td>
<td>97.7</td>
<td>95.3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>40</td>
<td>121.3</td>
<td>121.3</td>
<td>122.2</td>
<td>122.8</td>
<td>122.9</td>
<td>122.2</td>
<td>122.2</td>
<td>121.2</td>
<td>120.5</td>
<td>119.5</td>
<td>117.1</td>
<td>114.3</td>
<td>103.8</td>
<td>99.7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>35</td>
<td>127.9</td>
<td>128.9</td>
<td>131.2</td>
<td>132.1</td>
<td>140.8</td>
<td>132.3</td>
<td>131.7</td>
<td>130.9</td>
<td>129.7</td>
<td>126.5</td>
<td>122.7</td>
<td>114.9</td>
<td>108.5</td>
<td>103.7</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>132.6</td>
<td>134.0</td>
<td>137.4</td>
<td>139.3</td>
<td>147.2</td>
<td>141.2</td>
<td>140.9</td>
<td>140.2</td>
<td>138.8</td>
<td>134.6</td>
<td>129.5</td>
<td>119.7</td>
<td>112.5</td>
<td>108.2</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>136.0</td>
<td>137.5</td>
<td>141.7</td>
<td>144.4</td>
<td>151.6</td>
<td>148.3</td>
<td>146.8</td>
<td>147.9</td>
<td>146.5</td>
<td>146.0</td>
<td>134.3</td>
<td>122.9</td>
<td>115.0</td>
<td>110.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>138.4</td>
<td>140.0</td>
<td>144.5</td>
<td>147.8</td>
<td>154.6</td>
<td>153.2</td>
<td>153.7</td>
<td>151.2</td>
<td>151.7</td>
<td>144.8</td>
<td>137.1</td>
<td>124.7</td>
<td>116.5</td>
<td>111.8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>140.3</td>
<td>141.9</td>
<td>146.6</td>
<td>150.2</td>
<td>156.5</td>
<td>156.6</td>
<td>157.4</td>
<td>156.9</td>
<td>153.1</td>
<td>147.1</td>
<td>138.5</td>
<td>135.4</td>
<td>117.0</td>
<td>112.3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>141.6</td>
<td>143.2</td>
<td>148.0</td>
<td>151.8</td>
<td>154.6</td>
<td>158.7</td>
<td>159.5</td>
<td>159.0</td>
<td>157.1</td>
<td>148.5</td>
<td>139.4</td>
<td>126.0</td>
<td>117.6</td>
<td>112.9</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>142.4</td>
<td>143.9</td>
<td>148.8</td>
<td>152.6</td>
<td>157.4</td>
<td>159.5</td>
<td>160.7</td>
<td>160.2</td>
<td>158.2</td>
<td>149.4</td>
<td>140.1</td>
<td>126.6</td>
<td>118.1</td>
<td>113.4</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>142.8</td>
<td>144.4</td>
<td>149.3</td>
<td>153.1</td>
<td>157.9</td>
<td>160.2</td>
<td>161.1</td>
<td>160.6</td>
<td>158.7</td>
<td>149.9</td>
<td>140.6</td>
<td>127.1</td>
<td>118.5</td>
<td>113.8</td>
<td>112.3</td>
</tr>
</tbody>
</table>

*February 1977 59*
CAPACITANCES

Final accelerator to external conductive coating
\[ C_{a,g3,g5/m} < 900 \text{ pF} \]
Final accelerator to metal band
\[ C_{a,g3,g5/m'} = 450 \text{ pF} \]
Cathode to all
\[ C_k = 3 \text{ pF} \]
Grid no. 1 to all
\[ C_{g1} = 7 \text{ pF} \]

FOCUSING

electrostatic

DEFLECTION
magnetic

Diagonal deflection angle \( 110^\circ \)
Horizontal deflection angle \( 99^\circ \)
Vertical deflection angle \( 80^\circ \)

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe).
Maximum distance between centre of field of this magnet and reference line: 47 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service

Voltages are specified with respect to grid no. 1

Final accelerator voltage \( V_{a,g3,g5} = 12 \text{ kV} \)
Focusing electrode voltage \( V_{g4} = 0 \text{ to } 130 \text{ V} \)
Grid no. 2 voltage \( V_{g2} = 130 \text{ V} \)
Cathode voltage for visual extinction of focused raster \( V_{KR} = 30 \text{ to } 50 \text{ V} \)

*) Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps; 0 V and 130 V).
The optimum focusing voltage of individual tubes may be between -100 V and +200 V.
**LIMITING VALUES**  (Design max. rating system)

Final accelerator voltage

\[ V_{a, g3, g5} \text{ max. } 17 \text{ kV}^*) \]
\[ V_{a, g3, g5} \text{ min. } 10 \text{ kV} \]

Grid no. 4 voltage

- **positive**
  \[ V_{g4} \text{ max. } 500 \text{ V} \]
  \[ -V_{g4} \text{ max. } 200 \text{ V} \]

- **negative**
  \[ V_{g2} \text{ max. } 200 \text{ V} \]

Grid no. 2 voltage

- **positive**
  \[ V_{k/g1} \text{ max. } 200 \text{ V} \]
  \[ V_{k/g1p} \text{ max. } 400 \text{ V}^{**}) \]

- **negative**
  \[ -V_{k/g1} \text{ max. } 0 \text{ V} \]
  \[ -V_{k/g1p} \text{ max. } 2 \text{ V} \]

Cathode-to-grid no. 1 voltage

- **positive**
  \[ V_{k/f} \text{ max. } 100 \text{ V} \]

Circuit Design Values

Grid no. 4 current

- **positive**
  \[ I_{g4} \text{ max. } 25 \text{ µA} \]
  \[ -I_{g4} \text{ max. } 25 \text{ µA} \]

Grid no. 2 current

- **positive**
  \[ I_{g2} \text{ max. } 5 \text{ µA} \]
  \[ -I_{g2} \text{ max. } 5 \text{ µA} \]

**MAXIMUM CIRCUIT VALUES**

Resistance between cathode and heater

\[ R_{k/f} \text{ max. } 1 \text{ MΩ} \]

Impedance between cathode and heater

\[ Z_{k/f(50Hz)} \text{ max. } 0,1 \text{ MΩ} \]

Grid no. 1 circuit resistance

\[ R_{g1} \text{ max. } 1,5 \text{ MΩ} \]

Grid no. 1 circuit impedance

\[ Z_{g1(50Hz)} \text{ max. } 0,5 \text{ MΩ} \]

---

*) The X-ray dose rate remains below the acceptable value of 0,5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

**) Maximum pulse duration 22% of a cycle but max. 1,5 ms.
Final accelerator current as a function of cathode voltage
Limits of cathode cut-off voltage as a function of grid no. 2 voltage

\[ \frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3} \]
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

34 cm (14 in), 90°, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy. A special feature of this tube is its short cathode heating time.

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>34 cm (14 in)</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 287 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>11 V, 140 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>130 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5s</td>
</tr>
</tbody>
</table>

SCREEN

- Metal-backed phosphor: P4
- Luminescence: white
- Light transmission of face glass: 48%
- Useful diagonal: min. 322 mm
- Useful width: min. 270 mm
- Useful height: min. 210 mm

HEATING

- Indirect by a.c. or d.c.; parallel supply
- Heater voltage: \( V_f \) = 11 V
- Heater current: \( I_f \) = 140 mA
- Limits (Absolute maximum rating system) of r.m.s. heater voltage, measured in any 20 ms: \( V_f \) = max. 12.7 V*
  \( V_f \) = min. 9.3 V

For heating time as a function of source impedance see last page of this data sheet.

* This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.

For maximum cathode life it is recommended that the heater supply be regulated at 11 V.
MECHANICAL DATA

Notes are given after the drawings

Dimensions in mm

- 298 max
- 287 max
- 25 max
- Ø 20 ± 0.9
- 176.6 ± 4.0
- 314 max
- 290.3
- 255 max
- 231.7
- 350 max

Dimensions in mm
Mounting position  any
Nett mass  approx. 3.6 kg
Bulb contact designation  IEC 67-III-2; JEDEC J1-21
Base designation  JEDEC E7-91
Basing  7GR

The socket for this base should not be mounted rigidly; it should have flexible leads and be allowed to move freely.
Notes to outline drawings on the preceding pages

1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (gauge D).
2. The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing. The external conductive coating must be earthed.
3. This area must be kept clean.
5. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
6. The mounting screws in the cabinet must be situated inside a circle of 7 mm drawn around the true geometrical positions i.e. at the corners of a rectangle of 290,3 mm x 231,7 mm.
7. Electrical contact between the metal band and mounting lugs is guaranteed.
8. Distance from reference point Z to any hardware.
CAPACITANCES

Anode to external conductive coating  \( C_{a,g3,g5/m} \)  < 1100 pF
Anode to metal band  \( C_{a,g3,g5/m'} \)  > 450 pF
Cathode to all  \( C_k \)  150 pF
Grid 1 to all  \( C_{g1} \)  3 pF

FOCUSING

DEFLECTION

Diagonal deflection angle  90°
Horizontal deflection angle  82°
Vertical deflection angle  67°

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m. Maximum distance between centre of field of this magnet and reference line: 47 mm

TYPICAL OPERATING CONDITIONS

Cathode drive service
Voltages are specified with respect to grid 1
Anode voltage \( V_{a,g3,g5} \)  12 kV
Focusing electrode voltage \( V_g4 \)  0 to 130 V*
Grid 2 voltage \( V_{g2} \)  130 V
Cathode voltage for visual extinction of focused raster \( V_{KR} \)  45 to 65 V

* Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and + 130 V (e.g. two taps: 0 V and 130 V). The optimum focusing voltage of individual tubes may be between −150 and + 150 V).
LIMITING VALUES (Design maximum rating system)

Voltages are specified with respect to grid 1 unless stated otherwise.

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>Symbol(s)</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode voltage</td>
<td>$V_{a,g3,g5}$</td>
<td>max. 17 kV*</td>
<td>min. 10 kV</td>
</tr>
<tr>
<td>Grid 4 voltage</td>
<td>$V_{g4}$</td>
<td>max. 1000 V</td>
<td>$-V_{g4}$</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>$V_{g2}$</td>
<td>max. 200 V</td>
<td></td>
</tr>
<tr>
<td>Cathode voltage</td>
<td>$V_k$</td>
<td>max. 200 V</td>
<td>$V_{kp}$</td>
</tr>
<tr>
<td></td>
<td>$-V_k$</td>
<td>max. 0 V</td>
<td>$-V_{kp}$</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>$V_{k/f}$</td>
<td>max. 100 V</td>
<td></td>
</tr>
</tbody>
</table>

CIRCUIT DESIGN VALUES

<table>
<thead>
<tr>
<th>Current Type</th>
<th>Symbol(s)</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid 4 current</td>
<td>$I_{g4}$</td>
<td>max. 25 µA</td>
<td>$-I_{g4}$</td>
</tr>
<tr>
<td>Grid 2 current</td>
<td>$I_{g2}$</td>
<td>max. 5 µA</td>
<td>$-I_{g2}$</td>
</tr>
</tbody>
</table>

MAXIMUM CIRCUIT VALUES

<table>
<thead>
<tr>
<th>Property</th>
<th>Symbol(s)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance between cathode and heater</td>
<td>$R_{k/f}$</td>
<td>max. 1 MΩ</td>
</tr>
<tr>
<td>Impedance between cathode and heater</td>
<td>$Z_{k/f}$ (50 Hz)</td>
<td>max. 0,1 MΩ</td>
</tr>
<tr>
<td>Grid 1 circuit resistance</td>
<td>$R_{g1}$</td>
<td>max. 1,5 MΩ</td>
</tr>
<tr>
<td>Grid 1 circuit impedance</td>
<td>$Z_{g1}$ (50 Hz)</td>
<td>max. 0,5 MΩ</td>
</tr>
</tbody>
</table>

* The X-ray dose rate remains below the acceptable value of 0,5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.
** Maximum pulse duration 22% of a cycle but max. 1,5 ms.
Anode current as a function of cathode voltage.
Cathode drive: $V_{a,g3,g5} = 12$ kV.
Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}$$
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

44 cm (17 in), 110°, rectangular direct vision picture tube with integral protection for black and white TV. The 20 mm neck diameter ensures a low deflection energy.

A special feature of this tube is its short cathode heating time.
The tube is designed for "push through" application and is provided with four metal lugs for mounting into a cabinet.

---

<table>
<thead>
<tr>
<th>Face diagonal</th>
<th>44 cm (17 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 288 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>11 V, 140 mA</td>
</tr>
<tr>
<td>Grid no. 2 voltage</td>
<td>130 V</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
<td>15 kV</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s.</td>
</tr>
</tbody>
</table>

---

SCREEN

Metal-backed phosphor
Luminescence white
Light transmission of face glass ≈ 48 %
Useful diagonal ≥ 413 mm
Useful width ≥ 346 mm
Useful height ≥ 270 mm

HEATING

Indirect by a.c. or d.c.

<table>
<thead>
<tr>
<th>Heater voltage</th>
<th>$V_f$</th>
<th>11 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater current</td>
<td>$I_f$</td>
<td>140 mA</td>
</tr>
</tbody>
</table>

Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms:

<table>
<thead>
<tr>
<th>$V_f$</th>
<th>max. 12.7 V *)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_f$</td>
<td>min. 9.3 V</td>
</tr>
</tbody>
</table>

*) This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.

---
MECHANICAL DATA

Notes are given after the drawings.
Mounting position: any

Net mass: approx. 6 kg

Base: JEDEC E7-91

The socket for the base should not be mounted rigidly, it should have flexible leads and be allowed to move freely.
NOTES TO OUTLINE DRAWING

1. The reference line is determined by the plane of the upper edge of the flange of the reference line gauge when the gauge is resting on the cone (gauge G).

2. The configuration of the external conductive coating may be different, but covers the contact area shown in the drawing.
   The external conductive coating must be earthed.

3. End of guaranteed contour. The maximum neck and cone contour is given by the reference line gauge G.

4. This area must be kept clean.

5. Recessed cavity contact IEC67-III 2.

6. Minimum space to be reserved for mounting lug.

7. The mounting screws in the cabinet must be situated inside a circle of 7.5 mm drawn around the true geometrical positions i.e. at the corners of a rectangle of 363.5 mm x 288.5 mm.

8. The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.

9. The metal rim-band must be earthed. The hole of 3 mm dia in each lug is provided for this purpose. Electrical contact between the metal band and mounting lugs is guaranteed.

10. Max. curvatures of the outside rim-band are: nominal bulb radius + 4 mm.

11. Distance from reference point Z to any hardware.
Distance from centre (max values)

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. distance from section</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>25°</th>
<th>30°</th>
<th>32°</th>
<th>33°</th>
<th>37°</th>
<th>40°</th>
<th>45°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>90</td>
<td>73.8</td>
<td>73.6</td>
<td>73.1</td>
<td>72.9</td>
<td>72.6</td>
<td>72.5</td>
<td>72.3</td>
<td>72.2</td>
<td>72.1</td>
<td>71.9</td>
<td>71.8</td>
<td>71.7</td>
<td>71.7</td>
<td>71.9</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>104.7</td>
<td>103.9</td>
<td>102.1</td>
<td>101.0</td>
<td>99.9</td>
<td>99.4</td>
<td>98.6</td>
<td>98.4</td>
<td>98.0</td>
<td>97.2</td>
<td>96.5</td>
<td>95.6</td>
<td>95.2</td>
<td>95.3</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>123.9</td>
<td>124.0</td>
<td>123.8</td>
<td>123.5</td>
<td>123.0</td>
<td>122.6</td>
<td>122.0</td>
<td>121.8</td>
<td>121.2</td>
<td>120.1</td>
<td>118.7</td>
<td>116.0</td>
<td>113.5</td>
<td>111.1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>140.9</td>
<td>141.3</td>
<td>143.3</td>
<td>144.1</td>
<td>144.5</td>
<td>144.0</td>
<td>143.8</td>
<td>143.2</td>
<td>142.1</td>
<td>138.6</td>
<td>132.7</td>
<td>123.3</td>
<td>122.5</td>
<td>122.5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>154.8</td>
<td>156.3</td>
<td>160.3</td>
<td>162.5</td>
<td>164.3</td>
<td>164.9</td>
<td>164.7</td>
<td>163.7</td>
<td>160.5</td>
<td>156.0</td>
<td>146.1</td>
<td>138.1</td>
<td>133.2</td>
<td>131.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>166.9</td>
<td>168.9</td>
<td>174.5</td>
<td>178.1</td>
<td>181.6</td>
<td>183.1</td>
<td>183.4</td>
<td>182.1</td>
<td>177.2</td>
<td>170.2</td>
<td>156.6</td>
<td>146.6</td>
<td>140.8</td>
<td>138.9</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>176.8</td>
<td>179.1</td>
<td>185.9</td>
<td>190.9</td>
<td>196.3</td>
<td>198.9</td>
<td>200.0</td>
<td>199.8</td>
<td>198.4</td>
<td>191.2</td>
<td>181.2</td>
<td>164.4</td>
<td>153.0</td>
<td>146.7</td>
<td>144.6</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>184.1</td>
<td>186.6</td>
<td>194.4</td>
<td>200.4</td>
<td>206.0</td>
<td>212.0</td>
<td>214.6</td>
<td>214.3</td>
<td>212.6</td>
<td>202.0</td>
<td>189.0</td>
<td>169.6</td>
<td>157.4</td>
<td>150.8</td>
<td>148.6</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>188.6</td>
<td>191.2</td>
<td>199.3</td>
<td>205.6</td>
<td>213.9</td>
<td>218.4</td>
<td>221.3</td>
<td>221.2</td>
<td>219.2</td>
<td>207.2</td>
<td>193.1</td>
<td>172.9</td>
<td>160.4</td>
<td>153.6</td>
<td>151.4</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>190.0</td>
<td>192.6</td>
<td>200.7</td>
<td>207.1</td>
<td>215.3</td>
<td>219.9</td>
<td>222.7</td>
<td>222.5</td>
<td>220.5</td>
<td>208.6</td>
<td>194.4</td>
<td>174.1</td>
<td>161.5</td>
<td>154.7</td>
<td>152.5</td>
</tr>
</tbody>
</table>
TV picture tube

CAPACITANCES
Final accelerator to external conductive coating  \( C_{a,g3,g5/m} < \frac{1000}{3} \) pF  > 700 pF
Final accelerator to metal rimband  \( C_{a,g3,g5/m'} = 200 \) pF
Cathode to all  \( C_k = 3 \) pF
Grid no. 1 to all  \( C_{g1} = 7 \) pF

FOCUSING  electrostatic

DEFLECTION  magnetic
Diagonal deflection angle  110°
Horizontal deflection angle  98°
Vertical deflection angle  79°

PICTURE CENTRING MAGNET
Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe).
Maximum distance between centre of filed of this magnet and reference line: 47 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service
Volages are specified with respect to grid no. 1

Final accelerator voltage  \( V_{a,g3,g5} = 15 \) kV
Focusing electrode voltage  \( V_{g4} = 0 \) to 130 V *)
Grid no. 2 voltage  \( V_{g2} = 130 \) V
Cathode voltage for visual extinction of focused raster  \( V_{KR} = 30 \) to 50 V

*) Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 V and + 130 V (e.g. two taps, 0 V and 130 V).
The optimum focus voltage of individual tubes may be between -100 V and +200 V.
LIMITING VALUES (Design max. rating system)

Final accelerator voltage at $l_{a,g3,g5} = 0$

<table>
<thead>
<tr>
<th>Voltage</th>
<th>max. 17 kV*</th>
<th>min. 10 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{a,g3,g5}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grid no. 4 voltage
- Positive $V_{g4}$ max. 500 V
- Negative $-V_{g4}$ max. 200 V

Grid no. 2 voltage
$V_{g2/k}$ max. 200 V

Cathode to grid no. 1 voltage,
- positive $V_{k/g1}$ max. 200 V
- positive peak $V_{k/g1p}$ max. 400 V**
- negative $-V_{k/g1}$ max. 0 V
- negative peak $-V_{k/g1p}$ max. 2 V

$V_{k/f}$ max. 100 V

CIRCUIT DESIGN VALUES

Grid no. 4 current
- positive $I_{g4}$ max. 25 µA
- negative $-I_{g4}$ max. 25 µA

Grid no. 2 current
- positive $I_{g2}$ max. 5 µA
- negative $-I_{g2}$ max. 5 µA

MAXIMUM CIRCUIT VALUES

- Resistance between cathode and heater $R_{k/f}$ max. 1 MΩ
- Impedance between cathode and heater $Z_{f/k(50 Hz)}$ max. 0,1 MΩ
- Grid no. 1 circuit resistance $R_{g1}$ max. 1,5 MΩ
- Grid no. 1 impedance $Z_{g1(50 Hz)}$ max. 0,5 MΩ

*) The X-ray dose rate remains below the acceptable value of 0,5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

**) Maximum pulse duration 22% of a cycle but max. 1,5 ms.
Final accelerator current as a function of cathode voltage.
Limits of cathode cut-off voltage as a function of grid no. 2 voltage.

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}
\]
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

44 cm (17 in), 110°, rectangular direct vision picture tube with integral protection for black and white TV. A special feature of this tube is its short cathode heating time.

<table>
<thead>
<tr>
<th>QUICK REFERENCE DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
</tr>
<tr>
<td>Deflection angle</td>
</tr>
<tr>
<td>Overall length</td>
</tr>
<tr>
<td>Neck diameter</td>
</tr>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Grid no. 2 voltage</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
</tr>
<tr>
<td>Quick heating cathode</td>
</tr>
</tbody>
</table>

SCREEN

Metal-backed phosphor

Luminescence white

Light transmission of face glass ≈ 48 %

Useful diagonal ≥ 413 mm

Useful width ≥ 346 mm

Useful height ≥ 270 mm

HEATING

Indirect by a.c. or d.c.

Heater voltage \( V_f \) 6,3 V

Heater current \( I_f \) 240 mA

Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms

\( V_f \) max. 7,3 V*)

\( V_f \) min. 5,3 V

For heating time as a function of source impedance see last page of this data sheet.

*) This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.
MECHANICAL DATA

Notes are given after the drawings.

Dimensions in mm
Mounting position: any

Base: neo eightar 7 pin JEDEC B7-208, B8H, IEC 67-1-31a

Net mass: approx. 6 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of 40 mm.

The socket for the base should not be rigidly mounted; it should have flexible leads and be allowed to move freely.
NOTES TO OUTLINE DRAWING


2. The metal rim-band must be earthed. The hole of 3 mm dia in each lug is provided for this purpose.


4. End of guaranteed contour. The maximum contour from reference line towards screen is given by the reference line gauge C (18, 13 mm).

5. The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing. The external conductive coating must be earthed.

6. This area must be kept clean.

7. Minimum space to be reserved for mounting lug.

8. The mounting screws in the cabinet must be situated inside a circle of 7.5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 363.5 mm x 288.5 mm.

9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.

10. Max. curvatures of the outside rim-band are nominal bulb radius +4 mm.

11. Distance from reference point Z to any hardware.
MAXIMUM CONE CONTOUR DRAWING

Dimensions in mm

Distance from centre (max. values)

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. distance from point &quot;Z&quot;</th>
<th>$0^\circ$</th>
<th>$10^\circ$</th>
<th>$20^\circ$</th>
<th>$30^\circ$</th>
<th>$33^\circ30'$</th>
<th>$36^\circ30'$</th>
<th>Diagonal</th>
<th>$40^\circ$</th>
<th>$44^\circ$</th>
<th>$50^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$60^\circ$</th>
<th>$90^\circ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>128,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td>60,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>117,3</td>
<td>95,9</td>
<td>95,2</td>
<td>93,0</td>
<td>92,3</td>
<td>92,1</td>
<td>92,3</td>
<td>92,6</td>
<td>93,1</td>
<td>93,8</td>
<td>94,6</td>
<td>94,9</td>
<td>95,1</td>
<td>95,1</td>
<td>95,1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>107,3</td>
<td>118,1</td>
<td>117,8</td>
<td>118,3</td>
<td>118,6</td>
<td>119,2</td>
<td>117,8</td>
<td>117,7</td>
<td>117,2</td>
<td>115,5</td>
<td>113,3</td>
<td>111,2</td>
<td>109,8</td>
<td>109,8</td>
<td>109,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>97,3</td>
<td>135,0</td>
<td>136,1</td>
<td>138,3</td>
<td>139,9</td>
<td>141,0</td>
<td>141,6</td>
<td>141,1</td>
<td>135,4</td>
<td>135,4</td>
<td>130,5</td>
<td>125,6</td>
<td>121,8</td>
<td>120,8</td>
<td>120,8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>87,3</td>
<td>149,5</td>
<td>151,1</td>
<td>155,1</td>
<td>159,1</td>
<td>161,3</td>
<td>162,0</td>
<td>161,5</td>
<td>157,5</td>
<td>151,0</td>
<td>142,0</td>
<td>135,8</td>
<td>130,8</td>
<td>129,5</td>
<td>129,5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>77,3</td>
<td>162,5</td>
<td>164,0</td>
<td>168,8</td>
<td>176,0</td>
<td>179,0</td>
<td>179,5</td>
<td>178,0</td>
<td>173,5</td>
<td>163,4</td>
<td>156,8</td>
<td>143,3</td>
<td>138,3</td>
<td>136,4</td>
<td>136,4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>67,3</td>
<td>172,5</td>
<td>174,4</td>
<td>180,1</td>
<td>190,1</td>
<td>194,1</td>
<td>196,9</td>
<td>194,9</td>
<td>186,8</td>
<td>174,5</td>
<td>159,1</td>
<td>149,3</td>
<td>143,9</td>
<td>141,7</td>
<td>141,7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>57,3</td>
<td>179,7</td>
<td>183,1</td>
<td>189,3</td>
<td>201,1</td>
<td>207,4</td>
<td>210,9</td>
<td>206,1</td>
<td>196,0</td>
<td>182,8</td>
<td>165,5</td>
<td>154,0</td>
<td>147,9</td>
<td>145,6</td>
<td>145,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CAPACITANCES
Final accelerator to external conductive coating
Final accelerator to metal band
Cathode to all
Grid no. 1 to all

FOCUSING
electrostatic

DEFLECTION
magnetic

Diagonal deflection angle 110°
Horizontal deflection angle 100°
Vertical deflection angle 83°

PICTURE CENTRING MAGNET
Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe).
Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS
Cathode drive service
Voltages are specified with respect to grid no. 1

Final accelerator voltage
Focusing electrode voltage
Grid no. 2 voltage
Cathode voltage for visual extinction of focused raster

1) Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps, 0 V and 130 V).
The optimum focus voltage of individual tubes may be between −100 V and +200 V.
LIMITING VALUES  (Design max. rating system)

Final accelerator voltage at $I_{a,g3,g5} = 0$

\[ V_{a,g3,g5} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>23 kV*</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>14 kV</td>
</tr>
</tbody>
</table>

Grid no. 4 voltage,

- positive \[ V_{g4} \]
- negative \[ -V_{g4} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>1000 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>max.</td>
<td>500 V</td>
</tr>
</tbody>
</table>

Grid no. 2 voltage \[ V_{g2} \]

<table>
<thead>
<tr>
<th>min.</th>
<th>200 V**</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>80 V</td>
</tr>
</tbody>
</table>

Cathode to grid no. 1 voltage,

- positive \[ V_{k/g1} \]
- positive peak \[ V_{k/g1p} \]
- negative \[ -V_{k/g1} \]
- negative peak \[ -V_{k/g1p} \]

\[ V_{kf} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>100 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>max.</td>
<td>200 V</td>
</tr>
<tr>
<td>max.</td>
<td>400 V**</td>
</tr>
<tr>
<td>max.</td>
<td>0 V</td>
</tr>
<tr>
<td>max.</td>
<td>2 V</td>
</tr>
<tr>
<td>max.</td>
<td>100 V</td>
</tr>
</tbody>
</table>

CIRCUIT DESIGN VALUES

Grid no. 4 current,

- positive \[ I_{g4} \]
- negative \[ -I_{g4} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>25 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>max.</td>
<td>25 µA</td>
</tr>
</tbody>
</table>

Grid no. 2 current,

- positive \[ I_{g2} \]
- negative \[ -I_{g2} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>5 µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>max.</td>
<td>5 µA</td>
</tr>
</tbody>
</table>

MAXIMUM CIRCUIT VALUES

- Resistance between cathode and heater \[ R_{k/f} \]
- Impedance between cathode and heater \[ Z_{k/f} (50 Hz) \]
- Grid no. 1 circuit resistance \[ R_{g1} \]
- Grid no. 1 circuit impedance \[ Z_{g1} (50 Hz) \]

\[ R_{k/f} \]

<table>
<thead>
<tr>
<th>max.</th>
<th>1,0 MΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>max.</td>
<td>0,1 MΩ</td>
</tr>
<tr>
<td>max.</td>
<td>1,5 MΩ</td>
</tr>
<tr>
<td>max.</td>
<td>0,5 MΩ</td>
</tr>
</tbody>
</table>

*) The X-ray dose rate remains below the acceptable value of 0.5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

**) At $V_{k/g1} = 0$ V.

***) Maximum pulse duration 22% of a cycle but maximum 1.5 ms.
Final accelerator current as a function of cathode voltage

Cathode drive \( V_{a,g3,g5} = 20 \text{ kV} \)
Limits of cathode cut-off voltage as a function of grid no. 2 voltage

\[ \frac{\Delta V_{KR}}{\Delta V_{g3, g5}} = 0.75 \times 10^{-3} \]
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
TV PICTURE TUBE

50 cm (20 in), 110°, rectangular direct vision picture tube with integral protection for black and white TV. A special feature of this tube is its short cathode heating time.

### QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>50 cm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 319 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6.3 V, 240 mA</td>
</tr>
<tr>
<td>Grid no. 2 voltage</td>
<td>130 V</td>
</tr>
<tr>
<td>Final accelerator voltage</td>
<td>20 kV</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s.</td>
</tr>
</tbody>
</table>

### SCREEN

Metal-backed phosphor

- Luminescence: white
- Light transmission of face glass: ≈ 45 %
- Useful diagonal: ≥ 473 mm
- Useful width: ≥ 394 mm
- Useful height: ≥ 308 mm

### HEATING

Indirect by a.c. or d.c.

