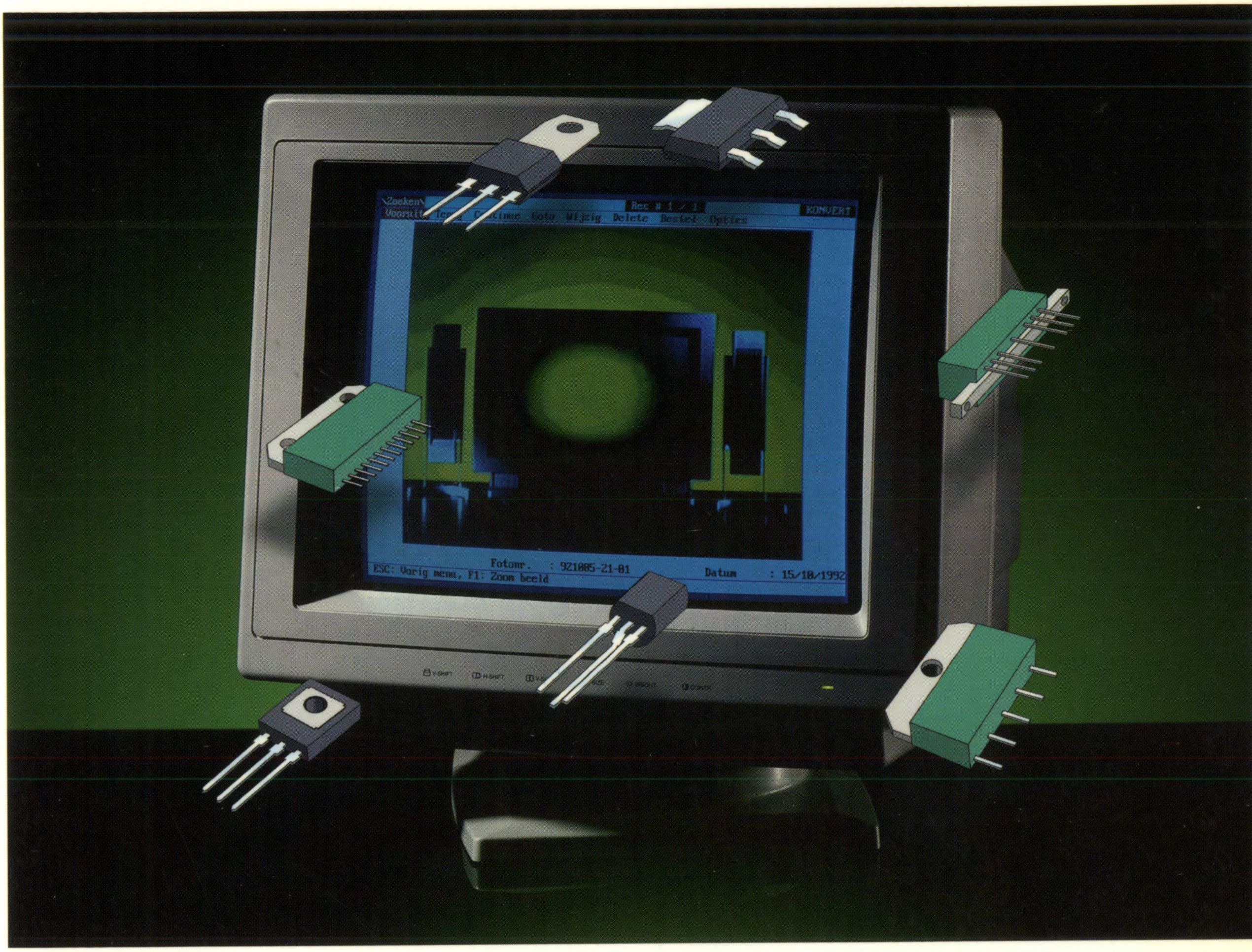
DISCRETE SEMICONDUCTORS

Video Transistors and Modules for Monitors



1998

Data Handbook SC05

Let's make things better.

Philips Semiconductors

PHILIPS

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

Data sheet status	
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.
Limiting values	
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.	
Application information	
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.

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Video Transistors and Modules for Monitors

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WIDEBAND TRANSISTORS FOR MONITOR VIDEO OUTPUT AMPLIFIERS

TYPE NUMBER	POLARITY	V_{CBO} max. (V)	V_{CER} max. (V)	I_C max. (mA)	h_{FE} min.	C_{CB} typ. (pF)	T_j (°C)	f_T min. (MHz)	PAGE
SOT54 (TO-92) package									
BFQ131	NPN	25	18 (2)	150	25	1.2 (1)	175	4000	59
BFQ151	PNP	–20	–15 (2)	–100	25	1.8 (1)	175	3500	63
BFQ161	NPN	20	19	500	25	4.3	150	1000	66
BFQ221	NPN	100	95	100	20	1.7 (1)	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 (1)	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 (2)	100	150	1.5 (1)	150	150	139
BFV421	PNP	–140	–100 (2)	–100	150	2.3 (1)	150	150	141
PH2369	NPN	40	15 (2)	200	40	–	150	500	199
SOT32 (TO-126) package									
BFQ162	NPN	20	19	500	40	4.2	175	1000	70
BFQ222	NPN	100	95	100	20	1.7 (1)	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 (1)	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 (2)	100	150	1.5 (1)	150	150	143
SOT128B (TO-202) package									
BFQ225	NPN	100	95	100	20	1.7 (1)	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 (1)	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
SOT223 (surface mount) package									
BFQ166	NPN	20	19	500	50	3.2	175	1000	74
BFQ226	NPN	100	95	100	20	1.7 (1)	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 (1)	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

TRANSISTORS FOR VIDEO AMPLIFIER BUFFER STAGES

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

VIDEO OUTPUT AMPLIFIER MODULES

TYPE NUMBER	CHANNELS	V_S (V)	V_O (V)	P_{tot} (V)	BANDWIDTH (MHz)	t_r typ. (ns)	t_f typ. (ns)	PACKAGE	PAGE
Cascode configuration									
CR1296	3	90	50	12.0 (3)	140	5.0	2.5	SOT454	149
Active load configuration									
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.

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

WIDEBAND TRANSISTORS FOR VIDEO OUTPUT AMPLIFIERS IN MONITORS - DEVICE USAGE

I_C max. (mA)	SOT54 (TO-92)	SOT32 (TO-126)	SOT128B (TO-202)	SOT223
NPN cascode driver				
150	BFQ131	–	–	BFG35
500	BFQ161	BFQ162	–	BFQ166
PNP cascode driver				
150	BFQ151	–	–	–
NPN cascode output				
100	BFQ221	BFQ222 BFV469(1)	BFQ225	BFQ226
300	– –	BFQ232 BFQ232A	BFQ235 BFQ235A	– –
400	– –	BFQ262 BFQ262A	– –	– –
NPN buffer				
100	BFQ221 BFV420	BFQ222 –	BFQ225 –	BFQ226 –
150	BFQ131	–	–	–
300	BFQ231 BFQ231A	BFQ232 BFQ232A	BFQ235 BFQ235A	BFQ236 BFQ236A
PNP buffer				
100	BFQ241 BFV421	BFQ242 –	BFQ245 –	BFQ246 –
300	BFQ251 BFQ251A	BFQ252 BFQ252A	BFQ255 BFQ255A	BFQ256 BFQ256A

video amplifier

Q1: cascode driver
Q2: cascode output
Q3: NPN buffer
Q4: PNP buffer

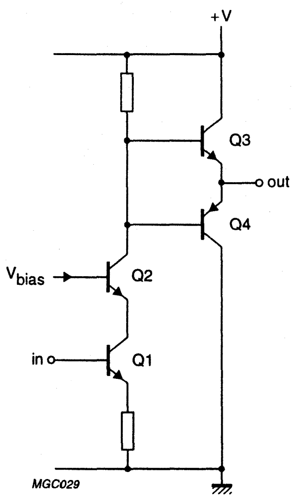

Fig.1 Typical 4-transistor video amplifier circuit.

WIDEBAND TRANSISTORS FOR VIDEO OUTPUT AMPLIFIERS - PER MONITOR TYPE

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

Internet World Wide Web Home Page

WHAT IS IT?

Welcome to our place in cyberspace.

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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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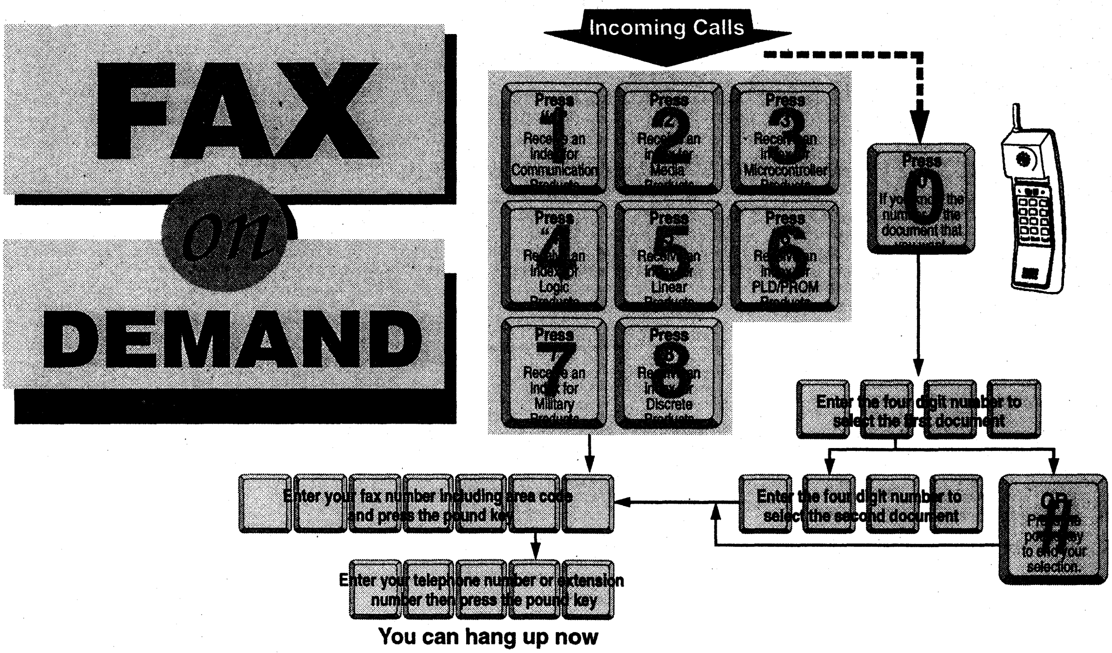
FAX-on-DEMAND System



What is it?

The FAX-on-DEMAND system is a computer facsimile system that allows customers to receive selected documents by fax automatically.

How does it work?

To order a document, you simply enter the document number. This number can be obtained by asking for an index of available documents to be faxed to you the first time you call the system.

