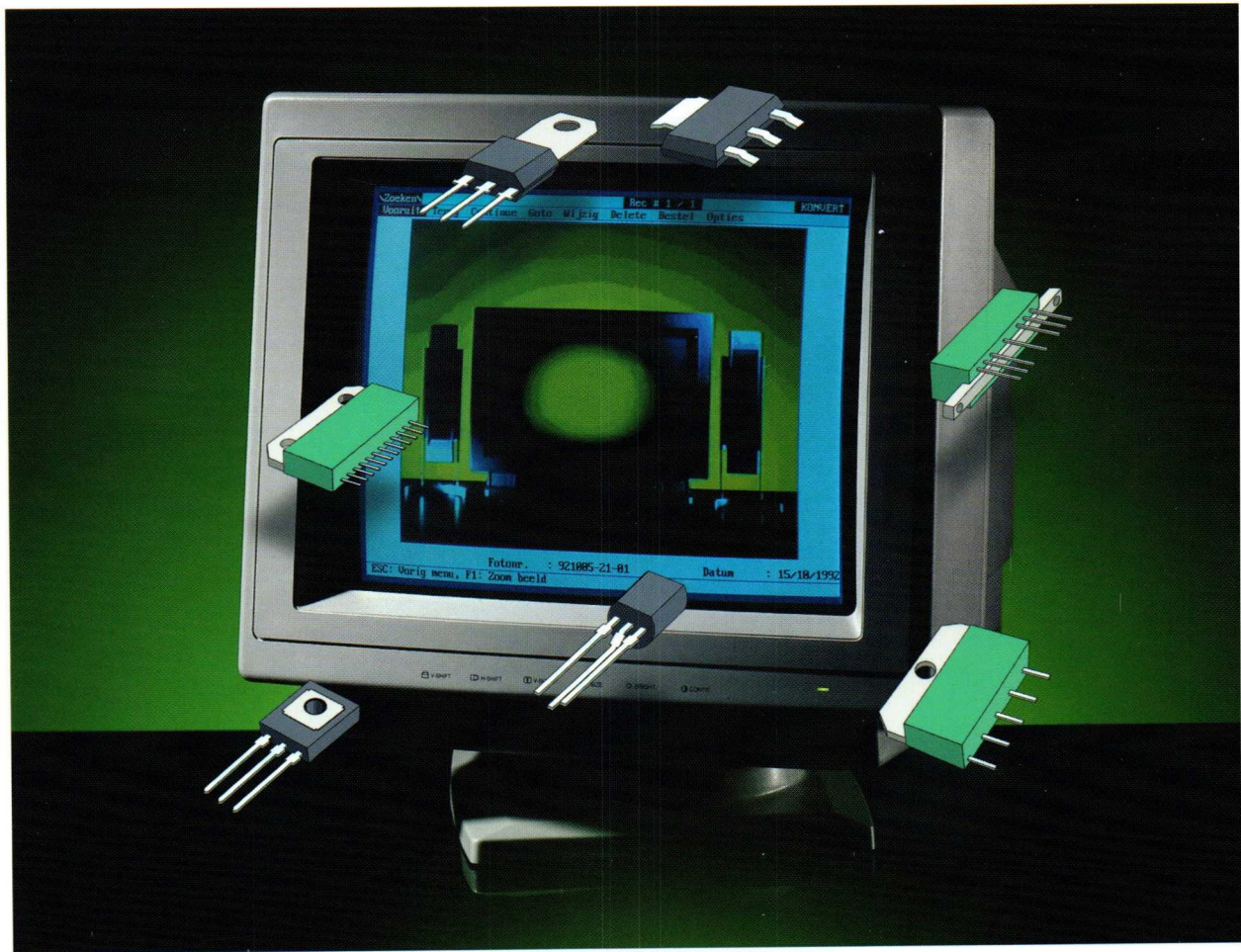


# Video Transistors and Modules for Monitors



1998

Data Handbook SC05

## **QUALITY ASSURED**

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

## **PRODUCT SAFETY**

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be 'chemical', 'special' or sometimes 'industrial' waste. Disposal as domestic waste is usually not permitted.



# Video Transistors and Modules for Monitors

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## DEFINITIONS

|                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Data sheet status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                       |
| Objective specification                                                                                                                                                                                                                                                                                                                                                                                                                                   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification                                                                                                                                                                                                                                                                                                                                                                                                                                 | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification                                                                                                                                                                                                                                                                                                                                                                                                                                     | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |                                                                                       |
| <b>Application information</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |

## LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.



## INDEX



# Video Transistors and Modules for Monitors

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THE UNIVERSITY OF CHICAGO  
DEPARTMENT OF CHEMISTRY  
505 EAST HALL  
CHICAGO, ILL. 60637  
U.S.A.

1. The following information is for the purpose of identifying the material and is not to be used for any other purpose. The material is a sample of the compound, which is a solid, white, crystalline powder. The sample was obtained from the following source: [Source of material]. The sample was analyzed by the following methods: [Methods of analysis]. The results of the analysis are as follows: [Results of analysis]. The material is identified as [Name of compound].

2. The following information is for the purpose of identifying the material and is not to be used for any other purpose. The material is a sample of the compound, which is a solid, white, crystalline powder. The sample was obtained from the following source: [Source of material]. The sample was analyzed by the following methods: [Methods of analysis]. The results of the analysis are as follows: [Results of analysis]. The material is identified as [Name of compound].

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## SELECTION GUIDES

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## Video Transistors and Modules for Monitors

## Selection guide

## WIDEBAND TRANSISTORS FOR MONITOR VIDEO OUTPUT AMPLIFIERS

| TYPE<br>NUMBER                        | POLARITY | V <sub>CBO</sub><br>max.<br>(V) | V <sub>CER</sub><br>max.<br>(V) | I <sub>C</sub><br>max.<br>(mA) | h <sub>FE</sub><br>min. | C <sub>CB</sub><br>typ.<br>(pF) | T <sub>j</sub><br>(°C) | f <sub>T</sub><br>min.<br>(MHz) | PAGE |
|---------------------------------------|----------|---------------------------------|---------------------------------|--------------------------------|-------------------------|---------------------------------|------------------------|---------------------------------|------|
| <b>SOT54 (TO-92) package</b>          |          |                                 |                                 |                                |                         |                                 |                        |                                 |      |
| BFQ131                                | NPN      | 25                              | 18 <sup>(2)</sup>               | 150                            | 25                      | 1.2 <sup>(1)</sup>              | 175                    | 4000                            | 59   |
| BFQ151                                | PNP      | -20                             | -15 <sup>(2)</sup>              | -100                           | 25                      | 1.8 <sup>(1)</sup>              | 175                    | 3500                            | 63   |
| BFQ161                                | NPN      | 20                              | 19                              | 500                            | 25                      | 4.3                             | 150                    | 1000                            | 66   |
| BFQ221                                | NPN      | 100                             | 95                              | 100                            | 20                      | 1.7 <sup>(1)</sup>              | 150                    | 1000                            | 78   |
| BFQ231                                | NPN      | 100                             | 95                              | 300                            | 20                      | 1.8                             | 150                    | 1000                            | 90   |
| BFQ231A                               | NPN      | 115                             | 110                             | 300                            | 20                      | 1.8                             | 150                    | 800                             | 90   |
| BFQ241                                | PNP      | -100                            | -95                             | -100                           | 20                      | 1.7 <sup>(1)</sup>              | 150                    | 1000                            | 106  |
| BFQ251                                | PNP      | -100                            | -95                             | -300                           | 20                      | 2.0                             | 150                    | 1000                            | 118  |
| BFQ251A                               | PNP      | -115                            | -110                            | -300                           | 20                      | 2.0                             | 150                    | 800                             | 118  |
| BFV420                                | NPN      | 140                             | 100 <sup>(2)</sup>              | 100                            | 150                     | 1.5 <sup>(1)</sup>              | 150                    | 150                             | 139  |
| BFV421                                | PNP      | -140                            | -100 <sup>(2)</sup>             | -100                           | 150                     | 2.3 <sup>(1)</sup>              | 150                    | 150                             | 141  |
| PH2369                                | NPN      | 40                              | 15 <sup>(2)</sup>               | 200                            | 40                      | —                               | 150                    | 500                             | 199  |
| <b>SOT32 (TO-126) package</b>         |          |                                 |                                 |                                |                         |                                 |                        |                                 |      |
| BFQ162                                | NPN      | 20                              | 19                              | 500                            | 40                      | 4.2                             | 175                    | 1000                            | 70   |
| BFQ222                                | NPN      | 100                             | 95                              | 100                            | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 81   |
| BFQ232                                | NPN      | 100                             | 95                              | 300                            | 20                      | 2.0                             | 175                    | 1000                            | 94   |
| BFQ232A                               | NPN      | 115                             | 110                             | 300                            | 20                      | 2.0                             | 175                    | 800                             | 94   |
| BFQ242                                | PNP      | -100                            | -95                             | -100                           | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 109  |
| BFQ252                                | PNP      | -100                            | -95                             | -300                           | 20                      | 2.5                             | 175                    | 1000                            | 122  |
| BFQ252A                               | PNP      | -115                            | -110                            | -300                           | 20                      | 2.5                             | 175                    | 800                             | 122  |
| BFQ262                                | NPN      | 100                             | 95                              | 400                            | 50                      | 2.0                             | 175                    | 1000                            | 134  |
| BFQ262A                               | NPN      | 115                             | 110                             | 400                            | 20                      | 2.0                             | 175                    | 800                             | 134  |
| BFV469                                | NPN      | 140                             | 100 <sup>(2)</sup>              | 100                            | 150                     | 1.5 <sup>(1)</sup>              | 150                    | 150                             | 143  |
| <b>SOT128B (TO-202) package</b>       |          |                                 |                                 |                                |                         |                                 |                        |                                 |      |
| BFQ225                                | NPN      | 100                             | 95                              | 100                            | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 84   |
| BFQ235                                | NPN      | 100                             | 95                              | 300                            | 20                      | 2.0                             | 175                    | 1000                            | 98   |
| BFQ235A                               | NPN      | 115                             | 110                             | 300                            | 20                      | 2.0                             | 175                    | 800                             | 98   |
| BFQ245                                | PNP      | -100                            | -95                             | -100                           | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 112  |
| BFQ255                                | PNP      | -100                            | -95                             | -300                           | 20                      | 2.0                             | 175                    | 1000                            | 126  |
| BFQ255A                               | PNP      | -115                            | -110                            | -300                           | 20                      | 2.0                             | 175                    | 800                             | 126  |
| <b>SOT223 (surface mount) package</b> |          |                                 |                                 |                                |                         |                                 |                        |                                 |      |
| BFQ166                                | NPN      | 20                              | 19                              | 500                            | 50                      | 3.2                             | 175                    | 1000                            | 74   |
| BFQ226                                | NPN      | 100                             | 95                              | 100                            | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 87   |
| BFQ236                                | NPN      | 100                             | 95                              | 300                            | 20                      | 1.5                             | 175                    | 1000                            | 102  |
| BFQ236A                               | NPN      | 115                             | 110                             | 300                            | 20                      | 1.5                             | 175                    | 800                             | 102  |
| BFQ246                                | PNP      | -100                            | -95                             | -100                           | 20                      | 1.7 <sup>(1)</sup>              | 175                    | 1000                            | 115  |
| BFQ256                                | PNP      | -100                            | -95                             | -300                           | 20                      | 1.6                             | 175                    | 1000                            | 130  |
| BFQ256A                               | PNP      | -115                            | -110                            | -300                           | 20                      | 1.6                             | 175                    | 800                             | 130  |

## Video Transistors and Modules for Monitors

## Selection guide

## TRANSISTORS FOR VIDEO AMPLIFIER BUFFER STAGES

| TYPE<br>NUMBER                        | POLARITY | $V_{CEO}$<br>max.<br>(V) | $I_C$<br>max.<br>(mA) | $h_{FE}$<br>min. | $f_T$<br>typ.<br>(MHz) | PAGE |
|---------------------------------------|----------|--------------------------|-----------------------|------------------|------------------------|------|
| <b>SOT54 (TO-92) package</b>          |          |                          |                       |                  |                        |      |
| BFQ131                                | NPN      | 18                       | 150                   | 25               | 4000                   | 59   |
| BFQ151                                | PNP      | -15                      | -100                  | 25               | 3500                   | 63   |
| <b>SOT223 (surface mount) package</b> |          |                          |                       |                  |                        |      |
| BFG35                                 | NPN      | 18                       | 150                   | 70               | 4000                   | 50   |

## VIDEO OUTPUT AMPLIFIER MODULES

| TYPE<br>NUMBER                   | CHANNELS | $V_S$<br>(V) | $V_O$<br>(V) | $P_{tot}$<br>(V)    | BANDWIDTH<br>(MHz) | $t_r$<br>typ.<br>(ns) | $t_f$<br>typ.<br>(ns) | PACKAGE | PAGE |
|----------------------------------|----------|--------------|--------------|---------------------|--------------------|-----------------------|-----------------------|---------|------|
| <b>Cascode configuration</b>     |          |              |              |                     |                    |                       |                       |         |      |
| CR1296                           | 3        | 90           | 50           | 12.0 <sup>(3)</sup> | 140                | 5.0                   | 2.5                   | SOT454  | 149  |
| <b>Active load configuration</b> |          |              |              |                     |                    |                       |                       |         |      |
| CR2424S                          | 1        | 70           | 40           | 4.6                 | 130                | 2.3                   | 2.1                   | SOT115L | 152  |
| CR2427S                          | 1        | 70           | 40           | 4.6                 | 130                | 2.3                   | 2.1                   | SOT348  | 158  |
| CR3424                           | 1        | 90           | 40           | 6.4                 | 130                | 2.3                   | 2.1                   | SOT115L | 164  |
| CR5427                           | 3        | 80           | 45           | 8.0                 | 120                | 3.0                   | 3.0                   | SOT451  | 169  |
| CR5527S                          | 3        | 90           | 50           | 9.6                 | 110                | 3.0                   | 2.2                   | SOT347  | 173  |
| CR5627                           | 3        | 90           | 50           | 9.6                 | 100                | 3.5                   | 2.7                   | SOT347  | 178  |
| CR6627                           | 3        | 90           | 50           | 9.6                 | 120                | 2.7                   | 2.2                   | SOT347  | 183  |
| CR6727A                          | 3        | 70           | 45           | 11.5                | 150                | 2.5                   | 2.1                   | SOT347  | 188  |
| CR6927                           | 3        | 90           | 45           | 10.6                | 140                | 2.5                   | 2.1                   | SOT347  | 191  |
| CR6927A                          | 3        | 90           | 45           | 12.5                | 150                | 2.5                   | 2.1                   | SOT347  | 195  |

## PRODUCT UPDATE - TRANSISTORS

| WITHDRAWN | SUCCESSOR TYPE |
|-----------|----------------|
| BFQ265    | BFQ262         |
| BFQ265A   | BFQ262A        |

## PRODUCT UPDATE - MODULES

| WITHDRAWN | SUCCESSOR TYPE |
|-----------|----------------|
| CR3427    | CR3424         |
| CR6727    | CR6727A        |

## Notes

1.  $C_{RE}$ .
2.  $V_{CEO}$  max.
3. Signal dependent.

**Video Transistors and  
Modules for Monitors****Replacement list****REPLACED/WITHDRAWN TYPES**

The following type numbers were included in the previous issue of this data handbook, but are not in the current edition

| TYPE NUMBER | REASON FOR DELETION |
|-------------|---------------------|
| BFQ265      | replaced by BFQ262  |
| BFQ265A     | replaced by BFQ262A |
| CR3427      | replaced by CR3424  |



## Video Transistors and Modules for Monitors

## Line-ups

## WIDEBAND TRANSISTORS FOR VIDEO OUTPUT AMPLIFIERS IN MONITORS - DEVICE USAGE

| $I_c$<br>max.<br>(mA)     | SOT54 (TO-92)     | SOT32 (TO-126)                  | SOT128B (TO-202)  | SOT223            |
|---------------------------|-------------------|---------------------------------|-------------------|-------------------|
| <b>NPN cascode driver</b> |                   |                                 |                   |                   |
| 150                       | BFQ131            | —                               | —                 | BFQ35             |
| 500                       | BFQ161            | BFQ162                          | —                 | BFQ166            |
| <b>PNP cascode driver</b> |                   |                                 |                   |                   |
| 150                       | BFQ151            | —                               | —                 | —                 |
| <b>NPN cascode output</b> |                   |                                 |                   |                   |
| 100                       | BFQ221            | BFQ222<br>BFV469 <sup>(1)</sup> | BFQ225            | BFQ226            |
| 300                       | —                 | BFQ232<br>BFQ232A               | BFQ235<br>BFQ235A | —<br>—            |
| 400                       | —                 | BFQ262<br>BFQ262A               | —<br>—            | —<br>—            |
| <b>NPN buffer</b>         |                   |                                 |                   |                   |
| 100                       | BFQ221<br>BFV420  | BFQ222<br>—                     | BFQ225<br>—       | BFQ226<br>—       |
| 150                       | BFQ131            | —                               | —                 | —                 |
| 300                       | BFQ231<br>BFQ231A | BFQ232<br>BFQ232A               | BFQ235<br>BFQ235A | BFQ236<br>BFQ236A |
| <b>PNP buffer</b>         |                   |                                 |                   |                   |
| 100                       | BFQ241<br>BFV421  | BFQ242<br>—                     | BFQ245<br>—       | BFQ246<br>—       |
| 300                       | BFQ251<br>BFQ251A | BFQ252<br>BFQ252A               | BFQ255<br>BFQ255A | BFQ256<br>BFQ256A |

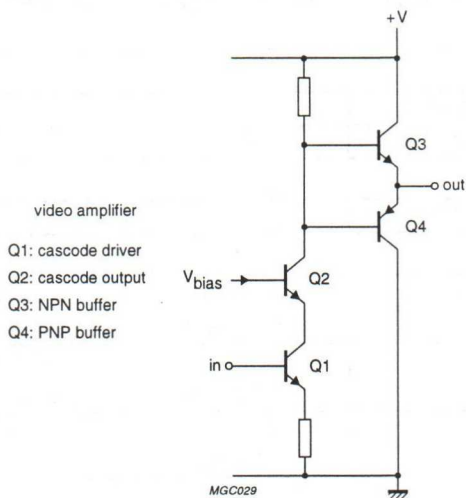


Fig.1 Typical 4-transistor video amplifier circuit.

## WIDEBAND TRANSISTORS FOR VIDEO OUTPUT AMPLIFIERS - PER MONITOR TYPE

| MONITOR SIZE<br>(inches) | DISPLAY<br>RESOLUTION | APPLICATION | RISE/FALL TIME<br>$t_r$ ; $t_f$ (ns) | LINE-UP                          |
|--------------------------|-----------------------|-------------|--------------------------------------|----------------------------------|
| 14 and 15                | 800 × 600             | economy     | 17                                   | PH2369, BFQ225                   |
| 15                       | 1024 × 768            | economy     | 10                                   | PH2369, BFV469<br>BFV420, BFV421 |
| 15 and 17                | 1280 × 1024           | economy     | 7                                    | PH2369, BFQ225<br>BFQ221, BFQ241 |
| 15 and 17                | 1280 × 1024           | high end    | 5                                    | BFQ131, BFQ225<br>BFQ221, BFQ241 |

## Internet World Wide Web Home Page

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### WHAT IS IT?

Welcome to our place in cyberspace.

Explore our Web pages and take a look at our product offering of advance High-performance Applications and Products.

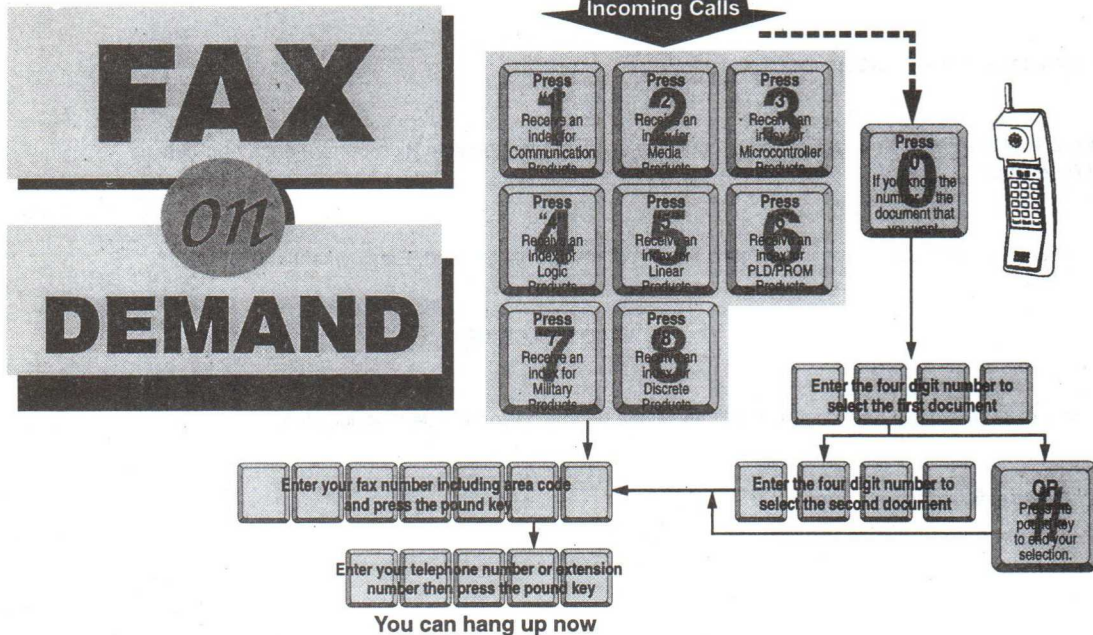
In addition, we offer you the latest information on Products, News, Support, Employment and Offices.

### HOW TO REACH US

For access to the Philips Semiconductors Home Page go to the World Wide Web location:

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### Who do I contact if I have a question about FAX-on-DEMAND?

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### FAX-on-DEMAND phone numbers:

|                                      |                  |
|--------------------------------------|------------------|
| England<br>(United Kingdom, Ireland) | 44-181-730-5020  |
| France                               | 33-1-40-99-60-60 |
| Italy                                | 39-167-295502    |
| North America                        | 1-800-282-2000   |

### Locations soon to be in operation:

Hong Kong  
Japan  
The Netherlands

## GENERAL

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## Video Transistors and Modules for Monitors

## General

### QUALITY

#### Total Quality Management

Philips Semiconductors is a Quality Company, renowned for the high quality of our products and service. We keep alive this tradition by constantly aiming towards one ultimate standard, that of zero defects. This aim is guided by our Total Quality Management (TQM) system, the basis of which is described in the following paragraphs.

#### QUALITY ASSURANCE

Based on ISO 9000 standards, customer standards such as Ford TQE and IBM MDQ. Our factories are certified to ISO 9000 by external inspectorates.

#### PARTNERSHIPS WITH CUSTOMERS

PPM co-operations, design-in agreements, ship-to-stock, just-in-time and self-qualification programmes, and application support.

#### PARTNERSHIPS WITH SUPPLIERS

Ship-to-stock, statistical process control and ISO 9000 audits.

#### QUALITY IMPROVEMENT PROGRAMME

Continuous process and system improvement, design improvement, complete use of statistical process control, realization of our final objective of zero defects, and logistics improvement by ship-to-stock and just-in-time agreements.

#### Advanced quality planning

During the design and development of new products and processes, quality is built-in by advanced quality planning. Through failure-mode-and-effect analysis the critical parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase.

#### Product conformance

The assurance of product conformance is an integral part of our quality assurance (QA) practice. This is achieved by:

- Incoming material management through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Critical process steps are 100% under statistical process control.

- Acceptance tests on finished products to verify conformance with the device specification. The test results are used for quality feedback and corrective actions. The inspection and test requirements are detailed in the general quality specifications.
- Periodic inspections to monitor and measure the conformance of products.

#### Product reliability

With the increasing complexity of Original Equipment Manufacturer (OEM) equipment, component reliability must be extremely high. Our research laboratories and development departments study the failure mechanisms of semiconductors. Their studies result in design rules and process optimization for the highest built-in product reliability. Highly accelerated tests are applied to the products reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

#### Customer responses

Our quality improvement depends on joint action with our customer. We need our customer's inputs and we invite constructive comments on all aspects of our performance. Please contact our local sales representative.

#### Recognition

The high quality of our products and services is demonstrated by many Quality Awards granted by major customers and international organizations.

### PRO ELECTRON TYPE NUMBERING SYSTEM

#### Basic type number

This type designation code applies to discrete semiconductor devices (not integrated circuits), multiples of such devices, semiconductor chips and Darlington transistors.

#### FIRST LETTER

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

- |   |                                                                             |
|---|-----------------------------------------------------------------------------|
| A | Germanium or other material with a band gap of 0.6 to 1 eV                  |
| B | Silicon or other material with a band gap of 1 to 1.3 eV                    |
| C | Gallium arsenide (GaAs) or other material with a band gap of 1.3 eV or more |
| R | Compound materials, e.g. cadmium sulphide.                                  |

## Video Transistors and Modules for Monitors

## General

## SECOND LETTER

The second letter indicates the function for which the device is primarily designed. The same letter can be used for multi-chip devices with similar elements.

In the following list low power types are defined by  $R_{th(j-mb)} > 15 \text{ K/W}$  and power types by  $R_{th(j-mb)} \leq 15 \text{ K/W}$ .

|   |                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------|
| A | Diode; signal, low power                                                                                                                  |
| B | Diode; variable capacitance                                                                                                               |
| C | Transistor; low power, audio frequency                                                                                                    |
| D | Transistor; power, audio frequency                                                                                                        |
| E | Diode; tunnel                                                                                                                             |
| F | Transistor; low power, high frequency                                                                                                     |
| G | Multiple of dissimilar devices/miscellaneous devices; e.g. oscillators. Also with special third letter; see under Section "Serial number" |
| H | Diode; magnetic sensitive                                                                                                                 |
| L | Transistor; power, high frequency                                                                                                         |
| N | Photocoupler                                                                                                                              |
| P | Radiation detector; e.g. high sensitivity photo-transistor; with special third letter                                                     |
| Q | Radiation generator; e.g. LED, laser; with special third letter                                                                           |
| R | Control or switching device; e.g. thyristor, low power; with special third letter                                                         |
| S | Transistor; low power, switching                                                                                                          |
| T | Control or switching device; e.g. thyristor, low power; with special third letter                                                         |
| U | Transistor; power, switching                                                                                                              |
| W | Surface acoustic wave device                                                                                                              |
| X | Diode; multiplier, e.g. varactor, step recovery                                                                                           |
| Y | Diode; rectifying, booster                                                                                                                |
| Z | Diode; voltage reference or regulator, transient suppressor diode; with special third letter.                                             |

## SERIAL NUMBER

The number comprises three figures running from 100 to 999 for devices primarily intended for consumer equipment, or one letter (Z, Y, X, etc.) and two figures running from 10 to 99 for devices primarily intended for industrial or professional equipment.<sup>(1)</sup>

## Version letter

A letter may be added to the basic type number to indicate minor electrical or mechanical variants of the basic type.

## RATING SYSTEMS

The rating systems described are those recommended by the IEC in its publication number 134.

## Definitions of terms used

## ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device. This definition excludes inductors, capacitors, resistors and similar components.

## CHARACTERISTIC

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

## BOGEY ELECTRONIC DEVICE

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

## RATING

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

## RATING SYSTEM

The set of principles upon which ratings are established and which determine their interpretation. The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

## Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic

(1) When the supply of these serial numbers is exhausted, the serial number may be expanded to three figures for industrial types and four figures for consumer types.



device of a specified type, as defined by its published data, which should not be exceeded under the worst probable conditions.

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

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

### Design maximum rating system

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

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

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

### Design centre rating system

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

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average

applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

## LETTER SYMBOLS

The letter symbols for transistors detailed in this section are based on IEC publication number 148.

### Basic letters

In the representation of currents, voltages and powers, lower-case letter symbols are used to indicate all instantaneous values that vary with time. All other values are represented by upper-case letters.

Electrical parameters<sup>(1)</sup> of external circuits and of circuits in which the device forms only a part are represented by upper-case letters. Lower-case letters are used for the representation of electrical parameters inherent in the device. Inductances and capacitances are always represented by upper-case letters.

The following is a list of basic letter symbols used with semiconductor devices:

|      |                                               |
|------|-----------------------------------------------|
| B, b | Susceptance (imaginary part of an admittance) |
| C    | Capacitance                                   |
| G, g | Conductance (real part of an admittance)      |
| H, h | Hybrid parameter                              |
| I, i | Current                                       |
| L    | Inductance                                    |
| P, p | Power                                         |
| R, r | Resistance (real part of an impedance)        |
| V, v | Voltage                                       |
| X, x | Reactance (imaginary part of an impedance)    |
| Y, y | Admittance                                    |
| Z, z | Impedance.                                    |

(1) For the purpose of this publication, the term 'electrical parameters' applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

## Video Transistors and Modules for Monitors

## General

**Subscripts**

Upper-case subscripts are used for the indication of:

- Continuous (DC) values (without signal), e.g.  $I_D$ ,  $I_B$
- Instantaneous total values, e.g.  $i_D$ ,  $i_B$
- Average total values, e.g.  $I_{D(AV)}$ ,  $I_{B(AV)}$
- Peak total values, e.g.  $I_{DM}$ ,  $I_{BM}$
- Root-mean-square total values, e.g.  $I_{D(RMS)}$ ,  $I_{B(RMS)}$

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

- Instantaneous values, e.g.  $i_b$
- Root-mean-square values, e.g.  $i_{d(rms)}$
- Peak values, e.g.  $i_{bm}$
- Average values, e.g.  $i_{d(av)}$

The following is a list of subscripts used with basic letter symbols for semiconductor devices:

|            |                                     |
|------------|-------------------------------------|
| A, a       | anode                               |
| amb        | ambient                             |
| (AV), (av) | average value                       |
| B, b       | base                                |
| (BO)       | breakover                           |
| (BR)       | breakdown                           |
| case       | case                                |
| C, c       | collector                           |
| C          | controllable                        |
| D, d       | drain                               |
| E, e       | emitter                             |
| F, f       | fall, forward (or forward transfer) |
| G, g       | gate                                |
| H          | holding                             |
| h          | heatsink                            |
| I, i       | input                               |
| j-a        | junction to ambient                 |
| j-mb       | junction to mounting base           |
| K, k       | cathode                             |
| L          | load                                |
| M, m       | peak value                          |
| (min)      | minimum                             |
| (max)      | maximum                             |
| mb         | mounting base                       |

|              |                                                                                                                                                                                                                   |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| O, o         | As first subscript: reverse (or reverse transfer), rise. As second subscript: repetitive, recovery. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal |
| (OV)         | Overload                                                                                                                                                                                                          |
| P, p         | Pulse                                                                                                                                                                                                             |
| Q, q         | Turn-off                                                                                                                                                                                                          |
| R, r         | As first subscript: reverse (or reverse transfer), rise. As second subscript: repetitive, recovery. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal |
| (RMS), (rms) | Root-mean-square value                                                                                                                                                                                            |
| S, s         | As first subscript: series, source, storage, stray, switching. As second subscript: surge (non-repetitive). As third subscript: short circuit between the terminal not mentioned and the reference terminal       |
| stg          | Storage                                                                                                                                                                                                           |
| th           | Thermal                                                                                                                                                                                                           |
| TO           | Threshold                                                                                                                                                                                                         |
| tot          | Total                                                                                                                                                                                                             |
| W            | Working                                                                                                                                                                                                           |
| X, x         | Specified circuit                                                                                                                                                                                                 |
| Z, z         | Reference or regulator (zener)                                                                                                                                                                                    |
| 1            | Input (four-pole matrix)                                                                                                                                                                                          |
| 2            | Output (four-pole matrix).                                                                                                                                                                                        |

**Applications and examples****TRANSISTOR CURRENTS**

The first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive).

Examples:  $I_D$ ,  $I_B$ ,  $i_D$ ,  $i_B$ ,  $i_d$ ,  $i_b$ ,  $I_{DM}$ ,  $i_{bm}$ .

**TRANSISTOR VOLTAGES**

A voltage is indicated by the first two subscripts: the first identifies the terminal at which the voltage is measured and the second the reference terminal or the circuit node. The second subscript may be omitted when there is no possibility of confusion.

Examples:  $V_{GS}$ ,  $V_{GS}$ ,  $V_{gs}$ ,  $V_{gsm}$ ,  $V_{BE}$ ,  $V_{BE}$ ,  $V_{be}$ ,  $V_{bem}$ .



## Video Transistors and Modules for Monitors

## General

## SUPPLY VOLTAGES OR CURRENTS

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

Examples:  $V_{DD}$ ,  $I_{SS}$ ,  $V_{CC}$ ,  $I_{EE}$ .

A reference terminal is indicated by a third subscript.

Example:  $V_{D DS}$ ,  $V_{C CE}$ .

## DEVICES WITH MORE THAN ONE TERMINAL OF THE SAME KIND

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal, followed by a number. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

|            |                                                                           |
|------------|---------------------------------------------------------------------------|
| $I_{D2}$   | Continuous (DC) current flowing into the second gate terminal             |
| $V_{B2-E}$ | Continuous (DC) voltage between the terminals of second base and emitter. |

## MULTIPLE DEVICES

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. Hyphens may be used to avoid confusion in multiple subscripts.

Examples:

|             |                                                                                    |
|-------------|------------------------------------------------------------------------------------|
| $I_{2B}$    | Continuous (DC) current flowing into the base terminal of the second unit          |
| $V_{1D-2D}$ | Continuous (DC) voltage between the drain terminals of the first and second units. |

## ELECTRICAL PARAMETERS

The upper-case variant of a subscript is used for the designation of static (DC) values.

Examples:

|          |                                                                                            |
|----------|--------------------------------------------------------------------------------------------|
| $g_{FS}$ | Static value of forward transconductance in common-source configuration (DC current gain)  |
| $h_{FE}$ | Static value of forward current transfer in common-emitter configuration (DC current gain) |
| $R_{DS}$ | DC value of the drain-source resistance.                                                   |
| $R_E$    | DC value of the external emitter resistance.                                               |

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

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

Examples:

|          |                                                                                                        |
|----------|--------------------------------------------------------------------------------------------------------|
| $g_{fs}$ | Small-signal value of the short-circuit forward transconductance in common-source configuration        |
| $h_{fe}$ | Small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration |

$Z_i = R_i + jX_i$  Small-signal value of the input impedance.

If more than one subscript is used, subscripts for which a choice of style is allowed, the subscripts chosen are all upper-case or all lower-case.

Examples:  $h_{FE}$ ,  $y_{RE}$ ,  $h_{fe}$ ,  $g_{FS}$ .

## FOUR-POLE MATRIX PARAMETERS

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

Examples:  $h_i$  (or  $h_{11}$ ),  $h_o$  (or  $h_{22}$ ),  $h_f$  (or  $h_{21}$ ),  $h_r$  (or  $h_{12}$ ).

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

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

## DISTINCTION BETWEEN REAL AND IMAGINARY PARTS

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

Examples:  $Z_i = R_i + jX_i$ ,  $y_{fe} = g_{fe} + jb_{fe}$ .

If such symbols do not exist or are not suitable, the notation shown in the following examples is used.

Examples:

$\text{Re}(h_{ib})$  etc. for the real part of  $h_{ib}$

$\text{Im}(h_{ib})$  etc. for the imaginary part of  $h_{ib}$ .

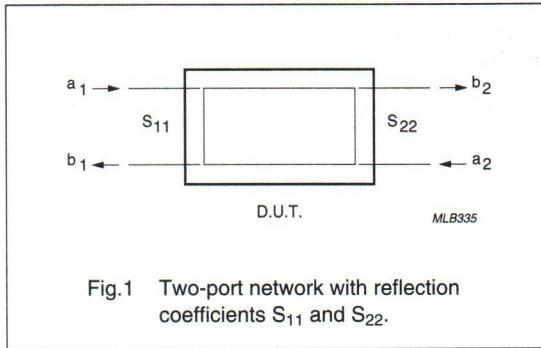


## Video Transistors and Modules for Monitors

## S-PARAMETER DEFINITIONS

The S-parameter symbols in this section are based on IEC publication 747-7.

S-parameters (return losses or reflection coefficients) of a module can be defined as the  $S_{11}$  and the  $S_{22}$  of a two-port network (see Fig.1).



$$b_1 = S_{11} \cdot a_1 + S_{12} \cdot a_2 \quad (1)$$

$$b_2 = S_{21} \cdot a_1 + S_{22} \cdot a_2 \quad (2)$$

where:

$$a_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 + Z_0 \cdot i_1) = \text{signal into port 1} \quad (3)$$

$$a_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 + Z_0 \cdot i_2) = \text{signal into port 2}$$

$$b_1 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_1 - Z_0 \cdot i_1) = \text{signal out port 1} \quad (4)$$

$$b_2 = \frac{1}{2 \cdot \sqrt{Z_0}} \cdot (V_2 - Z_0 \cdot i_2) = \text{signal out port 2}$$

From (1) and (2) formulae for the return losses can be derived:

$$S_{11} = \left. \frac{b_1}{a_1} \right|_{a_2 = 0} \quad (5)$$

$$S_{22} = \left. \frac{b_2}{a_2} \right|_{a_1 = 0} \quad (6)$$

In (5),  $a_2 = 0$  means output port terminated with  $Z_0$  (derived from formula (4)).

In (6),  $a_1 = 0$  means input port terminated with  $Z_0$  (derived from formula (3)).

## Measurement

The return losses are measured with a network analyzer after calibration, where the influence of the test jig is eliminated. The necessary termination of the other port with  $Z_0$  is done automatically by the network analyzer.

The network analyser must have a directivity of at least 40 dB to obtain an accuracy of 0.5 dB when measuring return loss figures of 20 dB. A full two-port correction method can be used to improve the accuracy.

### TAPE AND REEL PACKING

Tape and reel packing meets the feed requirements of automatic pick and place equipment (packing conforms to IEC publication 286-2 and 286-3). Additionally, the tape is an ideal shipping container.

#### Packing TO-92 (SOT54) leaded types

The transistors are supplied on tape in boxes (ammopack) or on reels. The number per reel and per ammpack is 2000. The ammpack has 80 layers of 25 transistors each. Each layer contains 25 transistors, plus one empty position in order to fold the layer correctly. The ammpack is accessible from both sides, enabling the user to choose between 'normal' (see Fig.3) and 'reverse' tape. 'Normal' is indicated by a plus sign (+) on the ammpack and 'reverse' by a minus sign (-). In the European version, the leading pin is the emitter.

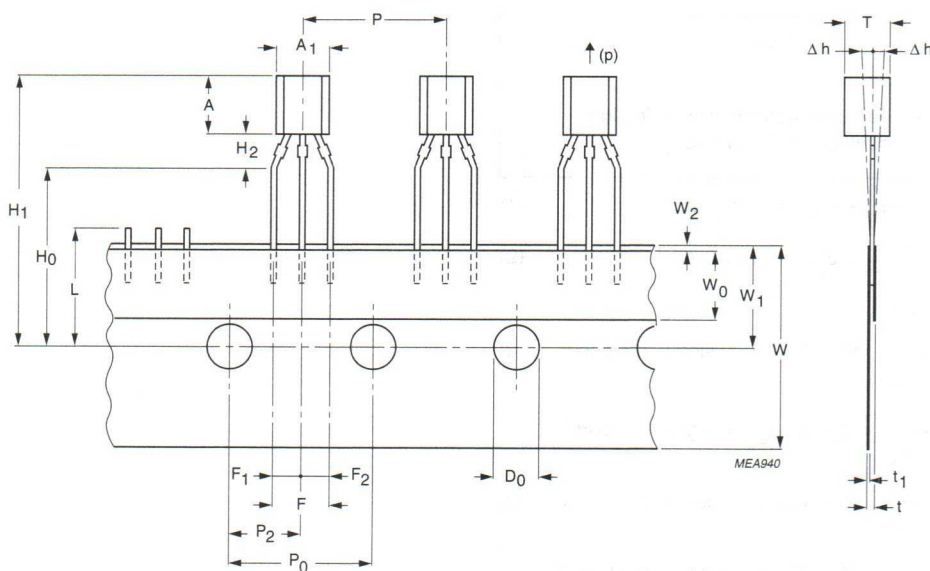


Fig.2 TO-92 (SOT54) transistors on tape.

## Video Transistors and Modules for Monitors

## General

**Table 1** Tape specification TO-92 (SOT54) leaded types

| SYMBOL                          | DIMENSION                            | SPECIFICATIONS |      |       |           |      | REMARKS                            |
|---------------------------------|--------------------------------------|----------------|------|-------|-----------|------|------------------------------------|
|                                 |                                      | MIN.           | NOM. | MAX.  | TOL.      | UNIT |                                    |
| A <sub>1</sub>                  | body width                           | 4              | —    | 4.8   | —         | mm   |                                    |
| A                               | body height                          | 4.8            | —    | 5.2   | —         | mm   |                                    |
| T                               | body thickness                       | 3.5            | —    | 3.9   | —         | mm   |                                    |
| P                               | pitch of component                   | —              | 12.7 | —     | ±1        | mm   |                                    |
| P <sub>0</sub>                  | feed hole pitch                      | —              | 12.7 | —     | ±0.3      | mm   |                                    |
|                                 | cumulative pitch error               | —              | —    | —     | ±0.1      |      | note 1                             |
| P <sub>2</sub>                  | feed hole centre to component centre | —              | 6.35 | —     | ±0.4      | mm   | to be measured at bottom of clinch |
| F                               | distance between outer leads         | —              | 5.08 | —     | +0.6/−0.2 | mm   |                                    |
| Δh                              | component alignment                  | —              | 0    | 1     | —         | mm   | at top of body                     |
| W                               | tape width                           | —              | 18   | —     | ±0.5      | mm   |                                    |
| W <sub>0</sub>                  | hold-down tape width                 | —              | 6    | —     | ±0.2      | mm   |                                    |
| W <sub>1</sub>                  | hole position                        | —              | 9    | —     | +0.7/−0.5 | mm   |                                    |
| W <sub>2</sub>                  | hold-down tape position              | —              | 0.5  | —     | ±0.2      | mm   |                                    |
| H <sub>0</sub>                  | lead wire clinch height              | —              | 16.5 | —     | ±0.5      | mm   |                                    |
| H <sub>1</sub>                  | component height                     | —              | —    | 23.25 | —         | mm   |                                    |
| L                               | length of snapped leads              | —              | —    | 11    | —         | mm   |                                    |
| D <sub>0</sub>                  | feed hole diameter                   | —              | 4    | —     | ±0.2      | mm   |                                    |
| t                               | total tape thickness                 | —              | —    | 1.2   | —         | mm   | t <sub>1</sub> = 0.3 to 0.6        |
| F <sub>1</sub> , F <sub>2</sub> | lead-to-lead distance                | —              | —    | —     | +0.4/−0.2 | mm   |                                    |
| H <sub>2</sub>                  | clinch height                        | —              | —    | —     | —         | mm   |                                    |
| (p)                             | pull-out force                       | 6              | —    | —     | —         | N    |                                    |

**Note**

1. Measured over 20 devices.

**Dropouts**

A maximum of 0.5% of the specified number of transistors in each packing may be missing. Up to 3 consecutive components may be missing provided the gap is followed by 6 consecutive components.

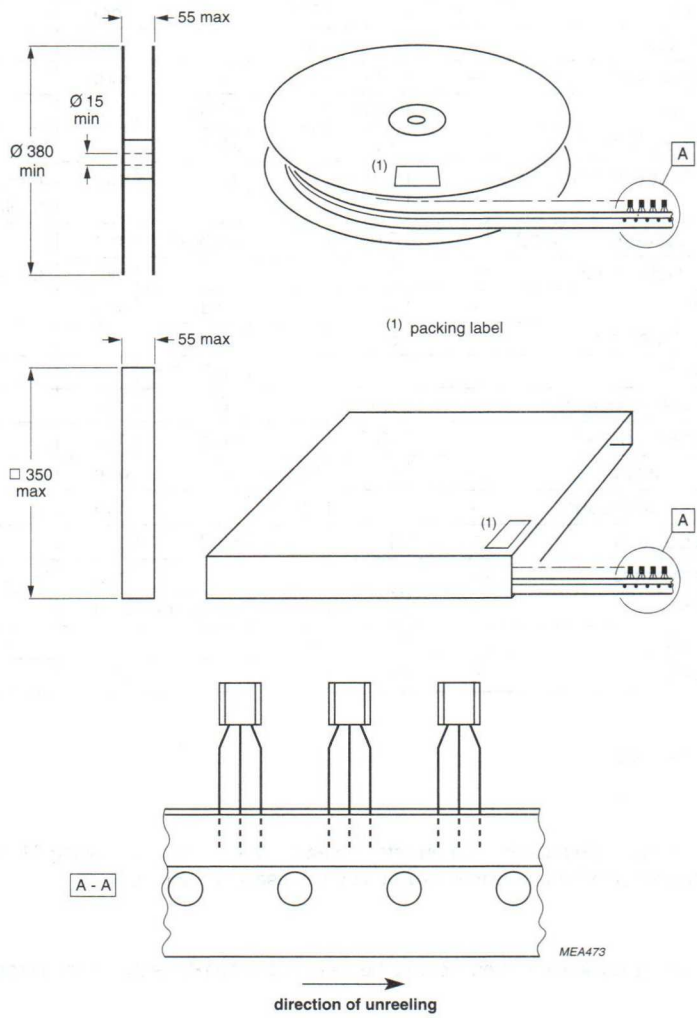
**Tape splicing**

Splice the carrier tape on the back and/or front so that the feed hole pitch (P<sub>0</sub>) is maintained (see Figs 2 and 4).

**Bulk packing**

In addition to TO-92 (SOT54) on tape, TO-92 can also be delivered in bulk. Products are packed in boxes in foil and plastic bags with 1000 pieces to a bag and 5 bags to a box.

As well as the standard TO-92 with straight leads (see Fig.5), leads with delta pinning are available in bulk, on request (see Fig.6).



Dimensions in mm.

Fig.3 Dimensions of reel and box.



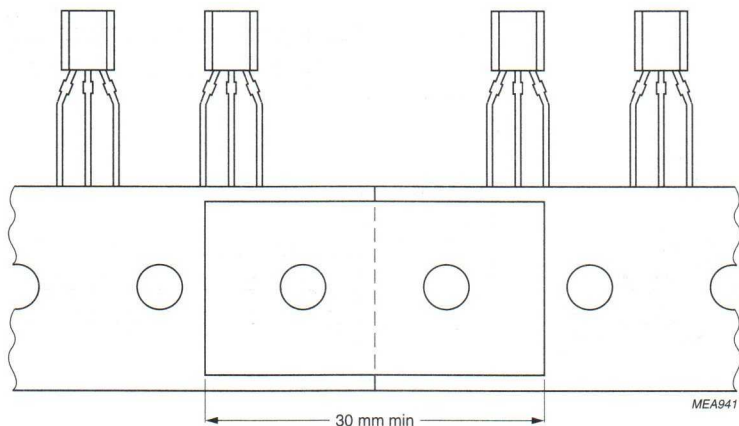
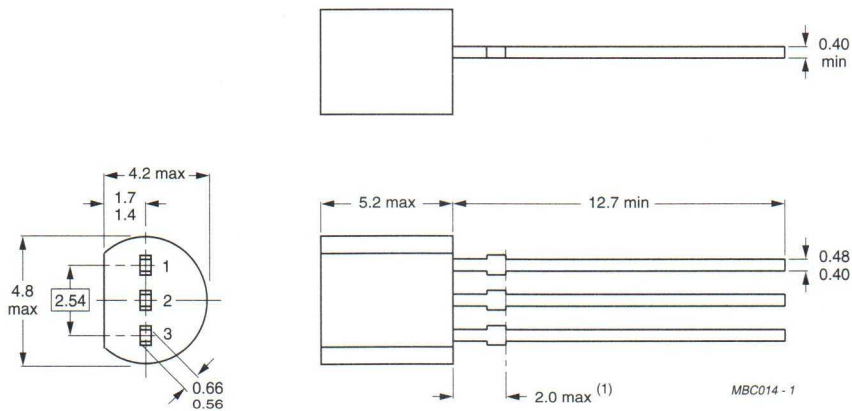


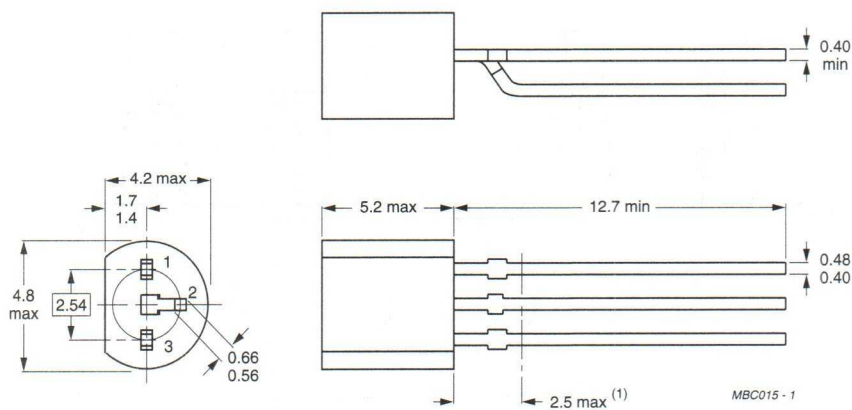
Fig.4 Joining tape with splicing patch.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.5 TO-92 (SOT54) with straight leads.



Dimensions in mm.

(1) Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

Fig.6 TO-92 (SOT54) with delta pinning.

Video Transistors and Modules for Monitors

General

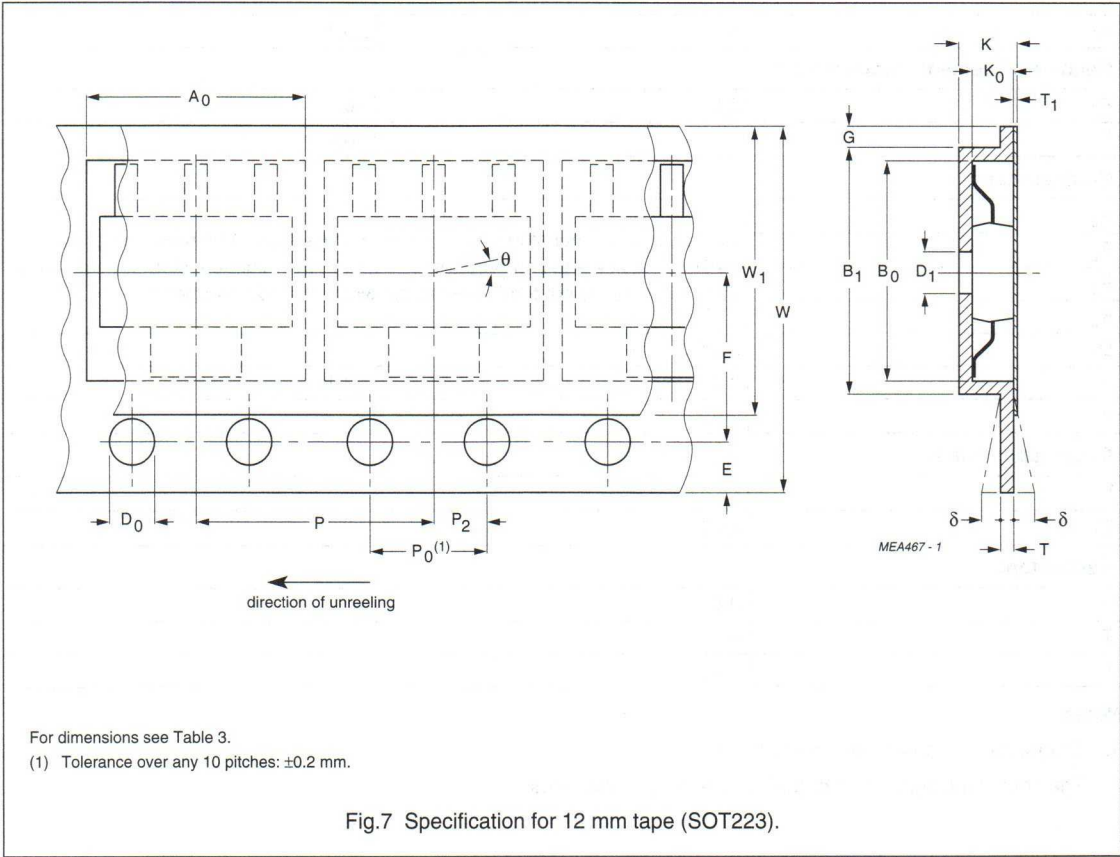
Packing SOT223

Table 2 Packing quantities per reel

| PACKAGE | TAPE WIDTH<br>(mm) | REEL SIZE<br>(mm) | QUANTITY PER<br>REEL | 12NC<br>(note 1)<br>ends with: |
|---------|--------------------|-------------------|----------------------|--------------------------------|
| SOT223  | 12                 | 180               | 3000                 | ...115                         |

Note

1. 12NC is the Philips twelve-digit ordering code.



## Video Transistors and Modules for Monitors

## General

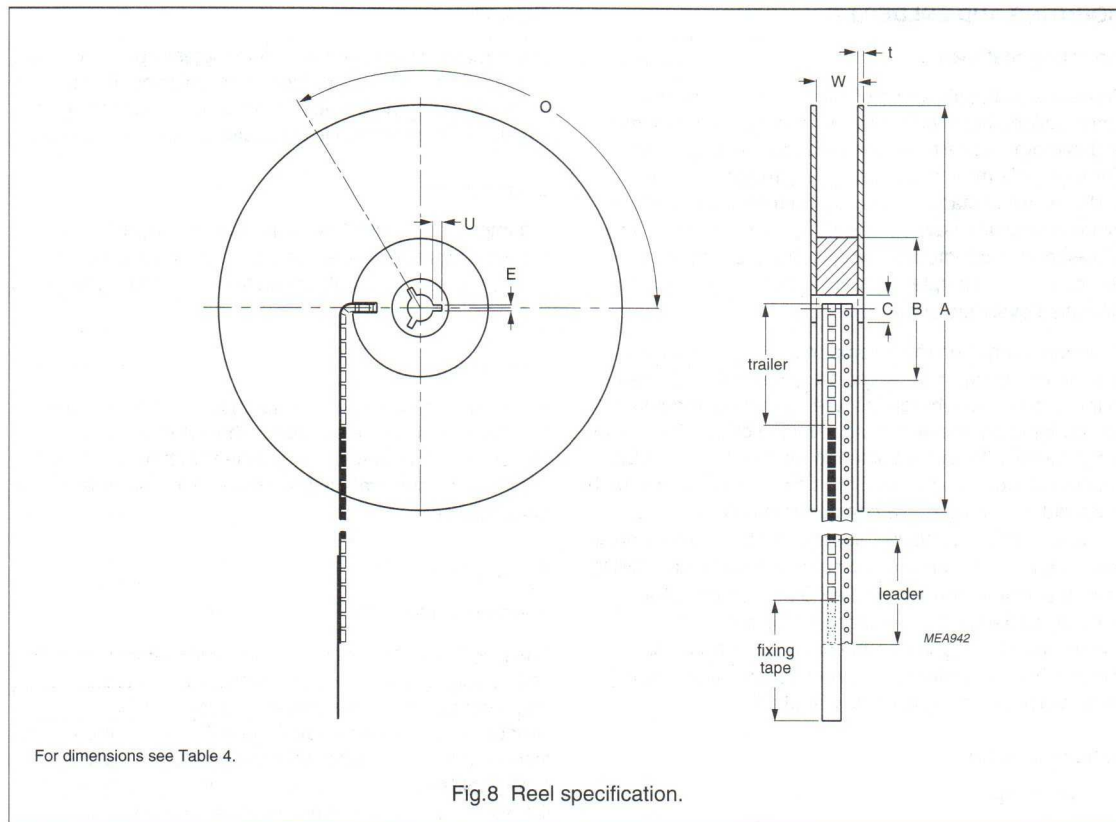
**Table 3** Tape dimensions (in mm)

| DIMENSION (Fig.7)                     | 12 mm CARRIER TAPE                                                                                                                                                                                         | TOLERANCE  |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>Overall dimensions</b>             |                                                                                                                                                                                                            |            |
| W                                     | 8.0                                                                                                                                                                                                        | $\pm 0.2$  |
| K                                     | $< 1.5$                                                                                                                                                                                                    | —          |
| G                                     | $> 0.75$                                                                                                                                                                                                   | —          |
| <b>Sprocket holes; note 1</b>         |                                                                                                                                                                                                            |            |
| D <sub>0</sub>                        | 1.5                                                                                                                                                                                                        | $+0.1/-0$  |
| E                                     | 1.75                                                                                                                                                                                                       | $\pm 0.1$  |
| P <sub>0</sub>                        | 4.0                                                                                                                                                                                                        | $\pm 0.1$  |
| <b>Relative placement compartment</b> |                                                                                                                                                                                                            |            |
| P <sub>2</sub>                        | 2.0                                                                                                                                                                                                        | $\pm 0.1$  |
| F                                     | 3.5                                                                                                                                                                                                        | $\pm 0.05$ |
| <b>Compartment</b>                    |                                                                                                                                                                                                            |            |
| A <sub>0</sub>                        | Compartment dimensions depend on package size. Maximum clearance between device and compartment is 0.3 mm; the minimum clearance ensures that the device is not totally restrained within the compartment. |            |
| B <sub>0</sub>                        |                                                                                                                                                                                                            |            |
| B <sub>1</sub>                        |                                                                                                                                                                                                            |            |
| K <sub>0</sub>                        |                                                                                                                                                                                                            |            |
| D <sub>1</sub>                        | $> 1.0$                                                                                                                                                                                                    | —          |
| P                                     | 4.0                                                                                                                                                                                                        | $\pm 0.1$  |
| $\theta$                              | $< 15^\circ$                                                                                                                                                                                               | —          |
| <b>Cover tape; note 2</b>             |                                                                                                                                                                                                            |            |
| W <sub>1</sub>                        | $< 5.4$                                                                                                                                                                                                    | —          |
| T <sub>1</sub>                        | $< 0.1$                                                                                                                                                                                                    | —          |
| <b>Carrier tape</b>                   |                                                                                                                                                                                                            |            |
| W                                     | 8.0                                                                                                                                                                                                        | $\pm 0.2$  |
| T                                     | $< 0.2$                                                                                                                                                                                                    | —          |
| $\delta$                              | $< 0.3$                                                                                                                                                                                                    | —          |

**Notes**

1. Tolerance over any 10 pitches  $\pm 0.2$  mm.
2. The cover tape shall not overlap the tape or sprocket holes.



**Table 4** Reel dimensions (in mm)

| DIMENSION (Fig.8) | 12 mm CARRIER TAPE | TOLERANCE      |
|-------------------|--------------------|----------------|
| <b>Flange</b>     |                    |                |
| A                 | 180 or 330; note 1 | $\pm 0.5$      |
| t                 | 1.5                | $+0.5/-0.1$    |
| W                 | 12.4               | $18.0 \pm 0.2$ |
| <b>Hub</b>        |                    |                |
| B                 | 62                 | $\pm 1.5$      |
| C                 | 12.75              | $+0.15/-0.2$   |
| <b>Key slot</b>   |                    |                |
| E                 | 2                  | $\pm 0.2$      |
| U                 | 4                  | $\pm 0.5$      |
| O                 | $120^\circ$        | —              |

**Note**

1. Large reel diameter depends on individual package (286 or 350).

## MOUNTING AND SOLDERING

### Mounting methods

There are two basic forms of electronic component construction, those with leads for through-hole mounting and microminiature types for surface mounting (SMD). Through-hole mounting gives a very rugged construction and uses well established soldering methods. Surface mounting has the advantages of high packing density plus high-speed automated assembly. Surface mounting techniques are complex and this chapter gives only a simplified overview of the subject.

Although many electronic components are available as surface mounting types, some are not and this often leads to the use of through-hole as well as surface mounting components on one substrate (a mixed print). The mix of components affects the soldering methods that can be applied. A substrate having SMDs mounted on one or both sides but no through-hole components is likely to be suitable for reflow or wave soldering. A double sided mixed print that has through-hole components and some SMDs on one side and densely packed SMDs on the other normally undergoes a sequential combination of reflow and wave soldering. When the mixed print has only through-hole components on one side and all SMDs on the other, wave soldering is usually applied.

### Reflow soldering

#### SOLDER PASTE

Most reflow soldering techniques utilize a paste that is a mixture of flux and solder. The solder paste is applied to the substrate before the components are placed. It is of sufficient viscosity to hold the components in place and, therefore, an application of adhesive is not required. Drying of the solder paste by preheating increases the viscosity and prevents any tendency for the components to become displaced during the soldering process. Preheating also minimizes thermal shock and drives off flux solvents.

#### Screen printing

This is the best high-volume production method of solder paste application. An emulsion-coated, fine mesh screen with apertures etched in the emulsion to coincide with the surfaces to be soldered is placed over the substrate. A squeegee is passed across the screen to force solder paste through the apertures and on to the substrate. The layer thickness of screened solder paste is usually between 150 and 200  $\mu\text{m}$ .

#### Stencilling

In this method a stencil with etched holes to pass the paste is used. The thickness of the stencil determines the amount of amount of solder paste that is deposited on the substrate. This method is also suited to high-volume work.

#### Dispensing

A computer-controlled pressure syringe dispenses small doses of paste to where it is required. This method is mainly suitable for small production runs and laboratory use.

#### Pin transfer

A pin picks up a droplet of solder paste from a reservoir and transfers it to the surface of the substrate or component. A multi-pin arrangement with pins positioned to match the substrate is possible and this speeds up the process time.

## REFLOW TECHNIQUES

### Thermal conduction

The prepared substrates are carried on a conveyor belt, first through a preheating stage and then through a soldering stage. Heat is transferred to the substrate by conduction through the belt. Figure 9 shows a theoretical time/temperature relationship for thermal conduction reflow soldering. This method is particularly suited to thick film substrates and is often combined with infrared heating.

### Infrared

An infrared oven has several heating elements giving a broad spectrum of infrared radiation, normally above and below a closed loop belt system. There are separate zones for preheating, soldering and cooling. Dwell time in the soldering zone is kept as short as possible to prevent damage to components and substrate. A typical heating profile is shown in Fig.10. This reflow method is often applied in double-sided prints.

### Vapour phase

A substrate is immersed in the vapours of a suitable boiling liquid. The vapours transfer latent heat of condensation to the substrate and solder reflow takes place. Temperature is controlled precisely by the boiling point of the liquid at a given pressure. Some systems employ two vapour zones, one above the other. An elevator tray, suspended from a hoist mechanism passes the substrate vertically through the first vapour zone into the secondary soldering zone

## Video Transistors and Modules for Monitors

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and then hoists it out of the vapour to be cooled. A theoretical time/temperature relationship for this method is shown in Fig.11.

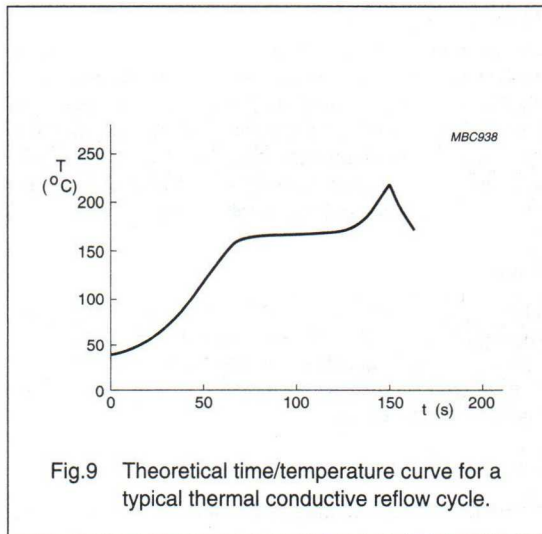


Fig.9 Theoretical time/temperature curve for a typical thermal conductive reflow cycle.