- Heater voltage: \( V_f \) = 6.3 V
- Heater current: \( I_f \) = 240 mA

Limits (Absolute max. rating system) of r.m.s. heater voltage measured in any 20 ms:

\[
\begin{align*}
V_f & \quad \text{max.} \\
& \quad 7.3 \text{ V *)}
\end{align*}
\]

\[
\begin{align*}
V_f & \quad \text{min.} \\
& \quad 5.3 \text{ V}
\end{align*}
\]

For heating time as a function of source impedance see last page of this data sheet.

*) This limit also applies during equipment warming-up. Use of the tube in a series heater chain is not allowed.
MECHANICAL DATA

Notes are given after the drawings.

Dimensions in mm
Mounting position: any

Base: neo eightar 7 pin JEDEC B7-208, B8H, IEC 67-1-31a

Net mass: approx. 8.5 kg

The bottom circumference of the base wafer will fall within a circle concentric with the tube axis and having a diameter of 40 mm.
NOTES TO OUTLINE DRAWINGS


2. The metal rim-band must be earthed. The holes of 3 mm dia in each lug are provided for this purpose.

3. Spherical face plate.

4. End of guaranteed contour. The maximum neck-and-cone contour is given by the reference line gauge C (18, 13 mm).

5. The configuration of the external conductive coating may be different but contains the contact area as shown in the drawing. The external conductive coating must be earthed.

6. This area must be kept clean.

7. Minimum space to be reserved for mounting lug.

8. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical position i.e. at the corners of a rectangle of 414 mm x 331 mm.

9. The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.

10. Max. curvatures of the outside rim-band are: nominal bulb radius + 4 mm.

11. Distance from reference point Z to any hardware.
MAXIMUM CONE CONTOUR DRAWING

Distance from centre (max. values)

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom distance from point &quot;Z&quot;</th>
<th>0° Long</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
<th>100°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>157.2</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
<td>69.0</td>
</tr>
<tr>
<td>2</td>
<td>147.2</td>
<td>109.2</td>
<td>107.8</td>
<td>107.1</td>
<td>106.4</td>
<td>106.0</td>
<td>105.9</td>
<td>105.5</td>
<td>105.0</td>
<td>104.5</td>
<td>103.9</td>
<td>102.8</td>
</tr>
<tr>
<td>3</td>
<td>137.2</td>
<td>136.7</td>
<td>134.5</td>
<td>133.7</td>
<td>133.0</td>
<td>132.3</td>
<td>131.8</td>
<td>130.7</td>
<td>129.3</td>
<td>127.5</td>
<td>125.3</td>
<td>121.9</td>
</tr>
<tr>
<td>4</td>
<td>127.2</td>
<td>157.2</td>
<td>156.5</td>
<td>155.7</td>
<td>154.8</td>
<td>153.8</td>
<td>153.0</td>
<td>151.5</td>
<td>150.0</td>
<td>147.5</td>
<td>144.7</td>
<td>138.7</td>
</tr>
<tr>
<td>5</td>
<td>117.2</td>
<td>174.2</td>
<td>174.0</td>
<td>174.4</td>
<td>174.3</td>
<td>173.4</td>
<td>172.8</td>
<td>171.0</td>
<td>169.3</td>
<td>165.7</td>
<td>160.8</td>
<td>152.0</td>
</tr>
<tr>
<td>6</td>
<td>107.2</td>
<td>185.8</td>
<td>186.3</td>
<td>188.4</td>
<td>190.0</td>
<td>191.2</td>
<td>191.2</td>
<td>189.5</td>
<td>186.7</td>
<td>181.7</td>
<td>174.7</td>
<td>163.2</td>
</tr>
<tr>
<td>7</td>
<td>97.2</td>
<td>194.5</td>
<td>195.7</td>
<td>202.2</td>
<td>203.8</td>
<td>206.6</td>
<td>207.3</td>
<td>206.4</td>
<td>203.5</td>
<td>196.4</td>
<td>187.4</td>
<td>173.0</td>
</tr>
<tr>
<td>8</td>
<td>87.2</td>
<td>201.7</td>
<td>203.8</td>
<td>210.2</td>
<td>215.4</td>
<td>220.6</td>
<td>222.1</td>
<td>222.2</td>
<td>218.8</td>
<td>210.5</td>
<td>198.8</td>
<td>181.2</td>
</tr>
<tr>
<td>9</td>
<td>77.2</td>
<td>208.2</td>
<td>210.6</td>
<td>218.5</td>
<td>224.8</td>
<td>231.4</td>
<td>234.8</td>
<td>236.5</td>
<td>233.5</td>
<td>222.2</td>
<td>208.5</td>
<td>188.5</td>
</tr>
<tr>
<td>10</td>
<td>67.2</td>
<td>213.1</td>
<td>215.9</td>
<td>225.2</td>
<td>231.9</td>
<td>239.8</td>
<td>244.3</td>
<td>248.5</td>
<td>244.8</td>
<td>230.3</td>
<td>216.0</td>
<td>194.7</td>
</tr>
<tr>
<td>11</td>
<td>57.2</td>
<td>215.6</td>
<td>219.0</td>
<td>228.2</td>
<td>235.4</td>
<td>244.5</td>
<td>249.6</td>
<td>253.7</td>
<td>250.2</td>
<td>235.7</td>
<td>220.5</td>
<td>198.6</td>
</tr>
<tr>
<td>12</td>
<td>49.3</td>
<td>217.0</td>
<td>219.8</td>
<td>229.3</td>
<td>236.6</td>
<td>246.0</td>
<td>251.2</td>
<td>254.5</td>
<td>251.7</td>
<td>237.2</td>
<td>222.0</td>
<td>199.6</td>
</tr>
</tbody>
</table>

February 1977
CAPACITANCES

Final accelerator to external conducitive coating
Ca,g3,g5/m < 1500 pF
Ca,g3,g5/m' > 1000 pF
Final accelerator to metal band
Ck 3 pF
Cathode to all
Cg1 7 pF
Grid no. 1 to all

FOCUSING electrostatic

DEFLECTION magnetic

Diagonal 110°
Horizontal deflection angle 98°
Vertical deflection angle 81°

PICTURE CENTRING MAGNET

Field intensity perpendicular to the tube axis adjustable from 0 to 800 A/m (0 to 10 Oe). Maximum distance between centre of field of this magnet and reference line: 57 mm.

TYPICAL OPERATING CONDITIONS

Cathode drive service
Volatges are specified with respect to grid no. 1

Final accelerator voltage Va,g3,g5 20 kV
Focusing electrode voltage Vg4 0 to 130 V *)
Grid no. 2 voltage Vg2 130 V
Cathode voltage for visual extinction of focused raster VKR 42 to 62 V

*) Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 and +130 V (e.g. two taps, 0 V and 130 V).
The optimum focus voltage of individual tubes may be between −100 V and +200 V.
**LIMITING VALUES** (Design max. rating system)

Final accelerator voltage at $I_{a,g3,g5} = 0$

<table>
<thead>
<tr>
<th>$V_{a,g3,g5}$</th>
<th>max. 23 kV*</th>
<th>min. 14 kV</th>
</tr>
</thead>
</table>

Grid no. 4 voltage
- positive $V_{g4}$ max. 1000 V
- negative $-V_{g4}$ max. 500 V

Grid no. 2 voltage
| $V_{g2}$ | max. 200 V** | min. 80 V |

Cathode to grid no. 1 voltage
- positive $V_{k/g1}$ max. 200 V
- positive peak $V_{k/g1p}$ max. 400 V***
- negative $-V_{k/g1}$ max. 0 V
- negative peak $-V_{k/g1p}$ max. 2 V

Cathode-to-heater voltage
| $V_{kf}$ | max. 100 V |

**CIRCUIT DESIGN VALUES**

Grid no. 4 current,
- positive $I_{g4}$ max. 25 $\mu$A
- negative $-I_{g4}$ max. 25 $\mu$A

Grid no. 2 current,
- positive $I_{g2}$ max. 5 $\mu$A
- negative $-I_{g2}$ max. 5 $\mu$A

**MAXIMUM CIRCUIT VALUES**

Resistance between cathode and heater
| $R_{k/f}$ | max. 1,0 M$\Omega$ |

Impedance between cathode and heater
| $Z_{k/(50 \text{ Hz})}$ | max. 0,1 M$\Omega$ |

Grid no. 1 circuit resistance
| $R_{g1}$ | max. 1,5 M$\Omega$ |

Grid no. 1 impedance
| $Z_{g1 (50 \text{ Hz})}$ | max. 0,5 M$\Omega$ |

*) The X-ray dose rate remains below the acceptable value of 0.5 mR/h, measured with ionization chamber when the tube is used within its limiting values, according to IEC 65.

**) At $V_{g1/k} = 0$ V.

**** Maximum pulse duration 22% of a cycle but maximum 1.5 ms.
Final accelerator current as a function of cathode voltage

Cathode drive \( V_{a,g3,g5} = 20 \text{ kV} \)
Limits of cathode cut-off voltage as a function of grid no. 2 voltage

\[ \frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.75 \times 10^{-3} \]
Cathode heating time to attain a certain percentage of the cathode current at equilibrium condition.
DEFLECTION UNITS FOR
BLACK & WHITE TV PICTURE TUBES
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Picture tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
</tr>
<tr>
<td>neck diameter</td>
</tr>
<tr>
<td>Deflection angle</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 18 kV</td>
</tr>
<tr>
<td>Inductance of line coils</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 18 kV</td>
</tr>
<tr>
<td>Resistance of field coils</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Picture tube</th>
<th>AT1040/04</th>
<th>AT1040/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>43 cm (17 in), 51 cm (20 in)</td>
<td></td>
</tr>
<tr>
<td>neck diameter</td>
<td>28,6 mm</td>
<td></td>
</tr>
<tr>
<td>Deflection angle</td>
<td>110°</td>
<td></td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 18 kV</td>
<td>2,92 A (p-p)</td>
<td>1,46 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>2,09 mH</td>
<td>8,36 mH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 18 kV</td>
<td>1,1 A (p-p)</td>
<td>1,1 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>7,4 Ω</td>
<td>7,4 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

These deflection units are for use with 110° black and white picture tubes.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the picture tube.

The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the frame and line deflection centres coincide.

The units meet the self-extinguishing and non-dripping requirements of IEC 65.

For centring and pin-cushion distortion see under “Correction facilities”.

August 1986
MECHANICAL DATA

Dimensions in mm

The units are provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the connection diagrams (Figs 2 and 3).

MOUNTING

The unit should be mounted as far forward as possible on the neck of the picture tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the picture tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
Deflection units

AT1040/04
AT1040/17

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 ºC.

<table>
<thead>
<tr>
<th></th>
<th>AT1040/04</th>
<th>AT1040/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line deflection coils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inductance</td>
<td>2,09 mH</td>
<td>8,36 mH</td>
</tr>
<tr>
<td>Resistance</td>
<td>3,55 Ω</td>
<td>14,2 Ω</td>
</tr>
<tr>
<td>Field deflection coils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inductance</td>
<td>17,0 mH</td>
<td>17,0 mH</td>
</tr>
<tr>
<td>Resistance</td>
<td>7,37 Ω</td>
<td>7,37 Ω</td>
</tr>
</tbody>
</table>

Maximum peak voltage between terminals of line and field coils (50 Hz)

Maximum operating temperature

Fig. 2a Line coils, AT1040/04.

The beginning of the windings is indicated with •.

Fig. 2b Field coils, AT1040/04.

The following characteristics are measured at an e.h.t. of 18 kV on a 61 cm (24 in) reference picture tube.

Sensitivity

<table>
<thead>
<tr>
<th></th>
<th>AT1040/04</th>
<th>AT1040/17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection current edge to edge in line direction</td>
<td>2,92 A (p-p)</td>
<td>1,46 A (p-p)</td>
</tr>
<tr>
<td>in field direction</td>
<td>1,1 A (p-p)</td>
<td>1,1 A (p-p)</td>
</tr>
</tbody>
</table>
Geometric distortion measured without correction and centring magnets (dimensions in mm)

The spreads in raster geometry are tabulated below as deviations from the ideal rectangle at the points indicated. Cartesian coordinates are used to show the extent of deviation resolved along x and y areas. Points A, B, C, D, E are fixed and hence have zero spreads.

Spreads (x,y) per point:
- F (-3 ± 4, +3 ± 4)
- G (+3 ± 4, +3 ± 4)
- H (-3 ± 4, -3 ± 4)
- J (+3 ± 4, -3 ± 4)

\[ |Fy - Gy| \leq 5 \]
\[ |Gx - Jx| \leq 5 \]
\[ |Jy - Hy| \leq 5 \]
\[ |Hx - Fx| \leq 5 \]

Fig. 4.

CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the picture tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetised diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets can not be used for compensating the effects of non-linearity or of phase differences between the synchronisation and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

Fig. 5.
For raster geometry

Pin-cushion distortion can be corrected by plastic bonded Ferroxdure magnet strips, which have been mounted on the deflection unit brackets. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal rotation of these magnets.

Notes

To correct the corners of the raster plastic bonded Ferroxdure magnets can be fitted to the deflection unit, (2), Fig. 1.

To optimize the raster geometry plastic bonded Ferroxdure magnet rods can be fitted to the deflection unit, (3), Fig. 1.
DEFLECTION UNIT

QUICK REFERENCE DATA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>43 cm (17 in), 51 cm (20 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 18 kV</td>
<td>2,35 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>3,32 mH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 18 kV</td>
<td>1,1 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>7,4 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 110° black and white picture tubes.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the picture tube.

The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the frame and line deflection centres coincide.

The unit meets the self-extinguishing and non-dripping requirements of IEC 65.

For centring and pin-cushion distortion see under “Correction facilities”. 

August 1986
MECHANICAL DATA

Fig. 1 Deflection unit AT1040/15.

(1) Plastic bonded FXD magnet strips, mounted on brackets.
(2) For fitting plastic bonded FXD magnets, available under catalogue number 3122 104 94120.
(3) For fitting plastic bonded FXD magnet rods, available under catalogue number 3122 104 90360.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the connection diagrams (Fig. 2).

MOUNTING

The unit should be mounted as far forward as possible on the neck of the picture tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the picture tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

Line deflection coils, parallel connected (Fig. 2a) terminals 3 and 4
  Inductance
  Resistance
Field deflection coils, parallel connected (Fig. 2b) terminals 1 and 6
  Inductance
  Resistance

Maximum peak voltage between terminals of line and field coils (50 Hz)

Maximum operating temperature

The beginning of the windings is indicated with •.

The following characteristics are measured at an e.h.t. of 18 kV on a 61 cm (24 in) reference picture tube.

Sensitivity

Deflection current edge to edge
  in line direction
  in field direction

2,35 A (p-p)
1,1 A (p-p)
Geometric distortion measured without correction and centring magnets (dimensions in mm)

The spreads in raster geometry are tabulated below as deviations from the ideal rectangle at the points indicated. Cartesian coordinates are used to show the extent of deviation resolved along x and y areas. Points A, B, C, D, E are fixed and hence have zero spreads.

Spreads (x,y) per point:
- F (-3 ± 4 , +3 ± 4)
- G (+3 ± 4 , +3 ± 4)
- H (-3 ± 4 , -3 ± 4)
- J (+3 ± 4 , -3 ± 4)

|Fy-Gy| ≤ 5
|Gx-Jx| ≤ 5
|Jy-Hy| ≤ 5
|Hx-Fx| ≤ 5

Fig. 3.

CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the picture tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetised diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets can not be used for compensating the effects of non-linearity or of phase differences between the synchronisation and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

Fig. 4.
For raster geometry
Pin-cushion distortion can be corrected by plastic bonded Ferroxdure magnet strips, which have been mounted on the deflection unit brackets. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal rotation of these magnets.

Notes
To correct the corners of the raster plastic bonded Ferroxdure magnets can be fitted to the deflection unit, (2), Fig. 1.
To optimize the raster geometry plastic bonded Ferroxdure magnet rods can be fitted to the deflection unit, (3), Fig. 1.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Picture tube</th>
<th>24 cm (9 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 10 kV</td>
<td>2.70 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 10 kV</td>
<td>0.24 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>40 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 24 cm (9 in) 90° black & white picture tubes and monitor tubes for basic displays. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA
The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

ELECTRICAL DATA
The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2), terminals 1 and 4
- Inductance: 475 µH ± 3.5%
- Resistance: 0.8 Ω ± 5%
- L/R: 594 µH/Ω
- Line deflection current, edge to edge (198 mm), at 10 kV: 2.70 A (p-p) ± 10%

**Field deflection coils**, series connected (Fig. 2), terminals 2 and 3
- Inductance: 72 mH ± 8%
- Resistance: 40 Ω ± 5%
- L/R: 1.80 mH/Ω
- Field deflection current, edge to edge (149 mm), at 10 kV: 0.24 A (p-p) ± 10%

Maximum d.c. voltage between terminals of line and field coils: 500 V

Maximum operating temperature (average copper temperature): 95 °C

Storage temperature range: -40 to +75 °C

Coupling between line and field coils, at 500 Hz: ≤ 1/50
Fig. 2a  Line coils.

Fig. 2b  Field coils.

The beginning of the windings is indicated with •.

**Geometric distortion** measured without centring magnets on a 24 cm (9 in) reference tube (dimensions in mm)

\[
\begin{align*}
|F_y - G_y| &\leq 2 \\
|G_x - J_x| &\leq 2 \\
|J_y - H_y| &\leq 2 \\
|H_x - F_x| &\leq 2
\end{align*}
\]

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

Fig. 5.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Picture tube diagonal</th>
<th>31 cm (12 in), 34 cm (14 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan (12 in), at 12 kV</td>
<td>2.93 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>436 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan (12 in), at 12 kV</td>
<td>0.26 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>33 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) and 34 cm (14 in) 90° picture tubes. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20,9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 2 and 5
- Inductance: 436 µH ± 3.5%
- Resistance: 0.80 Ω ± 5%
- L/R: 545 µH/Ω ± 5%
- Line deflection current, edge to edge (254 mm, 12 in), at 12 kV: 2.93 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 3 and 4
- Inductance: 68 mH ± 5%
- Resistance: 33,0 Ω ± 5%
- L/R: 2,06 mH/Ω
- Field deflection current, edge to edge (201 mm, 12 in), at 12 kV: 0.26 A (p-p) ± 5%

- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: −40 to +75 °C
- Coupling between line and field coils, at 500 Hz: ≪ 1/50
Deflection unit

Fig. 2a Line coils.
Fig. 2b Field coils.

The beginning of the windings is indicated with •.

**Geometric distortion** measured without centring magnets, on a 12 in reference tube (dimensions in mm)

\[
\begin{align*}
|F_y - G_y| & \leq 2 \\
|G_x - J_x| & \leq 2 \\
|J_y - H_y| & \leq 2 \\
|H_x - F_x| & \leq 2 \\
\end{align*}
\]

Fig. 3.

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

Fig. 5.
MONOCHROME DATA GRAPHIC DISPLAY TUBES
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 24 cm (9 in) face diagonal; rectangular glass
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Deflection angle</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>24 cm (9 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 227 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

AVAILABLE VERSIONS

The following versions are available: M24-306, M24-308, M24-310 and M24-328. Differences between the tubes can be found under ‘Dimensional data’.

July 1985
ELECTRICAL DATA

Focusing method
Deflection method
Deflection angles
diagonal
horizontal
vertical
Direct interelectrode capacitances
cathode to all other electrodes
grid 1 to all other electrodes
Capacitance of external conductive coating to anode*
Capacitance of external conductive coating to anode**
Capacitance of anode to implosion protection hardware**
Heater voltage
Heater current at 12 V

OPTICAL DATA

Phosphor type
Light transmission at screen centre
tube with normal tinted face glass
tube with dark tinted face glass

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
### High resolution monochrome display tubes

#### MECHANICAL DATA (see also the figures under Dimensions Data)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>max. 227 mm</td>
</tr>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>248,5 mm</td>
</tr>
<tr>
<td>width</td>
<td>216 mm</td>
</tr>
<tr>
<td>height</td>
<td>167 mm</td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>222,5 mm</td>
</tr>
<tr>
<td>horizontal axis</td>
<td>193 mm</td>
</tr>
<tr>
<td>vertical axis</td>
<td>145 mm</td>
</tr>
<tr>
<td>area</td>
<td>268 cm²</td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
</tr>
<tr>
<td>Bulb</td>
<td></td>
</tr>
<tr>
<td>contact designation</td>
<td></td>
</tr>
<tr>
<td>Base designation</td>
<td></td>
</tr>
<tr>
<td>Basing</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 1,8 kg</td>
</tr>
</tbody>
</table>

#### RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode voltage</td>
<td>max. 15 kV</td>
</tr>
<tr>
<td></td>
<td>min. 9,5 kV</td>
</tr>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>-200 to +1000 V</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 700 V</td>
</tr>
<tr>
<td>Anode current</td>
<td></td>
</tr>
<tr>
<td>long-term average value</td>
<td>max. 130 µA</td>
</tr>
<tr>
<td>peak value</td>
<td>max. 600 µA</td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 400 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V ± 10% *</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

\* For maximum cathode life it is recommended that the heater supply be regulated at 12 V\(^{\pm 0\%\, -5\%}\).
CIRCUIT DESIGN VALUES

| Grid 4 current                  | max. 25 µA | max. 25 µA |
| Grid 2 current                  | max. 5 µA  | max. 5 µA  |

MAXIMUM CIRCUIT VALUES

| Resistance between cathode and heater | max. 1,0 MΩ |
| Impedance between cathode and heater  | max. 0,1 MΩ |
| Grid 1 circuit resistance            | max. 1,5 MΩ |
| Grid 1 circuit impedance             | max. 0,5 MΩ |

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1

| Anode voltage                     | 12 kV  |
| Grid 4 (focusing electrode) voltage| 0 to 300 V* |
| Grid 2 voltage                    | 400 V  |
| Cathode cut-off voltage            | 30 to 60 V** |

Grid drive; voltages specified with respect to cathode

| Anode voltage                     | 12 kV  |
| Grid 4 (focusing electrode) voltage| 0 to 300 V* |
| Grid 2 voltage                    | 400 V  |
| Grid 1 cut-off voltage             | 34 to 64 V** |

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 168 mm x 126 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization): Typical correction for a video field of H x V = 168 mm x 126 mm:
- line parabola 200 V;
- field parabola 100 V.

** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

Anode current as a function of grid 1 voltage.
Grid drive; \( V_{a,g3,g5} = 12 \text{ kV} \).
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 1.8 mm.
Front view and lug dimensions of tube M24-306

(1) The position of the mounting screws in the cabinet must be within a circle of 5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 212 mm x 160 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M24-308

1. The position of the mounting screws in the cabinet must be within a circle of 3.4 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 205 mm x 154 mm.

September 1986
Front view and lug dimensions of tube M24-310

(1) The position of the mounting screws in the cabinet must be within a circle of 4 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 205 mm x 154 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M24-328 *

(1) The position of the mounting screws in the cabinet must be within a circle of 4 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 205 mm x 154 mm.

* This tube is still under development; data are provisional.
### Maximum Cone Contour

**Diagram**

- Maximum cone contour
- Reference line
- 34°40'
- Diagonal lines
- Angles 30°, 20°, 10°, 0°

**Table**

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. Distance from Section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>108.3</td>
<td>109.8</td>
<td>114.2</td>
<td>121.9</td>
<td>123.9</td>
<td>121.6</td>
<td>106.6</td>
<td>95.6</td>
<td>88.8</td>
<td>85.0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>105.4</td>
<td>106.8</td>
<td>111.0</td>
<td>117.7</td>
<td>119.4</td>
<td>117.4</td>
<td>104.4</td>
<td>93.9</td>
<td>87.3</td>
<td>83.7</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>98.0</td>
<td>99.2</td>
<td>102.9</td>
<td>107.8</td>
<td>109.2</td>
<td>108.1</td>
<td>99.1</td>
<td>90.0</td>
<td>83.9</td>
<td>80.6</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>88.4</td>
<td>89.4</td>
<td>92.2</td>
<td>95.7</td>
<td>96.6</td>
<td>96.2</td>
<td>91.0</td>
<td>84.2</td>
<td>79.0</td>
<td>76.1</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>78.1</td>
<td>78.9</td>
<td>81.0</td>
<td>83.2</td>
<td>83.8</td>
<td>83.8</td>
<td>81.2</td>
<td>76.8</td>
<td>72.9</td>
<td>70.5</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>66.8</td>
<td>67.4</td>
<td>68.8</td>
<td>70.4</td>
<td>70.9</td>
<td>71.2</td>
<td>70.3</td>
<td>68.1</td>
<td>65.6</td>
<td>63.8</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>54.5</td>
<td>54.9</td>
<td>55.8</td>
<td>56.8</td>
<td>57.2</td>
<td>57.5</td>
<td>57.5</td>
<td>56.8</td>
<td>55.8</td>
<td>54.9</td>
</tr>
<tr>
<td>8</td>
<td>61.2</td>
<td>53.0</td>
<td>53.3</td>
<td>54.2</td>
<td>55.1</td>
<td>55.4</td>
<td>55.7</td>
<td>55.7</td>
<td>55.2</td>
<td>54.3</td>
<td>53.4</td>
</tr>
</tbody>
</table>
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 24 cm (9 in) face diagonal; rectangular glass
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>24 cm (9 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 227 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/75 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1000 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

AVAILABLE VERSIONS

The following versions are available: M24-322 and M24-326. Differences between the tubes can be found under ‘Dimensional data’.
ELECTRICAL DATA

Focusing method
Deflection method
deflection angles
diagonal
horizontal
vertical
direct interelectrode capacitances
cathode to all other electrodes
grid 1 to all other electrodes
capacitance of external conductive coating to anode*
capacitance of external conductive coating to anode**
capacitance of anode to implosion protection hardware**
heater voltage
heater current at 12 V

OPTICAL DATA

phosphor type
light transmission at screen centre
tube with normal tinted face glass
tube with dark tinted face glass

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensions Data)

Overall length               max. 227 mm
Greatest dimensions of tube
  diagonal                  248.5 mm
  width                   216 mm
  height                 167 mm
Minimum useful screen dimensions (projected)
  diagonal              222.5 mm
  horizontal axis        193 mm
  vertical axis         145 mm
  area                  268 cm²
Implosion protection              T-band
Bulb                             EIAJ-JB240AA03 or
                                    EIAJ-JB240AA04
Bulb contact designation        IEC 67-III-2, EIA-J1-21
Base designation               EIA E7-91
Basing                           7GR
Mass                     approx. 1.8 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage
  max.  15 kV
  min.  9.5 kV
Grid 4 (focusing electrode) voltage
  -550 to + 1100 V
Grid 2 voltage               max.  550 V
Anode current
  long-term average value
    max.  100 µA
  peak value
    max.  150 µA
Cathode voltage, positive peak value
  max.  220 V
Heater voltage               12 V ± 10% *
Cathode-to-heater voltage
  max.  100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V 
  +0% -5%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive  max.  25 µA
  negative max.  25 µA

Grid 2 current
  positive  max.  5 µA
  negative max.  5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater  max.  1,0 MΩ
Impedance between cathode and heater  max.  0,1 MΩ
Grid 1 circuit resistance  max.  1,5 MΩ
Grid 1 circuit impedance  max.  0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage  12 kV
Grid 4 (focusing electrode) voltage  0 to 400 V*
Grid 2 voltage  400 V
  → Cathode cut-off voltage  36 to 66 V**

Grid drive; voltages specified with respect to cathode
Anode voltage  12 kV
Grid 4 (focusing electrode) voltage  0 to 400 V*
Grid 2 voltage  400 V
  → Grid 1 cut-off voltage  39 to 73 V**

RESOLUTION

The resolution is approx. 1000 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 550 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 168 mm x 126 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 50 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 168 mm x 126 mm:
  line parabola 200 V;
  field parabola 100 V.
  ** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

Anode current as a function of grid 1 voltage.
Grid drive; \( V_{a,g3,g5} = 12 \text{ kV} \).
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 12 \text{ kV}$.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$  

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; $V_{a,g3,g5} = 12 \text{ kV}$.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
High resolution monochrome display tubes

M24-322
M24-326

(1) The displacement of any lug with respect to the plane through the other three lugs is max. 1.8 mm.
Front view and lug dimensions of tube M24-322

(1) The position of the mounting screws in the cabinet must be within a circle of 5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 212 mm x 160 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M24-326

(1) The position of the mounting screws in the cabinet must be within a circle of 3.4 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 205 mm x 154 mm.
Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>diag.</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>108.3</td>
<td>109.8</td>
<td>114.2</td>
<td>121.9</td>
<td>123.9</td>
<td>121.6</td>
<td>106.6</td>
<td>95.6</td>
<td>88.8</td>
<td>85.0</td>
<td>83.8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>105.4</td>
<td>106.8</td>
<td>111.0</td>
<td>117.7</td>
<td>119.4</td>
<td>117.4</td>
<td>104.4</td>
<td>93.9</td>
<td>87.3</td>
<td>83.7</td>
<td>82.5</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>98.0</td>
<td>99.2</td>
<td>102.9</td>
<td>107.8</td>
<td>109.2</td>
<td>108.1</td>
<td>99.1</td>
<td>90.0</td>
<td>83.9</td>
<td>80.6</td>
<td>79.5</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>88.4</td>
<td>89.4</td>
<td>92.2</td>
<td>95.7</td>
<td>96.6</td>
<td>96.2</td>
<td>91.0</td>
<td>84.2</td>
<td>79.0</td>
<td>76.1</td>
<td>75.1</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>78.1</td>
<td>78.9</td>
<td>81.0</td>
<td>83.2</td>
<td>83.8</td>
<td>83.8</td>
<td>81.2</td>
<td>76.8</td>
<td>72.9</td>
<td>70.5</td>
<td>69.7</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>66.8</td>
<td>67.4</td>
<td>68.8</td>
<td>70.4</td>
<td>70.9</td>
<td>71.2</td>
<td>70.3</td>
<td>68.1</td>
<td>65.6</td>
<td>63.8</td>
<td>63.2</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>54.5</td>
<td>54.9</td>
<td>55.8</td>
<td>56.8</td>
<td>57.2</td>
<td>57.5</td>
<td>57.5</td>
<td>56.8</td>
<td>55.8</td>
<td>54.9</td>
<td>54.5</td>
</tr>
<tr>
<td>8</td>
<td>61,2</td>
<td>53.0</td>
<td>53.3</td>
<td>54.2</td>
<td>55.1</td>
<td>55.4</td>
<td>55.7</td>
<td>55.7</td>
<td>55.2</td>
<td>54.3</td>
<td>53.4</td>
<td>53.1</td>
</tr>
</tbody>
</table>
MONOCHROME DISPLAY TUBES

- 90° deflection angle
- 24 cm (9 in) face diagonal; rectangular glass
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>24 cm (9 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 227 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>11 V/140 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>130 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 800 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These display tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M24-511W, M24-512W and M24-514W. Differences between the tubes can be found under "Dimensional data".