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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 (United Kingdom, Ireland)	44-181-730-5020
France	33-1-40-99-60-60
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Locations soon to be in operation:

Hong Kong
Japan
The Netherlands

GENERAL

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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.

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 $R_{th(j-mb)} > 15$ K/W and power types by $R_{th(j-mb)} \leq 15$ 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.(1)

(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.

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 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[(1)] 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.

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}.

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_{DDS}, V_{CCE}.

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:

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

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

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).

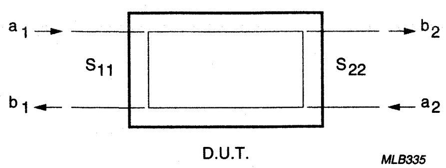


Fig.1 Two-port network with reflection coefficients S_{11} and S_{22}.

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

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

where:

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

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

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

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

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

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

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

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 ammopack is 2000. The ammopack has 80 layers of 25 transistors each. Each layer contains 25 transistors, plus one empty position in order to fold the layer correctly.The ammopack 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 ammopack and 'reverse' by a minus sign (–). In the European version, the leading pin is the emitter.

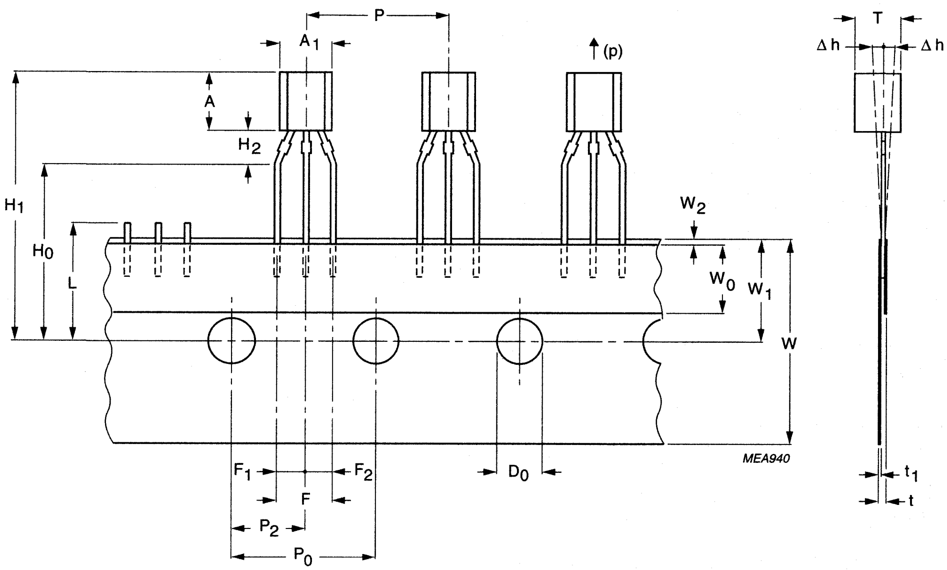


Fig.2 TO-92 (SOT54) transistors on tape.

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

SYMBOL	DIMENSION	SPECIFICATIONS					REMARKS
		MIN.	NOM.	MAX.	TOL.	UNIT	
A_1	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_0	feed hole pitch	–	12.7	–	±0.3	mm	
	cumulative pitch error	–	–	–	±0.1		note 1
P_2	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_0	hold-down tape width	–	6	–	±0.2	mm	
W_1	hole position	–	9	–	+0.7/–0.5	mm	
W_2	hold-down tape position	–	0.5	–	±0.2	mm	
H_0	lead wire clinch height	–	16.5	–	±0.5	mm	
H_1	component height	–	–	23.25	–	mm	
L	length of snipped leads	–	–	11	–	mm	
D_0	feed hole diameter	–	4	–	±0.2	mm	
t	total tape thickness	–	–	1.2	–	mm	t_1 = 0.3 to 0.6
F_1, F_2	lead-to-lead distance	–	–	–	+0.4/–0.2	mm	
H_2	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.

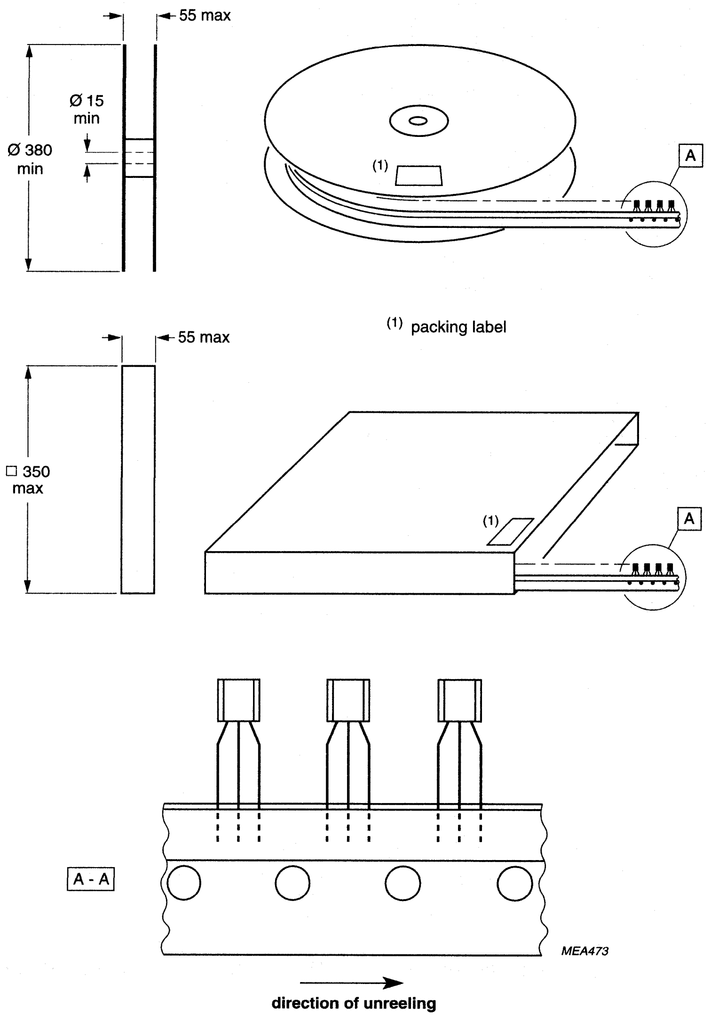
Tape splicing

Splice the carrier tape on the back and/or front so that the feed hole pitch (P_0) 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.

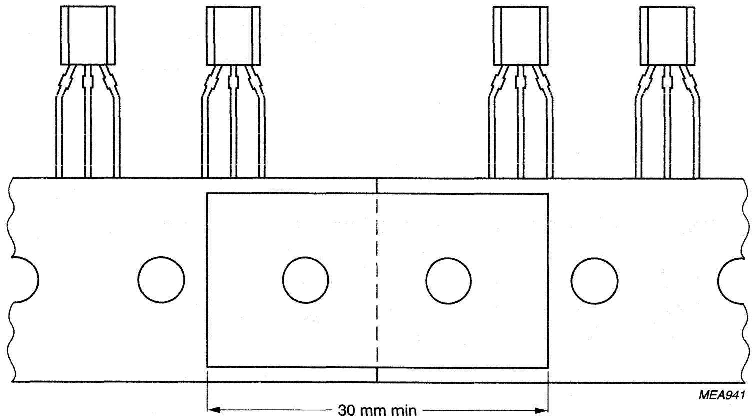
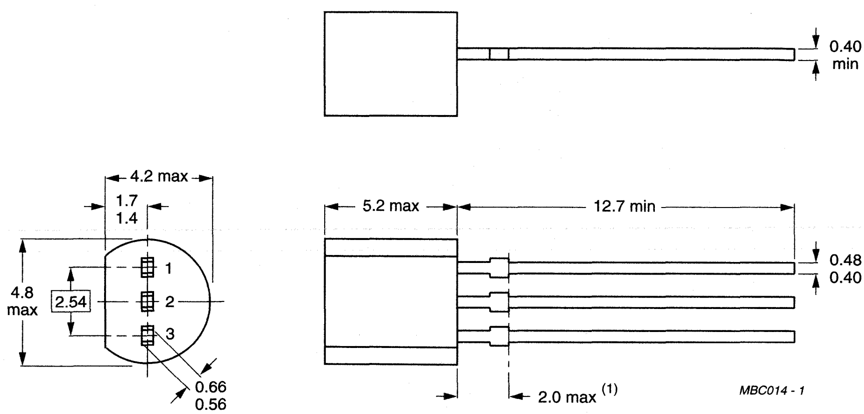


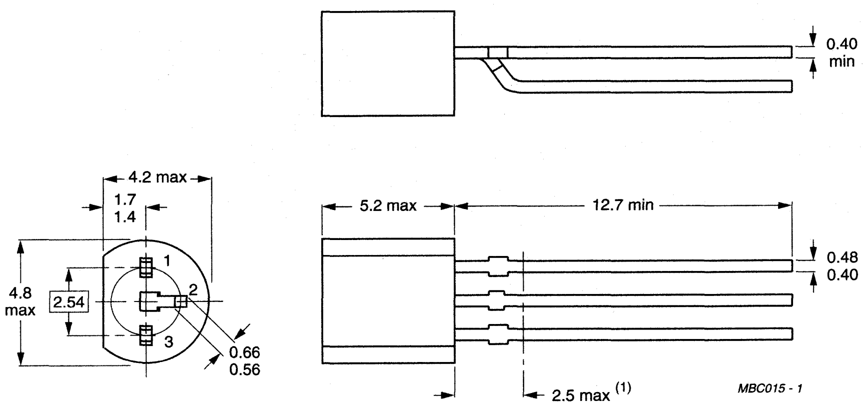
Fig.4 Joining tape with splicing patch.



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.

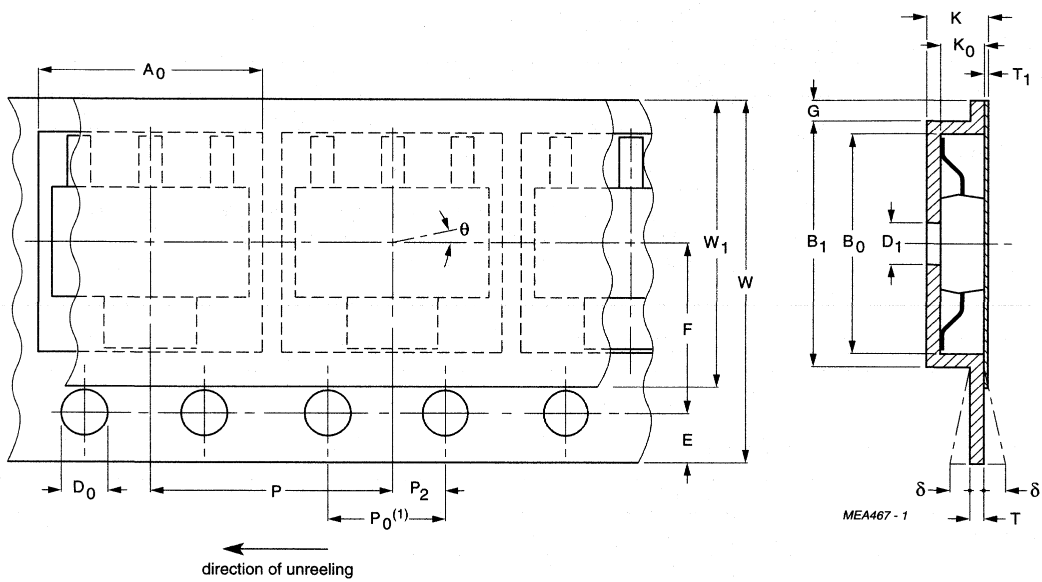
Packing SOT223

Table 2 Packing quantities per reel

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

Note

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



For dimensions see Table 3.