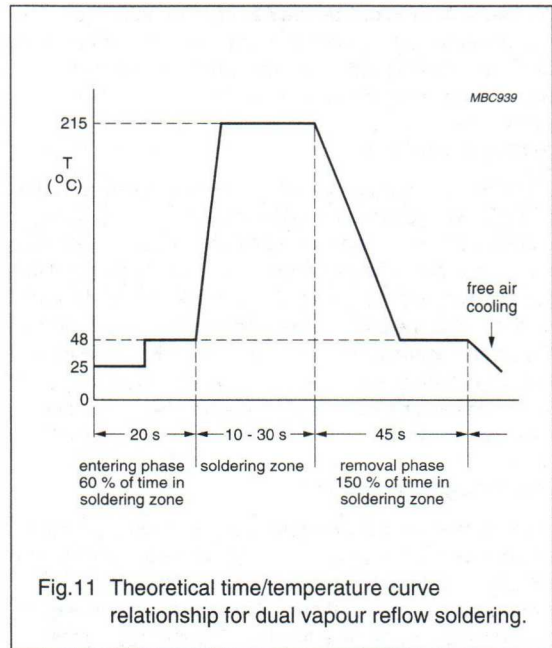


Fig.11 Theoretical time/temperature curve relationship for dual vapour reflow soldering.

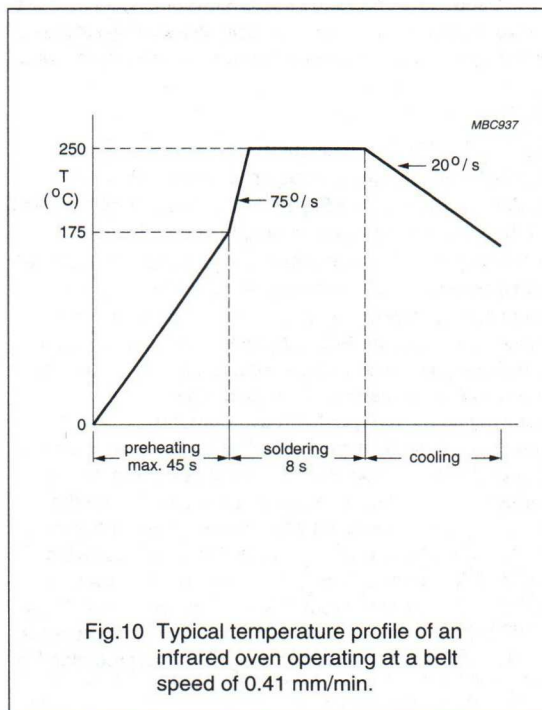


Fig.10 Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm/min.

### Wave soldering

This soldering technique is not recommended for SOT89.

### ADHESIVE APPLICATION

Since there are no connecting wires to retain them, leadless and short-leaded components are held in place with adhesive for wave soldering. A spot of adhesive is carefully placed between each SMD and the substrate. The adhesive is then heat-cured to withstand the forces of the soldering process, during which the components are fully immersed in solder. There are several methods of adhesive application.

### Pin transfer method

A pin is used to transfer a droplet of adhesive from a reservoir to a precise position on the surface where it is required. The size of the droplet depends on pin diameter, depth to which the pin is dipped in the reservoir, rheology of the adhesive, and the temperature of adhesive and surrounds. The pin can be part of a pin array (bed of nails) that corresponds exactly with the required adhesive positions on the substrate. With this method, adhesive can be applied to the whole of one side of a substrate in one operation and is therefore suitable for high-volume production and can be used with pre-loaded mixed prints.



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Alternatively, pins can be used to transfer adhesive to the components before they are placed on the substrate. This adds flexibility to production runs where variations in layout must be accommodated.

### *Screen printing method*

A fine mesh screen is coated with emulsion except in the positions where the adhesive is required to pass. The screen is placed on the substrate and a squeegee passing across it forces adhesive through the uncoated parts of the screen. The amount of adhesive printed-through depends on the size of the uncoated screen areas, the thickness of the screen coating, the rheology of the adhesive and various machine parameters. With this method, the substrate must be flat and pre-loaded mixed prints cannot be accommodated.

### *Pressure syringe method*

A computer-controlled syringe dispenses adhesive from an enclosed reservoir by means of pulses of compressed air. The adhesive dot size depends on the size of the syringe nozzle, the duration and pressure of the pulsed air and the viscosity of the adhesive. This method is most suited to low volume production. An advantage is the flexibility provided by computer programmability.

### FLUXING

The quality of the soldered connections between components and substrate is critical for circuit performance and reliability. Flux promotes solderability of the connecting surfaces and is chosen for the following attributes:

- Removal of surface oxides
- Prevention of reoxidation
- Transference of heat from source to joint area
- Residue that is non-corrosive or, if residue is corrosive, should be easy to clean away after soldering
- Ability to improve wettability (readiness of a metal surface to form an alloy at its interface with the solder) to ensure strong joints with low electrical resistance
- Suitability for the desired method of flux application.

In wave soldering, liquified flux is usually applied as a foam, a spray or in a wave.

### *Foam*

Flux foam is made by forcing low-pressure, water-free clean air through an aerator immersed in liquid flux. Fine bubbles of flux are directed onto the substrate/component

surfaces where they burst and form a thin, even layer. The flux also penetrates any plated-through holes. The flux has to be chosen for its foaming capabilities.

### *Spray*

Several methods of spray fluxing exist, the most common involves a mesh drum rotating in liquid flux. Air is blown into the drum which, when passing through the fine mesh, directs a spray of flux onto the underside of the substrate. The amount of flux deposited is controllable by the speed of the substrate passing through the spray, the speed of rotation of the drum and the density of the flux.

### *Wave*

A wave fluxer creates a double flowing wave of liquid flux which adheres to the surface as the substrate passes through. Wave height control is essential and a soft wipe-off brush is usually incorporated to remove excess flux from the substrate.

### PRE-HEATING

Pre-heating of the substrate and components is performed immediately before soldering. This reduces thermal shock as the substrate enters the soldering process, causes the flux to become more viscous and accelerates the chemical action of the flux and so speeds up the soldering action.

### SOLDERING

Wave soldering is usually the best method to use when high throughput rates are required. The single wave soldering principle (see Fig. 13) is the most straight forward method and can be used on simple substrates with two-terminal SMD components. More complex substrates with increased circuit density and closer spacing of conductors can pose the problems of nonwetting (dry joints) and solder bridging. Bridging can occur across the closely spaced leads of multi-leaded devices as well as across adjacent leads on neighbouring components. Nonwetting is usually caused by components with plastic bodies. The plastic is not wetted by solder and creates a depression in the solder wave, which is augmented by surface tension. This can cause a shadow behind the component and prevent solder from reaching the joint surfaces. A smooth laminar solder wave is required to avoid bridging and a high pressure wave is needed to completely cover the areas that are difficult to wet. These conflicting demands are difficult to attain in a single wave but dual wave techniques go a long way in overcoming the problem.



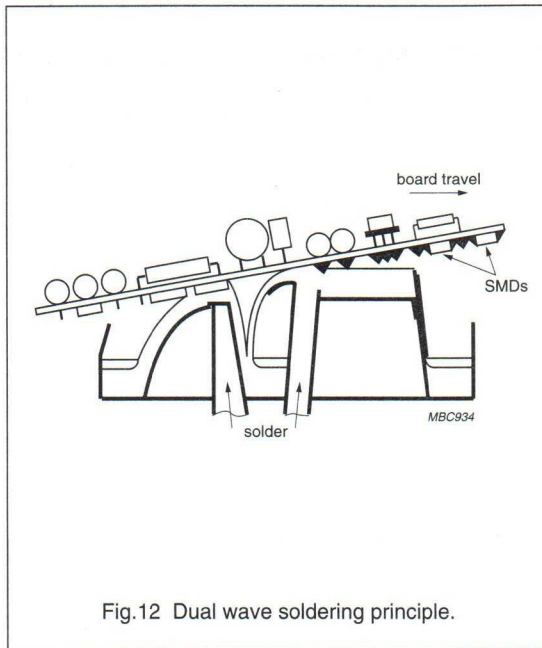


Fig.12 Dual wave soldering principle.

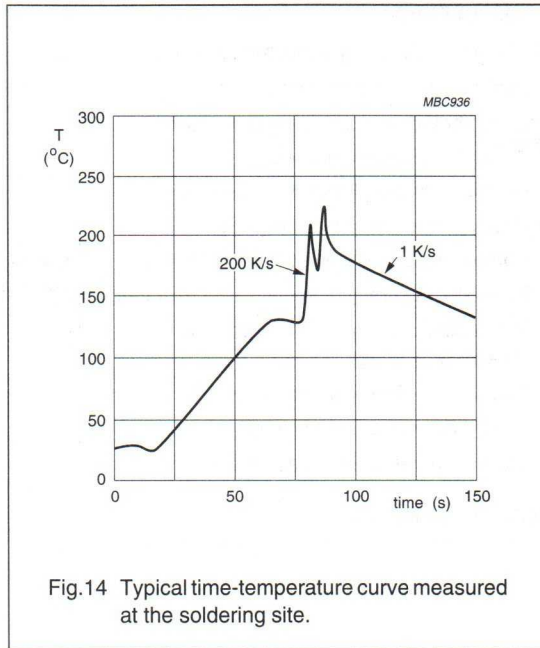


Fig.14 Typical time-temperature curve measured at the soldering site.

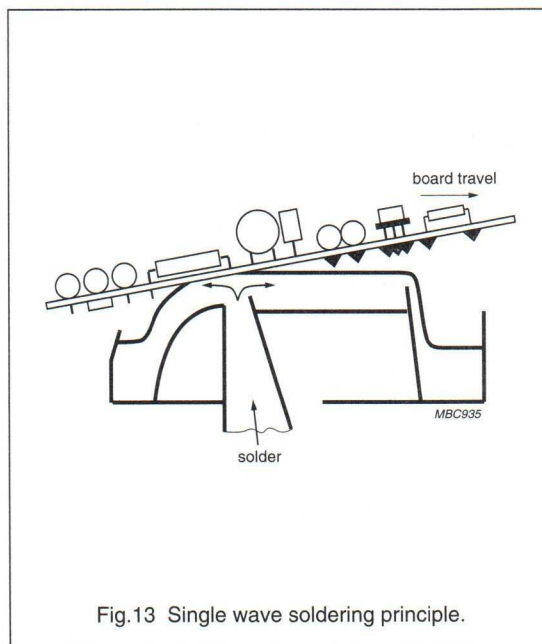


Fig.13 Single wave soldering principle.

New methods of wave soldering are developing continually. For example, the Omega System is a single wave agitated by pulses, which combines the functions of smoothness and turbulence. In another, a lambda wave injects air bubbles in the final part of the wave. A further innovation is the hollow jet wave in which the solder wave flows in the opposite direction to the substrate.

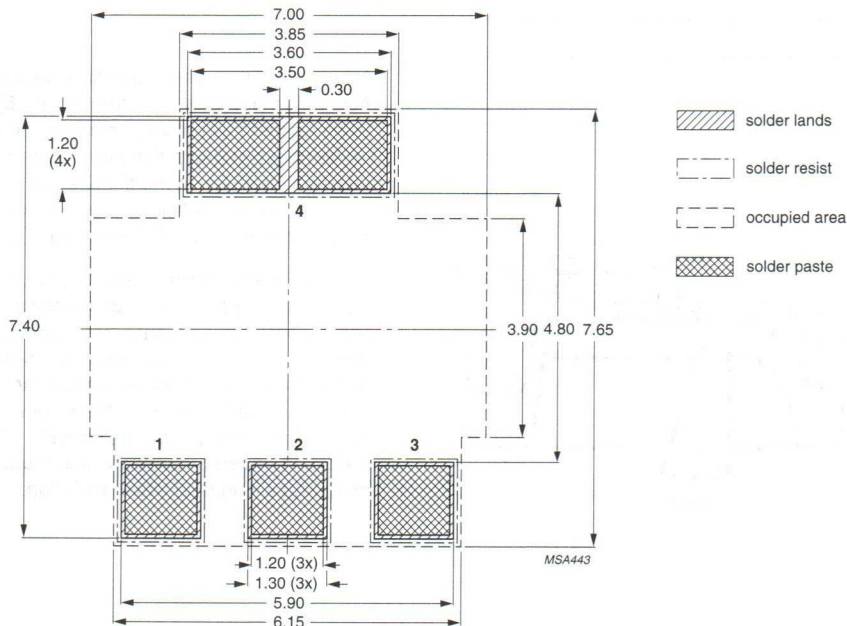
In a dual wave machine (see Fig.12), the substrate first comes into contact with a turbulent wave which has a high vertical velocity. This ensures good solder contact with both edges of the components and prevents joints from being missed. The second smooth laminar wave completes the formation of the solder fillet, removes excess solder and prevents bridging. Figure 14 indicates the time/temperature relationship measured at the soldering site in dual wave soldering.

### Footprint design

The footprint design of a component for surface mounting is influenced by many factors:

- Features of the component, its dimensions and tolerances
- Circuit board manufacturing processes
- Desired component density
- Minimum spacing between components
- Circuit tracks under the component
- Component orientation (if wave soldering)
- Positional accuracy of solder resist to solder lands
- Positional accuracy of solder paste to solder lands (if reflow soldering)
- Component placement accuracy
- Soldering process parameters
- Solder joint reliability parameters.

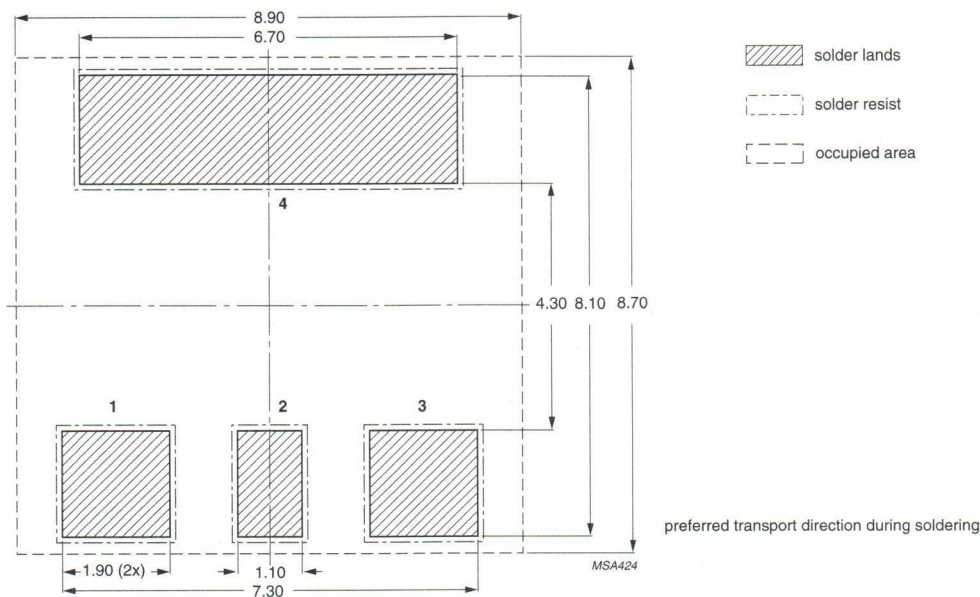
### SOT223 FOOTPRINTS



Dimensions in mm.

Placement accuracy:  $\pm 0.25$  mm.

Fig.15 Reflow soldering footprint for SOT223; typical dimensions.



Dimensions in mm.  
Placement accuracy:  $\pm 0.25$  mm.

Fig.16 Wave soldering footprint for SOT223; typical dimensions.

### Hand soldering microminiature components

It is possible to solder microminiature components with a light-weight hand-held soldering iron, but this method has obvious drawbacks and should be restricted to laboratory use and/or incidental repairs on production circuits:

- Hand-soldering is time-consuming and therefore expensive.
- The component cannot be positioned accurately and the connecting tags may come into contact with the substrate and damage it.
- There is a risk of breaking the substrate and internal connections in the component could be damaged.
- The component package could be damaged by the iron.

### THERMAL CONSIDERATIONS

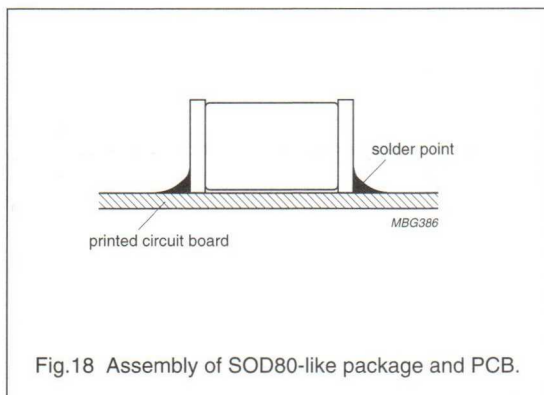
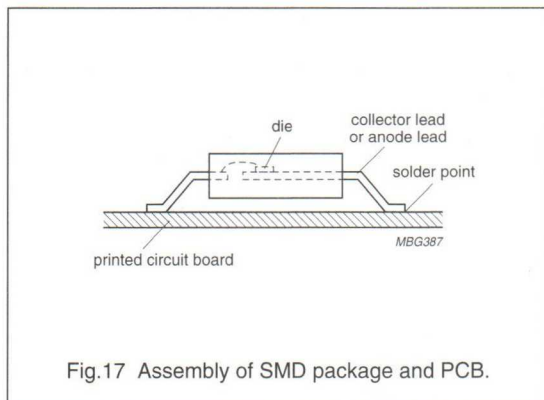
#### Thermal resistance

Circuit performance and long-term reliability are affected by the temperature of the transistor die. Normally, both are improved by keeping the die temperature (junction temperature) low.

Electrical power dissipated in any semiconductor device is a source of heat. This increases the temperature of the die above a certain reference point. The most relevant reference point of the semiconductor device is the soldering point (i.e. the point on the printed-circuit board where the collector lead is soldered to a heat-draining point see Figs 17 and 18).

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## General



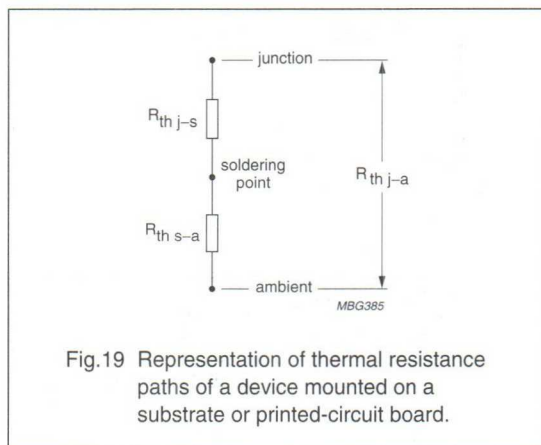
The temperature rise as a function of dissipation power, 'thermal resistance', is given in the data sheets as the  $R_{th(j-s)}$  value. The heat is drained by conduction via the leadframe, soldering point and substrate (printed-circuit board) to ambient. The amount of radiated and convected heat is negligible in comparison to the conducted heat.

The elements of thermal resistance are defined as follows:

|               |                                                           |
|---------------|-----------------------------------------------------------|
| $P_d$         | Power dissipation (W)                                     |
| $R_{th(j-s)}$ | Thermal resistance from junction to soldering point (K/W) |
| $R_{th(s-a)}$ | Thermal resistance from soldering point to ambient (K/W)  |
| $R_{th(j-a)}$ | Thermal resistance from junction to ambient (K/W)         |
| $T_j$         | Junction temperature of the die (°C)                      |
| $T_s$         | Soldering point temperature (°C)                          |
| $T_{amb}$     | Ambient temperature (°C)                                  |
| $T_{ref}$     | Temperature of the reference point (°C)                   |

The peak temperature of the die depends on the ability of the package and its mounting to transfer heat from this die to ambient environment (see Fig.19). The basic relationship between die temperature (junction temperature) and power dissipation is:

$$T_{j(max)} = T_{amb} + P_{d(max)} \times [R_{th(j-s)} + R_{th(s-a)}]$$



#### Thermal resistance from junction to soldering point [ $R_{th(j-s)}$ ]

In the example for  $T_{j(max)}$ , only  $T_{amb}$  and  $R_{th(s-a)}$  can be varied by the user. The construction of the printed-circuit board (PCB) and the ambient condition (as there is air flow) affect  $R_{th(s-a)}$ . The device power dissipation can be controlled to a limited extent, under recommended usage. The supply voltage and circuit loading dictate a fixed power maximum. The  $R_{th(j-s)}$  value is essentially independent of external mounting method and cooling air, but is sensitive to the materials used in the package construction, the die mount and the die area, all of which are fixed.

Values of  $T_{j(max)}$  and  $R_{th(j-s)}$ , or  $R_{th(j-c)}$  are given in the device data sheets. For applications where  $T_s$  is known,  $T_j$  can be calculated from:

$$T_j = T_s + P_d \times R_{th(j-s)}$$

#### Thermal resistance from soldering point to ambient [ $R_{th(s-a)}$ ]

There is a limiting value for the soldering point temperature. For the normal tin alloy (Sn-Pb 60%-40%):  $T_{s(max)} = 110^\circ\text{C}$ . The value of  $T_s$  can be calculated from:

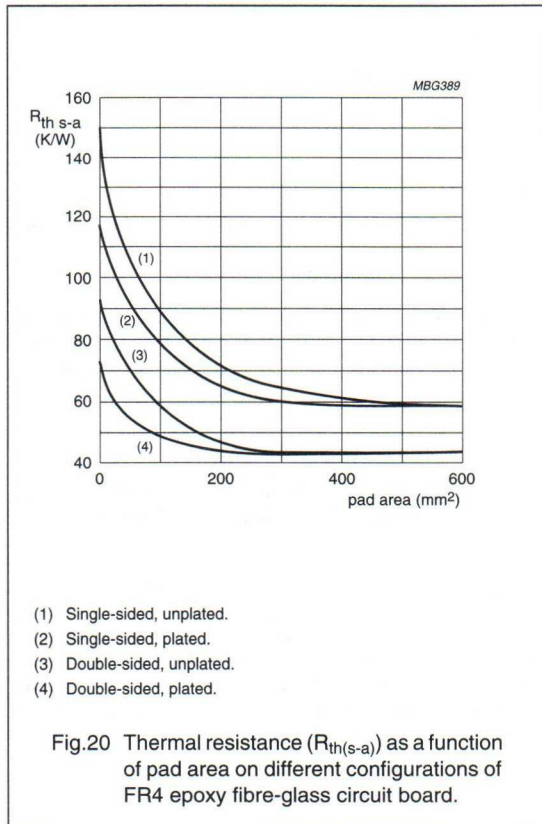
$$T_s = T_a + P_d \times R_{th(s-a)}$$



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The thermal resistance from soldering point to ambient depends on the shape and material of the tracks on a printed-circuit board as illustrated in Fig.20.



## Temperature calculation under pulsed conditions

In pulsed power conditions, the peak temperature of the die depends on the pulse time and duty factor as well as the ability of the package and its mounting to disperse heat.

When power is applied in repetitive square-wave pulses with a certain duty factor ( $\delta$ ), the variation in junction temperature has a sawtooth characteristic.

The average steady-state junction temperature is:

$$T_{j(av)} = T_{ref} + \delta \times P_d \times R_{th(j-ref)}$$

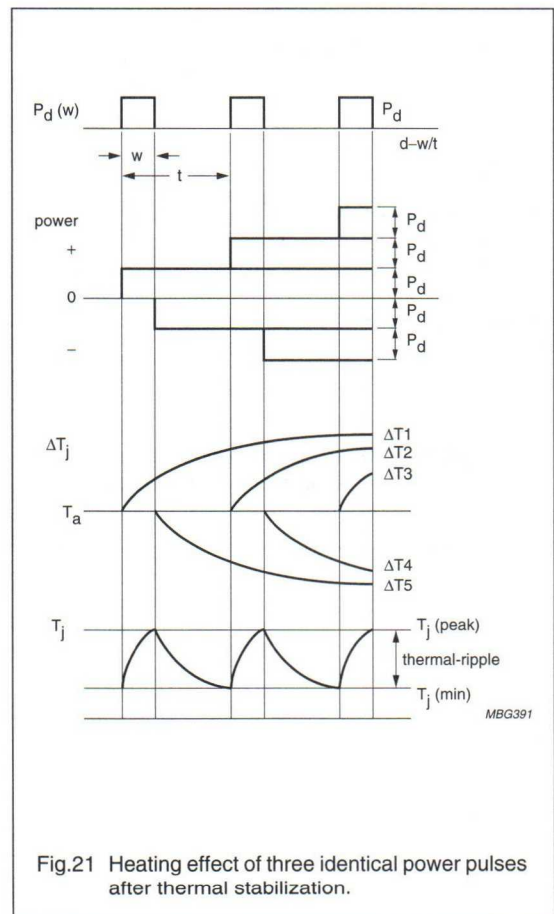
The peak junction temperature, however, is the most relevant to performance reliability. This can be calculated by heating and cooling step functions that result in heating and cooling curves shifted in time as shown in Fig.21.

The peak value of  $T_j$  is reached at the end of a power pulse and the minimum value immediately before the next power pulse. The thermal ripple is the difference between  $T_{j(peak)}$  and  $T_{j(min)}$ .

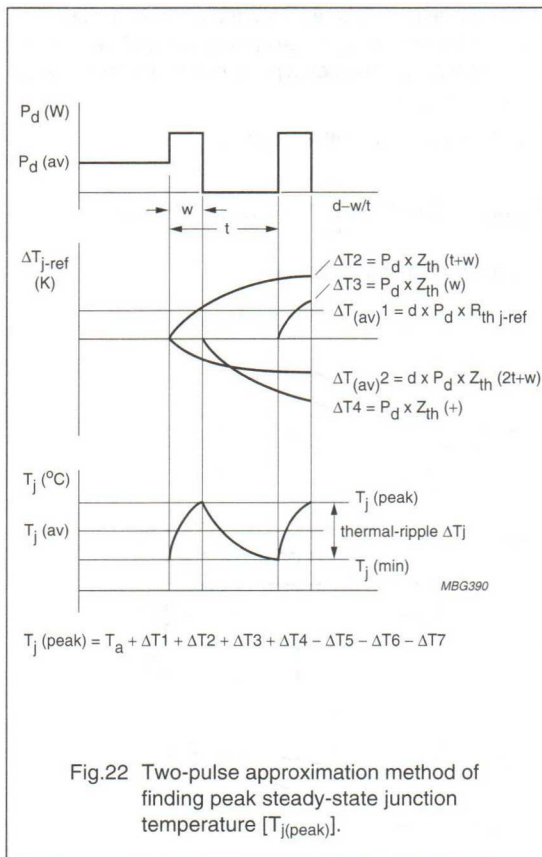
Calculation of  $T_{j(peak)}$  after  $n$  pulses:

$$T_{j(peak)} = T_{ref} + P_d \times \sum_{a=0}^{a=n-1} [Z_{th(at-w)} - Z_{th(at)}]$$

where  $a$  is an integer number.

Approximation method of finding  $T_{j(peak)}$ 

With this method it is assumed that the average load is immediately followed by two square power pulses as shown in Fig.22. This two-pulse approximation method is accurate enough for finding  $T_{j(peak)}$ .



The junction temperature at the end of the second pulse is:

$$T_{j(\text{peak})} = T_{\text{ref}} + P_d \times [\delta \times R_{\text{th}(j-\text{ref})} + (1 - \delta) \times Z_{\text{th}(t+w)} + Z_{\text{th}(w)} - Z_{\text{th}(t)}]$$

The junction temperature immediately before the second power pulse is:

$$T_{j(\text{min})} = T_{\text{ref}} + P_d \times [\delta \times R_{\text{th}(j-\text{ref})} + (1 - \delta) \times Z_{\text{th}(t)} + Z_{\text{th}(w)} - Z_{\text{th}(t-w)}]$$

The thermal ripple is:

$$\Delta T_j = T_{j(\text{peak})} - T_{j(\text{min})}$$

$$\Delta T_j = P_d \times [\delta \times (Z_{\text{th}(t)} - Z_{\text{th}(t+w)}) - 2 \times Z_{\text{th}(t)} + Z_{\text{th}(w)} + Z_{\text{th}(t-w)}]$$

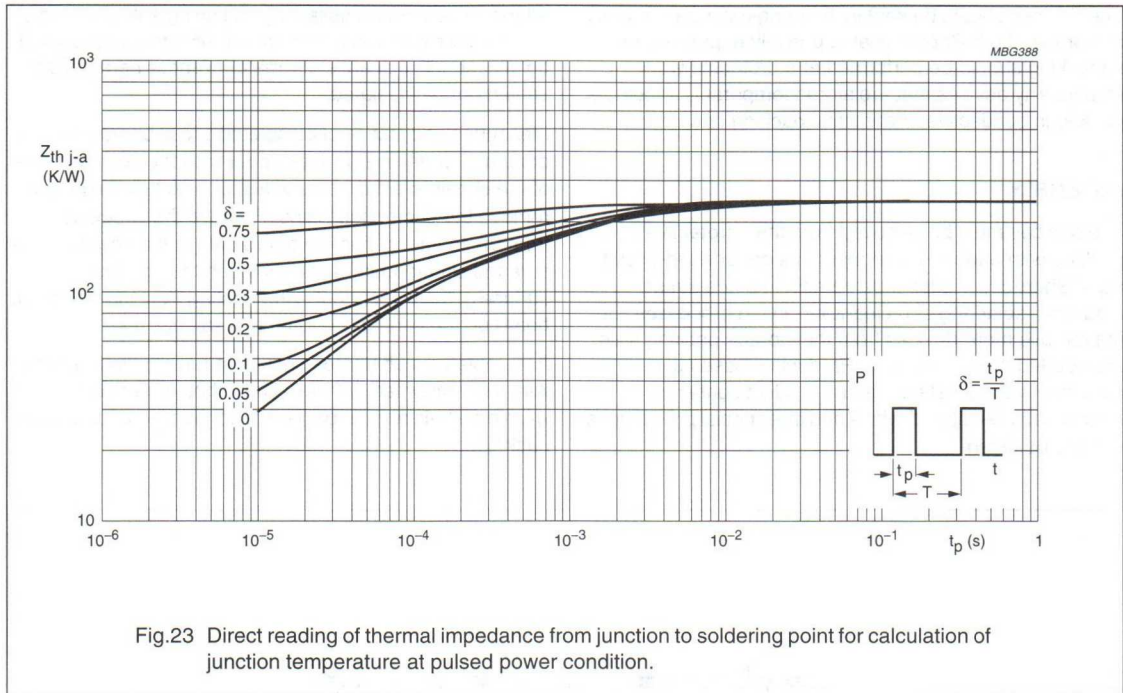
### Reducing calculation time

To be able to point out the junction peak temperature at a certain pulse time and duty cycle, a graph similar to that shown in Fig.23 is included in relevant data sheets. In this example, the curves have been derived using the formula  $T_{j(\text{peak})} = T_{\text{ref}} + P_d \times [\delta \times R_{\text{th}(j-\text{ref})} + (1 - \delta) \times Z_{\text{th}(t+w)} + Z_{\text{th}(w)} - Z_{\text{th}(t)}]$ , with typical values inserted.

The pulse width along the X-axis meets a particular duty cycle curve, indicating the  $Z_{\text{th}}$  value in K/W along the Y-axis.

$$T_{j(\text{peak})} = P_{d(\text{peak})} \times Z_{\text{th}(j-s)} + P_{d(\text{av})} \times R_{\text{th}(s-a)} + T_a \text{ (°C)}$$

Soldering point temperature provides a better reference point than ambient temperature as this is subject to many uncontrolled variables. Therefore, the thermal resistance from junction to soldering point  $[R_{\text{th}(j-s)}]$  is becoming a more relevant measurement path.



## ELECTROSTATIC CHARGES

Electrostatic charges can exist in many things; for example, man-made-fibre clothing, moving machinery, objects with air blowing across them, plastic storage bins, sheets of paper stored in plastic envelopes, paper from electrostatic copying machines, and people. The charges are caused by friction between two surfaces, at least one of which is non-conductive. The magnitude and polarity of the charges depend on the different affinities for electrons of the two materials rubbing together, the friction force and the humidity of the surrounding air.

Electrostatic discharge is the transfer of an electrostatic charge between bodies at different potentials and occurs with direct contact or when induced by an electrostatic field. Our devices **can** be damaged if the following precautions are not taken.

## WORK STATION

Figure 24 shows a working area suitable for safely handling electrostatic sensitive devices. It has a work bench, the surface of which is conductive or covered by an antistatic sheet.

Typical resistivity for the bench surface is between 1 and 500 k $\Omega$  per cm<sup>2</sup>. The floor should also be covered with antistatic material.

The following precautions should be observed:

- Persons at a work bench should be earthed via a wrist strap and a resistor.
- All mains-powered electrical equipment should be connected via an earth leakage switch.
- Equipment cases should be earthed.
- Relative humidity should be maintained between 50 and 65%.
- An ionizer should be used to neutralize objects with immobile static charges.

## RECEIPT AND STORAGE

Our devices are packed for dispatch in antistatic/conductive containers, usually boxes, tubes or blister tape. The fact that the contents are sensitive to electrostatic discharge is shown by warning labels on both primary and secondary packing.



## Video Transistors and Modules for Monitors

## General

The devices should be kept in their original packing whilst in storage. If a bulk container is partially unpacked, the unpacking should be performed at a protected work station. Any devices that are stored temporarily should be packed in conductive or antistatic packing or carriers.

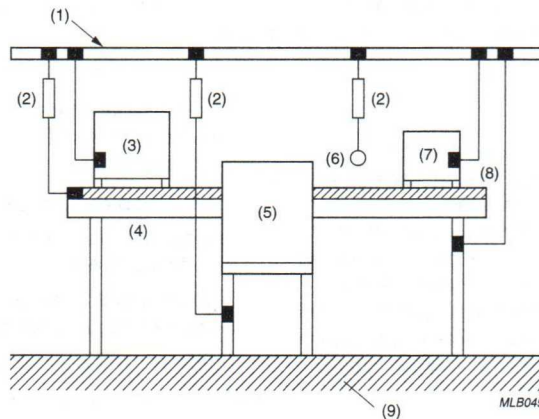
**ASSEMBLY**

The devices must be removed from their protective packing with earthed component pincers or short-circuit clips. Short-circuit clips must remain in place during mounting, soldering and cleansing/drying processes. Do not remove more devices from the storage packing than are needed at any one time. Production/assembly documents should state that the product contains electrostatic sensitive devices and that special precautions need to be taken.

All tools used during assembly, including soldering tools and solder baths, must be earthed. All hand tools should be of conductive or antistatic material and, where possible, should not be insulated.

Measuring and testing of completed circuit boards must be done at a protected work station. Place the soldered side of the circuit board on conductive or antistatic foam and remove the short-circuit clips. Remove the circuit board from the foam, holding the board only at the edges. Make sure the circuit board does not touch the conductive surface of the work bench. After testing, replace the circuit board on the conductive foam to await packing.

Assembled circuit boards should be handled in the same way as unmounted devices. They should also carry warning labels and be packed in conductive or antistatic packing.



- (1) Earthing rail.
- (2) Resistor ( $500\text{ k}\Omega \pm 10\%$ , 0.5 W).
- (3) Ionizer.
- (4) Work bench.
- (5) Chair.
- (6) Wrist strap.
- (7) Electrical equipment.
- (8) Conductive surface/antistatic sheet.
- (9) Antistatic floor.

Fig.24 Protected work station.



## APPLICATION INFORMATION



## Video Transistors and Modules for Monitors

## Application notes

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The following application notes are available:

1. "Video Amplifiers for VGA/XGA Monitors, with BFQ235A"; reference number ETV93001; release date 08 February 1993.
2. "OSD Update Video Amplifiers for VGA/XGA Monitors, with BFQ235A"; reference number ETV/AN93019; release date 13 September 1993.
3. "NEW BFQ Video Transistors for VGA/XGA Monitors, with BFQ 131, 221, 241, 225, 245, 162, 222, 242, 166, 226, 246"; reference number AN95046; release date 29 June 1995.
4. "Video Output Amplifiers for Colour Monitors, with BFQ and BFV transistors, BFQ221, 222, 225, 226, 241, 246, and BFV 420, 421, 469"; reference number AN97001; release date 06 February 1997.
5. "Video Amplifier Board with TDA4885 and CR1296"; reference number AN96074; release date 20 August 1996.
6. "Video Amplifier Board with TDA4885 and CR6927"; reference number AN97039; release date 15 July 1997.

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## **DEVICE DATA**

in alphanumeric sequence

NPN high-voltage transistors

BF420; BF422

FEATURES

- Low feedback capacitance.

APPLICATIONS

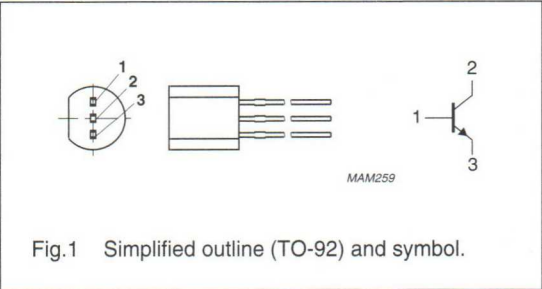
- Class-B video output stages in colour television and professional monitor equipment.

DESCRIPTION

NPN transistors in a TO-92 plastic package.  
PNP complements: BF421 and BF423.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                     | MIN. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                   | —    | 300  | V    |
|           | BF420                     |                                                                |      | 250  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                      | —    | 300  | V    |
|           | BF422                     |                                                                |      | 250  | V    |
| $I_{CM}$  | peak collector current    |                                                                | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                      | —    | 830  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = 25\text{ mA}; V_{CE} = 20\text{ V}$                     | 50   | —    |      |
| $C_{re}$  | feedback capacitance      | $I_C = i_c = 0; V_{CE} = 30\text{ V}; f = 1\text{ MHz}$        | —    | 1.6  | pF   |
| $f_T$     | transition frequency      | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$ | 60   | —    | MHz  |

## NPN high-voltage transistors

## BF420; BF422

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                           | MIN. | MAX. | UNIT |
|-----------|-------------------------------|--------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                         |      |      |      |
|           | BF420                         |                                      | –    | 300  | V    |
|           | BF422                         |                                      | –    | 250  | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                            |      |      |      |
|           | BF420                         |                                      | –    | 300  | V    |
|           | BF422                         |                                      | –    | 250  | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector                       | –    | 5    | V    |
| $I_C$     | collector current (DC)        |                                      | –    | 50   | mA   |
| $I_{CM}$  | peak collector current        |                                      | –    | 100  | mA   |
| $I_{BM}$  | peak base current             |                                      | –    | 50   | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ ; note 1 | –    | 830  | mW   |
| $T_{stg}$ | storage temperature           |                                      | –65  | +150 | °C   |
| $T_j$     | junction temperature          |                                      | –    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                                      | –65  | +150 | °C   |

## Note

1. Transistor mounted on a printed-circuit board.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 150   | K/W  |

## Note

1. Transistor mounted on a printed-circuit board.

## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL      | PARAMETER                            | CONDITIONS                                                           | MIN. | MAX. | UNIT |
|-------------|--------------------------------------|----------------------------------------------------------------------|------|------|------|
| $I_{CBO}$   | collector cut-off current            |                                                                      |      |      |      |
|             |                                      | $I_E = 0$ ; $V_{CB} = 200\text{ V}$                                  | –    | 10   | nA   |
|             |                                      | $I_E = 0$ ; $V_{CB} = 200\text{ V}$ ; $T_j = 150\text{ °C}$          | –    | 10   | μA   |
| $I_{EBO}$   | emitter cut-off current              | $I_C = 0$ ; $V_{EB} = 5\text{ V}$                                    | –    | 50   | nA   |
| $h_{FE}$    | DC current gain                      | $I_C = 25\text{ mA}$ ; $V_{CE} = 20\text{ V}$                        | 50   | –    |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 30\text{ mA}$ ; $I_B = 5\text{ mA}$                           | –    | 0.6  | V    |
| $C_{re}$    | feedback capacitance                 | $I_C = I_C = 0$ ; $V_{CE} = 30\text{ V}$ ; $f = 1\text{ MHz}$        | –    | 1.6  | pF   |
| $f_T$       | transition frequency                 | $I_C = 10\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 100\text{ MHz}$ | 60   | –    | MHz  |

PNP high-voltage transistors

BF421; BF423

FEATURES

- Low feedback capacitance.

APPLICATIONS

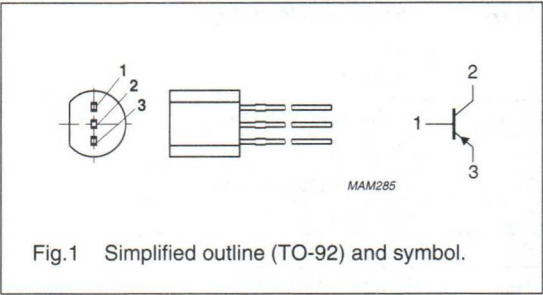
- Class-B video output stages in colour television and professional monitor equipment.

DESCRIPTION

PNP transistors in a TO-92 plastic package.  
NPN complements: BF420 and BF422.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                       | MIN. | MAX. | UNIT |
|-----------|---------------------------|------------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                     |      |      |      |
|           | BF421                     |                                                                  | –    | –300 | V    |
|           | BF423                     |                                                                  | –    | –250 | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                        |      |      |      |
|           | BF421                     |                                                                  | –    | –300 | V    |
|           | BF423                     |                                                                  | –    | –250 | V    |
| $I_{CM}$  | peak collector current    |                                                                  | –    | –100 | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                        | –    | 830  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = -25\text{ mA}; V_{CE} = -20\text{ V}$                     | 50   | –    |      |
| $C_{re}$  | feedback capacitance      | $I_C = i_c = 0; V_{CE} = -30\text{ V}; f = 1\text{ MHz}$         | –    | 1.6  | pF   |
| $f_T$     | transition frequency      | $I_C = -10\text{ mA}; V_{CE} = -10\text{ V}; f = 100\text{ MHz}$ | 60   | –    | MHz  |



## PNP high-voltage transistors

## BF421; BF423

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                           | MIN. | MAX. | UNIT |
|-----------|-------------------------------|--------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                         |      |      |      |
|           | BF421                         |                                      | –    | –300 | V    |
|           | BF423                         |                                      | –    | –250 | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                            |      |      |      |
|           | BF421                         |                                      | –    | –300 | V    |
|           | BF423                         |                                      | –    | –250 | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector                       | –    | –5   | V    |
| $I_C$     | collector current (DC)        |                                      | –    | –50  | mA   |
| $I_{CM}$  | peak collector current        |                                      | –    | –100 | mA   |
| $I_{BM}$  | peak base current             |                                      | –    | –50  | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ ; note 1 | –    | 830  | mW   |
| $T_{stg}$ | storage temperature           |                                      | –65  | +150 | °C   |
| $T_j$     | junction temperature          |                                      | –    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                                      | –65  | +150 | °C   |

## Note

1. Transistor mounted on a printed-circuit board.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 150   | K/W  |

## Note

1. Transistor mounted on a printed-circuit board.

## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL      | PARAMETER                            | CONDITIONS                                                             | MIN. | MAX. | UNIT |
|-------------|--------------------------------------|------------------------------------------------------------------------|------|------|------|
| $I_{CBO}$   | collector cut-off current            | $I_E = 0$ ; $V_{CB} = -200\text{ V}$                                   | –    | –10  | nA   |
|             |                                      | $I_E = 0$ ; $V_{CB} = -200\text{ V}$ ; $T_j = 150\text{ °C}$           | –    | –10  | μA   |
| $I_{EBO}$   | emitter cut-off current              | $I_C = 0$ ; $V_{EB} = -5\text{ V}$                                     | –    | –50  | nA   |
| $h_{FE}$    | DC current gain                      | $I_C = -25\text{ mA}$ ; $V_{CE} = -20\text{ V}$                        | 50   | –    |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = -30\text{ mA}$ ; $I_B = -5\text{ mA}$                           | –    | –0.6 | V    |
| $C_{re}$    | feedback capacitance                 | $I_C = I_C = 0$ ; $V_{CE} = -30\text{ V}$ ; $f = 1\text{ MHz}$         | –    | 1.6  | pF   |
| $f_T$       | transition frequency                 | $I_C = -10\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; $f = 100\text{ MHz}$ | 60   | –    | MHz  |

NPN 4 GHz wideband transistor

BFG35

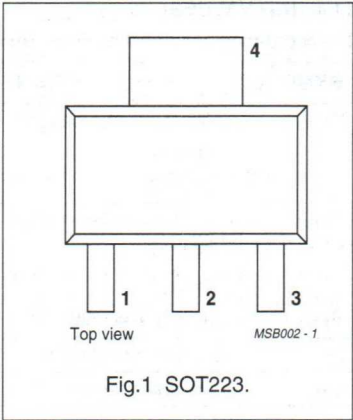
DESCRIPTION

NPN planar epitaxial transistor mounted in a plastic SOT223 envelope, intended for wideband amplifier applications. It features high output voltage capabilities.

PNP complement is the BFG55.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                     | CONDITIONS                                                                                                                                                                        | MIN. | TYP. | MAX. | UNIT |
|-----------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CEO}$ | collector-emitter voltage     | open base                                                                                                                                                                         | –    | –    | 18   | V    |
| $I_C$     | DC collector current          |                                                                                                                                                                                   | –    | –    | 150  | mA   |
| $P_{tot}$ | total power dissipation       | up to $T_s = 135\text{ }^{\circ}\text{C}$ (note 1)                                                                                                                                | –    | –    | 1    | W    |
| $h_{FE}$  | DC current gain               | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$                                                                                               | 25   | 70   | –    |      |
| $f_T$     | transition frequency          | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                    | –    | 4    | –    | GHz  |
| $G_{UM}$  | maximum unilateral power gain | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                    | –    | 15   | –    | dB   |
|           |                               | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 800\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                    | –    | 11   | –    | dB   |
| $V_o$     | output voltage                | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $d_{im} = -60\text{ dB}$ ; $R_L = 75\text{ }\Omega$ ; $f_{(p+q-r)} = 793.25\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$ | –    | 750  | –    | mV   |

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT               |
|-----------|---------------------------|----------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       | –    | 25   | V                  |
| $V_{CEO}$ | collector-emitter voltage | open base                                          | –    | 18   | V                  |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | –    | 2    | V                  |
| $I_C$     | DC collector current      |                                                    | –    | 150  | mA                 |
| $P_{tot}$ | total power dissipation   | up to $T_s = 135\text{ }^{\circ}\text{C}$ (note 1) | –    | 1    | W                  |
| $T_{stg}$ | storage temperature       |                                                    | –65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature      |                                                    | –    | 175  | $^{\circ}\text{C}$ |

Note

1.  $T_s$  is the temperature at the soldering point of the collector tab.

## NPN 4 GHz wideband transistor

BFG35

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                 | VALUE | UNIT |
|---------------|-----------------------------------------------------|--------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 135\ ^\circ\text{C}$ (note 1) | 40    | K/W  |

## Note

- $T_s$  is the temperature at the soldering point of the collector tab.

## CHARACTERISTICS

$T_j = 25\ ^\circ\text{C}$  unless otherwise specified.

| SYMBOL    | PARAMETER                                  | CONDITIONS                                                                                                   | MIN. | TYP. | MAX. | UNIT          |
|-----------|--------------------------------------------|--------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $I_{CBO}$ | collector cut-off current                  | $I_E = 0$ ; $V_{CB} = 10\ \text{V}$                                                                          | —    | —    | 1    | $\mu\text{A}$ |
| $h_{FE}$  | DC current gain                            | $I_C = 100\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$                                                             | 25   | 70   | —    |               |
| $C_C$     | collector capacitance                      | $I_E = I_E = 0$ ; $V_{CB} = 10\ \text{V}$ ; $f = 1\ \text{MHz}$                                              | —    | 2    | —    | pF            |
| $C_e$     | emitter capacitance                        | $I_C = I_C = 0$ ; $V_{EB} = 0.5\ \text{V}$ ; $f = 1\ \text{MHz}$                                             | —    | 10   | —    | pF            |
| $C_{re}$  | feedback capacitance                       | $I_C = 0$ ; $V_{CE} = 10\ \text{V}$ ; $f = 1\ \text{MHz}$                                                    | —    | 1.2  | —    | pF            |
| $f_T$     | transition frequency                       | $I_C = 100\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ;<br>$f = 500\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ | —    | 4    | —    | GHz           |
| $G_{UM}$  | maximum unilateral power gain<br>(note 1)  | $I_C = 100\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ;<br>$f = 500\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ | —    | 15   | —    | dB            |
|           |                                            | $I_C = 100\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ;<br>$f = 800\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ | —    | 11   | —    | dB            |
| $V_o$     | output voltage                             | note 2                                                                                                       | —    | 750  | —    | mV            |
|           |                                            | note 3                                                                                                       | —    | 800  | —    | mV            |
| $d_2$     | second order intermodulation<br>distortion | note 4                                                                                                       | —    | −55  | —    | dB            |
|           |                                            | note 5                                                                                                       | —    | −57  | —    | dB            |

## Notes

- $G_{UM}$  is the maximum unilateral power gain, assuming  $S_{12}$  is zero and  $G_{UM} = 10 \log \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}\ \text{dB}$ .
- $d_{im} = -60\ \text{dB}$  (DIN 45004B);  $I_C = 100\ \text{mA}$ ;  $V_{CE} = 10\ \text{V}$ ;  $R_L = 75\ \Omega$ ;  $T_{amb} = 25\ ^\circ\text{C}$   
 $V_p = V_o$  at  $d_{im} = -60\ \text{dB}$ ;  $f_p = 795.25\ \text{MHz}$ ;  
 $V_q = V_o - 6\ \text{dB}$ ;  $f_q = 803.25\ \text{MHz}$ ;  
 $V_r = V_o - 6\ \text{dB}$ ;  $f_r = 805.25\ \text{MHz}$ ;  
measured at  $f_{(p+q-r)} = 793.25\ \text{MHz}$ .
- $d_{im} = -60\ \text{dB}$  (DIN 45004B);  $I_C = 100\ \text{mA}$ ;  $V_{CE} = 10\ \text{V}$ ;  $R_L = 75\ \Omega$ ;  $T_{amb} = 25\ ^\circ\text{C}$   
 $V_p = V_o$  at  $d_{im} = -60\ \text{dB}$ ;  $f_p = 445.25\ \text{MHz}$ ;  
 $V_q = V_o - 6\ \text{dB}$ ;  $f_q = 453.25\ \text{MHz}$ ;  
 $V_r = V_o - 6\ \text{dB}$ ;  $f_r = 455.25\ \text{MHz}$ ;  
measured at  $f_{(p+q-r)} = 443.25\ \text{MHz}$ .
- $I_C = 60\ \text{mA}$ ;  $V_{CE} = 10\ \text{V}$ ;  $R_L = 75\ \Omega$ ;  
 $V_p = V_q = V_o = 50\ \text{dBmV}$ ;  
 $f_{(p+q)} = 450\ \text{MHz}$ ;  $f_p = 50\ \text{MHz}$ ;  $f_q = 400\ \text{MHz}$ .
- $I_C = 60\ \text{mA}$ ;  $V_{CE} = 10\ \text{V}$ ;  $R_L = 75\ \Omega$ ;  
 $V_p = V_q = V_o = 50\ \text{dBmV}$ ;  
 $f_{(p+q)} = 810\ \text{MHz}$ ;  $f_p = 250\ \text{MHz}$ ;  $f_q = 560\ \text{MHz}$ .



# NPN 4 GHz wideband transistor

BFG35

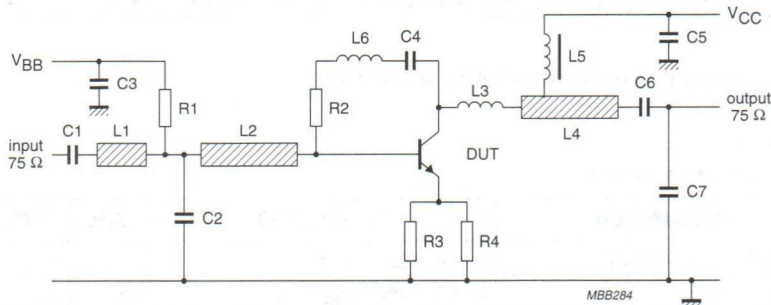


Fig.2 Intermodulation and second harmonic test circuit.

## List of components (see test circuit)

| DESIGNATION    | DESCRIPTION                       | VALUE  | DIMENSIONS                            | CATALOGUE NO.  |
|----------------|-----------------------------------|--------|---------------------------------------|----------------|
| C1, C3, C5, C6 | multilayer ceramic capacitor      | 10 nF  |                                       | 2222 590 08627 |
| C2, C7         | multilayer ceramic capacitor      | 1 pF   |                                       | 2222 851 12108 |
| C4 (note 1)    | miniature ceramic plate capacitor | 10 nF  |                                       | 2222 629 08103 |
| L1             | microstripline                    | 75 Ω   | length 7mm;<br>width 2.5 mm           |                |
| L2             | microstripline                    | 75 Ω   | length 22mm;<br>width 2.5 mm          |                |
| L3 (note 1)    | 1.5 turns 0.4 mm copper wire      |        | int. dia. 3 mm;<br>winding pitch 1 mm |                |
| L4             | microstripline                    | 75 Ω   | length 19 mm;<br>width 2.5 mm         |                |
| L5             | Ferroxcube choke                  | 5 μH   |                                       | 3122 108 20153 |
| L6 (note 1)    | 0.4 mm copper wire                | ≈25 nH | length 30 mm                          |                |
| R1             | metal film resistor               | 10 kΩ  |                                       | 2322 180 73103 |
| R2 (note 1)    | metal film resistor               | 200 Ω  |                                       | 2322 180 73201 |
| R3, R4         | metal film resistor               | 27 Ω   |                                       | 2322 180 73279 |

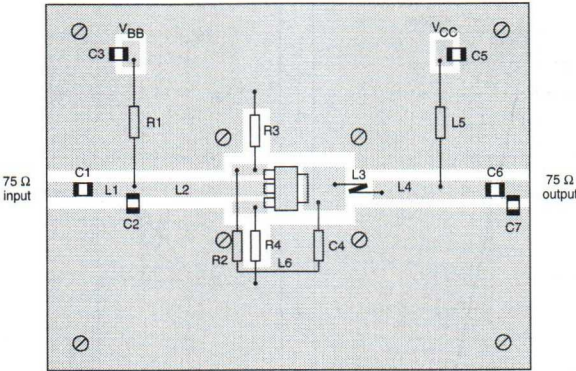
## Notes

- Components C4, L3, L6 and R2 are mounted on the underside of the PCB.  
The circuit is constructed on a double copper-clad printed circuit board with PTFE dielectric ( $\epsilon_r = 2.2$ ); thickness  $\frac{1}{16}$  inch; thickness of copper sheet  $\frac{1}{32}$  inch.

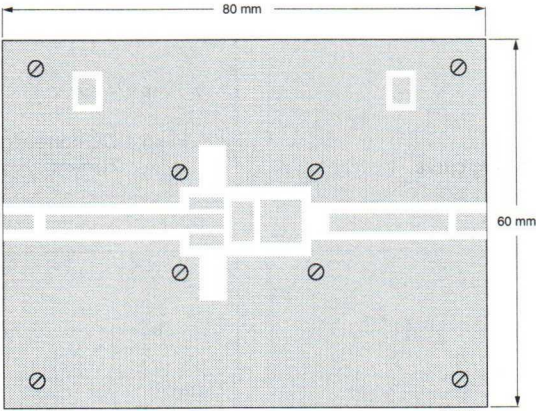


NPN 4 GHz wideband transistor

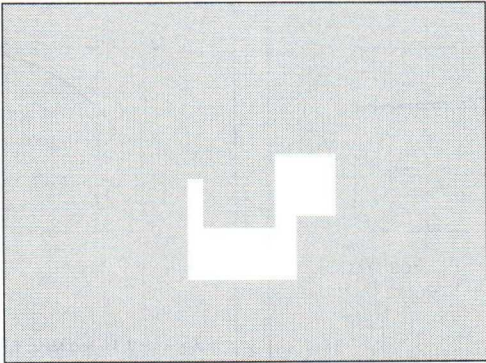
BFG35



MBB299



MBB298



MBB297

Fig.3 Intermodulation test circuit printed circuit board.

## NPN 4 GHz wideband transistor

BFG35

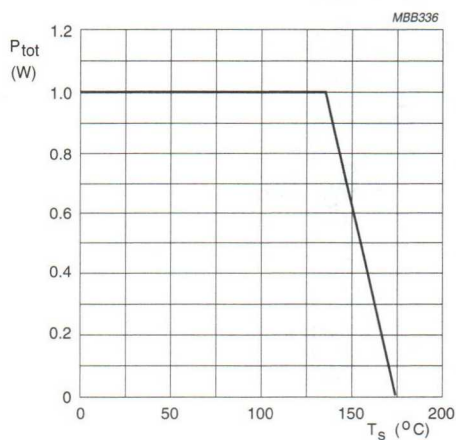


Fig.4 Power derating curve.

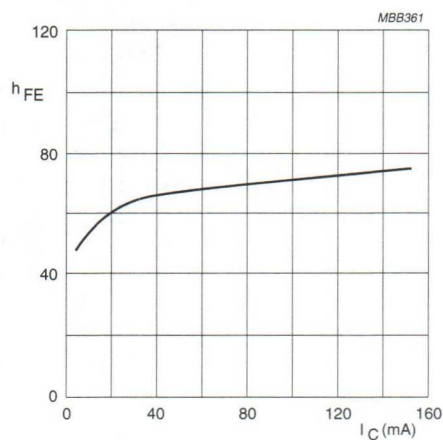
 $V_{CE} = 10$  V;  $T_j = 25$  °C.

Fig.5 DC current gain as a function of collector current.

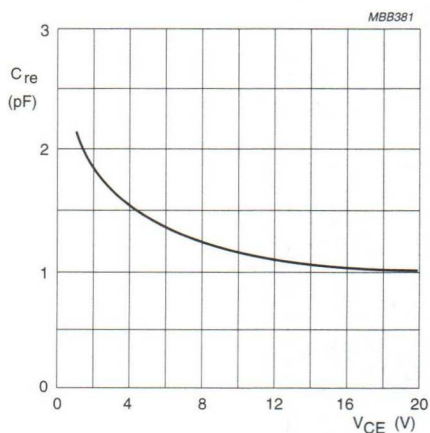
 $I_E = 0$ ;  $f = 1$  MHz;  $T_j = 25$  °C.

Fig.6 Feedback capacitance as a function of collector-emitter voltage.

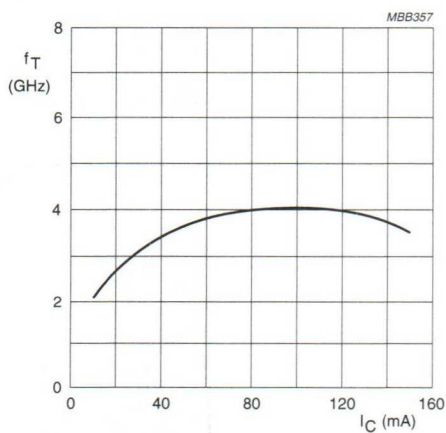
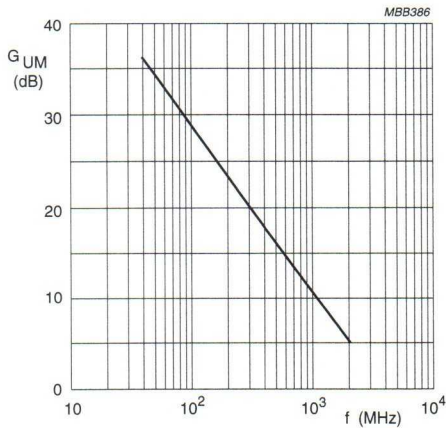
 $V_{CE} = 10$  V;  $f = 500$  MHz;  $T_j = 25$  °C

Fig.7 Transition frequency as a function of collector current.

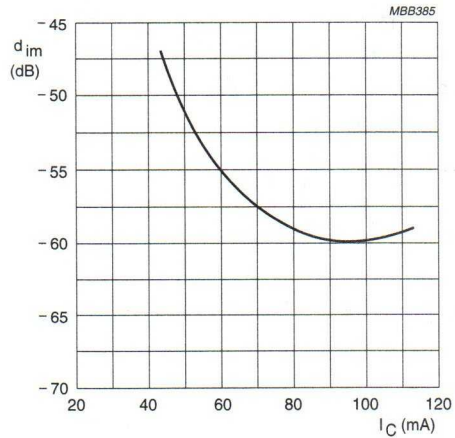
## NPN 4 GHz wideband transistor

BFG35



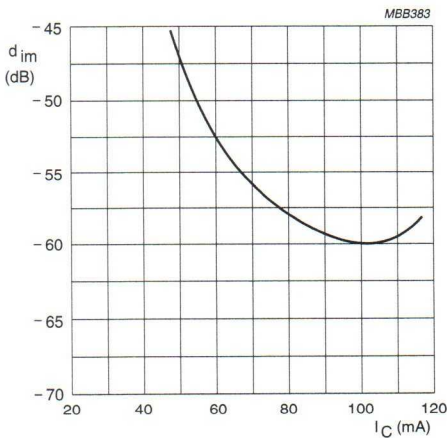
$I_C = 100$  mA;  $V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.8 Maximum unilateral power gain as a function of frequency.



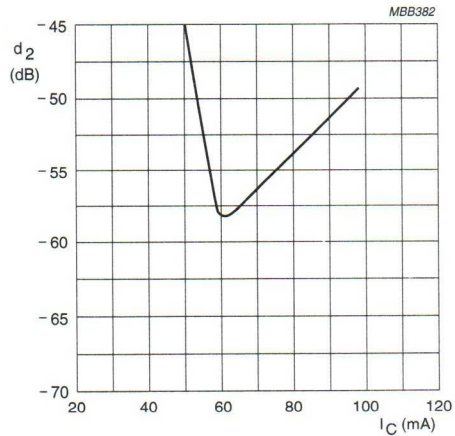
$V_{CE} = 10$  V;  $V_o = 800$  mV;  $f_{(p+q-r)} = 443.25$  MHz;  $T_{amb} = 25$  °C.

Fig.9 Intermodulation distortion as a function of collector current.



$V_{CE} = 10$  V;  $V_o = 750$  mV;  $f_{(p+q-r)} = 793.25$  MHz;  $T_{amb} = 25$  °C.

Fig.10 Intermodulation distortion as a function of collector current.

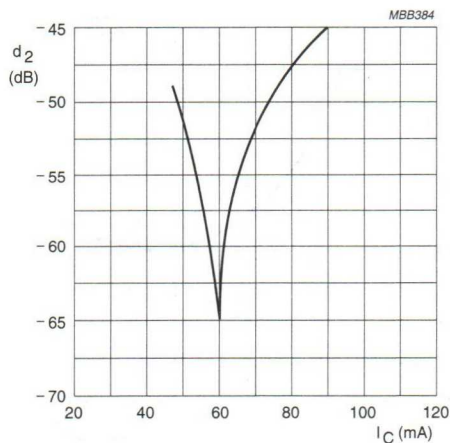


$V_{CE} = 10$  V;  $V_o = 50$  dBmV;  $f_{(p+q)} = 450$  MHz;  $T_{amb} = 25$  °C.

Fig.11 Second order intermodulation distortion as a function of collector current.

## NPN 4 GHz wideband transistor

BFG35



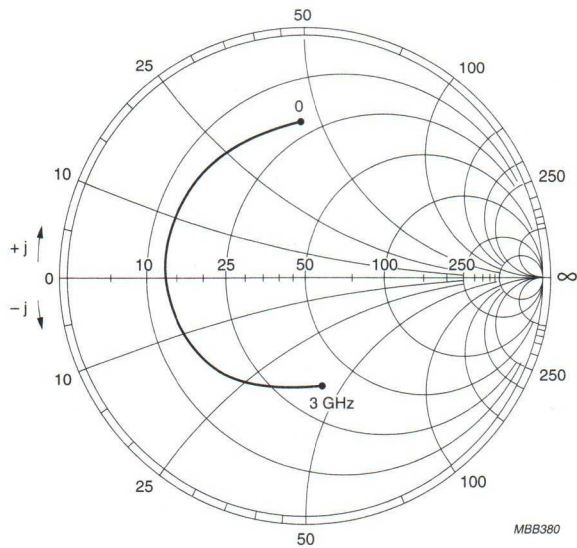
$V_{CE} = 10$  V;  $V_o = 50$  dBmV;  $f_{(p+q)} = 810$  MHz;  $T_{amb} = 25$  °C.