July 1985
THE FIELD INTENSITY PERPENDICULAR TO THE TUBE AXIS SHOULD BE ADJUSTABLE FROM 0 TO 800 A/M. FOR OPTIMUM OVERALL SHARPNESS IT IS RECOMMENDED TO CENTRE THE RASTER ELECTRICALLY VIA THE DEFLECTION COILS.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
### MECHANICAL DATA (see also the figures under Dimensions Data)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>max. 227 mm</td>
</tr>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>249,5 mm</td>
</tr>
<tr>
<td>width</td>
<td>216 mm</td>
</tr>
<tr>
<td>height</td>
<td>167 mm</td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>222,5 mm</td>
</tr>
<tr>
<td>horizontal axis</td>
<td>193 mm</td>
</tr>
<tr>
<td>vertical axis</td>
<td>145 mm</td>
</tr>
<tr>
<td>area</td>
<td>268 cm²</td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
</tr>
<tr>
<td>Bulb contact designation</td>
<td></td>
</tr>
<tr>
<td>Base designation</td>
<td></td>
</tr>
<tr>
<td>Basing</td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 1,8 kg</td>
</tr>
</tbody>
</table>

### RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode voltage</td>
<td>max. 15 kV</td>
</tr>
<tr>
<td></td>
<td>min. 9,5 kV</td>
</tr>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>−200 to +500 V</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 200 V</td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 200 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>11 V ± 10% *</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

### CIRCUIT DESIGN VALUES

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid 4 current</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>max. 25 µA</td>
</tr>
<tr>
<td>negative</td>
<td>max. 25 µA</td>
</tr>
<tr>
<td>Grid 2 current</td>
<td></td>
</tr>
<tr>
<td>positive</td>
<td>max. 5 µA</td>
</tr>
<tr>
<td>negative</td>
<td>max. 5 µA</td>
</tr>
</tbody>
</table>

### MAXIMUM CIRCUIT VALUES

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance between cathode and heater</td>
<td>max. 1,0 MΩ</td>
</tr>
<tr>
<td>Impedance between cathode and heater</td>
<td>max. 0,1 MΩ</td>
</tr>
<tr>
<td>Grid 1 circuit resistance</td>
<td>max. 1,5 MΩ</td>
</tr>
<tr>
<td>Grid 1 circuit impedance</td>
<td>max. 0,5 MΩ</td>
</tr>
</tbody>
</table>

* For maximum cathode life it is recommended that the heater supply be regulated at 11 V +0% -5%.
TYPICAL OPERATING CONDITIONS
Cathode drive; voltages specified with respect to grid 1
Anode voltage 12 kV
Grid 4 (focusing electrode) voltage 130 V*
Grid 2 voltage 130 V
Cathode cut-off voltage 45 to 65 V**

RESOLUTION
The resolution is approx. 800 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68.5 cd/m² (20 foot lambert), grid 2 voltage = 200 V, anode voltage = 12 kV; raster dimensions 168 mm x 126 mm.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0.5 mR/h throughout the useful life of the tube, when operated within the given ratings.

X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 12 kV, grid 2 voltage = 130 V. Because of the flat focus characteristic it is sufficient to choose a focusing voltage between 0 V and +130 V. The optimum focus voltage of individual tubes may be between -150 and +150 V.

** Visual extinction of focused raster.
Monochrome display tubes

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.

Anode current as a function of cathode voltage. Cathode drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; \( V_{a,g3,g5} = 12 \text{ kV} \).

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.3 \times 10^{-3}
\]
The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 1.8 mm.
Front view of tube M24-511W

- Welded joint
- Anode contact

Measurements:
- 246.5 max
- 228.6
- 2.5 ± 1.5
(1) The position of the mounting screws in the cabinet must be within a circle of 5 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 212 mm x 160 mm.
Front view and lug dimensions of tube M24-514W

1. The position of the mounting screws in the cabinet must be within a circle of 7 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 212 mm x 160 mm.
Monochrome display tubes

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>108,3</td>
<td>109,8</td>
</tr>
<tr>
<td>2</td>
<td>105,4</td>
<td>106,8</td>
</tr>
<tr>
<td>3</td>
<td>98,0</td>
<td>99,2</td>
</tr>
<tr>
<td>4</td>
<td>88,4</td>
<td>89,4</td>
</tr>
<tr>
<td>5</td>
<td>78,1</td>
<td>78,9</td>
</tr>
<tr>
<td>6</td>
<td>66,8</td>
<td>67,4</td>
</tr>
<tr>
<td>7</td>
<td>54,5</td>
<td>54,9</td>
</tr>
<tr>
<td>8</td>
<td>53,0</td>
<td>53,3</td>
</tr>
</tbody>
</table>

July 1985
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 1200 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

**QUICK REFERENCE DATA**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 275 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

**APPLICATION**

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

**AVAILABLE VERSIONS**

The following versions are available: M29EAA and M29EAB.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

Differences between the tubes can be found under ‘Dimensional data’.
ELECTRICAL DATA

Focusing method  electrostatic
Deflection method  magnetic
Deflection angles
  diagonal  approx. 90°
  horizontal  approx. 79°
  vertical  approx. 61°

Interelectrode capacitances
  cathode to all other electrodes  max. 4 pF
  grid 1 to all other electrodes  max. 7 pF

Capacitance of external conductive coating to anode*
  max. 1200 pF
  min. 600 pF

Heater voltage  12 V
Heater current at 12 V  130 mA

OPTICAL DATA

Phosphor type  see “High resolution monochrome display tubes, General”

Light transmission at screen centre
  tube with normal tinted face glass  approx. 43%
  tube with dark tinted face glass  approx. 32%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
**MECHANICAL DATA** (see also the figures under Dimensional Data)

Overall length  
max. 275 mm

Greatest dimensions of tube
- diagonal: 323,5 mm
- width: 273 mm
- height: 212,5 mm

Minimum useful screen dimensions (projected)
- diagonal: 294 mm
- horizontal axis: 246 mm
- vertical axis: 181 mm
- area: 440 cm²

Implosion protection  
T-band

Bulb  
EIAJ-JB320AA03 or EIAJ-JB320AA04

Bulb contact designation  
IEC 67-III-2, EIAJ1-21

Base designation  
EIA E7-91

Basing  
7GR

Mass  
approx. 3,5 kg

**RATINGS** (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage
- max. 15 kV
- min. 10 kV

Grid 4 (focusing electrode) voltage  
-200 to + 1000 V

Grid 2 voltage  
max. 700 V

Anode current
- long-term average value: max. 130 µA
- peak value: max. 600 µA

Cathode voltage, positive peak value  
max. 400 V

Heater voltage  
12 V ± 10%*

Cathode-to-heater voltage  
max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ± 0% −5%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive  max. 25 µA
  negative max. 25 µA

Grid 2 current
  positive  max. 5 µA
  negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater  max. 1,0 MΩ
Impedance between cathode and heater  max. 0,1 MΩ
Grid 1 circuit resistance  max. 1,5 MΩ
Grid 1 circuit impedance  max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
  Anode voltage  12 kV
  Grid 4 (focusing electrode) voltage  0 to 300 V*
  Grid 2 voltage  400 V
  Cathode cut-off voltage  30 to 60 V**

Grid drive; voltages specified with respect to cathode
  Anode voltage  12 kV
  Grid 4 (focusing electrode) voltage  0 to 300 V*
  Grid 2 voltage  400 V
  Grid 1 cut-off voltage  34 to 64 V**

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre:
  • with shrinking raster method,
  • at light output 68,5 cd/m² (20 foot lambert) and raster dimensions 216 mm x 162 mm,
  • at Vg2 = 700 V and anode voltage = 12 kV,
  • with phosphor type W (WW),
  • with normal tinted face glass, without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
    line parabola 250 V,
    field parabola 0 V.
** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage. Cathode drive; \( V_{a,g3,g5} = 12 \, \text{kV} \).

Anode current as a function of grid 1 voltage. Grid drive; \( V_{a,g3,g5} = 12 \, \text{kV} \).
Limits of cathode raster cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 12 \text{ kV}$.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$  

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 12 \text{ kV}$.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
FLAT SQUARE
High resolution monochrome display tubes

(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
Front view of tube M29EAA

- Welded joint
- Anode contact

Dimensions:
- 321.5 max
- 5.5 ± 1.5

Date: August 1986
FLAT SQUARE
High resolution monochrome display tubes

Front view and lug dimensions of tube M29EAB *

The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm

* This tube is still under development; data are provisional.
### Maximum cone contour

![Diagram of maximum cone contour]

#### Table: Nominal section distance from section 1 vs. Maximum distance from centre

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. section distance from section 1</th>
<th>Max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0^\circ$</td>
<td>$10^\circ$</td>
</tr>
<tr>
<td>1</td>
<td>136.4</td>
<td>138.3</td>
</tr>
<tr>
<td>2</td>
<td>135.5</td>
<td>137.4</td>
</tr>
<tr>
<td>3</td>
<td>132.7</td>
<td>134.6</td>
</tr>
<tr>
<td>4</td>
<td>128.2</td>
<td>129.9</td>
</tr>
<tr>
<td>5</td>
<td>121.8</td>
<td>123.3</td>
</tr>
<tr>
<td>6</td>
<td>113.6</td>
<td>114.8</td>
</tr>
<tr>
<td>7</td>
<td>103.3</td>
<td>104.2</td>
</tr>
<tr>
<td>8</td>
<td>90.7</td>
<td>91.2</td>
</tr>
<tr>
<td>9</td>
<td>75.3</td>
<td>75.7</td>
</tr>
<tr>
<td>10</td>
<td>57.7</td>
<td>57.7</td>
</tr>
<tr>
<td>11</td>
<td>44.7</td>
<td>44.7</td>
</tr>
</tbody>
</table>
FLAT SQUARE
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 1200 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 275 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/75 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1000 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M29ECA and M29ECB.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

Differences between the tubes can be found under ‘Dimensional data’.
**ELECTRICAL DATA**

Focusing method  
electrostatic

Deflection method  
magnetic

Deflection angles  
approx. 90°
approx. 79°
approx. 61°

Diagonal  
Horizontal  
Vertical

Inter-electrode capacitances  
max. 5 pF
max. 6 pF
max. 1200 pF
min. 600 pF

cathode to all other electrodes
grid 1 to all other electrodes

Capacitance of external conductive coating to anode*  
12 V
75 mA

**OPTICAL DATA**

Phosphor type  
see “High resolution monochrome display tubes, General”

Light transmission at screen centre  
approx. 43%
approx. 32%

tube with normal tinted face glass
tube with dark tinted face glass

**RASTER CENTRING**

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
FLAT SQUARE
High resolution monochrome display tubes

**MECHANICAL DATA** (see also the figures under Dimensional Data)

<table>
<thead>
<tr>
<th>Overall length</th>
<th>max. 275 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>323,5 mm</td>
</tr>
<tr>
<td>width</td>
<td>273 mm</td>
</tr>
<tr>
<td>height</td>
<td>212,5 mm</td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>294 mm</td>
</tr>
<tr>
<td>horizontal axis</td>
<td>246 mm</td>
</tr>
<tr>
<td>vertical axis</td>
<td>181 mm</td>
</tr>
<tr>
<td>area</td>
<td>440 cm²</td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
</tr>
<tr>
<td>Bulb</td>
<td>EIAJ-JB320AA03 or EIAJ-JB320AA04</td>
</tr>
<tr>
<td>Bulb contact designation</td>
<td>IEC 67-III-2, EIAJ1-21</td>
</tr>
<tr>
<td>Base designation</td>
<td>EIA E7-91</td>
</tr>
<tr>
<td>Basing</td>
<td>7GR</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 3,5 kg</td>
</tr>
</tbody>
</table>

**RATINGS (Absolute Maximum System)**

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Anode voltage</th>
<th>max. 15 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>-550 to +1100 V</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 550 V</td>
</tr>
<tr>
<td>Anode current</td>
<td></td>
</tr>
<tr>
<td>long-term average value</td>
<td>max. 100 µA</td>
</tr>
<tr>
<td>peak value</td>
<td>max. 150 µA</td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 220 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V ± 10%*</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ± 10%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive  max. 25 µA
  negative max. 25 µA

Grid 2 current
  positive  max. 5 µA
  negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater  max. 1,0 MΩ
Impedance between cathode and heater  max. 0,1 MΩ
Grid 1 circuit resistance  max. 1,5 MΩ
Grid 1 circuit impedance  max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage 12 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 36 to 66 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 12 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 39 to 73 V**

RESOLUTION

The resolution is approx. 1000 lines. It is measured at the screen centre:
• with shrinking raster method,
• at light output 68,5 cd/m² (20 foot lambert) and raster dimensions 216 mm x 162 mm,
• at \( V_{g2} = 550 \) V and anode voltage = 12 kV,
• with phosphor type WW,
• with normal tinted face glass, without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 50 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.

** Visual extinction of focused raster.
FLAT SQUARE
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12\text{ kV}$.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 12\text{ kV}$. 
Limits of cathode raster cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 12$ kV.

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 12$ kV.

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
Front view of tube M29ECA

welded joint

anode contact

321,5 max

294

5,5 ± 1,5

7293482

7293483
FLAT SQUARE
High resolution monochrome display tubes

Front view and lug dimensions of tube M29ECB

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
Maximum cone contour

<table>
<thead>
<tr>
<th>section distance from section 1</th>
<th>nom. section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>11</td>
<td>96,5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>136,4</td>
</tr>
<tr>
<td>135,5</td>
</tr>
<tr>
<td>132,7</td>
</tr>
<tr>
<td>128,2</td>
</tr>
<tr>
<td>121,8</td>
</tr>
<tr>
<td>113,6</td>
</tr>
<tr>
<td>103,3</td>
</tr>
<tr>
<td>90,7</td>
</tr>
<tr>
<td>75,3</td>
</tr>
<tr>
<td>57,7</td>
</tr>
<tr>
<td>44,7</td>
</tr>
</tbody>
</table>

May 1986
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 110° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 3:4 screen aspect ratio
- 635 mm radius of screen curvature
- 28.6 mm neck diameter
- Integral implosion protection

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 241 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6.3 V/240 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>17 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

**APPLICATION**

This high resolution tube is for alpha-numeric display applications, such as computer terminals, word processors, etc.

The tube can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

**AVAILABLE VERSIONS**

The following versions are available: M31-326 and M31-370. Differences between the tubes can be found under ‘Dimensional data’.
### ELECTRICAL DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Focusing method</strong></td>
<td>electrostatic</td>
</tr>
<tr>
<td><strong>Deflection method</strong></td>
<td>magnetic</td>
</tr>
<tr>
<td><strong>Deflection angles</strong></td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>approx. 110°</td>
</tr>
<tr>
<td>horizontal</td>
<td>approx. 98°</td>
</tr>
<tr>
<td>vertical</td>
<td>approx. 81°</td>
</tr>
<tr>
<td><strong>Direct interelectrode capacitances</strong></td>
<td></td>
</tr>
<tr>
<td>cathode to all other electrodes</td>
<td>max. 4 pF</td>
</tr>
<tr>
<td>grid 1 to all other electrodes</td>
<td>max. 9 pF</td>
</tr>
<tr>
<td><strong>Capacitance of external conductive coating to anode</strong></td>
<td></td>
</tr>
<tr>
<td>capacitive coating to anode</td>
<td>max. 900 pF</td>
</tr>
<tr>
<td>capacitive coating to anode</td>
<td>min. 450 pF</td>
</tr>
<tr>
<td><strong>Capacitance of anode to implosion protection hardware</strong></td>
<td></td>
</tr>
<tr>
<td>capacitive coating to anode</td>
<td>max. 750 pF</td>
</tr>
<tr>
<td>capacitive coating to anode</td>
<td>min. 450 pF</td>
</tr>
<tr>
<td><strong>Capacitance of anode to implosion protection hardware</strong></td>
<td></td>
</tr>
<tr>
<td>capacitive coating to anode</td>
<td>approx. 150 pF</td>
</tr>
<tr>
<td><strong>Heater voltage</strong></td>
<td>6.3 V</td>
</tr>
<tr>
<td><strong>Heater current at 6.3 V</strong></td>
<td>240 mA</td>
</tr>
</tbody>
</table>

### OPTICAL DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phosphor type</strong></td>
<td>see “High resolution monochrome display tubes, General”</td>
</tr>
<tr>
<td><strong>Light transmission at screen centre</strong></td>
<td></td>
</tr>
<tr>
<td>tube with normal tinted face glass</td>
<td>approx. 46%</td>
</tr>
<tr>
<td>tube with dark tinted face glass</td>
<td>approx. 34%</td>
</tr>
</tbody>
</table>

### RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

---

* Implosion protection hardware connected to external conductive coating.

** Implosion protection hardware not connected to external conductive coating.
High resolution monochrome display tubes

MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 241 mm

Greatest dimensions of tube
- diagonal 321 mm
- width 283 mm
- height 222 mm

Minimum useful screen dimensions (projected)
- diagonal 295 mm
- horizontal axis 257 mm
- vertical axis 195 mm
- area 478 cm²

Implosion protection T-band

Bulb
- EIAJ-JB310AT03 or EIAJ-JB310AT04

Bulb contact designation
- IEC 67-III-2, EIA-J1-21

Base designation
- IEC 67-I-31a; EIA-B7-208

Basing 8HR

Mass approx. 2,8 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

- Anode voltage max. 19 kV
  min. 13 kV

- Grid 4 (focusing electrode) voltage -500 to + 1000 V

- Grid 2 voltage max. 700 V

- Anode current
  - long-term average value max. 75 µA
  - peak value max. 300 µA

- Cathode voltage, positive peak value max. 400 V

- Heater voltage 6,3 V ± 10%*

- Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 6,3 V 10%
CIRCUIT DESIGN VALUES

Grid 4 current
positive max. 25 µA
negative max. 25 µA

Grid 2 current
positive max. 5 µA
negative max. 5 µA

MAXIMUM CIRCUIT VALUES
Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS
Cathode drive; voltages specified with respect to grid 1
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION
The resolution is approx. 1500 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 17 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0.5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 17 kV, grid 2 voltage = 400 V.
** Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm line parabola 300 V,
field parabola 100 V.
** Visual extinction of focused raster.
X-ray radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage. 
Cathode drive; $V_{a,g3,g5} = 17 \text{ kV}$.

Anode current as a function of grid 1 voltage. 
Grid drive; $V_{a,g3,g5} = 17 \text{ kV}$. 
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive: $V_{a,g3,g5} = 17$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.$$ 

Limits of grid 1 cut-off voltage as a function of grid 2 voltage. Grid drive: $V_{a,g3,g5} = 17$ kV.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273.3 mm x 190.2 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M31-370 (development data)

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273.3 mm x 190.2 mm.
Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>10°</td>
<td>20°</td>
</tr>
<tr>
<td>1</td>
<td>141,0 142,6 147,3 155,7 159,2 156,6 138,2 125,0 116,7 112,1 110,6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>140,3 141,9 146,7 154,8 157,8 154,9 137,3 124,0 115,6 110,9 109,5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>137,6 139,0 143,2 148,5 148,9 145,9 132,4 120,3 112,4 107,9 106,5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>130,4 131,3 133,1 133,5 131,9 129,3 121,3 113,0 106,7 103,0 101,7</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>114,0 114,3 114,3 113,0 111,6 110,0 105,8 101,4 97,7 95,2 94,3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>89,6 89,6 89,4 88,8 88,2 87,7 86,3 84,8 83,5 82,6 82,2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>70,9 71,0 71,0 71,0 70,9 70,9 70,6 70,3 70,0 69,8 69,7</td>
<td></td>
</tr>
</tbody>
</table>
HIGH RESOLUTION MONOCHROME DISPLAY TUBE

- For Data Graphic Displays
- 110° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 3:4 screen aspect ratio
- 635 mm radius of screen curvature
- 28.6 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 241 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>17 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, word processors, etc.

The tube can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”. 

July 1984
ELECTRICAL DATA

Focusing method
Deflection method
  electrostatic
  magnetic

Deflection angle
  diagonal  approx. 110°
  horizontal approx. 98°
  vertical  approx. 81°

Direct interelectrode capacitances
  cathode to all other electrodes max. 4 pF
  grid 1 to all other electrodes max. 9 pF

Capacitance of external conductive coating to anode*
  max. 1200 pF
  min. 700 pF

Heater voltage
  12 V

Heater current at 12 V
  130 mA

OPTICAL DATA

Phosphor type
  see “High resolution monochrome display tubes, General”

Light transmission at screen centre
  tube with normal tinted face glass approx. 46%
  tube with dark tinted face glass approx. 34%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 241 mm

Greatest dimensions of tube
- diagonal 321 mm
- width 283 mm
- height 222 mm

Minimum useful screen dimensions (projected)
- diagonal 295 mm
- horizontal axis 257 mm
- vertical axis 195 mm
- area 478 cm²

Implosion protection T-band

Bulb
- EIAJ-JB310AT03 or EIAJ-JB310AT04

Bulb contact designation
- IEC 67-I-31a; EIA B7-208

Base designation
- EIAJ-JB310AT03 or EIAJ-JB310AT04

Basing 8HR

Mass approx. 2,8 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage max. 19 kV
min. 13 kV

Grid 4 (focusing electrode) voltage -500 to +1000 V

Grid 2 voltage max. 700 V

Anode current
- long-term average value max. 75 µA
- peak value max. 300 µA

Cathode voltage, positive peak value max. 400 V

Heater voltage 12 V ± 10%*

Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ±5%
CIRCUIT DESIGN VALUES

Grid 4 current
- positive max. 25 µA
- negative max. 25 µA

Grid 2 current
- positive max. 5 µA
- negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
- Anode voltage 17 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
- Anode voltage 17 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION

The resolution is approx. 1500 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 17 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 17 kV, grid 2 voltage = 400 V.

** Visual extinction of focused raster.

* Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
- line parabola 300 V,
- field parabola 100 V.
X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 17\, \text{kV}$.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 17\, \text{kV}$. 
Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 17 \text{kV}$.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$ 

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; $V_{a,g3,g5} = 17 \text{kV}$.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
The displacement of any lug with respect to the plane through the three other lugs is max. 2 mm.
Front view and lug dimensions of tube M31-328

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
High resolution monochrome display tube

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>141,0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>140,3</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>137,6</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>130,4</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>114,0</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>89,6</td>
</tr>
<tr>
<td>7</td>
<td>56,4</td>
<td>70,9</td>
</tr>
</tbody>
</table>

July 1985
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 4:5 screen aspect ratio
- 510 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 280 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

AVAILABLE VERSIONS

The following versions are available: M31-336, M31-338 and M31-350. Differences between the tubes can be found under ‘Dimensional data’.

July 1984
ELECTRICAL DATA

Focusing method  electrostatic
Deflection method  magnetic
Deflection angles
  diagonal  approx. 90°
  horizontal  approx. 83°
  vertical  approx. 65°
Direct interelectrode capacitances
  cathode to all other electrodes  max. 4 pF
  grid 1 to all other electrodes  max. 7 pF
Capacitance of external conductive coating to anode*
  max. 1050 pF
  min. 450 pF
Capacitance of external conductive coating to anode**
  max. 900 pF
  min. 450 pF
Capacitance of anode to implosion protection hardware**
  approx. 150 pF
Heater voltage  12 V
Heater current at 12 V  130 mA

OPTICAL DATA

Phosphor type  see “High resolution monochrome display tubes, General”
Light transmission at screen centre
  tube with normal tinted face glass  approx. 50%
  tube with dark tinted face glass  approx. 34%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
High resolution monochrome display tubes

MECHANICAL DATA (see also the figures under Dimensional Data)

<table>
<thead>
<tr>
<th>Overall length</th>
<th>max. 280 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>315 mm</td>
</tr>
<tr>
<td>width</td>
<td>279 mm</td>
</tr>
<tr>
<td>height</td>
<td>227 mm</td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>292 mm</td>
</tr>
<tr>
<td>horizontal axis</td>
<td>254 mm</td>
</tr>
<tr>
<td>vertical axis</td>
<td>201 mm</td>
</tr>
<tr>
<td>area</td>
<td>484 cm²</td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
</tr>
<tr>
<td>Bulb</td>
<td>EIAJ-JB310AM03 or EIAJ-JB310AW04</td>
</tr>
<tr>
<td>Bulb contact designation</td>
<td>IEC 67-III-2, EIA-J1-21</td>
</tr>
<tr>
<td>Base designation</td>
<td>EIA E7-91</td>
</tr>
<tr>
<td>Basing</td>
<td>7GR</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 2.9 kg</td>
</tr>
</tbody>
</table>

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Anode voltage</th>
<th>max. 15 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>min. 10 kV</td>
<td></td>
</tr>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>–200 to +1000 V</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 700 V</td>
</tr>
<tr>
<td>Anode current</td>
<td></td>
</tr>
<tr>
<td>long-term average value</td>
<td>max. 130 µA</td>
</tr>
<tr>
<td>peak value</td>
<td>max. 600 µA</td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 400 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V ± 10%*</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ± 10%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive  max.  25 µA
  negative  max.  25 µA

Grid 2 current
  positive  max.  5 µA
  negative  max.  5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater  max.  1,0 MΩ
Impedance between cathode and heater  max.  0,1 MΩ
Grid 1 circuit resistance  max.  1,5 MΩ
Grid 1 circuit impedance  max.  0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1

Anode voltage  12 kV
Grid 4 (focusing electrode) voltage  0 to 300 V*
Grid 2 voltage  400 V
Cathode cut-off voltage  30 to 60 V**

Grid drive; voltages specified with respect to cathode

Anode voltage  12 kV
Grid 4 (focusing electrode) voltage  0 to 300 V*
Grid 2 voltage  400 V
Grid 1 cut-off voltage  34 to 64 V**

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68.5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
  line parabola 200 V,
  field parabola 100 V.
** Visual extinction of focused raster.

July 1984
X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 12$ kV.
Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 12$ kV.

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 12$ kV.

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
Front view and lug dimensions of tube M31-336

Dimensions in mm

The position of the mounting screws in the cabinet must be within a circle of 7 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 273.3 mm x 190.2 mm.
The position of the mounting screws in the cabinet must be within a circle of 7 mm diameter drawn around the true geometrical positions, i.e. corners of a rectangle of 267,5 mm x 204,4 mm.
Front view of tube M31-350

welded joint

anode contact

313 max

292

5.5±1.5

z

7290822

7290823.1
High resolution monochrome display tubes

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>diag.</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>138,3</td>
<td>139,9</td>
<td>145,0</td>
<td>153,9</td>
<td>156,6</td>
<td>154,7</td>
<td>138,9</td>
<td>126,3</td>
<td>118,2</td>
<td>113,7</td>
<td>112,3</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>136,5</td>
<td>138,1</td>
<td>143,2</td>
<td>151,5</td>
<td>154,4</td>
<td>152,6</td>
<td>137,5</td>
<td>125,0</td>
<td>116,9</td>
<td>112,4</td>
<td>110,9</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>131,8</td>
<td>133,4</td>
<td>138,1</td>
<td>145,1</td>
<td>147,5</td>
<td>146,2</td>
<td>133,8</td>
<td>122,1</td>
<td>114,3</td>
<td>110,0</td>
<td>108,6</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>125,2</td>
<td>126,6</td>
<td>130,6</td>
<td>136,0</td>
<td>137,5</td>
<td>136,6</td>
<td>127,9</td>
<td>117,8</td>
<td>110,7</td>
<td>106,6</td>
<td>105,3</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>117,0</td>
<td>118,2</td>
<td>121,3</td>
<td>124,8</td>
<td>125,6</td>
<td>125,0</td>
<td>119,6</td>
<td>112,1</td>
<td>106,1</td>
<td>102,5</td>
<td>101,3</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>107,9</td>
<td>108,8</td>
<td>111,0</td>
<td>113,1</td>
<td>113,5</td>
<td>113,2</td>
<td>110,2</td>
<td>105,2</td>
<td>100,6</td>
<td>97,6</td>
<td>96,6</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>98,1</td>
<td>98,7</td>
<td>100,0</td>
<td>101,1</td>
<td>101,3</td>
<td>101,2</td>
<td>99,8</td>
<td>97,2</td>
<td>94,3</td>
<td>92,0</td>
<td>91,2</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>87,7</td>
<td>88,0</td>
<td>88,5</td>
<td>89,0</td>
<td>89,1</td>
<td>89,1</td>
<td>88,8</td>
<td>87,9</td>
<td>86,6</td>
<td>85,5</td>
<td>84,9</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>76,6</td>
<td>76,5</td>
<td>76,5</td>
<td>76,6</td>
<td>76,8</td>
<td>76,9</td>
<td>77,1</td>
<td>77,3</td>
<td>77,4</td>
<td>77,3</td>
<td>77,2</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>64,6</td>
<td>64,4</td>
<td>64,1</td>
<td>64,1</td>
<td>64,2</td>
<td>64,3</td>
<td>64,8</td>
<td>65,5</td>
<td>66,3</td>
<td>66,9</td>
<td>67,3</td>
</tr>
<tr>
<td>11</td>
<td>99</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
<td>51,1</td>
</tr>
</tbody>
</table>
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 3:4 screen aspect ratio
- 635 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 277 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M31-340, M31-342, M31-344, M31346 and M31-348.