(1) Tolerance over any 10 pitches: ±0.2 mm.

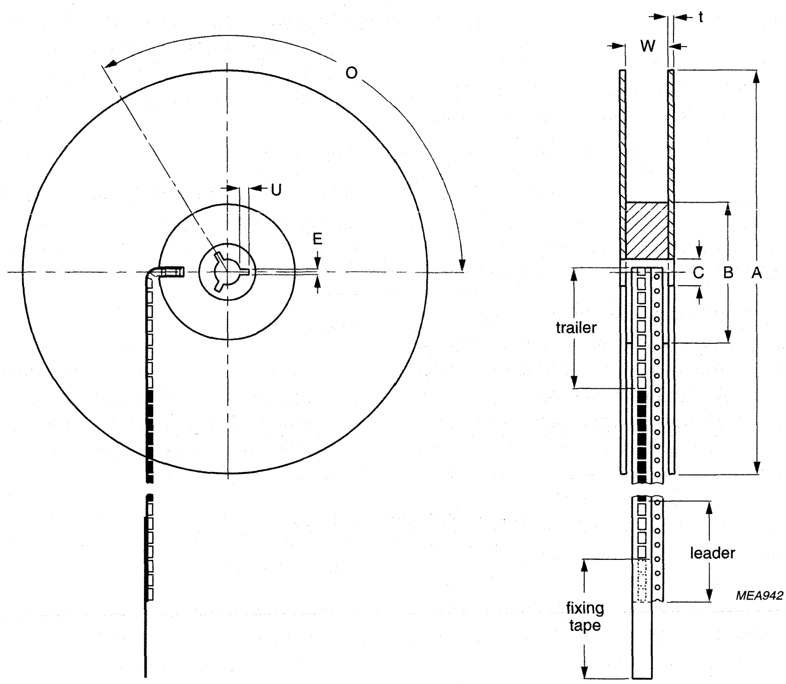
Fig.7 Specification for 12 mm tape (SOT223).

Table 3 Tape dimensions (in mm)

DIMENSION (Fig.7)	**12 mm CARRIER TAPE**	**TOLERANCE**
Overall dimensions		
W	8.0	±0.2
K	<1.5	–
G	>0.75	–
Sprocket holes; note 1		
D_0	1.5	+0.1/–0
E	1.75	±0.1
P_0	4.0	±0.1
Relative placement compartment		
P_2	2.0	±0.1
F	3.5	±0.05
Compartment		
A_0	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_0		
B_1		
K_0		
D_1	>1.0	–
P	4.0	±0.1
θ	<15°	–
Cover tape; note 2		
W_1	<5.4	–
T_1	<0.1	–
Carrier tape		
W	8.0	±0.2
T	<0.2	–
δ	<0.3	–

Notes

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



For dimensions see Table 4.

Fig.8 Reel specification.

Table 4 Reel dimensions (in mm)

DIMENSION (Fig.8)	**12 mm CARRIER TAPE**	**TOLERANCE**
Flange		
A	180 or 330; note 1	±0.5
t	1.5	+0.5/−0.1
W	12.4	18.0+0.2
Hub		
B	62	±1.5
C	12.75	+0.15/−0.2
Key slot		
E	2	±0.2
U	4	±0.5
O	120°	−

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 μm.

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

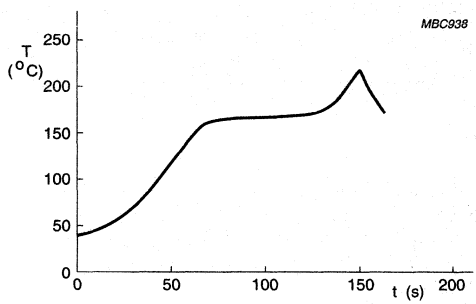


Fig.9 Theoretical time/temperature curve for a typical thermal conductive reflow cycle.

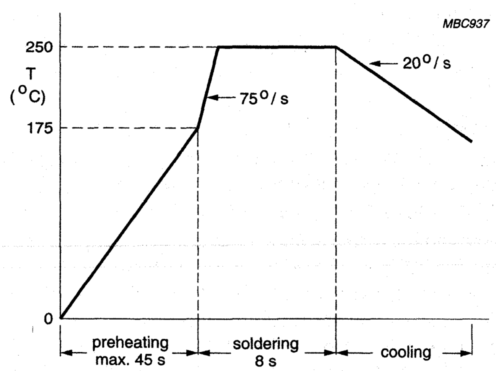


Fig.10 Typical temperature profile of an infrared oven operating at a belt speed of 0.41 mm/min.

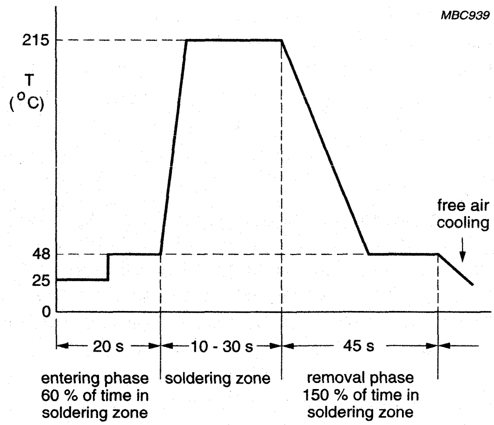


Fig.11 Theoretical time/temperature curve relationship for dual vapour reflow soldering.

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.

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.

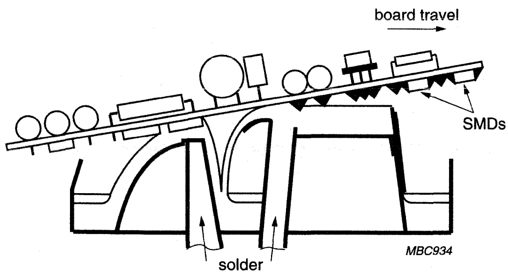


Fig.12 Dual wave soldering principle.

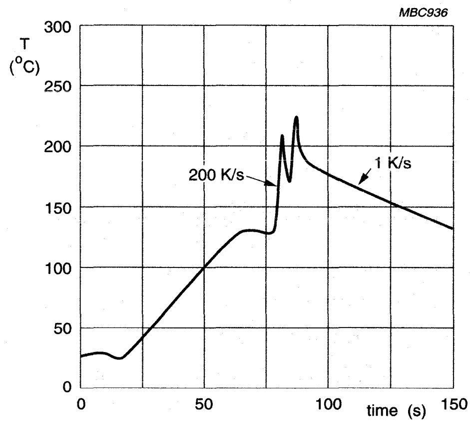


Fig.14 Typical time-temperature curve measured at the soldering site.

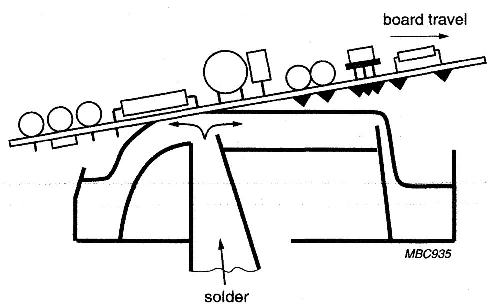


Fig.13 Single wave soldering principle.

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.

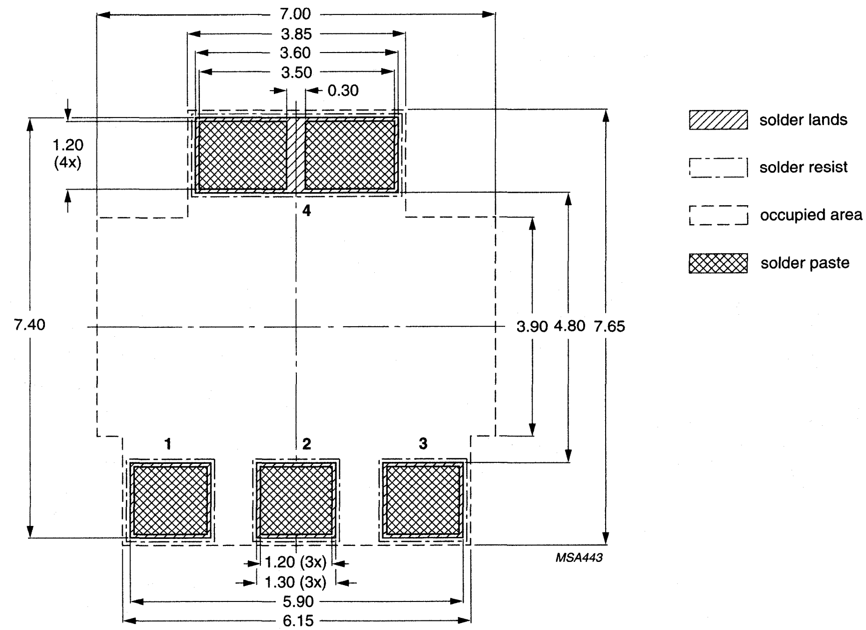
In a dual wave machine (see Fig.12), the substrate first comes into contact with a turbulent wave which has a high vertical velocity. This ensures good solder contact with both edges of the components and prevents joints from being missed. The second smooth laminar wave completes the formation of the 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:

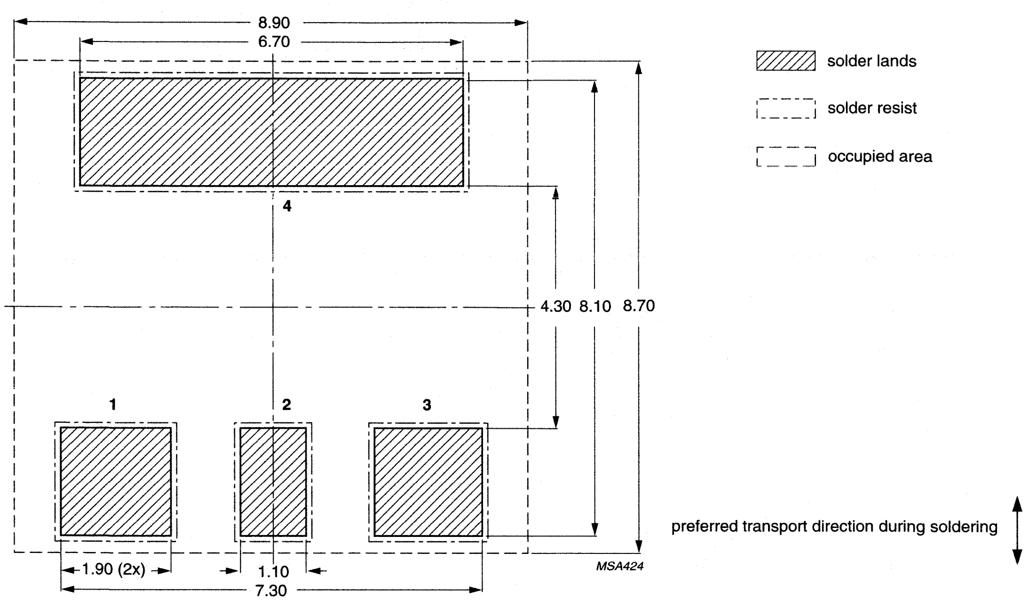
- Features of the component, its dimensions and tolerances
- Circuit board manufacturing processes
- Desired component density
- Minimum spacing between components
- Circuit tracks under the component
- Component orientation (if wave soldering)
- Positional accuracy of solder resist to solder lands
- 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: ±0.25 mm.