Fig.12 Second order intermodulation distortion as a function of collector current.



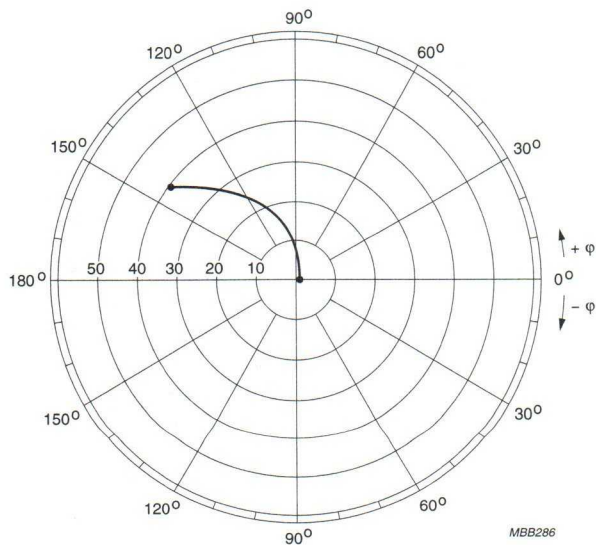
## NPN 4 GHz wideband transistor

BFG35



$I_C = 100 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{amb} = 25^\circ\text{C}$ ;  $Z_0 = 50 \Omega$ .

Fig.13 Common emitter input reflection coefficient ( $S_{11}$ ).

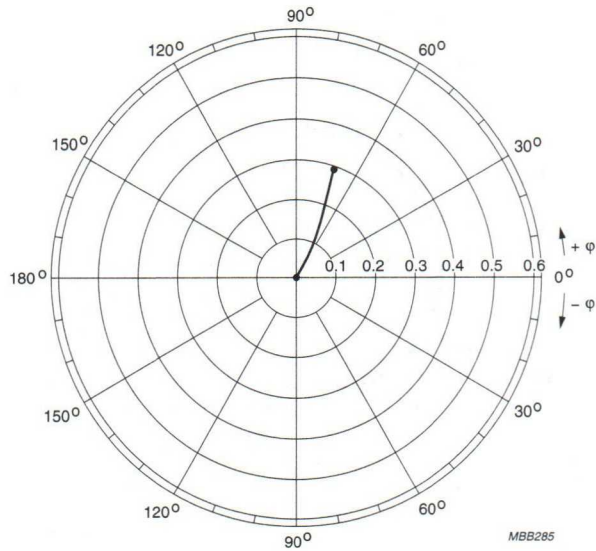


$I_C = 100 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{amb} = 25^\circ\text{C}$ .

Fig.14 Common emitter forward transmission coefficient ( $S_{21}$ ).

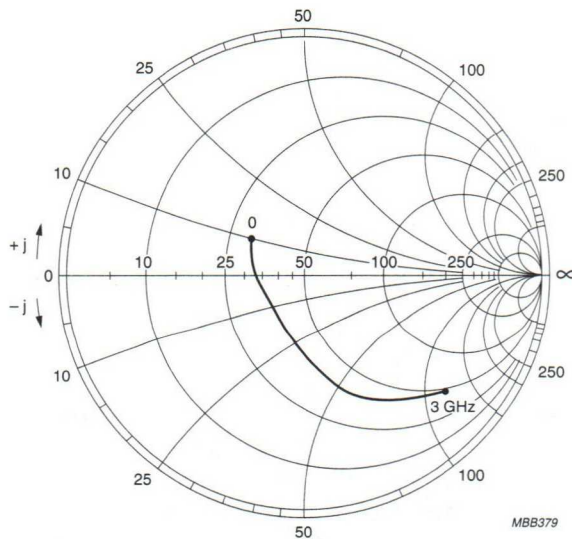
## NPN 4 GHz wideband transistor

BFG35



$I_C = 100 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ .

Fig.15 Common emitter reverse transmission coefficient ( $S_{12}$ ).



$I_C = 100 \text{ mA}$ ;  $V_{CE} = 10 \text{ V}$ ;  $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$ ;  $Z_0 = 50 \text{ } \Omega$ .

Fig.16 Common emitter output reflection coefficient ( $S_{22}$ ).

# NPN video transistor

BFQ131

## FEATURES

- Low output capacitance
- High dissipation
- High gain bandwidth product.

## APPLICATIONS

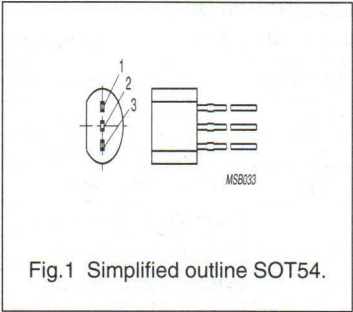
- Buffer stage in colour monitors between the video amplifier and the input of the video module
- Pre-stage (cascode driver) in discrete video amplifiers.

## DESCRIPTION

NPN silicon transistor in a 3-lead plastic SOT54 package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                 | TYP. | MAX. | UNIT               |
|-----------|---------------------------|------------------------------------------------------------|------|------|--------------------|
| $V_{CE0}$ | collector-emitter voltage | open base                                                  | —    | 18   | V                  |
| $I_C$     | collector current (DC)    |                                                            | —    | 150  | mA                 |
| $P_{tot}$ | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; see Fig.2       | —    | 1.9  | W                  |
| $f_T$     | transition frequency      | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; see Fig.4 | 4    | —    | GHz                |
| $C_{re}$  | feedback capacitance      | $I_C = 0$ ; $V_{CE} = 10\text{ V}$ ; see Fig.5             | 1.2  | —    | pF                 |
| $T_j$     | junction temperature      |                                                            | —    | 175  | $^{\circ}\text{C}$ |

NPN video transistor

BFQ131

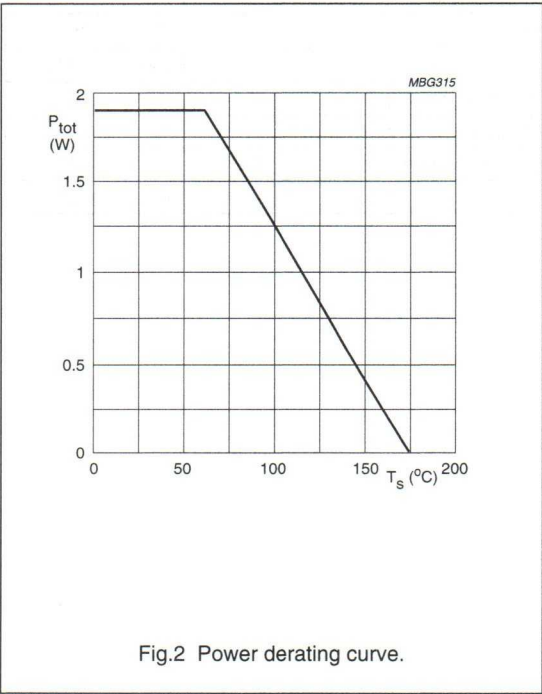
LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                                   | MIN. | MAX. | UNIT               |
|-----------|---------------------------|--------------------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                 | –    | 25   | V                  |
| $V_{CEO}$ | collector-emitter voltage | open base                                                    | –    | 18   | V                  |
| $V_{EBO}$ | emitter-base voltage      | open collector                                               | –    | 2    | V                  |
| $I_C$     | collector current (DC)    |                                                              | –    | 150  | mA                 |
| $P_{tot}$ | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.2 | –    | 1.9  | W                  |
| $T_{stg}$ | storage temperature       |                                                              | –65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature      |                                                              | –    | 175  | $^{\circ}\text{C}$ |

Note

1.  $T_s$  = the temperature at the soldering point of the collector pin.





NPN video transistor

BFQ131

THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                                  | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; $P_{tot} = 1.9\text{ W}$ | 60    | K/W  |

Note

1.  $T_s$  = the temperature at the soldering point of the collector pin.

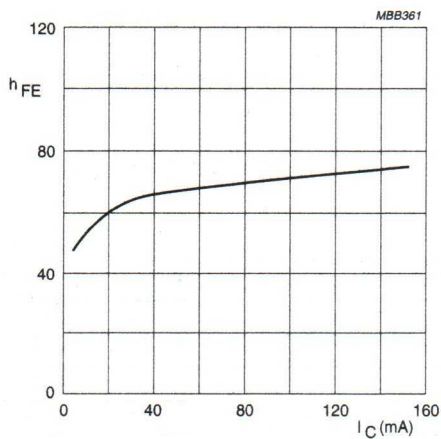
CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                           | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|--------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}$ ; $I_E = 0$                                                    | 25   | —    | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 0.1\text{ mA}$ ; $I_B = 0$                                                    | 18   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_E = 0.1\text{ mA}$ ; $I_C = 0$                                                    | 2    | —    | —    | V             |
| $I_{CES}$     | collector-emitter cut-off current   | $V_{CE} = 18\text{ V}$ ; $V_{BE} = 0$                                                | —    | —    | 1    | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>see Fig.3                         | 25   |      | —    |               |
| $f_T$         | transition frequency                | $I_C = 100\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$f = 500\text{ MHz}$ ; see Fig.4 | —    | 4    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CE} = 10\text{ V}$ ; $f = 1\text{ MHz}$ ;<br>see Fig.5               | —    | 1.2  | —    | pF            |

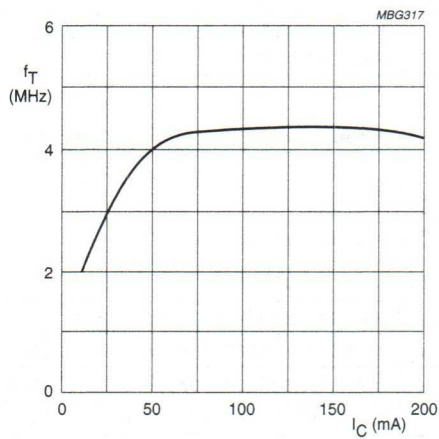
## NPN video transistor

BFQ131



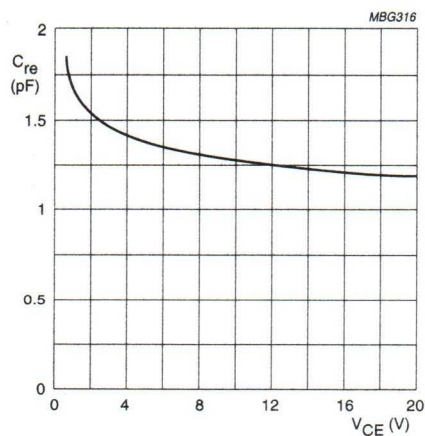
$V_{CE} = 10$  V;  $T_j = 25$  °C.

Fig.3 DC current gain as a function of collector current; typical values.



$V_{CE} = 10$  V;  $f = 500$  MHz;  $T_j = 25$  °C.

Fig.4 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz;  $I_C = 0$ ;  $T_j = 25$  °C.

Fig.5 Feedback capacitance as a function of collector-emitter voltage; typical values.

PNP video transistor

BFQ151

FEATURES

- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

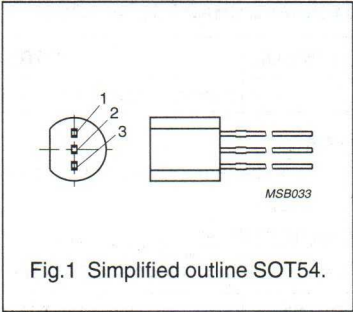
- Pre-stage driver between video amplifier and video module.

DESCRIPTION

PNP video transistor in a SOT54 plastic package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                      | TYP. | MAX. | UNIT               |
|-----------|-------------------------|-------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                    | —    | −20  | V                  |
| $I_C$     | collector current (DC)  |                                                 | —    | −100 | mA                 |
| $P_{tot}$ | total power dissipation | $T_s \leq 60\text{ }^{\circ}\text{C}$           | —    | 1.25 | W                  |
| $f_T$     | transition frequency    | $I_C = -70\text{ mA}$ ; $V_{CE} = -10\text{ V}$ | 3.5  | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = -10\text{ V}$             | 1.8  | —    | pF                 |
| $T_j$     | junction temperature    |                                                 | —    | 175  | $^{\circ}\text{C}$ |

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                                | MIN. | MAX. | UNIT               |
|-----------|---------------------------|-----------------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                              | —    | −20  | V                  |
| $V_{CEO}$ | collector-emitter voltage | open base                                                 | —    | −15  | V                  |
| $V_{EBO}$ | emitter-base voltage      | open collector                                            | —    | −3   | V                  |
| $I_C$     | collector current (DC)    |                                                           | —    | −100 | mA                 |
| $P_{tot}$ | total power dissipation   | $T_s \leq 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.2 | —    | 1.25 | W                  |
| $T_{stg}$ | storage temperature       |                                                           | −65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature      |                                                           | —    | 175  | $^{\circ}\text{C}$ |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

# PNP video transistor

BFQ151

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                             | VALUE | UNIT |
|---------------|-----------------------------------------------------|----------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 60\ ^\circ\text{C}$ ; note 1 | 90    | K/W  |

### Note

- $T_s$  is the temperature of the soldering point of the collector pin.

## CHARACTERISTICS

$T_j = 25\ ^\circ\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                                                                     | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = -0.1\ \text{mA}$ ; $I_E = 0$                                                                                            | -20  | —    | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = -10\ \text{mA}$ ; $I_B = 0$                                                                                             | -15  | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = -0.1\ \text{mA}$                                                                                            | -3   | —    | —    | V             |
| $I_{CBO}$     | collector-base leakage current      | $V_{CB} = -10\ \text{V}$ ; $I_E = 0$                                                                                           | —    | —    | -1   | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = -70\ \text{mA}$ ; $V_{CE} = -10\ \text{V}$ ;<br>see Fig.3                                                               | 25   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = -70\ \text{mA}$ ; $V_{CE} = -10\ \text{V}$ ;<br>$f_m = 500\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ ;<br>see Fig.5 | —    | 3.5  | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = -10\ \text{V}$ ;<br>$f = 1\ \text{MHz}$ ; see Fig.4                                                      | —    | 1.8  | —    | pF            |

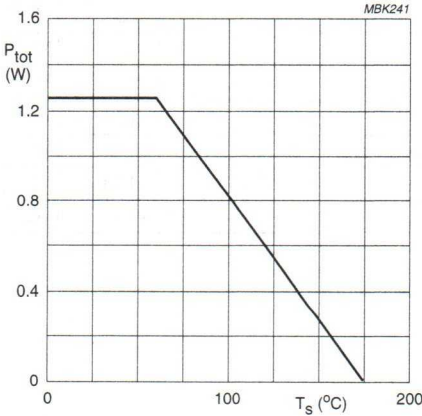
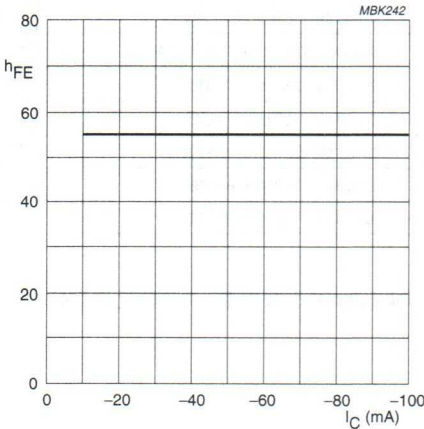


Fig.2 Power derating curve.



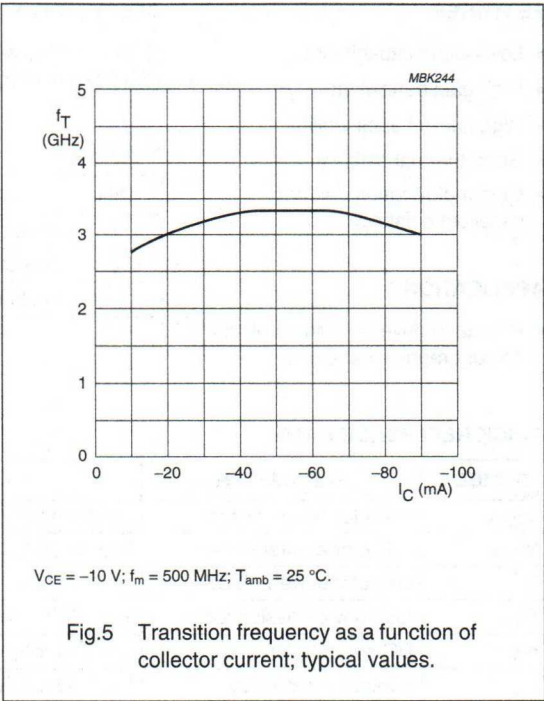
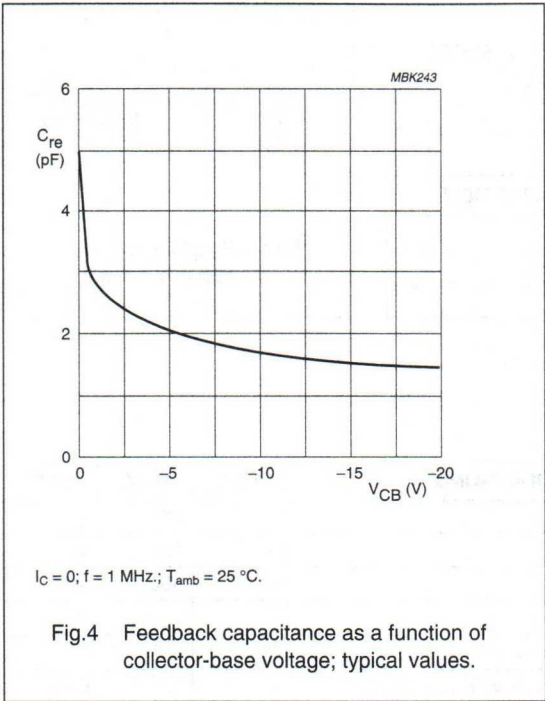
$V_{CE} = -10\ \text{V}$ ;  $T_{amb} = 25\ ^\circ\text{C}$ .

Fig.3 DC current gain as a function of collector current; typical values.



PNP video transistor

BFQ151



# NPN video transistor

BFQ161

## FEATURES

- Low output capacitance
- High gain bandwidth
- High current applicability
- Good thermal stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

- Pre-stage driver in high resolution colour graphics monitors.

## DESCRIPTION

NPN video transistor in a SOT54 (TO-92) plastic package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |

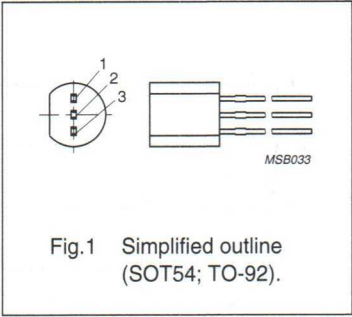


Fig.1 Simplified outline (SOT54; TO-92).

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                     | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                   | —    | 20   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                                          | —    | 19   | V                |
| $I_C$     | collector current (DC)    |                                                                                | —    | 500  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 75^\circ\text{C}$ ; note 1                                           | —    | 1    | W                |
| $h_{FE}$  | DC current gain           | $I_C = 300 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$                                | 25   | —    |                  |
| $f_T$     | transition frequency      | $I_C = 300 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $T_{amb} = 25^\circ\text{C}$ | 1    | —    | GHz              |
| $T_j$     | junction temperature      |                                                                                | —    | 150  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                             | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                           | —    | 20   | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                              | —    | 10   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                  | —    | 19   | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                         | —    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                        | —    | 500  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 75^\circ\text{C}$ ; notes 1 and 2; see Fig.3 | —    | 1    | W                |
| $T_{stg}$ | storage temperature range |                                                        | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                        | —    | 150  | $^\circ\text{C}$ |

## Notes

1.  $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.
2. Transistor mounted on a printed-circuit board with a metallized pad area of  $10 \text{ mm}^2$ .

## NPN video transistor

BFQ161

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS | VALUE | UNIT |
|---------------|-----------------------------------------------------|------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | note 1     | 75    | K/W  |
| $R_{th\ j-a}$ | thermal resistance from junction to ambient         |            | 175   | K/W  |
| $R_{th\ s-a}$ | thermal resistance from soldering point to ambient  |            | 100   | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.

## CHARACTERISTICS

$T_j = 25\ ^\circ\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                                      | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|-------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 5\ \text{mA}$ ; $I_E = 0$                                                                | 20   | —    | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 10\ \text{mA}$ ; $I_B = 0$                                                               | 10   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_E = 0.1\ \text{mA}$ ; $I_C = 0$                                                              | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter cut-off current   | $I_B = 0$ ; $V_{CE} = 10\ \text{V}$                                                             | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ ; see Fig.4 | 25   | —    | —    |               |
|               |                                     | $I_C = 100\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ ; see Fig.4 | 40   | 50   | —    |               |
| $C_{cb}$      | collector-base capacitance          | $I_C = 0$ ; $V_{CB} = 5\ \text{V}$ ; $f = 1\ \text{MHz}$ ;<br>see Fig.5                         | —    | 4.3  | —    | pF            |
| $C_c$         | collector capacitance               | $I_E = i_e = 0$ ; $V_{CB} = 5\ \text{V}$ ; $f = 1\ \text{MHz}$                                  | —    | 6    | —    | pF            |
| $f_T$         | transition frequency                | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ; see Fig.6                                     | 1    | —    | —    | GHz           |

## NPN video transistor

BFQ161

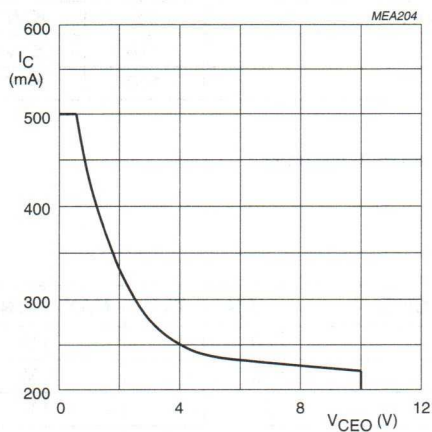


Fig.2 DC SOAR.

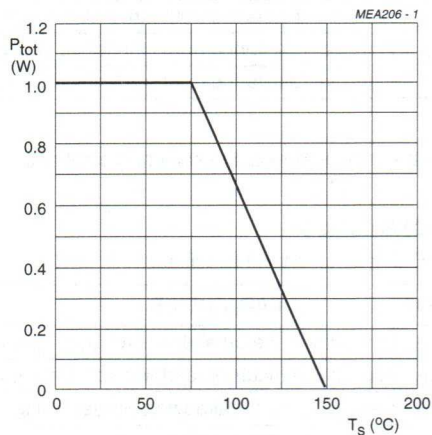


Fig.3 Power derating curve.

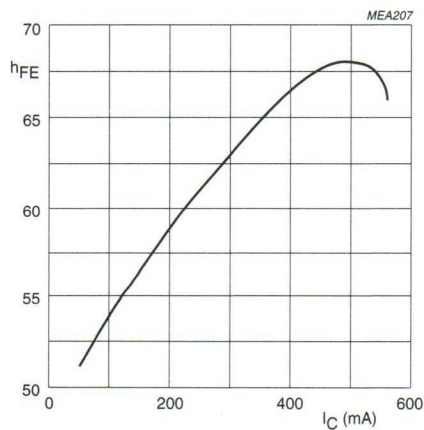
 $V_{CE} = 5$  V;  $T_{amb} = 25$   $^{\circ}\text{C}$ .

Fig.4 DC current gain as a function of collector current; typical values.

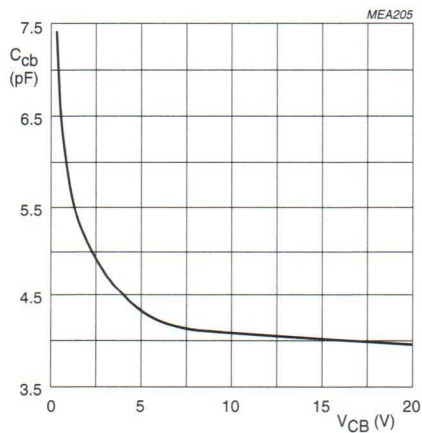
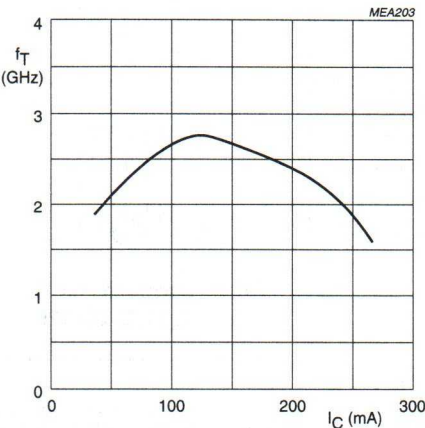
 $f = 1$  MHz;  $T_{amb} = 25$   $^{\circ}\text{C}$ .

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



NPN video transistor

BFQ161



$V_{CE} = 5\text{ V}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

Fig.6 Transition frequency as a function of collector current; typical values.

NPN video transistor

TO-18 SOT32 BFG162

FEATURES

- Low output capacitance
- Good thermal stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

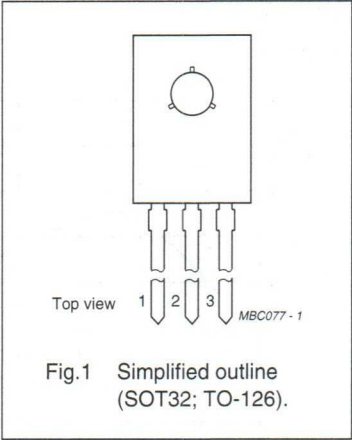
- Pre-stage driver in high-resolution colour graphics monitors.

DESCRIPTION

NPN video transistor in a SOT32 (TO-126) package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                                               | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                                             | —    | —    | 20   | V    |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                                                                                   | —    | —    | 19   | V    |
| $I_C$     | collector current (DC)    |                                                                                                          | —    | —    | 500  | mA   |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1                                                                  | —    | —    | 3    | W    |
| $h_{FE}$  | DC current gain           | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ; $T_{amb} = 25\ ^\circ\text{C}$                         | 50   | 60   | —    |      |
| $f_T$     | transition frequency      | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ; $f = 100\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ | 1    | —    | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT             |
|-----------|---------------------------|----------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       | —    | 20   | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                          | —    | 10   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                             | —    | 19   | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | —    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                    | —    | 500  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                |
| $T_{stg}$ | storage temperature       |                                                    | −65  | +175 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                    | —    | 175  | $^\circ\text{C}$ |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistor

BFQ162

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                              | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 115\ ^\circ\text{C}$ ; note 1 | 20    | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## CHARACTERISTICS

$T_j = 25\ ^\circ\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                                                                 | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 5\ \text{mA}$ ; $I_E = 0$                                                                                           | 20   | —    | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 10\ \text{mA}$ ; $I_B = 0$                                                                                          | 10   | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 10\ \text{mA}$ ; $R_{BE} = 100\ \Omega$                                                                             | 19   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_E = 1\ \text{mA}$ ; $I_C = 0$                                                                                           | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter cut-off current   | $V_{BE} = 0\ \text{V}$ ; $V_{CE} = 10\ \text{V}$                                                                           | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ ; see Fig.4                            | 50   | 60   | —    |               |
|               |                                     | $I_C = 100\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ ; see Fig.4                            | 40   | 50   | —    |               |
| $f_T$         | transition frequency                | $I_C = 300\ \text{mA}$ ; $V_{CE} = 5\ \text{V}$ ;<br>$f = 100\ \text{MHz}$ ; $T_{amb} = 25\ ^\circ\text{C}$ ;<br>see Fig.6 | 1    | —    | —    | GHz           |
| $C_{cb}$      | collector-base capacitance          | $I_C = i_c = 0$ ; $V_{CB} = 5\ \text{V}$ ; $f = 1\ \text{MHz}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ ; see Fig.5             | —    | 4.2  | —    | pF            |
| $C_c$         | collector capacitance               | $I_E = i_e = 0$ ; $V_{CB} = 5\ \text{V}$ ; $f = 1\ \text{MHz}$                                                             | —    | 5.8  | —    | pF            |

## NPN video transistor

BFQ162

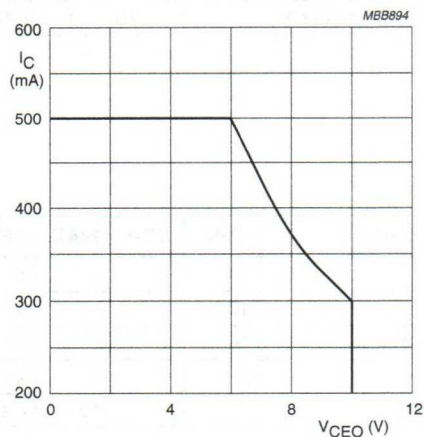


Fig.2 DC SOAR.

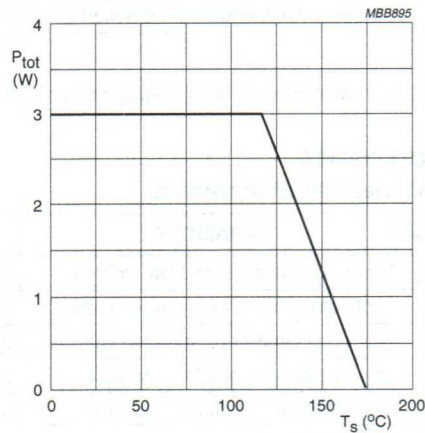


Fig.3 Power derating curve.

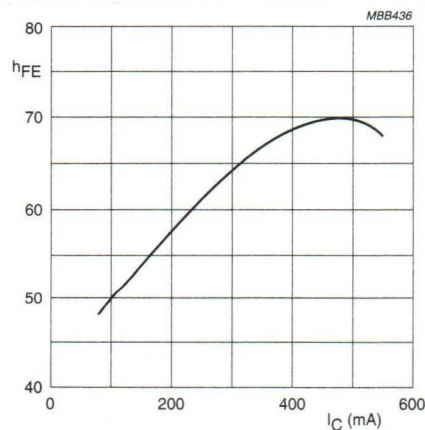
 $V_{CE} = 5$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.

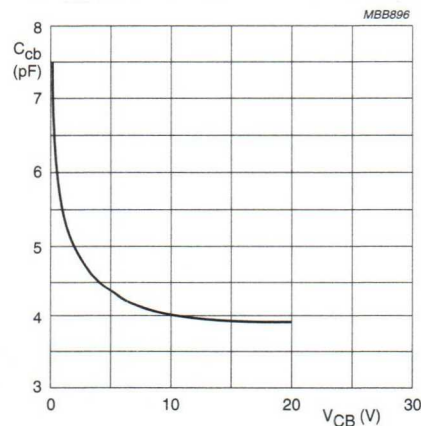
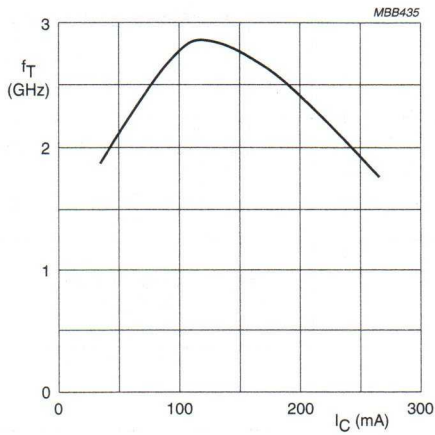
 $f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



## NPN video transistor

BFQ162



$V_{CE} = 5 \text{ V}$ ;  $f = 100 \text{ MHz}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

Fig.6 Transition frequency as a function of collector current; typical values.

# NPN video transistor

BFQ166

## FEATURES

- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability
- High current applicability
- Surface mounting.

## APPLICATIONS

- Video amplifier cascode driver in high-resolution colour graphics monitors.

## DESCRIPTION

NPN video transistor in a SOT223 plastic package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |

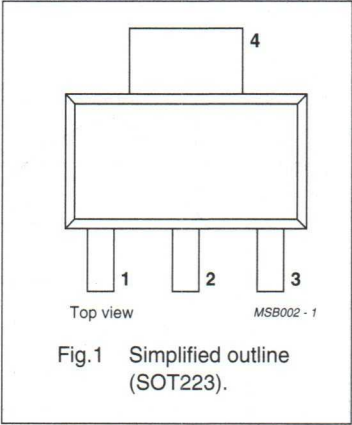


Fig.1 Simplified outline (SOT223).

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                                             | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|--------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                                           | —    | —    | 20   | V    |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                                                                  | —    | —    | 19   | V    |
| $I_C$     | collector current (DC)    |                                                                                                        | —    | —    | 500  | mA   |
| $P_{tot}$ | total power dissipation   | $T_s \leq 105^\circ\text{C}$ ; note 1                                                                  | —    | —    | 2    | W    |
| $h_{FE}$  | DC current gain           | $I_C = 300 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; see Fig.4                                            | 50   | 60   | —    |      |
| $f_T$     | transition frequency      | $I_C = 300 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 100 \text{ MHz}$ ; $T_{amb} = 25^\circ\text{C}$ | 1    | —    | —    | GHz  |

### Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                       | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                     | —    | 20   | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                        | —    | 10   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                            | —    | 19   | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                   | —    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                  | —    | 500  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 105^\circ\text{C}$ ; note 1; see Fig.3 | —    | 2    | W                |
| $T_{stg}$ | storage temperature       |                                                  | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                  | —    | 175  | $^\circ\text{C}$ |

### Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

# NPN video transistor

BFQ166

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                                      | VALUE | UNIT |
|---------------|-----------------------------------------------------|---------------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s = 105\text{ }^{\circ}\text{C}$ ; $P_{tot} = 2\text{ W}$ ;<br>notes 1 and 2 | 35    | K/W  |

### Notes

- $T_s$  is the temperature at the soldering point of the collector lead.
- Device mounted on a printed-circuit board measuring  $40 \times 40 \times 1\text{ mm}$  (collector pad  $35 \times 17\text{ mm}$ ).

## CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                                                                      | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 5\text{ mA}$ ; $I_E = 0$                                                                                                 | 20   | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 10\text{ mA}$ ; $R_{BE} = 100\text{ }\Omega$                                                                             | 19   | —    | —    | V             |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 10\text{ mA}$ ; $I_B = 0$                                                                                                | 10   | —    | —    | V             |
| $I_{CES}$     | collector-emitter cut-off current   | $V_{CE} = 10\text{ V}$ ; $V_{BE} = 0$                                                                                           | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 300\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ; see Fig.4                                                                       | 50   | 60   | —    |               |
| $C_c$         | collector capacitance               | $I_E = i_e = 0$ ; $V_{CB} = 5\text{ V}$ ; $f = 1\text{ MHz}$                                                                    | —    | 4.5  | —    | pF            |
| $C_{cb}$      | collector-base capacitance          | $I_C = i_c = 0$ ; $V_{CB} = 5\text{ V}$ ; $f = 1\text{ MHz}$ ;<br>see Fig.6                                                     | —    | 3.2  | —    | pF            |
| $f_T$         | transition frequency                | $I_C = 300\text{ mA}$ ; $V_{CE} = 5\text{ V}$ ;<br>$f = 100\text{ MHz}$ ; $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;<br>see Fig.5 | 1    | —    | —    | GHz           |

## NPN video transistor

BFQ166

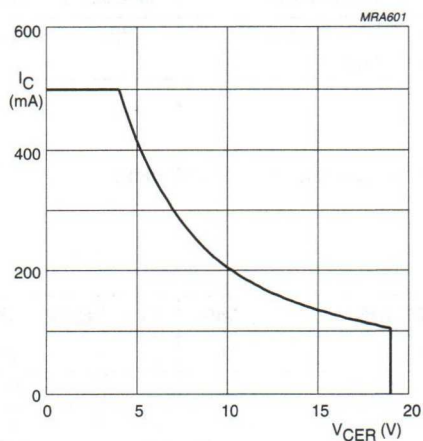
 $R_{BE} \leq 100 \Omega$ .

Fig.2 DC SOAR.

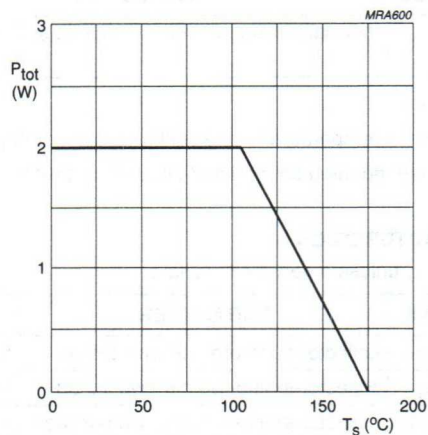


Fig.3 Power derating curve.

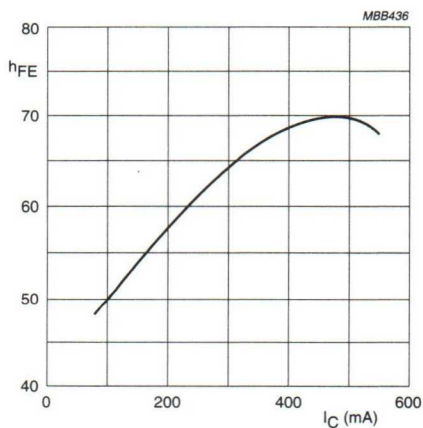
 $V_{CE} = 5$  V.

Fig.4 DC current gain as a function of collector current; typical values.

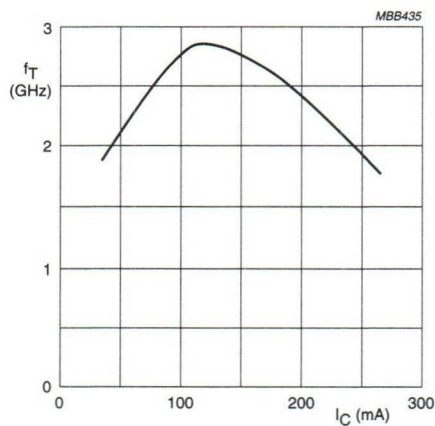
 $V_{CE} = 5$  V;  $T_{amb} = 25$   $^{\circ}\text{C}$ .

Fig.5 Transition frequency as a function of collector current; typical values.



## NPN video transistor

BFQ166

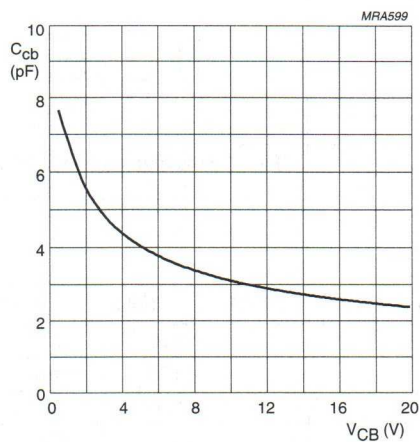
 $I_C = 0$ ;  $f = 1$  MHz.

Fig.6 Collector-base capacitance as a function of collector-base voltage; typical values.

## NPN video transistor

BFQ221

## APPLICATIONS

- Primarily intended for buffer stages in high resolution colour monitors.

## DESCRIPTION

NPN silicon transistor encapsulated in a 3-lead plastic SOT54 package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |

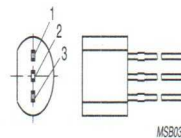


Fig.1 Simplified outline SOT54.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                    | TYP | MAX  | UNIT               |
|-----------|-------------------------|-----------------------------------------------|-----|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                  | —   | 100  | V                  |
| $I_C$     | collector current (DC)  |                                               | —   | 100  | mA                 |
| $P_{tot}$ | total power dissipation | up to $T_s = 60\text{ }^{\circ}\text{C}$      | —   | 1.15 | W                  |
| $f_T$     | transition frequency    | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ | 1   | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = 10\text{ V}$            | 1.7 | —    | pF                 |
| $T_j$     | junction temperature    |                                               | —   | 150  | $^{\circ}\text{C}$ |

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

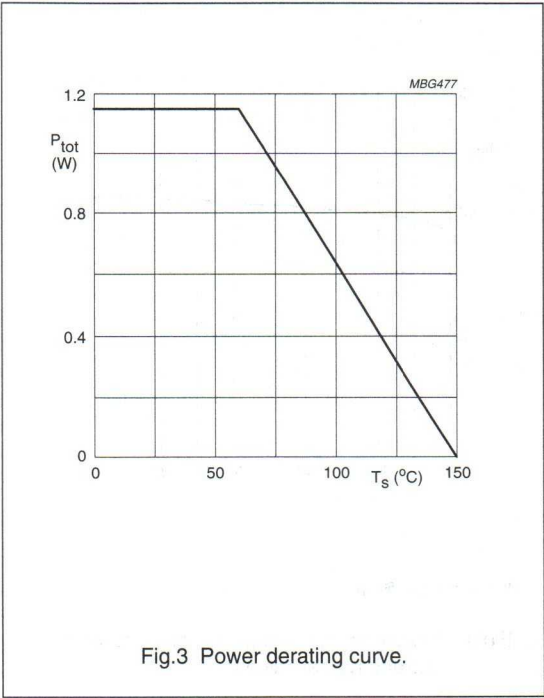
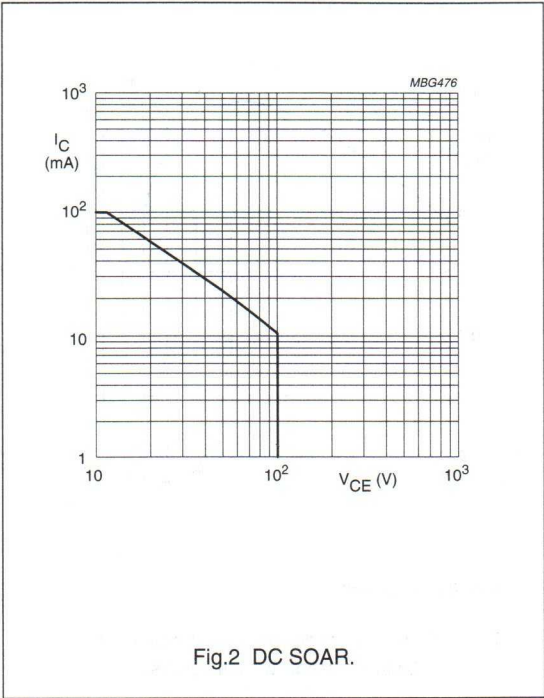
| SYMBOL      | PARAMETER                 | CONDITIONS                                                   | MIN | MAX  | UNIT               |
|-------------|---------------------------|--------------------------------------------------------------|-----|------|--------------------|
| $V_{CBO}$   | collector-base voltage    | open emitter                                                 | —   | 100  | V                  |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\text{ }\Omega$                                 | —   | 95   | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                               | —   | 3    | V                  |
| $I_C$       | collector current (DC)    | see Fig.2                                                    | —   | 100  | mA                 |
| $I_{C(AV)}$ | average collector current | see Fig.2                                                    | —   | 100  | mA                 |
| $P_{tot}$   | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.3 | —   | 1.15 | W                  |
| $T_{stg}$   | storage temperature       |                                                              | −65 | +150 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                              | —   | 150  | $^{\circ}\text{C}$ |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

# NPN video transistor

BFQ221



## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                      | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 1.15\text{ W}$ ; up to $T_s = 60\text{ °C}$ ; note 1 | 78    | K/W  |

### Note

- $T_s$  is the temperature of the soldering point of the collector pin.

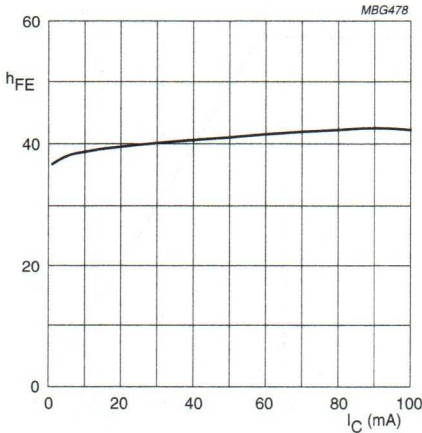
## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                       | MIN | TYP | MAX | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------------|-----|-----|-----|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}$ ; $I_E = 0$                                                | 100 | —   | —   | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 1\text{ mA}$ ; $R_{BE} = 100\ \Omega$                                     | 95  | —   | —   | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = 0.1\text{ mA}$                                                | 3   | —   | —   | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = 50\text{ V}$ ; $V_{BE} = 0$                                            | —   | —   | 100 | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; see Fig.4                        | 20  | —   | —   |               |
| $f_T$         | transition frequency                | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —   | 1   | —   | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6              | —   | 1.7 | —   | pF            |

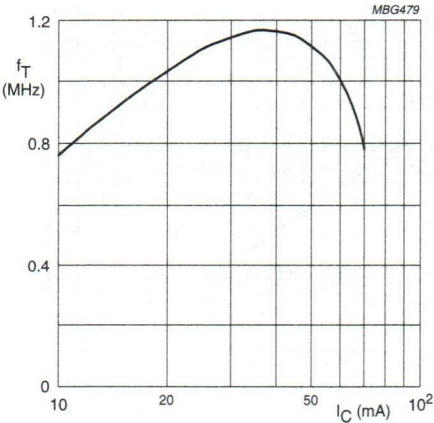
NPN video transistor

BFQ221



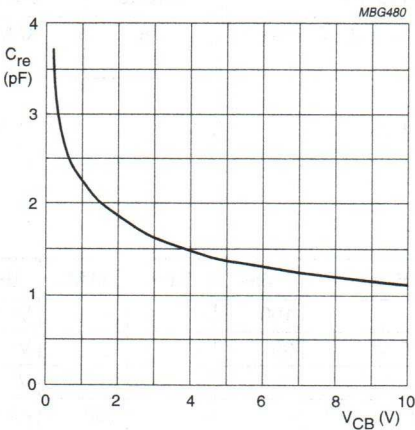
$V_{CE} = 10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = 10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.



## NPN video transistor

BFQ222

## APPLICATIONS

- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

## DESCRIPTION

NPN silicon transistor encapsulated in a 3-lead plastic SOT32 package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

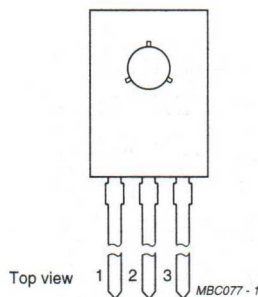


Fig.1 Simplified outline SOT32.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                    | TYP. | MAX. | UNIT |
|-----------|-------------------------|-----------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                  | —    | 100  | V    |
| $I_C$     | collector current (DC)  |                                               | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$                       | —    | 5    | W    |
| $f_T$     | transition frequency    | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ | 1    | —    | GHz  |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = 10\text{ V}$            | 1.7  | —    | pF   |
| $T_j$     | junction temperature    |                                               | —    | 175  | °C   |

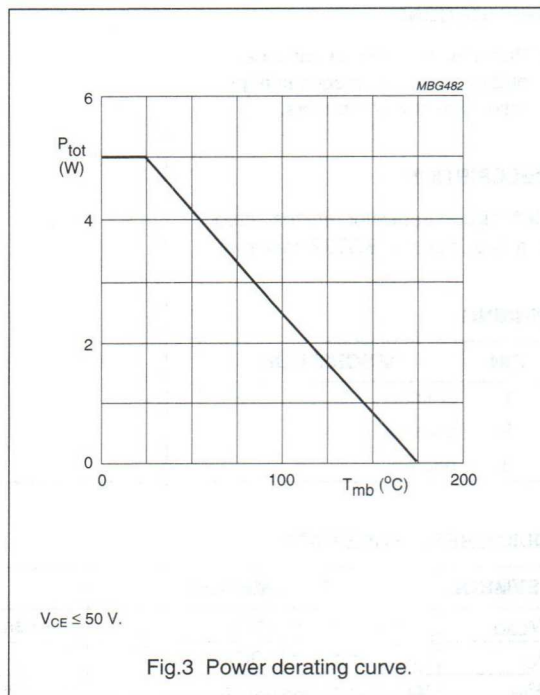
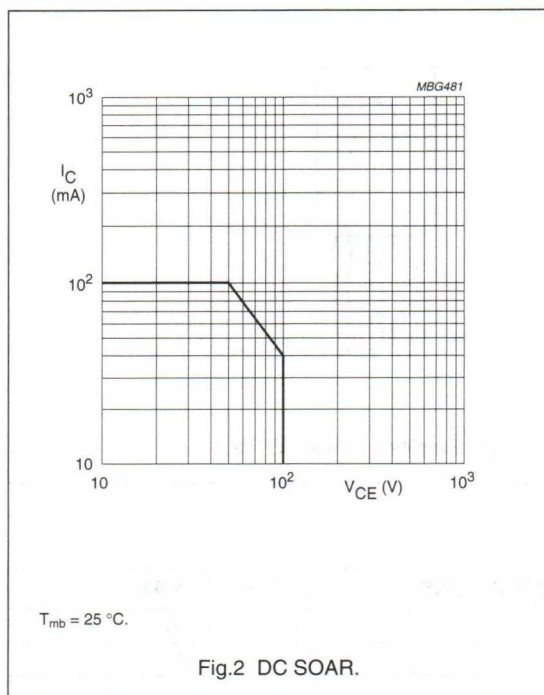
## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL      | PARAMETER                 | CONDITIONS                          | MIN. | MAX. | UNIT |
|-------------|---------------------------|-------------------------------------|------|------|------|
| $V_{CBO}$   | collector-base voltage    | open emitter                        | —    | 100  | V    |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\ \Omega$              | —    | 95   | V    |
| $V_{EBO}$   | emitter-base voltage      | open collector                      | —    | 3    | V    |
| $I_C$       | collector current (DC)    | see Fig.2                           | —    | 100  | mA   |
| $I_{C(AV)}$ | average collector current | see Fig.2                           | —    | 100  | mA   |
| $P_{tot}$   | total power dissipation   | $T_{mb} = 25\text{ °C}$ ; see Fig.3 | —    | 5    | W    |
| $T_{stg}$   | storage temperature       |                                     | −65  | +175 | °C   |
| $T_j$       | junction temperature      |                                     | —    | 175  | °C   |

## NPN video transistor

BFQ222



## THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS                                       | VALUE | UNIT |
|----------------|---------------------------------------------------|--------------------------------------------------|-------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $P_{tot} = 5\text{ W}$ ; $T_{mb} = 25\text{ °C}$ | 30    | K/W  |

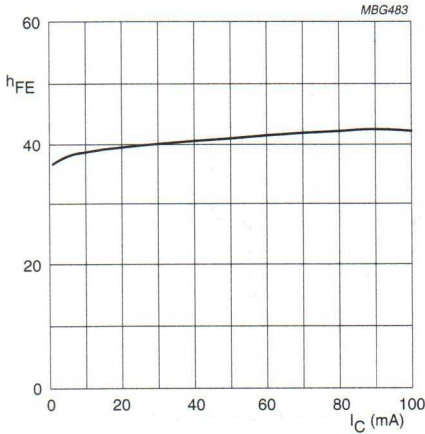
## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                       | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}$ ; $I_E = 0$                                                | 100  | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 1\text{ mA}$ ; $R_{BE} = 100\ \Omega$                                     | 95   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = 0.1\text{ mA}$                                                | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = 50\text{ V}$ ; $V_{BE} = 0$                                            | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; see Fig.4                        | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6              | —    | 1.7  | —    | pF            |

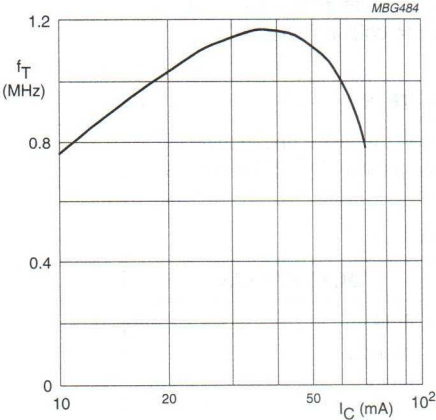
NPN video transistor

BFQ222



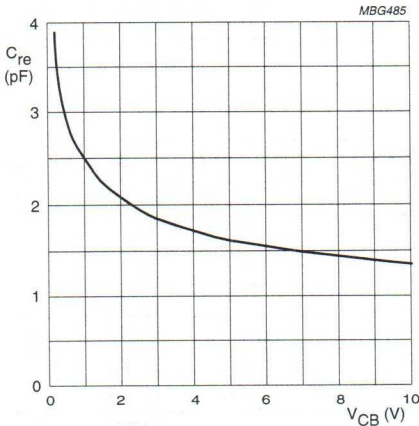
$V_{CE} = 10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = 10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

## NPN video transistor

BFQ225

## APPLICATIONS

- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

## DESCRIPTION

NPN silicon transistor encapsulated in a 3-lead plastic SOT128B package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

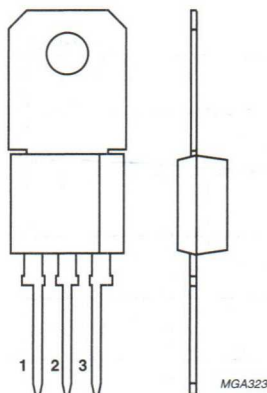


Fig.1 Simplified outline SOT128B.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                    | TYP. | MAX. | UNIT               |
|-----------|-------------------------|-----------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                  | —    | 100  | V                  |
| $I_C$     | collector current (DC)  |                                               | —    | 100  | mA                 |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ }^{\circ}\text{C}$         | —    | 3.75 | W                  |
| $f_T$     | transition frequency    | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ | 1    | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = 10\text{ V}$            | 1.7  | —    | pF                 |
| $T_j$     | junction temperature    |                                               | —    | 175  | $^{\circ}\text{C}$ |

## LIMITING VALUES

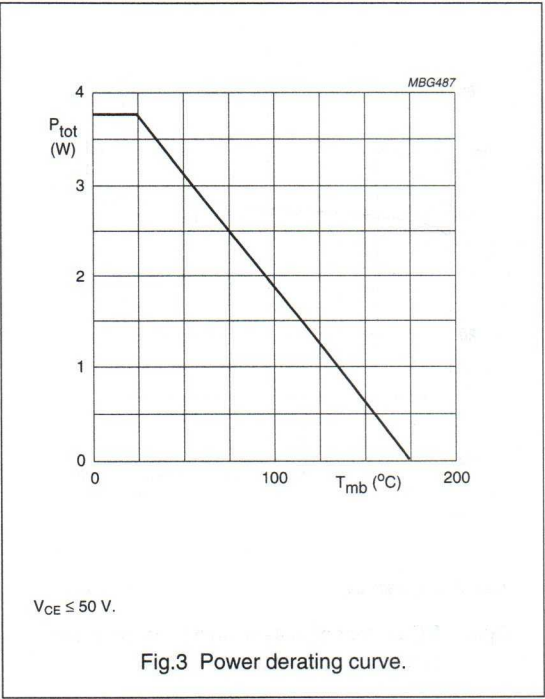
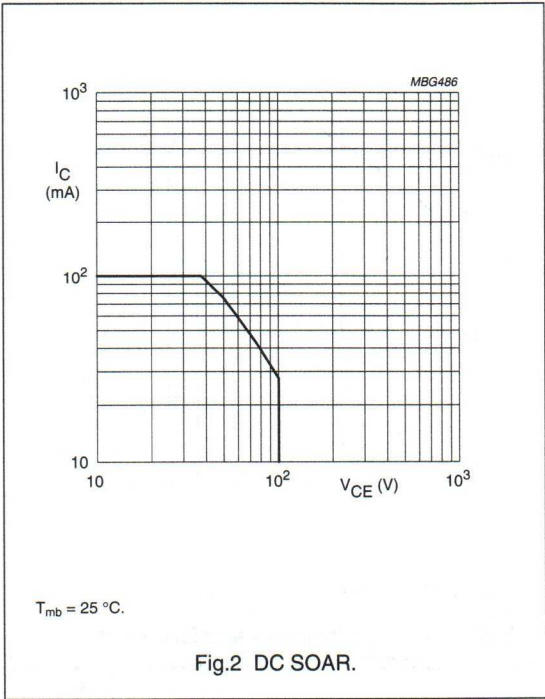
In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL      | PARAMETER                 | CONDITIONS                                        | MIN. | MAX. | UNIT               |
|-------------|---------------------------|---------------------------------------------------|------|------|--------------------|
| $V_{CBO}$   | collector-base voltage    | open emitter                                      | —    | 100  | V                  |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\text{ }\Omega$                      | —    | 95   | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                    | —    | 3    | V                  |
| $I_C$       | collector current (DC)    | see Fig.2                                         | —    | 100  | mA                 |
| $I_{C(AV)}$ | average collector current | see Fig.2                                         | —    | 100  | mA                 |
| $P_{tot}$   | total power dissipation   | $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; see Fig.3 | —    | 3.75 | W                  |
| $T_{stg}$   | storage temperature       |                                                   | -65  | +175 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                   | —    | 175  | $^{\circ}\text{C}$ |



NPN video transistor

BFQ225



THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS                                       | VALUE | UNIT |
|----------------|---------------------------------------------------|--------------------------------------------------|-------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $P_{tot} = 3.75\text{ W}; T_{mb} = 25\text{ °C}$ | 40    | K/W  |

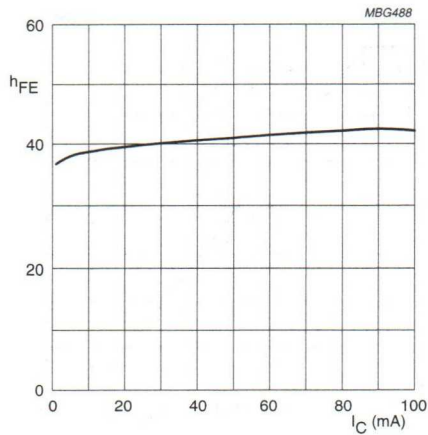
CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                     | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|--------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}; I_E = 0$                                                 | 100  | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 1\text{ mA}; R_{BE} = 100\text{ }\Omega$                                | 95   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0; I_E = 0.1\text{ mA}$                                                 | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = 50\text{ V}; V_{BE} = 0$                                             | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 25\text{ mA}; V_{CE} = 10\text{ V};$<br>see Fig.4                       | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = 25\text{ mA}; V_{CE} = 10\text{ V};$<br>$f = 500\text{ MHz};$ see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0; V_{CB} = 10\text{ V}; f = 1\text{ MHz};$<br>see Fig.6                | —    | 1.7  | —    | pF            |

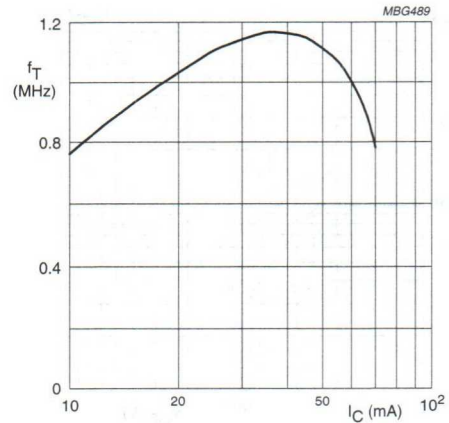
## NPN video transistor

BFQ225



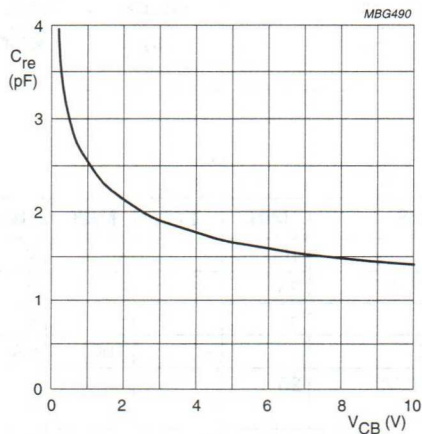
$V_{CE} = 10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = 10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

NPN video transistor

BFQ226

APPLICATIONS

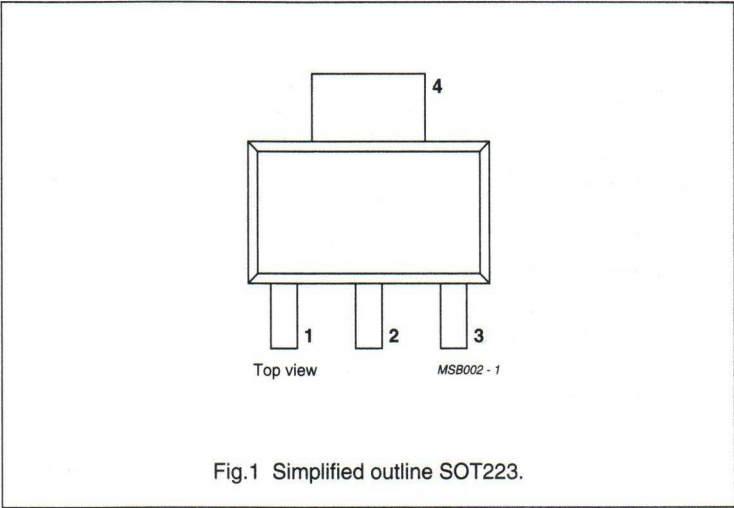
- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

DESCRIPTION

NPN silicon transistor encapsulated in a 4-lead plastic SOT223 package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                    | TYP. | MAX. | UNIT               |
|-----------|-------------------------|-----------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                  | —    | 100  | V                  |
| $I_C$     | collector current (DC)  |                                               | —    | 100  | mA                 |
| $P_{tot}$ | total power dissipation | up to $T_s = 60\text{ }^{\circ}\text{C}$      | —    | 3    | W                  |
| $f_T$     | transition frequency    | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ | 1    | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = 10\text{ V}$            | 1.7  | —    | pF                 |
| $T_j$     | junction temperature    |                                               | —    | 175  | $^{\circ}\text{C}$ |

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL      | PARAMETER                 | CONDITIONS                                                   | MIN. | MAX. | UNIT               |
|-------------|---------------------------|--------------------------------------------------------------|------|------|--------------------|
| $V_{CBO}$   | collector-base voltage    | open emitter                                                 | —    | 100  | V                  |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\text{ }\Omega$                                 | —    | 95   | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                               | —    | 3    | V                  |
| $I_C$       | collector current (DC)    | see Fig.2                                                    | —    | 100  | mA                 |
| $I_{C(AV)}$ | average collector current | see Fig.2                                                    | —    | 100  | mA                 |
| $P_{tot}$   | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                  |
| $T_{stg}$   | storage temperature       |                                                              | −65  | +175 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                              | —    | 175  | $^{\circ}\text{C}$ |

Note

- $T_s$  is the temperature at the soldering point of the collector pin.

# NPN video transistor

BFQ226

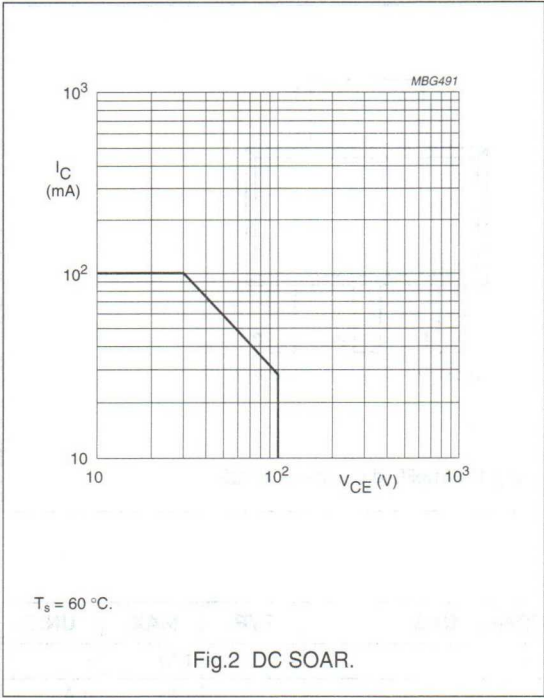


Fig.2 DC SOAR.