The tubes can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

Differences between the tubes can be found under ‘Dimensional data’.
**ELECTRICAL DATA**

- **Focusing method**
  - electrostatic
- **Deflection method**
  - magnetic
- **Deflection angles**
  - diagonal: approx. 90°
  - horizontal: approx. 78°
  - vertical: approx. 61°
- **Interelectrode capacitances**
  - cathode to all other electrodes: max. 4 pF
  - grid 1 to all other electrodes: max. 7 pF
- **Capacitance of external conductive coating to anode**
  - max. 1200 pF
  - min. 450 pF
- **Capacitance of external conductive coating to anode**
  - max. 1050 pF
  - min. 450 pF
- **Capacitance of anode to implosion protection hardware**
  - approx. 150 pF
- **Heater voltage**
  - 12 V
- **Heater current at 12 V**
  - 130 mA

**OPTICAL DATA**

- **Phosphor type**
  - see "High resolution monochrome display tubes, General"
- **Light transmission at screen centre**
  - tube with normal tinted face glass: approx. 46%
  - tube with dark tinted face glass: approx. 34%

**RASTER CENTRING**

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
### MECHANICAL DATA (see also the figures under Dimensional Data)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>M31-340</th>
<th>M31-342</th>
<th>M31-344</th>
<th>M31-346</th>
<th>M31-348</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>max. 277 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>321 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>width</td>
<td>283 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>height</td>
<td>222 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>295 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>horizontal axis</td>
<td>257 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vertical axis</td>
<td>195 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>area</td>
<td>478 cm²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulb contact designation</td>
<td>EIAJ-JB310AP03 or EIAJ-JB310AP04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base designation</td>
<td>IEC 67-III-2, EIAJ1-21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basing</td>
<td>EIA E7-91</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 2.9 kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode voltage</td>
<td>max. 15 kV, min. 10 kV</td>
</tr>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>-200 to + 1000 V</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 700 V</td>
</tr>
<tr>
<td>Anode current</td>
<td>max. 130 µA, max. 600 µA</td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 400 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V ± 10%*</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ± 5%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive max. 25 μA
  negative max. 25 μA

Grid 2 current
  positive max. 5 μA
  negative max. 5 μA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage 12 kV
Grid 4 (focusing electrode) voltage 0 to 300 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 30 to 60 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 12 kV
Grid 4 (focusing electrode) voltage 0 to 300 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 34 to 64 V**

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 μA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
  line parabola 200 V,
  field parabola 100 V.

** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 12$ kV.
Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.
\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; $V_{a,g3,g5} = 12$ kV.
\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
Front view and lug dimensions of tube M31-340

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M31-342

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 267,5 mm x 204,4 mm.
Front view of tube M31-344

- Anode contact
- Welded joint

7Z90816

295

6+1.5
-3

7Z90815.2
High resolution monochrome display tubes

Front view and lug dimensions of tube M31-346

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
Front view and lug dimensions of tube M31-348

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
High resolution monochrome display tubes

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>10°</td>
<td>20°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>140,6</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>139,8</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>137,8</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>133,5</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>126,9</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>117,9</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>107,2</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>95,5</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>82,4</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>67,5</td>
</tr>
<tr>
<td>11</td>
<td>99</td>
<td>50,3</td>
</tr>
</tbody>
</table>

July 1986 249
HIGH RESOLUTION MONOCHROME DISPLAY TUBE

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 4:5 screen aspect ratio
- 510 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 280 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/75 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1000 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tube can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.
ELECTRICAL DATA

Focusing method  electrostatic
Deflection method  magnetic
Deflection angles  
  diagonal  approx. 90°
  horizontal  approx. 83°
  vertical  approx. 65°
Direct interelectrode capacitances  
  cathode to all other electrodes  max. 5 pF
  grid 1 to all other electrodes  max. 6 pF
Capacitance of external conductive coating to anode*  max. 1050 pF
  min. 450 pF
Capacitance of external conductive coating to anode**  max. 900 pF
  min. 450 pF
Capacitance of anode to implosion protection hardware**  approx. 150 pF
Heater voltage  12 V
Heater current at 12 V  75 mA

OPTICAL DATA
Phosphor type  see “High resolution monochrome display tubes, General”
Light transmission at screen centre  
  tube with normal tinted face glass  approx. 50%
  tube with dark tinted face glass  approx. 34%

RASTER CENTRING
The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 280 mm

Greatest dimensions of tube
- diagonal 315 mm
- width 279 mm
- height 227 mm

Minimum useful screen dimensions (projected)
- diagonal 292 mm
- horizontal axis 254 mm
- vertical axis 201 mm
- area 484 cm²

Implosion protection T-band

Bulb EIAJ-JB310AM03 or EIAJ-JB310AW04

Bulb contact designation IEC67-III-2, EIAJ1-21

Base designation EIA E7-91

Basing 7GR

Mass approx. 2.9 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage max. 15 kV
min. 10 kV

Grid 4 (focusing electrode) voltage
-550 to +1100 V

Grid 2 voltage max. 550 V

Anode current
- long-term average value max. 100 µA
- peak value max. 150 µA

Cathode voltage, positive peak value max. 220 V

Heater voltage 12 V ± 10%*

Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V +0% 
-5%
CIRCUIT DESIGN VALUES

Grid 4 current
- positive
  max. 25 µA
- negative
  max. 25 µA

Grid 2 current
- positive
  max. 5 µA
- negative
  max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater
  max. 1,0 MΩ

Impedance between cathode and heater
  max. 0,1 MΩ

Grid 1 circuit resistance
  max. 1,5 MΩ

Grid 1 circuit impedance
  max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1

Anode voltage
  12 kV

Grid 4 (focusing electrode) voltage
  0 to 400 V*

Grid 2 voltage
  400 V

Cathode cut-off voltage
  36 to 66 V**

Grid drive; voltages specified with respect to cathode

Anode voltage
  12 kV

Grid 4 (focusing electrode) voltage
  0 to 400 V*

Grid 2 voltage
  400 V

Grid 1 cut-off voltage
  39 to 73 V**

RESOLUTION

The resolution is approx. 1000 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 550 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 50 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
- line parabola 200 V,
- field parabola 100 V.

** Visual extinction of focused raster.
X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12\ kV$.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 12\ kV$. 
Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.
$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
Front-view and lug dimensions of tube

(1) The position of the mounting screws in the cabinet must be within a circle of 7 mm diameter drawn around the true geometrical positions, i.e. the corners of a rectangle of 273.3 mm x 190.2 mm.
### High resolution monochrome display tube

#### Maximum cone contour

![Diagram of maximum cone contour]

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>138,3</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>136,5</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>131,8</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>125,2</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>117,0</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>107,9</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>98,1</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>87,7</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>76,6</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>64,6</td>
</tr>
<tr>
<td>11</td>
<td>99</td>
<td>51,1</td>
</tr>
</tbody>
</table>
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 31 cm (12 in) face diagonal; rectangular glass
- 3:4 screen aspect ratio
- 635 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 277 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/75 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1000 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M31-362, M31-364 and M31-366.

The tubes can be supplied with different phosphors and anti-reflective treatments, see "High resolution monochrome display tubes, General".

Differences between the tubes can be found under 'Dimensional Data'.

July 1986 263
### ELECTRICAL DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing method</td>
<td>electrostatic</td>
</tr>
<tr>
<td>Deflection method</td>
<td>magnetic</td>
</tr>
<tr>
<td>Deflection angles</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>approx. 90°</td>
</tr>
<tr>
<td>horizontal</td>
<td>approx. 78°</td>
</tr>
<tr>
<td>vertical</td>
<td>approx. 61°</td>
</tr>
<tr>
<td>Interelectrode capacitances</td>
<td>max. 5 pF</td>
</tr>
<tr>
<td>cathode to all other electrodes</td>
<td>max. 6 pF</td>
</tr>
<tr>
<td>grid 1 to all other electrodes</td>
<td>min. 450 pF</td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode*</td>
<td>max. 1200 pF</td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode**</td>
<td>max. 1050 pF</td>
</tr>
<tr>
<td>Capacitance of anode to implosion protective hardware**</td>
<td>min. 450 pF</td>
</tr>
<tr>
<td>Capacitance of anode to implosion protective hardware**</td>
<td>approx. 150 pF</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V</td>
</tr>
<tr>
<td>Heater current at 12 V</td>
<td>75 mA</td>
</tr>
</tbody>
</table>

### OPTICAL DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphor type</td>
<td>see “High resolution monochrome display tubes, General”</td>
</tr>
<tr>
<td>Light transmission at screen centre</td>
<td></td>
</tr>
<tr>
<td>tube with normal tinted face glass</td>
<td>approx. 46%</td>
</tr>
<tr>
<td>tube with dark tinted face glass</td>
<td>approx. 34%</td>
</tr>
</tbody>
</table>

### RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.

** Implosion protection hardware not connected to external conductive coating.
**High resolution monochrome display tubes**

### MECHANICAL DATA (See also the figures under Dimensional Data)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall length</td>
<td>max. 277 mm</td>
</tr>
<tr>
<td>Greatest dimensions of tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>321 mm</td>
</tr>
<tr>
<td>width</td>
<td>283 mm</td>
</tr>
<tr>
<td>height</td>
<td>222 mm</td>
</tr>
<tr>
<td>Minimum useful screen dimensions (projected)</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>295 mm</td>
</tr>
<tr>
<td>horizontal axis</td>
<td>257 mm</td>
</tr>
<tr>
<td>vertical axis</td>
<td>195 mm</td>
</tr>
<tr>
<td>area</td>
<td>$478 \text{ cm}^2$</td>
</tr>
<tr>
<td>Implosion protection</td>
<td>T-band</td>
</tr>
<tr>
<td>Bulb contact designation</td>
<td></td>
</tr>
<tr>
<td>Base designation</td>
<td>EIAE 97-91</td>
</tr>
<tr>
<td>Basing</td>
<td>7GR</td>
</tr>
<tr>
<td>Mass</td>
<td>approx. 2.9 kg</td>
</tr>
</tbody>
</table>

### RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode voltage</td>
<td>max. 15 kV</td>
</tr>
<tr>
<td>min. 10 kV</td>
<td></td>
</tr>
<tr>
<td>Grid 4 (focusing electrode) voltage</td>
<td>$-550 \text{ to } +1100 \text{ V}$</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>max. 550 V</td>
</tr>
<tr>
<td>Anode current</td>
<td>max. 100 µA</td>
</tr>
<tr>
<td>long-term average value</td>
<td>max. 150 µA</td>
</tr>
<tr>
<td>peak value</td>
<td></td>
</tr>
<tr>
<td>Cathode voltage, positive peak value</td>
<td>max. 220 V</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>$12 \text{ V } \pm 10%^*$</td>
</tr>
<tr>
<td>Cathode-to-heater voltage</td>
<td>max. 100 V</td>
</tr>
</tbody>
</table>

* For maximum cathode life it is recommended that the heater supply be regulated at $12 \text{ V } \pm 5\%$.
CIRCUIT DESIGN VALUES

Grid 4 current
- positive max. 25 µA
- negative max. 25 µA

Grid 2 current
- positive max. 5 µA
- negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
- Anode voltage 12 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Cathode cut-off voltage 36 to 66 V**

Grid drive; voltages specified with respect to cathode
- Anode voltage 12 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Grid 1 cut-off voltage 39 to 73 V**

RESOLUTION
The resolution is approx. 1000 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 550 V, anode voltage = 12 kV; phosphor type W, without anti-glare treatment, raster dimensions 216 mm x 162 mm.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 50 µA (peak), anode voltage = 12 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 216 mm x 162 mm:
  line parabola 200 V,
  field parabola 100 V.
** Visual extinction of focused raster.

266 July 1986
High resolution monochrome display tubes

M31-362
M31-364
M31-366

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 12$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 12$ kV.
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 12$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.$$  

Limits of grid 1 cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 12$ kV.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M31-364

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 267.5 mm x 204.4 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 273,3 mm x 190,2 mm.
High resolution monochrome display tubes

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M31-362
M31-364
M31-366

July 1986
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

• For Data Graphic Displays
• 90° deflection angle
• 34 cm (14 in) face diagonal; rectangular glass
• 20 mm neck diameter
• Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Deflection angle</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>34 cm (14 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 287 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>14 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M32EAA and M32EBF.

The tubes can be supplied with different phosphors and anti-reflective treatments, see "High resolution monochrome display tubes, General".

Differences between the tubes can be found under ‘Dimensional data’.
ELECTRICAL DATA

- **Focusing method**: electrostatic
- **Deflection method**: magnetic
- **Deflection angles**
  - diagonal: approx. 90°
  - horizontal: approx. 82°
  - vertical: approx. 67°
- **Interelectrode capacitances**
  - cathode to all other electrodes: max. 4 pF, min. 600 pF
  - grid 1 to all other electrodes: max. 7 pF, min. 450 pF
- **Capacitance of external conductive coating to anode***
  - max. 1200 pF
- **Capacitance of external conductive coating to anode****
  - max. 1050 pF
- **Capacitance of anode to implosion protection hardware****
  - approx. 150 pF
- **Heater voltage**: 12 V
- **Heater current at 12 V**: 130 mA

OPTICAL DATA

- **Phosphor type**: see “High resolution monochrome display tubes, General”
- **Light transmission at screen centre**
  - tube with normal tinted face glass: approx. 48%
  - tube with dark tinted face glass: approx. 34%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

---

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
High resolution monochrome display tubes

MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 287 mm

Greatest dimensions of tube
- diagonal 350 mm
- width 298 mm
- height 240 mm

Minimum useful screen dimensions (projected)
- diagonal 322 mm
- horizontal axis 270 mm
- vertical axis 210 mm
- area 554 cm²

Implosion protection T-band/rimband

Bulb EIAJ-JB340AB03 or EIAJ-JB340AD04

Bulb contact designation IEC 67-III-2, EIAJ1-21

Base designation EIA-E7-91

Basing 7GR

Mass approx. 3.6 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage max. 16 kV min. 10 kV

Grid 4 (focusing electrode) voltage -200 to +1000 V

Grid 2 voltage max. 700 V

Anode current
- long-term average value max. 130 µA
- peak value max. 600 µA

Cathode voltage, positive peak value max. 400 V

Heater voltage 12 V ± 10%*

Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ±0% -5%
CIRCUIT DESIGN VALUES

Grid 4 current
  positive max. 25 µA
  negative max. 25 µA

Grid 2 current
  positive max. 5 µA
  negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1 MΩ
Impedance between cathode and heater max. 0.1 MΩ
Grid 1 circuit resistance max. 1.5 MΩ
Grid 1 circuit impedance max. 0.5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage 14 kV
Grid 4 (focusing electrode) voltage 0 to 300 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 32 to 64 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 14 kV
Grid 4 (focusing electrode) voltage 0 to 300 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 35 to 70 V**

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre:
• with shrinking raster method,
• at light output 68.5 cd/m² (20 foot lambert) and raster dimensions 237 mm x 178 mm,
• at \( V_{g2} = 700 \text{ V} \) and anode voltage = 14 kV,
• with phosphor type WW,
• with normal tinted face glass, without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0.5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 14 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of \( H \times V = 237 \text{ mm} \times 178 \text{ mm} \):
  line parabola 200 V,
  field parabola 100 V.
** Visual extinction of focused raster.
High resolution monochrome display tubes

X-ray radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage. Cathode drive; $V_{a,g3,g5} = 14$ kV.

Anode current as a function of grid 1 voltage. Grid drive; $V_{a,g3,g5} = 14$ kV.
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 14 \text{ kV}$.
\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; $V_{a,g3,g5} = 14 \text{ kV}$.
\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
High resolution monochrome display tubes

(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.

July 1986
Front view and lug dimensions of tube M32EAA

The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 290,3 mm x 231,7 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M32EBF *

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 283,5 mm x 225,4 mm.

* This tube is still under development; data are provisional.
Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>0°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>148</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>146</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>142</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>136</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>129</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>119</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>109</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>98</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>87</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>75</td>
</tr>
<tr>
<td>11</td>
<td>100</td>
<td>62</td>
</tr>
<tr>
<td>12</td>
<td>105.7</td>
<td>51.5</td>
</tr>
</tbody>
</table>
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 34 cm (14 in) face diagonal; rectangular glass
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Deflection angle</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>34 cm (14 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 287 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/75 mA</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>14 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1000 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The following versions are available: M32EAB and M32EAK.

The tubes can be supplied with different phosphors and anti-reflective treatments, see "High resolution monochrome display tubes, General".

Differences between the tubes can be found under 'Dimensional Data'.
ELECTRICAL DATA

Focusing method  electrostatic
Deflection method magnetic
Deflection angles
  diagonal  approx. 90°
  horizontal approx. 82°
  vertical  approx. 67°
Interelectrode capacitances
  cathode to all other electrodes max. 5 pF
  grid 1 to all other electrodes max. 6 pF
Capacitance of external conductive coating to anode* max. 1200 pF
  min. 600 pF
Capacitance of external conductive coating to anode** max. 1050 pF
  min. 450 pF
Capacitance of anode to implosion protection hardware** approx. 150 pF
Heater voltage
  12 V
Heater current at 12 V 75 mA

OPTICAL DATA

Phosphor type  see "High resolution monochrome display tubes, General"
Light transmission at screen centre
  tube with normal tinted face glass approx. 48%
  tube with dark tinted face glass approx. 34%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
High resolution monochrome display tubes

M32EAB
M32EAK

MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length
max. 287 mm

Greatest dimensions of tube

- diagonal
  350 mm
- width
  298 mm
- height
  240 mm

Minimum useful screen dimensions (projected)

- diagonal
  322 mm
- horizontal axis
  270 mm
- vertical axis
  210 mm
- area
  554 cm²

Implosion protection
T-band/rimband

Bulb
EIAJ-JB340AB03 or
EIAJ-JB340AD04

Bulb contact designation
IEC 67-III-2, EIAJ1-21

Base designation
EIA-E7-91

Basing
7GR

Mass
approx. 3.6 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage
max. 16 kV
min. 10 kV

Grid 4 (focusing electrode) voltage
-550 to +1100 V

Grid 2 voltage
max. 550 V

Anode current

- long-term average value
  max. 100 µA
- peak value
  max. 150 µA

Cathode voltage, positive peak value
max. 220 V

Heater voltage
12 V ± 10%*

Cathode-to-heater voltage
max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V ± 0% -5%.
CIRCUIT DESIGN VALUES
Grid 4 current
  positive max. 25 μA
  negative max. 25 μA
Grid 2 current
  positive max. 5 μA
  negative max. 5 μA

MAXIMUM CIRCUIT VALUES
Resistance between cathode and heater max. 1 MΩ
Impedance between cathode and heater max. 0.1 MΩ
Grid 1 circuit resistance max. 1.5 MΩ
Grid 1 circuit impedance max. 0.5 MΩ

TYPICAL OPERATING CONDITIONS
Cathode drive; voltages specified with respect to grid 1
Anode voltage 14 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 38 to 68 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 14 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 41 to 75 V**

RESOLUTION
The resolution is approx. 1000 lines. It is measured at the screen centre:
• with shrinking raster method,
• at light output 68.5 cd/m² (20 foot lambert) and raster dimensions 237 mm x 178 mm,
• at \( V_{g2} = 550 \text{ V} \) and anode voltage = 14 kV,
• with phosphor type WW,
• with normal tinted face glass, without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0.5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 50 μA (peak), anode voltage = 14 kV, grid 2 voltage = 400 V.
  Dynamic focus (only for optimization): Typical correction for a video field of H x V = 237 mm x 178 mm:
  line parabola 200 V,
  field parabola 100 V.
** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage. 
Cathode drive; \( V_{a,g3,g5} = 14 \text{ kV} \).

Anode current as a function of grid 1 voltage. 
Grid drive; \( V_{a,g3,g5} = 14 \text{ kV} \).
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage. 
Cathode drive; \( V_{a,g3,g5} = 14 \text{ kV} \).

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage.
Grid drive; \( V_{a,g3,g5} = 14 \text{ kV} \).

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
High resolution monochrome display tubes

\[ \text{240 max} \]

\[ \text{127 \pm 3} \]

(1) The displacement of any lug with respect to the plane through the other three lugs is max. 2 mm.

\[ \text{322} \]

\[ \text{270} \]

\[ \text{210} \]

\[ \text{9,8 \pm 0,5} \]

\[ \text{17 \pm 1,5} \]

\[ \text{5,1 \pm 0,5} \]

May 1986
Front view of tube M32EAB

welded joint

anode contact

348 max

322

5,5 ± 1,5
High resolution monochrome display tubes

M32EAB
M32EAK

Front view and lug dimensions of tube M32EAK

(1) The mounting screws in the cabinet must be situated inside a circle of 4 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 290,3 mm x 231,7 mm.
Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>148.0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>146.1</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>142.4</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>136.7</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>128.9</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>119.5</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>109.2</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>98.7</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>87.6</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>75.5</td>
</tr>
<tr>
<td>11</td>
<td>100</td>
<td>62.0</td>
</tr>
<tr>
<td>12</td>
<td>105.7</td>
<td>51.5</td>
</tr>
</tbody>
</table>
DEVELOPMENT DATA
This data sheet contains advance information and specifications are subject to change without notice.

M33EAA
M33EAB

FLAT SQUARE
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 90° deflection angle
- 34 cm (14 in) face diagonal; rectangular glass
- 1200 mm radius of screen curvature
- 20 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Field</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>34 cm (14 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 295 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>14 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1300 lines</td>
</tr>
</tbody>
</table>

APPLICATION
These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS
The following versions are available: M33EAA and M33EAB.

The tubes can be supplied with different phosphors and anti-reflective treatments, see "High resolution monochrome display tubes, General".

Differences between the tubes can be found under ‘Dimensional data’.
ELECTRICAL DATA

Focusing method
Deflection method
Deflection angles
diagonal
horizontal
vertical
Inter electrode capacitances
cathode to all other electrodes
grid 1 to all other electrodes
Capacitance of external conductive coating to anode*
Capacitance of external conductive coating to anode**
Capacitance of anode to implosion protection hardware**
Heater voltage
Heater current at 12 V

OPTICAL DATA
Phosphor type
Light transmission at screen centre
tube with normal tinted face glass
tube with dark tinted face glass

RASTER CENTRING
The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

---

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
FLAT SQUARE
High resolution monochrome display tubes

MECHANICAL DATA (see also the figures under Dimensional Data)
Overall length max. 295 mm
Greatest dimensions of tube
  diagonal 368 mm
  width 308 mm
  height 249 mm
Minimum useful screen dimensions (projected)
  diagonal 333 mm
  horizontal axis 271,5 mm
  vertical axis 210 mm
  area 561 cm²
Implosion protection T-band/rimband
Bulb contact designation IEC 67-III-2, EIAJ1-21
Base designation EIA E7-91
Basing 7GR
Mass approx. 4,5 kg

RATINGS (Absolute Maximum System)
Unless otherwise specified voltage values are positive and measured with respect to grid 1.
Anode voltage max. 16 kV
  min. 10 kV
Grid 4 (focusing electrode) voltage -200 to + 1000 V
Grid 2 voltage max. 700 V
Anode current
  long-term average value max. 130 µA
  peak value max. 600 µA
Cathode voltage, positive peak value max. 400 V
Heater voltage 12 V ± 10%*
Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V +0% -5%
CIRCUIT DESIGN VALUES

Grid 4 current
   positive  max.  25 µA
   negative max.  25 µA

Grid 2 current
   positive  max.  5 µA
   negative max.  5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater  max.  1,0 MΩ
Impedance between cathode and heater max.  0,1 MΩ
Grid 1 circuit resistance max.  1,5 MΩ
Grid 1 circuit impedance max.  0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
   Anode voltage  14 kV
   Grid 4 (focusing electrode) voltage  0 to 300 V*
   Grid 2 voltage  400 V
   Cathode cut-off voltage  32 to 64 V**

Grid drive; voltages specified with respect to cathode
   Anode voltage  14 kV
   Grid 4 (focusing electrode) voltage  0 to 300 V*
   Grid 2 voltage  400 V
   Grid 1 cut-off voltage  35 to 70 V**

RESOLUTION

The resolution is approx. 1300 lines. It is measured at the screen centre:
• with shrinking raster method,
• at light output 68,5 cd/m² (20 foot lambert) and raster dimensions 245 mm x 184 mm,
• at Vg2 = 700 V and anode voltage = 14 kV,
• with phosphor type W (WW),
• with normal tinted face glass, without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

*  Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 14 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization): Typical correction for a video field of H x V = 245 x 184 mm:
   line parabola 250 V,
   field parabola 0 V.

** Visual extinction of focused raster.
X-radiation limit curve according to JEDEC94, at a constant anode current of 250 μA, measured according to TEPAC103A.

0,5 mR/h isoexposure-rate limit curve, according to JEDEC94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 14$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 14$ kV.
Limits of cathode raster cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 14 \text{kV}$.

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 14 \text{kV}$.

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
The reference line is determined by the plane of the upper edge of reference line gauge D when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 1,5 mm.
Front view of tube M33EAA

welded joint

anode contact

368 max

333

5,5

± 1,5

7293547

7293549

January 1986
FLAT SQUARE
High resolution monochrome display tubes

Front view and lug dimensions of tube M33EAB

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 296 mm x 238 mm.
Maximum cone contour

<table>
<thead>
<tr>
<th>section from section 1</th>
<th>nom. distance</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>152,8</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>151,3</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>147,9</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>143,4</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>137,3</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>129,5</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>120,3</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>109,4</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>96,3</td>
</tr>
<tr>
<td>10</td>
<td>90</td>
<td>82,1</td>
</tr>
<tr>
<td>11</td>
<td>100</td>
<td>67,4</td>
</tr>
<tr>
<td>12</td>
<td>110</td>
<td>52,2</td>
</tr>
<tr>
<td>13</td>
<td>113</td>
<td>45,3</td>
</tr>
</tbody>
</table>
FLAT SQUARE
HIGH RESOLUTION MONOCHROME DISPLAY TUBE

- For Data Graphic Displays
- 110° deflection angle
- 38 cm (15 in) face diagonal; rectangular glass
- 1200 mm radius of screen curvature
- 28,6 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>38 cm (15 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 276 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6,3 V/240 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>17 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

AVAILABLE VERSIONS

The tube can be supplied with different phosphors and anti-reflective treatments, see “High resolution monochrome display tubes, General”.

December 1985
ELECTRICAL DATA

Focusing method: electrostatic
Deflection method: magnetic
Deflection angles:
  diagonal: approx. 110°
  horizontal: approx. 97°
  vertical: approx. 80°
Inter electrode capacitances:
  cathode to all other electrodes: max. 4 pF
  grid 1 to all other electrodes: max. 9 pF
  max. 1200 pF
  min. 600 pF
Capacitance of external conductive coating to anode*:
Heater voltage: 6.3 V
Heater current at 6.3 V: 240 mA

OPTICAL DATA

Phosphor type: see "High resolution monochrome display tubes, General"
Light transmission at screen centre: approx. 34%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
FLAT SQUARE
High resolution monochrome display tube

MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 276 mm
Greatest dimensions of tube
  diagonal 396 mm
  width 332 mm
  height 267 mm
Minimum useful screen dimensions (projected)
  diagonal 363 mm
  horizontal axis 296 mm
  vertical axis 229 mm
  area 670 cm²
Implosion protection rimband
Bulb EIAJ-JB390AA03
Bulb contact designation IEC 67-III-2, EIAJ1-21
Base designation EIA-B7-208; IEC 67-1-31a
Basing 8HR
Mass approx. 5.8 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage max. 19 kV
  min. 13 kV
Grid 4 (focusing electrode) voltage
  −500 to + 1000 V
Grid 2 voltage max. 700 V
Anode current
  long-term average value max. 75 µA
  peak value max. 300 µA
Cathode voltage, positive peak value max. 400 V
Heater voltage 6.3 V ± 10%*
Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 6.3 V + 0% −5%
CIRCUIT DESIGN VALUES
Grid 4 current
positive max. 25 µA
negative max. 25 µA
Grid 2 current
positive max. 5 µA
negative max. 5 µA

MAXIMUM CIRCUIT VALUES
Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS
Cathode drive; voltages specified with respect to grid 1
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION
The resolution is approx. 1500 lines. It is measured at the screen centre:
• with shrinking raster method,
• at light output 68,5 cd/m² (20 foot lambert) and raster dimensions 267 mm x 200 mm,
• at Vg2 = 700 V and anode voltage = 17 kV,
• with phosphor type W (WW),
• without anti-glare treatment of screen surface.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 17 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization):
typical correction for a video field of H x V = 267 mm x 200 mm (landscape format):
line parabola 350 V, field parabola 100 V;
typical correction for a video field of H x V = 200 mm x 267 mm (portrait format):
line parabola 200 V, field parabola 250 V.
** Visual extinction of focused raster.
FLAT SQUARE
High resolution monochrome display tube

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure-rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 17$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 17$ kV.
Limits of cathode raster cut-off voltage as a function of grid 2 voltage.
Cathode drive; $V_{a,g3,g5} = 17$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}. $$

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage.
Grid drive; $V_{a,g3,g5} = 17$ kV.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}. $$
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the other three lugs is max. 1,5 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 7 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 326.4 mm x 261 mm.
FLAT SQUARE
High resolution monochrome display tube

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>diag.</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>164,4</td>
<td>166,7</td>
<td>174,0</td>
<td>187,2</td>
<td>196,5</td>
<td>194,1</td>
<td>168,0</td>
<td>150,4</td>
<td>139,5</td>
<td>133,6</td>
<td>131,7</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>162,5</td>
<td>164,8</td>
<td>171,9</td>
<td>184,8</td>
<td>193,4</td>
<td>190,6</td>
<td>165,2</td>
<td>147,9</td>
<td>137,2</td>
<td>131,3</td>
<td>129,5</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>157,6</td>
<td>159,7</td>
<td>166,3</td>
<td>177,4</td>
<td>182,4</td>
<td>179,2</td>
<td>157,5</td>
<td>141,4</td>
<td>131,4</td>
<td>125,8</td>
<td>124,1</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>149,7</td>
<td>151,5</td>
<td>156,5</td>
<td>162,6</td>
<td>162,6</td>
<td>160,2</td>
<td>145,9</td>
<td>132,6</td>
<td>123,8</td>
<td>118,9</td>
<td>117,4</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>138,1</td>
<td>139,3</td>
<td>141,8</td>
<td>143,0</td>
<td>141,4</td>
<td>139,8</td>
<td>131,7</td>
<td>122,7</td>
<td>115,7</td>
<td>111,6</td>
<td>110,2</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>121,0</td>
<td>121,4</td>
<td>121,9</td>
<td>121,4</td>
<td>120,0</td>
<td>119,1</td>
<td>115,1</td>
<td>110,3</td>
<td>105,9</td>
<td>102,9</td>
<td>101,8</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>99,2</td>
<td>99,3</td>
<td>99,4</td>
<td>99,0</td>
<td>98,4</td>
<td>98,1</td>
<td>96,6</td>
<td>94,7</td>
<td>92,7</td>
<td>91,2</td>
<td>90,5</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>76,2</td>
<td>76,2</td>
<td>76,2</td>
<td>76,0</td>
<td>75,9</td>
<td>75,8</td>
<td>75,5</td>
<td>75,2</td>
<td>74,7</td>
<td>74,4</td>
<td>74,2</td>
</tr>
<tr>
<td>9</td>
<td>75,39</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
<td>57,8</td>
</tr>
</tbody>
</table>

December 1985 323
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

- For Data Graphic Displays
- 110° deflection angle
- 38 cm (15 in) face diagonal; rectangular glass
- 28,6 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Deflection angle</th>
<th>110°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>38 cm (15 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 279 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6,3 V/240 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>17 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

APPLICATION

These high resolution tubes are for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tubes can be supplied with different phosphors and anti-reflective treatments, see ‘High resolution monochrome display tubes, General’.