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



Dimensions in mm.
Placement accuracy: ±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).

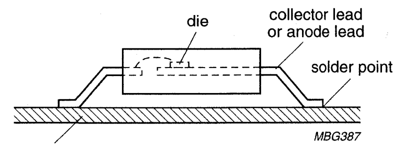


Fig.17 Assembly of SMD package and PCB.

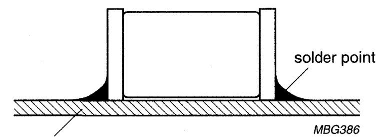


Fig.18 Assembly of SOD80-like package and PCB.

The temperature rise as a function of dissipation power, 'thermal resistance', is given in the data sheets as the $R_{th(j\text{-}s)}$ 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)
- $R_{th(j\text{-}s)}$ Thermal resistance from junction to soldering point (K/W)
- $R_{th(s\text{-}a)}$ Thermal resistance from soldering point to ambient (K/W)
- $R_{th(j\text{-}a)}$ 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:

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

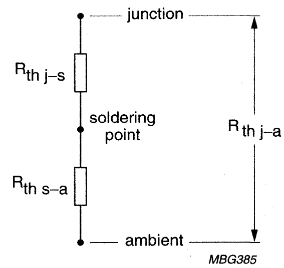


Fig.19 Representation of thermal resistance paths of a device mounted on a substrate or printed-circuit board.

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

In the example for $T_{j(max)}$, only T_{amb} and $R_{th(s\text{-}a)}$ can be varied by the user. The construction of the printed-circuit board (PCB) and the ambient condition (as there is air flow) affect $R_{th(s\text{-}a)}$. 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 $R_{th(j\text{-}s)}$ 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 $R_{th(j\text{-}s)}$, or $R_{th(j\text{-}c)}$ are given in the device data sheets. For applications where T_s is known, T_j can be calculated from:

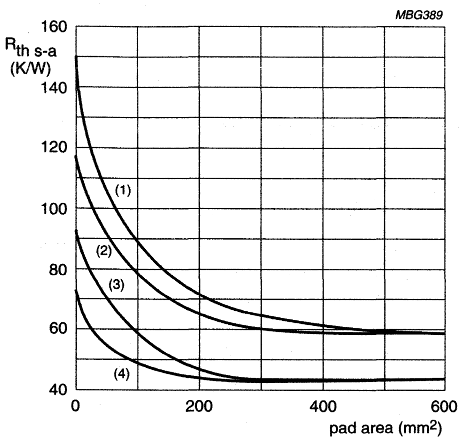
$$T_j = T_s + P_d \times R_{th(j\text{-}s)}$$

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

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

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

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.



(1) Single-sided, unplated.
(2) Single-sided, plated.
(3) Double-sided, unplated.
(4) Double-sided, plated.

Fig.20 Thermal resistance ($R_{th(s\text{-}a)}$) as a function of pad area on different configurations of FR4 epoxy fibre-glass circuit board.

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 (δ), the variation in junction temperature has a sawtooth characteristic.

The average steady-state junction temperature is:

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

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.

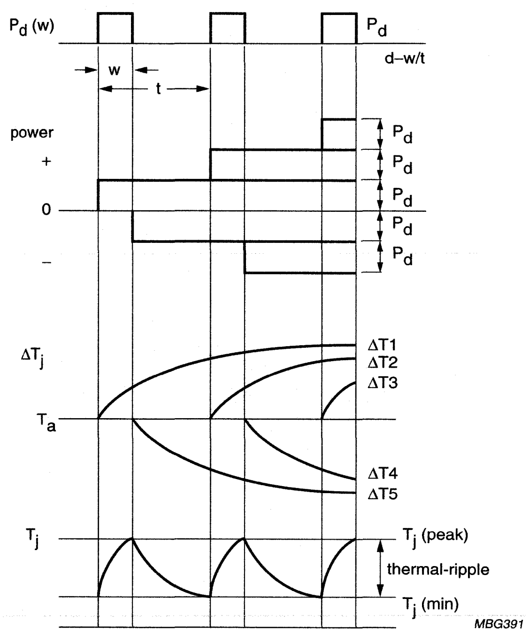


Fig.21 Heating effect of three identical power pulses after thermal stabilization.

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 $T_{j(peak)}$.

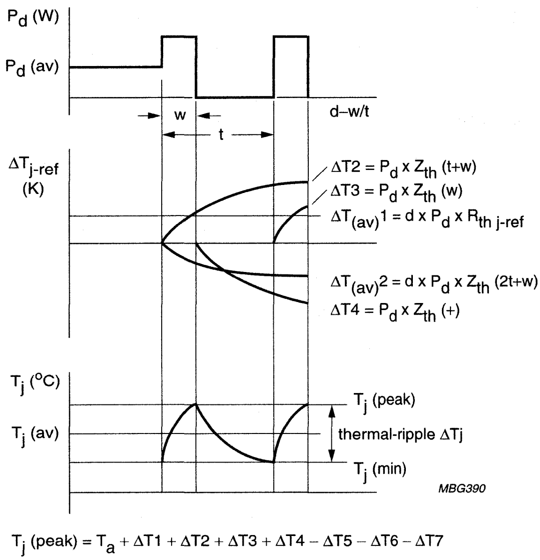


Fig.22 Two-pulse approximation method of finding peak steady-state junction temperature [$T_{j(peak)}$].

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

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

The junction temperature immediately before the second power pulse is:

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

The thermal ripple is:

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

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

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

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

$T_{j(peak)} = P_{d(peak)} \times Z_{th(j\text{-}s)} + P_{d(av)} \times R_{th(s\text{-}a)} + T_a$ (°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 [$R_{th(j\text{-}s)}$] is becoming a more relevant measurement path.

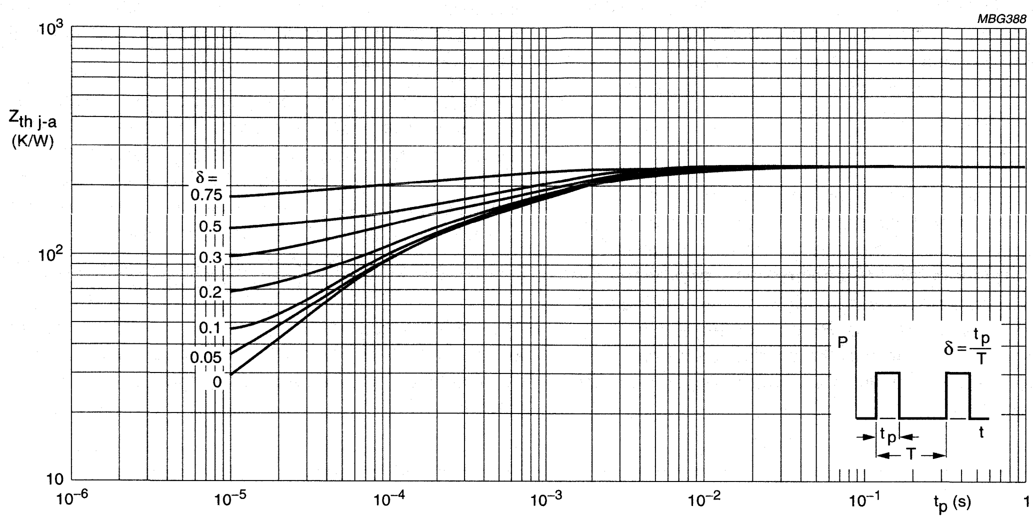


Fig.23 Direct reading of thermal impedance from junction to soldering point for calculation of junction temperature at pulsed power condition.

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 kΩ per cm^2. 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.

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.

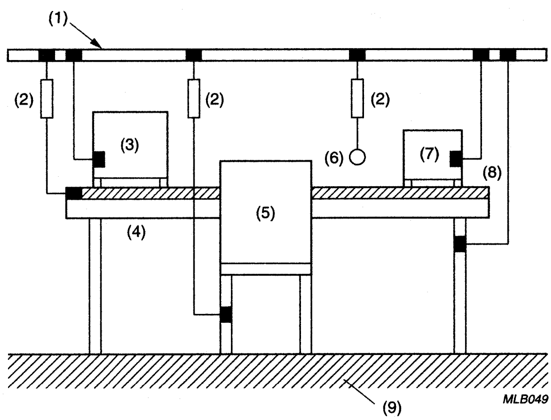
ASSEMBLY

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 kΩ ± 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

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.

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

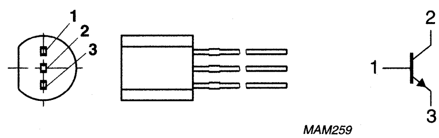


Fig.1 Simplified outline (TO-92) and symbol.

QUICK REFERENCE DATA

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
I_{CM}	peak collector current		–	100	mA
P_{tot}	total power dissipation	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	I_C = 25 mA; V_{CE} = 20 V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; V_{CE} = 30 V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	60	–	MHz

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	$T_{amb} \leq 25$ °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
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

1. Transistor mounted on a printed-circuit board.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

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

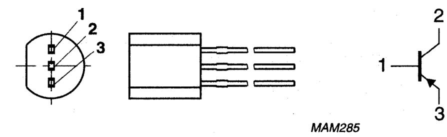


Fig.1 Simplified outline (TO-92) and symbol.

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	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = -25$ mA; $V_{CE} = -20$ V	50	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -30$ V; f = 1 MHz	–	1.6	pF
f_T	transition frequency	$I_C = -10$ mA; $V_{CE} = -10$ V; f = 100 MHz	60	–	MHz

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	$T_{amb} \leq 25$ °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

$T_j = 25$ °C unless otherwise specified.