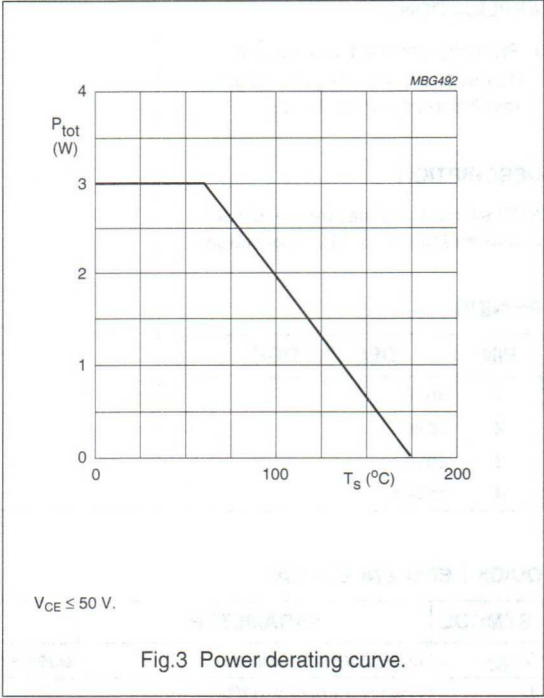


Fig.3 Power derating curve.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                                 | VALUE | UNIT |
|---------------|-----------------------------------------------------|----------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 3\text{ W}$ ; up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1 | 38.5  | K/W  |

### Note

- $T_s$  is the temperature of the soldering point of the collector pin.

## CHARACTERISTICS

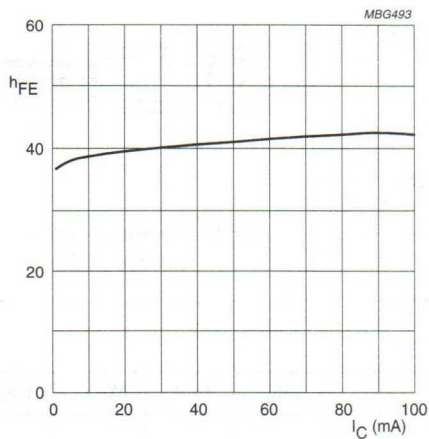
$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                       | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}$ ; $I_E = 0$                                                | 100  | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 1\text{ mA}$ ; $R_{BE} = 100\text{ }\Omega$                               | 95   | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = 0.1\text{ mA}$                                                | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = 50\text{ V}$ ; $V_{BE} = 0$                                            | —    | —    | 100  | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; see Fig.4                        | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = 25\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = 10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6              | —    | 1.7  | —    | pF            |



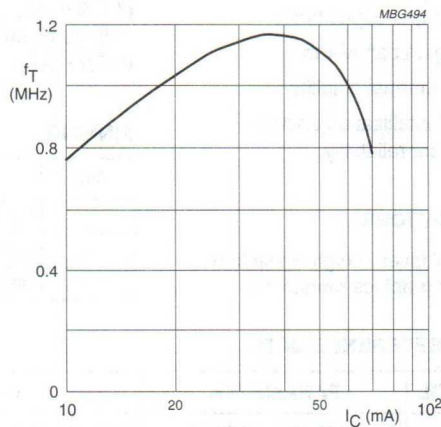
## NPN video transistor

BFQ226



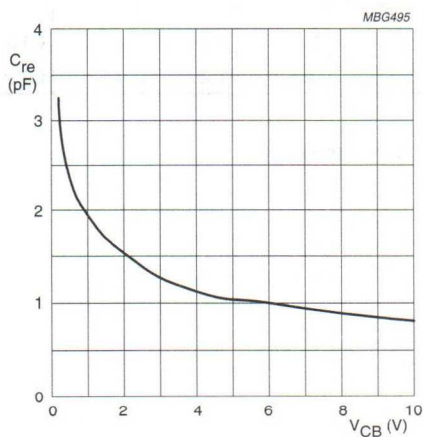
$V_{CE} = 10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = 10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

NPN video transistors

BFQ231; BFQ231A

FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

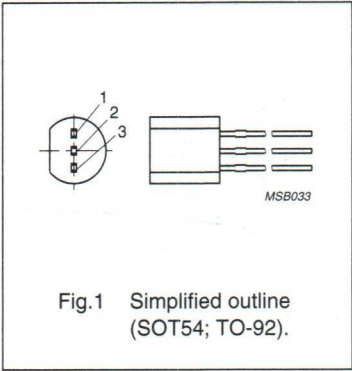
- Buffer/driver in high-resolution colour graphics monitors.

DESCRIPTION

NPN video transistor in a SOT54 (TO-92) plastic package.  
PNP complements: BFQ251 and BFQ251A.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                                              | MIN. | TYP. | MAX. | UNIT |
|-----------|------------------------------------------------|-----------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage<br>BFQ231<br>BFQ231A    | open emitter                                                                            | —    | —    | 100  | V    |
|           |                                                |                                                                                         | —    | —    | 115  | V    |
| $V_{CER}$ | collector-emitter voltage<br>BFQ231<br>BFQ231A | $R_{BE} = 100 \Omega$                                                                   | —    | —    | 95   | V    |
|           |                                                |                                                                                         | —    | —    | 110  | V    |
| $I_C$     | collector current (DC)                         |                                                                                         | —    | —    | 300  | mA   |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 65 \text{ }^\circ\text{C}$ ; note 1                                           | —    | —    | 1    | W    |
| $h_{FE}$  | DC current gain                                | $I_C = 50 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$                                         | 20   | 35   | —    |      |
| $f_T$     | transition frequency<br>BFQ231<br>BFQ231A      | $I_C = 50 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$ | 1    | 1.4  | —    | GHz  |
|           |                                                |                                                                                         | 0.8  | 1.2  | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.

## NPN video transistors

## BFQ231; BFQ231A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                             | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                           | —    | 100  | V                |
|           | BFQ231<br>BFQ231A         |                                                        |      | 115  | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                              | —    | 65   | V                |
|           | BFQ231<br>BFQ231A         |                                                        |      | 95   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                  | —    | 95   | V                |
|           | BFQ231<br>BFQ231A         |                                                        |      | 110  | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                         | —    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                        | —    | 300  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 65^\circ\text{C}$ ; notes 1 and 2; see Fig.3 | —    | 1    | W                |
| $T_{stg}$ | storage temperature       |                                                        | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                        | —    | 150  | $^\circ\text{C}$ |

## Notes

- $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.
- Transistor mounted on a printed-circuit board with a metallized pad area of 10 mm<sup>2</sup>.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS | VALUE | UNIT |
|---------------|-----------------------------------------------------|------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | note 1     | 85    | K/W  |
| $R_{th\ j-a}$ | thermal resistance from junction to ambient         |            | 185   | K/W  |
| $R_{th\ s-a}$ | thermal resistance from soldering point to ambient  |            | 100   | K/W  |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

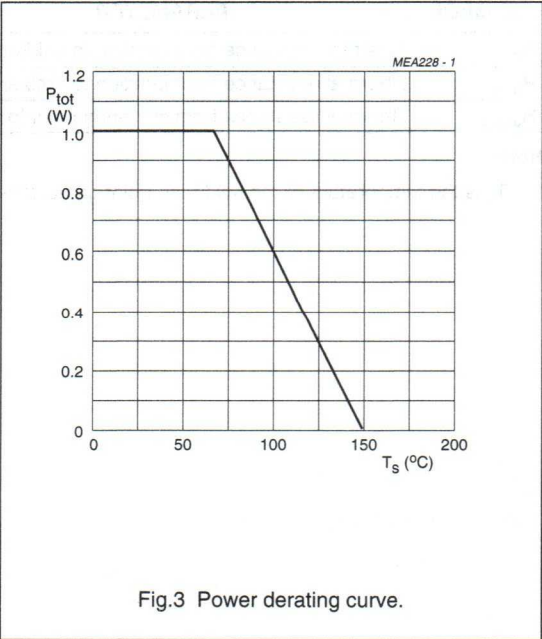
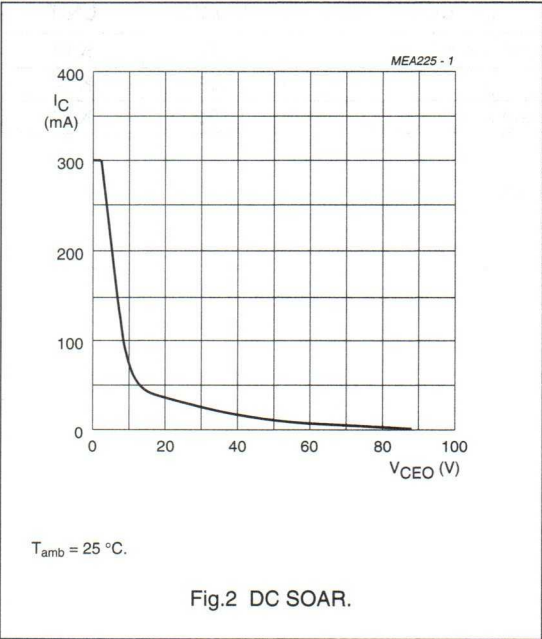
# NPN video transistors

# BFQ231; BFQ231A

## CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

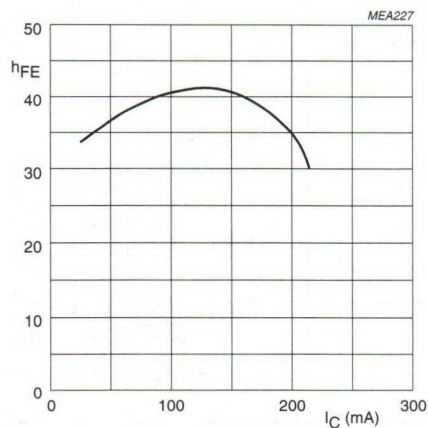
| SYMBOL        | PARAMETER                           | CONDITIONS                                                                 | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = 0.1\text{ mA}; I_E = 0$                                             | 100  | —    | —    | V             |
|               | BFQ231                              |                                                                            | 115  | —    | —    | V             |
|               | BFQ231A                             |                                                                            |      |      |      |               |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage | $I_C = 10\text{ mA}; I_B = 0$                                              | 65   | —    | —    | V             |
|               | BFQ231                              |                                                                            | 95   | —    | —    | V             |
|               | BFQ231A                             |                                                                            |      |      |      |               |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = 10\text{ mA}; R_{BE} = 100\text{ }\Omega$                           | 95   | —    | —    | V             |
|               | BFQ231                              |                                                                            | 110  | —    | —    | V             |
|               | BFQ231A                             |                                                                            |      |      |      |               |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_E = 0.1\text{ mA}; I_C = 0$                                             | 3    | —    | —    | V             |
| $I_{CES}$     | collector-emitter cut-off current   | $I_B = 0; V_{CE} = 50\text{ V}$                                            | —    | —    | 100  | $\mu\text{A}$ |
| $I_{CBO}$     | collector-base cut-off current      | $I_E = 0; V_{CB} = 10\text{ V}$                                            | —    | —    | 20   | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; \text{ see Fig.4}$              | 20   | 35   | —    |               |
| $C_{cb}$      | collector-base capacitance          | $I_C = i_c = 0; V_{CB} = 10\text{ V}; f = 1\text{ MHz}; \text{ see Fig.5}$ | —    | 1.8  | —    | pF            |
| $f_T$         | transition frequency                | $I_C = 50\text{ mA}; V_{CE} = 10\text{ V}; \text{ see Fig.6}$              | 1    | 1.4  | —    | GHz           |
|               | BFQ231                              |                                                                            | 0.8  | 1.2  | —    | GHz           |
|               | BFQ231A                             |                                                                            |      |      |      |               |





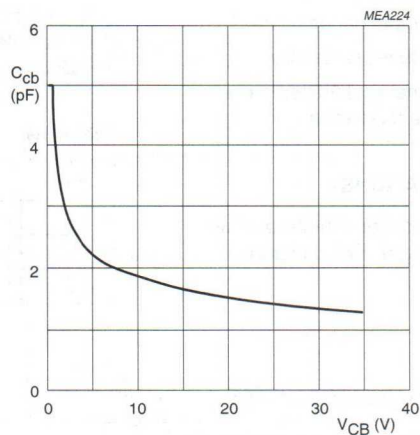
## NPN video transistors

## BFQ231; BFQ231A



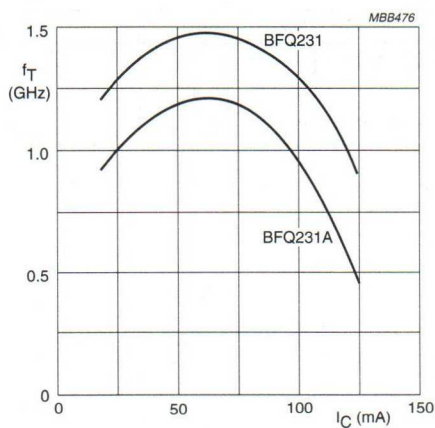
$V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

NPN video transistors

BFQ232; BFQ232A

FEATURES

- High breakdown voltages
- Low output capacitance
- Good thermal stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

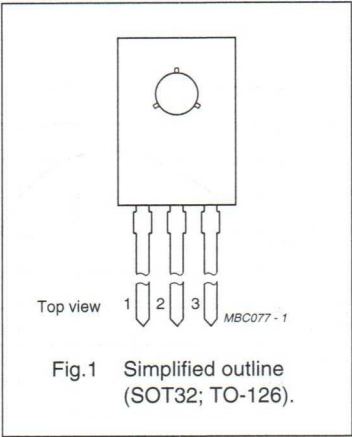
- Buffer/driver in high-resolution colour graphics monitors.

DESCRIPTION

NPN video transistor in a SOT32 (TO-126) plastic package.  
PNP complements: BFQ252 and BFQ252A.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                                                                  | MIN. | TYP. | MAX. | UNIT |
|-----------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage<br>BFQ232<br>BFQ232A    | open emitter                                                                                                | —    | —    | 100  | V    |
|           |                                                |                                                                                                             | —    | —    | 115  | V    |
| $V_{CER}$ | collector-emitter voltage<br>BFQ232<br>BFQ232A | $R_{BE} = 100\ \Omega$                                                                                      | —    | —    | 95   | V    |
|           |                                                |                                                                                                             | —    | —    | 110  | V    |
| $I_C$     | collector current (DC)                         |                                                                                                             | —    | —    | 300  | mA   |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3                                                          | —    | —    | 3    | W    |
| $h_{FE}$  | DC current gain                                | $I_C = 50\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ; $T_{amb} = 25\ ^\circ\text{C}$                            | 20   | 35   | —    |      |
| $f_T$     | transition frequency<br>BFQ232<br>BFQ232A      | $I_C = 50\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ; $f = 100\ \text{MHz}$ ;<br>$T_{amb} = 25\ ^\circ\text{C}$ | 1    | 1.4  | —    | GHz  |
|           |                                                |                                                                                                             | 0.8  | 1.2  | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistors

## BFQ232; BFQ232A

**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT             |
|-----------|---------------------------|----------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       |      |      |                  |
|           | BFQ232                    |                                                    | —    | 100  | V                |
|           | BFQ232A                   |                                                    | —    | 115  | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                          |      |      |                  |
|           | BFQ232                    |                                                    | —    | 65   | V                |
|           | BFQ232A                   |                                                    | —    | 95   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                             |      |      |                  |
|           | BFQ232                    |                                                    | —    | 95   | V                |
|           | BFQ232A                   |                                                    | —    | 110  | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | —    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                    | —    | 300  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                |
| $T_{stg}$ | storage temperature       |                                                    | −65  | +175 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                    | —    | 175  | $^\circ\text{C}$ |

**Note**

1.  $T_s$  is the temperature at the soldering point of the collector pin.

**THERMAL CHARACTERISTICS**

| SYMBOL        | PARAMETER                                           | CONDITIONS                              | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 115\ ^\circ\text{C}$ ; note 1 | 20    | K/W  |

**Note**

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistors

## BFQ232; BFQ232A

## CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                                                | CONDITIONS                                                                                                              | MIN.       | TYP.       | MAX.   | UNIT          |
|---------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------|------------|--------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage<br>BFQ232<br>BFQ232A    | $I_C = 0.1\text{ mA}; I_E = 0$                                                                                          | 100<br>115 | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage<br>BFQ232<br>BFQ232A | $I_C = 10\text{ mA}; I_B = 0$                                                                                           | 65<br>95   | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage<br>BFQ232<br>BFQ232A | $I_C = 10\text{ mA}; R_{BE} = 100\text{ }\Omega$                                                                        | 95<br>110  | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage                           | $I_E = 0.1\text{ mA}; I_C = 0$                                                                                          | 3          | —          | —      | V             |
| $I_{CES}$     | collector-emitter cut-off current                        | $I_B = 0; V_{CE} = 50\text{ V}$                                                                                         | —          | —          | 100    | $\mu\text{A}$ |
| $I_{CBO}$     | collector-base cut-off current                           | $I_E = 0; V_{CB} = 50\text{ V}$                                                                                         | —          | —          | 20     | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                                          | $I_C = 50\text{ mA}; V_{CE} = 10\text{ V};$<br>$T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.4                        | 20         | 35         | —      |               |
| $f_T$         | transition frequency<br>BFQ232<br>BFQ232A                | $I_C = 50\text{ mA}; V_{CE} = 10\text{ V};$<br>$f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C};$<br>see Fig.6 | 1<br>0.8   | 1.4<br>1.2 | —<br>— | GHz<br>GHz    |
| $C_{cb}$      | collector-base capacitance                               | $I_C = 0; V_{CB} = 10\text{ V}; f = 1\text{ MHz};$<br>$T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.5                 | —          | 2          | —      | pF            |

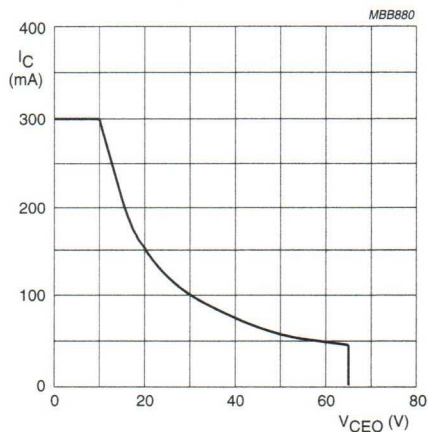


Fig.2 DC SOAR.

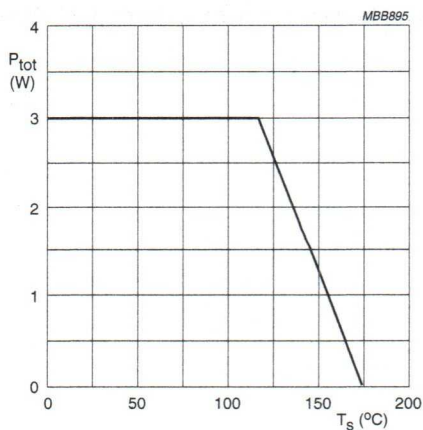
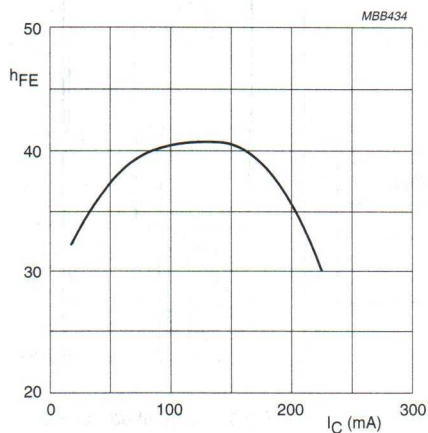


Fig.3 Power derating curve.



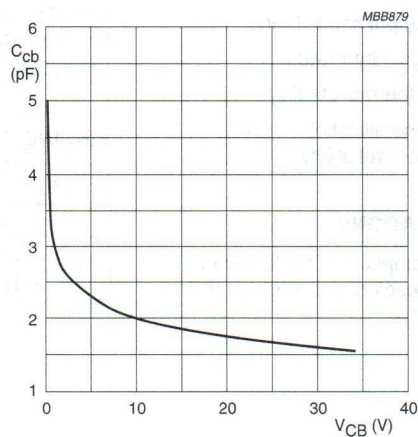
## NPN video transistors

## BFQ232; BFQ232A



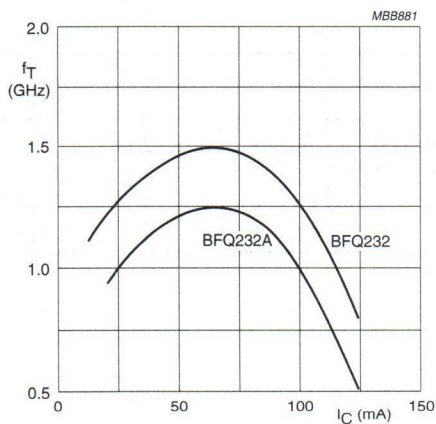
$V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = 10$  V;  $f = 100$  MHz;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

NPN video transistors

BFQ235; BFQ235A

FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

- CRT amplifier buffer/driver in high-resolution colour graphics monitors.

DESCRIPTION

NPN video transistor in a SOT128B (TO-202) plastic package.  
PNP complements: BFQ255 and BFQ255A.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

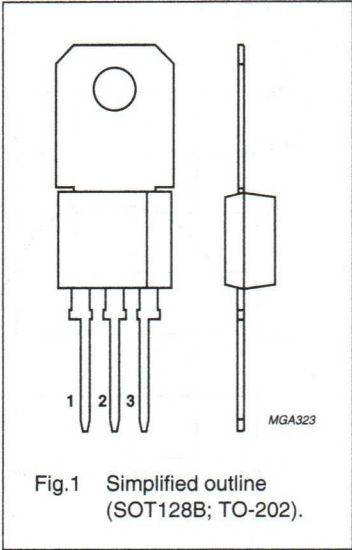


Fig.1 Simplified outline (SOT128B; TO-202).

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                              | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|-----------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                            | —    | —    | 100  | V    |
|           | BFQ235                    |                                                                                         | —    | —    | 115  | V    |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                                                   | —    | —    | 95   | V    |
|           | BFQ235                    |                                                                                         | —    | —    | 110  | V    |
| $I_C$     | collector current (DC)    |                                                                                         | —    | —    | 300  | mA   |
| $P_{tot}$ | total power dissipation   | $T_s \leq 100 \text{ }^\circ\text{C}$ ; note 1                                          | —    | —    | 3    | W    |
| $h_{FE}$  | DC current gain           | $I_C = 50 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$ | 20   | 35   | —    |      |
| $f_T$     | transition frequency      | $I_C = 50 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = 25 \text{ }^\circ\text{C}$ | 1    | 1.4  | —    | GHz  |
|           | BFQ235                    |                                                                                         | 0.8  | 1.2  | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistors

## BFQ235; BFQ235A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                       | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                     |      |      |                  |
|           | BFQ235                    |                                                  | –    | 100  | V                |
|           | BFQ235A                   |                                                  | –    | 115  | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                        |      |      |                  |
|           | BFQ235                    |                                                  | –    | 65   | V                |
|           | BFQ235A                   |                                                  | –    | 95   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                            |      |      |                  |
|           | BFQ235                    |                                                  | –    | 95   | V                |
|           | BFQ235A                   |                                                  | –    | 110  | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                   | –    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                  | –    | 300  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 100^\circ\text{C}$ ; note 1; see Fig.3 | –    | 3    | W                |
| $T_{stg}$ | storage temperature       |                                                  | –65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                  | –    | 175  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                            | VALUE | UNIT |
|---------------|-----------------------------------------------------|---------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 100^\circ\text{C}$ ; note 1 | 25    | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

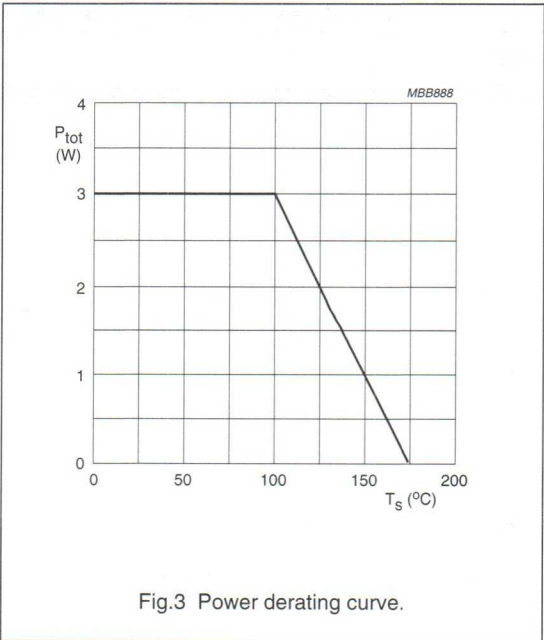
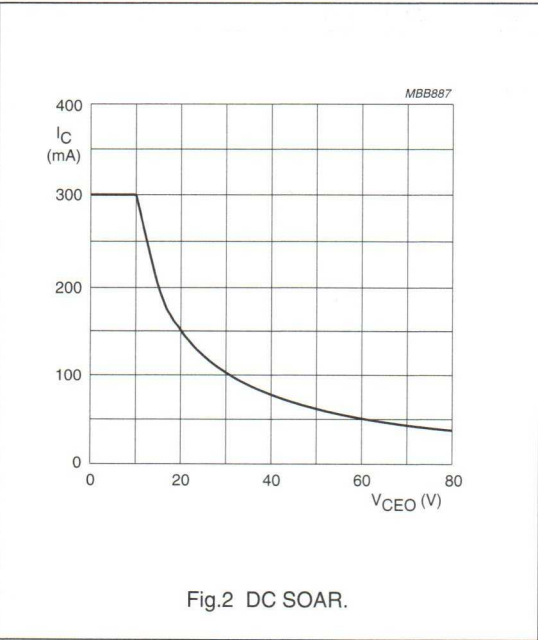
NPN video transistors

BFQ235; BFQ235A

CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

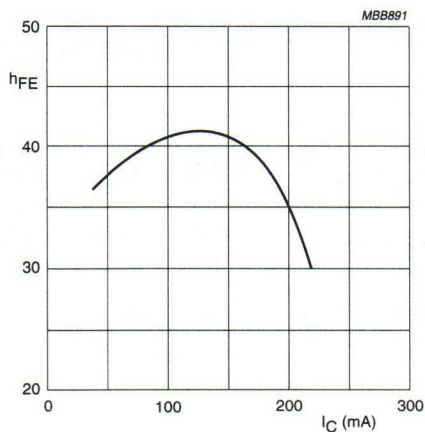
| SYMBOL               | PARAMETER                           | CONDITIONS                                                                                       | MIN. | TYP. | MAX. | UNIT |
|----------------------|-------------------------------------|--------------------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)CBO</sub> | collector-base breakdown voltage    | I <sub>C</sub> = 0.1 mA; I <sub>E</sub> = 0                                                      | 100  | —    | —    | V    |
|                      | BFQ235                              |                                                                                                  | 115  | —    | —    | V    |
| V <sub>(BR)CEO</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = 10 mA; I <sub>B</sub> = 0                                                       | 65   | —    | —    | V    |
|                      | BFQ235A                             |                                                                                                  | 95   | —    | —    | V    |
| V <sub>(BR)CER</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = 10 mA; R <sub>BE</sub> = 100 Ω                                                  | 95   | —    | —    | V    |
|                      | BFQ235A                             |                                                                                                  | 110  | —    | —    | V    |
| V <sub>(BR)EBO</sub> | emitter-base breakdown voltage      | I <sub>E</sub> = 0.1 mA; I <sub>C</sub> = 0                                                      | 3    | —    | —    | V    |
| I <sub>CES</sub>     | collector cut-off current           | I <sub>B</sub> = 0; V <sub>CE</sub> = 50 V                                                       | —    | —    | 100  | μA   |
| I <sub>CBO</sub>     | collector cut-off current           | I <sub>E</sub> = 0; V <sub>CB</sub> = 50 V                                                       | —    | —    | 20   | μA   |
| h <sub>FE</sub>      | DC current gain                     | I <sub>C</sub> = 50 mA; V <sub>CE</sub> = 10 V; T <sub>amb</sub> = 25 °C; see Fig.4              | 20   | 35   | —    |      |
| f <sub>T</sub>       | transition frequency                | I <sub>C</sub> = 50 mA; V <sub>CE</sub> = 10 V; f = 100 MHz; T <sub>amb</sub> = 25 °C; see Fig.6 | 1    | 1.4  | —    | GHz  |
|                      | BFQ235                              |                                                                                                  | 0.8  | 1.2  | —    | GHz  |
| C <sub>cb</sub>      | collector-base capacitance          | I <sub>C</sub> = 0; V <sub>CB</sub> = 10 V; f = 1 MHz; T <sub>amb</sub> = 25 °C; see Fig.5       | —    | 2    | —    | pF   |





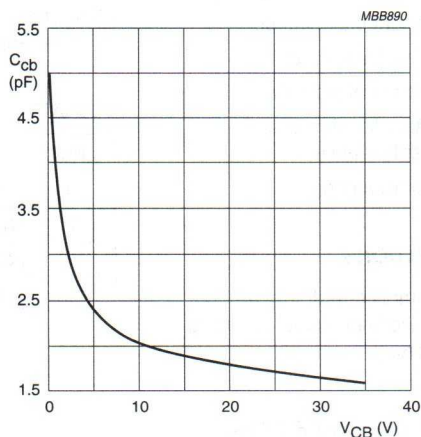
## NPN video transistors

## BFQ235; BFQ235A



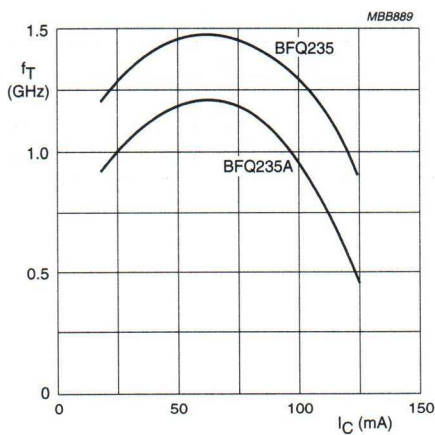
$V_{CE} = 10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = 10$  V;  $f = 100$  MHz;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

NPN video transistors

BFQ236; BFQ236A

FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability
- Surface mounting.

APPLICATIONS

- CRT amplifier buffer/driver in high-resolution colour graphics monitors.

DESCRIPTION

NPN video transistor in a SOT223 plastic package. PNP complements: BFQ256 and BFQ256A.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |

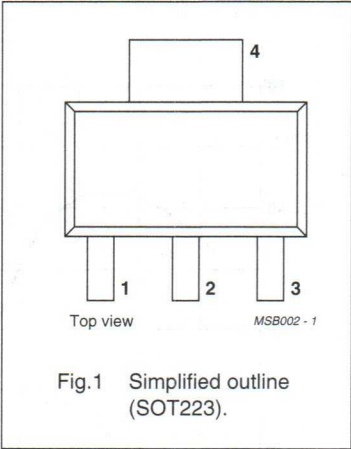


Fig.1 Simplified outline (SOT223).

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                              | MIN. | TYP. | MAX. | UNIT |
|-----------|------------------------------------------------|-------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage<br>BFQ236<br>BFQ236A    | open emitter                                                            | —    | —    | 100  | V    |
|           |                                                |                                                                         | —    | —    | 115  | V    |
| $V_{CER}$ | collector-emitter voltage<br>BFQ236<br>BFQ236A | $R_{BE} = 100\ \Omega$                                                  | —    | —    | 95   | V    |
|           |                                                |                                                                         | —    | —    | 110  | V    |
| $I_C$     | collector current (DC)                         |                                                                         | —    | —    | 300  | mA   |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 115\ ^\circ\text{C}$ ; note 1                                 | —    | —    | 2    | W    |
| $h_{FE}$  | DC current gain                                | $I_C = 50\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ; see Fig.4             | 20   | 35   | —    |      |
| $f_T$     | transition frequency<br>BFQ236<br>BFQ236A      | $I_C = 50\ \text{mA}$ ; $V_{CE} = 10\ \text{V}$ ; $f = 100\ \text{MHz}$ | 1    | 1.4  | —    | GHz  |
|           |                                                |                                                                         | 0.8  | 1.2  | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## NPN video transistors

## BFQ236; BFQ236A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT             |
|-----------|---------------------------|----------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       |      |      |                  |
|           | BFQ236                    |                                                    | –    | 100  | V                |
|           | BFQ236A                   |                                                    | –    | 115  | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                          |      |      |                  |
|           | BFQ236                    |                                                    | –    | 65   | V                |
|           | BFQ236A                   |                                                    | –    | 95   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                             |      |      |                  |
|           | BFQ236                    |                                                    | –    | 95   | V                |
|           | BFQ236A                   |                                                    | –    | 110  | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | –    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                    | –    | 300  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3 | –    | 2    | W                |
| $T_{stg}$ | storage temperature       |                                                    | –65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                    | –    | 175  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                               | VALUE | UNIT |
|---------------|-----------------------------------------------------|--------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s = 115\ ^\circ\text{C}$ ; $P_{tot} = 2\ \text{W}$ ;<br>notes 1 and 2 | 30    | K/W  |

## Notes

1.  $T_s$  is the temperature at the soldering point of the collector lead.
2. Device mounted on a printed-circuit board measuring  $40 \times 40 \times 1\ \text{mm}$  (collector pad  $35 \times 17\ \text{mm}$ ).

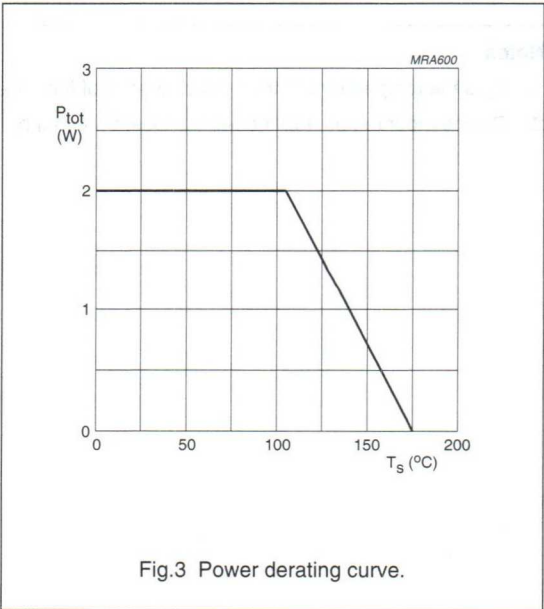
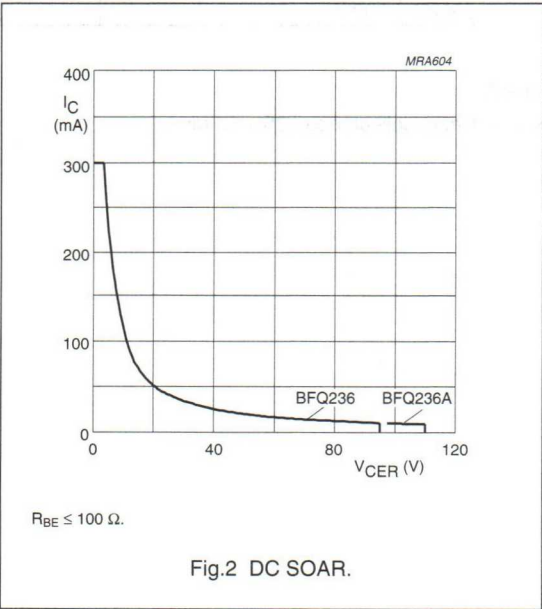
NPN video transistors

BFQ236; BFQ236A

CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

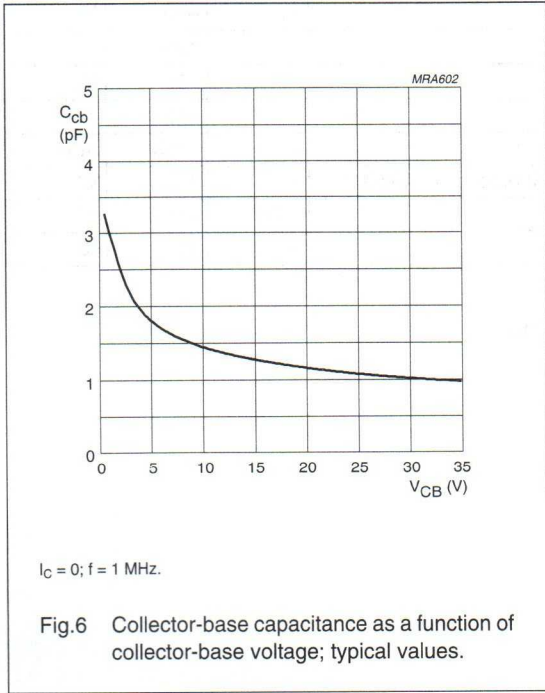
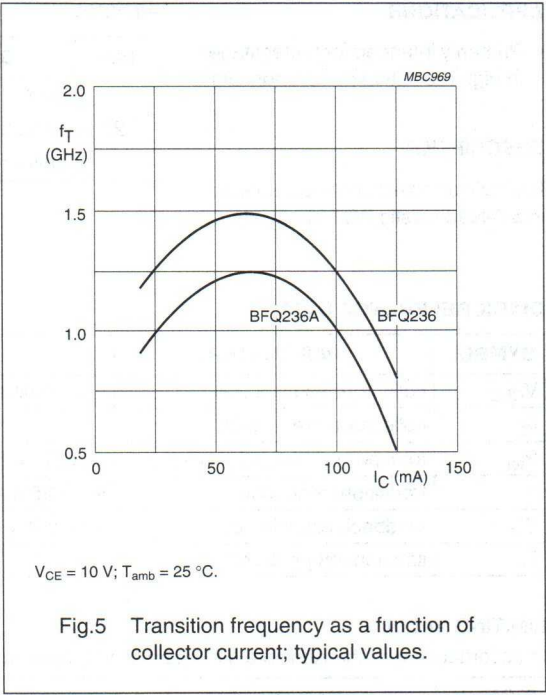
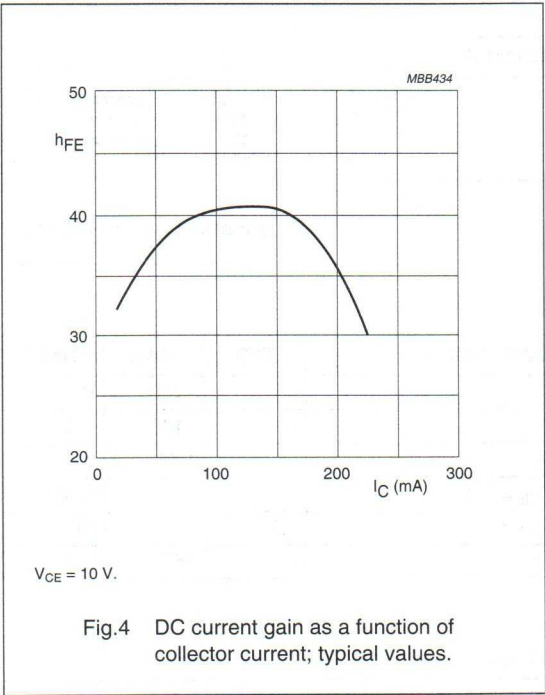
| SYMBOL               | PARAMETER                           | CONDITIONS                                                                           | MIN. | TYP. | MAX. | UNIT |
|----------------------|-------------------------------------|--------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)CBO</sub> | collector-base breakdown voltage    | I <sub>C</sub> = 100 µA; I <sub>E</sub> = 0                                          | 100  | –    | –    | V    |
|                      | BFQ236                              |                                                                                      | 115  | –    | –    | V    |
| V <sub>(BR)CEO</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = 10 mA; I <sub>B</sub> = 0                                           | 65   | –    | –    | V    |
|                      | BFQ236A                             |                                                                                      | 95   | –    | –    | V    |
| V <sub>(BR)CER</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = 1 mA; R <sub>BE</sub> = 100 Ω                                       | 95   | –    | –    | V    |
|                      | BFQ236A                             |                                                                                      | 110  | –    | –    | V    |
| I <sub>CES</sub>     | collector-emitter cut-off current   | I <sub>B</sub> = 0; V <sub>CE</sub> = 50 V                                           | –    | –    | 100  | µA   |
| I <sub>CBO</sub>     | collector-base cut-off current      | I <sub>E</sub> = 0; V <sub>CB</sub> = 50 V                                           | –    | –    | 20   | µA   |
| h <sub>FE</sub>      | DC current gain                     | I <sub>C</sub> = 50 mA; V <sub>CE</sub> = 10 V;<br>see Fig.4                         | 20   | 35   | –    |      |
| C <sub>c</sub>       | collector capacitance               | I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = 10 V;<br>f = 1 MHz            | –    | 1.8  | –    | pF   |
| C <sub>cb</sub>      | collector-base capacitance          | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = 10 V;<br>f = 1 MHz; see Fig.6 | –    | 1.5  | –    | pF   |
| f <sub>T</sub>       | transition frequency                | I <sub>C</sub> = 50 mA; V <sub>CE</sub> = 10 V;<br>f = 100 MHz; see Fig.5            | 1    | 1.4  | –    | GHz  |
|                      | BFQ236A                             |                                                                                      | 0.8  | 1.2  | –    | GHz  |





NPN video transistors

BFQ236; BFQ236A



PNP video transistor

BFQ241

APPLICATIONS

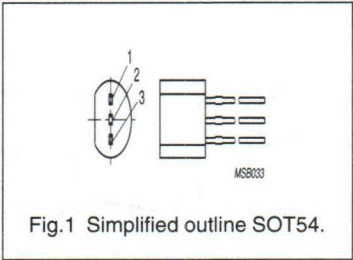
- Primarily intended for buffer stages in high resolution colour monitors.

DESCRIPTION

PNP silicon transistor encapsulated in a 3-lead plastic SOT54 package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                      | TYP | MAX  | UNIT               |
|-----------|-------------------------|-------------------------------------------------|-----|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                    | —   | −100 | V                  |
| $I_C$     | collector current (DC)  |                                                 | —   | −100 | mA                 |
| $P_{tot}$ | total power dissipation | up to $T_s = 60\text{ }^{\circ}\text{C}$        | —   | 1.15 | W                  |
| $f_T$     | transition frequency    | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ | 1   | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = -10\text{ V}$             | 1.7 | —    | pF                 |
| $T_j$     | junction temperature    |                                                 | —   | 150  | $^{\circ}\text{C}$ |

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

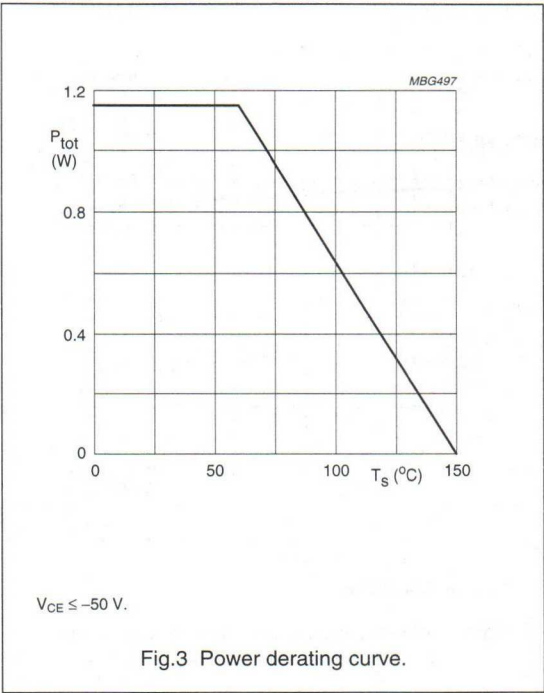
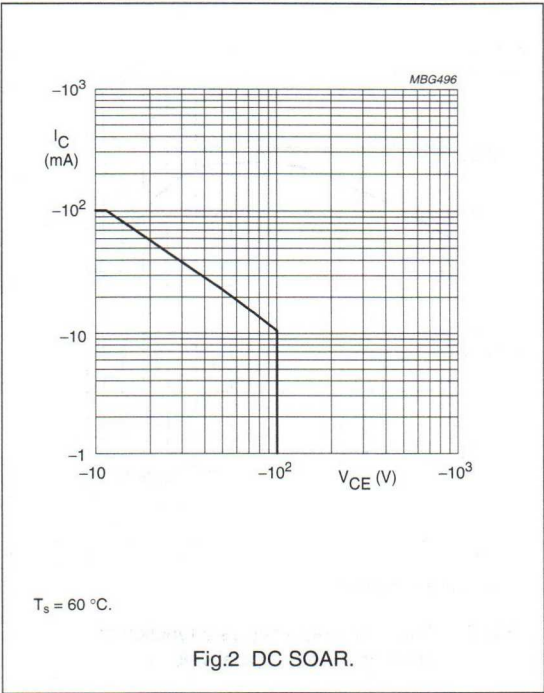
| SYMBOL      | PARAMETER                 | CONDITIONS                                                   | MIN | MAX  | UNIT               |
|-------------|---------------------------|--------------------------------------------------------------|-----|------|--------------------|
| $V_{CBO}$   | collector-base voltage    | open emitter                                                 | —   | −100 | V                  |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\text{ }\Omega$                                 | —   | −95  | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                               | —   | −3   | V                  |
| $I_C$       | collector current (DC)    | see Fig.2                                                    | —   | −100 | mA                 |
| $I_{C(AV)}$ | average collector current | see Fig.2                                                    | —   | −100 | mA                 |
| $P_{tot}$   | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.3 | —   | 1.15 | W                  |
| $T_{stg}$   | storage temperature       |                                                              | −65 | +150 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                              | —   | 150  | $^{\circ}\text{C}$ |

Note

- $T_s$  is the temperature at the soldering point of the collector pin.

PNP video transistor

BFQ241



THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                      | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 1.15\text{ W}$ ; up to $T_s = 60\text{ °C}$ ; note 1 | 78    | K/W  |

Note

- $T_s$  is the temperature of the soldering point of the collector pin.

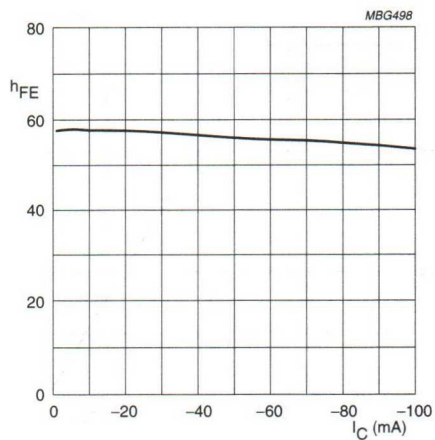
CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                         | MIN  | TYP | MAX  | UNIT          |
|---------------|-------------------------------------|------------------------------------------------------------------------------------|------|-----|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = -0.1\text{ mA}$ ; $I_E = 0$                                                 | -100 | —   | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = -1\text{ mA}$ ; $R_{BE} = 100\ \Omega$                                      | -95  | —   | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = -0.1\text{ mA}$                                                 | -3   | —   | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = -50\text{ V}$ ; $V_{BE} = 0$                                             | —    | —   | -100 | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; see Fig.4                        | 20   | —   | —    |               |
| $f_T$         | transition frequency                | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —    | 1   | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = -10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6               | —    | 1.7 | —    | pF            |

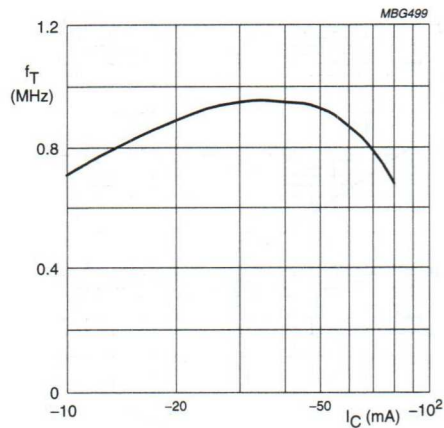
## PNP video transistor

BFQ241



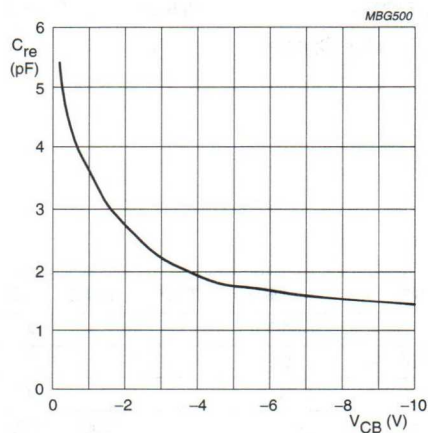
$V_{CE} = -10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = -10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.



# PNP video transistor

BFQ242

## APPLICATIONS

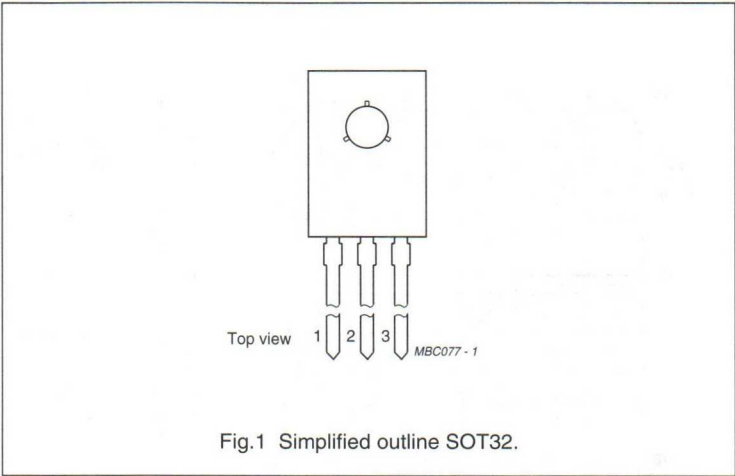
- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

## DESCRIPTION

PNP silicon transistor encapsulated in a 3-lead plastic SOT32 package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                      | TYP. | MAX. | UNIT |
|-----------|-------------------------|-------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                    | —    | −100 | V    |
| $I_C$     | collector current (DC)  |                                                 | —    | −100 | mA   |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$                         | —    | 5    | W    |
| $f_T$     | transition frequency    | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ | 1    | —    | GHz  |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = -10\text{ V}$             | 1.7  | —    | pF   |
| $T_j$     | junction temperature    |                                                 | —    | 175  | °C   |

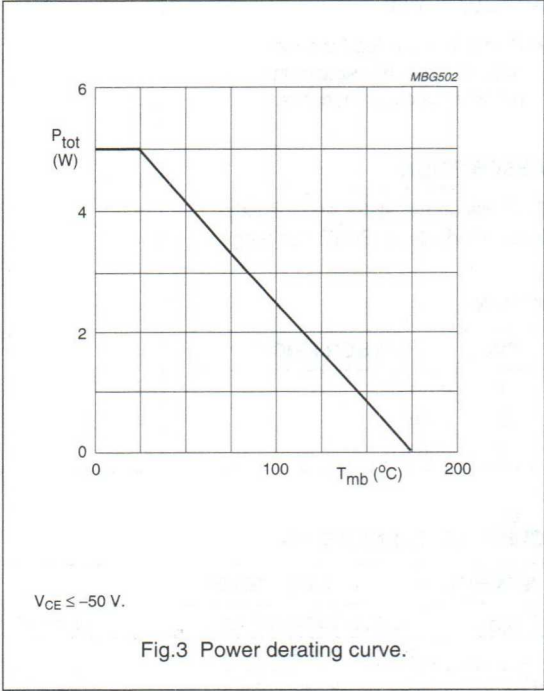
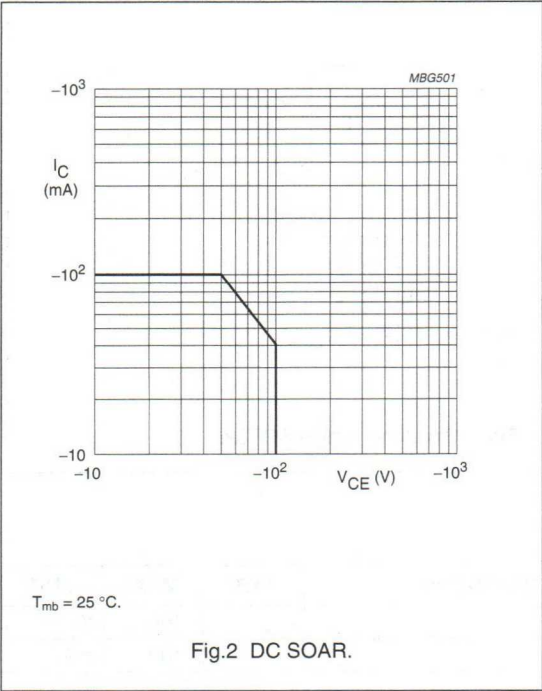
## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL      | PARAMETER                 | CONDITIONS                          | MIN. | MAX. | UNIT |
|-------------|---------------------------|-------------------------------------|------|------|------|
| $V_{CBO}$   | collector-base voltage    | open emitter                        | —    | −100 | V    |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\ \Omega$              | —    | −95  | V    |
| $V_{EBO}$   | emitter-base voltage      | open collector                      | —    | −3   | V    |
| $I_C$       | collector current (DC)    | see Fig.2                           | —    | −100 | mA   |
| $I_{C(AV)}$ | average collector current | see Fig.2                           | —    | −100 | mA   |
| $P_{tot}$   | total power dissipation   | $T_{mb} = 25\text{ °C}$ ; see Fig.3 | —    | 5    | W    |
| $T_{stg}$   | storage temperature       |                                     | −65  | +175 | °C   |
| $T_j$       | junction temperature      |                                     | —    | 175  | °C   |

PNP video transistor

BFQ242



THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS                                    | VALUE | UNIT |
|----------------|---------------------------------------------------|-----------------------------------------------|-------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $P_{tot} = 5\text{ W}; T_{mb} = 25\text{ °C}$ | 30    | K/W  |

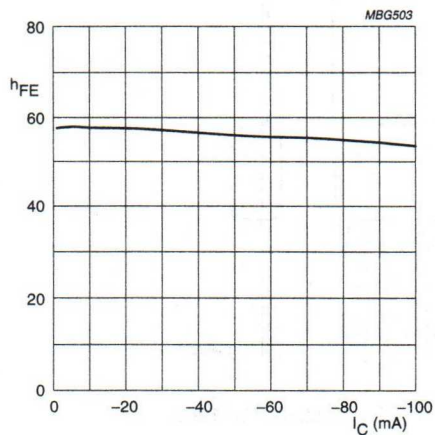
CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                       | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|----------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = -0.1\text{ mA}; I_E = 0$                                                  | -100 | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = -1\text{ mA}; R_{BE} = 100\ \Omega$                                       | -95  | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0; I_E = -0.1\text{ mA}$                                                  | -3   | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = -50\text{ V}; V_{BE} = 0$                                              | —    | —    | -100 | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = -25\text{ mA}; V_{CE} = -10\text{ V};$<br>see Fig.4                       | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = -25\text{ mA}; V_{CE} = -10\text{ V};$<br>$f = 500\text{ MHz};$ see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0; V_{CB} = -10\text{ V};$<br>$f = 1\text{ MHz};$ see Fig.6               | —    | 1.7  | —    | pF            |

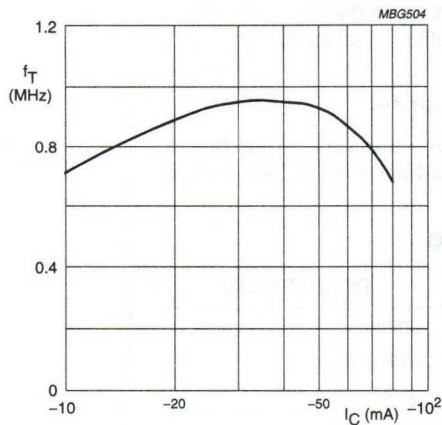
## PNP video transistor

BFQ242



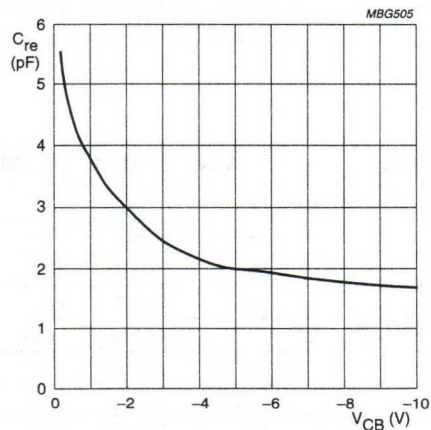
$V_{CE} = -10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = -10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

## PNP video transistor

BFQ245

## APPLICATIONS

- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

## DESCRIPTION

PNP silicon transistor encapsulated in a 3-lead plastic SOT128B package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

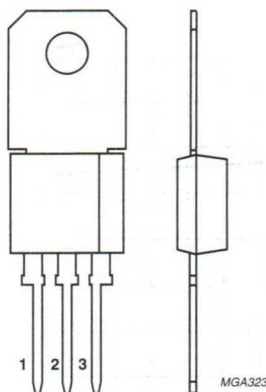


Fig.1 Simplified outline SOT128B.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                      | TYP. | MAX. | UNIT |
|-----------|-------------------------|-------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                    | —    | −100 | V    |
| $I_C$     | collector current (DC)  |                                                 | —    | −100 | mA   |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25\text{ °C}$                         | —    | 3.75 | W    |
| $f_T$     | transition frequency    | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ | 1    | —    | GHz  |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = -10\text{ V}$             | 1.7  | —    | pF   |
| $T_j$     | junction temperature    |                                                 | —    | 175  | °C   |

## LIMITING VALUES

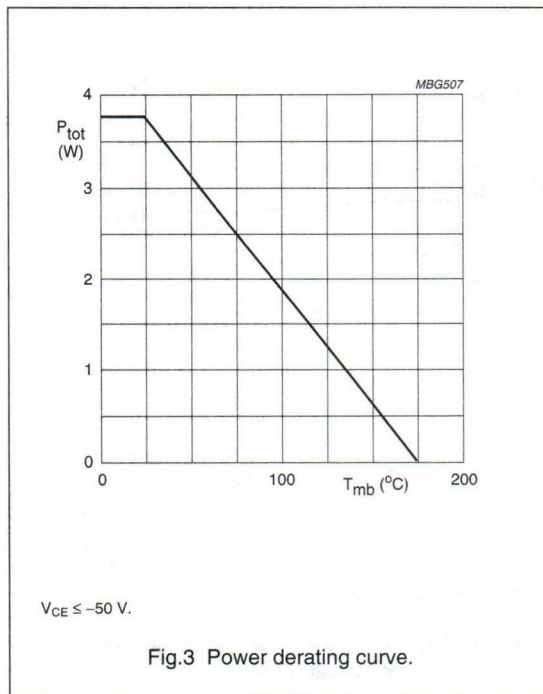
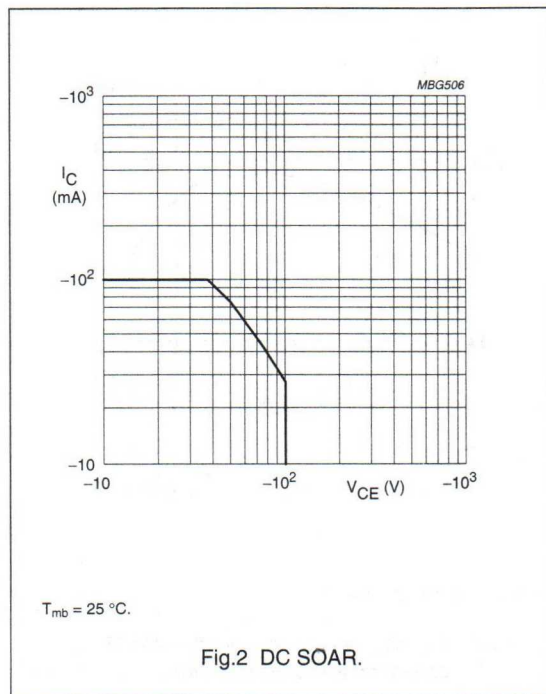
In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL      | PARAMETER                 | CONDITIONS                          | MIN. | MAX. | UNIT |
|-------------|---------------------------|-------------------------------------|------|------|------|
| $V_{CBO}$   | collector-base voltage    | open emitter                        | —    | −100 | V    |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\ \Omega$              | —    | −95  | V    |
| $V_{EBO}$   | emitter-base voltage      | open collector                      | —    | −3   | V    |
| $I_C$       | collector current (DC)    | see Fig.2                           | —    | −100 | mA   |
| $I_{C(AV)}$ | average collector current | see Fig.2                           | —    | −100 | mA   |
| $P_{tot}$   | total power dissipation   | $T_{mb} = 25\text{ °C}$ ; see Fig.3 | —    | 3.75 | W    |
| $T_{stg}$   | storage temperature       |                                     | −65  | +175 | °C   |
| $T_j$       | junction temperature      |                                     | —    | 175  | °C   |



## PNP video transistor

BFQ245



## THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS                                          | VALUE | UNIT |
|----------------|---------------------------------------------------|-----------------------------------------------------|-------|------|
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base | $P_{tot} = 3.75\text{ W}$ ; $T_{mb} = 25\text{ °C}$ | 40    | K/W  |

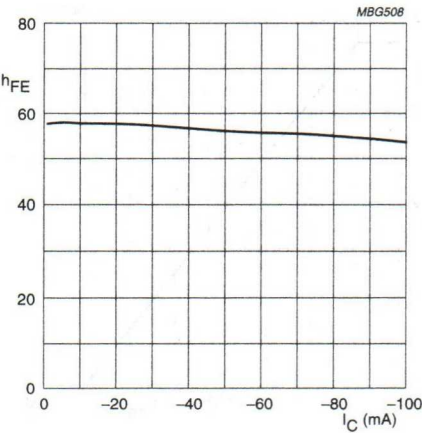
## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                         | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = -0.1\text{ mA}$ ; $I_E = 0$                                                 | -100 | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = -1\text{ mA}$ ; $R_{BE} = 100\ \Omega$                                      | -95  | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = -0.1\text{ mA}$                                                 | -3   | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = -50\text{ V}$ ; $V_{BE} = 0$                                             | —    | —    | -100 | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; see Fig.4                        | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = -10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6               | —    | 1.7  | —    | pF            |

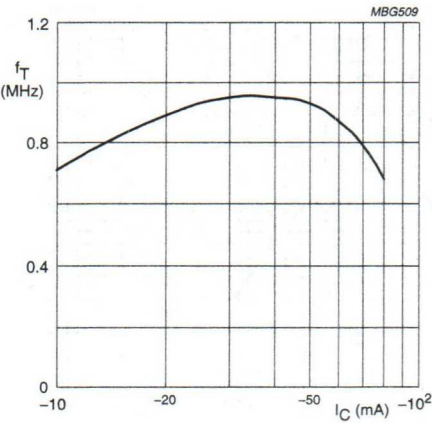
PNP video transistor

BFQ245



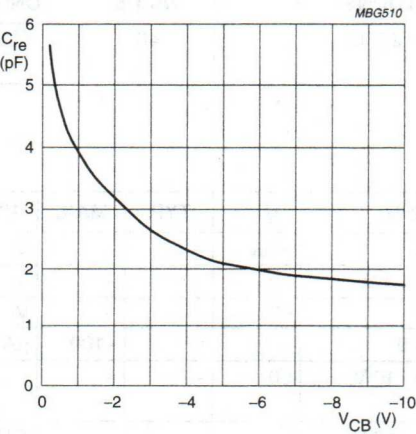
$V_{CE} = -10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = -10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

# PNP video transistor

BFQ246

## APPLICATIONS

- Primarily intended for cascode output and buffer stages in high resolution colour monitors.

## DESCRIPTION

PNP silicon transistor encapsulated in a 4-lead plastic SOT223 package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |

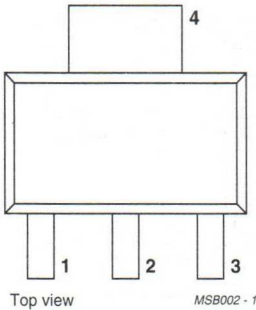


Fig.1 Simplified outline SOT223.