AVAILABLE VERSIONS

The following versions are available: M38-328, M38-330, M38-332, M38-334, M38-336, M38-338, M38-342 and M38-344.

Differences between the tubes can be found under ‘Dimensional data’.
### ELECTRICAL DATA

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing method</td>
<td>electrostatic</td>
</tr>
<tr>
<td>Deflection method</td>
<td>magnetic</td>
</tr>
<tr>
<td>Deflection angles</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>approx. 110°</td>
</tr>
<tr>
<td>horizontal</td>
<td>approx. 98°</td>
</tr>
<tr>
<td>vertical</td>
<td>approx. 81°</td>
</tr>
<tr>
<td>Direct interelectrode capacitances</td>
<td></td>
</tr>
<tr>
<td>cathode to all other electrodes</td>
<td>max. 4 pF</td>
</tr>
<tr>
<td>grid 1 to all other electrodes</td>
<td>max. 9 pF</td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode*</td>
<td>max. 1200 pF</td>
</tr>
<tr>
<td></td>
<td>min. 600 pF</td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode**</td>
<td>max. 1000 pF</td>
</tr>
<tr>
<td></td>
<td>min. 500 pF</td>
</tr>
<tr>
<td>Capacitance of anode to implosion protection hardware**</td>
<td>approx. 200 pF</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>6.3 V</td>
</tr>
<tr>
<td>Heater current at 6.3 V</td>
<td>240 mA</td>
</tr>
</tbody>
</table>

### OPTICAL DATA

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphor type</td>
<td>see “High resolution monochrome display tubes, General”</td>
</tr>
<tr>
<td>Light transmission at screen centre</td>
<td></td>
</tr>
<tr>
<td>tube with normal tinted face glass</td>
<td>approx. 46%</td>
</tr>
<tr>
<td>tube with dark tinted face glass</td>
<td>approx. 34%</td>
</tr>
</tbody>
</table>

### RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
**MECHANICAL DATA** (see also the figures under Dimensional Data)

Overall length  max.  279 mm

Greatest dimensions of tube
- diagonal  383 mm
- width  324 mm
- height  262 mm

Minimum useful screen dimensions (projected)
- diagonal  352 mm
- horizontal axis  292 mm
- vertical axis  227 mm
- area  652 cm²

Implosion protection  rimband

Bulb  EIAJ-JB370AB03 or EIAJ-JB370AB04

Bulb contact designation  IEC 67-111-2; EIA-J1-21

Base designation  IEC 67-1-31a; EIA-B7-208

Basing  8 HR

Mass  approx. 4 kg

**RATINGS (Absolute Maximum System)**

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage  max.  19 kV  min.  13 kV

Grid 4 (focusing electrode) voltage  -500 to +1000 V

Grid 2 voltage  max.  700 V

Anode current
- long-term average value  max.  75 µA
- peak value  max.  300 µA

Cathode voltage, positive peak value  max.  400 V

Heater voltage  6,3 V ± 10%*

Cathode-to-heater voltage  max.  100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 6,3 V ± 5%.
CIRCUIT DESIGN VALUES

Grid 4 current
- positive max. 25 µA
- negative max. 25 µA

Grid 2 current
- positive max. 5 µA
- negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
- Anode voltage 17 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
- Anode voltage 17 kV
- Grid 4 (focusing electrode) voltage 0 to 400 V*
- Grid 2 voltage 400 V
- Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION

The resolution is approx. 1500 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 17 kV; phosphor type W, without anti-glare treatment, raster dimensions 259 mm x 194 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 17 kV, grid 2 voltage = 400 V.

** Dynamic focus (only for optimization): Typical correction for a video field of
- H x V = 259 mm x 194 mm (landscape format): line parabola 300 V, field parabola 100 V;
- H x V = 194 mm x 259 mm (portrait format): line parabola 200 V, field parabola 250 V.

** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.  
Cathode drive; $V_{a,g3,g5} = 17$ kV.

Anode current as a function of grid 1 voltage.  
Grid drive; $V_{a,g3,g5} = 17$ kV.
High resolution monochrome display tubes

Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 17 \text{kV}$.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$  

Limits of grid 1 cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 17 \text{kV}$.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}.$$
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
High resolution monochrome display tubes

(1) The displacement of any lug with respect to the plane through the three other lugs is max. 1.5 mm.
Front view and lug dimensions of tube M38-328

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 311,4 mm x 244,5 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M38-330

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314,3 mm x 247,6 mm.
The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 327 mm x 247,7 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M38-334

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314,3 mm x 247,6 mm.
Front view and lug dimensions of tube M38-336

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314,3 mm x 247,6 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M38-338

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314,3 mm × 247,6 mm.
Front view and lug dimensions of tube M38-342

1. The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314,3 mm x 247,6 mm.
High resolution monochrome display tubes

Front view of tube M38-344
Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>diag.</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
<td>160.0</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
<td>158.2</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
<td>152.8</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
<td>143.4</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
<td>131.3</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
<td>116.9</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
<td>101.1</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
<td>84.5</td>
</tr>
<tr>
<td>9</td>
<td>76.7</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
</tr>
</tbody>
</table>

July 1986
HIGH RESOLUTION MONOCHROME DISPLAY TUBES

• For Data Graphic Displays
• 110° deflection angle
• 38 cm (15 in) face diagonal; rectangular glass
• 28.6 mm neck diameter
• Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>38 cm (15 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 279 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>12 V/130 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture</td>
</tr>
<tr>
<td></td>
<td>will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>17 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, small business computers, etc.

The tube can be supplied with different phosphors and anti-reflective treatments, see "High resolution monochrome display tubes, General".

AVAILABLE VERSIONS

The following versions are available: M38-346 and M38-348. Differences between the tubes can be found under 'Dimensional data'.
### ELECTRICAL DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focusing method</td>
<td>electrostatic</td>
</tr>
<tr>
<td>Deflection method</td>
<td>magnetic</td>
</tr>
<tr>
<td>Deflection angles</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>approx. 110°</td>
</tr>
<tr>
<td>horizontal</td>
<td>approx. 98°</td>
</tr>
<tr>
<td>vertical</td>
<td>approx. 81°</td>
</tr>
<tr>
<td>Direct interelectrode capacitances</td>
<td></td>
</tr>
<tr>
<td>cathode to all other electrodes</td>
<td>max. 4 pF</td>
</tr>
<tr>
<td>grid 1 to all other electrodes</td>
<td>max. 9 pF</td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode*</td>
<td>max. 1200 pF</td>
</tr>
<tr>
<td>min. 600 pF</td>
<td></td>
</tr>
<tr>
<td>Capacitance of external conductive coating to anode**</td>
<td>max. 1000 pF</td>
</tr>
<tr>
<td>min. 500 pF</td>
<td></td>
</tr>
<tr>
<td>Capacitance of anode to implosion protection hardware**</td>
<td>approx. 200 pF</td>
</tr>
<tr>
<td>Heater voltage</td>
<td>12 V</td>
</tr>
<tr>
<td>Heater current at 12 V</td>
<td>130 mA</td>
</tr>
</tbody>
</table>

### OPTICAL DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphor type</td>
<td>see “High resolution monochrome display tubes, General”</td>
</tr>
<tr>
<td>Light transmission at screen centre</td>
<td></td>
</tr>
<tr>
<td>tube with normal tinted face glass</td>
<td>approx. 46%</td>
</tr>
<tr>
<td>tube with dark tinted face glass</td>
<td>approx. 34%</td>
</tr>
</tbody>
</table>

### RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

---

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length  
max. 279 mm

Greatest dimensions of tube
- diagonal: 383 mm
- width: 324 mm
- height: 262 mm

Minimum useful screen dimensions (projected)
- diagonal: 352 mm
- horizontal axis: 292 mm
- vertical axis: 227 mm
- area: 652 cm²

Implosion protection  
rimband

Bulb  
EIAJ-JB370AB03 or EIAJ-JB370AB04

Bulb contact designation
IEC 67-111-2; EIA-J1-21

Base designation
IEC 67-1-31a; EIA-B7-208

Basing  
8 HR

Mass  
approx. 4 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage  
max. 19 kV
min. 13 kV

Grid 4 (focusing electrode) voltage  
-500 to +1000 V

Grid 2 voltage  
max. 700 V

Anode current
- long-term average value: max. 75 µA
- peak value: max. 300 µA

Cathode voltage, positive peak value  
max. 400 V

Heater voltage  
12 V ± 10%*

Cathode-to-heater voltage  
max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 12 V +0% -5%
CIRCUIT DESIGN VALUES

Grid 4 current
positive max. 25 µA
negative max. 25 µA

Grid 2 current
positive max. 5 µA
negative max. 5 µA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 17 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION

The resolution is approx. 1500 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 17 kV; phosphor type W, without anti-glare treatment, raster dimensions 259 mm x 194 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 17 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization): Typical correction for a video field of
H x V = 259 mm x 194 mm (landscape format): line parabola 300 V, field parabola 100 V;
H x V = 194 mm x 259 mm (portrait format): line parabola 200 V, field parabola 250 V.

** Visual extinction of focused raster.
High resolution monochrome display tubes

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage. Cathode drive; $V_{a,g3,g5} = 17 \text{kV}$.

Anode current as a function of grid 1 voltage. Grid drive; $V_{a,g3,g5} = 17 \text{kV}$.
Limits of cathode cut-off voltage as a function of grid 2 voltage. Cathode drive; \( V_{a,g3,g5} = 17 \text{ kV} \).

\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}
\]

Limits of grid 1 cut-off voltage as a function of grid 2 voltage. Grid drive; \( V_{a,g3,g5} = 17 \text{ kV} \).

\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0,15 \times 10^{-3}
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the three other lugs is max. 1.5 mm.
Front view and lug dimensions of tube M38-346

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 314.3 mm x 247.6 mm.
High resolution monochrome display tubes

Front view and lug dimensions of tube M38-348

(1) The mounting screws in the cabinet must be situated inside a circle of 5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 311,4 mm x 244,5 mm.
## Maximum Cone Contour

![Diagram of maximum cone contour](image)

### Reference Line

- Reference line is indicated with a dashed line.
- The angle marked is 36°42'.

### Nominal Maximum Distance from Centre

<table>
<thead>
<tr>
<th>Section</th>
<th>Nom. Distance from Section 1 (mm)</th>
<th>0°</th>
<th>10°</th>
<th>20°</th>
<th>30°</th>
<th>40°</th>
<th>50°</th>
<th>60°</th>
<th>70°</th>
<th>80°</th>
<th>90°</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>160.0</td>
<td>162.2</td>
<td>168.9</td>
<td>180.8</td>
<td>187.8</td>
<td>185.9</td>
<td>163.3</td>
<td>146.7</td>
<td>136.3</td>
<td>130.6</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>158.2</td>
<td>160.4</td>
<td>167.2</td>
<td>179.3</td>
<td>186.4</td>
<td>184.5</td>
<td>161.6</td>
<td>144.8</td>
<td>134.5</td>
<td>128.8</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>152.8</td>
<td>154.9</td>
<td>161.5</td>
<td>173.6</td>
<td>181.3</td>
<td>179.1</td>
<td>155.7</td>
<td>139.5</td>
<td>129.4</td>
<td>123.9</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>143.4</td>
<td>145.4</td>
<td>151.7</td>
<td>163.1</td>
<td>170.9</td>
<td>169.1</td>
<td>147.1</td>
<td>131.6</td>
<td>122.1</td>
<td>116.8</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>131.3</td>
<td>133.1</td>
<td>138.8</td>
<td>149.0</td>
<td>156.3</td>
<td>155.4</td>
<td>136.6</td>
<td>122.3</td>
<td>113.4</td>
<td>108.6</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>116.9</td>
<td>118.5</td>
<td>123.4</td>
<td>132.0</td>
<td>138.1</td>
<td>138.2</td>
<td>124.1</td>
<td>111.7</td>
<td>103.8</td>
<td>99.5</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>101.1</td>
<td>102.3</td>
<td>106.2</td>
<td>112.4</td>
<td>116.2</td>
<td>116.6</td>
<td>109.5</td>
<td>100.0</td>
<td>93.6</td>
<td>89.9</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>84.5</td>
<td>85.3</td>
<td>87.4</td>
<td>89.9</td>
<td>90.9</td>
<td>91.0</td>
<td>89.4</td>
<td>85.8</td>
<td>82.1</td>
<td>79.7</td>
</tr>
<tr>
<td>9</td>
<td>76.7</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
<td>67.3</td>
</tr>
</tbody>
</table>

**July 1985**
HIGH RESOLUTION MONOCHROME DISPLAY TUBE

- For Data Graphic Displays
- 114° deflection angle
- 44 cm (17 in) face diagonal; rectangular glass
- 28.6 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>114°</td>
</tr>
<tr>
<td>Face diagonal</td>
<td>44 cm (17 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 291 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6.3 V/240 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>20 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1500 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, etc.

The tube can be supplied with different phosphors, see "High resolution monochrome display tubes, General".
ELECTRICAL DATA

Focusing method
Deflection method
Deflection angles
diagonal
horizontal
vertical
Direct interelectrode capacitances
cathode to all other electrodes
grid 1 to all other electrodes
Capacitance of external conductive coating to anode*
Capacitance of external conductive coating to anode**
Capacitance of anode to implosion protection hardware**
Heater voltage
Heater current at 6,3 V

OPTICAL DATA
Phosphor type
Light transmission at screen centre (normal tinted glass)

RASTER CENTRING
The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 291 mm

Greatest dimensions of tube
diagonal 441 mm
width 377 mm
height 302 mm

Minimum useful screen dimensions (projected)
diagonal 413 mm
horizontal axis 346 mm
vertical axis 270 mm
area 912 cm²

Implosion protection rimband

Bulb EIA J436A

Bulb contact designation IEC 67-III-2; EIA J1-21

Base designation IEC 67-1-31a; EIA B7-208

Basing 8 HR

Mass approx. 6 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage max. 23 kV
min. 15 kV

Grid 4 (focusing electrode) voltage −500 to +1000 V

Grid 2 voltage max. 700 V

Anode current
long-term average value max. 75 µA
peak value max. 300 µA

Cathode voltage, positive peak value max. 400 V

Heater voltage 6,3 V ± 10%*

Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 6,3 V ± 0% −5%.
CIRCUIT DESIGN VALUES
Grid 4 current
  positive  max.  25 µA
  negative max.  25 µA
Grid 2 current
  positive  max.  5 µA
  negative max.  5 µA

MAXIMUM CIRCUIT VALUES
Resistance between cathode and heater max.  1,0 MΩ
Impedance between cathode and heater max.  0,1 MΩ
Grid 1 circuit resistance max.  1,5 MΩ
Grid 1 circuit impedance max.  0,5 MΩ

TYPICAL OPERATING CONDITIONS
Cathode drive; voltages specified with respect to grid 1
  Anode voltage 20 kV
  Grid 4 (focusing electrode) voltage 0 to 400 V*
  Grid 2 voltage 400 V
  Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
  Anode voltage 20 kV
  Grid 4 (focusing electrode) voltage 0 to 400 V*
  Grid 2 voltage 400 V
  Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION
The resolution is approx. 1500 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 20 kV; phosphor type W, without anti-glare treatment, raster dimensions 304 mm x 228 mm.

X-RADIATION CHARACTERISTIC
X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 µA (peak), anode voltage = 20 kV, grid 2 voltage = 400 V.
** Visual extinction of focused raster.
X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.  
Cathode drive; \( V_{a,g3,g5} = 20 \text{ kV} \).

Anode current as a function of grid 1 voltage.  
Grid drive; \( V_{a,g3,g5} = 20 \text{ kV} \).
Limits of cathode raster cut-off voltage as a function of grid 2 voltage. Cathode drive; $V_{a,g3,g5} = 20$ kV.

$$\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}. $$

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage. Grid drive; $V_{a,g3,g5} = 20$ kV.

$$\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}. $$
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the three other lugs is max. 1.5 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 7,5 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 363,5 mm x 288,5 mm.
High resolution monochrome display tube

Maximum cone contour

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>186.3 188.9 196.8 211.1 219.2 216.8 190.0 170.4 158.2 151.5 149.4</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>184.6 187.1 194.9 209.0 216.8 214.4 188.3 168.9 156.9 150.3 148.2</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>179.9 182.3 189.6 202.4 208.9 206.9 183.9 165.3 153.7 147.2 145.2</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>171.8 173.9 180.2 189.6 192.8 191.2 175.2 159.1 148.4 142.4 140.5</td>
</tr>
<tr>
<td>5</td>
<td>40</td>
<td>161.7 163.4 168.3 173.7 174.5 173.2 163.3 151.1 141.9 136.6 134.8</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>148.7 150.0 152.9 155.1 154.8 153.7 147.9 140.1 133.2 128.8 127.3</td>
</tr>
<tr>
<td>7</td>
<td>60</td>
<td>134.2 134.7 135.3 135.0 134.0 133.2 129.9 125.9 122.1 119.2 118.2</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>114.0 113.4 112.1 110.5 109.5 108.9 107.5 106.3 105.6 105.1 105.0</td>
</tr>
<tr>
<td>9</td>
<td>80</td>
<td>82.9 82.3 81.5 80.8 80.5 80.3 80.2 80.5 81.0 81.8 82.3</td>
</tr>
<tr>
<td>10</td>
<td>83.5</td>
<td>71.3 71.1 70.7 70.3 70.2 70.2 70.2 70.4 70.8 71.2 71.5</td>
</tr>
</tbody>
</table>

May 1985 365
HIGH RESOLUTION MONOCHROME DISPLAY TUBE

- For Data Graphic Displays
- 114° deflection angle
- 50 cm (20 in) face diagonal; rectangular glass
- 28,6 mm neck diameter
- Integral implosion protection

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Deflection angle</th>
<th>114°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face diagonal</td>
<td>50 cm (20 in)</td>
</tr>
<tr>
<td>Overall length</td>
<td>max. 319 mm</td>
</tr>
<tr>
<td>Neck diameter</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Heating</td>
<td>6,3 V/240 mA</td>
</tr>
<tr>
<td>Quick heating cathode</td>
<td>with a typical tube a legible picture will appear within 5 s</td>
</tr>
<tr>
<td>Grid 2 voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Anode voltage</td>
<td>20 kV</td>
</tr>
<tr>
<td>Resolution</td>
<td>approx. 1400 lines</td>
</tr>
</tbody>
</table>

APPLICATION

This high resolution tube is for alpha-numeric and graphic display applications, such as computer terminals, etc.

The tube can be supplied with different phosphors, see "High resolution monochrome display tubes, General".

May 1985 367
ELECTRICAL DATA

Focusing method
electrostatic

Deflection method
magnetic

Deflection angles
- diagonal: approx. 114°
- horizontal: approx. 104°
- vertical: approx. 90°

Direct interelectrode capacitances
- cathode to all other electrodes: max. 4 pF, min. 9 pF
- grid 1 to all other electrodes: max. 1750 pF, min. 1100 pF

Capacitance of external conductive coating to anode*
- max. 1750 pF, min. 1100 pF

Capacitance of external conductive coating to anode**
- max. 1500 pF, min. 1000 pF

Capacitance of anode to implosion protection hardware**
- approx. 250 pF

Heater voltage
6,3 V

Heater current at 6,3 V
240 mA

OPTICAL DATA

Phosphor type
see "High resolution monochrome display tubes, General"

Light transmission at screen centre (normal tinted glass)
approx. 46%

RASTER CENTRING

The field intensity perpendicular to the tube axis should be adjustable from 0 to 800 A/m. For optimum overall sharpness it is recommended to centre the raster electrically via the deflection coils.

---

* Implosion protection hardware connected to external conductive coating.
** Implosion protection hardware not connected to external conductive coating.
MECHANICAL DATA (see also the figures under Dimensional Data)

Overall length max. 319 mm

Greatest dimensions of tube
- diagonal 504,5 mm
- width 430,5 mm
- height 346,5 mm

Minimum useful screen dimensions (projected)
- diagonal 473 mm
- horizontal axis 394 mm
- vertical axis 308 mm
- area 1187 cm²

Implosion protection rimband

Bulb EIA J500A

Bulb contact designation IEC 67-III-2; EIA J1-21

Base designation IEC 67-1-31a; EIA B7-208

Basing 8 HR

Mass approx. 8,5 kg

RATINGS (Absolute Maximum System)

Unless otherwise specified voltage values are positive and measured with respect to grid 1.

Anode voltage
- max. 23 kV
- min. 15 kV

Grid 4 (focusing electrode) voltage -500 to +1000 V

Grid 2 voltage max. 700 V

Anode current
- long-term average value max. 75 µA
- peak value max. 300 µA

Cathode voltage, positive peak value max. 400 V

Heater voltage 6,3 V ± 10%*

Cathode-to-heater voltage max. 100 V

* For maximum cathode life it is recommended that the heater supply be regulated at 6,3 V ± 10%.
CIRCUIT DESIGN VALUES

Grid 4 current
  positive max. 25 μA
  negative max. 25 μA

Grid 2 current
  positive max. 5 μA
  negative max. 5 μA

MAXIMUM CIRCUIT VALUES

Resistance between cathode and heater max. 1,0 MΩ
Impedance between cathode and heater max. 0,1 MΩ
Grid 1 circuit resistance max. 1,5 MΩ
Grid 1 circuit impedance max. 0,5 MΩ

TYPICAL OPERATING CONDITIONS

Cathode drive; voltages specified with respect to grid 1
Anode voltage 20 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Cathode cut-off voltage 40 to 70 V**

Grid drive; voltages specified with respect to cathode
Anode voltage 20 kV
Grid 4 (focusing electrode) voltage 0 to 400 V*
Grid 2 voltage 400 V
Grid 1 cut-off voltage 45 to 83 V**

RESOLUTION

The resolution is approx. 1400 lines. It is measured at the screen centre, with shrinking raster method, at light output = 68,5 cd/m² (20 foot lambert), grid 2 voltage = 700 V, anode voltage = 20 kV; phosphor type W, without anti-glare treatment, raster dimensions 348 mm x 261 mm.

X-RADIATION CHARACTERISTIC

X-radiation emitted will not exceed 0,5 mR/h throughout the useful life of the tube, when operated within the given ratings.

* Measured at screen centre on spot at anode current = 250 μA (peak), anode voltage = 20 kV, grid 2 voltage = 400 V.

Dynamic focus (only for optimization): Typical correction for a video field of H x V = 348 mm x 261 mm (landscape format): line parabola 300 V, field parabola 100 V.

** Visual extinction of focused raster.
High resolution monochrome display tube

X-radiation limit curve according to JEDEC 94, at a constant anode current of 250 µA, measured according to TEPAC103A.

0.5 mR/h isoexposure rate limit curve, according to JEDEC 94, measured according to TEPAC103A.
Anode current as a function of cathode voltage.
Cathode drive; $V_{a,g3,g5} = 20$ kV.

Anode current as a function of grid 1 voltage.
Grid drive; $V_{a,g3,g5} = 20$ kV.
Limits of cathode raster cut-off voltage as a function of grid 2 voltage.
Cathode drive; \( V_{a,g3,g5} = 20 \text{ kV} \).
\[
\frac{\Delta V_{KR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]

Limits of grid 1 raster cut-off voltage as a function of grid 2 voltage.
Grid drive; \( V_{a,g3,g5} = 20 \text{ kV} \).
\[
\frac{\Delta V_{GR}}{\Delta V_{a,g3,g5}} = 0.15 \times 10^{-3}.
\]
(1) The reference line is determined by the plane of the upper edge of reference line gauge C when the
gauge is resting on the cone.
(1) The displacement of any lug with respect to the plane through the three other lugs is max. 1.5 mm.
(1) The mounting screws in the cabinet must be situated inside a circle of 8 mm diameter drawn around the true geometrical positions i.e. at the corners of a rectangle of 414 mm x 331 mm.
### Maximum cone contour

![Diagram of maximum cone contour](image)

<table>
<thead>
<tr>
<th>section</th>
<th>nom. distance from section 1</th>
<th>max. distance from centre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°</td>
<td>10°</td>
</tr>
<tr>
<td>1</td>
<td>213,1</td>
<td>216,0</td>
</tr>
<tr>
<td>2</td>
<td>212,0</td>
<td>214,9</td>
</tr>
<tr>
<td>3</td>
<td>209,2</td>
<td>212,0</td>
</tr>
<tr>
<td>4</td>
<td>203,6</td>
<td>206,2</td>
</tr>
<tr>
<td>5</td>
<td>194,7</td>
<td>197,0</td>
</tr>
<tr>
<td>6</td>
<td>183,8</td>
<td>185,8</td>
</tr>
<tr>
<td>7</td>
<td>171,8</td>
<td>173,5</td>
</tr>
<tr>
<td>8</td>
<td>158,5</td>
<td>159,5</td>
</tr>
<tr>
<td>9</td>
<td>143,3</td>
<td>143,7</td>
</tr>
<tr>
<td>10</td>
<td>125,7</td>
<td>125,7</td>
</tr>
<tr>
<td>11</td>
<td>104,9</td>
<td>104,2</td>
</tr>
<tr>
<td>12</td>
<td>78,0</td>
<td>77,3</td>
</tr>
<tr>
<td>13</td>
<td>71,1</td>
<td>70,8</td>
</tr>
</tbody>
</table>
DEFLECTION UNITS FOR MONOCHROME DATA GRAPHIC DISPLAY TUBES
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 17 kV</td>
<td>4.88 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>700 µH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 17 kV</td>
<td>1.12 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils (parallel connected)</td>
<td>7.6 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit has been designed for use with 31 cm (12 in) 110° monochrome monitor tubes in conjunction with:
- line output transformer AT2076/84;
- linearity control unit AT4042/08A;
- line driver transformer AT4043/64;
- dynamic focusing transformer AT4043/67.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the monitor tube. The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the field and line deflection centres coincide. Provisions are made for centring, and correction of pin-cushion distortion.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the monitor tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the monitor tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
Fig. 1 Deflection unit AT1038/41.
(1) for plastic-bonded FXD magnets 3122 104 94120.
(2) for plastic-bonded FXD magnet rods 3122 104 90360.
ELECTRICAL DATA
The electrical values apply at an ambient temperature of 25 °C.

Line deflection coils, parallel connected (Fig. 2a);
terminals 3 and 4
Inductance 700 µH ± 3,5%
Resistance 1,03 Ω ± 5%

Field deflection coils, parallel or series connected (Fig. 2b);
terminals 1 and 2 for parallel connected coils (terminals 1 and 6, and 2 and 5 to be interconnected); terminals 2 and 6 for series connected coils (terminals 1 and 5 to be interconnected)
Inductance (parallel connected coils) 14,1 mH ± 5%
Inductance (series connected coils) 56,4 mH ± 5%
Resistance (parallel connected coils) 7,6 Ω ± 5%
Resistance (series connected coils) 30,4 Ω ± 5%

Maximum d.c. voltage between line and field coils 2500 V
Maximum operating temperature 95 °C

Fig. 2a Line coils.
Fig. 2b Field coils.

The beginning of the windings is indicated with •.
The following characteristics are measured at an e.h.t. of 17 kV on a 31 cm (12 in) reference tube.

**Sensitivity**

Deflection current edge to edge
- in line direction
- in field direction (parallel connected coils)

<table>
<thead>
<tr>
<th></th>
<th>4,46 A (p-p)</th>
<th>0,98 A (p-p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>direction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>direction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Geometric distortion** measured without correction and centring magnets on a 31 cm (12 in) reference tube.

Fig. 3.

\[\begin{align*}
Fy: & +4 + 2 \\
Fx: & -4 - 2 \\
Gy: & +4 + 2 \\
Gx: & +4 - 2 \\
Jy: & -4 + 2 \\
Jx: & +4 + 2 \\
Hy: & -4 + 2 \\
Hx: & -4 - 2
\end{align*}\]

**Obliquity (mm)**

- \(|Fx - Hx| \leq 3,0|
- \(|Gx - Jx| \leq 3,0|
- \(|Fy - Gy| \leq 3,0|
- \(|Hy - Jy| \leq 3,0|
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

Fig. 4.