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

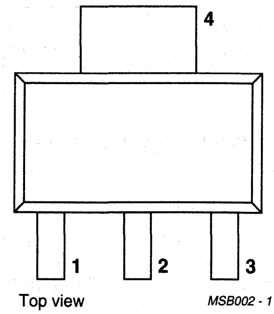


Fig.1 SOT223.

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 °C (note 1)	–	–	1	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V; T_j = 25 °C	25	70	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	4	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 100 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	–	15	–	dB
		I_C = 100 mA; V_{CE} = 10 V; f = 800 MHz; T_{amb} = 25 °C	–	11	–	dB
V_o	output voltage	I_C = 100 mA; V_{CE} = 10 V; d_{im} = –60 dB; R_L = 75 Ω; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °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 °C (note 1)	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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

Notes

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

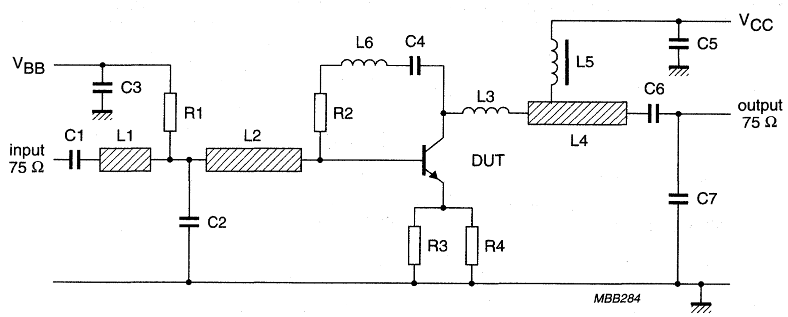


Fig.2 Intermodulation and second harmonic test circuit.

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; width 2.5 mm	
L2	microstripline	75 Ω	length 22mm; width 2.5 mm	
L3 (note 1)	1.5 turns 0.4 mm copper wire		int. dia. 3 mm; winding pitch 1 mm	
L4	microstripline	75 Ω	length 19 mm; 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

1. 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 ($\varepsilon_r = 2.2$); thickness $^1/_{16}$ inch; thickness of copper sheet $^1/_{32}$ inch.

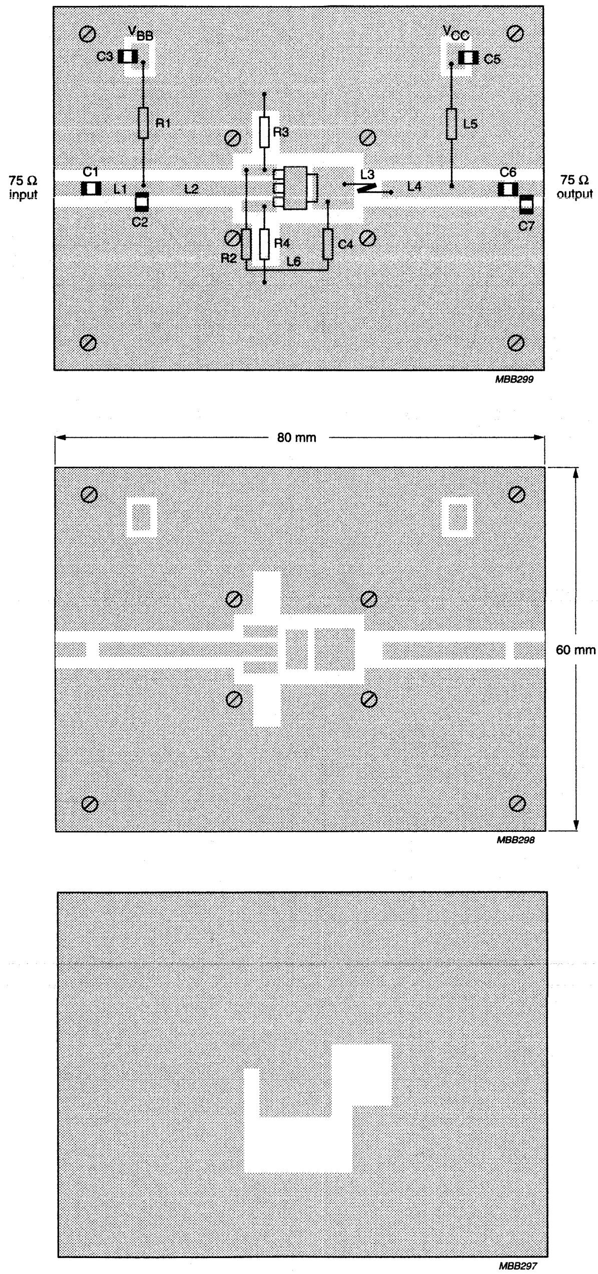


Fig.3 Intermodulation test circuit printed circuit board.

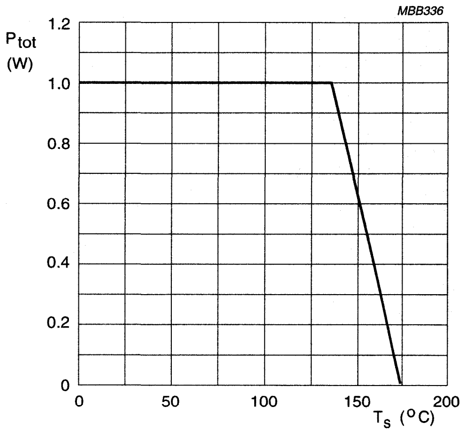
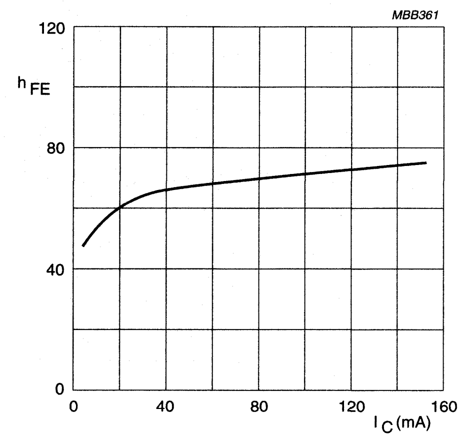
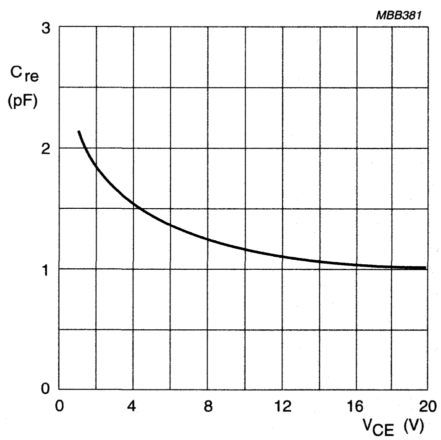


Fig.4 Power derating curve.



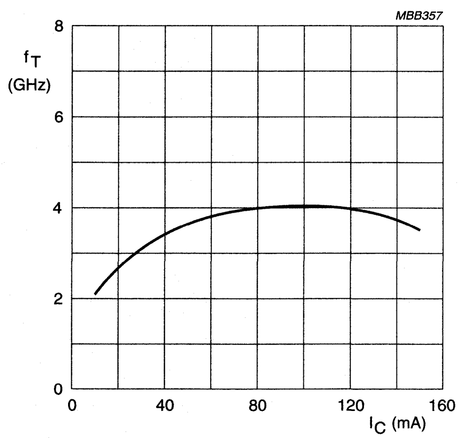
V_{CE} = 10 V; T_j = 25 °C.

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



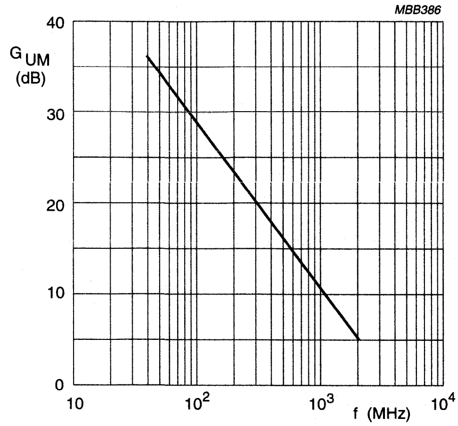
I_E = 0; f = 1 MHz; T_j = 25 °C.

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



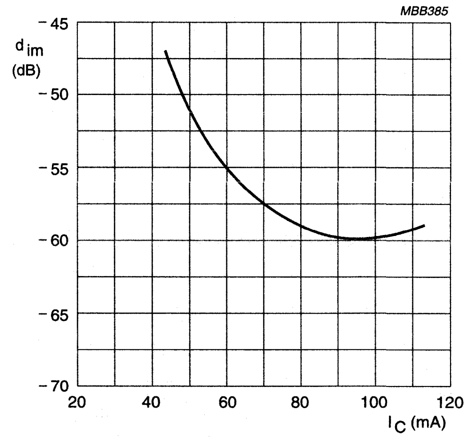
V_{CE} = 10 V; f = 500 MHz; T_j = 25 °C

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



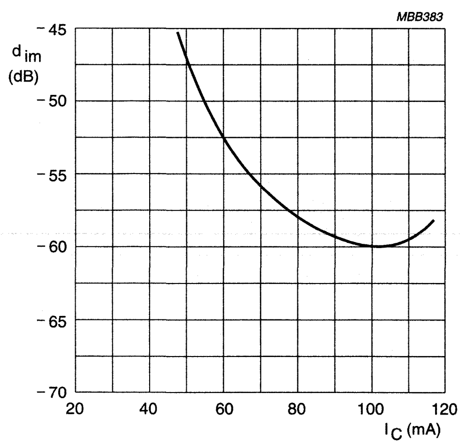
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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



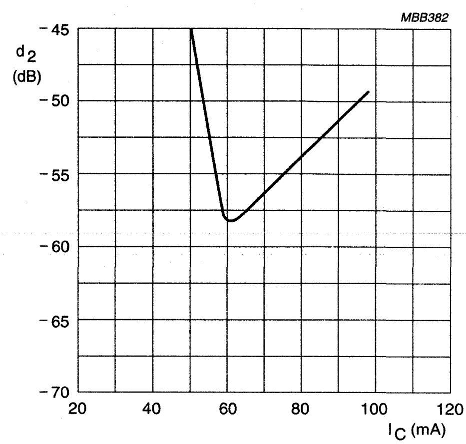
V_{CE} = 10 V; V_o = 800 mV; $f_{(p+q-r)}$ = 443.25 MHz; T_{amb} = 25 °C.

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



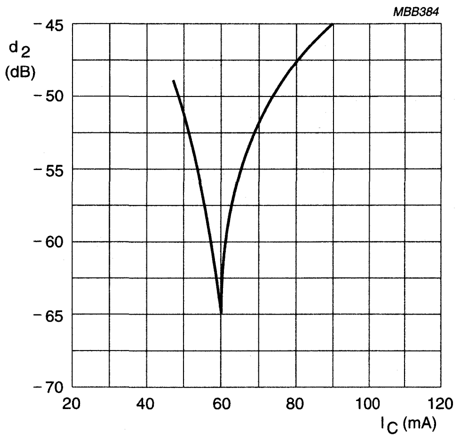
V_{CE} = 10 V; V_o = 750 mV; $f_{(p+q-r)}$ = 793.25 MHz; T_{amb} = 25 °C.