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER               | CONDITIONS                                      | TYP. | MAX. | UNIT               |
|-----------|-------------------------|-------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage  | open emitter                                    | —    | −100 | V                  |
| $I_C$     | collector current (DC)  |                                                 | —    | −100 | mA                 |
| $P_{tot}$ | total power dissipation | up to $T_s = 60\text{ }^{\circ}\text{C}$        | —    | 3    | W                  |
| $f_T$     | transition frequency    | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ | 1    | —    | GHz                |
| $C_{re}$  | feedback capacitance    | $I_C = 0$ ; $V_{CB} = -10\text{ V}$             | 1.7  | —    | pF                 |
| $T_j$     | junction temperature    |                                                 | —    | 175  | $^{\circ}\text{C}$ |

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

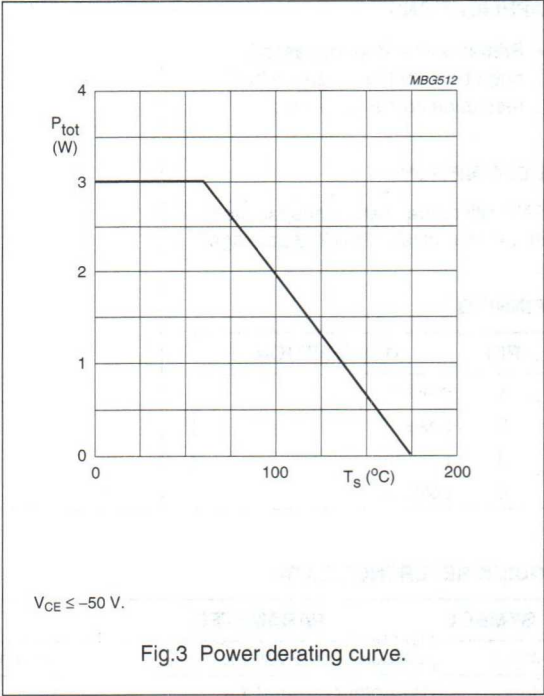
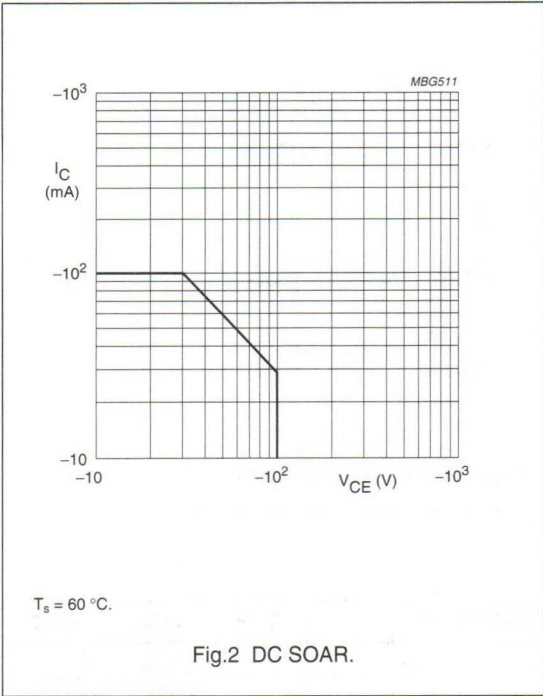
| SYMBOL      | PARAMETER                 | CONDITIONS                                                   | MIN. | MAX. | UNIT               |
|-------------|---------------------------|--------------------------------------------------------------|------|------|--------------------|
| $V_{CBO}$   | collector-base voltage    | open emitter                                                 | —    | −100 | V                  |
| $V_{CER}$   | collector-emitter voltage | $R_{BE} = 100\text{ }\Omega$                                 | —    | −95  | V                  |
| $V_{EBO}$   | emitter-base voltage      | open collector                                               | —    | −3   | V                  |
| $I_C$       | collector current (DC)    | see Fig.2                                                    | —    | −100 | mA                 |
| $I_{C(AV)}$ | average collector current | see Fig.2                                                    | —    | −100 | mA                 |
| $P_{tot}$   | total power dissipation   | up to $T_s = 60\text{ }^{\circ}\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                  |
| $T_{stg}$   | storage temperature       |                                                              | −65  | +175 | $^{\circ}\text{C}$ |
| $T_j$       | junction temperature      |                                                              | —    | 175  | $^{\circ}\text{C}$ |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

# PNP video transistor

BFQ246



## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                   | VALUE | UNIT |
|---------------|-----------------------------------------------------|--------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $P_{tot} = 3\text{ W}$ ; up to $T_s = 60\text{ °C}$ ; note 1 | 38.5  | K/W  |

### Note

- $T_s$  is the temperature of the soldering point of the collector pin.

## CHARACTERISTICS

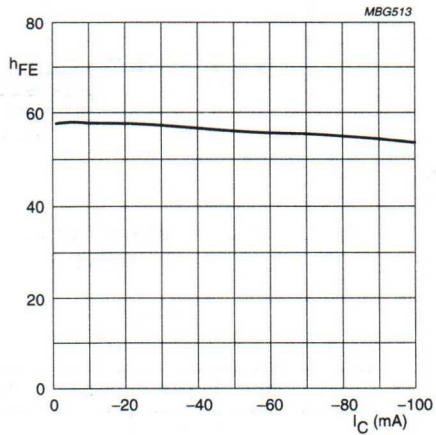
$T_j = 25\text{ °C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                           | CONDITIONS                                                                         | MIN. | TYP. | MAX. | UNIT          |
|---------------|-------------------------------------|------------------------------------------------------------------------------------|------|------|------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage    | $I_C = -0.1\text{ mA}$ ; $I_E = 0$                                                 | -100 | —    | —    | V             |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage | $I_C = -1\text{ mA}$ ; $R_{BE} = 100\ \Omega$                                      | -95  | —    | —    | V             |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage      | $I_C = 0$ ; $I_E = -0.1\text{ mA}$                                                 | -3   | —    | —    | V             |
| $I_{CES}$     | collector-emitter leakage current   | $V_{CE} = -50\text{ V}$ ; $V_{BE} = 0$                                             | —    | —    | -100 | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                     | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; see Fig.4                        | 20   | —    | —    |               |
| $f_T$         | transition frequency                | $I_C = -25\text{ mA}$ ; $V_{CE} = -10\text{ V}$ ; $f = 500\text{ MHz}$ ; see Fig.5 | —    | 1    | —    | GHz           |
| $C_{re}$      | feedback capacitance                | $I_C = 0$ ; $V_{CB} = -10\text{ V}$ ; $f = 1\text{ MHz}$ ; see Fig.6               | —    | 1.7  | —    | pF            |



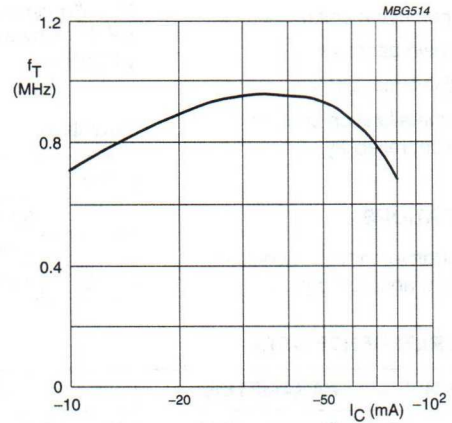
## PNP video transistor

BFQ246



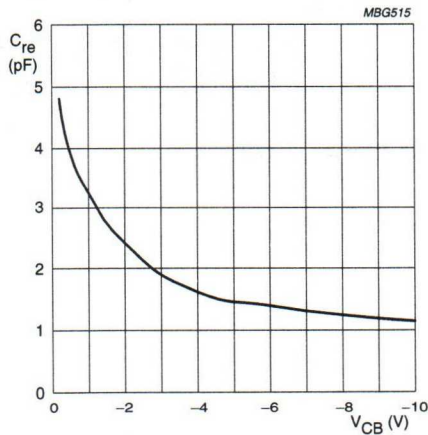
$V_{CE} = -10$  V;  $t_p = 500$   $\mu$ s.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = -10$  V;  $f = 500$  MHz.

Fig.5 Transition frequency as a function of collector current; typical values.



$f = 1$  MHz.

Fig.6 Feedback capacitance as a function of collector-base voltage; typical values.

## PNP video transistors

## BFQ251; BFQ251A

## FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

- Buffer/driver in high-resolution colour graphics monitors.

## DESCRIPTION

PNP video transistor in a SOT54 (TO-92) plastic package.  
NPN complements: BFQ231 and BFQ231A.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |

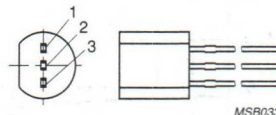


Fig.1 Simplified outline (SOT54; TO-92).

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                                       | MIN.     | TYP.       | MAX.         | UNIT       |
|-----------|------------------------------------------------|----------------------------------------------------------------------------------|----------|------------|--------------|------------|
| $V_{CBO}$ | collector-base voltage<br>BFQ251<br>BFQ251A    | open emitter                                                                     | —        | —          | -100<br>-115 | V<br>V     |
| $V_{CER}$ | collector-emitter voltage<br>BFQ251<br>BFQ251A | $R_{BE} = 100 \Omega$                                                            | —        | —          | -95<br>-110  | V<br>V     |
| $I_C$     | collector current (DC)                         |                                                                                  | —        | —          | -300         | mA         |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 65^\circ\text{C}$ ; note 1                                             | —        | —          | 1            | W          |
| $h_{FE}$  | DC current gain                                | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$                                | 20       | 30         | —            |            |
| $f_T$     | transition frequency<br>BFQ251<br>BFQ251A      | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$ ; $T_{amb} = 25^\circ\text{C}$ | 1<br>0.8 | 1.3<br>1.2 | —            | GHz<br>GHz |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.

## PNP video transistors

## BFQ251; BFQ251A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                                  | MIN. | MAX. | UNIT             |
|-----------|---------------------------|-------------------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                |      |      |                  |
|           | BFQ251                    |                                                             | —    | −100 | V                |
|           | BFQ251A                   |                                                             | —    | −115 | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                                   |      |      |                  |
|           | BFQ251                    |                                                             | —    | −65  | V                |
|           | BFQ251A                   |                                                             | —    | −95  | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                                      |      |      |                  |
|           | BFQ251                    |                                                             | —    | −95  | V                |
|           | BFQ251A                   |                                                             | —    | −110 | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                              | —    | −3   | V                |
| $I_C$     | collector current (DC)    |                                                             | —    | −300 | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 65\ ^\circ\text{C}$ ; notes 1 and 2;<br>see Fig.3 | —    | 1    | W                |
| $T_{stg}$ | storage temperature       |                                                             | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                             | —    | 150  | $^\circ\text{C}$ |

## Notes

- $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.
- Transistor mounted on a printed-circuit board with a metallized pad area of 10 mm<sup>2</sup>.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS | VALUE | UNIT |
|---------------|-----------------------------------------------------|------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | note 1     | 85    | K/W  |
| $R_{th\ j-a}$ | thermal resistance from junction to ambient         |            | 185   | K/W  |
| $R_{th\ s-a}$ | thermal resistance from soldering point to ambient  |            | 100   | K/W  |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin, 4 mm from the body.

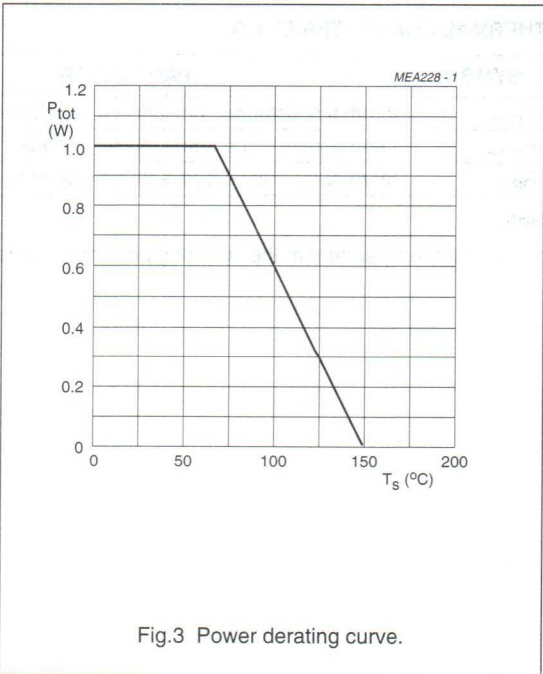
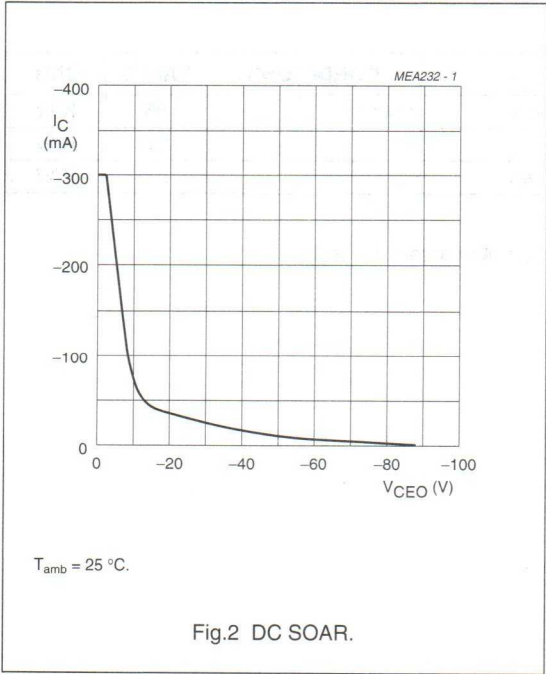
PNP video transistors

BFQ251; BFQ251A

CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

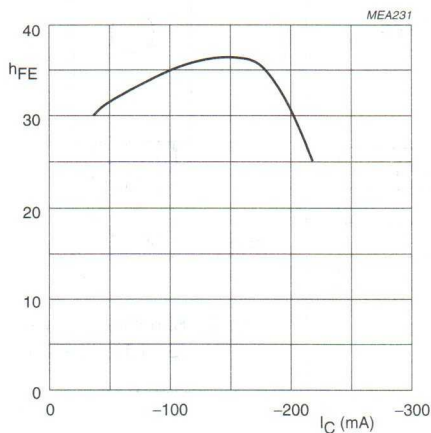
| SYMBOL               | PARAMETER                           | CONDITIONS                                                                         | MIN. | TYP. | MAX. | UNIT |
|----------------------|-------------------------------------|------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)CBO</sub> | collector-base breakdown voltage    | I <sub>C</sub> = -0.1 mA; I <sub>E</sub> = 0                                       | -100 | -    | -    | V    |
|                      | BFQ251                              |                                                                                    | -115 | -    | -    | V    |
| V <sub>(BR)CEO</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = -10 mA; I <sub>B</sub> = 0                                        | -65  | -    | -    | V    |
|                      | BFQ251A                             |                                                                                    | -95  | -    | -    | V    |
| V <sub>(BR)CER</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = -10 mA; R <sub>BE</sub> = 100 Ω                                   | -95  | -    | -    | V    |
|                      | BFQ251A                             |                                                                                    | -110 | -    | -    | V    |
| V <sub>(BR)EBO</sub> | emitter-base breakdown voltage      | I <sub>E</sub> = -0.1 mA; I <sub>C</sub> = 0                                       | -3   | -    | -    | V    |
| I <sub>CES</sub>     | collector-emitter cut-off current   | I <sub>B</sub> = 0; V <sub>CE</sub> = -50 V                                        | -    | -    | -100 | µA   |
| I <sub>CBO</sub>     | collector-base cut-off current      | I <sub>E</sub> = 0; V <sub>CB</sub> = -50 V                                        | -    | -    | -20  | µA   |
| h <sub>FE</sub>      | DC current gain                     | I <sub>C</sub> = -50 mA; V <sub>CE</sub> = -10 V; see Fig.4                        | 20   | 30   | -    |      |
| C <sub>cb</sub>      | collector-base capacitance          | I <sub>C</sub> = I <sub>c</sub> = 0; V <sub>CB</sub> = -10 V; f = 1 MHz; see Fig.5 | -    | 2    | -    | pF   |
| f <sub>T</sub>       | transition frequency                | I <sub>C</sub> = -50; V <sub>CE</sub> = -10 V; see Fig.6                           | 1    | 1.3  | -    | GHz  |
|                      | BFQ251A                             |                                                                                    | 0.8  | 1.2  | -    | GHz  |





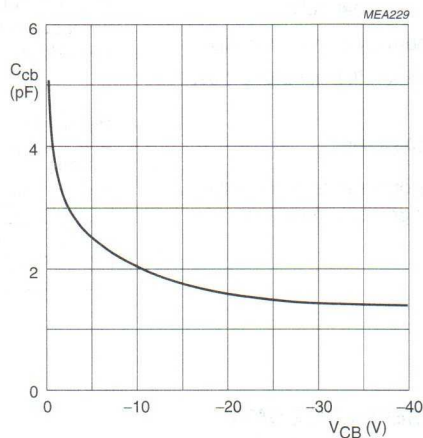
## PNP video transistors

## BFQ251; BFQ251A



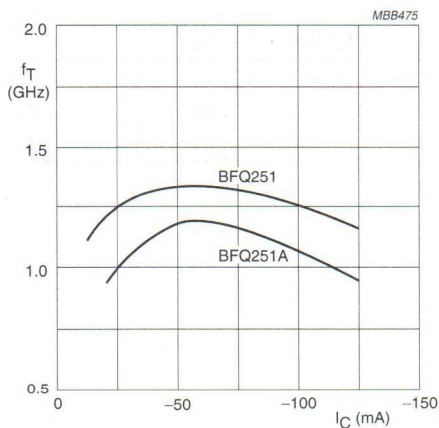
$V_{CE} = -10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = -10$  V;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

## PNP video transistors

## BFQ252; BFQ252A

## FEATURES

- High breakdown voltages
- Low output capacitance
- Optimum temperature profile
- Excellent reliability properties.

## APPLICATIONS

- Buffer/driver in high-resolution colour graphics monitors.

## DESCRIPTION

PNP video transistor in a SOT32 (TO-126) plastic package.  
NPN complements: BFQ232 and BFQ232A.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

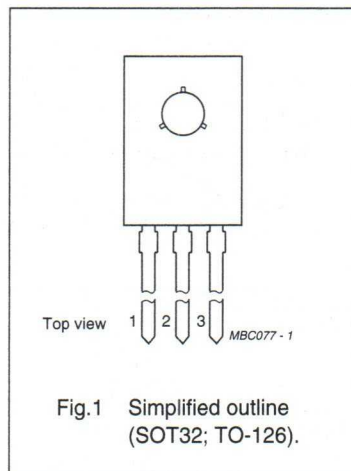


Fig.1 Simplified outline (SOT32; TO-126).

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                                                                  | MIN. | TYP. | MAX. | UNIT |
|-----------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage<br>BFQ252<br>BFQ252A    | open emitter                                                                                                | —    | —    | —100 | V    |
|           |                                                |                                                                                                             | —    | —    | —115 | V    |
| $V_{CER}$ | collector-emitter voltage<br>BFQ252<br>BFQ252A | $R_{BE} = 100 \Omega$                                                                                       | —    | —    | —95  | V    |
|           |                                                |                                                                                                             | —    | —    | —110 | V    |
| $I_C$     | collector current (DC)                         |                                                                                                             | —    | —    | —300 | mA   |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 115^\circ\text{C}$ ; note 1                                                                       | —    | —    | 3    | W    |
| $h_{FE}$  | DC current gain                                | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$ ; $T_{amb} = 25^\circ\text{C}$                            | 20   | 30   | —    |      |
| $f_T$     | transition frequency<br>BFQ252<br>BFQ252A      | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$ ; $f = 100 \text{ MHz}$ ;<br>$T_{amb} = 25^\circ\text{C}$ | 1    | 1.3  | —    | GHz  |
|           |                                                |                                                                                                             | 0.8  | 1.2  | —    | GHz  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## PNP video transistors

## BFQ252; BFQ252A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT             |
|-----------|---------------------------|----------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       | —    | −100 | V                |
|           | BFQ252<br>BFQ252A         |                                                    | —    | −115 | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                          | —    | −65  | V                |
|           | BFQ252<br>BFQ252A         |                                                    | —    | −95  | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                             | —    | −95  | V                |
|           | BFQ252<br>BFQ252A         |                                                    | —    | −110 | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | —    | −3   | V                |
| $I_C$     | collector current (DC)    |                                                    | —    | −300 | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                |
| $T_{stg}$ | storage temperature       |                                                    | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                    | —    | 175  | $^\circ\text{C}$ |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                              | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 115\ ^\circ\text{C}$ ; note 1 | 20    | K/W  |

## Note

- $T_s$  is the temperature at the soldering point of the collector pin.

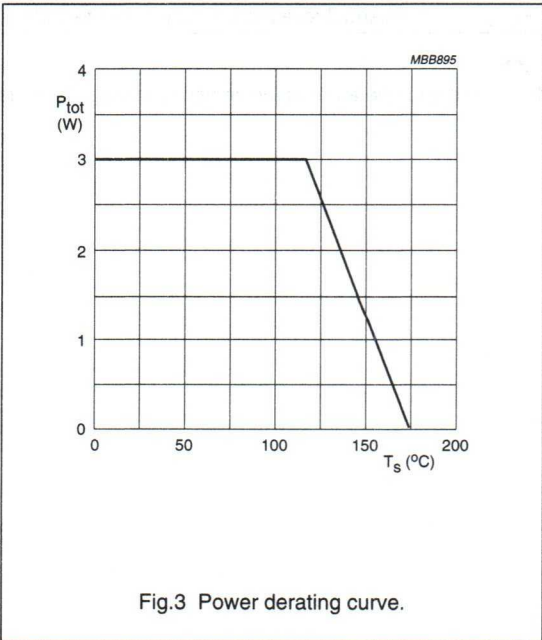
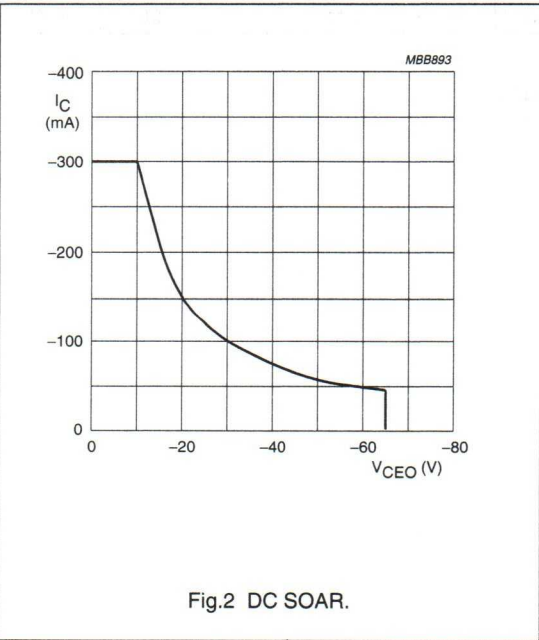
PNP video transistors

BFQ252; BFQ252A

CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

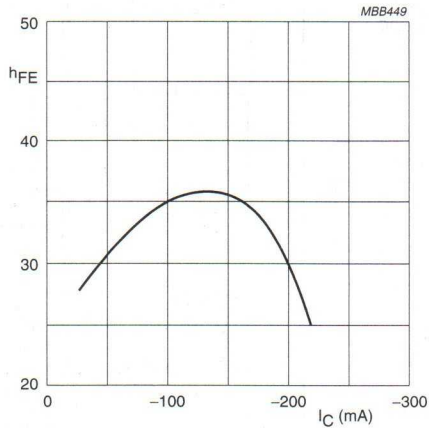
| SYMBOL               | PARAMETER                                                | CONDITIONS                                                                                                      | MIN.         | TYP.       | MAX. | UNIT       |
|----------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------|------------|------|------------|
| V <sub>(BR)CBO</sub> | collector-base breakdown voltage<br>BFQ252<br>BFQ252A    | I <sub>C</sub> = -0.1 mA; I <sub>E</sub> = 0                                                                    | -100<br>-115 | -          | -    | V<br>V     |
| V <sub>(BR)CEO</sub> | collector-emitter breakdown voltage<br>BFQ252<br>BFQ252A | I <sub>C</sub> = -10 mA; I <sub>B</sub> = 0                                                                     | -65<br>-95   | -          | -    | V<br>V     |
| V <sub>(BR)CER</sub> | collector-emitter breakdown voltage<br>BFQ252<br>BFQ252A | I <sub>C</sub> = -10 mA; R <sub>BE</sub> = 100 Ω                                                                | -95<br>-110  | -          | -    | V<br>V     |
| V <sub>(BR)EBO</sub> | emitter-base breakdown voltage                           | I <sub>E</sub> = -0.1 mA; I <sub>C</sub> = 0                                                                    | -3           | -          | -    | V          |
| I <sub>CES</sub>     | collector-emitter cut-off current                        | I <sub>B</sub> = 0; V <sub>CE</sub> = -50 V                                                                     | -            | -          | -100 | μA         |
| I <sub>CBO</sub>     | collector-base cut-off current                           | I <sub>E</sub> = 0; V <sub>CB</sub> = -50 V                                                                     | -            | -          | -20  | μA         |
| h <sub>FE</sub>      | DC current gain                                          | I <sub>C</sub> = -50 mA; V <sub>CE</sub> = -10 V;<br>T <sub>amb</sub> = 25 °C; see Fig.4                        | 20           | 30         | -    |            |
| C <sub>cb</sub>      | collector-base capacitance                               | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = -10 V; f = 1 MHz;<br>T <sub>amb</sub> = 25 °C; see Fig.5 | -            | 2.5        | -    | pF         |
| f <sub>T</sub>       | transition frequency<br>BFQ252<br>BFQ252A                | I <sub>C</sub> = -50 mA; V <sub>CE</sub> = -10 V;<br>f = 100 MHz; T <sub>amb</sub> = 25 °C; see Fig.6           | 1<br>0.8     | 1.3<br>1.2 | -    | GHz<br>GHz |





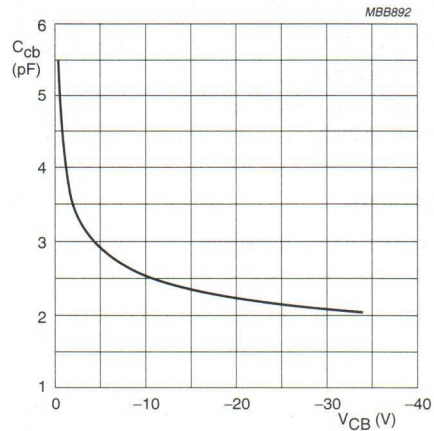
## PNP video transistors

## BFQ252; BFQ252A



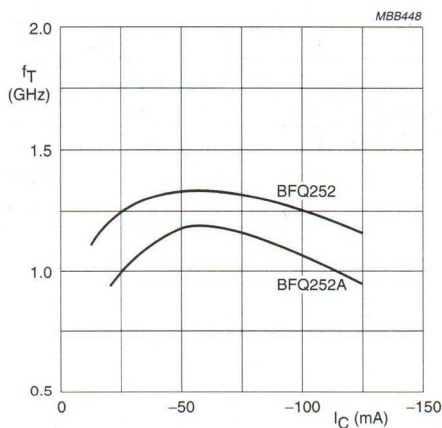
$V_{CE} = -10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = -10$  V;  $f = 100$  MHz;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

## PNP video transistors

## BFQ255; BFQ255A

## FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

- Buffer/driver in high-resolution colour graphics monitors.

## DESCRIPTION

PNP video transistor in a SOT128B (TO-202) plastic package.  
NPN complements: BFQ235 and BFQ235A.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

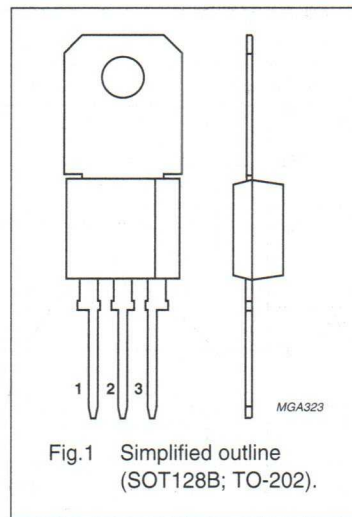


Fig.1 Simplified outline (SOT128B; TO-202).

## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                                                  | MIN.     | TYP.       | MAX. | UNIT       |
|-----------|---------------------------|-------------------------------------------------------------------------------------------------------------|----------|------------|------|------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                                                | —        | —          | —100 | V          |
|           | BFQ255<br>BFQ255A         |                                                                                                             | —        | —          | —115 | V          |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                                                                       | —        | —          | —95  | V          |
|           | BFQ255<br>BFQ255A         |                                                                                                             | —        | —          | —110 | V          |
| $I_C$     | collector current (DC)    |                                                                                                             | —        | —          | —300 | mA         |
| $P_{tot}$ | total power dissipation   | $T_s \leq 100^\circ\text{C}$ ; note 1                                                                       | —        | —          | 3    | W          |
| $h_{FE}$  | DC current gain           | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$ ; $T_{amb} = 25^\circ\text{C}$                            | 20       | 30         | —    |            |
| $f_T$     | transition frequency      | $I_C = -50 \text{ mA}$ ; $V_{CE} = -10 \text{ V}$ ; $f = 100 \text{ MHz}$ ;<br>$T_{amb} = 25^\circ\text{C}$ | —        | —          | —    | —          |
|           | BFQ255<br>BFQ255A         |                                                                                                             | 1<br>0.8 | 1.3<br>1.2 | —    | GHz<br>GHz |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## PNP video transistors

## BFQ255; BFQ255A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                       | MIN. | MAX. | UNIT             |
|-----------|---------------------------|--------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                     | —    | −100 | V                |
|           | BFQ255<br>BFQ255A         |                                                  | —    | −115 | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                        | —    | −65  | V                |
|           | BFQ255<br>BFQ255A         |                                                  | —    | −95  | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                            | —    | −95  | V                |
|           | BFQ255<br>BFQ255A         |                                                  | —    | −110 | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                   | —    | −3   | V                |
| $I_C$     | collector current (DC)    |                                                  | —    | −300 | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 100^\circ\text{C}$ ; note 1; see Fig.3 | —    | 3    | W                |
| $T_{stg}$ | storage temperature       |                                                  | −65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                  | —    | 175  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                            | VALUE | UNIT |
|---------------|-----------------------------------------------------|---------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 100^\circ\text{C}$ ; note 1 | 25    | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

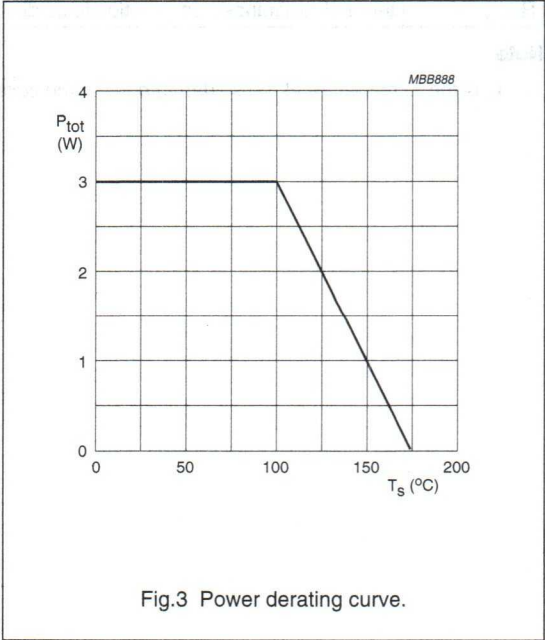
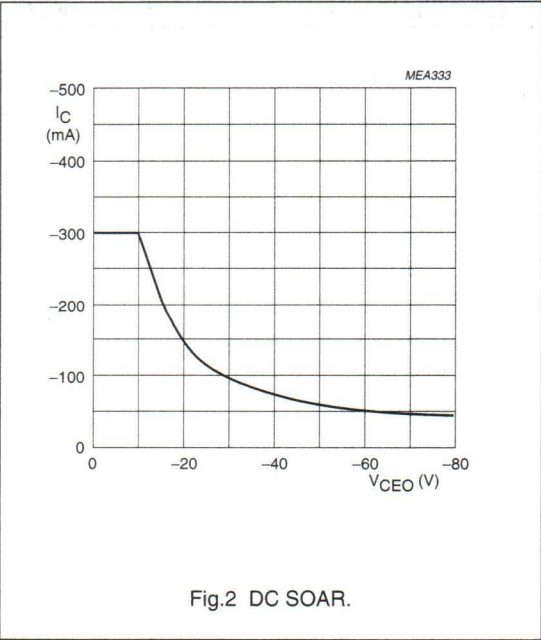
# PNP video transistors

# BFQ255; BFQ255A

## CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

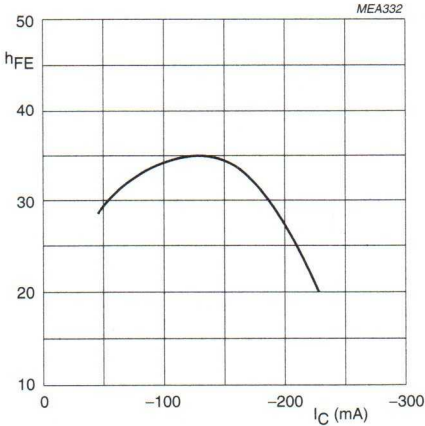
| SYMBOL        | PARAMETER                                                | CONDITIONS                                                                                                             | MIN.         | TYP.       | MAX.   | UNIT          |
|---------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------|------------|--------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage<br>BFQ255<br>BFQ255A    | $I_C = -0.1\text{ mA}; I_E = 0$                                                                                        | -100<br>-115 | -          | -      | V<br>V        |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage<br>BFQ255<br>BFQ255A | $I_C = -10\text{ mA}; I_B = 0$                                                                                         | -66<br>-95   | -          | -      | V<br>V        |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage<br>BFQ255<br>BFQ255A | $I_C = -10\text{ mA}; R_{BE} = 100\text{ }\Omega$                                                                      | -95<br>-110  | -          | -      | V<br>V        |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage                           | $I_E = -0.1\text{ mA}; I_C = 0$                                                                                        | -3           | -          | -      | V             |
| $I_{CES}$     | collector-emitter cut-off current                        | $I_B = 0; V_{CE} = -50\text{ V}$                                                                                       | -            | -          | -100   | $\mu\text{A}$ |
| $I_{CBO}$     | collector-base cut-off current                           | $I_E = 0; V_{CB} = -50\text{ V}$                                                                                       | -            | -          | -20    | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain                                          | $I_C = -50\text{ mA}; V_{CE} = -10\text{ V};$<br>$T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.4                     | 20           | 30         | -      |               |
| $C_{cb}$      | collector-base capacitance                               | $I_C = 0; V_{CB} = -10\text{ V}; f = 1\text{ MHz};$<br>see Fig.5                                                       | -            | 2          | -      | pF            |
| $f_T$         | transition frequency<br>BFQ255<br>BFQ255A                | $I_C = -50\text{ mA}; V_{CE} = -10\text{ V};$<br>$f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.6 | 1<br>0.8     | 1.3<br>1.2 | -<br>- | GHz<br>GHz    |





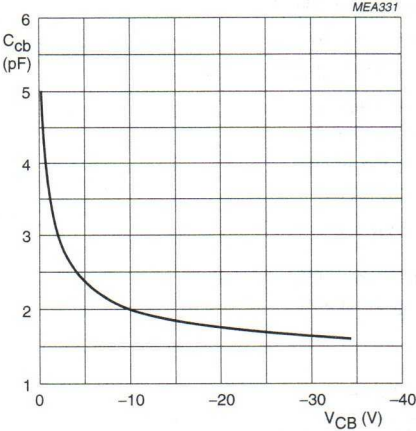
PNP video transistors

BFQ255; BFQ255A



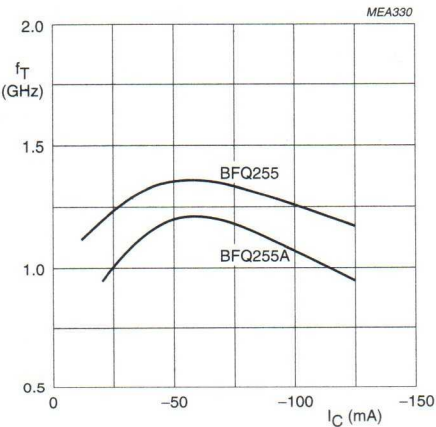
$V_{CE} = -10$  V;  $T_{amb} = 25$  °C.

Fig.4 DC current gain as a function of collector current; typical values.



$f = 1$  MHz;  $T_{amb} = 25$  °C.

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.



$V_{CE} = -10$  V;  $f = 100$  MHz;  $T_{amb} = 25$  °C.

Fig.6 Transition frequency as a function of collector current; typical values.

PNP video transistors

BFQ256; BFQ256A

FEATURES

- High breakdown voltages
- Low output capacitance
- High gain bandwidth
- Good thermal stability
- Gold metallization ensures excellent reliability
- Surface mounting.

APPLICATIONS

- Buffer/driver in high-resolution colour graphics monitors.

DESCRIPTION

PNP video transistor in a SOT223 plastic package.  
NPN complements: BFQ236 and BFQ236A.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | emitter     |
| 4   | collector   |

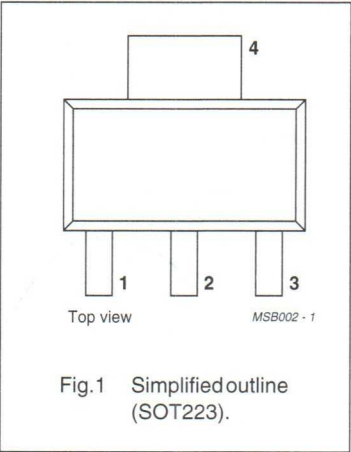


Fig.1 Simplified outline (SOT223).

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                                      | CONDITIONS                                                                | MIN. | TYP. | MAX. | UNIT |
|-----------|------------------------------------------------|---------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage<br>BFQ256<br>BFQ256A    | open emitter                                                              | —    | —    | −100 | V    |
|           |                                                |                                                                           | —    | —    | −115 | V    |
| $V_{CER}$ | collector-emitter voltage<br>BFQ256<br>BFQ256A | $R_{BE} = 100\ \Omega$                                                    | —    | —    | −95  | V    |
|           |                                                |                                                                           | —    | —    | −110 | V    |
| $I_C$     | collector current (DC)                         |                                                                           | —    | —    | −300 | mA   |
| $P_{tot}$ | total power dissipation                        | $T_s \leq 115\ ^\circ\text{C}$ ; note 1                                   | —    | —    | 2    | W    |
| $h_{FE}$  | DC current gain                                | $I_C = -50\ \text{mA}$ ; $V_{CE} = -10\ \text{V}$                         | 20   | 30   | —    |      |
| $f_T$     | transition frequency<br>BFQ256<br>BFQ256A      | $I_C = -50\ \text{mA}$ ; $V_{CE} = -10\ \text{V}$ ; $f = 100\ \text{MHz}$ | 1    | 1.3  | —    | GHz  |
|           |                                                |                                                                           | 0.8  | 1.2  | —    | GHz  |

Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## PNP video transistors

## BFQ256; BFQ256A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                         | MIN. | MAX. | UNIT             |
|-----------|---------------------------|----------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                       |      |      |                  |
|           | BFQ256                    |                                                    | –    | –100 | V                |
|           | BFQ256A                   |                                                    | –    | –115 | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                          |      |      |                  |
|           | BFQ256                    |                                                    | –    | –65  | V                |
|           | BFQ256A                   |                                                    | –    | –95  | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100\ \Omega$                             |      |      |                  |
|           | BFQ256                    |                                                    | –    | –95  | V                |
|           | BFQ256A                   |                                                    | –    | –110 | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                     | –    | –3   | V                |
| $I_C$     | collector current (DC)    |                                                    | –    | –300 | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 115\ ^\circ\text{C}$ ; note 1; see Fig.3 | –    | 2    | W                |
| $T_{stg}$ | storage temperature       |                                                    | –65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                    | –    | 175  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector lead.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                                                                  | VALUE | UNIT |
|---------------|-----------------------------------------------------|-----------------------------------------------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 115\ ^\circ\text{C}$ ; $P_{tot} = 2\ \text{W}$ ;<br>notes 1 and 2 | 30    | K/W  |

## Notes

1.  $T_s$  is the temperature at the soldering point of the collector lead.
2. Device mounted on a printed-circuit board measuring  $40 \times 40 \times 1\ \text{mm}$  (collector pad  $35 \times 17\ \text{mm}$ ).

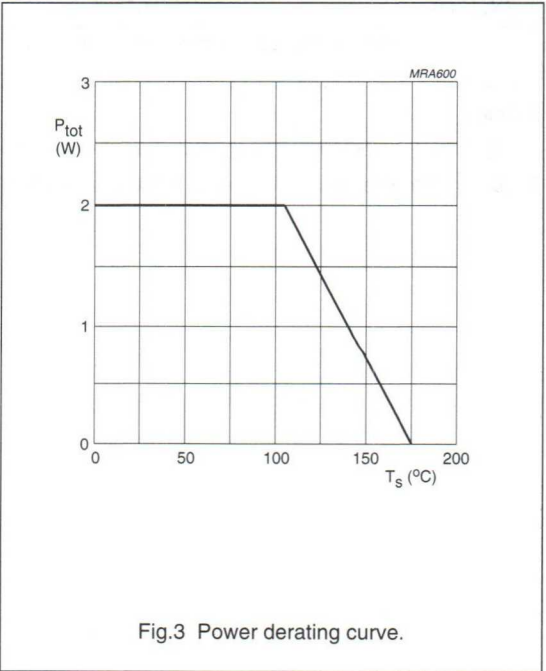
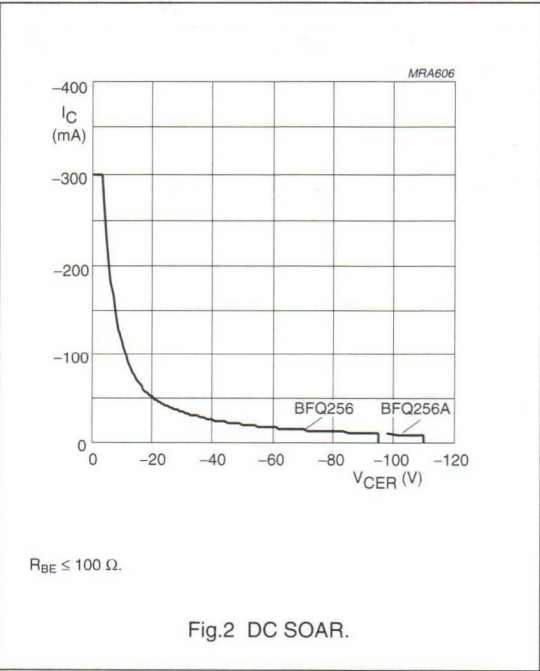
PNP video transistors

BFQ256; BFQ256A

CHARACTERISTICS

T<sub>j</sub> = 25 °C unless otherwise specified.

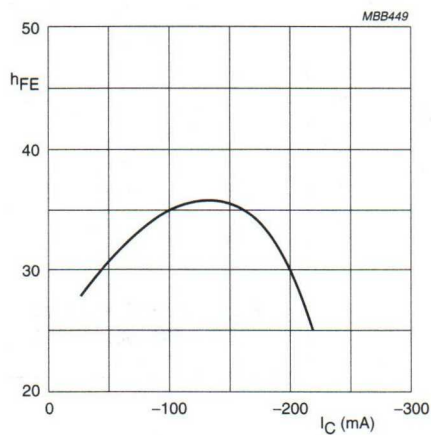
| SYMBOL               | PARAMETER                           | CONDITIONS                                                                         | MIN. | TYP. | MAX. | UNIT |
|----------------------|-------------------------------------|------------------------------------------------------------------------------------|------|------|------|------|
| V <sub>(BR)CBO</sub> | collector-base breakdown voltage    | I <sub>C</sub> = -100 µA; I <sub>E</sub> = 0                                       | -100 | -    | -    | V    |
|                      | BFQ256                              |                                                                                    |      |      |      |      |
|                      | BFQ256A                             |                                                                                    | -115 | -    | -    | V    |
| V <sub>(BR)CEO</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = -10 mA; I <sub>B</sub> = 0                                        | -65  | -    | -    | V    |
|                      | BFQ256                              |                                                                                    |      |      |      |      |
|                      | BFQ256A                             |                                                                                    | -95  | -    | -    | V    |
| V <sub>(BR)CER</sub> | collector-emitter breakdown voltage | I <sub>C</sub> = -1 mA; R <sub>BE</sub> = 100 Ω                                    | -95  | -    | -    | V    |
|                      | BFQ256                              |                                                                                    |      |      |      |      |
|                      | BFQ256A                             |                                                                                    | -110 | -    | -    | V    |
| I <sub>CES</sub>     | collector-emitter cut-off current   | I <sub>B</sub> = 0; V <sub>CE</sub> = -50 V                                        | -    | -    | -100 | µA   |
| I <sub>CBO</sub>     | collector-base cut-off current      | I <sub>E</sub> = 0; V <sub>CB</sub> = -50 V                                        | -    | -    | -20  | µA   |
| h <sub>FE</sub>      | DC current gain                     | I <sub>C</sub> = -50 mA; V <sub>CE</sub> = -10 V; see Fig.4                        | 20   | 30   | -    |      |
| C <sub>c</sub>       | collector capacitance               | I <sub>E</sub> = i <sub>e</sub> = 0; V <sub>CB</sub> = -10 V; f = 1 MHz            | -    | 1.9  | -    | pF   |
| C <sub>cb</sub>      | collector-base capacitance          | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = -10 V; f = 1 MHz; see Fig.6 | -    | 1.6  | -    | pF   |
| f <sub>T</sub>       | transition frequency                | I <sub>C</sub> = -50 mA; V <sub>CE</sub> = -10 V; f = 100 MHz; see Fig.5           | 1    | 1.3  | -    | GHz  |
|                      | BFQ256                              |                                                                                    |      |      |      |      |
|                      | BFQ256A                             |                                                                                    | 0.8  | 1.2  | -    | GHz  |





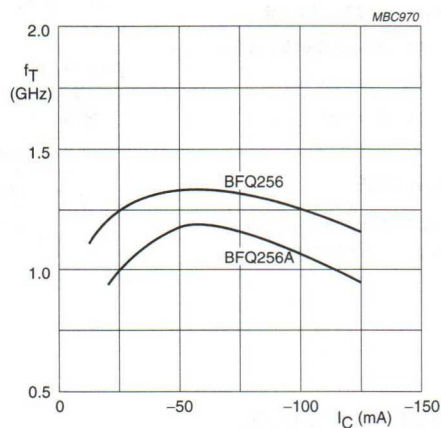
## PNP video transistors

## BFQ256; BFQ256A



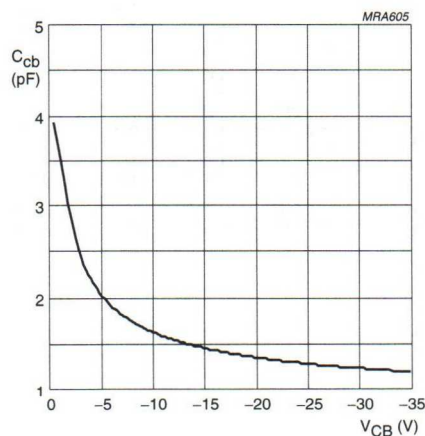
$V_{CE} = -10$  V.

Fig.4 DC current gain as a function of collector current; typical values.



$V_{CE} = -10$  V;  $T_{amb} = 25$  °C.

Fig.5 Transition frequency as a function of collector current; typical values.



$I_C = 0$ ;  $f = 1$  MHz.

Fig.6 Collector-base capacitance as a function of collector-base voltage; typical values.

## NPN video transistors

## BFQ262; BFQ262A

## FEATURES

- High breakdown voltages
- Low output capacitance
- Optimum temperature profile
- Good thermal stability
- Excellent reliability properties.

## APPLICATIONS

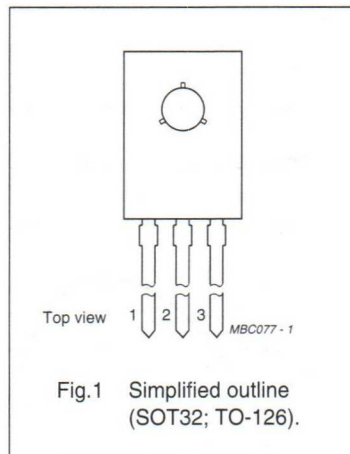
- Buffer/driver in high-resolution colour graphics monitors.

## DESCRIPTION

NPN video transistor in a SOT32 (TO-126) plastic package.

## PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |



## QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                                              | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|---------------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                                                            |      |      |      |      |
|           | BFQ262                    |                                                                                                         | —    | —    | 100  | V    |
|           | BFQ262A                   |                                                                                                         | —    | —    | 115  | V    |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                                                                                   |      |      |      |      |
|           | BFQ262                    |                                                                                                         | —    | —    | 95   | V    |
|           | BFQ262A                   |                                                                                                         | —    | —    | 110  | V    |
| $I_C$     | collector current (DC)    |                                                                                                         | —    | —    | 400  | mA   |
| $P_{tot}$ | total power dissipation   | $T_s \leq 85^\circ\text{C}$ ; note 1                                                                    | —    | —    | 5    | W    |
| $h_{FE}$  | DC current gain           | $I_C = 100 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = 25^\circ\text{C}$                         |      |      |      |      |
|           | BFQ262                    |                                                                                                         | 50   | 60   | —    |      |
|           | BFQ262A                   |                                                                                                         | 20   | 35   | —    |      |
| $f_T$     | transition frequency      | $I_C = 100 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $f = 100 \text{ MHz}$ ; $T_{amb} = 25^\circ\text{C}$ |      |      |      |      |
|           | BFQ262                    |                                                                                                         | 1    | 1.4  | —    | GHz  |
|           | BFQ262A                   |                                                                                                         | 0.8  | 1.2  | —    | GHz  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistors

## BFQ262; BFQ262A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                 | CONDITIONS                                      | MIN. | MAX. | UNIT             |
|-----------|---------------------------|-------------------------------------------------|------|------|------------------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                    |      |      |                  |
|           | BFQ262                    |                                                 | –    | 100  | V                |
|           | BFQ262A                   |                                                 | –    | 115  | V                |
| $V_{CEO}$ | collector-emitter voltage | open base                                       |      |      |                  |
|           | BFQ262                    |                                                 | –    | 65   | V                |
|           | BFQ262A                   |                                                 | –    | 95   | V                |
| $V_{CER}$ | collector-emitter voltage | $R_{BE} = 100 \Omega$                           |      |      |                  |
|           | BFQ262                    |                                                 | –    | 95   | V                |
|           | BFQ262A                   |                                                 | –    | 110  | V                |
| $V_{EBO}$ | emitter-base voltage      | open collector                                  | –    | 3    | V                |
| $I_C$     | collector current (DC)    |                                                 | –    | 400  | mA               |
| $P_{tot}$ | total power dissipation   | $T_s \leq 85^\circ\text{C}$ ; note 1; see Fig.3 | –    | 5    | W                |
| $T_{stg}$ | storage temperature       |                                                 | –65  | +150 | $^\circ\text{C}$ |
| $T_j$     | junction temperature      |                                                 | –    | 175  | $^\circ\text{C}$ |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                           | CONDITIONS                           | VALUE | UNIT |
|---------------|-----------------------------------------------------|--------------------------------------|-------|------|
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | $T_s \leq 85^\circ\text{C}$ ; note 1 | 18    | K/W  |

## Note

1.  $T_s$  is the temperature at the soldering point of the collector pin.

## NPN video transistors

## BFQ262; BFQ262A

## CHARACTERISTICS

$T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL        | PARAMETER                                                | CONDITIONS                                                                                                               | MIN.       | TYP.       | MAX.   | UNIT          |
|---------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------|------------|--------|---------------|
| $V_{(BR)CBO}$ | collector-base breakdown voltage<br>BFQ262<br>BFQ262A    | $I_C = 0.1\text{ mA}; I_E = 0$                                                                                           | 100<br>115 | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)CEO}$ | collector-emitter breakdown voltage<br>BFQ262<br>BFQ262A | $I_C = 10\text{ mA}; I_B = 0$                                                                                            | 65<br>95   | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)CER}$ | collector-emitter breakdown voltage<br>BFQ262<br>BFQ262A | $I_C = 10\text{ mA}; R_{BE} = 100\text{ }\Omega$                                                                         | 95<br>110  | —<br>—     | —<br>— | V<br>V        |
| $V_{(BR)EBO}$ | emitter-base breakdown voltage                           | $I_E = 0.1\text{ mA}; I_C = 0$                                                                                           | 3          | —          | —      | V             |
| $I_{CES}$     | collector-emitter cut-off current                        | $I_B = 0; V_{CE} = 50\text{ V}$                                                                                          | —          | —          | 100    | $\mu\text{A}$ |
| $I_{CBO}$     | collector-base cut-off current                           | $I_E = 0; V_{CB} = 50\text{ V}$                                                                                          | —          | —          | 20     | $\mu\text{A}$ |
| $h_{FE}$      | DC current gain<br>BFQ262<br>BFQ262A                     | $I_C = 100\text{ mA}; V_{CE} = 10\text{ V};$<br>$T_{amb} = 25\text{ }^{\circ}\text{C};$ see Fig.4                        | 50<br>20   | 60<br>35   | —<br>— |               |
| $f_T$         | transition frequency<br>BFQ262<br>BFQ262A                | $I_C = 100\text{ mA}; V_{CE} = 10\text{ V};$<br>$f = 100\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C};$<br>see Fig.6 | 1<br>0.8   | 1.4<br>1.2 | —<br>— | GHz<br>GHz    |
| $C_{cb}$      | collector-base capacitance                               | $I_C = i_c = 0; V_{CB} = 10\text{ V};$<br>$f = 1\text{ MHz}; T_{amb} = 25\text{ }^{\circ}\text{C};$<br>see Fig.5         | —          | 2          | —      | pF            |
| $C_c$         | collector capacitance                                    | $I_E = i_e = 0; V_{CB} = 10\text{ V};$<br>$f = 1\text{ MHz}$                                                             | —          | 3.5        | —      | pF            |



## NPN video transistors

## BFQ262; BFQ262A

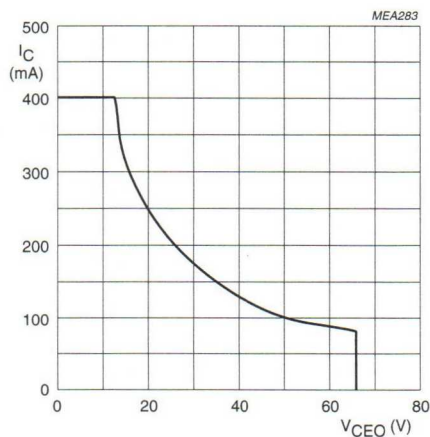


Fig.2 DC SOAR.

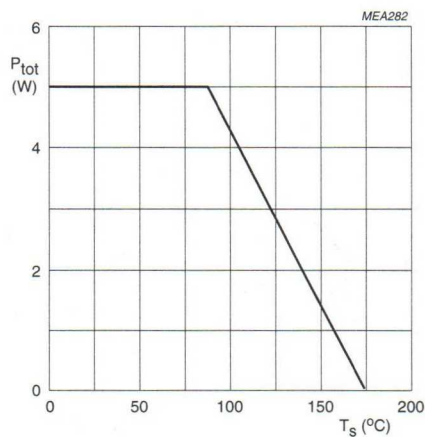
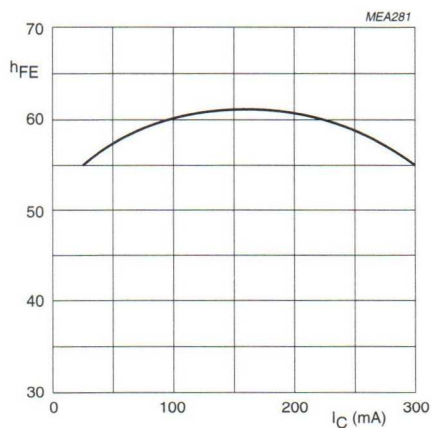
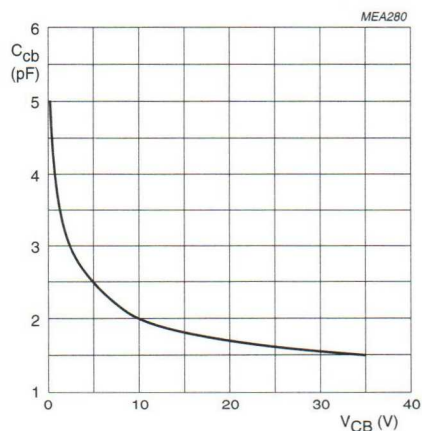


Fig.3 Power derating curve.



$V_{CE} = 10 \text{ V}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .

Fig.4 DC current gain as a function of collector current; typical values.

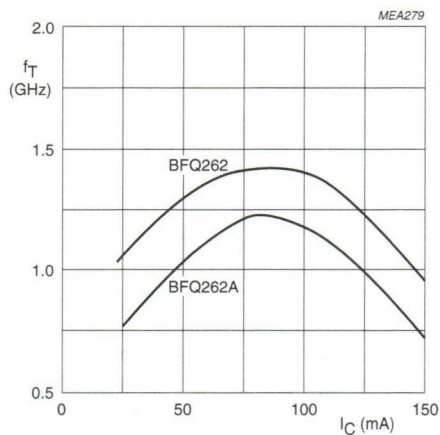


$f = 1 \text{ MHz}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .

Fig.5 Collector-base capacitance as a function of collector-base voltage; typical values.

## NPN video transistors

## BFQ262; BFQ262A



$V_{CE} = 10 \text{ V}$ ;  $f = 500 \text{ MHz}$ ;  $T_{amb} = 25^\circ\text{C}$ .

Fig.6 Transition frequency as a function of collector current; typical values.

NPN high-voltage transistor

BFV420

FEATURES

- Low current (max. 100 mA)
- High voltage (max. 100 V).

APPLICATIONS

- Primarily intended for video applications (monitors).

DESCRIPTION

NPN high-voltage transistor in a TO-92; SOT54 plastic package. PNP complement: BFV421.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |

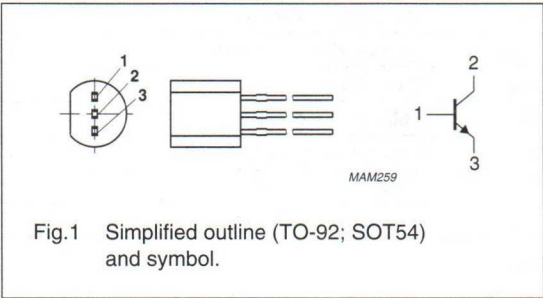


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                     | MIN. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                   | —    | 140  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                      | —    | 100  | V    |
| $I_{CM}$  | peak collector current    |                                                                | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                      | —    | 830  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}$                     | 150  | —    |      |
| $C_{re}$  | feedback capacitance      | $I_C = I_c = 0; V_{CE} = 25\text{ V}; f = 1\text{ MHz}$        | —    | 1.5  | pF   |
| $f_T$     | transition frequency      | $I_C = 20\text{ mA}; V_{CE} = 20\text{ V}; f = 100\text{ MHz}$ | 150  | —    | MHz  |

## NPN high-voltage transistor

BFV420

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                           | MIN. | MAX. | UNIT |
|-----------|-------------------------------|--------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                         | –    | 140  | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                            | –    | 100  | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector                       | –    | 5    | V    |
| $I_C$     | collector current (DC)        |                                      | –    | 100  | mA   |
| $I_{CM}$  | peak collector current        |                                      | –    | 100  | mA   |
| $I_{BM}$  | peak base current             |                                      | –    | 100  | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ ; note 1 | –    | 830  | mW   |
| $T_{stg}$ | storage temperature           |                                      | –65  | +150 | °C   |
| $T_j$     | junction temperature          |                                      | –    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                                      | –65  | +150 | °C   |

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 150   | K/W  |

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## CHARACTERISTICS

 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

| SYMBOL      | PARAMETER                            | CONDITIONS                                                              | MIN. | MAX. | UNIT |
|-------------|--------------------------------------|-------------------------------------------------------------------------|------|------|------|
| $I_{CBO}$   | collector cut-off current            | $I_E = 0$ ; $V_{CB} = 100\text{ V}$                                     | –    | 100  | nA   |
|             |                                      | $I_E = 0$ ; $V_{CB} = 100\text{ V}$ ; $T_{amb} = 150\text{ °C}$         | –    | 10   | μA   |
| $I_{EBO}$   | emitter cut-off current              | $I_C = 0$ ; $V_{EB} = 4\text{ V}$                                       | –    | 100  | nA   |
| $h_{FE}$    | DC current gain                      | $I_C = 10\text{ mA}$ ; $V_{CE} = 10\text{ V}$                           | 150  | –    |      |
|             |                                      | $I_C = 50\text{ mA}$ ; $V_{CE} = 10\text{ V}$                           | 20   | –    |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 30\text{ mA}$ ; $I_B = 5\text{ mA}$                              | –    | 200  | mV   |
| $C_{re}$    | feedback capacitance                 | $I_C = I_c = 0$ ; $V_{CE} = 25\text{ V}$ ; $f = 1\text{ MHz}$           | –    | 1.5  | pF   |
| $f_T$       | transition frequency                 | $I_C = 20\text{ mA}$ ; $V_{CE} = 20\text{ V}$ ;<br>$f = 100\text{ MHz}$ | 150  | –    | MHz  |



PNP high voltage transistor

BFV421

FEATURES

- High voltage
- High transition frequency
- Low output capacitance.

APPLICATIONS

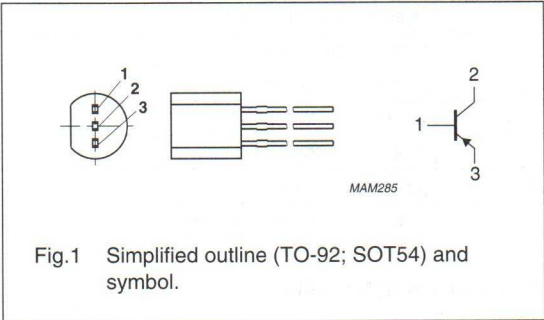
- Primarily intended for video applications (monitors).

DESCRIPTION

PNP transistor in a plastic TO-92; SOT54 package.  
NPN complement: BFV420.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | collector   |
| 3   | emitter     |



QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                       | MIN. | MAX. | UNIT |
|-----------|---------------------------|------------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                     | —    | −140 | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                        | —    | −100 | V    |
| $I_{CM}$  | peak collector current    |                                                                  | —    | −100 | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                        | —    | 830  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = -10\text{ mA}; V_{CE} = -10\text{ V}$                     | 150  | —    |      |
| $C_{re}$  | feedback capacitance      | $I_C = i_c = 0; V_{CE} = -25\text{ V}; f = 1\text{ MHz}$         | —    | 2.3  | pF   |
| $f_T$     | transition frequency      | $I_C = -20\text{ mA}; V_{CE} = -20\text{ V}; f = 100\text{ MHz}$ | 150  | —    | MHz  |

PRELIMINARY  
See Philips Semiconductors for Design-in information

## PNP high voltage transistor

BFV421

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                  | MIN. | MAX. | UNIT |
|-----------|-------------------------------|-----------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                | —    | −140 | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                   | —    | −100 | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector              | —    | −5   | V    |
| $I_C$     | collector current (DC)        |                             | —    | −100 | mA   |
| $I_{CM}$  | peak collector current        |                             | —    | −100 | mA   |
| $I_{BM}$  | peak base current             |                             | —    | −100 | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ | —    | 830  | mW   |
| $T_{stg}$ | storage temperature           |                             | −65  | +150 | °C   |
| $T_j$     | junction temperature          |                             | —    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                             | −65  | +150 | °C   |

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS          | VALUE | UNIT |
|---------------|---------------------------------------------|---------------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | in free air; note 1 | 150   | K/W  |

## Note

1. Transistor mounted on a printed-circuit board; maximum lead length 4 mm; mounting pad for collector lead minimum  $10 \times 10\text{ mm}$ .