For pin-cushion distortion

Pin-cushion distortion can be corrected by two Ferroxdure magnets with pole-shoe brackets, which have been mounted on the deflection unit. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal movement of these magnets. The field strength can be adjusted by rotation of these magnets.

To correct the top and bottom of the raster, two plastic-bonded Ferroxdure magnet rods* can be fitted (Fig. 1). To correct the corners of the raster, four plastic-bonded Ferroxdure magnets** can be fitted (Fig. 1).

Note: After adjustment centring magnets and pole-shoe brackets have to be locked with locking paint.

* Available under catalogue number 3122 104 90360.
** Available under catalogue number 3122 104 94120.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>38 cm (15 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>neck diameter</td>
<td></td>
</tr>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 17 kV</td>
<td>4.12 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>700 µH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 17 kV</td>
<td>0.93 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils (parallel connected)</td>
<td>7.6 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit has been designed for use with 38 cm (15 in) 110° monochrome monitor tubes in conjunction with:
- line output transformer AT2076/84;
- linearity control unit AT4042/08A;
- line driver transformer AT4043/64;
- dynamic focusing transformer AT4043/67.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the monitor tube. The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the field and line deflection centres coincide. Provisions are made for centring, and correction of pin-cushion distortion.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the monitor tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the monitor tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
MECHANICAL DATA

Fig. 1 Deflection unit AT1038/42.
(1) for plastic-bonded FXD magnets 3122 104 94120.
(2) for plastic-bonded FXD magnet rods 3122 104 90360.
ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

Line deflection coils, parallel connected (Fig. 2a);
terminals 3 and 4
- Inductance: 700 µH ± 3,5%
- Resistance: 1,03 Ω ± 5%

Field deflection coils, parallel or series connected (Fig. 2b);
terminals 1 and 2 for parallel connected coils (terminals 1 and 6, and 2 and 5 to be interconnected); terminals 2 and 6 for series connected coils (terminals 1 and 5 to be interconnected)
- Inductance (parallel connected coils): 14,1 mH ± 5%
- Inductance (series connected coils): 56,4 mH ± 5%
- Resistance (parallel connected coils): 7,6 Ω ± 5%
- Resistance (series connected coils): 30,4 Ω ± 5%

Maximum d.c. voltage between line and field coils: 2500 V
Maximum operating temperature: 95 °C

Fig. 2a Line coils.  Fig. 2b Field coils.

The beginning of the windings is indicated with •.
The following characteristics are measured at an e.h.t. of 17 kV on a 38 cm (15 in) reference tube.

**Sensitivity**

Deflection current edge to edge
- in line direction: 4,12 A (p-p)
- in field direction (parallel connected coils): 0,93 A (p-p)

**Geometric distortion** measured without correction and centring magnets on a 38 cm (15 in) reference tube.

![Diagram of deflection unit with coordinates](image)

**Obliquity (mm)**
- $|F_x - H_x| \leq 2.5$
- $|G_x - J_x| \leq 2.5$
- $|F_y - G_y| \leq 2.5$
- $|H_y - J_y| \leq 2.5$
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram showing magnetic field and adjustment area](image)

Fig. 4.

For pin-cushion distortion
Pin-cushion distortion can be corrected by four Ferroxdure magnets with pole-shoe brackets, which have been mounted on the deflection unit. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal movement of these magnets. The field strength can be adjusted by rotation of these magnets.

To correct the top and bottom of the raster, two plastic-bonded Ferroxdure magnet rods* can be fitted (Fig. 1). To correct the corners of the raster, four plastic-bonded Ferroxdure magnets** can be fitted (Fig. 1).

Note: After adjustment centring magnets and pole-shoe brackets have to be locked with locking paint.

* Available under catalogue number 3122 104 90360.
** Available under catalogue number 3122 104 94120.
DEFLECTION UNITS

- For Data Graphic Displays
- For use with high resolution 38 cm (15 in)/110° monochrome CRTs*
- Optimized for minimum deflection defocusing
- Preset raster geometry for high resolution display tube M38-328
- Separate types for landscape and portrait formats

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th></th>
<th>AT1039/00</th>
<th>AT1039/01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
<td>110°</td>
</tr>
<tr>
<td>Neck diameter of CRT</td>
<td>28,6 mm</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Screen diagonal of CRT</td>
<td>38 cm</td>
<td>38 cm</td>
</tr>
<tr>
<td>Display format</td>
<td>portrait</td>
<td>landscape</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 17 kV</td>
<td>5,60 A(p-p)</td>
<td>7,20 A(p-p)</td>
</tr>
<tr>
<td>Inductance of line coils, parallel connected</td>
<td>225 µH</td>
<td>206 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 17 kV</td>
<td>1,15 A(p-p)</td>
<td>0,90 A(p-p)</td>
</tr>
<tr>
<td>Resistance of field coils, series connected</td>
<td>10,2 Ω</td>
<td>10,5 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

These deflection units are for Data Graphic Displays, especially when high resolution and/or high frequency operation is required. They are developed in conjunction with the high resolution display tube M38-328 to provide minimum deflection defocusing and good raster geometry without additional adjustments. Deflection unit AT1039/00 is for displays in vertical (portrait) format, AT1039/01 for displays in horizontal (landscape, TV) format.

To utilize the full potential of these deflection units in respect of deflection defocusing, dynamic focusing has to be applied in horizontal and vertical directions.

The line scan frequency is limited by the temperature of the deflection coils. The practical value depends on environmental conditions, but in general terms the highest operating frequency is approx. 50 kHz in landscape format and approx. 70 kHz in portrait format.

To provide some choice of impedances, the termination of the coils are brought out permitting either series or parallel connections.

When the coils are connected in parallel it is possible to provide scan at the highest frequency using existing devices. The impedance of the field coils (series connected) is adjusted for operation with integrated circuits (e.g. TDA2653A).
The following associated wound components are available for use in line time base circuits:

- **AT2076/84** - universal line output transformer;
- **AT4042/33A** - linearity control unit (parallel connection);
- **AT4042/0BA** - linearity control unit (series connection);
- **AT4043/64** - line driver transformer;
- **AT4043/29** - d.c. shift transformer;
- **AT4044/35** - amplitude control unit.

A universal monitor design (C64) has been developed, which is based on **AT1039** deflection coils; it permits adjustment of the operating frequencies to the desired value by replacement of a few components only. Further details are available on request.

**DESCRIPTION**

The line and field deflection coils are basically saddle-shaped and are surrounded by a Ferroxcube yoke ring. A special winding technique guarantees a precise magnetic field and a high reproducibility. Ferroxdure magnets are provided for beam centring. Provisions are made for mounting raster correction magnets. The units meet the self-extinguishing requirements of CSA, IEC and UL. The top of the units is marked.

**MOUNTING**

The unit should be mounted as far forward as possible on the neck of the tube so that it touches the cone; the maximum push-on force on the tube is 50 N.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,75 to 0,90 Nm.
Fig. 1 Deflection units AT1039/00 and AT1039/01.

If a further improvement of raster geometry is required use can be made of correction magnets*, which must be fitted to mounting posts (1); posts a to be used for AT1039/00, posts b for AT1039/01.

The unit has solder pins for connection. The pin numbering in Fig. 1 corresponds to that in Fig. 2.

* Catalogue number 3122 134 92300.
# ELECTRICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>AT1039/00</th>
<th></th>
<th>AT1039/01</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>parallel</td>
<td>series</td>
<td>parallel</td>
<td>series</td>
</tr>
<tr>
<td></td>
<td>connected</td>
<td>connected</td>
<td>connected</td>
<td>connected</td>
</tr>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>225 µH ± 5%</td>
<td>900 µH ± 5%</td>
<td>206 µH ± 5%</td>
<td>824 µH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>0,39 Ω ± 5%</td>
<td>1,56 Ω ± 5%</td>
<td>0,36 Ω ± 5%</td>
<td>1,44 Ω ± 5%</td>
</tr>
<tr>
<td>line deflection current, edge to edge, at 17 kV</td>
<td>5,60 A(_{\text{p-p}}) ± 5%</td>
<td>2,80 A(_{\text{p-p}}) ± 5%</td>
<td>7,20 A(_{\text{p-p}}) ± 5%</td>
<td>6,30 A(_{\text{p-p}}) ± 5%</td>
</tr>
<tr>
<td><strong>Field deflection coils</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>2,30 mH ± 5%</td>
<td>9,18 mH ± 5%</td>
<td>2,38 mH ± 5%</td>
<td>9,50 mH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>2,55 Ω ± 5%</td>
<td>10,2 Ω ± 5%</td>
<td>2,63 Ω ± 5%</td>
<td>10,5 Ω ± 5%</td>
</tr>
<tr>
<td>field deflection current, edge to edge, at 17 kV</td>
<td>2,30 A(_{\text{p-p}}) ± 5%</td>
<td>1,15 A(_{\text{p-p}}) ± 5%</td>
<td>1,8 A(_{\text{p-p}}) ± 5%</td>
<td>0,90 A(_{\text{p-p}}) ± 5%</td>
</tr>
</tbody>
</table>

Maximum permissible d.c. voltage between line and field coils: 3000 V

Maximum permissible d.c. voltage between field coil and yoke ring: 300 V

Coupling between line and field coils, at 1 V, 500 Hz: ≤ 1/100

Note: The values apply at an ambient temperature of 23 °C.

![Diagram of line and field coils](7285485.1)

Fig. 2 Diagram of line and field coils; R = 270 Ω. The beginning of the windings is indicated with •.
## Interconnections

<table>
<thead>
<tr>
<th>Line deflection coils</th>
<th>terminals to be interconnected</th>
<th>output terminals*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>live</td>
</tr>
<tr>
<td>parallel connection</td>
<td>3, 4 to 5', 6'</td>
<td>3', 4', 5', 6'</td>
</tr>
<tr>
<td></td>
<td>and</td>
<td></td>
</tr>
<tr>
<td>series connection</td>
<td>3, 4 to 3', 4'</td>
<td>5', 6'</td>
</tr>
</tbody>
</table>

| Field deflection coils |                                |                   |
|-----------------------|                                |                   |
| parallel connection   | 1 to 2'                         | 1', 2             | 1, 2'             |
|                       | and                            |                   |                   |
|                       | 1' to 2                         |                   |                   |
| series connection     | 2 to 2'                         | 1'                | 1                 |

**Geometric distortion**, without raster correction and centring magnets.

*Terminals which are most convenient to be used as output terminals are underlined.*
Obliquity

\[ |Fy-Gy| \leq 2.0 \text{ mm} \]
\[ |Gx-Jx| \leq 2.0 \text{ mm} \]
\[ |Jy-Hy| \leq 2.0 \text{ mm} \]
\[ |Hx-Fx| \leq 2.0 \text{ mm} \]

Fig. 4b AT1039/01.

Note: The edges of the displayed raster should fall within the two rectangles.

Fig. 4a AT1039/00.

**ENVIRONMENTAL DATA**

- **Maximum operating temperature (average copper temperature)**: 95 °C
- **Maximum possible temperature rise (ΔT) as a result of coil losses**: 35 °C
- **Storage temperature range**: -25 to +95 °C
- **Flame retarding**: according to UL1413
- **Flammability**: according to UL94, category V1

**ENVIRONMENTAL TESTS**

The deflection units withstand the following tests:

- **Vibration**: IEC 68-2-6; test Fc, procedure B4; 10-55-10 Hz, amplitude 0.35 mm, 3 x 30 min.
- **Bump**: IEC 68-2-29, test Eb; 250 m/s², 1000 bumps, 6 directions.
- **Shock**: IEC 68-2-27; test Ea; 11 ms, half-sine pulse shape, 350 m/s², 3 x 6 directions.
- **Cold**: IEC 68-2-1, test Ab; 96 h, -25 °C.
- **Dry heat**: IEC 68-2-2, test Bb; 96 h, +95 °C.
- **Cyclic damp heat**: IEC 68-2-30, test Db; 21 cycles, +40 °C.
- **Damp heat, steady state**: IEC 68-2-3, test Ca, 21 days.
- **Change of temperature**: IEC 68-2-14, test Nb; 5 cycles of 2 h at -25 °C and 2 h at +95 °C, duration of one cycle 5 h.
BEAM CENTRING

The deflection units have two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are for placing the electron beam coaxially with the deflection coils. They are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The required torque on the magnets is 35 to 250 mNm. See also Fig. 5.

The correct position of the magnets ensures freedom from curved lines in the centre of the raster and is beneficial with regard to raster geometry, deflection defocusing, corner cutting etc. For quality performance, picture shift should be obtained by applying d.c. current through the deflection coils. This should be done after adjustment of raster linearity and after correct phasing of displayed information in respect of the raster.

PACKING

The deflection units are packed in boxes of 16.
DEFLECTION UNIT

- For Data Graphic Displays
- For use with high resolution 31 cm (12 in)/110° monochrome CRTs
- Optimized for minimum deflection defocusing
- Preset raster geometry for high resolution display tube M31-326

QUICK REFERENCE DATA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Neck diameter of CRT</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Screen diagonal of CRT</td>
<td>31 cm</td>
</tr>
<tr>
<td>Display format</td>
<td>landscape</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 17 kV</td>
<td>7,95 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils, parallel connected</td>
<td>228 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 17 kV</td>
<td>1,21 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils, series connected</td>
<td>10,2 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for Data Graphic Displays, especially when high resolution and/or high frequency operation is required. It is developed in conjunction with the high resolution display tube M31-326 to provide minimum deflection defocusing and good raster geometry without additional adjustments.

To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied in horizontal and vertical directions.

The line scan frequency is limited by the temperature of the deflection coils. The practical value depends on environmental conditions, but in general terms the highest operating frequency is approx. 50 kHz.

To provide some choice of impedances, the terminations of the coils are brought out permitting either series or parallel connections.

When the coils are connected in parallel it is possible to provide scan at the highest frequency using existing devices. The impedance of the field coils (series connected) is adjusted for operation with integrated circuits (e.g. TDA2653A).
The following associated wound components are available for use in line time base circuits:

- AT2076/84 universal line output transformer;
- AT4042/33A linearity control unit (parallel connection);
- AT4042/08A linearity control unit (series connection);
- AT4043/64 line driver transformer;
- AT4043/29 d.c. shift transformer;
- AT4044/35 amplitude control unit.

A universal monitor design (C64) has been developed, which is based on AT1039 deflection coils; it permits adjustment of the operating frequencies to the desired value by replacement of a few components only.

Further details are available on request.

DESCRIPTION

The line and field deflection coils are basically saddle-shaped and are surrounded by a ferroxcube yoke ring. A special winding technique guarantees a precise magnetic field and a high reproducibility. Ferroxdure magnets are provided for beam centring. Provisions are made for mounting raster correction magnets.

The unit meets the self-extinguishing requirements of CSA, IEC and UL.

The top of the unit is marked.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube so that it touches the cone; the maximum push-on force on the tube is 50 N.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.75 to 0.90 Nm.
Fig. 1 Deflection unit AT1039/03.

If a further improvement of raster geometry is required use can be made of correction magnets*, which must be fitted to mounting posts (1).

The unit has solder pins for connection. The pin numbering in Fig. 1 corresponds to that in Fig. 2.

* Catalogue number 3122 134 92300. Six magnets are included in the packing of the deflection unit.
ELECTRICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>parallel connected</th>
<th>series connected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>228 µH ± 4%</td>
<td>912 µH ± 4%</td>
</tr>
<tr>
<td>resistance</td>
<td>0,41 Ω ± 10%</td>
<td>1,64 Ω ± 10%</td>
</tr>
<tr>
<td>line deflection current, edge to edge, at 17 kV</td>
<td>7,95 A (p-p) ± 5%</td>
<td>3,98 A (p-p) ± 5%</td>
</tr>
<tr>
<td><strong>Field deflection coils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>2,30 mH ± 10%</td>
<td>9,18 mH ± 10%</td>
</tr>
<tr>
<td>resistance</td>
<td>2,55 Ω ± 7%</td>
<td>10,2 Ω ± 7%</td>
</tr>
<tr>
<td>field deflection current, edge to edge, at 17 kV</td>
<td>2,42 A (p-p) ± 5%</td>
<td>1,21 A (p-p) ± 5%</td>
</tr>
</tbody>
</table>

Maximum permissible d.c. voltage between line and field coils 3000 V
Maximum permissible d.c. voltage between field coil and yoke ring 300 V
Coupling between line and field coils, at 1 V, 500 Hz $\leq 1/100$

Note: The values apply at an ambient temperature of 23 °C.

Fig. 2 Diagram of line and field coils; $R = 270 \, \Omega$.
The beginning of the windings is indicated with •.
Interconnections

<table>
<thead>
<tr>
<th>Terminals to be interconnected</th>
<th>Output terminals*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
</tr>
<tr>
<td>parallel connected 3, 4 to 5', 6' and 3', 4' to 5, 6</td>
<td>3, 4', 5', 6' 3', 4', 5, 6</td>
</tr>
<tr>
<td>series connection 3, 4 to 3', 4'</td>
<td>5', 6' 5, 6</td>
</tr>
<tr>
<td><strong>Field deflection coils</strong></td>
<td></td>
</tr>
<tr>
<td>parallel connected 1 to 2' and 1' to 2</td>
<td>1', 2 1, 2'</td>
</tr>
<tr>
<td>series connection 2 to 2'</td>
<td>1' 1</td>
</tr>
</tbody>
</table>

Tolerances of raster geometry due to deflection coils

The nominal shape of the raster geometry is tabulated below as deviations from the ideal rectangle at the points indicated. Cartesian coordinates are used to show the extent of deviation resolved along x and y areas. Points A, B, C, D, E are fixed.
The values were obtained from measurements on a nominal tube M31-326, (without raster correction and centring magnets) at \( V_a = 17 \text{ kV} \), with terrestrial magnetic field compensated.

Nominal deviation \((x, y)\) per point (mm)

- \( F(0,0), 0,0 \)
- \( G(+0,2, -0,5) \)
- \( J(+0,1, +0,1) \)
- \( H(-0,6, +0,5) \)
- \( K(-0,8, 0,0) \)
- \( L(+0,7, -0,7) \)
- \( N(+0,7, -0,1) \)
- \( M(-0,8, +0,4) \)
- \( F'(0,1, 0,1) \)
- \( G'(0,1, -0,1) \)
- \( J'(0,0, -0,1) \)
- \( H'(-0,7, -0,1) \)

Fig. 3.

* Terminals which are most convenient to be used as output terminals are underlined.
Spreads (mm)
The spreads in raster geometry are indicated in Fig. 4. The edges of the displayed raster fall between the two rectangles. The obliquity of the raster is as follows:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>F_x-G_x</td>
<td>\leq 2$</td>
</tr>
<tr>
<td>$</td>
<td>F_y-H_y</td>
<td>\leq 2$</td>
</tr>
<tr>
<td>$</td>
<td>G_y-J_y</td>
<td>\leq 2$</td>
</tr>
<tr>
<td>$</td>
<td>H_x-J_x</td>
<td>\leq 2$</td>
</tr>
</tbody>
</table>

Fig. 4.

ENVIRONMENTAL DATA
Maximum operating temperature (average copper temperature) 95 °C
Maximum possible temperature rise ($\Delta T$) as a result of coil losses 35 °C
Storage temperature range $-25$ to $+95$ °C according to UL1413
Flame retarding according to UL94, category V1
Flammability

ENVIRONMENTAL TESTS
The deflection units withstand the following tests:

- **Vibration** IEC 68-2-6; test Fc, procedure B4;
  10-55-10 Hz, amplitude 0,35 mm, 3 x 30 min.
- **Bump** IEC 68-2-29, test Eb;
  250 m/s², 1000 bumps, 6 directions.
- **Shock** IEC 68-2-27, test Ea;
  11 ms, half-sine pulse shape, 350 m/s², 3 x 6 directions.
- **Cold** IEC 68-2-1, test Ab;
  96 h, $-25$ °C.
- **Dry heat** IEC 68-2-2, test Bb;
  96 h, $+95$ °C.
- **Cyclic damp heat** IEC 68-2-30, test Db;
  21 cycles, $+40$ °C.
- **Damp heat, steady state** IEC 68-2-3, test Ca, 21 days.
- **Change of temperature** IEC 68-2-14, test Nb;
  5 cycles of 2 h at $-25$ °C and 2 h at $+95$ °C, duration of one cycle 5 h.
BEAM CENTRING
The deflection unit has two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are for placing the electron beam coaxially with the deflection coils. They are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The required torque on the magnets is 35 to 250 mNm. See also Fig. 5.
The correct position of the magnets ensures freedom from curved lines in the centre of the raster and is beneficial with regard to raster geometry, deflection defocusing, corner cutting etc. For quality performance, picture shift should be obtained by applying d.c. current through the deflection coils. This should be done after adjustment of raster linearity and after correct phasing of displayed information in respect of the raster.

PACKING
The deflection unit is packed in boxes of 16.
DEFLECTION UNIT

- For Data Graphic Displays
- For use with high resolution 47 cm (20 in)/110° monochrome CRTs
- Optimized for minimum deflection defocusing
- Preset raster geometry for high resolution display tube M47EAA

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Neck diameter of CRT</td>
<td>28,6 mm</td>
</tr>
<tr>
<td>Screen diagonal of CRT</td>
<td>47 cm</td>
</tr>
<tr>
<td>Display format</td>
<td>landscape</td>
</tr>
<tr>
<td>Line deflection current for raster scan, at 20 kV</td>
<td>8,16 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils, parallel connected</td>
<td>213 µH</td>
</tr>
<tr>
<td>Field deflection current for raster scan, at 20 kV</td>
<td>1,08 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils, series connected</td>
<td>10,5 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for Data Graphic Displays, especially when high resolution and/or high frequency operation is required. It is developed in conjunction with the high resolution display tube M47EAA to provide minimum deflection defocusing and good raster geometry without additional adjustments. Deflection unit AT1039/09 is for displays in horizontal (landscape, TV) format.

To utilize the full potential of the deflection unit in respect of deflection defocusing, dynamic focusing has to be applied in horizontal and vertical directions.

The line scan frequency is limited by the temperature of the deflection coils. The practical value depends on environmental conditions, but in general terms the highest operating frequency is approx. 50 kHz.

To provide some choice of impedances, the termination of the coils are brought out permitting either series or parallel connections.

When the coils are connected in parallel it is possible to provide scan at the highest frequency using existing devices. The impedance of the field coils (series connected) is adjusted for operating with integrated circuits (e.g. TDA2653A).
The following associated wound components are available for use in line time base circuits:

- AT2076/84 — universal line output transformer;
- AT4042/33A — linearity control unit (parallel connection);
- AT4042/08A — linearity control unit (series connection);
- AT4043/64 — line driver transformer;
- AT4043/29 — d.c. shift transformer;
- AT4044/35 — amplitude control unit.

A universal monitor design (C64) has been developed, which is based on AT1039 deflection coils; it permits adjustment of the operating frequencies to the desired value by replacement of a few components only. Further details are available on request.

DESCRIPTION

The line and field deflection coils are basically saddle-shaped and are surrounded by a Ferroxcube yoke ring. A special winding technique guarantees a precise magnetic field and a high reproducibility. Ferroxdure magnets are provided for beam centring. Provisions are made for mounting raster correction magnets.

The unit meets the self-extinguishing requirements of CSA, IEC and UL. The top of the unit is marked.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube so that it touches the cone; the maximum push-on force on the tube is 50 N.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,75 to 0,90 Nm.
Fig. 1 Deflection unit AT1039/09.

If a further improvement of raster geometry is required use can be made of correction magnets*, which must be fitted to mounting posts (1). The unit has solder pins for connection. The pin numbering in Fig. 1 corresponds to that in Fig. 2.

* Catalogue number 3122 134 92300.
### ELECTRICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>parallel connected</th>
<th>series connected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>213 µH ± 5%</td>
<td>852 µH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>0,35 Ω ± 5%</td>
<td>1,4 Ω ± 5%</td>
</tr>
<tr>
<td>line deflection current, edge to edge, at 20 kV</td>
<td>8,16 A(p-p) ± 5%</td>
<td>4,08 A(p-p) ± 5%</td>
</tr>
<tr>
<td><strong>Field deflection coils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>2,38 mH ± 5%</td>
<td>9,5 mH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>2,63 Ω ± 5%</td>
<td>10,5 Ω ± 5%</td>
</tr>
<tr>
<td>field deflection current, edge to edge, at 20 kV</td>
<td>2,16 A(p-p) ± 5%</td>
<td>1,08 A(p-p) ± 5%</td>
</tr>
</tbody>
</table>

Maximum permissible d.c. voltage between line and field coils: 3000 V

Maximum permissible d.c. voltage between field coil and yoke ring: 300 V

Coupling between line and field coils, at 1 V, 500 Hz: \( \leq 1/100 \)

Note: The values apply at an ambient temperature of 23 °C

![Diagram of line and field coils](7285485.1)

Fig. 2 Diagram of line and field coils; \( R = 270 \, \Omega \). The beginning of the windings is indicated with •.
Deflection unit

Interconnections

<table>
<thead>
<tr>
<th>terminals to be interconnected</th>
<th>output terminals*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>live</td>
</tr>
<tr>
<td>Line deflection coils</td>
<td></td>
</tr>
<tr>
<td>parallel connection</td>
<td>3, 4 to 5', 6'</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td>series connection</td>
<td>3, 4 to 3', 4'</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Field deflection coils</td>
<td></td>
</tr>
<tr>
<td>parallel connection</td>
<td>1 to 2'</td>
</tr>
<tr>
<td></td>
<td>and</td>
</tr>
<tr>
<td>series connection</td>
<td>2 to 2'</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Geometric distortion, without raster correction and centring magnets.

![Diagram](image1)

**Fig. 3.**

Obliquity

\[
|Fy-Gy| \leq 3,0 \text{ mm} \\
|Gx-Jx| \leq 3,0 \text{ mm} \\
|Jy-Hy| \leq 3,0 \text{ mm} \\
|Hx-Fx| \leq 3,0 \text{ mm}
\]

![Diagram](image2)

**Fig. 4.** The edges of the displayed raster should fall within the two rectangles.

* Terminals which are most convenient to be used as output terminals are underlined.
ENVIRONMENTAL DATA

Maximum operating temperature (average copper temperature) 95 °C
Maximum possible temperature rise (ΔT) as a result of coil losses 35 °C
Storage temperature range -25 to +95 °C
Flame retarding according to UL1413
Flammability according to UL94, category V1

ENVIRONMENTAL TESTS

The deflection units withstand the following tests:

Vibration IEC 68-2-6; test Fc, procedure B4;
10-55-10 Hz, amplitude 0,35 mm, 3 x 30 min.

Bump IEC 68-2-29, test Eb;
250 m/s², 1000 bumps, 6 directions.

Shock IEC 68-2-27, test Ea;
11 ms, half-sine pulse shape, 350 m/s², 3 x 6 directions.

Cold IEC 68-2-1, test Ab;
96 h, -25 °C.

Dry heat IEC 68-2-2, test Bb;
96 h, + 95 °C.

Cyclic damp heat IEC 68-2-30, test Db;
21 cycles, +40 °C.

Damp heat, steady state IEC 68-2-3, test Ca, 21 days.

Change of temperature IEC 68-2-14, test Nb;
5 cycles of 2 h at -25 °C and 2 h at +95 °C,
duration of one cycle 5 h.
Deflection unit AT1039/09

BEAM CENTRING

The deflection units have two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are for placing the electron beam coaxially with the deflection coils. They are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The required torque on the magnets is 35 to 250 mNm. See also Fig. 5.

The correct position of the magnets ensures freedom from curved lines in the centre of the raster and is beneficial with regard to raster geometry, deflection defocusing, corner cutting etc. For quality performance, picture shift should be obtained by applying d.c. current through the deflection coils.

This should be done after adjustment of raster linearity and after correct phasing of displayed information in respect of the raster.

![Fig. 5.](image)

PACKING

The deflection units are packed in boxes of 16.
DEVELOPMENT DATA
This data sheet contains advance information and specifications are subject to change without notice.

DEFLECTION UNIT

• For Data Graphic Displays
• For use with high resolution 47 cm (20 in)/110° monochrome CRTs
• Optimized for minimum deflection defocusing
• Preset raster geometry for high resolution display tube M47EAA
• Specially made for high line frequencies (up to 70 kHz)

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Neck diameter of CRT</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Screen diagonal of CRT</td>
<td>47 cm</td>
</tr>
<tr>
<td>Display format</td>
<td>landscape</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 17.5 kV</td>
<td>13.1 A(p-p)</td>
</tr>
<tr>
<td>Inductance of line coils, parallel connected</td>
<td>72 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 17.5 kV</td>
<td>0.9 A(p-p)</td>
</tr>
<tr>
<td>Resistance of field coils, series connected</td>
<td>13.5 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for Data Graphic Displays, especially when high resolution and/or high frequency operation is required. It is developed in conjunction with the high resolution display tube M47EAA to provide minimum deflection defocusing and good raster geometry without additional adjustments. Deflection unit AT1039/16 is for displays in horizontal (landscape, TV) format.

To utilize the full potential of these deflection units in respect of deflection defocusing, dynamic focusing has to be applied in horizontal and vertical directions.

The line scan frequency is limited by the temperature of the deflection coils. The practical value depends on environmental conditions, but in general terms the highest operating frequency is approx. 70 kHz, thanks to the use of Litze wire in the line coils.
The following associated wound components are available for use in line time base circuits:

- AT2076/84 — universal line output transformer;
- AT4042/33A — linearity control unit (parallel connection);
- AT4042/08A — linearity control unit (series connection);
- AT4043/64 — line driver transformer;
- AT4043/29 — d.c. shift transformer;
- AT4044/35 — amplitude control unit.

A universal monitor design (C64) has been developed, which is based on AT1039 deflection coils; it permits adjustment of the operating frequencies to the desired value by replacement of a few components only.

Further details are available on request.

DESCRIPTION

The line and field deflection coils are basically saddle-shaped and are surrounded by a Ferroxcube yoke ring. A special winding technique guarantees a precise magnetic field and a high reproducibility. Ferroxdure magnets are provided for beam centring. Provisions are made for mounting raster correction magnets.