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



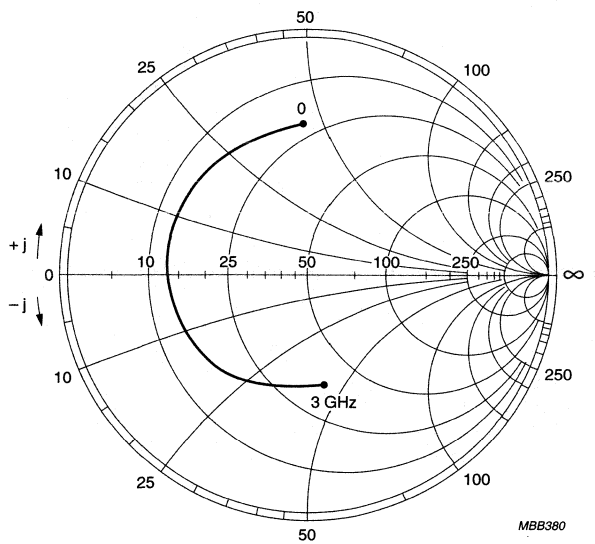
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 450 MHz; T_{amb} = 25 °C.

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



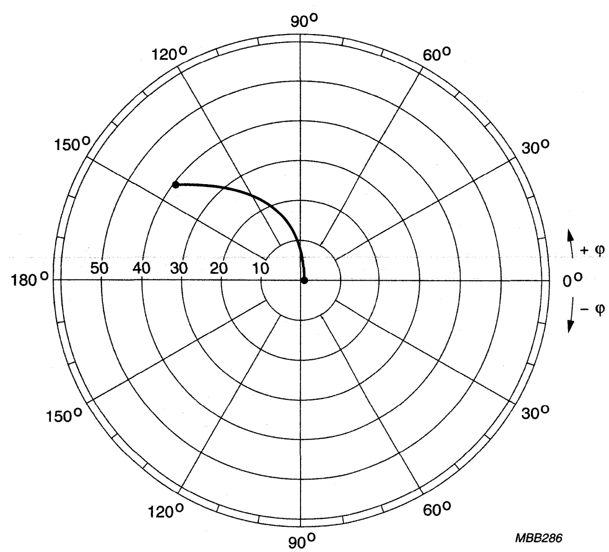
V_{CE} = 10 V; V_o = 50 dBmV; $f_{(p+q)}$ = 810 MHz; T_{amb} = 25 °C.

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



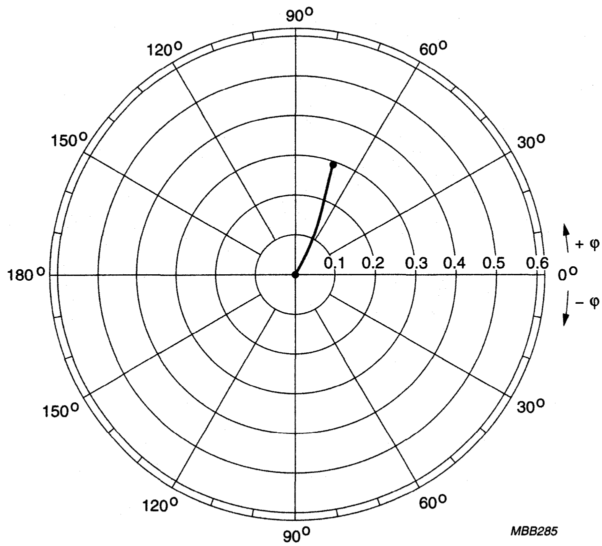
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

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



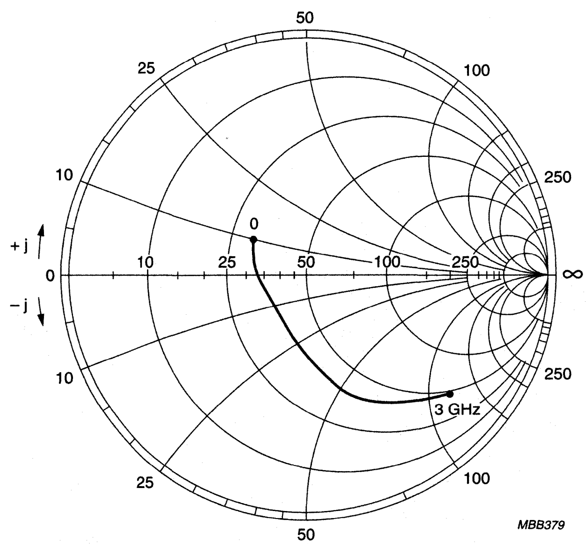
I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C.

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



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

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



I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C; Z_o = 50 Ω.

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

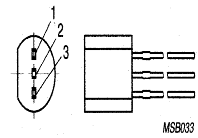


Fig.1 Simplified outline SOT54.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	18	V
I_C	collector current (DC)		–	150	mA
P_{tot}	total power dissipation	up to T_s = 60 °C; see Fig.2	–	1.9	W
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; see Fig.4	4	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 10 V; see Fig.5	1.2	–	pF
T_j	junction temperature		–	175	°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 °C; note 1; see Fig.2	–	1.9	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

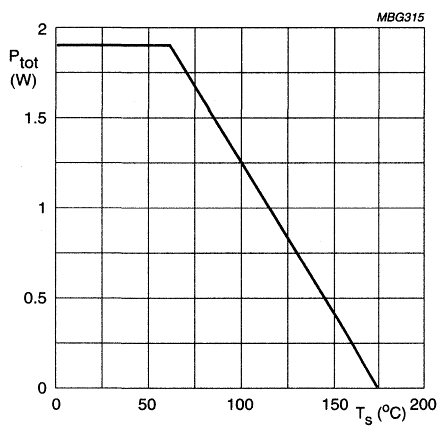


Fig.2 Power derating curve.

NPN video transistor BFQ131

THERMAL CHARACTERISTICS

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

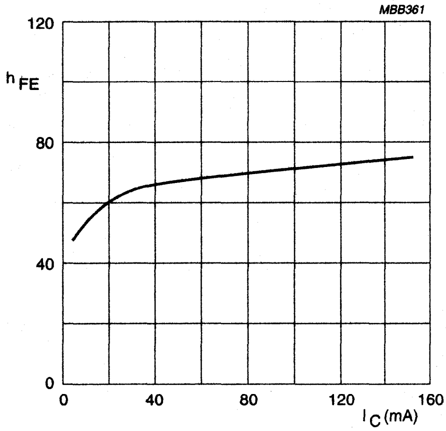
Note

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

CHARACTERISTICS

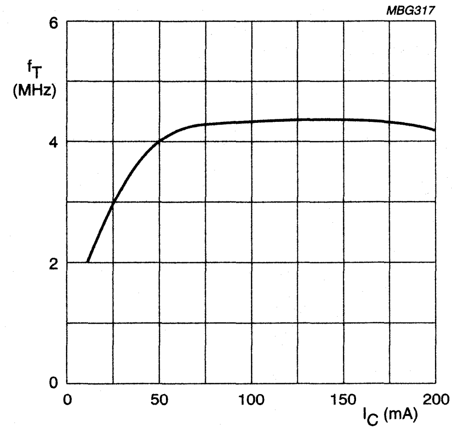
T_j = 25 °C unless otherwise specified.

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



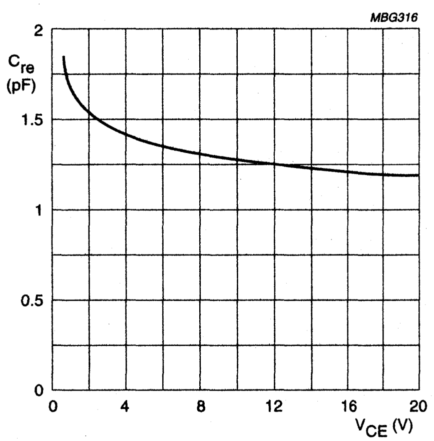
V_{CE} = 10 V; T_j = 25 °C.

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

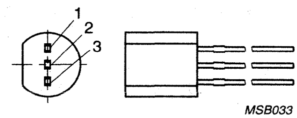


Fig.1 Simplified outline SOT54.

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	$T_s \leq 60$ °C	–	1.25	W
f_T	transition frequency	$I_C = -70$ mA; $V_{CE} = -10$ V	3.5	–	GHz
C_{re}	feedback capacitance	$I_C = 0$; $V_{CB} = -10$ V	1.8	–	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	–	–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	$T_s \leq 60$ °C; note 1; see Fig.2	–	1.25	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	$T_s \le 60$ °C; note 1	90	K/W

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

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

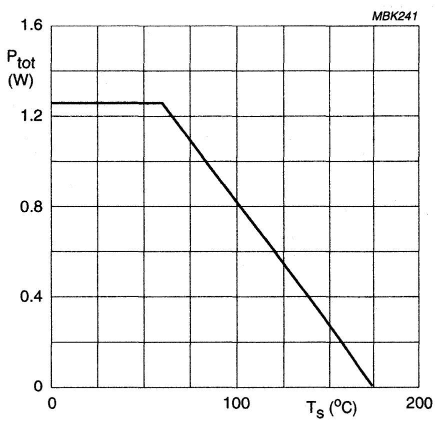
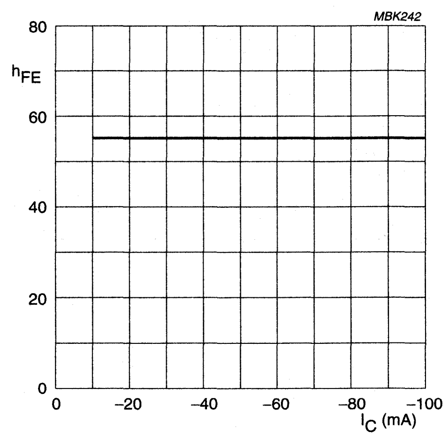
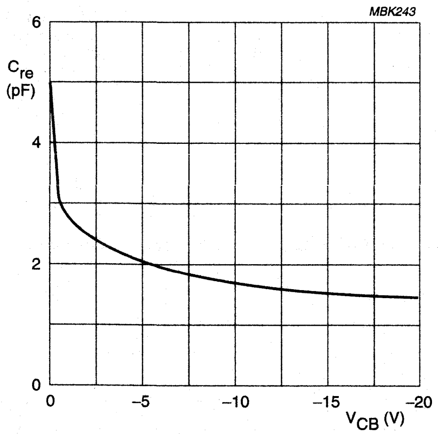


Fig.2 Power derating curve.