## CHARACTERISTICS

 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

| SYMBOL      | PARAMETER                            | CONDITIONS                                                       | MIN. | MAX. | UNIT |
|-------------|--------------------------------------|------------------------------------------------------------------|------|------|------|
| $I_{CBO}$   | collector cut-off current            | $I_E = 0; V_{CB} = -100\text{ V}$                                | —    | −100 | nA   |
|             |                                      | $I_E = 0; V_{CB} = -100\text{ V}; T_{amb} = 150\text{ °C}$       | —    | −10  | μA   |
| $I_{EBO}$   | emitter cut-off current              | $I_C = 0; V_{EB} = -4\text{ V}$                                  | —    | −100 | nA   |
| $h_{FE}$    | DC current gain                      | $I_C = -10\text{ mA}; V_{CE} = -10\text{ V}$                     | 150  | —    |      |
|             |                                      | $I_C = -50\text{ mA}; V_{CE} = -10\text{ V}$                     | 20   | —    |      |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = -30\text{ mA}; I_B = -5\text{ mA}$                        | —    | −200 | mV   |
| $C_{re}$    | feedback capacitance                 | $I_C = i_c = 0; V_{CE} = -25\text{ V}; f = 1\text{ MHz}$         | —    | 2.3  | pF   |
| $f_T$       | transition frequency                 | $I_C = -20\text{ mA}; V_{CE} = -20\text{ V}; f = 100\text{ MHz}$ | 150  | —    | MHz  |

NPN high-voltage transistor

BFV469

FEATURES

- High transition frequency
- Low feedback capacitance.

APPLICATIONS

- Buffer transistor in monitors.

DESCRIPTION

NPN high-voltage transistor in a TO-126; SOT32 plastic package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | collector   |
| 3   | base        |

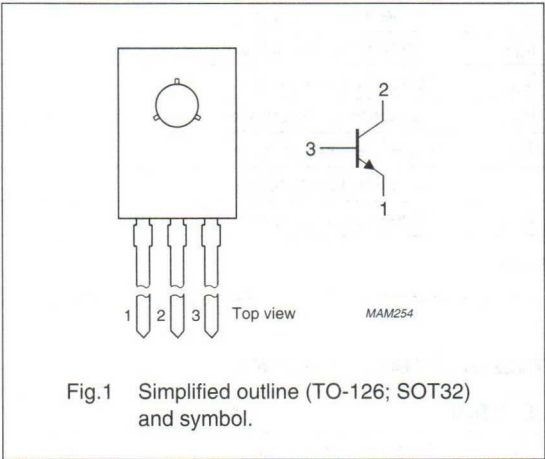


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                     | MIN. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                   | —    | 140  | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                      | —    | 100  | V    |
| $I_{CM}$  | peak collector current    |                                                                | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                      | —    | 2    | W    |
| $h_{FE}$  | DC current gain           | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}$                     | 150  | —    |      |
| $C_{re}$  | feedback capacitance      | $I_C = i_c = 0; V_{CB} = 25\text{ V}; f = 1\text{ MHz}$        | —    | 1.5  | pF   |
| $f_T$     | transition frequency      | $I_C = 20\text{ mA}; V_{CE} = 20\text{ V}; f = 100\text{ MHz}$ | 150  | —    | MHz  |

## NPN high-voltage transistor

BFV469

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                                         | MIN. | MAX. | UNIT               |
|-----------|-------------------------------|----------------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage        | open emitter                                       | –    | 140  | V                  |
| $V_{CEO}$ | collector-emitter voltage     | open base                                          | –    | 100  | V                  |
| $V_{EBO}$ | emitter-base voltage          | open collector                                     | –    | 5    | V                  |
| $I_C$     | collector current (DC)        |                                                    | –    | 100  | mA                 |
| $I_{CM}$  | peak collector current        |                                                    | –    | 100  | mA                 |
| $I_{BM}$  | peak base current             |                                                    | –    | 100  | mA                 |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$ ; note 1 | –    | 2    | W                  |
| $T_{stg}$ | storage temperature           |                                                    | –65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature          |                                                    | –    | 150  | $^{\circ}\text{C}$ |
| $T_{amb}$ | operating ambient temperature |                                                    | –65  | +150 | $^{\circ}\text{C}$ |

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## THERMAL CHARACTERISTICS

| SYMBOL         | PARAMETER                                         | CONDITIONS | VALUE | UNIT |
|----------------|---------------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$  | thermal resistance from junction to ambient       | note 1     | 100   | K/W  |
| $R_{th\ j-mb}$ | thermal resistance from junction to mounting base |            | 10    | K/W  |

## Note

1. Transistor mounted on an FR4 printed-circuit board.



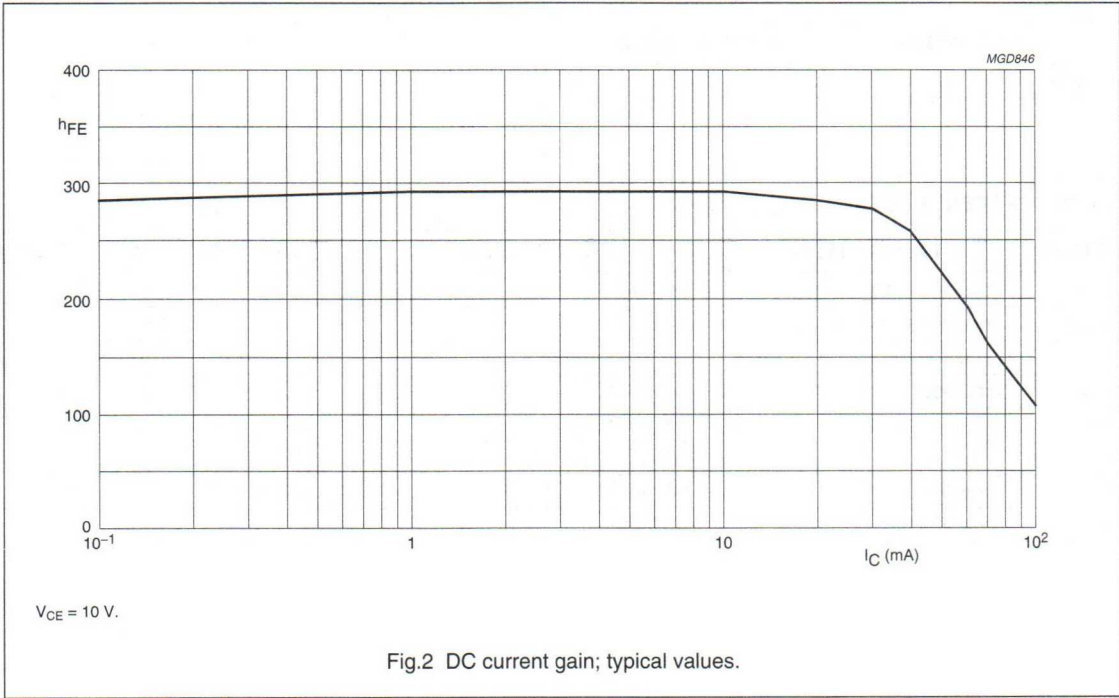
NPN high-voltage transistor

BFV469

CHARACTERISTICS

T<sub>amb</sub> = 25 °C unless otherwise specified.

| SYMBOL             | PARAMETER                            | CONDITIONS                                                                            | MIN.      | MAX.   | UNIT |
|--------------------|--------------------------------------|---------------------------------------------------------------------------------------|-----------|--------|------|
| I <sub>CBO</sub>   | collector cut-off current            | I <sub>E</sub> = 0; V <sub>CB</sub> = 100 V                                           | –         | 100    | nA   |
| I <sub>EBO</sub>   | emitter cut-off current              | I <sub>C</sub> = 0; V <sub>EB</sub> = 4 V                                             | –         | 100    | nA   |
| h <sub>FE</sub>    | DC current gain                      | V <sub>CE</sub> = 10 V; see Fig.2<br>I <sub>C</sub> = 10 mA<br>I <sub>C</sub> = 50 mA | 150<br>20 | –<br>– |      |
| V <sub>CEsat</sub> | collector-emitter saturation voltage | I <sub>C</sub> = 30 mA; I <sub>B</sub> = 5 mA                                         | –         | 200    | mV   |
| C <sub>re</sub>    | feedback capacitance                 | I <sub>C</sub> = i <sub>c</sub> = 0; V <sub>CB</sub> = 25 V; f = 1 MHz                | –         | 1.5    | pF   |
| f <sub>T</sub>     | transition frequency                 | I <sub>C</sub> = 20 mA; V <sub>CE</sub> = 20 V; f = 100 MHz                           | 150       | –      | MHz  |



NPN switching transistor

BSV52

FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 12 V).

APPLICATIONS

- High speed saturated switching applications, especially in portable equipment.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.

MARKING

| TYPE NUMBER | MARKING CODE |
|-------------|--------------|
| BSV52       | B2p          |

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | emitter     |
| 3   | collector   |

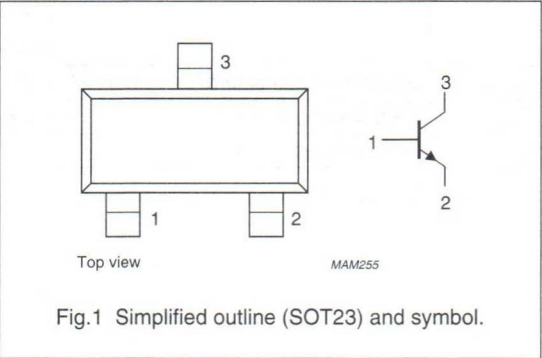


Fig.1 Simplified outline (SOT23) and symbol.

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | CONDITIONS                                                                 | MIN. | TYP. | MAX. | UNIT |
|-----------|---------------------------|----------------------------------------------------------------------------|------|------|------|------|
| $V_{CBO}$ | collector-base voltage    | open emitter                                                               | —    | —    | 20   | V    |
| $V_{CEO}$ | collector-emitter voltage | open base                                                                  | —    | —    | 12   | V    |
| $I_C$     | collector current (DC)    |                                                                            | —    | —    | 100  | mA   |
| $P_{tot}$ | total power dissipation   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                                  | —    | —    | 250  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$                                  | 40   | —    | 120  |      |
|           |                           | $I_C = 50\text{ mA}; V_{CE} = 1\text{ V}$                                  | 25   | —    | —    |      |
| $f_T$     | transition frequency      | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$             | 400  | 500  | —    | MHz  |
| $t_{off}$ | turn-off time             | $I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA}$ | —    | —    | 30   | ns   |

## NPN switching transistor

BSV52

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                                | MIN. | MAX. | UNIT               |
|-----------|-------------------------------|-------------------------------------------|------|------|--------------------|
| $V_{CBO}$ | collector-base voltage        | open emitter                              | –    | 20   | V                  |
| $V_{CEO}$ | collector-emitter voltage     | open base                                 | –    | 12   | V                  |
| $V_{EBO}$ | emitter-base voltage          | open collector                            | –    | 5    | V                  |
| $I_C$     | collector current (DC)        |                                           | –    | 100  | mA                 |
| $I_{CM}$  | peak collector current        |                                           | –    | 200  | mA                 |
| $I_{BM}$  | peak base current             |                                           | –    | 100  | mA                 |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$ | –    | 250  | mW                 |
| $T_{stg}$ | storage temperature           |                                           | –65  | +150 | $^{\circ}\text{C}$ |
| $T_j$     | junction temperature          |                                           | –    | 150  | $^{\circ}\text{C}$ |
| $T_{amb}$ | operating ambient temperature |                                           | –65  | +150 | $^{\circ}\text{C}$ |

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 500   | K/W  |

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## CHARACTERISTICS

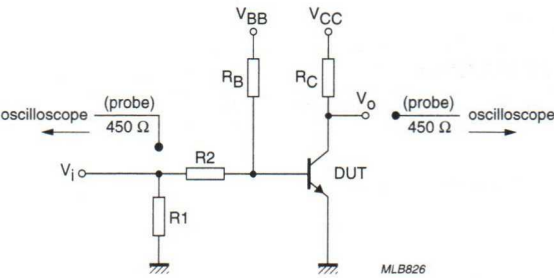
 $T_j = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| SYMBOL      | PARAMETER                            | CONDITIONS                                                         | MIN. | TYP. | MAX. | UNIT          |
|-------------|--------------------------------------|--------------------------------------------------------------------|------|------|------|---------------|
| $I_{CBO}$   | collector cut-off current            | $I_E = 0; V_{CB} = 20\text{ V}$                                    | –    | –    | 400  | nA            |
|             |                                      | $I_E = 0; V_{CB} = 20\text{ V}; T_j = 125\text{ }^{\circ}\text{C}$ | –    | –    | 30   | $\mu\text{A}$ |
| $I_{EBO}$   | emitter cut-off current              | $I_C = 0; V_{EB} = 4\text{ V}$                                     | –    | –    | 100  | nA            |
| $h_{FE}$    | DC current gain                      | $V_{CE} = 1\text{ V}$                                              |      |      |      |               |
|             |                                      | $I_C = 1\text{ mA}$                                                | 25   | –    | –    |               |
|             |                                      | $I_C = 10\text{ mA}$                                               | 40   | –    | 120  |               |
|             |                                      | $I_C = 50\text{ mA}$                                               | 25   | –    | –    |               |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 10\text{ mA}; I_B = 300\text{ }\mu\text{A}$                 | –    | –    | 300  | mV            |
|             |                                      | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                            | –    | –    | 250  | mV            |
|             |                                      | $I_C = 50\text{ mA}; I_B = 5\text{ mA}$                            | –    | –    | 400  | mV            |
| $V_{BEsat}$ | base-emitter saturation voltage      | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                            | 700  | –    | 850  | mV            |
|             |                                      | $I_C = 50\text{ mA}; I_B = 5\text{ mA}$                            | –    | –    | 1.2  | V             |
| $C_c$       | collector capacitance                | $I_E = i_e = 0; V_{CB} = 5\text{ V}; f = 1\text{ MHz}$             | –    | –    | 4    | pF            |
| $C_e$       | emitter capacitance                  | $I_C = i_c = 0; V_{EB} = 1\text{ V}; f = 1\text{ MHz}$             | –    | –    | 4.5  | pF            |
| $f_T$       | transition frequency                 | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$     | 400  | 500  | –    | MHz           |

NPN switching transistor

BSV52

| SYMBOL                                                  | PARAMETER     | CONDITIONS                                                                      | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------------------------|---------------|---------------------------------------------------------------------------------|------|------|------|------|
| Switching times (between 10% and 90% levels); see Fig.2 |               |                                                                                 |      |      |      |      |
| $t_{on}$                                                | turn-on time  | $I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA};$<br>$I_{Boff} = -1.5\text{ mA}$ | —    | —    | 10   | ns   |
| $t_d$                                                   | delay time    |                                                                                 | —    | —    | 4    | ns   |
| $t_r$                                                   | rise time     |                                                                                 | —    | —    | 6    | ns   |
| $t_{off}$                                               | turn-off time |                                                                                 | —    | —    | 30   | ns   |
| $t_s$                                                   | storage time  |                                                                                 | —    | —    | 15   | ns   |
| $t_f$                                                   | fall time     |                                                                                 | —    | —    | 15   | ns   |



$V_i = 0.5\text{ V to } 4.2\text{ V}; T = 500\text{ }\mu\text{s}; t_p = 10\text{ }\mu\text{s}; t_r = t_s \leq 3\text{ ns}.$   
 $R_1 = 56\text{ }\Omega; R_2 = 1\text{ k}\Omega; R_B = 1\text{ k}\Omega; R_C = 270\text{ }\Omega.$   
 $V_{BB} = 0.2\text{ V}; V_{CC} = 2.7\text{ V}.$   
Oscilloscope: input impedance  $Z_i = 50\text{ }\Omega.$

Fig.2 Test circuit for switching times.



# Triple video driver hybrid amplifier

CR1296

## FEATURES

- Cascode configuration
- Typical voltage gain of 15
- Directly driven by pre-amplifier: no buffer required
- Typical transition times (10 to 90%) with  $C_L = 10$  pF at 50 V<sub>p-p</sub> swing:  $t_r = 5$  ns;  $t_f = 2.5$  ns
- Typical small signal bandwidth 140 MHz
- Suited for both AC and DC coupling.

## APPLICATIONS

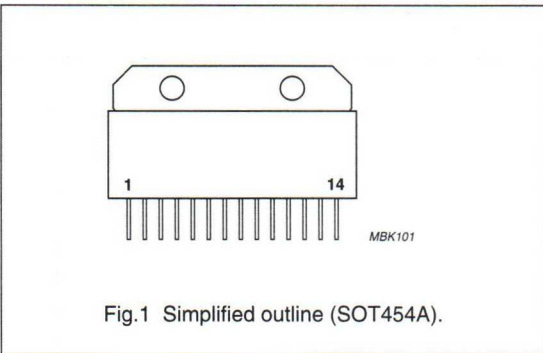
- Cathode-ray tube (CRT) drivers in high-resolution colour monitors.

## DESCRIPTION

Hybrid amplifier module in cascode configuration comprising three video amplifiers in a SOT454A package.

## PINNING - SOT454A

| PIN | DESCRIPTION                          |
|-----|--------------------------------------|
| 1   | input A                              |
| 2   | compensation A                       |
| 3   | output A                             |
| 4   | ground                               |
| 5   | output B                             |
| 6   | compensation B                       |
| 7   | input B                              |
| 8   | supply voltage 1 ( $V_{S1}$ ) (8 V)  |
| 9   | ground                               |
| 10  | supply voltage 2 ( $V_{S2}$ ) (8 V)  |
| 11  | input C                              |
| 12  | compensation C                       |
| 13  | output C                             |
| 14  | supply voltage 3 ( $V_{S3}$ ) (80 V) |



## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                           | CONDITIONS | MIN. | MAX. | UNIT |
|-----------|-------------------------------------|------------|------|------|------|
| $V_{S1}$  | power supply voltage (DC)           |            | –    | 10   | V    |
| $V_{S2}$  | power supply voltage (DC)           |            | –    | 10   | V    |
| $V_{S3}$  | power supply voltage (DC)           |            | –    | 90   | V    |
| $T_{mb}$  | operating mounting base temperature | note 1     | –20  | +100 | °C   |
| $T_{stg}$ | storage temperature                 |            | –40  | +125 | °C   |

## Note

1. The module flange is the mounting base.

Triple video driver hybrid amplifier

CR1296

CHARACTERISTICS

$V_{S1} = V_{S2} = 8\text{ V}$ ;  $V_{S3} = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing =  $50\text{ V}_{(p-p)}$  with  $45\text{ V}$  DC offset; unless otherwise specified.

| SYMBOL | PARAMETER                    | CONDITIONS                       | MIN. | TYP. | MAX. | UNIT |
|--------|------------------------------|----------------------------------|------|------|------|------|
| $t_r$  | rise time transient response | 10 to 90%; note 1                | –    | 5    | 6    | ns   |
| $t_f$  | fall time transient response | 10 to 90%; note 1                | –    | 2.5  | 3.5  | ns   |
| BW     | small signal bandwidth       | between –3 dB points; note 2     | –    | 140  | –    | MHz  |
| NLN    | non-linearity                | $V_O = 15\text{ to }75\text{ V}$ | –    | 2    | 5    | %    |
| $A_V$  | DC voltage gain              |                                  | 14   | 15   | 16   |      |

Notes

1. Input signal delivered by pre-IC:  $t_r \leq 1\text{ ns}$ ;  $t_f \leq 1\text{ ns}$ ;  $V_{i(p-p)} = 3.3\text{ V}$ ; see Fig. 2.
2. Sinewave output signal:  $1\text{ V}_{(p-p)}$ .

APPLICATION INFORMATION

Application information is available in Application note AN96074 'Video Amplifier Board with TDA4885 and CR1296'. A copy of this report can be requested via the local sales office.

Heatsink design is supported by Figs. 3, 4 and 5.

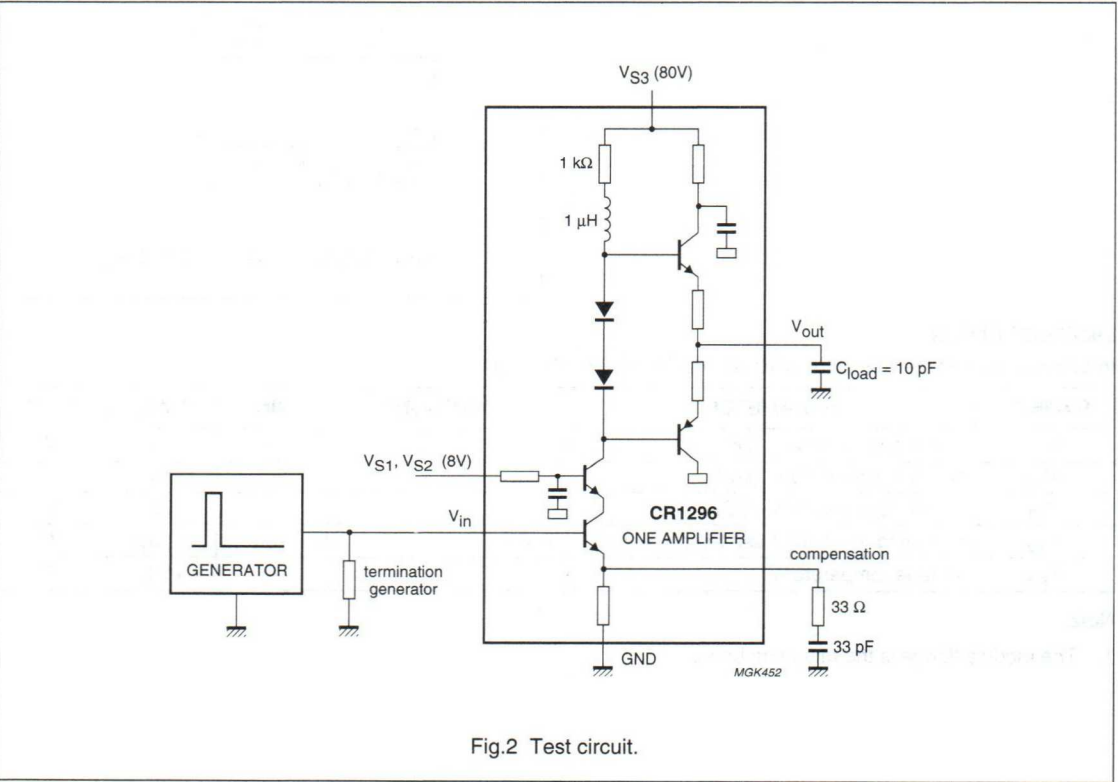
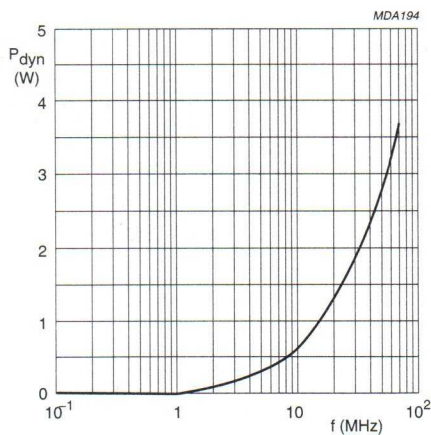


Fig.2 Test circuit.

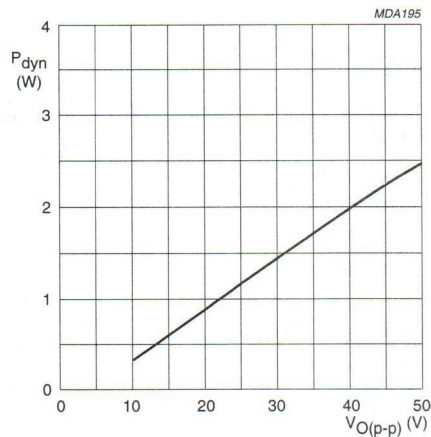
## Triple video driver hybrid amplifier

CR1296



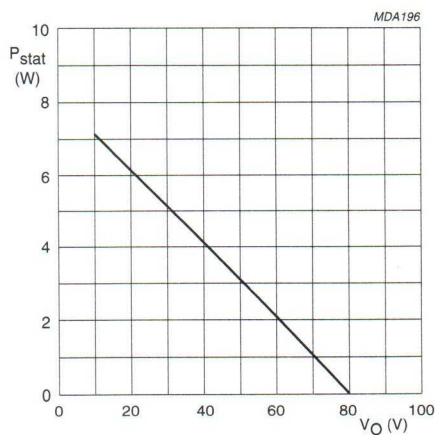
$V_S = 80$  V;  $V_{O(p-p)} = 40$  V;  $V_{O(mean)} = 40$  V.

Fig.3 Dynamic output power as a function of frequency; typical values.



$V_S = 80$  V;  $V_{O(p-p)} = 40$  V;  $V_{O(mean)} = 40$  V.

Fig.4 Dynamic output power as a function of peak to peak output voltage; typical values.



$V_S = 26$  V.

Fig.5 Static output power as a function of mean output voltage; typical values.

## Video driver hybrid amplifier

CR2424S

## FEATURES

- Typical transition times (10 to 90%) with  $C_L$  at 8.5 pF:
  - 2.2 ns rise and 2.0 ns fall with 35 V (p-p) swing
  - 2.3 ns rise and 2.1 ns fall with 40 V (p-p) swing
  - 2.5 ns rise and 2.2 ns fall with 50 V (p-p) swing
- Low power consumption
- Minimum small-signal bandwidth 130 MHz
- Very fast slew rate; 15000 V/ $\mu$ s
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

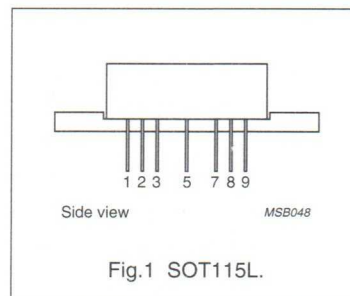
It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour and monochrome monitors.

## DESCRIPTION

Hybrid amplifier module mounted in SOT115L package.

## PINNING

| PIN | DESCRIPTION              |
|-----|--------------------------|
| 1   | input                    |
| 2   | ground                   |
| 3   | ground                   |
| 5   | supply voltage ( $V_S$ ) |
| 7   | ground                   |
| 8   | ground                   |
| 9   | output                   |



## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                           | MIN. | MAX. | UNIT |
|-----------|-------------------------------------|------|------|------|
| $V_S$     | supply voltage (DC)                 | –    | 70   | V    |
| $T_{mb}$  | operating mounting base temperature | –20  | +100 | °C   |
| $T_{stg}$ | storage temperature                 | –40  | +125 | °C   |



## Video driver hybrid amplifier

CR2424S

## CHARACTERISTICS

$T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; measured in test circuit (see Fig.10); unless otherwise specified.

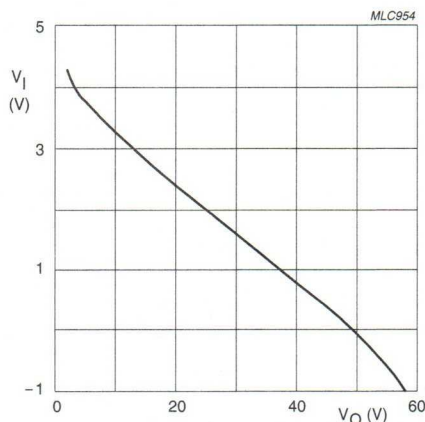
| SYMBOL                                                                                                                                        | PARAMETER                    | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------|------|------|------|------|
| <b><math>V_S = 60\text{ V}</math>; output swing = 40 V (p-p) with 30 V (DC) offset; unless otherwise specified</b>                            |                              |                                 |      |      |      |      |
| $I_S$                                                                                                                                         | supply current               | input and output open           | 39   | 45   | 51   | mA   |
| $V_I$                                                                                                                                         | input voltage (DC)           | input and output open           | 1.3  | 1.6  | 1.9  | V    |
| $t_r$                                                                                                                                         | rise time transient response | 10 to 90%; note 1               | —    | 2.3  | 2.9  | ns   |
| $t_f$                                                                                                                                         | fall time transient response | 10 to 90%; note 1               | —    | 2.1  | 2.6  | ns   |
| <b><math>V_S = 65\text{ V}</math>; output swing = 50 V (p-p) with 32.5 V (DC) offset; unless otherwise specified</b>                          |                              |                                 |      |      |      |      |
| $I_S$                                                                                                                                         | supply current               | input and output open           | —    | 50   | 57   | mA   |
| $V_I$                                                                                                                                         | input voltage (DC)           | input and output open           | 1.4  | 1.75 | 2.1  | V    |
| $t_r$                                                                                                                                         | rise time transient response | 10 to 90%; note 2               | —    | 2.5  | 3.2  | ns   |
| $t_f$                                                                                                                                         | fall time transient response | 10 to 90%; note 2               | —    | 2.2  | 3.2  | ns   |
| <b><math>V_S = 60\text{ or }65\text{ V}</math>; output swing = 40 or 50 V (p-p) with 30 or 32.5 V (DC) offset; unless otherwise specified</b> |                              |                                 |      |      |      |      |
| $P_{tot}$                                                                                                                                     | total power dissipation      | 50 MHz square wave              | —    | 4.6  | 6    | W    |
| BW                                                                                                                                            | small-signal bandwidth       | between -3 dB points; note 3    | 130  | 145  | —    | MHz  |
| $V_{tilt}$                                                                                                                                    | low frequency tilt voltage   | 1 kHz square wave               | —    | 1.3  | 1.5  | V    |
| $V_{os}$                                                                                                                                      | overshoot voltage            | varied by C1; see Fig.10        | —    | 3    | 10   | %    |
| NLN                                                                                                                                           | non-linearity                | $V_O = 5\text{ to }55\text{ V}$ | —    | 2    | 5    | %    |
| $A_V$                                                                                                                                         | DC voltage gain              | 50 $\Omega$ source; note 4      | 11.2 | 12.4 | 13.2 |      |
| $V_G$                                                                                                                                         | insertion gain               | 50 $\Omega$ source; note 5      | 160  | 180  | 200  |      |

## Notes

1. Input signal is a 100 kHz square wave of 3.25 V (p-p), with 1.5 V (DC) offset (50  $\Omega$  source).
2. Input signal is a 100 kHz square wave of 3.4 V (p-p), with 1.65 V (DC) offset (50  $\Omega$  source).
3. Sine wave output signal: 1 V (p-p).
4. Measured  $V_O/V_I$  (Figs 2 and 6) at input test circuit (see Fig.10).
5. Measured  $V_O/V_I$  (Figs 3 and 7) at input module (see Fig.10).

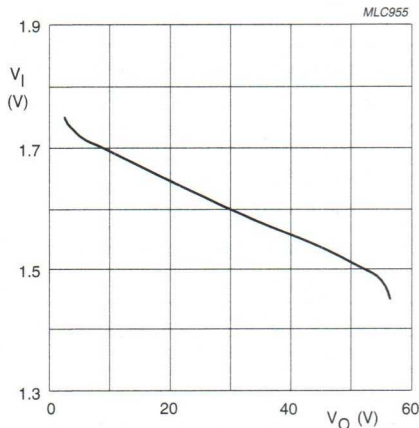
## Video driver hybrid amplifier

CR2424S



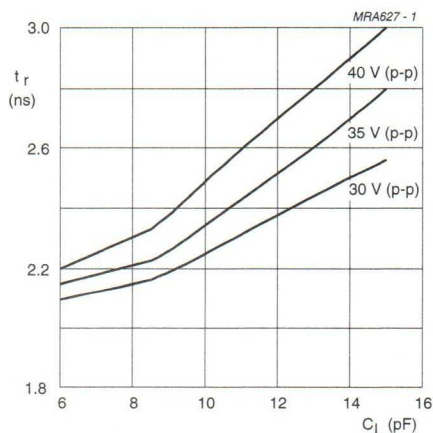
$V_S = 60\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 40 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

Fig.2 Input voltage at input test circuit as a function of output voltage; typical values.



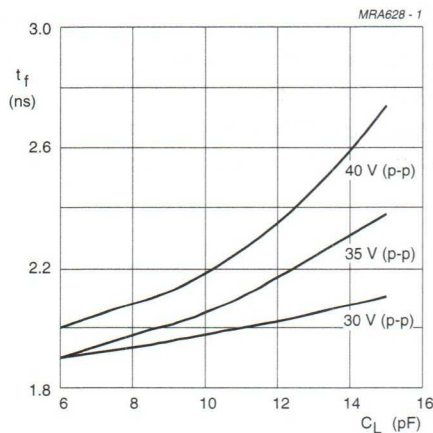
$V_S = 60\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 40 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 60\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 40, 35, 30 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

Fig.4 Rise time transient response as a function of load capacitance; typical values.

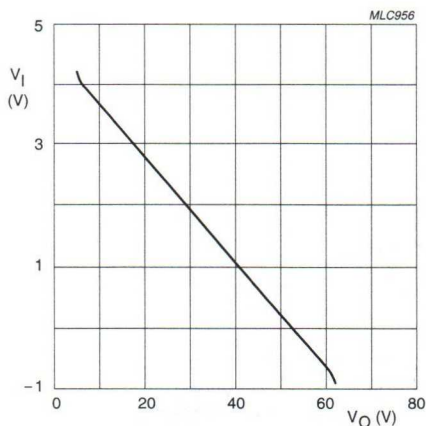


$V_S = 60\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 40, 35, 30 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

Fig.5 Fall time transient response as a function of load capacitance; typical values.

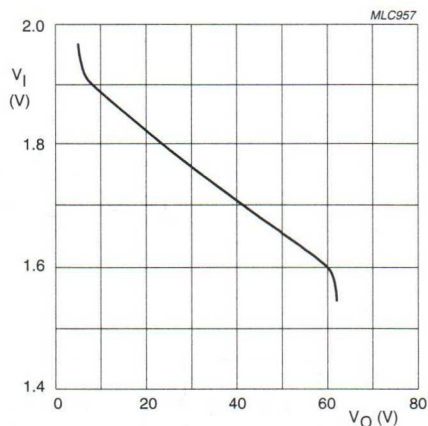
## Video driver hybrid amplifier

## CR2424S



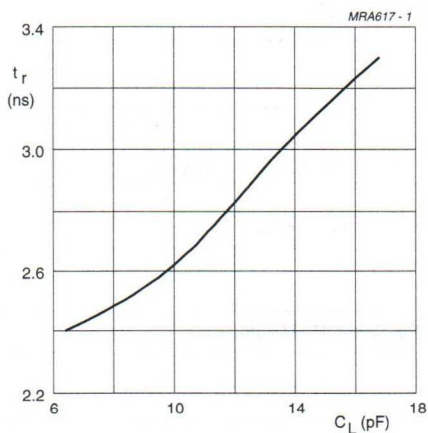
$V_S = 65\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

Fig.6 Input voltage at input test circuit as a function of output voltage; typical values.



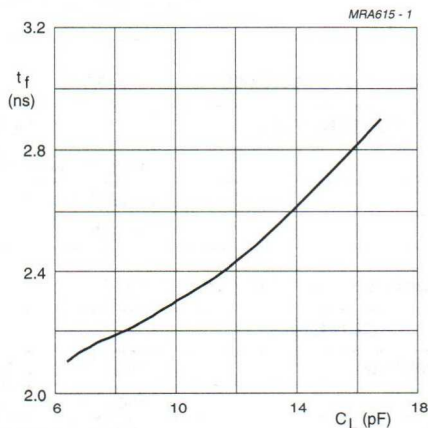
$V_S = 65\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

Fig.7 Input voltage at input module as a function of output voltage; typical values.



$V_S = 65\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

Fig.8 Rise time transient response as a function of load capacitance; typical values.



$V_S = 65\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

Fig.9 Fall time transient response as a function of load capacitance; typical values.

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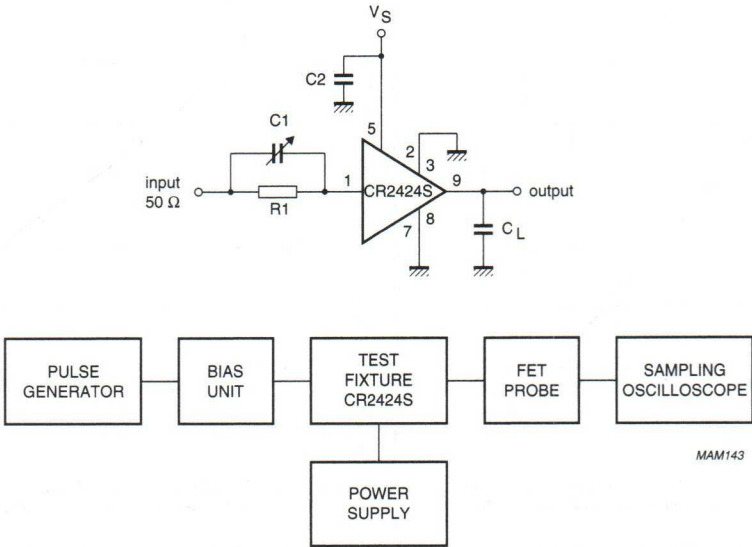


Fig.10 CRT amplifier test circuit and block diagram.

Components used in test circuit (see Fig.10)

| DESIGNATION    | DESCRIPTION        | VALUE                     |
|----------------|--------------------|---------------------------|
| C <sub>1</sub> | variable capacitor | 10 to 120 pF (typ. 50 pF) |
| C <sub>2</sub> | chip capacitor     | 10 nF                     |
| R1             | resistor           | typ. 215 Ω                |

Equipment used in test circuit (see Fig.10)

| EQUIPMENT             | TYPE DESCRIPTION                           |
|-----------------------|--------------------------------------------|
| Pulse generator       | Pico Second; Model 2600B                   |
| Bias unit             | Pico Second; Model 5555                    |
| Power supply          | Philips; Model PE1541, 80 V                |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1 |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24 |



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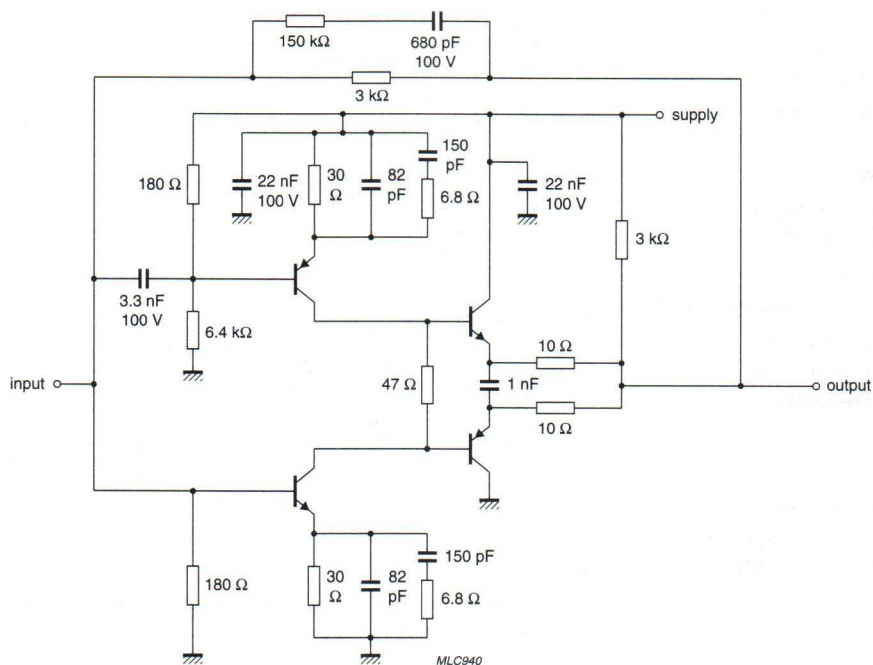


Fig.11 Internal circuit.

## Video driver hybrid amplifier

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## FEATURES

- Typical transition times (10 to 90%) with  $C_L = 8.5$  pF:
  - at 35 V (p-p) swing  
 $t_r = 2.2$  ns;  $t_f = 2.0$  ns
  - at 40 V (p-p) swing  
 $t_r = 2.3$  ns;  $t_f = 2.1$  ns
  - at 50 V (p-p) swing  
 $t_r = 2.5$  ns;  $t_f = 2.2$  ns
- Low power consumption
- Minimum small signal bandwidth 130 MHz
- Very fast slew rate; 15000 V/ $\mu$ s
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour and monochrome monitors.

## DESCRIPTION

Hybrid amplifier module mounted in SOT348 package.

## PINNING

| PIN | DESCRIPTION              |
|-----|--------------------------|
| 1   | input                    |
| 2   | ground                   |
| 3   | supply voltage ( $V_S$ ) |
| 4   | ground                   |
| 5   | output                   |

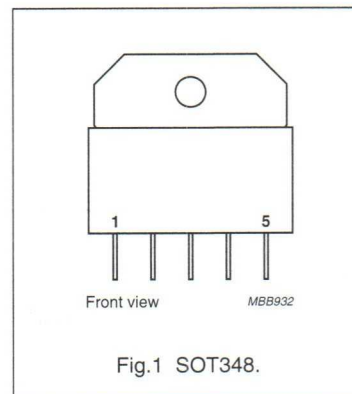


Fig.1 SOT348.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                                   | MIN. | MAX. | UNIT |
|-----------|---------------------------------------------|------|------|------|
| $V_S$     | supply voltage (DC)                         | –    | 70   | V    |
| $T_{mb}$  | operating mounting base temperature; note 1 | –20  | +100 | °C   |
| $T_{stg}$ | storage temperature                         | –40  | +125 | °C   |

## Note

1. To ensure proper thermal contact, a layer of heatsink compound should be applied between module and heatsink.

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## CHARACTERISTICS

$T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 8.5\text{ pF}$ ;  $R_1 = 215\text{ }\Omega$ ;  $C_1 = 50\text{ pF}$  (see Fig.10); unless otherwise specified.

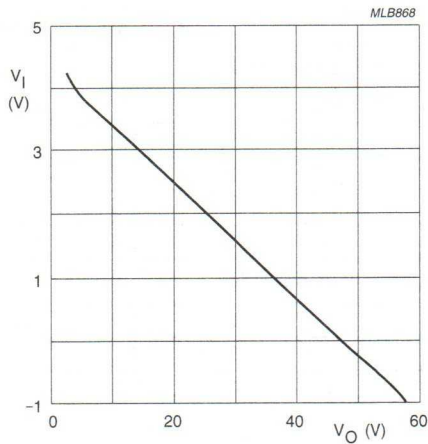
| SYMBOL                                                                                                                                                                    | PARAMETER                    | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------|------|------|------|------|
| <b><math>V_S = 60\text{ V}</math>; 40 V (p-p) output swing with 30 V (DC) offset; unless otherwise specified</b>                                                          |                              |                                 |      |      |      |      |
| $I_S$                                                                                                                                                                     | supply current               | input and output open           | 39   | 45   | 51   | mA   |
| $V_I$                                                                                                                                                                     | input voltage (DC)           | input and output open           | 1.3  | 1.6  | 1.9  | V    |
| $V_O$                                                                                                                                                                     | output voltage (DC)          | input and output open           | 28   | 31   | 34   | V    |
| $t_r$                                                                                                                                                                     | rise time transient response | 10 to 90%; note 1               | —    | 2.3  | 2.9  | ns   |
| $t_f$                                                                                                                                                                     | fall time transient response | 10 to 90%; note 1               | —    | 2.1  | 2.6  | ns   |
| <b><math>V_S = 65\text{ V}</math>; 50 V (p-p) output swing with 32.5 V (DC) offset; unless otherwise specified</b>                                                        |                              |                                 |      |      |      |      |
| $I_S$                                                                                                                                                                     | supply current               | input and output open           | —    | 50   | 57   | mA   |
| $V_I$                                                                                                                                                                     | input voltage (DC)           | input and output open           | 1.4  | 1.75 | 2.1  | V    |
| $V_O$                                                                                                                                                                     | output voltage (DC)          | input and output open           | 29   | 32   | 35   | V    |
| $t_r$                                                                                                                                                                     | rise time transient response | 10 to 90%; note 2               | —    | 2.5  | 3.2  | ns   |
| $t_f$                                                                                                                                                                     | fall time transient response | 10 to 90%; note 2               | —    | 2.2  | 3.2  | ns   |
| <b><math>V_S = 60\text{ V}</math> or <math>65\text{ V}</math>; 40 V (p-p) or 50 V (p-p) output swing with 30 V (DC) or 32.5 V (DC) offset; unless otherwise specified</b> |                              |                                 |      |      |      |      |
| $P_{tot}$                                                                                                                                                                 | total power dissipation      | 50 MHz square wave              | —    | 4.6  | 6    | W    |
| $B_s$                                                                                                                                                                     | small signal bandwidth       | between -3 dB points; note 3    | 130  | 145  | —    | MHz  |
| $V_{tilt}$                                                                                                                                                                | low frequency tilt voltage   | 1 kHz square wave               | —    | 1.3  | 1.5  | V    |
| $V_{os}$                                                                                                                                                                  | overshoot voltage            | varied by $C_1$ ; see Fig.10    | —    | 3    | 10   | %    |
| NLN                                                                                                                                                                       | non-linearity                | $V_O = 5\text{ to }55\text{ V}$ | —    | 2    | 5    | %    |
| $A_V$                                                                                                                                                                     | DC voltage gain              | 50 $\Omega$ source; note 4      | 11.2 | 12.4 | 13.2 |      |
| $V_G$                                                                                                                                                                     | insertion gain               | 50 $\Omega$ source; note 5      | 160  | 180  | 200  |      |

## Notes

1. Input signal is a nominal 100 kHz square wave of 3.25 V (p-p), with 1.5 V (DC) offset (50  $\Omega$  source).
2. Input signal is a nominal 100 kHz square wave of 3.4 V (p-p), with 1.65 V (DC) offset (50  $\Omega$  source).
3. Sine wave output signal: 1 V (p-p).
4. Measured  $V_O/V_I$  (Figs 2 and 6) at input test circuit (see Fig.10).
5. Measured  $V_O/V_I$  (Figs 3 and 7) at input module (see Fig.10).

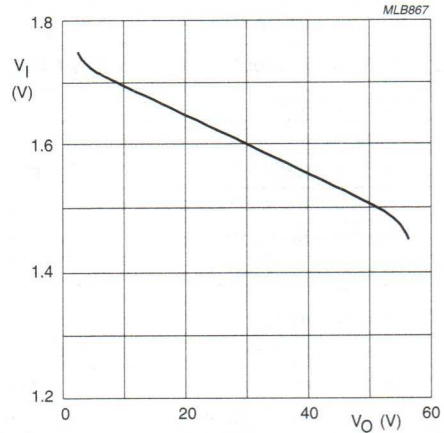
## Video driver hybrid amplifier

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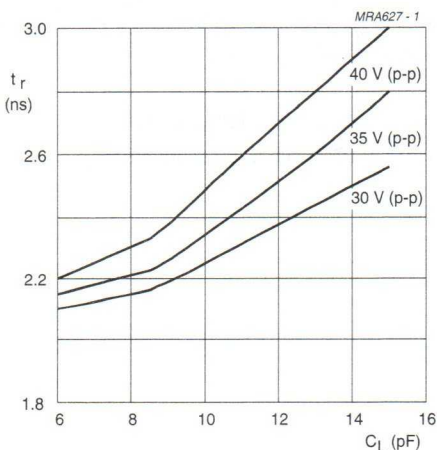
$V_S = 60 \text{ V}$ ;  $T_{mb} = 25 \text{ }^\circ\text{C}$ ;  $C_L = 8.5 \text{ pF}$ ;  $R_1 = 215 \text{ }\Omega$ ;  $C_1 = 50 \text{ pF}$ ;  
**40 V (p-p)** output swing with 30 V (DC) offset (see Fig.10).

Fig.2 Input voltage at input test-circuit as a function of output voltage; typical values.



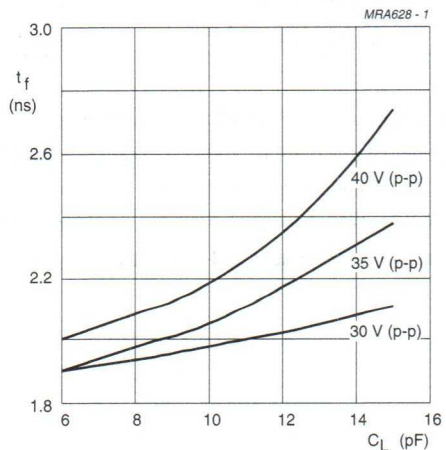
$V_S = 60 \text{ V}$ ;  $T_{mb} = 25 \text{ }^\circ\text{C}$ ;  $C_L = 8.5 \text{ pF}$ ;  $R_1 = 215 \text{ }\Omega$ ;  $C_1 = 50 \text{ pF}$ ;  
**40 V (p-p)** output swing with 30 V (DC) offset (see Fig.10).

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 60 \text{ V}$ ;  $T_{mb} = 25 \text{ }^\circ\text{C}$ ;  $C_L = 8.5 \text{ pF}$ ;  $R_1 = 215 \text{ }\Omega$ ;  $C_1 = 50 \text{ pF}$ ;  
**40, 35, 30 V (p-p)** output swing with 30 V (DC) offset.

Fig.4 Rise time transient response as a function of load capacitance; typical values.



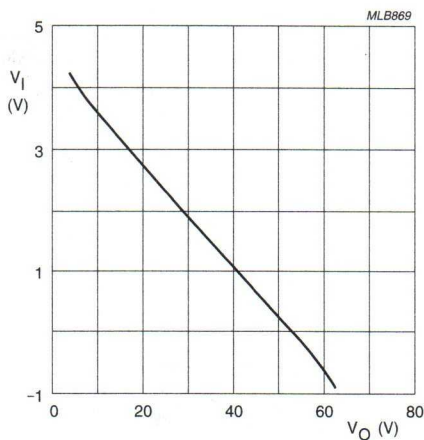
$V_S = 60 \text{ V}$ ;  $T_{mb} = 25 \text{ }^\circ\text{C}$ ;  $C_L = 8.5 \text{ pF}$ ;  $R_1 = 215 \text{ }\Omega$ ;  $C_1 = 50 \text{ pF}$ ;  
**40, 35, 30 V (p-p)** output swing with 30 V (DC) offset.

Fig.5 Fall time transient response as a function of load capacitance; typical values.



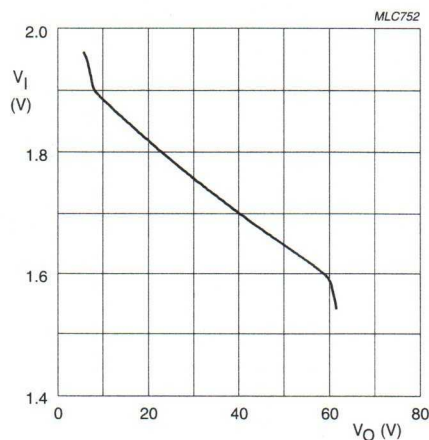
## Video driver hybrid amplifier

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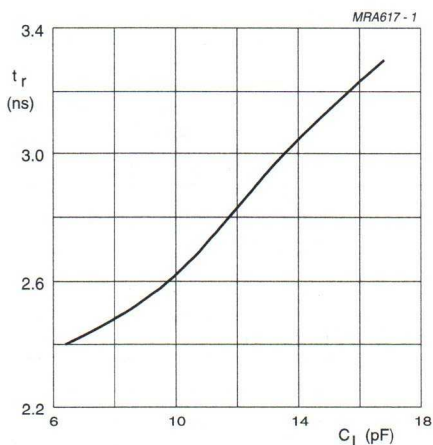
$V_S = 65$  V;  $T_{mb} = 25$  °C;  $C_L = 8.5$  pF;  $R_1 = 215$   $\Omega$ ;  $C_1 = 50$  pF;  
**50 V (p-p)** output swing with 32.5 V (DC) offset (see Fig.10).

Fig.6 Input voltage at input test-circuit as a function of output voltage; typical values.



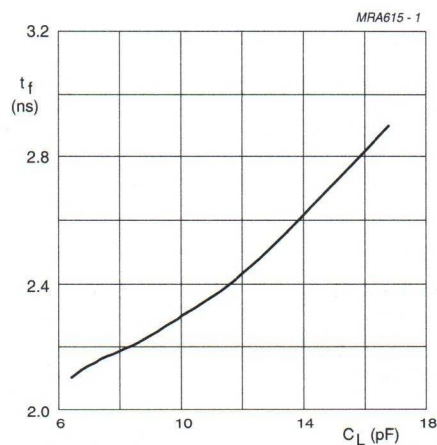
$V_S = 65$  V;  $T_{mb} = 25$  °C;  $C_L = 8.5$  pF;  $R_1 = 215$   $\Omega$ ;  $C_1 = 50$  pF;  
**50 V (p-p)** output swing with 32.5 V (DC) offset (see Fig.10).

Fig.7 Input voltage at input module as a function of output voltage; typical values.



$V_S = 65$  V;  $T_{mb} = 25$  °C;  $C_L = 8.5$  pF;  $R_1 = 215$   $\Omega$ ;  $C_1 = 50$  pF;  
**50 V (p-p)** output swing with 32.5 V (DC) offset.

Fig.8 Rise time transient response as a function of load capacitance; typical values.

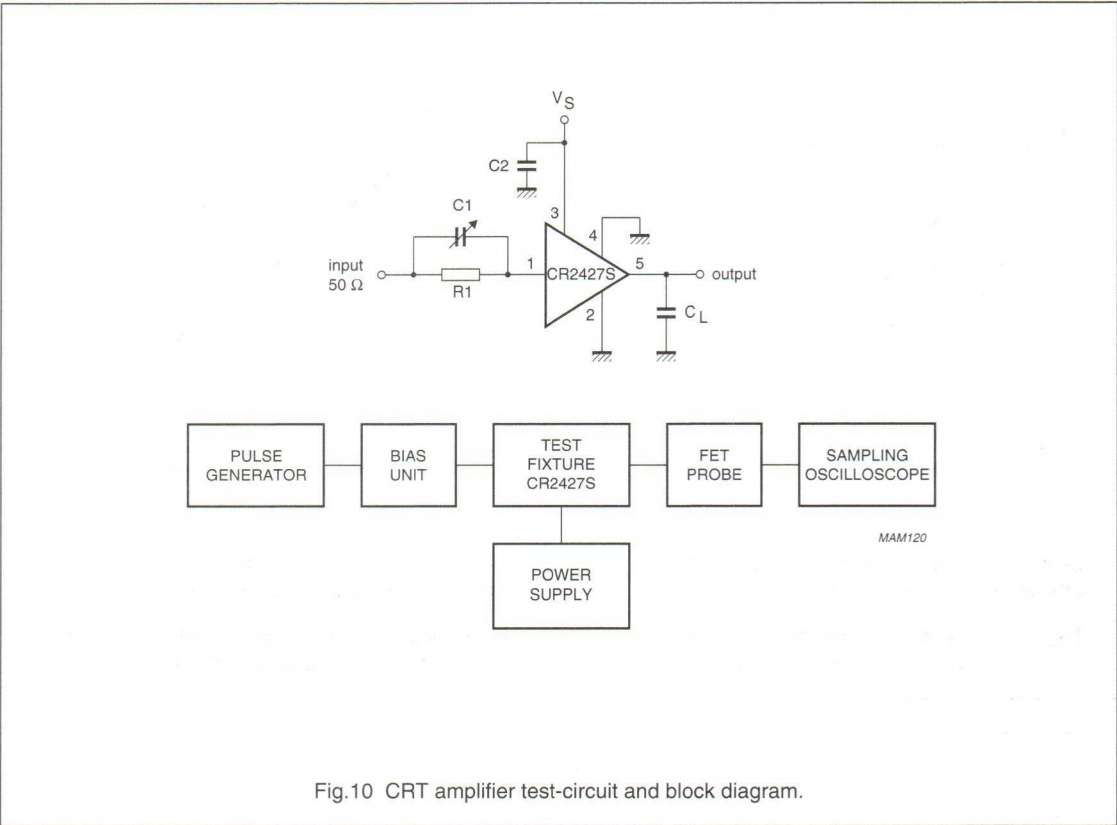


$V_S = 65$  V;  $T_{mb} = 25$  °C;  $C_L = 8.5$  pF;  $R_1 = 215$   $\Omega$ ;  $C_1 = 50$  pF;  
**50 V (p-p)** output swing with 32.5 V (DC) offset.

Fig.9 Fall time transient response as a function of load capacitance; typical values.

Video driver hybrid amplifier

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Components used in test-circuit (see Fig.10)

| DESIGNATION    | DESCRIPTION        | VALUE                     |
|----------------|--------------------|---------------------------|
| C <sub>1</sub> | variable capacitor | 10 to 120 pF (typ. 50 pF) |
| C <sub>2</sub> | chip capacitor     | 10 nF                     |
| R1             | resistor           | typ. 215 $\Omega$         |

Equipment used in test-circuit (see Fig.10)

| EQUIPMENT             | TYPE DESCRIPTION                           |
|-----------------------|--------------------------------------------|
| Pulse generator       | Pico Second; Model 2600B                   |
| Bias unit             | Pico Second; Model 5555                    |
| Power supply          | Philips; Model PE1541, 80 V                |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1 |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24 |

## Video driver hybrid amplifier

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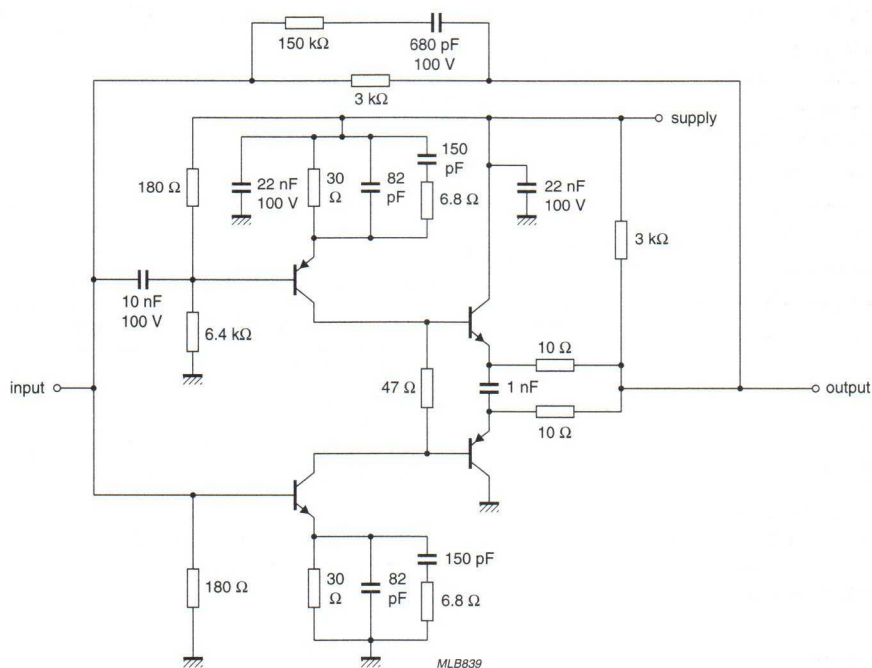


Fig.11 Internal circuit.

Video driver hybrid amplifier

CR3424

FEATURES

- Typical transition times (10 to 90%) with  $C_L = 10\text{ pF}$ :
  - at 35 V (p-p) swing  
 $t_r = 2.2\text{ ns}$ ;  $t_f = 2.0\text{ ns}$
  - at 40 V (p-p) swing  
 $t_r = 2.3\text{ ns}$ ;  $t_f = 2.1\text{ ns}$
  - at 50 V (p-p) swing  
 $t_r = 2.5\text{ ns}$ ;  $t_f = 2.2\text{ ns}$
- Low power consumption
- Minimum small signal bandwidth 130 MHz
- Very fast slew rate; 15000 V/ $\mu\text{s}$
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

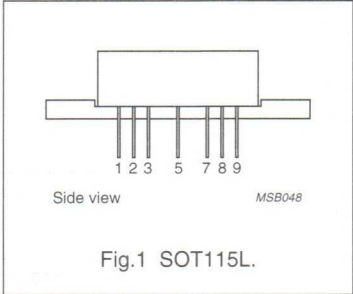
It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour and monochrome monitors.

DESCRIPTION

Hybrid amplifier module mounted in a SOT115L package.

PINNING

| PIN | DESCRIPTION              |
|-----|--------------------------|
| 1   | input                    |
| 2   | ground                   |
| 3   | ground                   |
| 5   | supply voltage ( $V_S$ ) |
| 7   | ground                   |
| 8   | ground                   |
| 9   | output                   |



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                                   | MIN. | MAX. | UNIT |
|-----------|---------------------------------------------|------|------|------|
| $V_S$     | supply voltage (DC)                         | –    | 90   | V    |
| $T_{mb}$  | operating mounting base temperature; note 1 | –20  | +100 | °C   |
| $T_{stg}$ | storage temperature                         | –40  | +125 | °C   |

Note

1. To ensure proper thermal contact, a layer of heatsink compound should be applied between module and heatsink.



Video driver hybrid amplifier

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CHARACTERISTICS

$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 287\text{ }\Omega$ ;  $C_1 = 60\text{ pF}$ ; 40 V (p-p) output swing with 40 V DC offset (see Fig.6); unless otherwise specified.

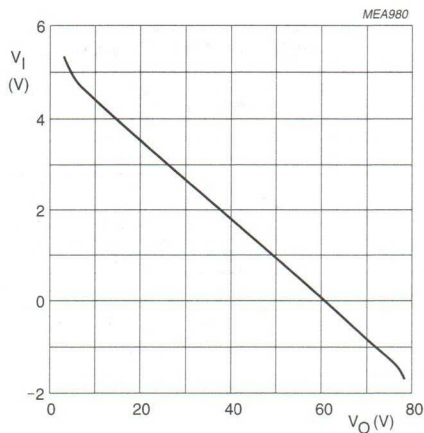
| SYMBOL     | PARAMETER                    | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|------------|------------------------------|---------------------------------|------|------|------|------|
| $I_S$      | supply current               | input and output open           | 41   | 47   | 53   | mA   |
| $V_I$      | input voltage (DC)           | input and output open           | 1.4  | 1.6  | 1.9  | V    |
| $V_O$      | output voltage (DC)          | input and output open           | 37   | 41   | 45   | V    |
| $P_{tot}$  | total power dissipation      | 50 MHz square wave              | –    | 6.4  | 8    | W    |
| $t_r$      | rise time transient response | 10 to 90%; note 1               | –    | 2.3  | 2.9  | ns   |
| $t_f$      | fall time transient response | 10 to 90%; note 1               | –    | 2.1  | 2.6  | ns   |
| BW         | small signal bandwidth       | between –3 dB points; note 2    | 130  | 145  | –    | MHz  |
| $V_{tilt}$ | low frequency tilt voltage   | 1 kHz square wave               | –    | 1.3  | 1.5  | V    |
| $V_{os}$   | overshoot voltage            | varied by $C_1$ ; see Fig.6     | –    | 3    | 10   | %    |
| NLN        | non-linearity                | $V_O = 5\text{ to }75\text{ V}$ | –    | 2    | 5    | %    |
| $A_V$      | DC voltage gain              | 50 $\Omega$ source; note 3      | 11.2 | 12.4 | 13.2 |      |
| $V_G$      | insertion gain               | 50 $\Omega$ source; note 4      | 160  | 180  | 200  |      |

Notes

1. Input signal is a 100 kHz square wave of 3.25 V (p-p), with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  (Fig.2) at input test-circuit (see Fig.6).
4. Measured  $V_O/V_I$  (Fig.3) at input module (see Fig.6).