The unit meets the self-extinguishing requirements of CSA, IEC and UL.

The top of the unit is marked.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube so that it touches the cone; the maximum push-on force on the tube is 50 N.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.75 to 0.90 Nm.
DEVELOPMENT DATA

MECHANICAL DATA

Fig. 1 Deflection unit AT1039/16.

If a further improvement of raster geometry is required use can be made of correction magnets*, which must be fitted to mounting posts (1). The unit has solder pins for connection. The pin numbering in Fig. 1 corresponds to that in Fig. 2.

* Catalogue number 3122 134 92300.
## ELECTRICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>Line deflection coils</th>
<th>Field deflection coils</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inductance</strong></td>
<td>72 (\mu)H ± 5%</td>
<td>12,8 mH ± 5%</td>
</tr>
<tr>
<td><strong>Resistance</strong></td>
<td>0,15 (\Omega) ± 5%</td>
<td>13,5 (\Omega) ± 5%</td>
</tr>
<tr>
<td><strong>Line deflection current, edge to edge, at 17,5 kV</strong></td>
<td>13,1 (A_{(p-p)}) ± 5%</td>
<td>0,9 (A_{(p-p)}) ± 5%</td>
</tr>
</tbody>
</table>

Maximum permissible d.c. voltage between line and field coils 3000 V
Maximum permissible d.c. voltage between field coil and yoke ring 300 V
Coupling between line and field coils, at 1 V, 500 Hz \(< 1/100\)

Note: The values apply at an ambient temperature of 23 °C

Fig. 2 Diagram of line and field coils; \(R = 270 \Omega\). The beginning of the windings is indicated with •.
Geometric distortion, without raster correction and centring magnets.

Fig. 3.

Obliquity

\[ |Fy-Gy| \leq 3.0 \text{ mm} \]
\[ |Gx-Jx| \leq 3.0 \text{ mm} \]
\[ |Jy-Hy| \leq 3.0 \text{ mm} \]
\[ |Hx-Fx| \leq 3.0 \text{ mm} \]

Fig. 4 The edges of the displayed raster should fall within the two rectangles.
ENVIRONMENTAL DATA

Maximum operating temperature (average copper temperature) 95 °C
Maximum possible temperature rise (ΔT) as a result of coil losses 35 °C
Storage temperature range -25 to +95 °C
Flame retardning according to UL1413
Flammability according to UL94, category V1

ENVIRONMENTAL TESTS

The deflection units withstand the following tests:

Vibration IEC 68-2-6; test Fc, procedure B4;
10-55-10 Hz, amplitude 0,35 mm, 3 x 30 min.

Bump IEC 68-2-29, test Eb;
250 m/s², 1000 bumps, 6 directions.

Shock IEC 68-2-27, test Ea;
11 ms, half-sine pulse shape, 350 m/s², 3 x 6 directions.

Cold IEC 68-2-1, test Ab;
96 h, −25 °C.

Dry heat IEC 68-2-2, test Bb;
96 h, +95 °C.

Cyclic damp heat IEC 68-2-30, test Db;
21 cycles, +40 °C.

Damp heat, steady state IEC 68-2-3, test Ca, 21 days.

Change of temperature IEC 68-2-14, test Nb;
5 cycles of 2 h at −25 °C and 2 h at +95 °C,
duration of one cycle 5 h.
BEAM CENTRING
The deflection units have two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are for placing the electron beam coaxially with the deflection coils. They are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The required torque on the magnets is 35 to 250 mNm. See also Fig. 5.

The correct position of the magnets ensures freedom from curved lines in the centre of the raster and is beneficial with regard to raster geometry, deflection defocusing, corner cutting etc. For quality performance, picture shift should be obtained by applying d.c. current through the deflection coils. This should be done after adjustment of raster linearity and after correct phasing of displayed information in respect of the raster.

PACKING
The deflection units are packed in boxes of 16.
DEFLECTION UNIT

- For Data Graphic Displays
- For use with high resolution 36 cm (15 in)/110° Flat Square monochrome CRTs
- Optimized for minimum deflection defocusing
- Preset raster geometry for high resolution display tube M36EAB

QUICK REFERENCE DATA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>110°</td>
</tr>
<tr>
<td>Neck diameter of CRT</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Screen diagonal of CRT</td>
<td>36 cm</td>
</tr>
<tr>
<td>Display format</td>
<td>landscape</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 17 kV</td>
<td>7.64 A(_{\text{p-p}})</td>
</tr>
<tr>
<td>Inductance of line coils, parallel connected</td>
<td>205 μH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 17 kV</td>
<td>0.95 A(_{\text{p-p}})</td>
</tr>
<tr>
<td>Resistance of field coils, series connected</td>
<td>10.4 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for Data Graphic Displays, especially when high resolution and/or high frequency operation is required. It is developed in conjunction with the high resolution display tube M36EAB to provide minimum deflection defocusing and good raster geometry without additional adjustments. Deflection unit AT1039/21 is for displays in horizontal (landscape, TV) format.

To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied in horizontal and vertical directions.

The line scan frequency is limited by the temperature of the deflection coils. The practical value depends on environmental conditions, but in general terms the highest operating frequency is approx. 50 kHz.

To provide some choice of impedances, the termination of the coils are brought out permitting either series or parallel connections.

When the coils are connected in parallel it is possible to provide scan at the highest frequency using existing devices. The impedance of the field coils (series connected) is adjusted for operation with integrated circuits (e.g. TDA2653A).
The following associated wound components are available for use in line time base circuits:

- **AT2076/84** — universal line output transformer;
- **AT4042/33A** — linearity control unit (parallel connection);
- **AT4042/08A** — linearity control unit (series connection);
- **AT4043/64** — line driver transformer;
- **AT4043/29** — d.c. shift transformer;
- **AT4044/35** — amplitude control unit.

A universal monitor design (C64) has been developed, which is based on AT1039 deflection coils; it permits adjustment of the operating frequencies to the desired value by replacement of a few components only. Further details are available on request.

**DESCRIPTION**

The line and field deflection coils are basically saddle-shaped and are surrounded by a Ferroxcube yoke ring. A special winding technique guarantees a precise magnetic field and a high reproducibility.

Ferroxdure magnets are provided for beam centring. Provisions are made for mounting raster correction magnets.

The unit meets the self-extinguishing requirements of CSA, IEC and UL.

The top of the unit is marked.

**MOUNTING**

The unit should be mounted as far forward as possible on the neck of the tube so that it touches the cone; the maximum push-on force on the tube is 50 N.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.75 to 0.90 Nm.
Fig. 1 Deflection unit AT1039/21.

If a further improvement of raster geometry is required use can be made of correction magnets*, which must be fitted to mounting posts (1). The unit has solder pins for connection. The pin numbering in Fig. 1 corresponds to that in Fig. 2.

* Catalogue number 3122 134 92300.
## ELECTRICAL DATA

<table>
<thead>
<tr>
<th></th>
<th>parallel connected</th>
<th>series connected</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>inductance</td>
<td>205 µH ± 5%</td>
<td>820 µH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>0,33 Ω ± 5%</td>
<td>1,32 Ω ± 5%</td>
</tr>
<tr>
<td>line deflection current, edge to edge, at 17 kV</td>
<td>7,64 A(p-p) ± 5%</td>
<td>3,82 A(p-p) ± 5%</td>
</tr>
</tbody>
</table>

**Field deflection coils**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>inductance</td>
<td>2,38 mH ± 5%</td>
<td>9,5 mH ± 5%</td>
</tr>
<tr>
<td>resistance</td>
<td>2,60 Ω ± 5%</td>
<td>10,4 Ω ± 5%</td>
</tr>
<tr>
<td>field deflection current, edge to edge, at 17 kV</td>
<td>1,90 A(p-p) ± 5%</td>
<td>0,95 A(p-p) ± 5%</td>
</tr>
</tbody>
</table>

Maximum permissible d.c. voltage between line and field coils 3000 V
Maximum permissible d.c. voltage between field coil and yoke ring 300 V
Coupling between line and field coils, at 1 V, 500 Hz \( \leq 1/100 \)

Note: The values apply at an ambient temperature of 23 °C.

Fig. 2 Diagram of line and field coils; \( R = 270 \, \Omega \). The beginning of the windings is indicated with \( \bullet \).
Interconnections

<table>
<thead>
<tr>
<th>terminals to be interconnected</th>
<th>output terminals*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line deflection coils</strong></td>
<td></td>
</tr>
<tr>
<td>parallel connection</td>
<td>3, 4 to 5', 6'</td>
</tr>
<tr>
<td>and</td>
<td>3', 4' to 5, 6</td>
</tr>
<tr>
<td>series connection</td>
<td>3, 4 to 3', 4'</td>
</tr>
<tr>
<td><strong>Field deflection coils</strong></td>
<td></td>
</tr>
<tr>
<td>parallel connection</td>
<td>1 to 2'</td>
</tr>
<tr>
<td>and</td>
<td>1' to 2</td>
</tr>
<tr>
<td>series connection</td>
<td>2 to 2'</td>
</tr>
</tbody>
</table>

**Geometric distortion**, without raster correction and centring magnets.

![Diagram of geometric distortion](image)

**Obliquity**

$|Fy - Gy| \leq 2.0 \text{ mm}$

$|Gx - Jx| \leq 2.0 \text{ mm}$

$|Jy - Hy| \leq 2.0 \text{ mm}$

$|Hx - Fx| \leq 2.0 \text{ mm}$

![Diagram of obliquity](image)

Fig. 4 The edges of the displayed raster should fall within the two rectangles.

* Terminals which are most convenient to be used as output terminals are underlined.
ENVIRONMENTAL DATA

Maximum operating temperature (average copper temperature) 95 °C
Maximum possible temperature rise (ΔT) as a result of coil losses 35 °C
Storage temperature range -25 to + 95 °C
Flame retarding according to UL1413
Flammability according to UL94, category V1

ENVIRONMENTAL TESTS

The deflection units withstand the following tests:

Vibration  IEC 68-2-6; test Fc, procedure B4;
10-55-10 Hz, amplitude 0.35 mm, 3 x 30 min.

Bump  IEC 68-2-29, test Eb;
250 m/s², 1000 bumps, 6 directions.

Shock  IEC 68-2-27, test Ea;
11 ms, half-sine pulse shape, 350 m/s², 3 x 6 directions.

Cold  IEC 68-2-1, test Ab;
96 h, -25 °C.

Dry heat  IEC 68-2-2, test Bb;
96 h, + 95 °C.

Cyclic damp heat  IEC 68-2-30, test Db;
21 cycles, + 40 °C.

Damp heat, steady state  IEC 68-2-3, test Ca, 21 days.

Change of temperature  IEC 68-2-14, test Nb;
5 cycles of 2 h at -25 °C and 2 h at + 95 °C,
duration of one cycle 5 h.
BEAM CENTRING

The deflection units have two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are for placing the electron beam coaxially with the deflection coils. They are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The required torque on the magnets is 35 to 250 mNm. See also Fig. 5.

The correct position of the magnets ensures freedom from curved lines in the centre of the raster and is beneficial with regard to raster geometry, deflection defocusing, corner cutting etc. For quality performance, picture shift should be obtained by applying d.c. current through the deflection coils. This should be done after adjustment of raster linearity and after correct phasing of displayed information in respect of the raster.

PACKING

The deflection units are packed in boxes of 16.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tube</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>diagonal</td>
<td></td>
</tr>
<tr>
<td>neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 17 kV</td>
<td>9.2 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils (parallel connected)</td>
<td>91.5 µH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 17 kV</td>
<td>0.91 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>7.0 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for use with 31 cm (12 in) 90° high resolution monochrome monitor tube M31-250, in conjunction with:
- line output transformer AT2102/02;
- linearity control unit AT4036/00A;
- line driver transformer AT4043/56.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the monitor tube. The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the frame and line deflection centres coincide. Provisions are made for centring, and correction of raster-geometry distortion. The unit meets the self-extinguishing and non-dripping requirements of IEC 65.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the monitor tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the monitor tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
MECHANICAL DATA

Fig. 1 Deflection unit AT1071/05.

(1) Facilities for fitting plastic-bonded FXD correction magnets, catalogue number 3122 104 94120.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the connection diagram (Figs 2a and 2b).

ELECTRICAL DATA

Line deflection coils (Fig. 2a):
- Inductance (parallel connected coils) 91,5 µH
- Resistance (parallel connected coils) 0,15 Ω

Field deflection coils, (Fig. 2b):
- Inductance 13,0 mH
- Resistance 7,0 Ω

Maximum d.c. voltage between terminals of line and field coils 2000 V

Maximum operating temperature 95 °C
Fig. 2a Line coils.  
Fig. 2b Field coils.

The beginning of the windings is indicated with •.

The following characteristics are measured at an e.h.t. of 17 kV on a M31-250 reference tube.

**Sensitivity**

Deflection current edge to edge (without correction and centring magnets)
- in line direction (parallel connected coils) 9,2 A (p-p)
- in field direction 0,91 A (p-p)

Deflection current edge to edge (with correction and centring magnets)
- in line direction (parallel connected coils) approx. 8,7 A (p-p)
- in field direction approx. 0,93 A (p-p)

**Geometric distortion** measured without correction and centring magnets on a M31-250 reference tube (dimensions in mm)

The spreads in raster geometry are tabulated below as deviations from the ideal rectangle at the points indicated. Cartesian coordinates are used to show the extent of deviation resolved along x and y areas. Points A, B, C, D, E are fixed and hence have zero spreads.

<table>
<thead>
<tr>
<th>Spreads (x,y) per point</th>
</tr>
</thead>
<tbody>
<tr>
<td>F (-3,5 ± 2,0, +4,0 ± 2,0)</td>
</tr>
<tr>
<td>G (+3,5 ± 2,0, +4,0 ± 2,0)</td>
</tr>
<tr>
<td>H (-3,5 ± 2,0, -4,0 ± 2,0)</td>
</tr>
<tr>
<td>J (+3,5 ± 2,0, -4,0 ± 2,0)</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fx-Hx</td>
<td>≤ 2,0</td>
</tr>
<tr>
<td>Gx-Jx</td>
<td>≤ 2,0</td>
</tr>
<tr>
<td>Fy-Gy</td>
<td>≤ 2,0</td>
</tr>
<tr>
<td>Hy-Jy</td>
<td>≤ 2,0</td>
</tr>
</tbody>
</table>
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram of magnetic field](image)

**Fig. 4.**

For raster-geometry distortion

Pin-cushion distortion can be corrected by two Ferroxdure magnets with pole-shoe brackets, which have been mounted on the deflection unit. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal movement of these magnets. The field strength can be adjusted by rotation of these magnets. To correct the corners of the raster, four plastic-bonded Ferroxdure magnets* (Fig. 1) can be fitted.

**Recommended adjustment procedure**

- Place the centring magnets in zero position (marking holes in opposite directions).
- Adjust the two magnets with pole-shoe brackets to obtain a straight east-west raster.
- Adjust the optimum horizontal and vertical linearity of deflection current.
- Centre the raster with the two centring magnets.
- Small readjustment of the magnets with pole-shoes may be necessary to obtain an optimum overall raster. If required correction of the corners can be done with the magnets mentioned in the foot note.
- Lock the centring magnets and pole-shoes with locking paint.

* Available under catalogue number 3122 104 94120.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>17 cm (7 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>28.6 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current, edge to edge at 15 kV</td>
<td>6.85 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils (parallel connected)</td>
<td>84.5 µH</td>
</tr>
<tr>
<td>Field deflection current, edge to edge at 15 kV</td>
<td>0.35 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils (series connected)</td>
<td>16.8 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for use with 17 cm (7 in) 70° monitor tube M17-142 in conjunction with:
- line output transformer AT2102/02;
- linearity control unit AT4036/00A;
- line driver transformer AT4043/56.

DESCRIPTION

The saddle-shaped line deflection coils are moulded so that the deflection centre is well within the conical part of the monitor tube. The field deflection coils are wound on a Ferroxcube yoke ring which is flared so that the frame and line deflection centres coincide. Provisions are made for centring, and correction of pin-cushion distortion. The unit meets the self-extinguishing and non-dripping requirements of IEC 65.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the monitor tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the monitor tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position.
Fig. 1 Deflection unit AT1071/07; Facilities for fitting correction magnets:
(1) for plastic-bonded FXD magnet rods catalogue number 3122 104 90360;
(2) for plastic-bonded FXD magnets, catalogue number 3122 104 94120.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the connection diagram (Figs 2a and 2b).

**ELECTRICAL DATA**

- **Line deflection coils** (Fig. 2a);
  - Inductance (parallel connected coils) 84,5 µH ± 3,5%
  - Resistance (parallel connected coils) 0,14 Ω ± 8%
  - Line deflection current, edge to edge (116 mm) at 15 kV 6,85 A (p-p)

- **Field deflection coils**, series connected (Fig. 2b);
  - Inductance 41,6 mH ± 8%
  - Resistance 16,8 Ω ± 8%
  - Field deflection current, edge to edge (87 mm) at 15 kV 0,35 A (p-p)
  - Maximum d.c. voltage between terminals of line and field coils 2000 V
  - Maximum operating temperature 95 ºC
The beginning of the windings is indicated with •.

**Sensitivity** measured at an e.h.t. of 15 kV on a 17 cm (7 in) 70° reference tube.

Deflection current edge to edge
- in line direction
- in field direction (parallel connected coils)

<table>
<thead>
<tr>
<th></th>
<th>6.85 A (p-p)</th>
<th>0.35 A (p-p)</th>
</tr>
</thead>
</table>
| Geometric distortion measured without correction and centring magnets on a 17 cm (7 in) 70° reference tube (dimensions in mm)

The spreads in raster geometry are tabulated below as deviations from the ideal rectangle at the points indicated. Cartesian coordinates are used to show the extent of deviation resolved along x and y areas. Points A, B, C, D, E are fixed and hence zero spreads.

**Spreads (x,y) per point**
- F (-0.5±2.0 , +1.0±1.5)
- G (+0.5±2.0 , +1.0±1.5)
- H (-0.5±2.0 , -1.0±1.5)
- J (+0.5±2.0 , -1.0±1.5)

Fig. 3.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets of plastic-bonded Ferroxdure. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram of centring magnets](image)

**Fig. 4.**

For pin-cushion distortion

Pin-cushion distortion can be corrected by two Ferroxdure magnets with pole-shoe brackets, which have been mounted on the deflection unit. Limited correction of asymmetrical pin-cushion distortion can be achieved by unequal movement of these magnets. The field strength can be adjusted by rotation of these magnets. To correct the top and bottom of the raster, two plastic-bonded Ferroxdure magnet rods* can be fitted (Fig. 1). To correct the corners of the raster, four plastic-bonded Ferroxdure magnets** (Fig. 1) can be fitted.

* Available under catalogue number 3122 104 90360.
** Available under catalogue number 3122 104 94120.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Picture tube</th>
<th>24 cm (9 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td></td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 10 kV</td>
<td>2,70 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 10 kV</td>
<td>0,24 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>40 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 24 cm (9 in) 90° black & white picture tubes and monitor tubes for basic displays. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20,9 mm.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/01.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2), terminals 1 and 4
- Inductance: $475 \mu H$ +3,5%
- Resistance: $0,8 \Omega \pm 5\%$
- $L/R$: $594 \mu H/\Omega$
- Line deflection current, edge to edge (198 mm), at 10 kV: $2,70 A (p-p)$ +10%

**Field deflection coils**, series connected (Fig. 2), terminals 2 and 3
- Inductance: $72 mH \pm 8\%$
- Resistance: $40 \Omega \pm 5\%$
- $L/R$: $1,80 mH/\Omega$
- Field deflection current, edge to edge (149 mm), at 10 kV: $0,24 A (p-p) \pm 10\%$

Maximum d.c. voltage between terminals of line and field coils: $500 V$

Maximum operating temperature (average copper temperature): $95 ^\circ C$

Storage temperature range: $-40$ to $+75 ^\circ C$

Coupling between line and field coils, at 500 Hz: $\leq 1/50$
The beginning of the windings is indicated with •.

**Geometric distortion** measured without centring magnets on a 24 cm (9 in) reference tube (dimensions in mm)

\[
\begin{align*}
|Fy - Gy| & \leq 2 \\
|Gx - Jx| & \leq 2 \\
|Jy - Hy| & \leq 2 \\
|Hx - Fx| & \leq 2
\end{align*}
\]

Fig. 3.

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram of magnetic field areas](image)

Fig. 5.
DEFLECTION UNIT

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Picture tube</th>
<th>24 cm (9 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td></td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 10 kV</td>
<td>2.70 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 10 kV</td>
<td>0.24 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>40 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 24 cm (9 in) 90° black & white picture tubes and monitor tubes for basic displays. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20,9 mm.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/01A.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see "Correction facilities".

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2), terminals 1 and 4

- Inductance: 475 µH ± 3,5%
- Resistance: 0,8 Ω ± 5%
- L/R: 594 µH/Ω

Line deflection current, edge to edge (198 mm), at 10 kV

- 2,70 A (p-p) ± 10% - 4%

**Field deflection coils**, series connected (Fig. 2), terminals 2 and 3

- Inductance: 72 mH ± 8%
- Resistance: 40 Ω ± 5%
- L/R: 1,80 mH/Ω

- Field deflection current, edge to edge (149 mm), at 10 kV

- 0,24 A (p-p) ± 10%

- Maximum d.c. voltage between terminals of line and field coils

- 500 V

- Maximum operating temperature (average copper temperature)

- 95 °C

- Storage temperature range

- -40 to +75 °C

- Coupling between line and field coils, at 500 Hz

- ≤ 1/50
Geometric distortion measured without centring magnets on a 24 cm (9 in) reference tube (dimensions in mm)

\[ |F_y - G_y| \leq 2 \]
\[ |G_x - J_x| \leq 2 \]
\[ |J_y - H_y| \leq 2 \]
\[ |H_x - F_x| \leq 2 \]

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current</td>
<td>2,9 A (p-p)</td>
</tr>
<tr>
<td>Line deflection current</td>
<td>0,485 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current</td>
<td>10 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

Comprehensive application information is available on request.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.

* In the C6T concept.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 1 and 4

- Inductance: 475 µH ± 3.5%
- Resistance: 0.8 Ω ± 5%
- Line deflection current, edge to edge (257 mm), at 12 kV: 2.9 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b), terminals 2 and 3

- Inductance: 18 mH ± 5%
- Resistance: 10 Ω ± 5%
- L/R: 1.80 mH/Ω
- Field deflection current, edge to edge (195 mm), at 12 kV: 0.485 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to +75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
The beginning of the windings is indicated with •.

**Geometric distortion** measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm)

\[
|Fy-Gy| \leq 3 \\
|Gx-Jx| \leq 3 \\
|Jy-Hy| \leq 3 \\
|Hx-Fx| \leq 3
\]

Fig. 2a Line coils. Fig. 2b Field coils.

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction
Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current</td>
<td>2,9 A (p-p)</td>
</tr>
<tr>
<td>Line deflection current</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current</td>
<td>0,24 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>40 Ω</td>
</tr>
</tbody>
</table>

APPLICATION
This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION
The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING
The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.
**MECHANICAL DATA**

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/06.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see "Correction facilities".

**ELECTRICAL DATA**

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 1 and 4

- Inductance: 475 µH ± 3,5%
- Resistance: 0,8 Ω ± 5%
- L/R: 594 µH/Ω
- Line deflection current, edge to edge (257 mm), at 12 kV: 2,9 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b), terminals 2 and 3

- Inductance: 72 mH ± 5%
- Resistance: 40 Ω ± 5%
- L/R: 1,80 mH/Ω

Field deflection current, edge to edge (195 mm), at 12 kV: 0,24 A (p-p) ± 5%

Maximum d.c. voltage between terminals of line and field coils: 500 V

Maximum operating temperature (average copper temperature): 95 °C

Storage temperature range: -40 to +75 °C

Coupling between line and field coils, at 500 Hz: ≤ 1/50
Geometric distortion measured without raster correction and centring magnets, on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>5.8 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>118 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.485 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>10 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/07.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see “Correction facilities”.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, parallel connected (Fig. 2a), terminals 1 and 4
- Inductance: 118 µH ± 3.5%
- Resistance: 0.22 Ω ± 5%
- L/R: 536 µH/Ω ± 5%
- Line deflection current, edge to edge (257 mm), at 12 kV: 5.8 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 2 and 3
- Inductance: 18 mH ± 5%
- Resistance: 10 Ω ± 5%
- L/R: 1.80 mH/Ω ± 5%
- Field deflection current, edge to edge (195 mm), at 12 kV: 0.485 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to +75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
Deflection unit

The beginning of the windings is indicated with •.

**Geometric distortion** measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

![Diagram](image)

\[
\begin{align*}
|F_y - G_y| & \leq 3.0 \\
|G_x - J_x| & \leq 3.0 \\
|J_y - H_y| & \leq 3.0 \\
|H_x - F_x| & \leq 3.0
\end{align*}
\]

![Diagram](image)

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Fig. 5.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>24 cm (9 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>neck diagram</td>
<td></td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>2.91 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.508 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>10 Ω</td>
</tr>
</tbody>
</table>

APPLICATION
This deflection unit is for 24 cm (9 in) 90° monochrome monitor tubes. The unit is used in conjunction with*:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

Comprehensive application information is available on request.

DESCRIPTION
The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING
The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.

* In the C6T concept.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm. The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/09.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see “Correction facilities”.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 1 and 4
- Inductance: 475 µH ± 3.5%
- Resistance: 0.8 Ω ± 5%
- L/R: 594 µH/Ω
- Line deflection current, edge to edge (198 mm), at 12 kV: 2.91 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 2 and 3
- Inductance: 18 mH ± 5%
- Resistance: 10 Ω ± 5%
- L/R: 1.80 mH/Ω
- Field deflection current, edge to edge (149 mm) at 12 kV: 0.508 A (p-p) ± 5%

Maximum d.c. voltage between terminals of line and field coils: 500 V

Maximum operating temperature (average copper temperature): 95 °C

Storage temperature range: -40 to +75 °C

Coupling between line and field coils, at 500 Hz: ≤ 1/50
Deflection unit

1  
line  
top 
● (7)  

line  
bottom 
• 
4 7Z95174

Fig. 2a  Line coils.  

Fig. 2b  Field coils.  
The beginning of the windings is indicated with ●.

Geometric distortion measured without raster correction and centring magnets, on a 24 cm (9 in) reference tube M24-306 (dimensions in mm).

\[ |Fy-Gy| \leq 2 \]
\[ |Gx-Jx| \leq 2 \]
\[ |Jy-Hy| \leq 2 \]
\[ |Hx-Fx| \leq 2 \]

anode/contact

deflection unit

Fig. 3.

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the
deflection unit can be corrected by means of two independently movable centring magnets. These
magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting
field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets
simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase
differences between the synchronization and time base, as otherwise the correction needed becomes
excessive. Even if the correction is within the range of the magnets, curved lines may appear in the
centre of the raster.

For raster correction
The unit has plastic bonded Ferroxdure magnet strips for raster correction. Up to eight plastic bonded
Ferroxdure magnets can be mounted to the back of the front rim to optimize the raster geometry.
See also Fig. 1.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>diagonal 24 cm (9 in)</th>
<th>neck diameter 20 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deflection angle</td>
<td>90°</td>
<td></td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>2,91 A (p-p)</td>
<td></td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>475 µH</td>
<td></td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0,255 A (p-p)</td>
<td></td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>40 Ω</td>
<td></td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 24 cm (9 in) 90° monochrome monitor tubes. The unit is used in conjunction with:
- line output transformer AT2140/16 or AT2140/16B;
- linearity control unit AT4042/08A or linearity corrector AT4042/46.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound fields coils. The line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20,9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/10.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see "Correction facilities".

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 1 and 4
- Inductance: 475 µH ± 3,5%
- Resistance: 0,8 Ω ± 5%
- L/R: 594 µH/Ω
- Line deflection current, edge to edge (198 mm), at 12 kV: 2,91 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b), terminals 2 and 3
- Inductance: 72 mH ± 5%
- Resistance: 40 Ω ± 5%
- L/R: 1,80 mH/Ω
- Field deflection current, edge to edge (149 mm), at 12 kV: 0,255 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to + 75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
Deflection unit

Fig. 2a Line coils.

The beginning of the windings is indicated with ♦.

**Geometric distortion** measured without raster correction and centring magnets, on a 24 cm (9 in) reference tube M24-306 (dimensions in mm).

\[
\begin{align*}
|Fy-Gy| & \leq 2 \\
|Gx-Jx| & \leq 2 \\
|Jy-Hy| & \leq 2 \\
|Hx-Fx| & \leq 2
\end{align*}
\]

Fig. 3.

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

The unit has plastic bonded Ferroxdure magnet strips for raster correction. Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to optimize the raster geometry. See also Fig. 1.

![Diagram](image)
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>4.2 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>240 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.60 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>7.25 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA
The deflection unit fits a tube with a neck diameter of max. 20,9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/15.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see "Correction facilities".

ELECTRICAL DATA
The electrical values apply at an ambient temperature of 25 °C.

<table>
<thead>
<tr>
<th></th>
<th>Line deflection coils, parallel connected (Fig. 2a), terminals 1 and 4</th>
<th>Field deflection coils, series connected (Fig. 2b) terminals 2 and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>240 µH ± 3,5%</td>
<td>12,5 mH ± 5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>0,42 Ω ± 5%</td>
<td>7,25 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>565 µH/Ω ± 5%</td>
<td>1,7 mH/Ω ± 5%</td>
</tr>
<tr>
<td>Line deflection current, edge to edge (257 mm), at 12 kV</td>
<td>4,2 A (p-p) ± 5%</td>
<td>0,60 A (p-p) ± 5%</td>
</tr>
<tr>
<td>Field deflection current, edge to edge (195 mm), at 12 kV</td>
<td></td>
<td>500 V</td>
</tr>
<tr>
<td>Maximum d.c. voltage between terminals of line and field coils</td>
<td></td>
<td>95 °C</td>
</tr>
<tr>
<td>Maximum operating temperature (average copper temperature)</td>
<td></td>
<td>−40 to + 75 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td></td>
<td>Λ 1/50</td>
</tr>
<tr>
<td>Coupling between line and field coils, at 500 Hz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The beginning of the windings is indicated with ●.