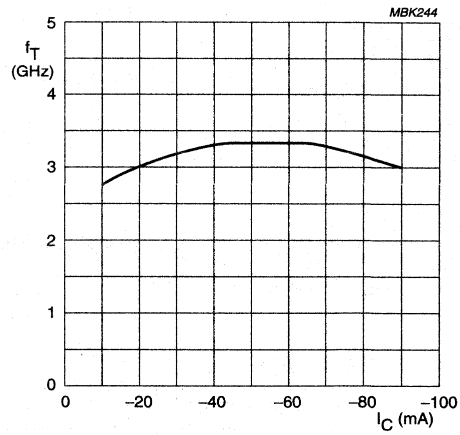
$V_{CE} = -10$ V; $T_{amb} = 25$ °C.

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



$I_C = 0$; f = 1 MHz.; $T_{amb} = 25$ °C.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



$V_{CE} = -10$ V; $f_m = 500$ MHz; $T_{amb} = 25$ °C.

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

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

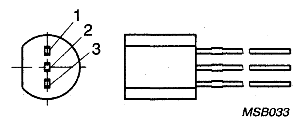


Fig.1 Simplified outline (SOT54; TO-92).

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 Ω	–	19	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s \leq 75$ °C; note 1	–	1	W
h_{FE}	DC current gain	I_C = 300 mA; V_{CE} = 5 V	25	–	
f_T	transition frequency	I_C = 300 mA; V_{CE} = 5 V; T_{amb} = 25 °C	1	–	GHz
T_j	junction temperature		–	150	°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 Ω	–	19	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s \leq 75$ °C; notes 1 and 2; see Fig.3	–	1	W
T_{stg}	storage temperature range		–65	+150	°C
T_j	junction temperature		–	150	°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 mm^2.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 1	75	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		175	K/W
$R_{th\ s\text{-}a}$	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 °C unless otherwise specified.

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

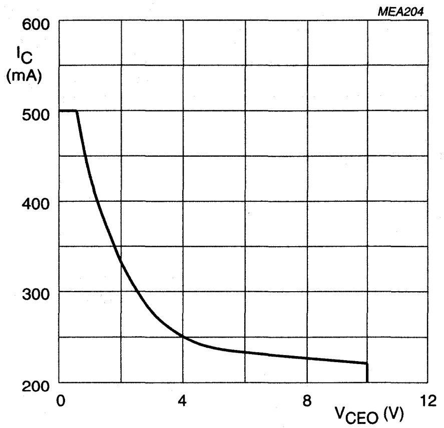


Fig.2 DC SOAR.

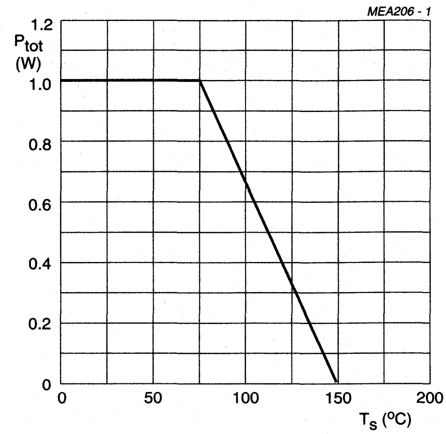
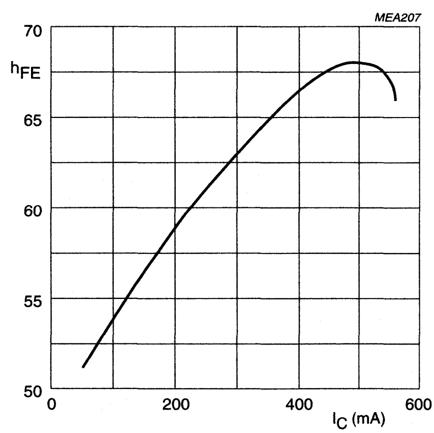
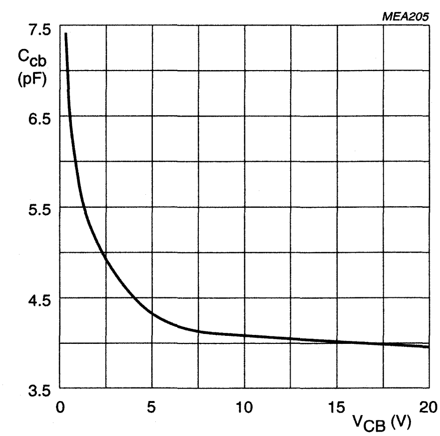


Fig.3 Power derating curve.



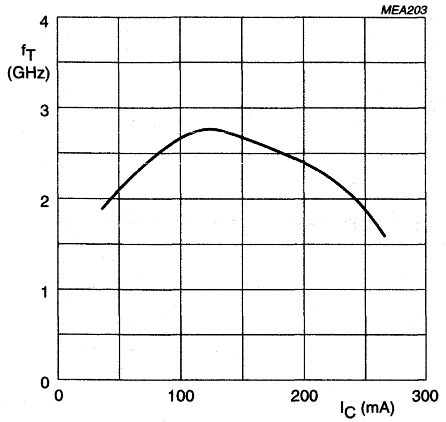
V_{CE} = 5 V; T_{amb} = 25 °C.

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.



V_{CE} = 5 V; T_{amb} = 25 °C.

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

NPN video transistor | BFQ162

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

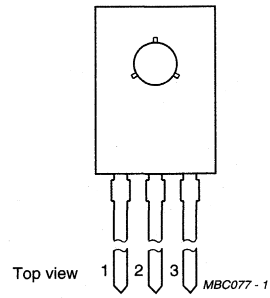


Fig.1 Simplified outline (SOT32; TO-126).

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 Ω	–	–	19	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1	–	–	3	W
h_{FE}	DC current gain	I_C = 300 mA; V_{CE} = 5 V; T_{amb} = 25 °C	50	60	–	
f_T	transition frequency	I_C = 300 mA; V_{CE} = 5 V; f = 100 MHz; T_{amb} = 25 °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 Ω	–	19	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

Note

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

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

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

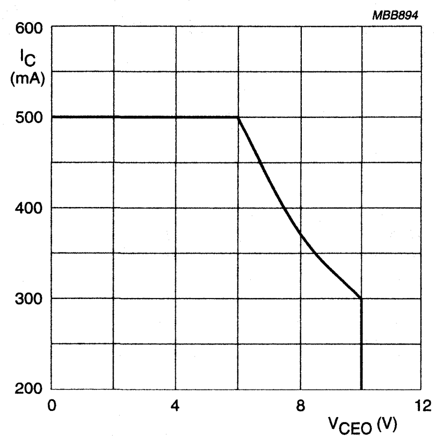


Fig.2 DC SOAR.

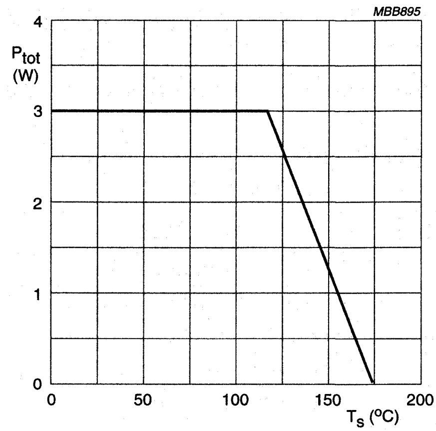
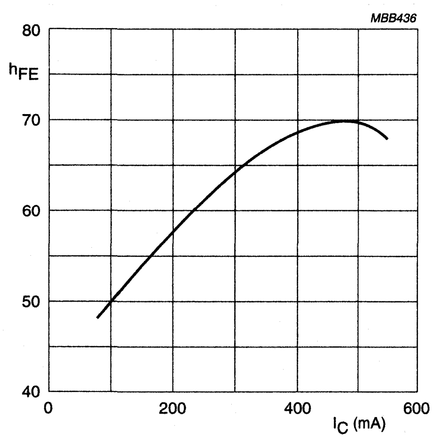
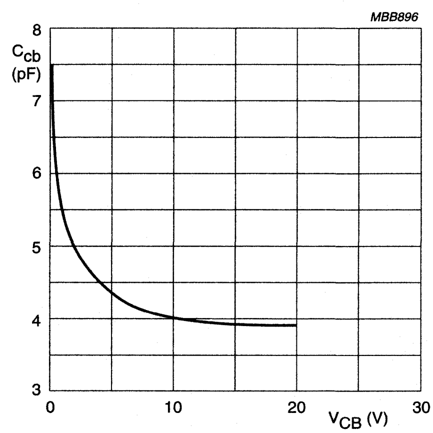


Fig.3 Power derating curve.



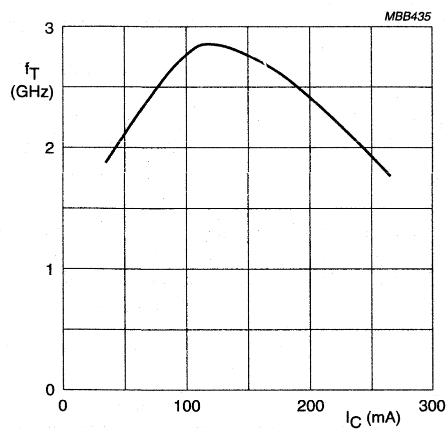
V_{CE} = 5 V; T_{amb} = 25 °C.

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.



V_{CE} = 5 V; f = 100 MHz; T_{amb} = 25 °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

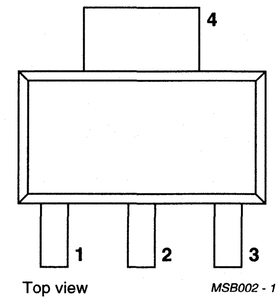


Fig.1 Simplified outline (SOT223).

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 Ω	–	–	19	V
I_C	collector current (DC)		–	–	500	mA
P_{tot}	total power dissipation	$T_s \leq 105$ °C; note 1	–	–	2	W
h_{FE}	DC current gain	I_C = 300 mA; V_{CE} = 5 V; see Fig.4	50	60	–	
f_T	transition frequency	I_C = 300 mA; V_{CE} = 5 V; f = 100 MHz; T_{amb} = 25 °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 Ω	–	19	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	500	mA
P_{tot}	total power dissipation	$T_s \leq 105$ °C; note 1; see Fig.3	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

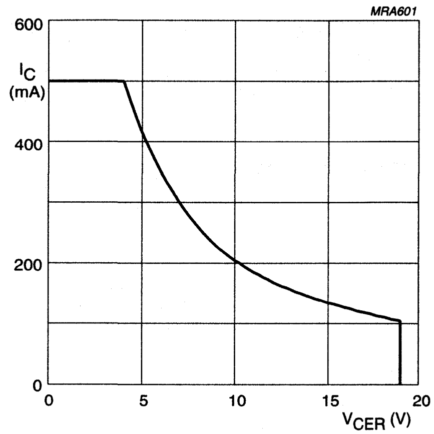
Notes

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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



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

Fig.2 DC SOAR.