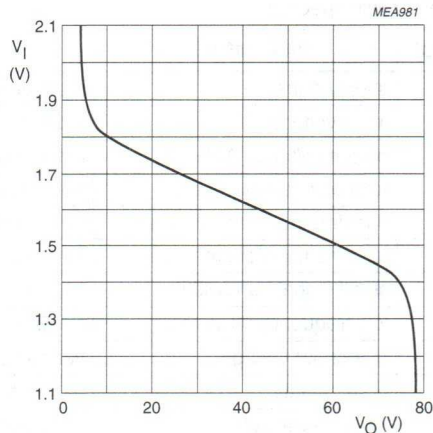
## Video driver hybrid amplifier

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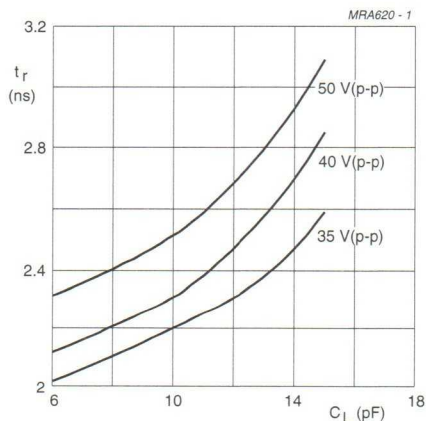
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 287\text{ }\Omega$ ;  $C_1 = 60\text{ pF}$ ;  
40 V (p-p) output swing with 40 V DC offset.

Fig.2 Input voltage at input test-circuit as a function of output voltage; typical values.



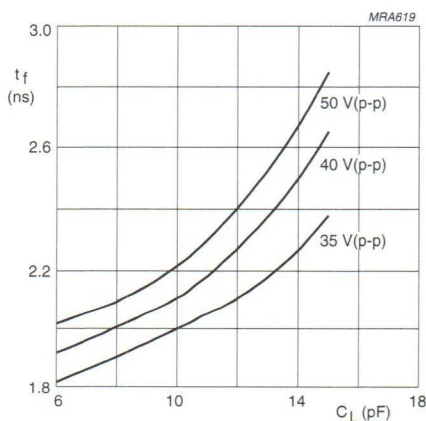
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 287\text{ }\Omega$ ;  $C_1 = 60\text{ pF}$ ;  
40 V (p-p) output swing with 40 V DC offset.

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 287\text{ }\Omega$ ;  $C_1 = 60\text{ pF}$ ;  
50, 40, 35 V (p-p) output swing with 40 V DC offset.

Fig.4 Rise time transient response as a function of load capacitance; typical values.



$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 287\text{ }\Omega$ ;  $C_1 = 60\text{ pF}$ ;  
50, 40, 35 V (p-p) output swing with 40 V DC offset.

Fig.5 Fall time transient response as a function of load capacitance; typical values.

Video driver hybrid amplifier

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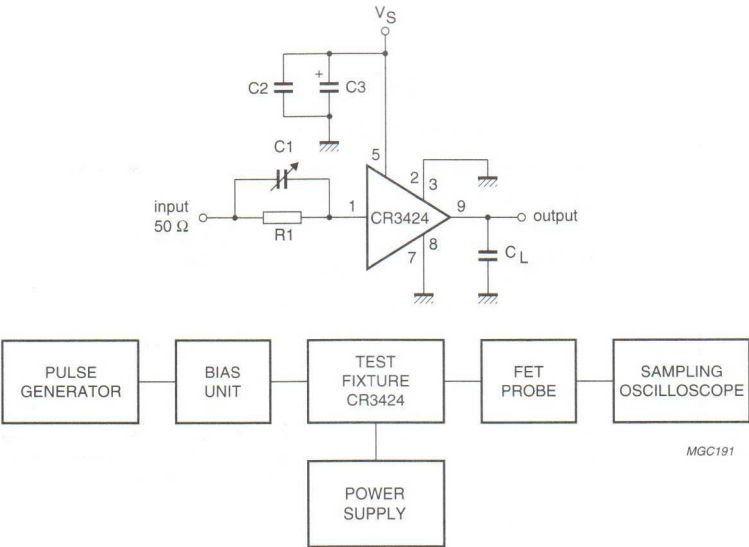


Fig.6 CRT amplifier test-circuit and block diagram.

Components used in test-circuit (see Fig.6)

| DESIGNATION    | DESCRIPTION            | VALUE                     |
|----------------|------------------------|---------------------------|
| C <sub>1</sub> | variable capacitor     | 10 to 120 pF (typ. 60 pF) |
| C <sub>2</sub> | chip capacitor         | 10 nF                     |
| C <sub>3</sub> | electrolytic capacitor | 4.7 μF; 160 V             |
| R1             | resistor               | typ. 287 Ω                |

Equipment used in test-circuit (see Fig.6)

| EQUIPMENT             | TYPE DESCRIPTION                           |
|-----------------------|--------------------------------------------|
| Pulse generator       | Pico Second; Model 2600B                   |
| Bias unit             | Pico Second; Model 5555                    |
| Power supply          | Philips; Model PE1541, 80 V                |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1 |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24 |

## Video driver hybrid amplifier

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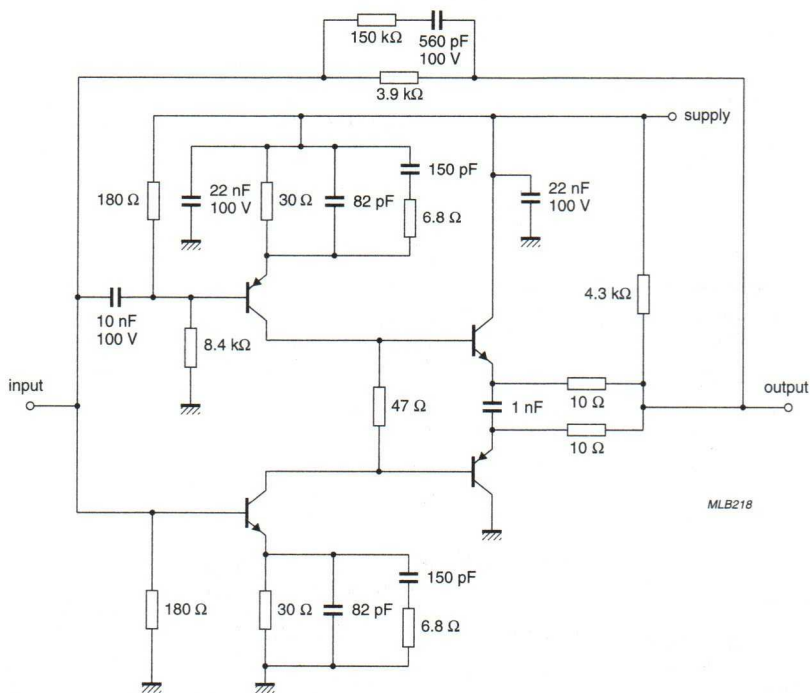


Fig.7 Internal circuit.



# Triple video driver hybrid amplifier

**CR5427**

## FEATURES

- Transition times (10 to 90%) with 45 V (p-p) swing and  $C_L = 10$  pF: rise time (typ.) 3 ns fall time (typ.) 3 ns
- Very low power consumption: 7 Watt with 25 MHz square wave
- Minimum small signal bandwidth: 100 MHz
- Very fast slew rate 12000 V/ $\mu$ s
- Excellent grey-scale linearity
- Internal supply decoupling per channel for optimum EMI performance and minimal crosstalk
- Gold metallization ensures excellent reliability
- No negative supply required in the final stage.

## APPLICATIONS

- Cathode-ray tube (CRT) drivers in high-resolution colour monitors
- For 1280 x 1024 pixels (good picture quality) with single PNP buffer
- For 1024 x 768 pixels (acceptable picture quality) when directly driven from the video pre-amp IC.

## DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT451A package.

## PINNING - SOT451A

| PIN | DESCRIPTION              |
|-----|--------------------------|
| 1   | input 1                  |
| 2   | ground                   |
| 3   | output 1                 |
| 4   | supply voltage ( $V_S$ ) |
| 5   | input 2                  |
| 6   | ground                   |
| 7   | output 2                 |
| 8   | supply voltage ( $V_S$ ) |
| 9   | input 3                  |
| 10  | ground                   |
| 11  | output 3                 |

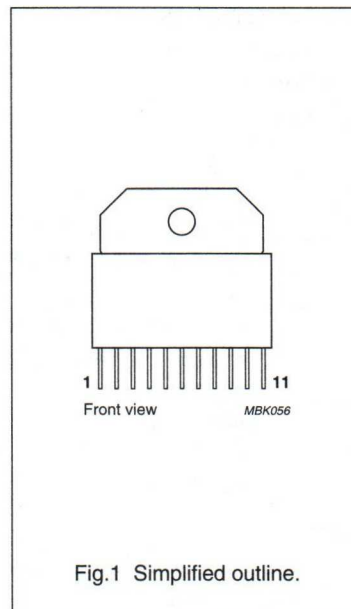


Fig.1 Simplified outline.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL               | PARAMETER                           | MIN. | MAX. | UNIT |
|----------------------|-------------------------------------|------|------|------|
| <b>Per amplifier</b> |                                     |      |      |      |
| $V_S$                | supply voltage (DC)                 | —    | 80   | V    |
| $T_{mb}$             | operating mounting base temperature | −20  | +100 | °C   |
| $T_{stg}$            | storage temperature                 | −40  | +125 | °C   |

Triple video driver hybrid amplifier

CR5427

CHARACTERISTICS

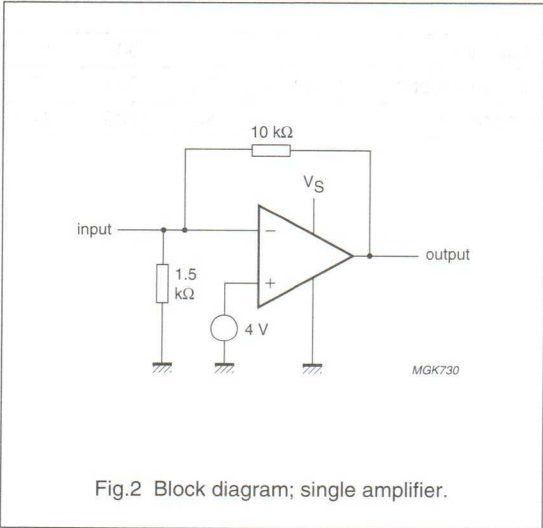
$V_S = 75\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 45 V (p-p) with 32.5 V DC offset (see Fig.3); unless otherwise specified.

| SYMBOL     | PARAMETER                              | CONDITIONS                         | MIN. | TYP. | MAX. | UNIT |
|------------|----------------------------------------|------------------------------------|------|------|------|------|
| $I_S$      | supply current                         | open input and open output         | 50   | 60   | 75   | mA   |
| $P_{tot}$  | total power consumption                | 25 MHz square wave                 | –    | 7    | 8    | W    |
| $t_r$      | rise time transient response           | 10 to 90%; note 1                  | –    | 3    | 4    | ns   |
| $t_f$      | fall time transient response           | 10 to 90%; note 1                  | –    | 3    | 4    | ns   |
| BW         | small signal bandwidth                 | between –3 dB points; note 2       | 100  | 120  | –    | MHz  |
| $V_{tilt}$ | low frequency tilt voltage             | 10 kHz square wave                 | –    | 1.3  | 1.5  | V    |
| $V_{os}$   | overshoot voltage (rise and fall time) | adjustable by C1 and C2; see Fig.3 | –    | 3    | 10   | %    |
| NLN        | non-linearity                          | $V_O = 10\text{ to }60\text{ V}$   | –    | 2    | 5    | %    |
| $A_V$      | DC voltage gain                        | 50 $\Omega$ source; note 3         | 11   | 12.5 | 14   |      |
| $V_G$      | insertion gain                         | 50 $\Omega$ source; note 4         | 110  | 130  | 150  |      |

Notes

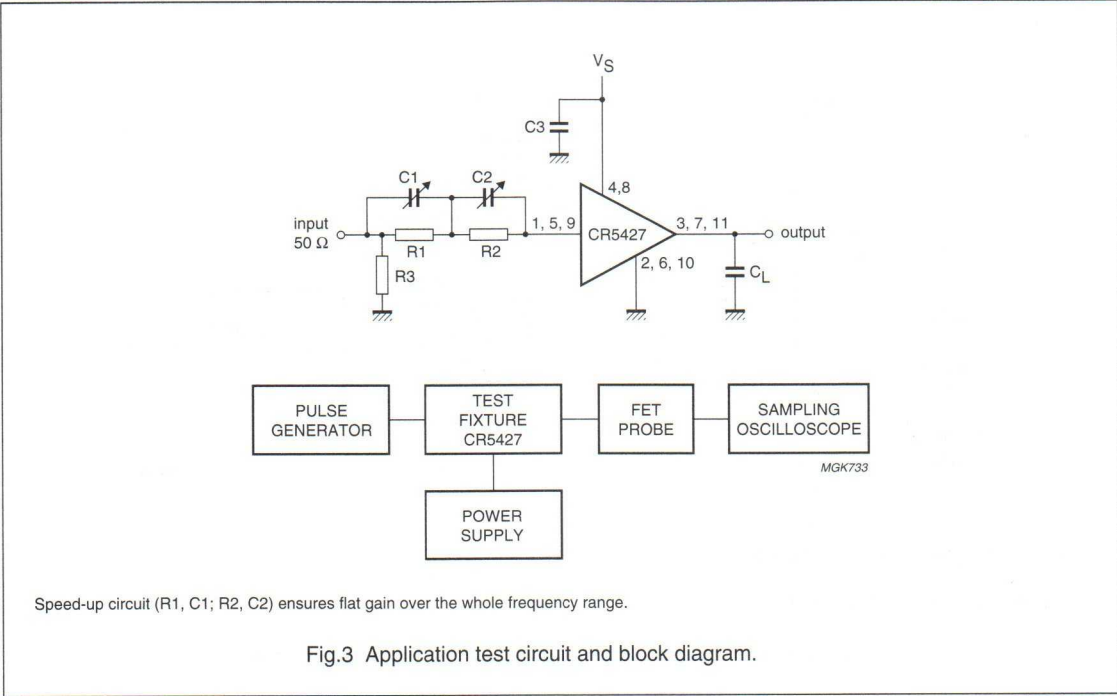
1. Input signal is a 100 kHz square wave of 3.5 V (p-p) with 3.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_i$  at input test circuit.
4. Measured  $V_O/V_i$  at input module.

APPLICATION NOTES



Triple video driver hybrid amplifier

CR5427



Components used in test circuit (see Fig.3)

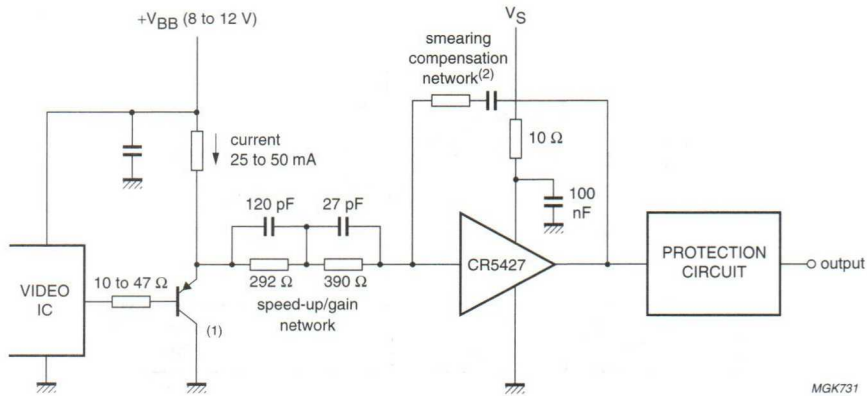
| COMPONENT | DESCRIPTION                                | VALUE                      |
|-----------|--------------------------------------------|----------------------------|
| C1        | variable capacitor                         | 10 to 160 pF (typ. 120 pF) |
| C2        | variable capacitor                         | 10 to 160 pF (typ. 27 pF)  |
| C3        | chip capacitor plus electrolytic capacitor | 10 nF plus 4.7 μF; 160 V   |
| R1        | resistor                                   | 292 Ω                      |
| R2        | resistor                                   | 390 Ω                      |
| R3        | resistor                                   | 100 Ω                      |

Test equipment (see Fig.3)

| EQUIPMENT             | TYPE DESCRIPTION                                         |
|-----------------------|----------------------------------------------------------|
| Pulse generator       | Le Croy; model 9210 with unit 9212                       |
|                       | Philips; model PM5785B (125 MHz) with internal DC offset |
| Power supply          | Philips; model PE1541, 80 V                              |
| FET probe             | Philips; model PM8943, attenuation 100 : 1               |
| Sampling oscilloscope | Tektronix; model 11803, sampling head SD24               |

## Triple video driver hybrid amplifier

CR5427

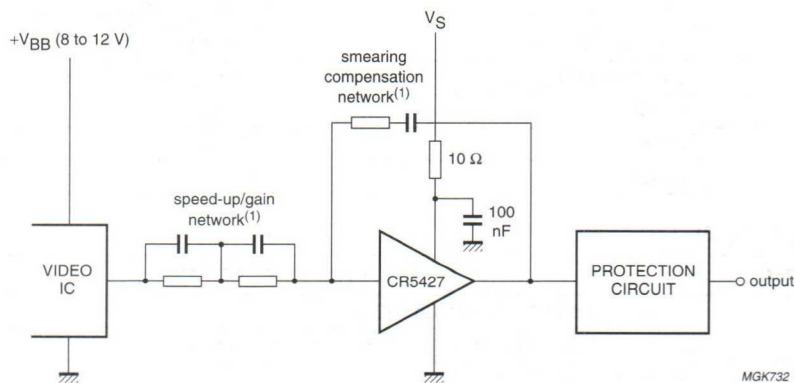


$t_r, t_f < 4$  ns (determined by current drive capability of the video IC).

(1)  $f_T > 3$  GHz;  $I_{Cmax} > 100$  mA.

(2) Component values dependent on CRT.

Fig.3 Application circuit with buffer stage for maximum performance.



$t_r, t_f < 7$  ns (determined by current drive capability of the video IC).

(1) Component values dependent on video IC and CRT.

Fig.4 Application circuit without buffer stage for economy.



Triple video driver hybrid amplifier

CR5527S

FEATURES

- Typical transition times (10 to 90%) with  $C_L = 10\text{ pF}$ :
  - at 50 V (p-p) swing  
 $t_r = 3\text{ ns}$ ;  $t_f = 2.2\text{ ns}$
- Low power consumption
- Minimum small signal bandwidth 100 MHz
- Very fast slew rate; 12000 V/ $\mu\text{s}$
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

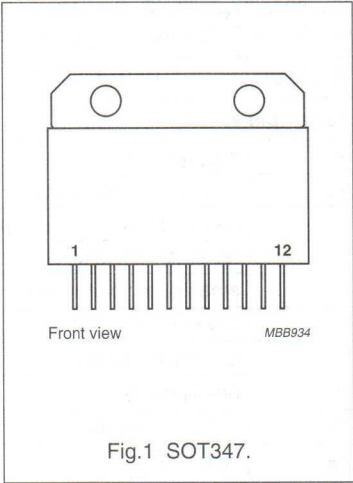
It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour monitors.

DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

PINNING

| PIN | DESCRIPTION                   |
|-----|-------------------------------|
| 1   | supply voltage 1 ( $V_{S1}$ ) |
| 2   | input 1                       |
| 3   | ground                        |
| 4   | output 1                      |
| 5   | supply voltage 2 ( $V_{S2}$ ) |
| 6   | input 2                       |
| 7   | ground                        |
| 8   | output 2                      |
| 9   | supply voltage 3 ( $V_{S3}$ ) |
| 10  | input 3                       |
| 11  | ground                        |
| 12  | output 3                      |



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL        | PARAMETER                                   | MIN. | MAX. | UNIT |
|---------------|---------------------------------------------|------|------|------|
| Per amplifier |                                             |      |      |      |
| $V_S$         | supply voltage (DC)                         | –    | 90   | V    |
| $T_{mb}$      | operating mounting base temperature; note 1 | –20  | +100 | °C   |
| $T_{stg}$     | storage temperature                         | –40  | +125 | °C   |

Note

1. To ensure proper thermal contact, a layer of heatsink compound should be applied between module and heatsink.

## Triple video driver hybrid amplifier

CR5527S

**CHARACTERISTICS**

$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset (see Fig.6); unless otherwise specified.

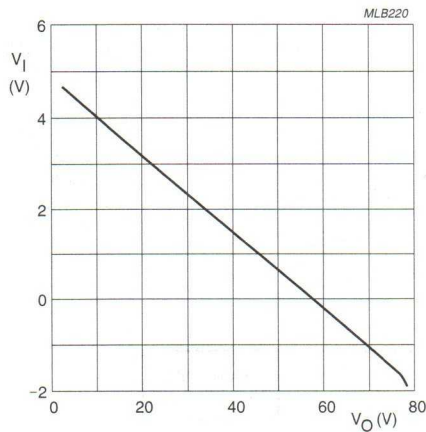
| SYMBOL               | PARAMETER                    | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|----------------------|------------------------------|---------------------------------|------|------|------|------|
| <b>Per amplifier</b> |                              |                                 |      |      |      |      |
| $I_S$                | supply current               | input and output open           | 19   | 25   | 31   | mA   |
| $P_{tot}$            | total power dissipation      | 25 MHz square wave              | –    | 9.6  | 11   | W    |
| $t_r$                | rise time transient response | 10 to 90%; note 1               | –    | 3    | 4    | ns   |
| $t_f$                | fall time transient response | 10 to 90%; note 1               | –    | 2.2  | 3    | ns   |
| BW                   | small signal bandwidth       | between –3 dB points; note 2    | 100  | 110  | –    | MHz  |
| $V_{tilt}$           | low frequency tilt voltage   | 10 kHz square wave              | –    | 1.3  | 1.5  | V    |
| $V_{os}$             | overshoot voltage            | varied by C1 and C2; see Fig.6  | –    | 3    | 10   | %    |
| NLN                  | non-linearity                | $V_O = 5\text{ to }75\text{ V}$ | –    | 2    | 5    | %    |
| $A_V$                | DC voltage gain              | 50 $\Omega$ source; note 3      | 11   | 12   | 13   |      |
| $V_G$                | insertion gain               | 50 $\Omega$ source; note 4      | 350  | 370  | 390  |      |

**Notes**

1. Input signal is a 100 kHz square wave of 4.15 V (p-p), with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  (Fig.2) at input test-circuit (see Fig.6).
4. Measured  $V_O/V_I$  (Fig.3) at input module (see Fig.6).

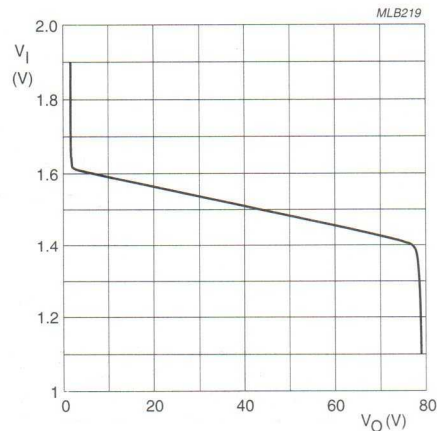
## Triple video driver hybrid amplifier

CR5527S



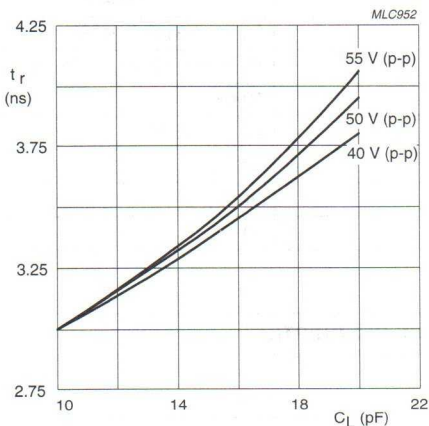
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset.

Fig.2 Input voltage at input test-circuit as a function of output voltage; typical values.



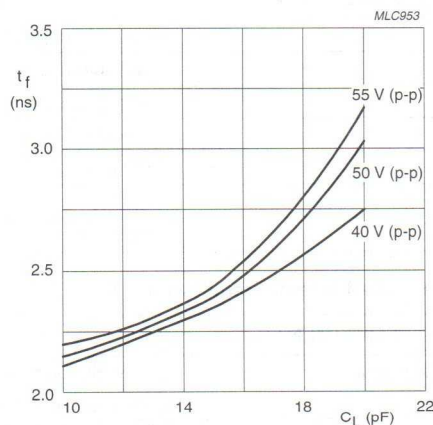
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset.

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 55, 50, 40 V (p-p) output swing with 40 V DC offset.

Fig.4 Rise time transient response as a function of load capacitance; typical values.

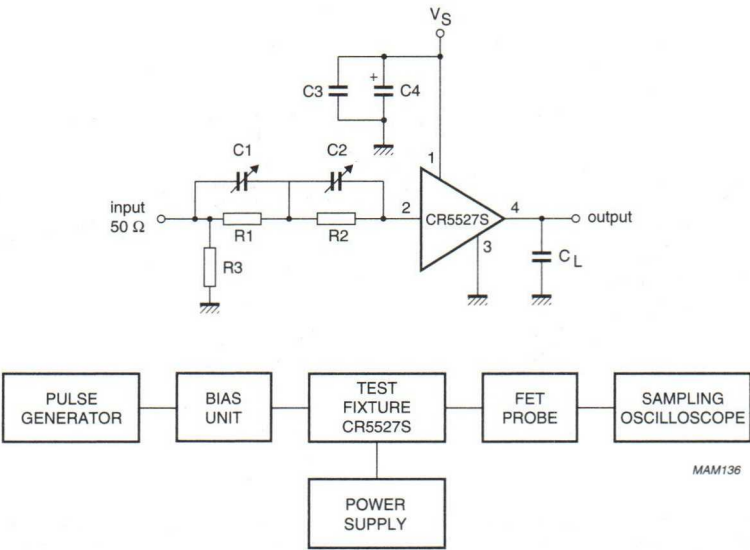


$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 55, 50, 40 V (p-p) output swing with 40 V DC offset.

Fig.5 Fall time transient response as a function of load capacitance; typical values.

# Triple video driver hybrid amplifier

CR5527S



Test-circuit for one of the three CRT amplifiers.

Fig.6 CRT amplifier test-circuit and block diagram.

## Components used in test-circuit (see Fig.6)

| DESIGNATION    | DESCRIPTION            | VALUE                      |
|----------------|------------------------|----------------------------|
| C <sub>1</sub> | variable capacitor     | 10 to 160 pF (typ. 90 pF)  |
| C <sub>2</sub> | variable capacitor     | 10 to 160 pF (typ. 100 pF) |
| C <sub>3</sub> | chip capacitor         | 10 nF                      |
| C <sub>4</sub> | electrolytic capacitor | 4.7 μF; 160 V              |
| R1             | resistor               | typ. 348 Ω                 |
| R2             | resistor               | typ. 82 Ω                  |
| R3             | resistor               | 50 Ω                       |

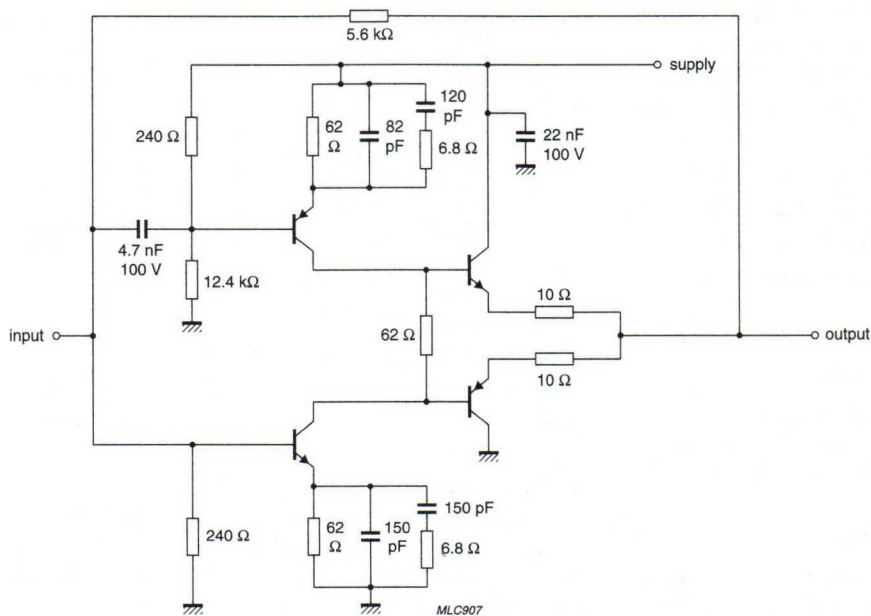
## Equipment used in test-circuit (see Fig.6)

| EQUIPMENT             | TYPE DESCRIPTION                           |
|-----------------------|--------------------------------------------|
| Pulse generator       | Pico Second; Model 2600B                   |
| Bias unit             | Pico Second; Model 5555                    |
| Power supply          | Philips; Model PE1541, 80 V                |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1 |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24 |



## Triple video driver hybrid amplifier

CR5527S



Supply voltage  $V_{S1}$ ,  $V_{S2}$  and  $V_{S3}$  are internally connected.

Fig.7 Internal circuit.

Triple video driver hybrid amplifier

CR5627

FEATURES

- Transition times (10 to 90%): 3.5 ns rise and 2.7 ns fall with 50 V (p-p) swing and C<sub>L</sub> at 10 pF
- Low power consumption: 10 W with 25 MHz square wave
- Minimum small signal bandwidth: 85 MHz
- Very fast slew rate: 12000 V/μs
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

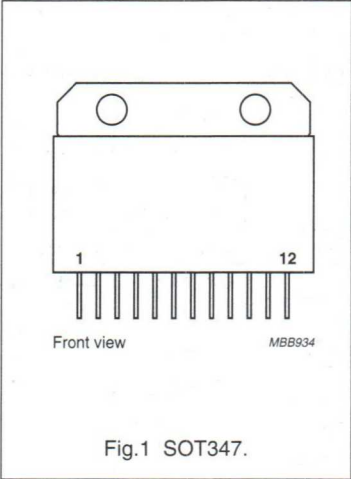
It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour monitors.

DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

PINNING

| PIN | DESCRIPTION                         |
|-----|-------------------------------------|
| 1   | supply voltage 1 (V <sub>S1</sub> ) |
| 2   | input 1                             |
| 3   | ground                              |
| 4   | output 1                            |
| 5   | supply voltage 2 (V <sub>S2</sub> ) |
| 6   | input 2                             |
| 7   | ground                              |
| 8   | output 2                            |
| 9   | supply voltage 3 (V <sub>S3</sub> ) |
| 10  | input 3                             |
| 11  | ground                              |
| 12  | output 3                            |



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL           | PARAMETER                           | MIN. | MAX. | UNIT |
|------------------|-------------------------------------|------|------|------|
| Per amplifier    |                                     |      |      |      |
| V <sub>S</sub>   | supply voltage (DC)                 | –    | 90   | V    |
| T <sub>mb</sub>  | operating mounting base temperature | –20  | +100 | °C   |
| T <sub>stg</sub> | storage temperature                 | –40  | +125 | °C   |

## Triple video driver hybrid amplifier

CR5627

**CHARACTERISTICS**

$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing =  $50\text{ V}$  (p-p) with  $40\text{ V}$  DC offset; measured in test circuit (see Fig.6); unless otherwise specified.

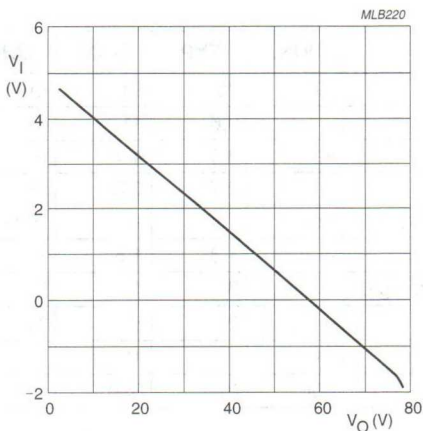
| SYMBOL     | PARAMETER                    | CONDITIONS                        | MIN. | TYP. | MAX. | UNIT |
|------------|------------------------------|-----------------------------------|------|------|------|------|
| $I_S$      | supply current               | input and output open             | 57   | 75   | 91   | mA   |
| $P_{tot}$  | total power dissipation      | 25 MHz square wave                | –    | 9.6  | 11   | W    |
| $t_r$      | rise time transient response | 10 to 90%; note 1                 | –    | 3.5  | 4.1  | ns   |
| $t_f$      | fall time transient response | 10 to 90%; note 1                 | –    | 2.7  | 3.3  | ns   |
| BW         | small signal bandwidth       | between –3 dB points; note 2      | 85   | 100  | –    | MHz  |
| $V_{tilt}$ | low frequency tilt voltage   | 10 kHz square wave                | –    | 1.3  | 1.5  | V    |
| $V_{os}$   | overshoot voltage            | varied by C1 and C2; see Fig.6    | –    | 3    | 10   | %    |
| NLN        | non-linearity                | $V_O = 5\text{ to }75\text{ V}$   | –    | 2    | 5    | %    |
| $A_V$      | DC voltage gain              | $50\text{ }\Omega$ source; note 3 | 11   | 12   | 13   |      |
| $V_G$      | insertion gain               | $50\text{ }\Omega$ source; note 4 | 350  | 370  | 390  |      |

**Notes**

1. Input signal is a 100 kHz square wave of 4.15 V (p-p) with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  (Fig.2) at input test-circuit (see Fig.6).
4. Measured  $V_O/V_I$  (Fig.3) at input module (see Fig.6).

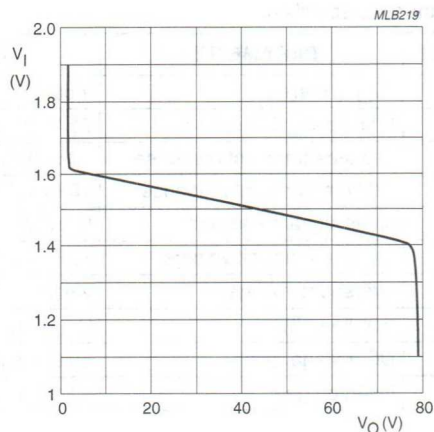
## Triple video driver hybrid amplifier

Figures of merit of CR5627



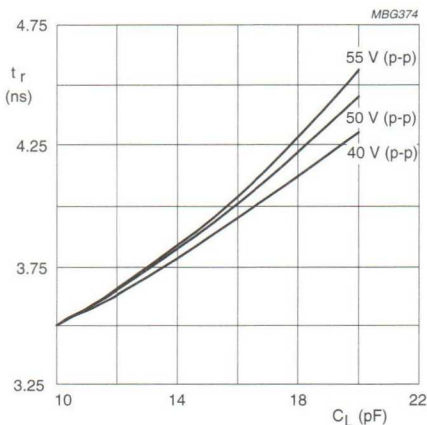
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 50 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

Fig.2 Input voltage at input test-circuit as a function of output voltage; typical values.



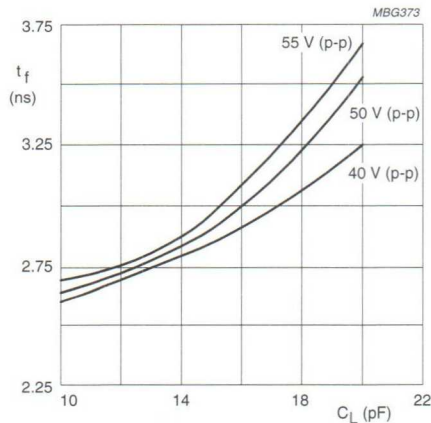
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 50 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 55, 50, 40 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

Fig.4 Rise time transient response as a function of load capacitance; typical values.



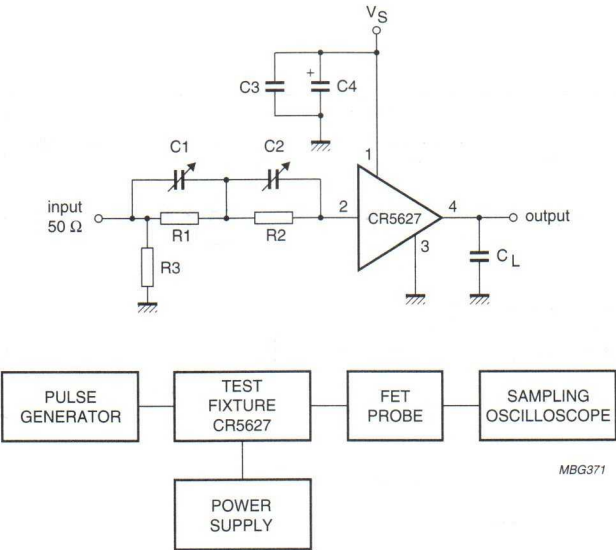
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 55, 50, 40 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

Fig.5 Fall time transient response as a function of load capacitance; typical values.



Triple video driver hybrid amplifier

CR5627



Test-circuit for one of the three CRT amplifiers.

Fig.6 CRT amplifier test-circuit and block diagram.

Components used in test-circuit (see Fig.6)

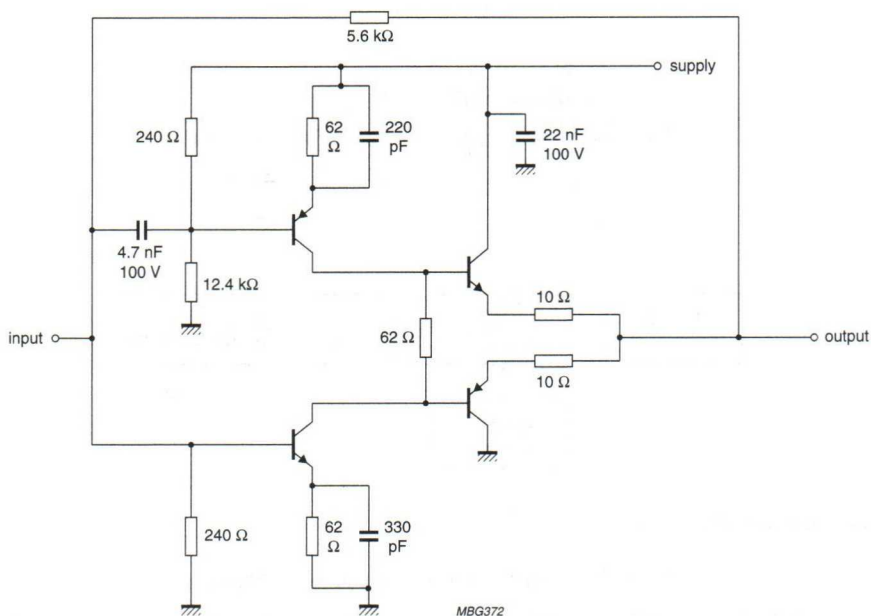
| DESIGNATION | DESCRIPTION            | VALUE                      |
|-------------|------------------------|----------------------------|
| C1          | variable capacitor     | 10 to 160 pF (typ. 90 pF)  |
| C2          | variable capacitor     | 10 to 160 pF (typ. 100 pF) |
| C3          | chip capacitor         | 10 nF                      |
| C4          | electrolytic capacitor | 4.7 μF; 160 V              |
| R1          | resistor               | typ. 348 Ω                 |
| R2          | resistor               | typ. 82 Ω                  |
| R3          | resistor               | 50 Ω                       |

Equipment used in test-circuit (see Fig.6)

| EQUIPMENT             | TYPE DESCRIPTION                                         |
|-----------------------|----------------------------------------------------------|
| Pulse generator       | Le Croy; Model 9210 with unit 9212                       |
|                       | Philips; Model PM5785B (125 MHz) with internal DC offset |
| Power supply          | Philips; Model PE1541, 80 V                              |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1               |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24               |

## Triple video driver hybrid amplifier

CR5627



Supply voltage  $V_{S1}$ ,  $V_{S2}$  and  $V_{S3}$  are internally connected.

Fig.7 Internal circuit, single amplifier.

Triple video driver hybrid amplifier

CR6627

FEATURES

- Typical transition times (10 to 90%) with  $C_L = 10\text{ pF}$ :
  - at 50 V (p-p) swing  
 $t_r = 2.7\text{ ns}$ ;  $t_f = 2.2\text{ ns}$
- Low power consumption
- Minimum small signal bandwidth 110 MHz
- Very fast slew rate; 12000 V/ $\mu\text{s}$
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

APPLICATIONS

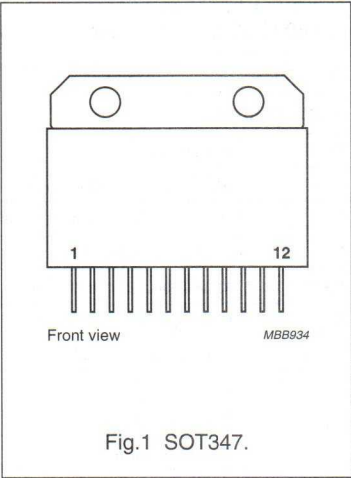
It is designed for application in cathode-ray tube (CRT) drivers in high-resolution colour monitors.

DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

PINNING

| PIN | DESCRIPTION                   |
|-----|-------------------------------|
| 1   | supply voltage 1 ( $V_{S1}$ ) |
| 2   | input 1                       |
| 3   | ground                        |
| 4   | output 1                      |
| 5   | supply voltage 2 ( $V_{S2}$ ) |
| 6   | input 2                       |
| 7   | ground                        |
| 8   | output 2                      |
| 9   | supply voltage 3 ( $V_{S3}$ ) |
| 10  | input 3                       |
| 11  | ground                        |
| 12  | output 3                      |



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL        | PARAMETER                                   | MIN. | MAX. | UNIT |
|---------------|---------------------------------------------|------|------|------|
| Per amplifier |                                             |      |      |      |
| $V_S$         | supply voltage (DC)                         | –    | 90   | V    |
| $T_{mb}$      | operating mounting base temperature; note 1 | –20  | +100 | °C   |
| $T_{stg}$     | storage temperature                         | –40  | +125 | °C   |

Note

1. To ensure proper thermal contact, a layer of heatsink compound should be applied between module and heatsink.

## Triple video driver hybrid amplifier

CR6627

## CHARACTERISTICS

$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset (see Fig.6); unless otherwise specified.

| SYMBOL               | PARAMETER                    | CONDITIONS                      | MIN. | TYP. | MAX. | UNIT |
|----------------------|------------------------------|---------------------------------|------|------|------|------|
| <b>Per amplifier</b> |                              |                                 |      |      |      |      |
| $I_S$                | supply current               | input and output open           | 19   | 25   | 31   | mA   |
| $P_{tot}$            | total power dissipation      | 25 MHz square wave              | —    | 9.6  | 11   | W    |
| $t_r$                | rise time transient response | 10 to 90%; note 1               | —    | 2.7  | 3.3  | ns   |
| $t_f$                | fall time transient response | 10 to 90%; note 1               | —    | 2.2  | 2.6  | ns   |
| BW                   | small signal bandwidth       | between -3 dB points; note 2    | 110  | 120  | —    | MHz  |
| $V_{tilt}$           | low frequency tilt voltage   | 10 kHz square wave              | —    | 1.3  | 1.5  | V    |
| $V_{os}$             | overshoot voltage            | varied by C1 and C2; see Fig.6  | —    | 3    | 10   | %    |
| NLN                  | non-linearity                | $V_O = 5\text{ to }75\text{ V}$ | —    | 2    | 5    | %    |
| $A_V$                | DC voltage gain              | 50 $\Omega$ source; note 3      | 11   | 12   | 13   |      |
| $V_G$                | insertion gain               | 50 $\Omega$ source; note 4      | 350  | 370  | 390  |      |

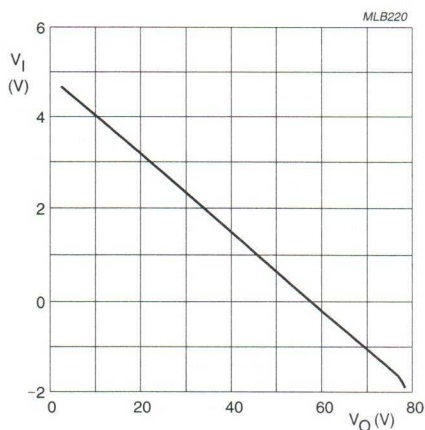
## Notes

1. Input signal is a 100 kHz square wave of 4.15 V (p-p), with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  (Fig.2) at input test-circuit (see Fig.6).
4. Measured  $V_O/V_I$  (Fig.3) at input module (see Fig.6).



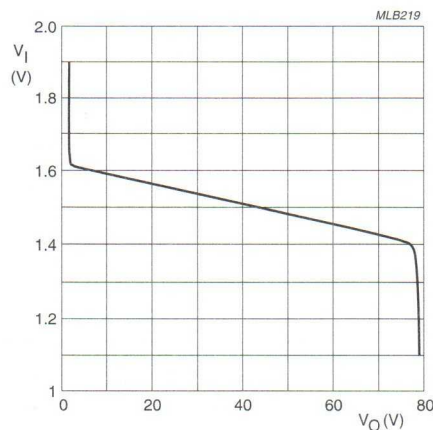
## Triple video driver hybrid amplifier

CR6627



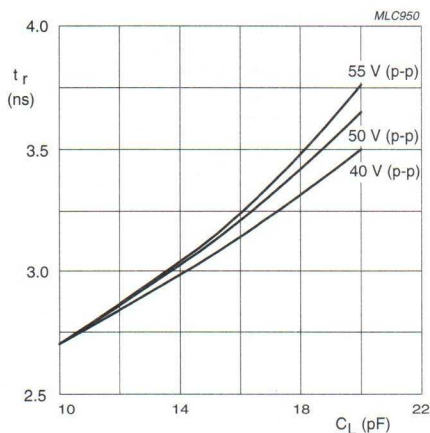
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset.

Fig.2 Input voltage at input test-circuit as a function of output voltage; typical values.



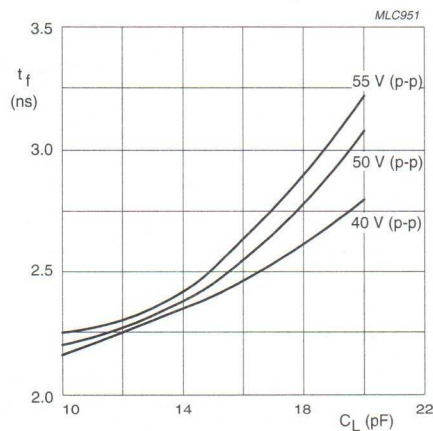
$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 50 V (p-p) output swing with 40 V DC offset.

Fig.3 Input voltage at input module as a function of output voltage; typical values.



$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 55, 50, 40 V (p-p) output swing  
 with 40 V DC offset.

Fig.4 Rise time transient response as a function of load capacitance; typical values.

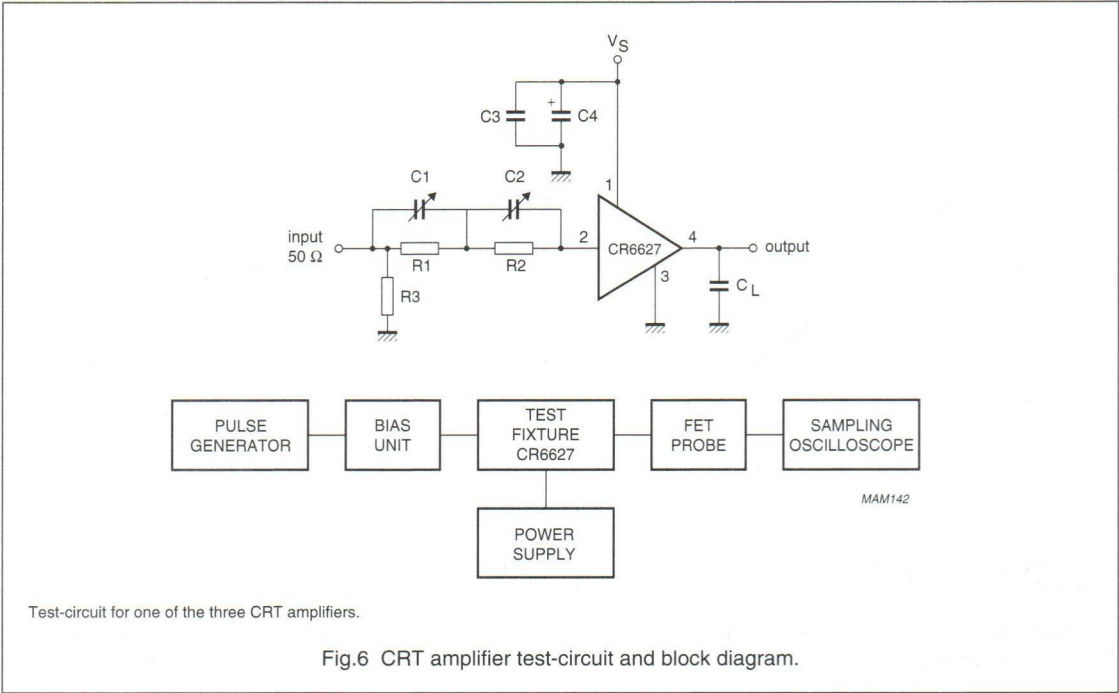


$V_S = 80\text{ V}$ ;  $T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $R_1 = 348\text{ }\Omega$ ;  $C_1 = 90\text{ pF}$ ;  
 $R_2 = 82\text{ }\Omega$ ;  $C_2 = 100\text{ pF}$ ; 55, 50, 40 V (p-p) output swing  
 with 40 V DC offset.

Fig.5 Fall time transient response as a function of load capacitance; typical values.

Triple video driver hybrid amplifier

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Components used in test-circuit (see Fig.6)

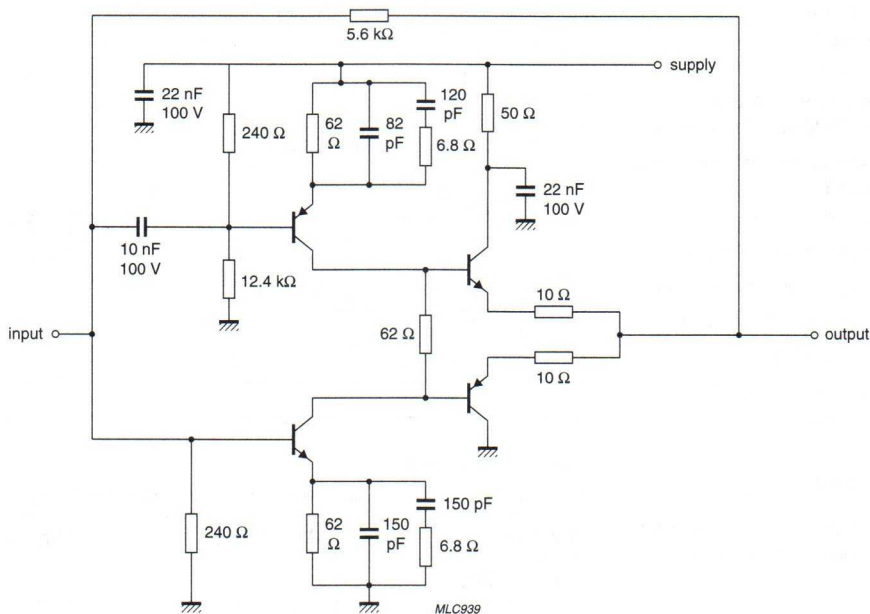
| DESIGNATION    | DESCRIPTION            | VALUE                      |
|----------------|------------------------|----------------------------|
| C <sub>1</sub> | variable capacitor     | 10 to 160 pF (typ. 90 pF)  |
| C <sub>2</sub> | variable capacitor     | 10 to 160 pF (typ. 100 pF) |
| C <sub>3</sub> | chip capacitor         | 10 nF                      |
| C <sub>4</sub> | electrolytic capacitor | 4.7 μF; 160 V              |
| R1             | resistor               | typ. 348 Ω                 |
| R2             | resistor               | typ. 82 Ω                  |
| R3             | resistor               | 50 Ω                       |

Equipment used in test-circuit (see Fig.6)

| EQUIPMENT             | TYPE DESCRIPTION                           |
|-----------------------|--------------------------------------------|
| Pulse generator       | Pico Second; Model 2600B                   |
| Bias unit             | Pico Second; Model 5555                    |
| Power supply          | Philips; Model PE1541, 80 V                |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1 |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24 |

## Triple video driver hybrid amplifier

CR6627



Supply voltage  $V_{S1}$ ,  $V_{S2}$  and  $V_{S3}$  are internally connected.

Fig.7 Internal circuit.

# Triple video driver hybrid amplifier

CR6727A

## FEATURES

- Transition times (10 to 90%) with 45 V (p-p) swing and  $C_L = 10$  pF: rise time (typ.) 2.5 ns fall time (typ.) 2.1 ns
- Low power consumption: 10 W with 25 MHz square wave
- Minimum small signal bandwidth: 140 MHz at 1 V (p-p) or 120 MHz at 40 V (p-p)
- Very fast slew rate: 16000 V/ $\mu$ s
- Internal smearing compensation
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

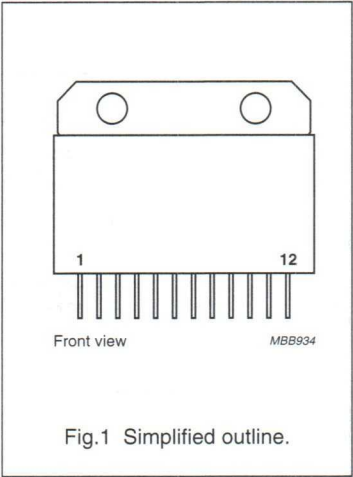
- Cathode-ray tube (CRT) drivers in high-resolution colour monitors.

## DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

## PINNING - SOT347

| PIN | DESCRIPTION                   |
|-----|-------------------------------|
| 1   | supply voltage 1 ( $V_{S1}$ ) |
| 2   | input 1                       |
| 3   | ground                        |
| 4   | output 1                      |
| 5   | supply voltage 2 ( $V_{S2}$ ) |
| 6   | input 2                       |
| 7   | ground                        |
| 8   | output 2                      |
| 9   | supply voltage 3 ( $V_{S3}$ ) |
| 10  | input 3                       |
| 11  | ground                        |
| 12  | output 3                      |



## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL               | PARAMETER                           | MIN. | MAX. | UNIT         |
|----------------------|-------------------------------------|------|------|--------------|
| <b>Per amplifier</b> |                                     |      |      |              |
| $V_S$                | supply voltage (DC)                 | 60   | 70   | V            |
| $T_{mb}$             | operating mounting base temperature | -20  | +100 | $^{\circ}$ C |
| $T_{stg}$            | storage temperature                 | -40  | +125 | $^{\circ}$ C |



Triple video driver hybrid amplifier

CR6727A

CHARACTERISTICS

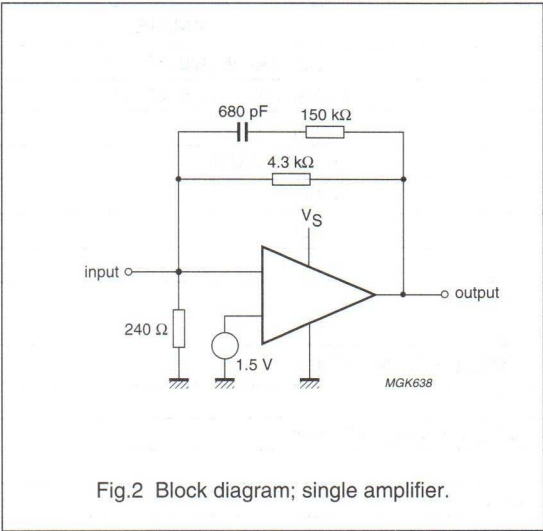
$V_S = 65\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing =  $45\text{ V}$  (p-p) with  $32\text{ V}$  DC offset (see Fig.3); unless otherwise specified.

| SYMBOL            | PARAMETER                              | CONDITIONS                         | MIN. | TYP. | MAX. | UNIT |
|-------------------|----------------------------------------|------------------------------------|------|------|------|------|
| $I_S$             | supply current                         | open input and open output         | 105  | 120  | 135  | mA   |
| $P_{\text{tot}}$  | total power dissipation                | 25 MHz square wave                 | –    | 11   | 11.5 | W    |
| $t_r$             | rise time transient response           | 10 to 90%; note 1                  | –    | 2.5  | 3.1  | ns   |
| $t_f$             | fall time transient response           | 10 to 90%; note 1                  | –    | 2.1  | 2.5  | ns   |
| BW                | small signal bandwidth                 | between –3 dB points; note 2       | 140  | 150  | –    | MHz  |
| $V_{\text{tilt}}$ | low frequency tilt voltage             | 10 kHz square wave                 | –    | 1.3  | 1.5  | V    |
| $V_{\text{os}}$   | overshoot voltage (rise and fall time) | adjustable by C1 and C2; see Fig.3 | –    | 3    | 10   | %    |
| NLN               | non-linearity                          | $V_O = 5\text{ to }55\text{ V}$    | –    | 2    | 5    | %    |
| $A_V$             | DC voltage gain                        | $50\text{ }\Omega$ source; note 3  | 11.2 | 12.4 | 13.6 |      |
| $V_G$             | insertion gain                         | $50\text{ }\Omega$ source; note 4  | 160  | 180  | 200  |      |

Notes

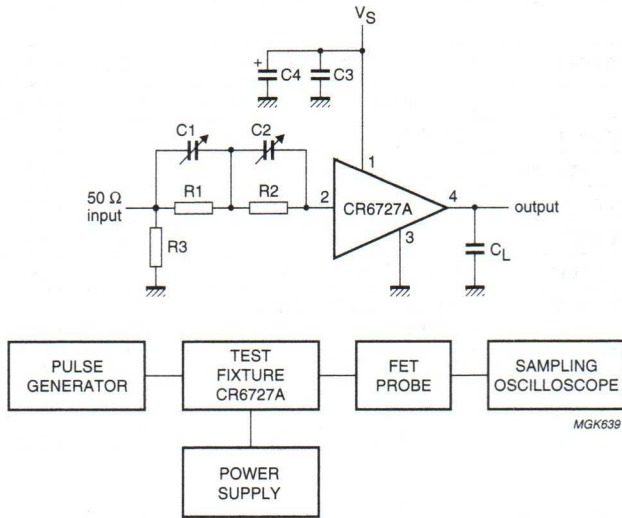
1. Input signal is a 100 kHz square wave of 3.8 V (p-p) with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  at input test circuit.
4. Measured  $V_O/V_I$  at input module.

APPLICATION NOTES



# Triple video driver hybrid amplifier

CR6727A



Speed-up circuit (R1, C1; R2, C2) ensures flat gain over the whole frequency range.

Fig.3 Application test circuit and block diagram.

## Components used in test circuit (see Fig.3)

| COMPONENT | DESCRIPTION            | VALUE                     |
|-----------|------------------------|---------------------------|
| C1        | variable capacitor     | 10 to 160 pF (typ. 68 pF) |
| C2        | variable capacitor     | 10 to 160 pF (typ. 86 pF) |
| C3        | chip capacitor         | 10 pF                     |
| C4        | electrolytic capacitor | 4.7 $\mu$ F; 160 V        |
| R1        | resistor               | 275 $\Omega$              |
| R2        | resistor               | 62 $\Omega$               |
| R3        | resistor               | 50 $\Omega$               |

## Test equipment (see Fig.3)

| EQUIPMENT             | TYPE DESCRIPTION                                         |
|-----------------------|----------------------------------------------------------|
| Pulse generator       | Le Croy; model 9210 with unit 9212                       |
|                       | Philips; model PM5785B (125 MHz) with internal DC offset |
| Power supply          | Philips; model PE1541, 80 V                              |
| FET probe             | Philips; model PM8943, attenuation 100 : 1               |
| Sampling oscilloscope | Tektronix; model 11803, sampling head SD24               |

# Triple video driver hybrid amplifier

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## FEATURES

- Transition times (10 to 90%) with 45 V (p-p) swing and  $C_L = 10$  pF: rise time (typ.) 2.5 ns fall time (typ.) 2.1 ns
- Low power consumption: 11 W with 25 MHz square wave
- Minimum small signal bandwidth: 140 MHz at 1 V (p-p) or 120 MHz at 40 V (p-p)
- Very fast slew rate: 16000 V/ $\mu$ s
- Internal low frequency smearing compensation
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

## APPLICATIONS

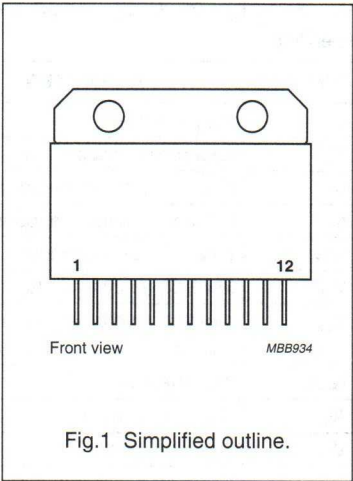
- Cathode-ray tube (CRT) drivers in high-resolution colour monitors.

## DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

## PINNING - SOT347

| PIN | DESCRIPTION                   |
|-----|-------------------------------|
| 1   | supply voltage 1 ( $V_{S1}$ ) |
| 2   | input 1                       |
| 3   | ground                        |
| 4   | output 1                      |
| 5   | supply voltage 2 ( $V_{S2}$ ) |
| 6   | input 2                       |
| 7   | ground                        |
| 8   | output 2                      |
| 9   | supply voltage 3 ( $V_{S3}$ ) |
| 10  | input 3                       |
| 11  | ground                        |
| 12  | output 3                      |



## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL               | PARAMETER                           | MIN. | MAX. | UNIT         |
|----------------------|-------------------------------------|------|------|--------------|
| <b>Per amplifier</b> |                                     |      |      |              |
| $V_S$                | supply voltage (DC)                 | 80   | 90   | V            |
| $T_{mb}$             | operating mounting base temperature | -20  | +100 | $^{\circ}$ C |
| $T_{stg}$            | storage temperature                 | -40  | +125 | $^{\circ}$ C |

Triple video driver hybrid amplifier

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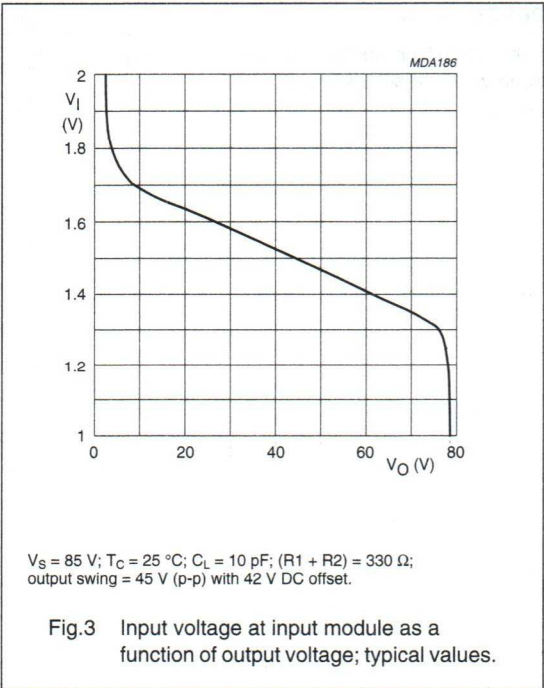
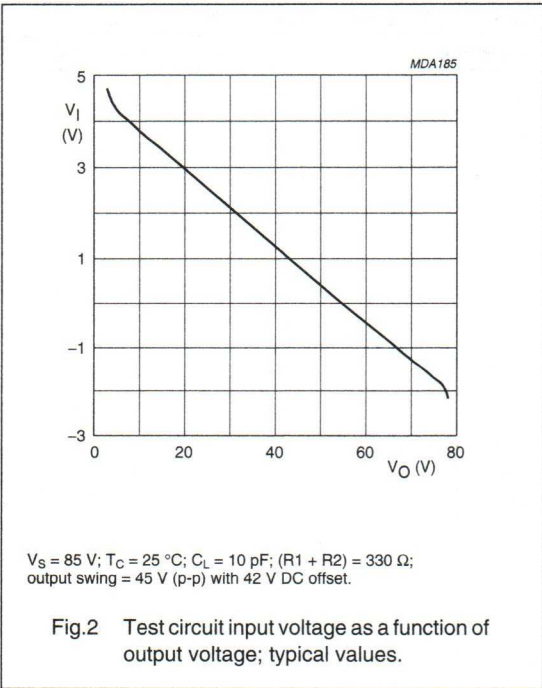
CHARACTERISTICS

$V_S = 85\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing = 45 V (p-p) with 42.5 V DC offset (see Fig 7); unless otherwise specified.

| SYMBOL     | PARAMETER                              | CONDITIONS                         | MIN. | TYP. | MAX. | UNIT |
|------------|----------------------------------------|------------------------------------|------|------|------|------|
| $I_S$      | supply current                         | open input and open output         | 85   | 100  | 115  | mA   |
| $P_{tot}$  | total power dissipation                | 25 MHz square wave                 | –    | 10.6 | 12   | W    |
| $t_r$      | rise time transient response           | 10 to 90%; note 1                  | –    | 2.5  | 3.1  | ns   |
| $t_f$      | fall time transient response           | 10 to 90%; note 1                  | –    | 2.1  | 2.5  | ns   |
| BW         | small signal bandwidth                 | between –3 dB points; note 2       | 140  | 150  | –    | MHz  |
| $V_{tilt}$ | low frequency tilt voltage             | 10 kHz square wave                 | –    | 1.3  | 1.5  | V    |
| $V_{os}$   | overshoot voltage (rise and fall time) | adjustable by C1 and C2; see Fig 7 | –    | 3    | 10   | %    |
| NLN        | non-linearity                          | $V_O = 5\text{ to }75\text{ V}$    | –    | 2    | 5    | %    |
| $A_V$      | DC voltage gain                        | 50 $\Omega$ source; note 3         | 11.2 | 12.4 | 13.6 |      |
| $V_G$      | insertion gain                         | 50 $\Omega$ source; note 4         | 160  | 180  | 200  |      |

Notes

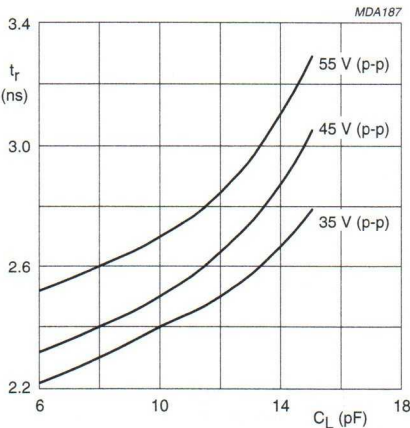
1. Input signal is a 100 kHz square wave of 3.8 V (p-p) with 1.5 V DC offset (50  $\Omega$  source).
2. Sinewave output signal: 1 V (p-p).
3. Measured  $V_O/V_I$  at input test circuit.
4. Measured  $V_O/V_I$  at input module.