**Geometric distortion** measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

\[
\begin{align*}
|F_y - G_y| & \leq 2.5 \\
|G_x - J_x| & \leq 2.5 \\
|J_y - H_y| & \leq 2.5 \\
|H_x - F_x| & \leq 2.5
\end{align*}
\]

**Fig. 2a** Line coils.  
**Fig. 2b** Field coils.

**Fig. 3.**

**Fig. 4** The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the
deflection unit can be corrected by means of two independently movable centring magnets. These
magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting
field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets
simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase
differences between the synchronization and time base, as otherwise the correction needed becomes
excessive. Even if the correction is within the range of the magnets, curved lines may appear in the
centre of the raster.

For raster correction
Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to
correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td></td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>4,92 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>170 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0,80 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>4,35 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/16.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see "Correction facilities".

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

<table>
<thead>
<tr>
<th>Line deflection coils, parallel connected (Fig. 2a), terminals 1 and 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>170 μH ± 3.5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>0.35 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>485 μH/Ω ± 5%</td>
</tr>
<tr>
<td>Line deflection current, edge to edge (257 mm), at 12 kV</td>
<td>4.92 A (p-p) ± 5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field deflection coils, series connected (Fig. 2b) terminals 2 and 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>6.6 mH ± 5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>4.35 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>1.5 mH/Ω ± 5%</td>
</tr>
<tr>
<td>Field deflection current, edge to edge (195 mm), at 12 kV</td>
<td>0.80 A (p-p) ± 5%</td>
</tr>
<tr>
<td>Maximum d.c. voltage between terminals of line and field coils</td>
<td>500 V</td>
</tr>
<tr>
<td>Maximum operating temperature (average copper temperature)</td>
<td>95 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>−40 to + 75 °C</td>
</tr>
<tr>
<td>Coupling between line and field coils, at 500 Hz</td>
<td>≤ 1/50</td>
</tr>
</tbody>
</table>
Deflection unit

Fig. 2a Line coils.

The beginning of the windings is indicated with ⋄.

Geometric distortion measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

\[ |F_y - G_y| \leq 2.5 \]
\[ |G_x - J_x| \leq 2.5 \]
\[ |J_y - H_y| \leq 2.5 \]
\[ |H_x - F_x| \leq 2.5 \]

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tube diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>Monitor tube neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>5.30 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>145 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.50 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>10 Ω</td>
</tr>
</tbody>
</table>

**APPLICATION**

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

**DESCRIPTION**

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

**MOUNTING**

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A srew-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20,9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

---

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, parallel connected (Fig. 2a), terminals 1 and 4

- Inductance: $145 \mu H \pm 3,5\%$
- Resistance: $0,25 \Omega \pm 5\%$
- L/R: $575 \mu H/\Omega \pm 5\%$
- Line deflection current, edge to edge (257 mm), at 12 kV: $5,30 A (p-p) \pm 5\%$

**Field deflection coils**, series connected (Fig. 2b), terminals 2 and 3

- Inductance: $18 mH \pm 5\%$
- Resistance: $10 \Omega \pm 5\%$
- L/R: $1,80 mH/\Omega \pm 5\%$
- Field deflection current, edge to edge (195 mm), at 12 kV: $0,50 A (p-p) \pm 5\%$
- Maximum d.c. voltage between terminals of line and field coils: $500 V$
- Maximum operating temperature (average copper temperature): $95^\circ C$
- Storage temperature range: $-40$ to $+ 75^\circ C$
- Coupling between line and field coils, at 500 Hz: $\leq 1/50$

---

Fig. 1 Deflection unit AT1077/20.

(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see “Correction facilities”.
**Deflection unit**

Fig. 2a Line coils.

Fig. 2b Field coils.

The beginning of the windings is indicated with •.

**Geometric distortion** measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

\[
\begin{align*}
|Fy-Gy| & \leq 2.5 \\
|Gx-Jx| & \leq 2.5 \\
|Jy-Hy| & \leq 2.5 \\
|Hx-Fx| & \leq 2.5
\end{align*}
\]

Fig. 3 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEVELOPMENT DATA
This data sheet contains advance information and specifications are subject to change without notice.

DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>neck diameter</td>
<td></td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>6.10 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>112 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.74 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>4.15 Ω</td>
</tr>
</tbody>
</table>

APPLICATION
This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

DESCRIPTION
The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING
The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm. The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/22.

For fitting plastic-bonded FXD magnet, catalogue number 3121 104 94 120, see "Correction facilities".

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, parallel connected (Fig. 2a), terminals 1 and 4

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>112 µH ± 3.5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>0.20 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>535 µH/Ω ± 5%</td>
</tr>
<tr>
<td>Line deflection current, edge to edge (257 mm), at 12 kV</td>
<td>6.10 A (p-p) ± 5%</td>
</tr>
</tbody>
</table>

**Field deflection coils**, series connected (Fig. 2b) terminals 2 and 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>7.7 mH ± 5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>4.15 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>1.85 mH/Ω ± 5%</td>
</tr>
<tr>
<td>Field deflection current, edge to edge (195 mm), at 12 kV</td>
<td>0.74 A (p-p) ± 5%</td>
</tr>
<tr>
<td>Maximum d.c. voltage between terminals of line and field coils</td>
<td>500 V</td>
</tr>
<tr>
<td>Maximum operating temperature (average copper temperature)</td>
<td>95 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-40 to + 75 °C</td>
</tr>
<tr>
<td>Coupling between line and field coils, at 500 Hz</td>
<td>≤ 1/50</td>
</tr>
</tbody>
</table>
Deflection unit

Fig. 2a Line coils. Fig. 2b Field coils.

The beginning of the windings is indicated with •.

**Geometric distortion** measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

\[
\begin{align*}
|F_y - G_y| & \leq 2.5 \\
|G_x - J_x| & \leq 2.5 \\
|J_y - H_y| & \leq 2.5 \\
|H_x - F_x| & \leq 2.5
\end{align*}
\]

Fig. 3. The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.
These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram showing magnetic field and adjustment area]

**Fig. 5.**

For raster correction
Up to eight plastic bonded Ferroxdure magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>neck diameter</td>
<td>90°</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>4,20 A (p-p)</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>240 µH</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>0,37 A (p-p)</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>16,6 Ω</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td></td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes. Application information is available on request.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1077/23.
(1) For fitting plastic-bonded FXD magnet, catalogue number 3122 104 94120, see “Correction facilities”.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25°C.

Line deflection coils, parallel connected (Fig. 2a), terminals 1 and 4
- Inductance: 240 µH ± 3.5%
- Resistance: 0.42 Ω ± 5%
- L/R: 572 µH/Ω ± 5%
- Line deflection current, edge to edge (257 mm), at 12 kV: 4.20 A (p-p) ± 5%

Field deflection coils, series connected (Fig. 2b), terminals 2 and 3
- Inductance: 31.0 mH ± 5%
- Resistance: 16.6 Ω ± 5%
- L/R: 1.8 mH/Ω ± 5%
- Field deflection current, edge to edge (195 mm), at 12 kV: 0.37 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to +75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
Geometric distortion measured without raster correction and centring magnets on a 31 cm (12 in) reference tube M31-340 (dimensions in mm).

| \( |Fy-Gy| \leq 2.5 \) |
| \( |Gx-Jx| \leq 2.5 \) |
| \( |Jy-Hy| \leq 2.5 \) |
| \( |Hx-Fx| \leq 2.5 \) |

Fig. 2a Line coils. Fig. 2b Field coils.

The beginning of the windings is indicated with •.

Fig. 3. Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction
Up to eight plastic bonded Ferroxdue magnets can be mounted to the back of the front rim to correct raster distortion. See also Fig. 1.
DEVELOPMENT DATA
This data sheet contains advance information and specifications are subject to change without notice.

DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>3.40 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>310 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.455 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>13.6 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes, especially when high resolution is required. It is developed in conjunction with the high resolution display tube M31-340 to provide minimum deflection defocusing and pre-adjusted raster geometry, requiring only small additional adjustments. To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction*. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.

* At delivery of the deflection unit the beam centring and raster correction magnets are pre-adjusted on a reference tube.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1078/01.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

Line deflection coils, series connected (Fig. 2a), terminals 2 and 5
- Inductance: \(310 \mu H \pm 3.5\%\)
- Resistance: \(0.66 \Omega \pm 5\%\)
- \(L/R\): 470 \(\mu H/\Omega\)
- Line deflection current, edge to edge (257 mm), at 12 kV: 3.4 A (p-p) \(\pm 5\%\)

Field deflection coils, series connected (Fig. 2b) terminals 3 and 4
- Inductance: 23.8 mH \(\pm 5\%\)
- Resistance: 13.6 \(\Omega \pm 5\%\)
- \(L/R\): 1.75 mH/\(\Omega\)
- Field deflection current, edge to edge (195 mm), at 12 kV: 0.455 A (p-p) \(\pm 5\%\)
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: \(-40\) to \(+75\) °C
- Coupling between line and field coils, at 500 Hz: \(\leq 1/50\)
The beginning of the windings is indicated with •.

**Geometric distortion**, measured with beam centring and raster correction magnets pre-adjusted on a 31 cm (12 in) reference tube M31-340 (dimensions in mm)

**Fig. 2a** Line coils.

**Fig. 2b** Field coils.

**Fig. 4** The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

![Diagram of magnetic field](image)

Fig. 5.

For raster correction

Eight plastic bonded Ferroxdue magnets are mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Recommended adjustment procedure

- Centre the raster with the two centring magnets.
- Adjust the east-west raster correction magnets.
- Adjust the north-south raster correction magnets.
- Adjust the corner raster correction magnets.
- If required, repeat these adjustments in the same sequence.
- Lock the centring and raster correction magnets with locking paint.
DEFLECTION UNIT

• For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>31 cm (12 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>2.96 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>480 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.52 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>11.5 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes, especially when high resolution is required. It is developed in conjunction with the high resolution display tube M31:340 to provide minimum deflection defocusing and pre-adjusted raster geometry, requiring only small additional adjustments. To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction*. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.

* At delivery of the deflection unit the beam centring and raster correction magnets are pre-adjusted on a reference tube.
MECHANICAL DATA

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1078/02.

ELECTRICAL DATA

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 2 and 5

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>480 µH ± 3,5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>0.9 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>533 µH/Ω</td>
</tr>
<tr>
<td>Line deflection current, edge to edge (257 mm), at 12 kV</td>
<td>2.96 A (p-p) ± 5%</td>
</tr>
</tbody>
</table>

**Field deflection coils**, series connected (Fig. 2b) terminals 3 and 4

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductance</td>
<td>18 mH ± 5%</td>
</tr>
<tr>
<td>Resistance</td>
<td>11.5 Ω ± 5%</td>
</tr>
<tr>
<td>L/R</td>
<td>1.64 mH/Ω</td>
</tr>
<tr>
<td>Field deflection current, edge to edge (195 mm), at 12 kV</td>
<td>0.52 A (p-p) ± 5%</td>
</tr>
<tr>
<td>Maximum d.c. voltage between terminals of line and field coils</td>
<td>500 V</td>
</tr>
<tr>
<td>Maximum operating temperature (average copper temperature)</td>
<td>95 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-40 to + 75 °C</td>
</tr>
<tr>
<td>Coupling between line and field coils, at 500 Hz</td>
<td>≤ 1/50</td>
</tr>
</tbody>
</table>
Deflection unit

Fig. 2a Line coils.
Fig. 2b Field coils.

The beginning of the windings is indicated with •.

**Geometric distortion**, measured with beam centring and raster correction magnets pre-adjusted on a 31 cm (12 in) reference tube M31-340 (dimensions in mm)

\[
\begin{align*}
|Fy-Gy| & \leq 2.0 \\
|Gx-Jx| & \leq 2.0 \\
|Jy-Hy| & \leq 2.0 \\
|Fx-Hx| & \leq 2.0
\end{align*}
\]

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Eight plastic bonded Ferroxdure magnets are mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Recommended adjustment procedure

- Centre the raster with the two centring magnets.
- Adjust the east-west raster correction magnets.
- Adjust the north-south raster correction magnets.
- Adjust the corner raster correction magnets.
- If required, repeat these adjustments in the same sequence.
- Lock the centring and raster correction magnets with locking paint.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>32 cm (14 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>3.56 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>310 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0.516 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>13.6 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 32 cm (14 in) 90° monochrome monitor tubes, especially when high resolution is required. It is developed in conjunction with the high resolution display tube M32EAA to provide minimum deflection defocusing and pre-adjusted raster geometry, requiring only small additional adjustments. To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction*. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL 1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0.6 ± 0.2 Nm.

* At delivery of the deflection unit the beam centring and raster correction magnets are pre-adjusted on a reference tube.
MECHANICAL DATA
The deflection unit fits a tube with a neck diameter of max. 20,9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1078/04.

ELECTRICAL DATA
The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 2 and 5
- Inductance: 310 µH ± 3,5%
- Resistance: 0,66 Ω ± 5%
- L/R: 470 µH/Ω
- Line deflection current, edge to edge (277 mm), at 14 kV: 3,56 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 3 and 4
- Inductance: 23,8 mH ± 5%
- Resistance: 13,6 Ω ± 5%
- L/R: 1,75 mH/Ω
- Field deflection current, edge to edge (215 mm), at 14 kV: 0,516 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to + 75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
Deflection unit

---

AT1078/04

Fig. 2a Line coils. Fig. 2b Field coils.

The beginning of the windings is indicated with •.

Geometric distortion, measured with beam centring and raster correction magnets pre-adjusted on a 31 cm (12 in) reference tube M31-340 (dimensions in mm)

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring

After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction

Eight plastic bonded Ferroxdure magnets are mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Recommended adjustment procedure

• Centre the raster with the two centring magnets.
• Adjust the east-west raster correction magnets.
• Adjust the north-south raster correction magnets.
• Adjust the corner raster correction magnets.
• If required, repeat these adjustments in the same sequence.
• Lock the centring and raster correction magnets with locking paint.
DEVELOPMENT DATA
This data sheet contains advance information and specifications are subject to change without notice.

DEFLECTION UNIT

For FLAT SQUARE Monochrome Data Graphic Displays

QUICK REFERENCE DATA

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Square monitor tube</td>
<td></td>
</tr>
<tr>
<td>diagonal</td>
<td>29 cm (12 in)</td>
</tr>
<tr>
<td>neck diameter</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>3,33 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>310 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0,44 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>13,6 Ω</td>
</tr>
</tbody>
</table>

APPLICATION

This deflection unit is for 29 cm (12 in) 90° FLAT SQUARE monochrome monitor tubes, especially when high resolution is required. It is developed in conjunction with the high resolution display tube M29EAA to provide minimum deflection defocusing and pre-adjusted raster geometry, requiring only small additional adjustments. To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied.

DESCRIPTION

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. Both the line coils and the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction*. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

MOUNTING

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.

* At delivery of the deflection unit the beam centring and raster correction magnets are pre-adjusted on a reference tube.
MECHANICAL DATA
The deflection unit fits a tube with a neck diameter of max. 20.9 mm.
The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

Fig. 1 Deflection unit AT1078/10.

ELECTRICAL DATA
The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, series connected (Fig. 2a), terminals 2 and 5
- Inductance: 310 µH ± 3.5%
- Resistance: 0.66 Ω ± 5%
- L/R: 470 µH/Ω
- Line deflection current, edge to edge (246 mm), at 12 kV: 3.33 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 3 and 4
- Inductance: 23.8 mH ± 5%
- Resistance: 13.6 Ω ± 5%
- L/R: 1.75 mH/Ω
- Field deflection current, edge to edge (181 mm), at 12 kV: 0.44 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to +75 °C
- Coupling between line and field coils, at 500 Hz: < 1/50
Fig. 2a Line coils.

The beginning of the windings is indicated with •.

Geometric distortion, measured with beam centring and raster correction magnets pre-adjusted on a 29 cm (12 in) Flat Square reference tube M29EAA (dimensions in mm).

Fig. 2b Field coils.

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction
Eight plastic bonded Ferroxdure magnets are mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Recommended adjustment procedure
- Centre the raster with the two centring magnets.
- Adjust the east-west raster correction magnets.
- Adjust the north-south raster correction magnets.
- Adjust the corner raster correction magnets.
- If required, repeat these adjustments in the same sequence.
- Lock the centring and raster correction magnets with locking paint.
DEFLECTION UNIT

- For Monochrome Data Graphic Displays

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Monitor tube</th>
<th>31 cm (12 in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>diagonal</td>
<td>20 mm</td>
</tr>
<tr>
<td>Deflection angle</td>
<td>90°</td>
</tr>
<tr>
<td>Line deflection current for full scan, at 12 kV</td>
<td>3,90 A (p-p)</td>
</tr>
<tr>
<td>Inductance of line coils</td>
<td>245 µH</td>
</tr>
<tr>
<td>Field deflection current for full scan, at 12 kV</td>
<td>0,85 A (p-p)</td>
</tr>
<tr>
<td>Resistance of field coils</td>
<td>4,10 Ω</td>
</tr>
</tbody>
</table>

**APPLICATION**

This deflection unit is for 31 cm (12 in) 90° monochrome monitor tubes, especially when high resolution is required. It is developed in conjunction with the high resolution display tube M31-340 to provide minimum deflection defocusing and pre-adjusted raster geometry, requiring only small additional adjustments. To utilize the full potential of this deflection unit in respect of deflection defocusing, dynamic focusing has to be applied.

**DESCRIPTION**

The deflection unit is of the hybrid type, with saddle wound line coils and toroidal wound field coils. The line coils are parallel connected, the field coils are series connected. The unit has a non-magnetic metal clamping ring for fixing to the tube neck. Provisions are made for beam centring and raster correction*. The unit meets the self-extinguishing and non-dripping requirements of IEC 65 and UL1413.

**MOUNTING**

The unit should be mounted as far forward as possible on the neck of the tube, so that it touches the cone.

To orient the raster correctly, the unit may be rotated by hand on the neck of the tube, with which it makes a slip fit. A screw-tightened clamping ring permits it to be locked, both axially and radially, in the desired position; the tightening torque is 0,6 ± 0,2 Nm.

* At delivery of the deflection unit the beam centring and raster correction magnets are pre-adjusted on a reference tube.
**MECHANICAL DATA**

The deflection unit fits a tube with a neck diameter of max. 20.9 mm.

The unit is provided with solder pins for connection. The pin numbering in Fig. 1 corresponds to that in the diagram (Fig. 2).

**ELECTRICAL DATA**

The electrical values apply at an ambient temperature of 25 °C.

**Line deflection coils**, parallel connected (Fig. 2a), terminals 2 and 5
- Inductance: 245 µH ± 3.5%
- Resistance: 0.53 Ω ± 5%
- L/R: 462 µH/Ω
- Line deflection current, edge to edge (257 mm), at 12 kV: 3.90 A (p-p) ± 5%

**Field deflection coils**, series connected (Fig. 2b) terminals 3 and 4
- Inductance: 6.85 mH ± 5%
- Resistance: 4.10 Ω ± 5%
- L/R: 1.66 mH/Ω
- Field deflection current, edge to edge (195 mm), at 12 kV: 0.85 A (p-p) ± 5%
- Maximum d.c. voltage between terminals of line and field coils: 500 V
- Maximum operating temperature (average copper temperature): 95 °C
- Storage temperature range: -40 to +75 °C
- Coupling between line and field coils, at 500 Hz: ≤ 1/50
Deflection unit

Fig. 2a Line coils.

Fig. 2b Field coils.

The beginning of the windings is indicated with ●.

**Geometric distortion**, measured with beam centring and raster correction magnets pre-adjusted on a 31 cm (12 in) reference tube M31-340 (dimensions in mm)

\[
\begin{align*}
|F_y - G_y| & \leq 2,0 \\
|G_x - J_x| & \leq 2,0 \\
|J_y - H_y| & \leq 2,0 \\
|H_x - F_x| & \leq 2,0
\end{align*}
\]

Fig. 4 The edges of the displayed raster fall within the two rectangles.
CORRECTION FACILITIES

For centring
After adjustment of the linearity of the deflection current, the eccentricity of the monitor tube and the deflection unit can be corrected by means of two independently movable centring magnets. These magnets are magnetized diametrically. By turning the magnets with respect to each other the resulting field strength is varied. The direction of the resulting magnetic field is adjusted by turning the magnets simultaneously. The torque on the magnets is 50 to 200 mNm.

These centring magnets cannot be used for compensating the effects of non-linearity or of phase differences between the synchronization and time base, as otherwise the correction needed becomes excessive. Even if the correction is within the range of the magnets, curved lines may appear in the centre of the raster.

For raster correction
Eight plastic bonded Ferroxdure magnets are mounted to the back of the front rim to correct raster distortion. See also Fig. 1.

Recommended adjustment procedure
• Centre the raster with the two centring magnets.
• Adjust the east-west raster correction magnets.
• Adjust the north-south raster correction magnets.
• Adjust the corner raster correction magnets.
• If required, repeat these adjustments in the same sequence.
• Lock the centring and raster correction magnets with locking paint.
Conversion of catalogue number to type number (deflection units only)

<table>
<thead>
<tr>
<th>catalogue number</th>
<th>type number</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3122 137 12160</td>
<td>AT1040/15</td>
<td>119</td>
</tr>
<tr>
<td>14610</td>
<td>AT1040/04</td>
<td>113</td>
</tr>
<tr>
<td>16370</td>
<td>AT1040/17</td>
<td>113</td>
</tr>
<tr>
<td>17087</td>
<td>AT1071/07</td>
<td>437</td>
</tr>
<tr>
<td>18697</td>
<td>AT1039/00</td>
<td>393</td>
</tr>
<tr>
<td>18701</td>
<td>AT1039/01</td>
<td>393</td>
</tr>
<tr>
<td>19620</td>
<td>AT1077/02</td>
<td>129</td>
</tr>
<tr>
<td>19640</td>
<td>AT1077/05</td>
<td>449</td>
</tr>
<tr>
<td>19720</td>
<td>AT1077/01</td>
<td>125, 441</td>
</tr>
<tr>
<td>20080</td>
<td>AT1077/06</td>
<td>453</td>
</tr>
<tr>
<td>20200</td>
<td>AT1077/07</td>
<td>457</td>
</tr>
<tr>
<td>20430</td>
<td>AT1039/03</td>
<td>401</td>
</tr>
<tr>
<td>20462</td>
<td>AT1071/05</td>
<td>433</td>
</tr>
<tr>
<td>20750</td>
<td>AT1077/09</td>
<td>461</td>
</tr>
<tr>
<td>20760</td>
<td>AT1077/10</td>
<td>465</td>
</tr>
<tr>
<td>3138 137 30040</td>
<td>AT1077/01A</td>
<td>445</td>
</tr>
<tr>
<td>30060</td>
<td>AT1078/02</td>
<td>493</td>
</tr>
<tr>
<td>3322 603 00030</td>
<td>AT1077/15</td>
<td>469</td>
</tr>
<tr>
<td>00040</td>
<td>AT1077/16</td>
<td>473</td>
</tr>
<tr>
<td>00050</td>
<td>AT1078/19</td>
<td>505</td>
</tr>
<tr>
<td>00060</td>
<td>AT1077/20</td>
<td>477</td>
</tr>
<tr>
<td>00080</td>
<td>AT1077/22</td>
<td>481</td>
</tr>
<tr>
<td>00100</td>
<td>AT1077/23</td>
<td>485</td>
</tr>
<tr>
<td>00120</td>
<td>AT1078/10</td>
<td>501</td>
</tr>
<tr>
<td>00130</td>
<td>AT1078/01</td>
<td>489</td>
</tr>
<tr>
<td>00151</td>
<td>AT1038/42</td>
<td>387</td>
</tr>
<tr>
<td>00381</td>
<td>AT1039/09</td>
<td>409</td>
</tr>
<tr>
<td>00391</td>
<td>AT1038/41</td>
<td>381</td>
</tr>
<tr>
<td>00521</td>
<td>AT1039/16</td>
<td>417</td>
</tr>
<tr>
<td>00551</td>
<td>AT1039/21</td>
<td>425</td>
</tr>
<tr>
<td>00570</td>
<td>AT1078/04</td>
<td>497</td>
</tr>
</tbody>
</table>
Electronic components and materials for professional, industrial and consumer uses from the world-wide Philips Group of Companies


Australia: PHILIPS INDUSTRIES HOLDINGS LTD., Elcoma Division, 11 Watham Street, ARTARMON, N.S.W. 2064, Tel. (02) 439 3322.

Austria: ÖSTERREICHISCHE PHILIPS BAULELEMENTE INDUSTRY G.m.b.H., Triester Str. 64, A-1101 WIEN, Tel. 629111-0.

Belgium: N.V. PHILIPS & MBLE ASSOCIATED, 9 rue du Pavillon, B-1030 BRUXELLES, Tel. (02) 242 7400.


Canada: PHILIPS ELECTRONICS LTD., Elcoma Division, 601 Milner Ave., SCARBOROUGH, Ontario, M1B 1M8, Tel. 292-5161.

Chile: PHILIPS CHILESA, S.A., Santa Maria 0760, SANTIAGO, Tel. 39-4001.

Colombia: IND. PHILIPS DE COLOMBIA S.A., c/o IPRELSENS LTD., Cra. 21, No. 56-17, BOGOTA, D.E., Tel. 2497624.

Denmark: MINIWATT A/S, Strandlodsvej 2, P.O. Box 1919, DK 2300 COPENHAGEN S, Tel. (01) 541133.

Finland: OTY PHILIPS AB, Elcoma Division, Kaivokatu 8, SF-00100 HELSINKI 10, Tel. 17271.

France: RTC-COMPELEC, 130 Avenue Ledru Rollin, F-75540 PARIS 11, Tel. 43388000.

Germany (Fed. Republic): VALVO, UB Baulelemente der G.m.b.h., Valvo Haus, Burchardstrasse 19, D-2 HAMBURG 1, Tel. (040) 3296-0.

Greece: PHILIPS HELLENIQUE A., Elcoma Division, 54, Syrgru Av., ATHENS 11742, Tel. 9215311/319.

Hong Kong: PHILIPS HONG KONG LTD., Elcoma Div., 15/F Philips Ind. Bldg., 24-28 Kung Yip St., KWAI CHUNG, Tel. (0)-245121.

India: PEICO ELECTRONICS & ELECTRICALS LTD., Elcoma Dept., Band Box Building, 254-D Dr. Annie Besant Rd., BOMBAY - 400025, Tel. 4930311/4930590.

Indonesia: P.T. PHILIPS-RALIN ELECTRONICS, Elcoma Div., Setiabudi II Building, 6th Fl., Jalan H.R. Rasuna Said (P.O. Box 223/KBY) Kuningan, JAKARTA - Selatan, Tel. 512572.

Ireland: PHILIPS ELECTRICAL (IRELAND) LTD., Newstead, Clonskeagh, DUBLIN 14, Tel. 693355.

Italy: PHILIPS S.p.A., Sezione Elcoma, Piazza II Novembre 3, I-20124 MILANO, Tel. 2-6752.1.

Japan: NI WooCommerce S , Shuwa Shinagawa Bldg., 26-23 Takanawa 3-chome, Minato-ku, TOKYO (108), Tel. 448-5611.


Malaysia: PHILIPS MALAYSIA SDN. BERNAD, No. 4 Persiaran Barat, Petaling Jaya, P.O.B. 2163, KUALA LUMPUR, Selangor, Tel. 774411.


Netherlands: PHILIPS NEDERLAND, Marktgroep Elcoma, Postbus 90050, 5600 PB EINDHOVEN, Tel. (040) 793333.

New Zealand: PHILIPS NEW ZEALAND LTD., Elcoma Division, 110 Mt. Eden Road, C.P.O. Box 1041, AUCKLAND, Tel. 605-914.

Norway: NORSK A/S PHILIPS, Electronica Dept., Sandstuveien 70, OSLO 6, Tel. 680200.

Philippines: PHILIPS INDUSTRIAL DEV. INC., 2246 Pasong Tamo, P.O. Box 911, Makati Comm. Centre, MAKATI-RIZAL 3116, Tel. 86-89-51 to 59.

Portugal: N.V. PHILIPS & MBLE ASSOCIATED, 9 rue du Pavilion, B-1030 BRUXELLES, Tel. 683121.

Singapore: PHILIPS PROJECT DEV. (Singapore) PTE LTD., Elcoma Div., Lorong 1, Toa Payoh, SINGAPORE 1231, Tel. 3502000.


Spain: MINIWATT S.A., Balmes 22, BARCELONA 7, Tel. 3016312.

Sweden: PHILIPS KOMPONENTER A.B., Lidingövägen 50, S-11584 STOCKHOLM 27, Tel. 087621000.

Switzerland: PHILIPS A.G., Elcoma Dept., Alimentstrasse 140-142, CH-8027 ZURICH, Tel. 01-4882211.

Taiwan: PHILIPS TAIWAN LTD., 150 Tun Hua North Road, P.O. Box 22978, TAIPEI, Taiwan, Tel. 7120500.

Thailand: PHILIPS ELECTRICAL CO. OF THAILAND LTD., 283 Silom Road, P.O. Box 961, BANGKOK, Tel. 233-6330-9.

Turkey: TÜRK PHILIPS TICARET A.S., Elcoma Department, İnönü Cad. No. 78-80, P.K.504, 00874 İSTANBUL, Tel. 435910.

United Kingdom: MULLARD LTD., Mullard House, Torrington Place, LONDON WC1E 7HD, Tel. 01-5806633.

United States: (Active Devices & Materials) AMPEREX SALES CORP., Providence Pike, SLATERSVILLE, R.I. 02876, Tel. (401) 762-9000.


Uruguay: LUZILECTRON SA, Avda Uruguay 1287, P.O. Box 907, MONTEVIDEO, Tel. 914321.


For all other countries apply to: Philips Electronic Components and Materials Division, International Business Relations, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Telex 35000 philon