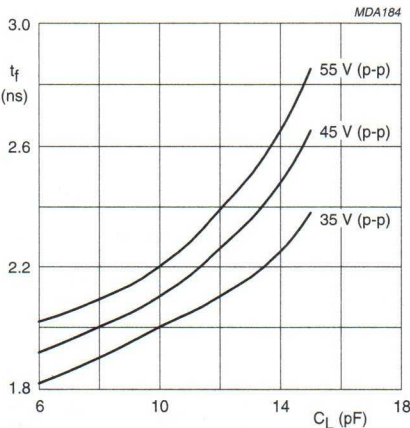
Triple video driver hybrid amplifier

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$V_S = 85$  V;  $T_C = 25$  °C;  $C_L = 10$  pF;  $(R_1 + R_2) = 330$   $\Omega$ ;  
output swing = 45 V (p-p) with 42 V DC offset.

Fig.4 Rise time as a function of load capacitance; typical values.



$V_S = 85$  V;  $T_C = 25$  °C;  $C_L = 10$  pF;  $(R_1 + R_2) = 330$   $\Omega$ ;  
output swing = 45 V (p-p) with 42 V DC offset.

Fig.5 Fall time as a function of load capacitance; typical values.

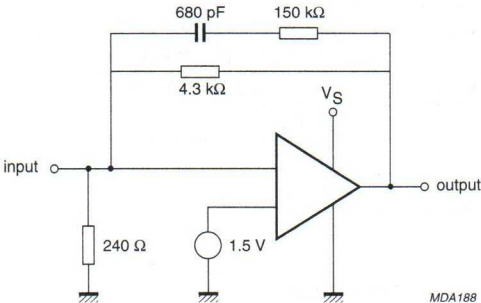
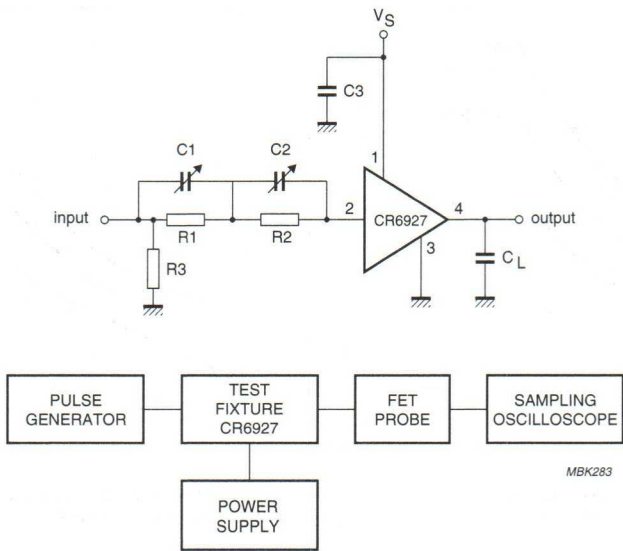


Fig.6 Block diagram; single amplifier.

Triple video driver hybrid amplifier CR6927



Speed-up circuit (R1, C1; R2, C2) ensures flat gain over the whole frequency range.

Fig.7 Application test circuit and block diagram.

Components used in test circuit (see Fig.7)

| DESIGNATION | DESCRIPTION                                | VALUE                         |
|-------------|--------------------------------------------|-------------------------------|
| C1          | variable capacitor                         | 10 to 160 pF (typ. 68 pF)     |
| C2          | variable capacitor                         | 10 to 160 pF (typ. 86 pF)     |
| C3          | chip capacitor plus electrolytic capacitor | 10 nF plus 4.7 $\mu$ F; 160 V |
| R1          | resistor                                   | 270 $\Omega$                  |
| R2          | resistor                                   | 62 $\Omega$                   |
| R3          | resistor                                   | 50 $\Omega$                   |

Test equipment (see Fig.7)

| EQUIPMENT             | TYPE DESCRIPTION                                         |
|-----------------------|----------------------------------------------------------|
| Pulse generator       | Le Croy; Model 9210 with unit 9212                       |
|                       | Philips; Model PM5785B (125 MHz) with internal DC offset |
| Power supply          | Philips; Model PE1541, 80 V                              |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1               |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24               |

# Triple video driver hybrid amplifier

CR6927A

## FEATURES

- Transition times (10 to 90%) with 45 V (p-p) swing and  $C_L = 10$  pF: rise time (typ.) 2.5 ns fall time (typ.) 2.1 ns
- Low power consumption: 11 W with 25 MHz square wave
- Minimum small signal bandwidth: 140 MHz at 1 V (p-p) or 120 MHz at 40 V (p-p)
- Very fast slew rate: 16000 V/ $\mu$ s
- Internal smearing compensation
- Excellent grey-scale linearity
- Unconditional stability
- Gold metallization ensures excellent reliability.

## PINNING - SOT347

| PIN | DESCRIPTION                   |
|-----|-------------------------------|
| 1   | supply voltage 1 ( $V_{S1}$ ) |
| 2   | input 1                       |
| 3   | ground                        |
| 4   | output 1                      |
| 5   | supply voltage 2 ( $V_{S2}$ ) |
| 6   | input 2                       |
| 7   | ground                        |
| 8   | output 2                      |
| 9   | supply voltage 3 ( $V_{S3}$ ) |
| 10  | input 3                       |
| 11  | ground                        |
| 12  | output 3                      |

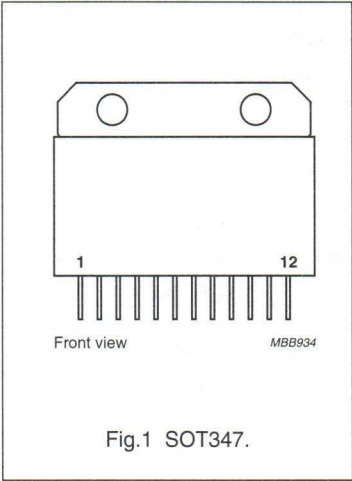


Fig.1 SOT347.

## APPLICATIONS

Cathode-ray tube (CRT) drivers in high-resolution colour monitors.

## DESCRIPTION

Hybrid amplifier module comprising three video amplifiers in a SOT347 package.

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL               | PARAMETER                           | MIN. | MAX. | UNIT |
|----------------------|-------------------------------------|------|------|------|
| <b>Per amplifier</b> |                                     |      |      |      |
| $V_S$                | supply voltage (DC)                 | –    | 90   | V    |
| $T_{mb}$             | operating mounting base temperature | –20  | +100 | °C   |
| $T_{stg}$            | storage temperature                 | –40  | +125 | °C   |

Triple video driver hybrid amplifier

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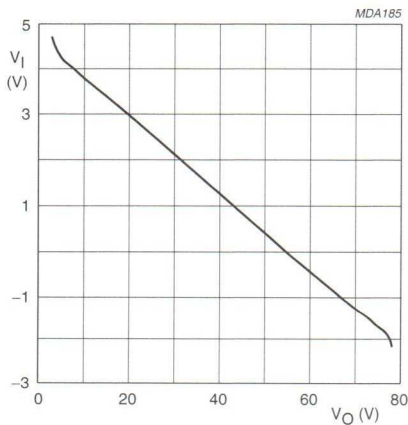
CHARACTERISTICS

$V_S = 85\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing =  $45\text{ V}$  (p-p) with  $42.5\text{ V}$  DC offset (see Fig 7); unless otherwise specified.

| SYMBOL            | PARAMETER                              | CONDITIONS                            | MIN. | TYP. | MAX. | UNIT |
|-------------------|----------------------------------------|---------------------------------------|------|------|------|------|
| $I_S$             | supply current                         | open input and open output            | 105  | 120  | 135  | mA   |
| $P_{\text{tot}}$  | total power dissipation                | 25 MHz square wave                    | —    | 12   | 12.5 | W    |
| $t_r$             | rise time transient response           | 10 to 90%; note 1                     | —    | 2.5  | 3.1  | ns   |
| $t_f$             | fall time transient response           | 10 to 90%; note 1                     | —    | 2.1  | 2.5  | ns   |
| BW                | small signal bandwidth                 | between $-3\text{ dB}$ points; note 2 | 140  | 150  | —    | MHz  |
| $V_{\text{tilt}}$ | low frequency tilt voltage             | 10 kHz square wave                    | —    | 1.3  | 1.5  | V    |
| $V_{\text{os}}$   | overshoot voltage (rise and fall time) | adjustable by C1 and C2; see Fig 7    | —    | 3    | 10   | %    |
| NLN               | non-linearity                          | $V_O = 5\text{ to }75\text{ V}$       | —    | 2    | 5    | %    |
| $A_V$             | DC voltage gain                        | $50\text{ }\Omega$ source; note 3     | 11.2 | 12.4 | 13.6 |      |
| $V_G$             | insertion gain                         | $50\text{ }\Omega$ source; note 4     | 160  | 180  | 200  |      |

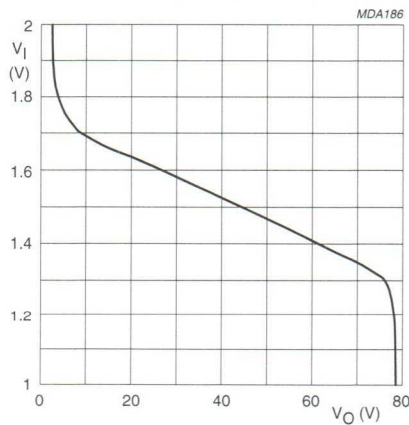
Notes

1. Input signal is a 100 kHz square wave of  $3.8\text{ V}$  (p-p) with  $1.5\text{ V}$  DC offset ( $50\text{ }\Omega$  source).
2. Sinewave output signal:  $1\text{ V}$  (p-p).
3. Measured  $V_O/V_I$  at input test-circuit.
4. Measured  $V_O/V_I$  at input module.



$V_S = 85\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ;  $(R_1 + R_2) = 330\text{ }\Omega$ ; output swing =  $45\text{ V}$  (p-p) with  $42\text{ V}$  DC offset.

Fig.2 Test-circuit input voltage as a function of output voltage; typical values.



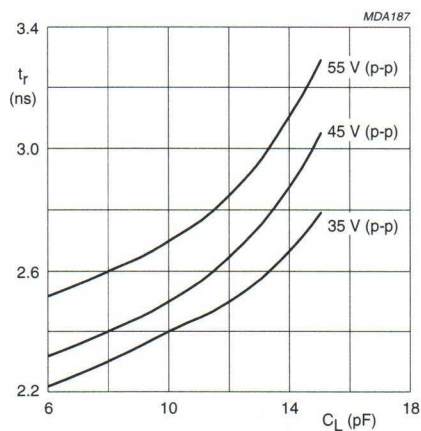
$V_S = 85\text{ V}$ ;  $T_C = 25\text{ }^\circ\text{C}$ ;  $C_L = 10\text{ pF}$ ; output swing =  $45\text{ V}$  (p-p) with  $42\text{ V}$  DC offset.

Fig.3 Input voltage at input module as a function of output voltage; typical values.



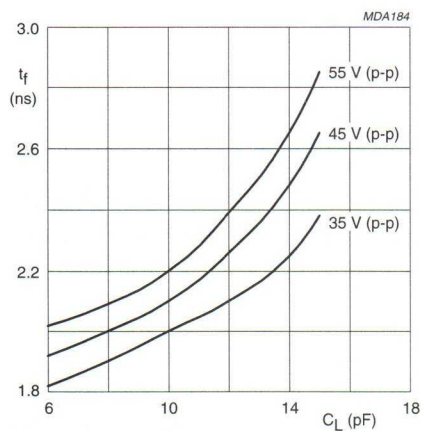
## Triple video driver hybrid amplifier

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$V_S = 85$  V;  $T_C = 25$  °C;  $C_L = 10$  pF;  $(R_1 + R_2) = 330$   $\Omega$ ;  
output swing = 45 V (p-p) with 42 V DC offset.

Fig.4 Rise time as a function of load capacitance; typical values.



$V_S = 85$  V;  $T_C = 25$  °C;  $C_L = 10$  pF;  $(R_1 + R_2) = 330$   $\Omega$ ;  
output swing = 45 V (p-p) with 42 V DC offset.

Fig.5 Fall time as a function of load capacitance; typical values.

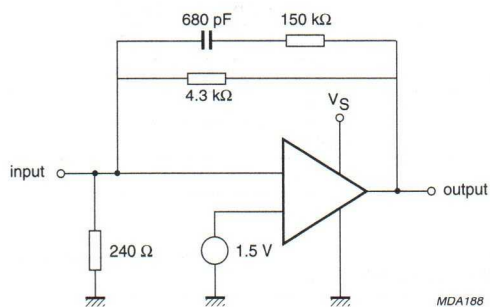
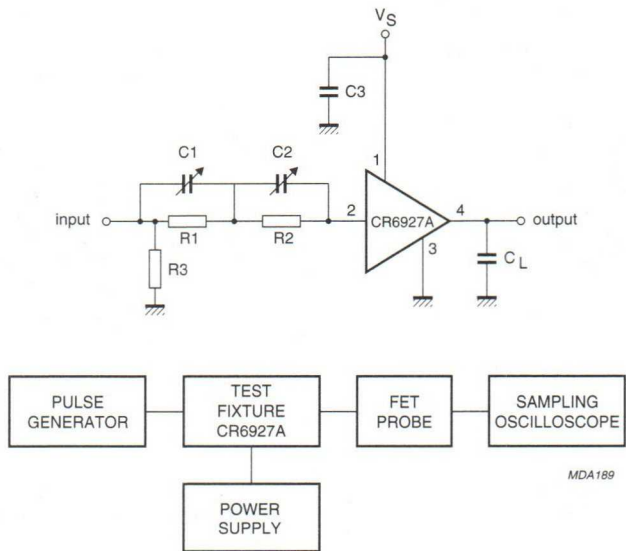


Fig.6 Block diagram.

Triple video driver hybrid amplifier

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With the speed-up circuit (R1, C1 and R2, C2) it is possible to achieve a flat gain over the whole frequency range.

Fig.7 Application test-circuit and block diagram.

Components used in Test-circuit (see Fig.7)

| DESIGNATION | DESCRIPTION                                | VALUE                         |
|-------------|--------------------------------------------|-------------------------------|
| C1          | variable capacitor                         | 10 to 160 pF (typ. 68 pF)     |
| C2          | variable capacitor                         | 10 to 160 pF (typ. 86 pF)     |
| C3          | chip capacitor plus electrolytic capacitor | 10 nF plus 4.7 $\mu$ F; 160 V |
| R1          | resistor                                   | 275 $\Omega$                  |
| R2          | resistor                                   | 62 $\Omega$                   |
| R3          | resistor                                   | 50 $\Omega$                   |

Test-equipment (see Fig.7)

| EQUIPMENT             | TYPE DESCRIPTION                                         |
|-----------------------|----------------------------------------------------------|
| Pulse generator       | Le Croy; Model 9210 with unit 9212                       |
|                       | Philips; Model PM5785B (125 MHz) with internal DC offset |
| Power supply          | Philips; Model PE1541, 80 V                              |
| FET probe             | Philips; Model PM8943, attenuation 100 : 1               |
| Sampling oscilloscope | Tektronix; Model 11803, sampling head SD24               |

NPN switching transistors

PH2369; PH2369A

FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

APPLICATIONS

- High-speed switching.

DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | emitter     |
| 2   | base        |
| 3   | collector   |

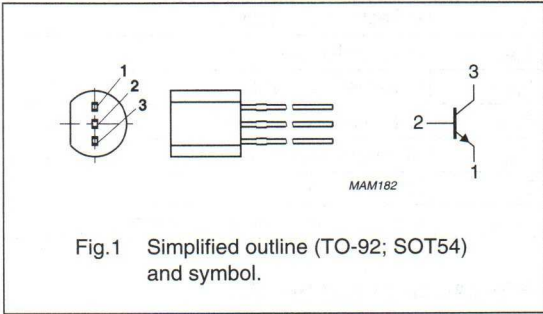


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                            | CONDITIONS                                                                  | MIN. | MAX. | UNIT |
|-----------|--------------------------------------|-----------------------------------------------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage               | open emitter                                                                | —    | 40   | V    |
| $V_{CEO}$ | collector-emitter voltage            | open base                                                                   | —    | 15   | V    |
| $I_C$     | collector current (DC)               |                                                                             | —    | 200  | mA   |
| $P_{tot}$ | total power dissipation              | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                                   | —    | 500  | mW   |
| $h_{FE}$  | DC current gain<br>PH2369<br>PH2369A | $I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$                                   | 40   | 120  |      |
|           |                                      | $I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}$                                | 40   | 120  |      |
| $f_T$     | transition frequency                 | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$              | 500  | —    | MHz  |
| $t_{off}$ | turn-off time                        | $I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA}$  | —    | 30   | ns   |
|           |                                      | $I_{Con} = 100\text{ mA}; I_{Bon} = 40\text{ mA}; I_{Boff} = -20\text{ mA}$ | —    | 35   | ns   |

## NPN switching transistors

PH2369; PH2369A

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL    | PARAMETER                     | CONDITIONS                  | MIN. | MAX. | UNIT |
|-----------|-------------------------------|-----------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                | –    | 40   | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                   | –    | 15   | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector              | –    | 4.5  | V    |
| $I_C$     | collector current (DC)        |                             | –    | 200  | mA   |
| $I_{CM}$  | peak collector current        |                             | –    | 300  | mA   |
| $I_{BM}$  | peak base current             |                             | –    | 100  | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ | –    | 500  | mW   |
| $T_{stg}$ | storage temperature           |                             | –65  | +150 | °C   |
| $T_j$     | junction temperature          |                             | –    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                             | –65  | +150 | °C   |

## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---------------------------------------------|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 250   | K/W  |

## Note

1. Transistor mounted on an FR4 printed-circuit board.



## NPN switching transistors

## PH2369; PH2369A

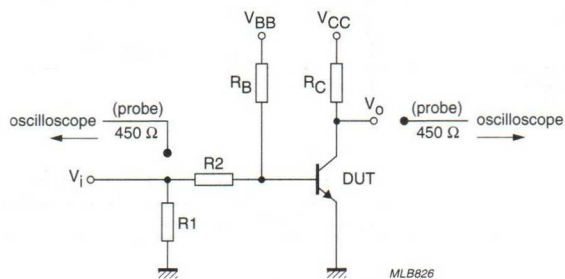
## CHARACTERISTICS

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

| SYMBOL                                              | PARAMETER                                       | CONDITIONS                                                                                                  | MIN. | MAX. | UNIT          |
|-----------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------|------|------|---------------|
| $I_{CBO}$                                           | collector cut-off current                       | $I_E = 0; V_{CB} = 20\text{ V}$                                                                             | –    | 400  | nA            |
|                                                     |                                                 | $I_E = 0; V_{CB} = 20\text{ V}; T_j = 125\text{ }^{\circ}\text{C}$                                          | –    | 30   | $\mu\text{A}$ |
| $I_{EBO}$                                           | emitter cut-off current                         | $I_C = 0; V_{EB} = 4\text{ V}$                                                                              | –    | 100  | nA            |
| $h_{FE}$                                            | DC current gain<br>PH2369                       | $I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$                                                                   | 40   | 120  |               |
|                                                     |                                                 | $I_C = 10\text{ mA}; V_{CE} = 1\text{ V}; T_{amb} = -55\text{ }^{\circ}\text{C}$                            | 20   | –    |               |
|                                                     |                                                 | $I_C = 100\text{ mA}; V_{CE} = 2\text{ V}$                                                                  | 20   | –    |               |
| $h_{FE}$                                            | DC current gain<br>PH2369A                      | $I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}$                                                                | 40   | 120  |               |
|                                                     |                                                 | $I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}; T_{amb} = -55\text{ }^{\circ}\text{C}$                         | 20   | –    |               |
|                                                     |                                                 | $I_C = 30\text{ mA}; V_{CE} = 400\text{ mV}$                                                                | 30   | –    |               |
|                                                     |                                                 | $I_C = 100\text{ mA}; V_{CE} = 1\text{ V}$                                                                  | 20   | –    |               |
| $V_{CEsat}$                                         | collector-emitter saturation voltage<br>PH2369  | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                                                                     | –    | 250  | mV            |
| $V_{CEsat}$                                         | collector-emitter saturation voltage<br>PH2369A | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                                                                     | –    | 200  | mV            |
|                                                     |                                                 | $I_C = 10\text{ mA}; I_B = 10\text{ mA}$                                                                    | –    | 300  | mV            |
|                                                     |                                                 | $I_C = 30\text{ mA}; I_B = 3\text{ mA}$                                                                     | –    | 250  | mV            |
|                                                     |                                                 | $I_C = 100\text{ mA}; I_B = 10\text{ mA}$                                                                   | –    | 500  | mV            |
| $V_{BEsat}$                                         | base-emitter saturation voltage                 | $I_C = 10\text{ mA}; I_B = 1\text{ mA}$                                                                     | 700  | 850  | mV            |
| $C_c$                                               | collector capacitance                           | $I_E = i_e = 0; V_{CB} = 5\text{ V}; f = 1\text{ MHz}$                                                      | –    | 4    | pF            |
| $C_e$                                               | emitter capacitance                             | $I_C = i_c = 0; V_{EB} = 1\text{ V}; f = 1\text{ MHz}$                                                      | –    | 4.5  | pF            |
| $f_T$                                               | transition frequency                            | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$                                              | 500  | –    | MHz           |
| <b>Switching times (between 10% and 90% levels)</b> |                                                 |                                                                                                             |      |      |               |
| $t_{on}$                                            | turn-on time                                    | $I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA};$<br>see Fig.2 test conditions A  | –    | 10   | ns            |
| $t_d$                                               | delay time                                      |                                                                                                             | –    | 4    | ns            |
| $t_r$                                               | rise time                                       |                                                                                                             | –    | 6    | ns            |
| $t_{off}$                                           | turn-off time                                   |                                                                                                             | –    | 30   | ns            |
| $t_s$                                               | storage time                                    |                                                                                                             | –    | 15   | ns            |
| $t_f$                                               | fall time                                       |                                                                                                             | –    | 15   | ns            |
| $t_{on}$                                            | turn-on time                                    | $I_{Con} = 100\text{ mA}; I_{Bon} = 40\text{ mA}; I_{Boff} = -20\text{ mA};$<br>see Fig.2 test conditions B | –    | 13   | ns            |
| $t_{off}$                                           | turn-off time                                   |                                                                                                             | –    | 35   | ns            |

## NPN switching transistors

PH2369; PH2369A

**Test conditions A.**

$V_I = 0.5$  to  $4.2$  V;  $T = 500$   $\mu$ s;  $t_p = 10$   $\mu$ s;  $t_r = t_f \leq 3$  ns.

$R_1 = 56$   $\Omega$ ;  $R_2 = 1$  k $\Omega$ ;  $R_B = 1$  k $\Omega$ ;  $R_C = 270$   $\Omega$ .

$V_{BB} = 0.2$  V;  $V_{CC} = 2.7$  V.

Oscilloscope: input impedance  $Z_i = 50$   $\Omega$ .

**Test conditions B.**

$V_I = 0.5$  to  $4.52$  V;  $T = 200$   $\mu$ s;  $t_p = 10$   $\mu$ s;  $t_r = t_f \leq 3$  ns.

$R_1 = 100$   $\Omega$ ;  $R_2 = 68$   $\Omega$ ;  $R_B = 390$   $\Omega$ ;  $R_C = 47$   $\Omega$ .

$V_{BB} = -3$  V;  $V_{CC} = 4.6$  V.

Oscilloscope: input impedance  $Z_i = 50$   $\Omega$ .

Fig.2 Test circuit for switching times.

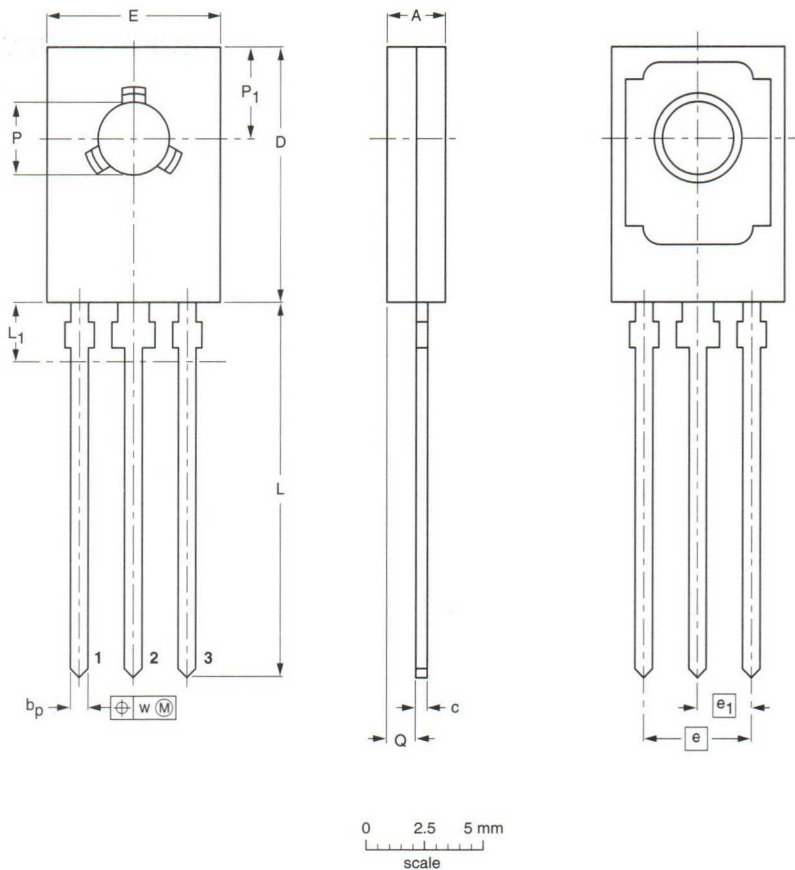
## PACKAGE INFORMATION

Video Transistors and Modules for Monitors

Package outlines

SOT32 (TO-126)

Plastic single-ended leaded (through hole) package; mountable to heatsink, 1 mounting hole; 3 leads SOT32



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b <sub>p</sub> | c            | D            | E          | e    | e <sub>1</sub> | L            | L <sub>1</sub> <sup>(1)</sup><br>max | Q          | P          | P <sub>1</sub> | w     |
|------|------------|----------------|--------------|--------------|------------|------|----------------|--------------|--------------------------------------|------------|------------|----------------|-------|
| mm   | 2.7<br>2.3 | 0.88<br>0.65   | 0.60<br>0.45 | 11.1<br>10.5 | 7.8<br>7.2 | 4.58 | 2.29           | 16.5<br>15.3 | 2.54                                 | 1.5<br>0.9 | 3.2<br>3.0 | 3.9<br>3.6     | 0.254 |

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

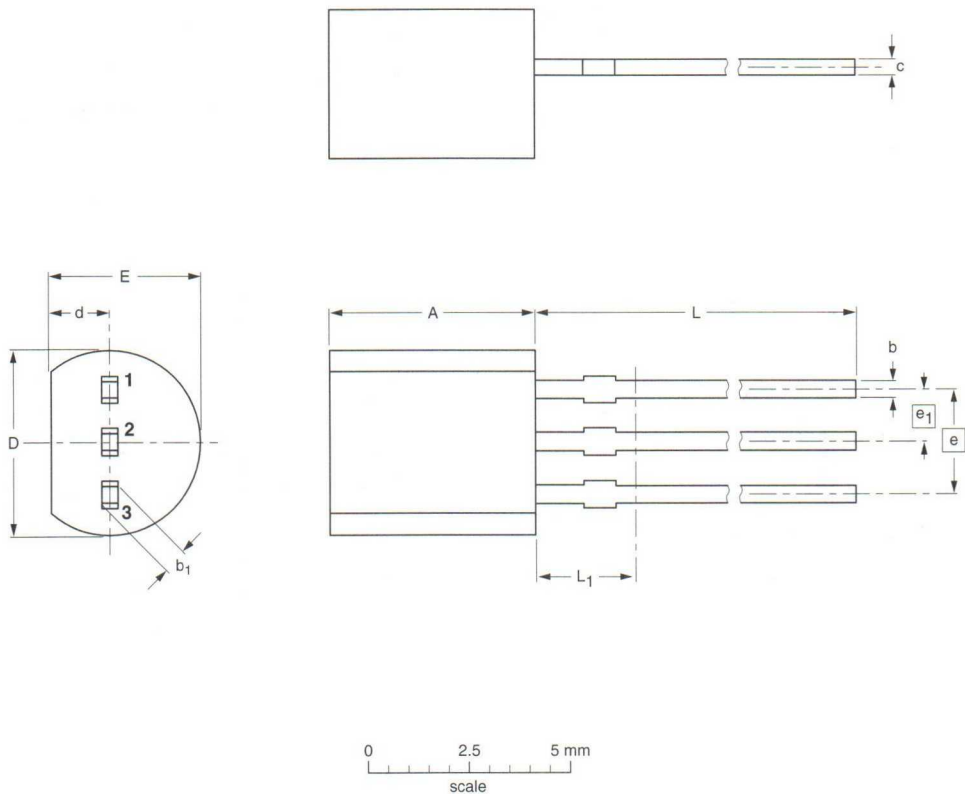
| OUTLINE<br>VERSION | REFERENCES |        |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|--------|------|--|------------------------|------------|
|                    | IEC        | JEDEC  | EIAJ |  |                        |            |
| SOT32              |            | TO-126 |      |  |                        | 97-03-04   |



SOT54/18; SOT54/23 (TO-92)

Plastic single-ended leaded (through hole) package; 3 leads

SOT54



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b            | b <sub>1</sub> | c            | D          | d          | E          | e    | e <sub>1</sub> | L            | L <sub>1</sub> <sup>(1)</sup> |
|------|------------|--------------|----------------|--------------|------------|------------|------------|------|----------------|--------------|-------------------------------|
| mm   | 5.2<br>5.0 | 0.48<br>0.40 | 0.66<br>0.56   | 0.45<br>0.40 | 4.8<br>4.4 | 1.7<br>1.4 | 4.2<br>3.6 | 2.54 | 1.27           | 14.5<br>12.7 | 2.5                           |

Note

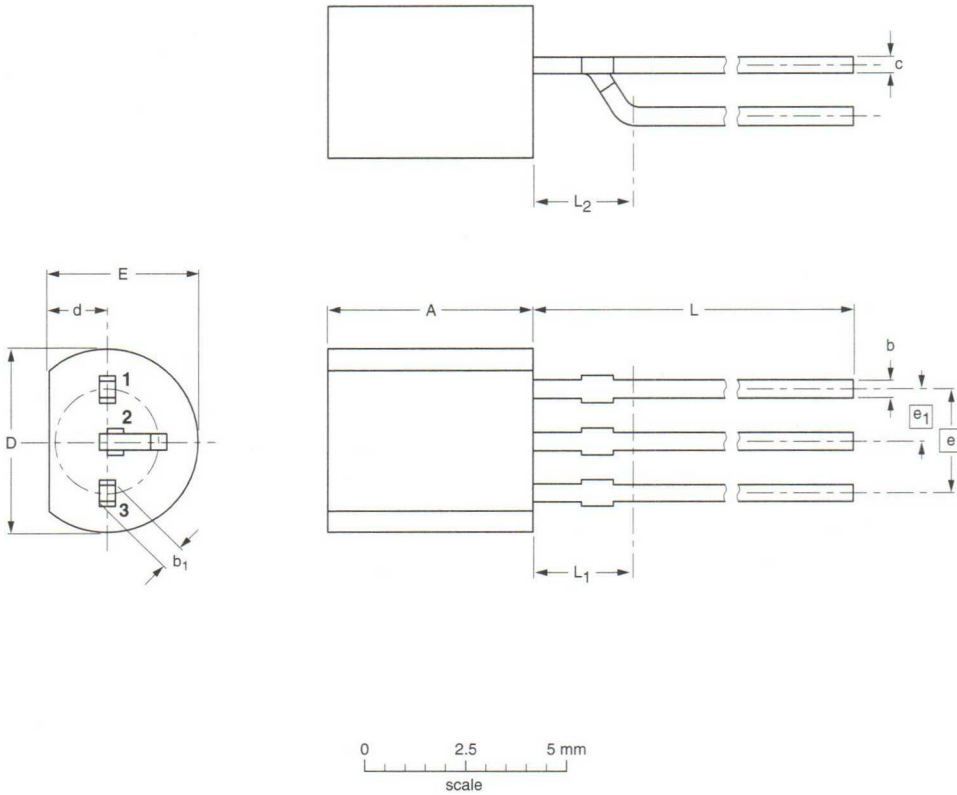
1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION                                                               | ISSUE DATE |
|--------------------|------------|-------|-------|--|--------------------------------------------------------------------------------------|------------|
|                    | IEC        | JEDEC | EIAJ  |  |                                                                                      |            |
| SOT54              |            | TO-92 | SC-43 |  |  | 97-02-28   |

SOT54/12 to /17 and /19 to /22 (TO-92)

Plastic single-ended leaded (through hole) package; 3 leads (on-circle)

SOT54 variant



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b            | b <sub>1</sub> | c            | D          | d          | E          | e    | e <sub>1</sub> | L            | L <sub>1</sub> <sup>(1)</sup><br>max | L <sub>2</sub><br>max |
|------|------------|--------------|----------------|--------------|------------|------------|------------|------|----------------|--------------|--------------------------------------|-----------------------|
| mm   | 5.2<br>5.0 | 0.48<br>0.40 | 0.66<br>0.56   | 0.45<br>0.40 | 4.8<br>4.4 | 1.7<br>1.4 | 4.2<br>3.6 | 2.54 | 1.27           | 14.5<br>12.7 | 2.5                                  | 2.5                   |

Notes

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|-------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ  |  |                        |            |
| SOT54 variant      |            | TO-92 | SC-43 |  |                        | 97-04-14   |

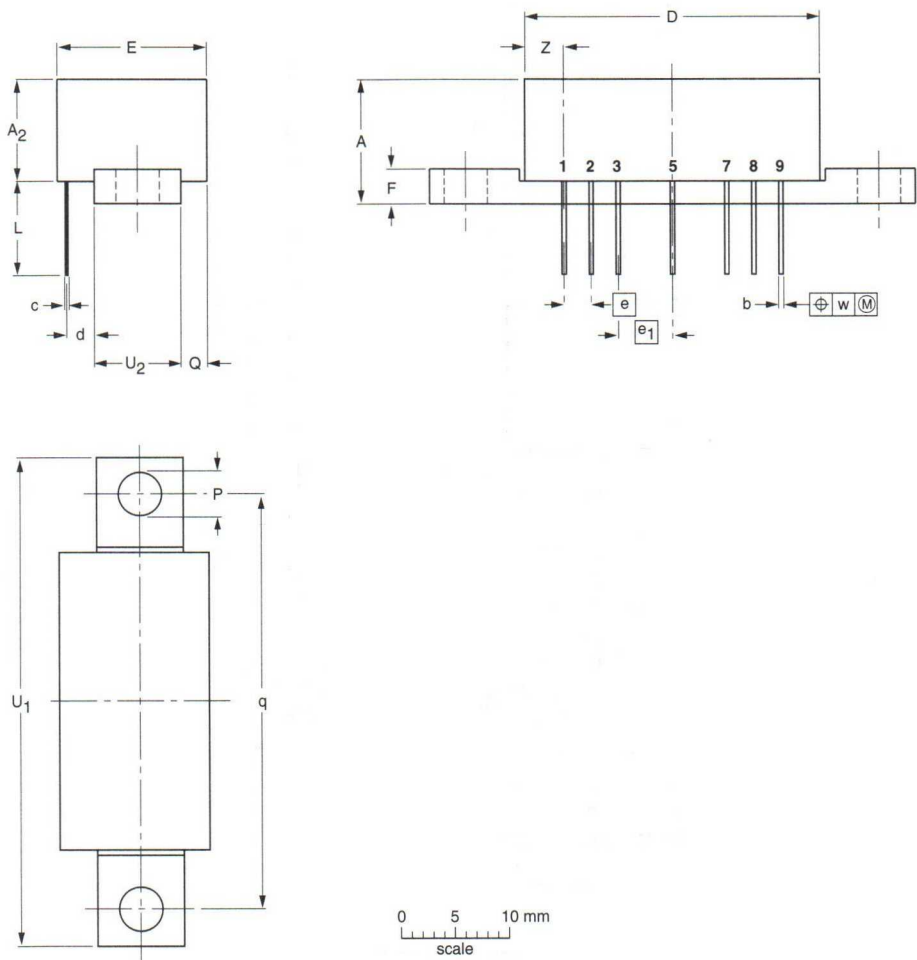
Video Transistors and Modules for Monitors

Package outlines

SOT115L

Rectangular single-ended package; aluminium flange;  
2 vertical mounting holes; 7 gold-plated in-line leads

SOT115L



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>2</sub><br>max. | b            | c    | D<br>max. | d<br>max. | E<br>max. | e    | e <sub>1</sub> | F   | L<br>min. | Ø P          | Q<br>max. | q    | U <sub>1</sub><br>max. | U <sub>2</sub> | w    | Z<br>max. |
|------|-----------|------------------------|--------------|------|-----------|-----------|-----------|------|----------------|-----|-----------|--------------|-----------|------|------------------------|----------------|------|-----------|
| mm   | 11.5      | 9.1                    | 0.51<br>0.38 | 0.25 | 27.2      | 2.54      | 13.75     | 2.54 | 5.08           | 3.2 | 8.8       | 4.15<br>3.85 | 2.4       | 38.1 | 44.75                  | 8              | 0.25 | 3.8       |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION                                                               | ISSUE DATE |
|--------------------|------------|-------|------|--|--------------------------------------------------------------------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                                                                                      |            |
| SOT115L            |            |       |      |  |  | 97-06-05   |

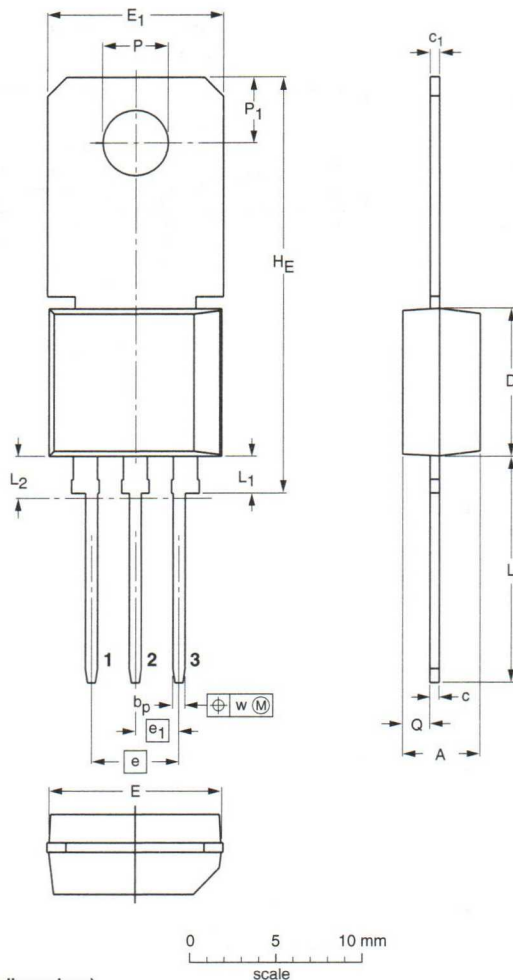
Video Transistors and Modules for Monitors

Package outlines

SOT128B (TO-202)

Plastic single-ended leaded (through hole) package; with cooling fin, mountable to heatsink,  
1 mounting hole; 3 leads (in-line)

SOT128B



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b <sub>p</sub> | c           | c <sub>1</sub> | D          | E           | E <sub>1</sub> | e    | e <sub>1</sub> | H <sub>E</sub> | L            | L <sub>1</sub> | L <sub>2</sub> <sup>(1)</sup><br>max | P          | P <sub>1</sub> | Q          | w    |
|------|------------|----------------|-------------|----------------|------------|-------------|----------------|------|----------------|----------------|--------------|----------------|--------------------------------------|------------|----------------|------------|------|
| mm   | 4.6<br>4.4 | 0.8<br>0.6     | 0.65<br>0.5 | 0.56<br>0.46   | 8.6<br>8.4 | 10.1<br>9.9 | 10.4<br>10.0   | 5.08 | 2.54           | 24.2<br>23.8   | 13.3<br>12.2 | 2.4<br>2.0     | 2.5                                  | 3.8<br>3.6 | 3.9<br>3.7     | 1.7<br>1.5 | 0.25 |

Note

1. Plastic flash allowed within this zone

| OUTLINE<br>VERSION | REFERENCES |        |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|--------|------|--|------------------------|------------|
|                    | IEC        | JEDEC  | EIAJ |  |                        |            |
| SOT128B            |            | TO-202 |      |  |                        | 97-02-28   |



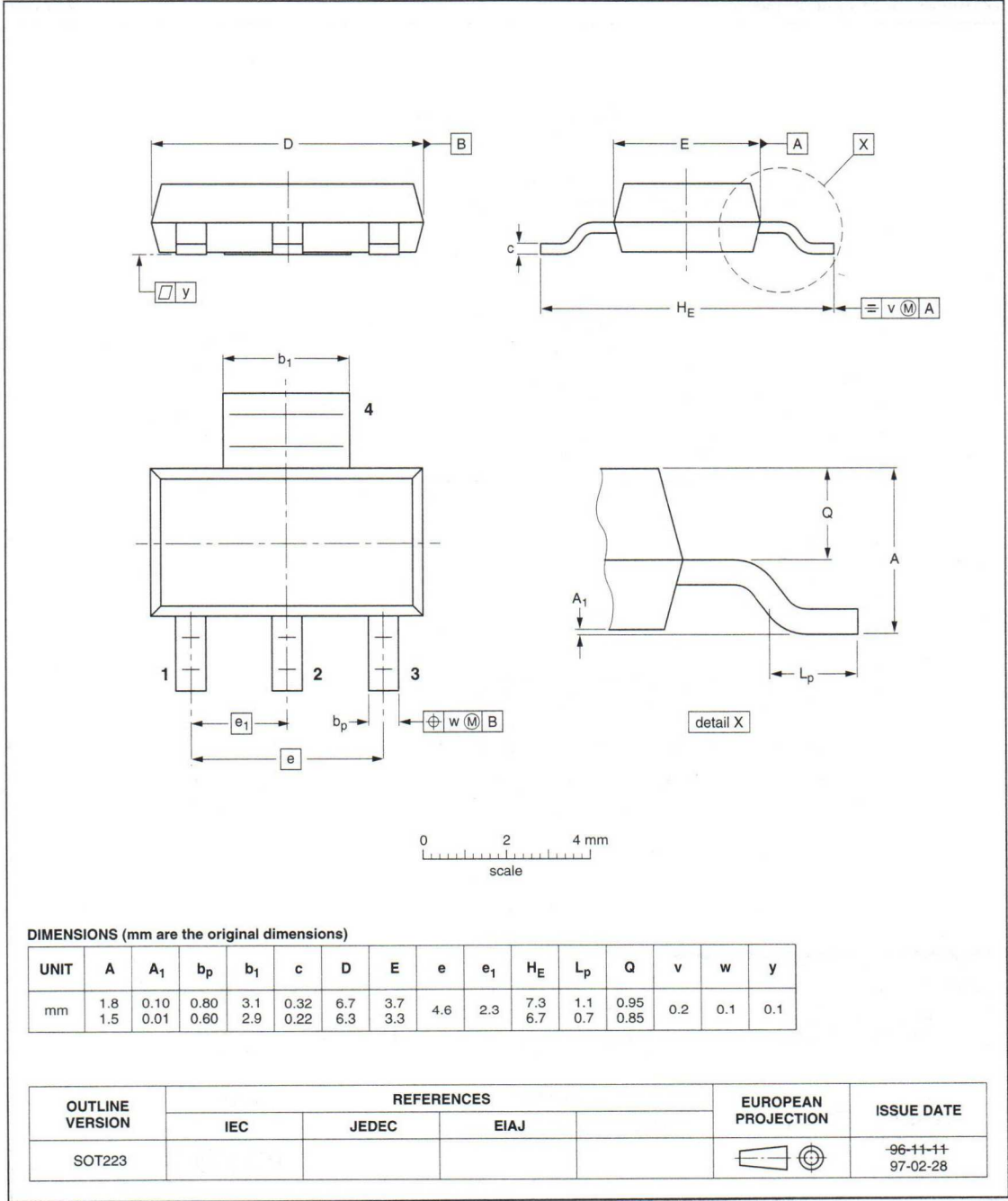
Video Transistors and Modules for Monitors

Package outlines

SOT223

Plastic surface mounted package; collector pad for good heat transfer; 4 leads

SOT223

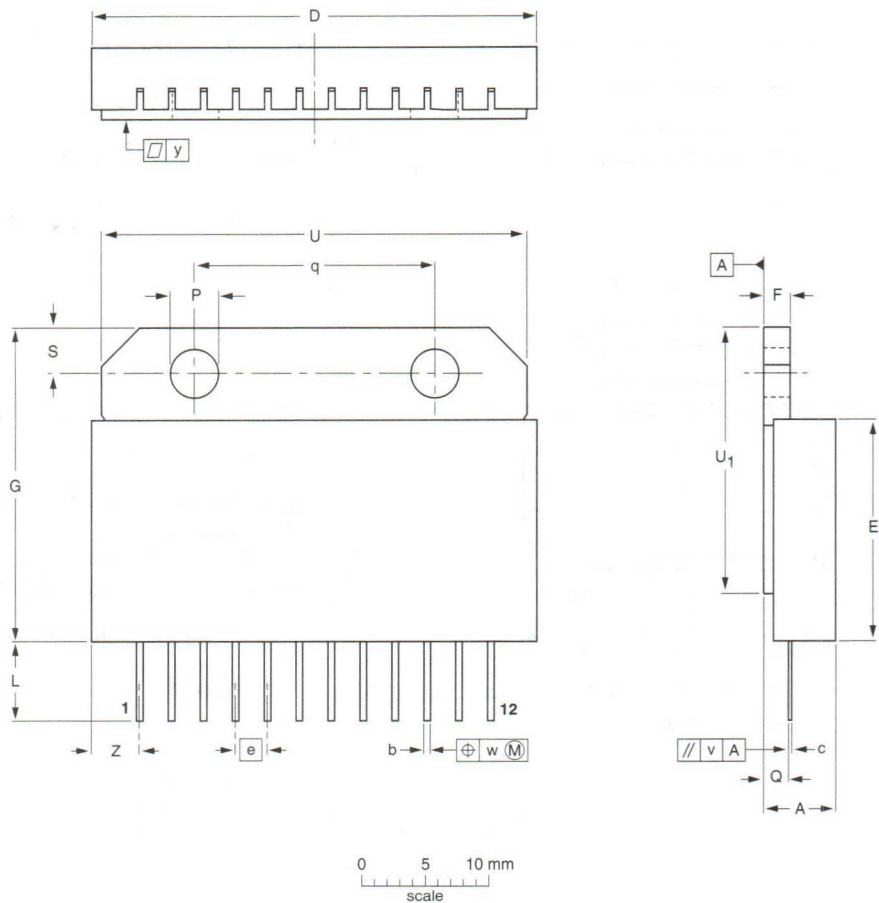


Package outlines

SOT347

Ceramic single-ended flat package; heatsink mounted; 2 mounting holes;  
12 in-line tin (Sn) plated leads

SOT347



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b            | c    | D            | E            | e    | F   | G            | L<br>min. | P            | Q   | q  | S          | U            | U <sub>1</sub> | v   | w    | y   | Z<br>max. |
|------|------------|--------------|------|--------------|--------------|------|-----|--------------|-----------|--------------|-----|----|------------|--------------|----------------|-----|------|-----|-----------|
| mm   | 6.0<br>5.6 | 0.51<br>0.38 | 0.25 | 36.2<br>35.8 | 18.2<br>17.8 | 2.54 | 2.0 | 25.5<br>24.5 | 6         | 4.15<br>3.85 | 1.8 | 19 | 3.5<br>3.4 | 34.4<br>34.0 | 22.2<br>21.8   | 0.3 | 0.25 | 0.1 | 4.1       |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT347             |            |       |      |  |                        | 97-06-28   |

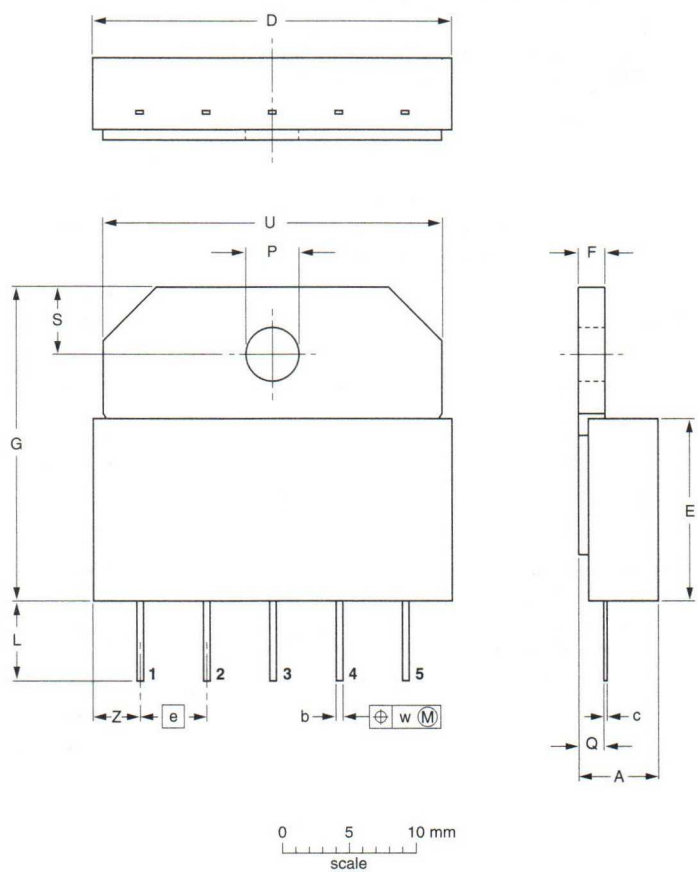
Video Transistors and Modules for Monitors

Package outlines

SOT348

Rectangular single-ended flat package;plastic cap; heatsink mounted; 1 mounting hole;  
5 in-line gold-metallized leads

SOT348



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | b            | c    | D<br>max. | E<br>max. | e    | F   | G<br>max. | L<br>min. | P            | Q   | S | U    | w    | Z<br>max. |
|------|-----------|--------------|------|-----------|-----------|------|-----|-----------|-----------|--------------|-----|---|------|------|-----------|
| mm   | 6.0       | 0.51<br>0.38 | 0.25 | 27.2      | 13.8      | 5.08 | 2.0 | 23.5      | 6         | 4.15<br>3.85 | 1.8 | 5 | 25.5 | 0.25 | 3.8       |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT348             |            |       |      |  |                        | 97-04-14   |

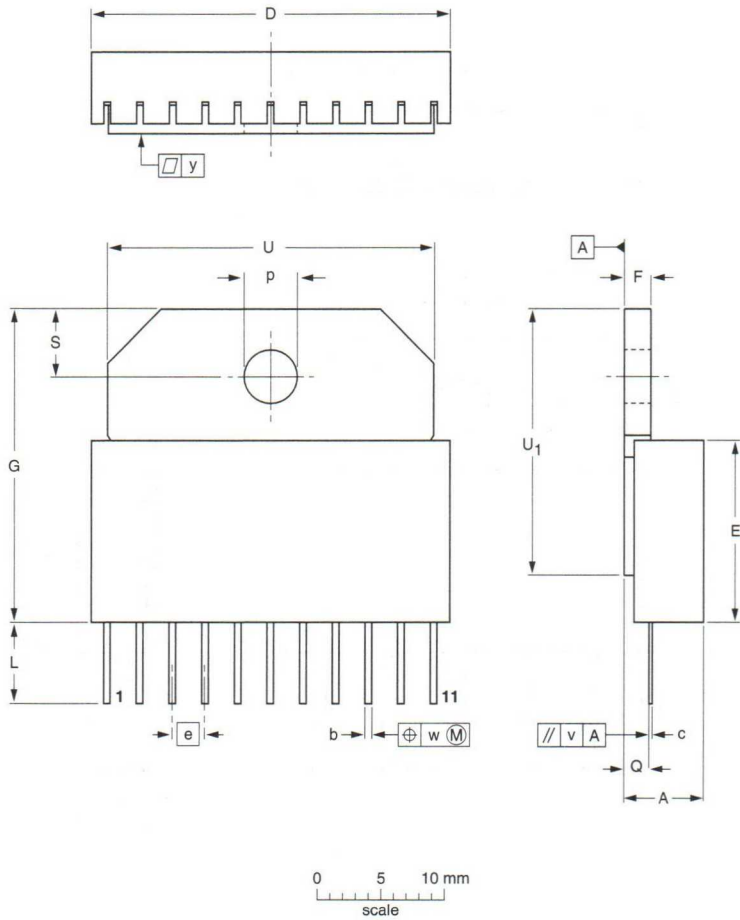
Video Transistors and Modules for Monitors

Package outlines

SOT451A

Ceramic single-ended flat package; heatsink mounted; 1 mounting hole;  
11 in-line gold-metallized leads

SOT451A



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b            | c    | D            | E            | e    | F          | G            | L          | p          | Q          | S          | U            | U <sub>1</sub> | v   | w    | y   |
|------|------------|--------------|------|--------------|--------------|------|------------|--------------|------------|------------|------------|------------|--------------|----------------|-----|------|-----|
| mm   | 5.9<br>5.5 | 0.56<br>0.46 | 0.25 | 28.3<br>27.9 | 13.9<br>13.5 | 2.54 | 2.2<br>1.8 | 23.8<br>23.4 | 6.2<br>5.8 | 4.2<br>3.8 | 2.0<br>1.6 | 5.2<br>4.8 | 25.4<br>25.0 | 20.4<br>20.0   | 0.3 | 0.25 | 0.1 |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT451A            |            |       |      |  |                        | 97-06-26   |



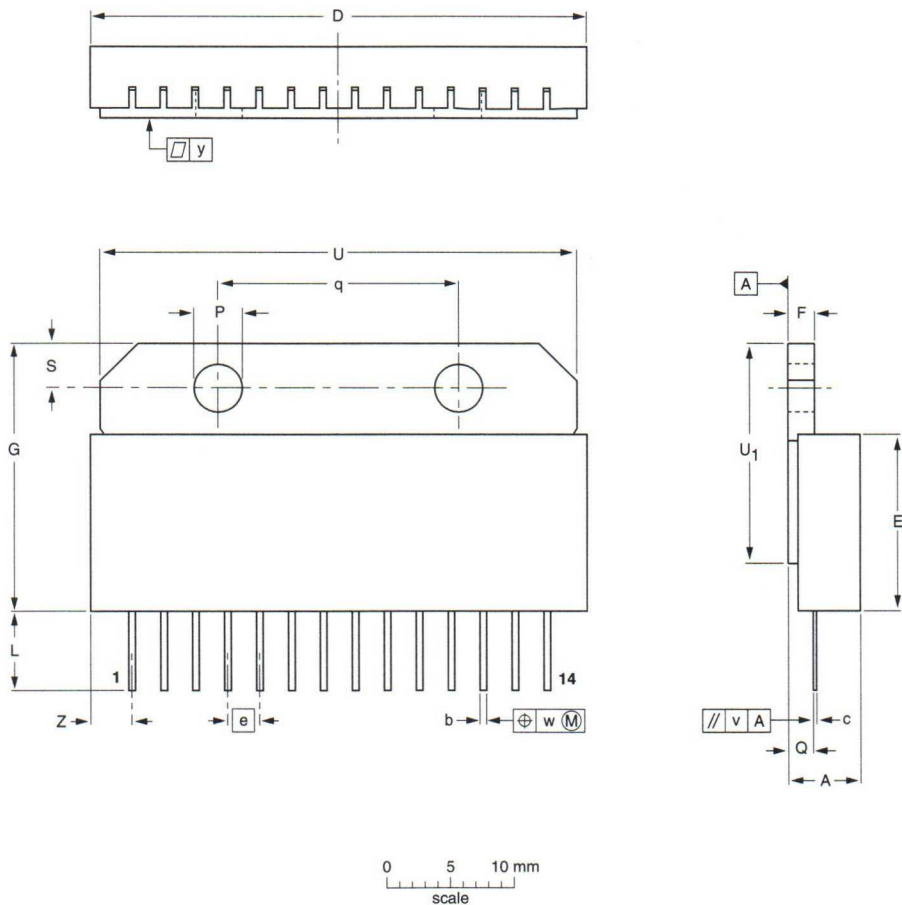
Video Transistors and Modules for Monitors

Package outlines

SOT454A

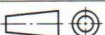
Ceramic single-ended flat package; heatsink mounted; 2 mounting holes;  
14 in-line tin (Sn) plated leads

SOT454A



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | b   | c    | D<br>max. | E    | e    | F          | G<br>max. | L<br>min. | P            | Q          | q  | S   | U<br>max. | U <sub>1</sub> | v   | w    | y   | Z          |
|------|------------|-----|------|-----------|------|------|------------|-----------|-----------|--------------|------------|----|-----|-----------|----------------|-----|------|-----|------------|
| mm   | 5.9<br>5.5 | 0.5 | 0.25 | 39.6      | 13.7 | 2.54 | 2.1<br>1.9 | 21.2      | 6         | 4.15<br>3.85 | 2.9<br>2.5 | 19 | 3.5 | 37.8      | 18.3           | 0.3 | 0.25 | 0.1 | 3.4<br>3.0 |

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION                                                               | ISSUE DATE |
|--------------------|------------|-------|------|--|--------------------------------------------------------------------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                                                                                      |            |
| SOT454A            |            |       |      |  |  | 97-07-01   |



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**Integrated circuits**

| <i>Book</i> | <i>Title</i>                                            |
|-------------|---------------------------------------------------------|
| IC01        | Semiconductors for Radio, Audio and CD/DVD Systems      |
| IC02        | Semiconductors for Television and Video Systems         |
| IC03        | Semiconductors for Wired Telecom Systems                |
| IC04        | HE4000B Logic Family CMOS                               |
| IC05        | Advanced Low-power Schottky (ALS) Logic                 |
| IC06        | High-speed CMOS Logic Family                            |
| IC11        | General-purpose/Linear ICs                              |
| IC12        | I <sup>2</sup> C Peripherals                            |
| IC13        | Programmable Logic Devices (PLD)                        |
| IC14        | 8048-based 8-bit Microcontrollers                       |
| IC15        | FAST TTL Logic Series                                   |
| IC16        | CMOS ICs for Clocks and Watches                         |
| IC17        | Semiconductors for Wireless Communications              |
| IC18        | Semiconductors for In-Car Electronics                   |
| IC19        | ICs for Data Communications                             |
| IC20        | 80C51-based 8-bit Microcontrollers                      |
| IC22        | Multimedia ICs                                          |
| IC23        | BiCMOS Bus Interface Logic                              |
| IC24        | Low Voltage CMOS & BiCMOS Logic                         |
| IC25        | 16-bit 80C51XA Microcontrollers (eXtended Architecture) |
| IC26        | Integrated Circuit Packages                             |
| IC27        | Complex Programmable Logic Devices                      |

**Discrete semiconductors**

| <i>Book</i> | <i>Title</i>                                                                    |
|-------------|---------------------------------------------------------------------------------|
| SC01        | Small-signal and Medium-power Diodes                                            |
| SC02        | Power Diodes                                                                    |
| SC03        | Thyristors and Triacs                                                           |
| SC04        | Small-signal Transistors                                                        |
| SC05        | Video Transistors and Modules for Monitors                                      |
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| SC13b       | Small-signal and Medium-power MOS<br>Transistors                                |
| SC14        | RF Wideband Transistors                                                         |
| SC16        | Wideband Hybrid IC Modules                                                      |
| SC17        | Semiconductor Sensors                                                           |
| SC18        | Discrete Semiconductor Packages                                                 |
| SC19        | RF & Microwave Power Transistors,<br>RF Power Modules and Circulators/Isolators |

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## OVERVIEW OF PHILIPS COMPONENTS DATA HANDBOOKS

Our sister product division, Philips Components, also has a comprehensive data handbook system to support their products. Their data handbook titles are listed here.

### Display components

| <i>Book</i> | <i>Title</i>                                       |
|-------------|----------------------------------------------------|
| DC01        | Colour Television Tubes                            |
| DC02        | Monochrome Monitor Tubes and Deflection Units      |
| DC03        | Television Tuners, Coaxial Aerial Input Assemblies |
| DC04        | Colour Monitor and Multimedia Tubes                |
| DC05        | Wire Wound Components                              |

### Magnetic products

|      |                                              |
|------|----------------------------------------------|
| MA01 | Soft Ferrites                                |
| MA03 | Piezoelectric Ceramics<br>Specialty Ferrites |
| MA04 | Dry-reed Switches                            |

### Passive components

|       |                                               |
|-------|-----------------------------------------------|
| PA01  | Electrolytic Capacitors                       |
| PA02  | Varistors, Thermistors and Sensors            |
| PA03  | Potentiometers                                |
| PA04  | Variable Capacitors                           |
| PA05  | Film Capacitors                               |
| PA06  | Ceramic Capacitors                            |
| PA06A | Surface Mounted Ceramic Multilayer Capacitors |
| PA08  | Fixed Resistors                               |
| PA10  | Quartz Crystals                               |
| PA11  | Quartz Oscillators                            |

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