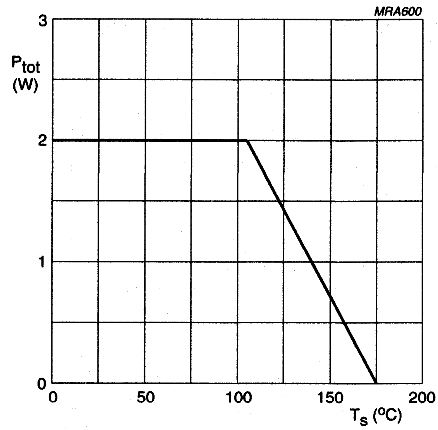
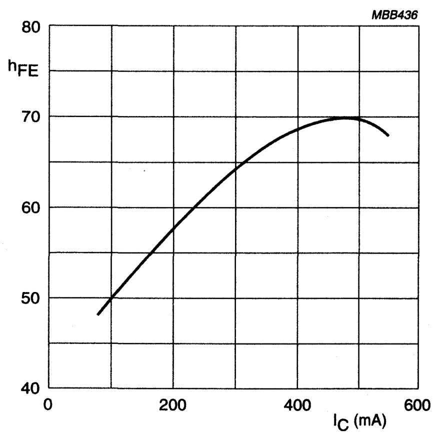
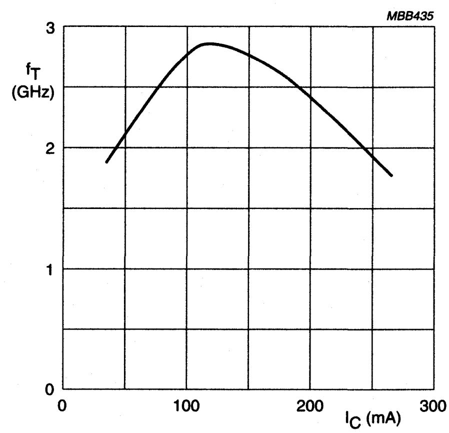


Fig.3 Power derating curve.



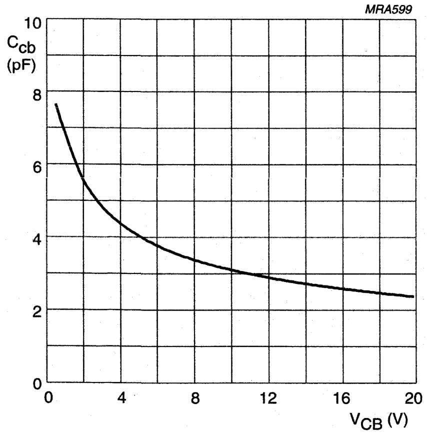
$V_{CE} = 5$ V.

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



$V_{CE} = 5$ V; $T_{amb} = 25$ °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 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

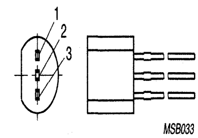


Fig.1 Simplified outline SOT54.

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 °C	–	1.15	W
f_T	transition frequency	I_C = 25 mA; V_{CE} = 10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 10 V	1.7	–	pF
T_j	junction temperature		–	150	°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 Ω	–	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 °C; note 1; see Fig.3	–	1.15	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

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

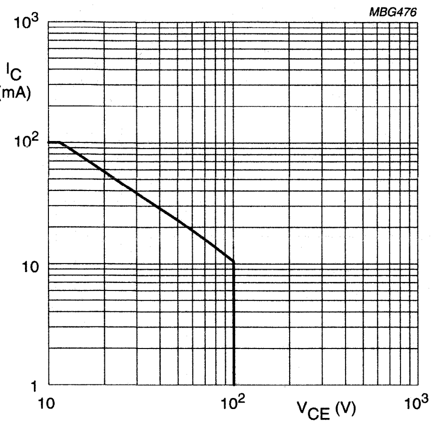


Fig.2 DC SOAR.

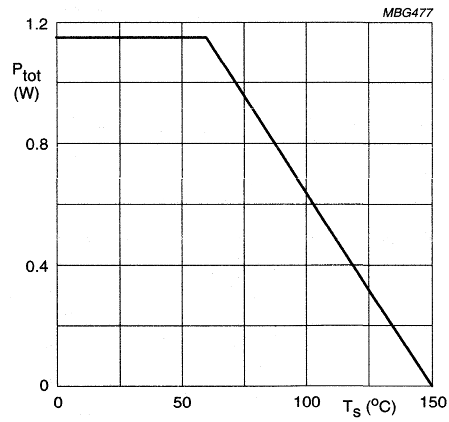


Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

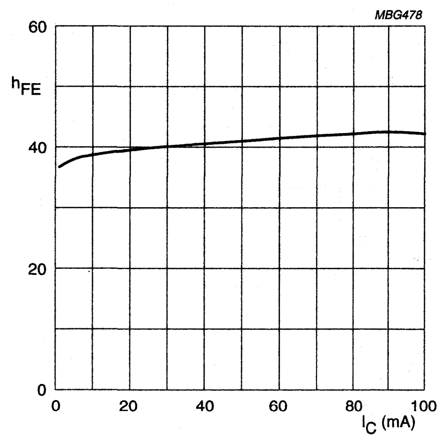
Note

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

CHARACTERISTICS

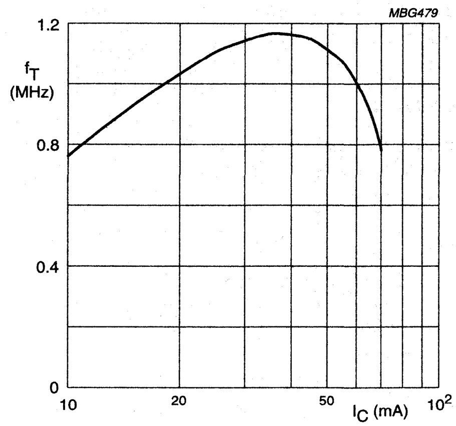
T_j = 25 °C unless otherwise specified.

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



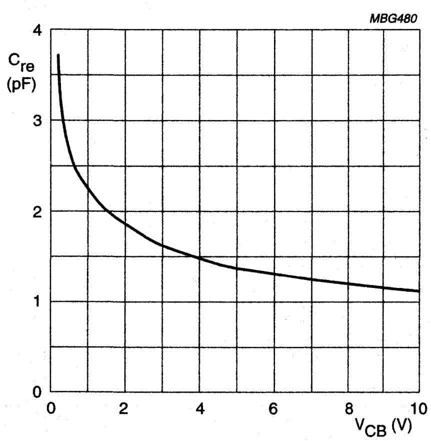
V_{CE} = 10 V; t_p = 500 µs.

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

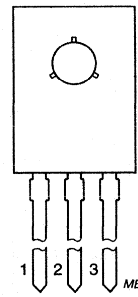


Fig.1 Simplified outline SOT32.

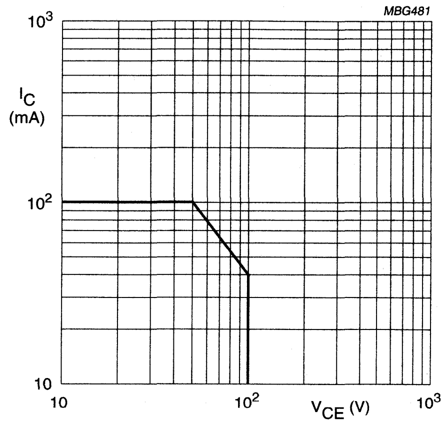
QUICK REFERENCE DATA

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 °C	–	5	W
f_T	transition frequency	I_C = 25 mA; V_{CE} = 10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

LIMITING VALUES

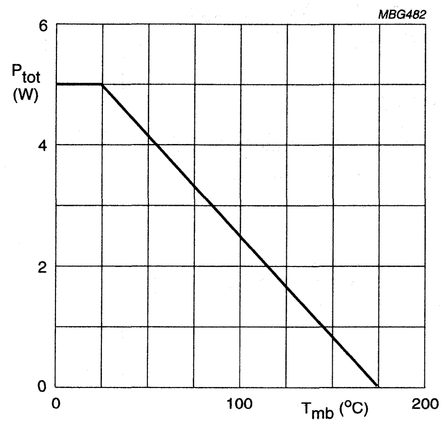
In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	100	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	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 °C; see Fig.3	–	5	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C



T_{mb} = 25 °C.

Fig.2 DC SOAR.



$V_{CE} \leq 50$ V.

Fig.3 Power derating curve.

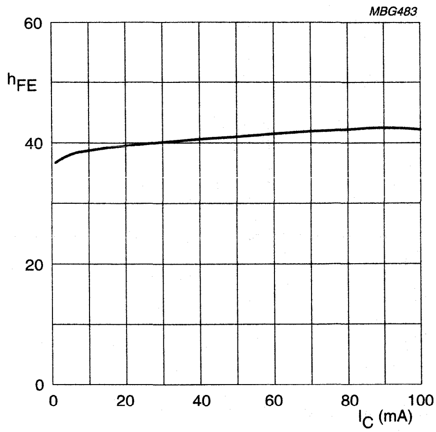
THERMAL CHARACTERISTICS

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

CHARACTERISTICS

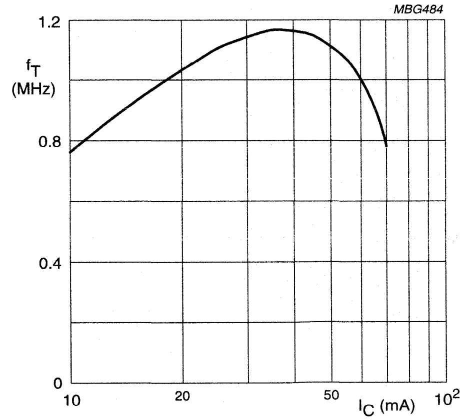
T_j = 25 °C unless otherwise specified.

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



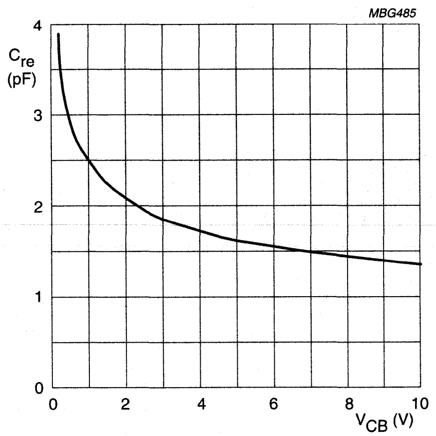
V_{CE} = 10 V; t_p = 500 μs.

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

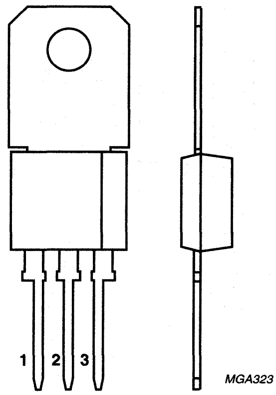


Fig.1 Simplified outline SOT128B.

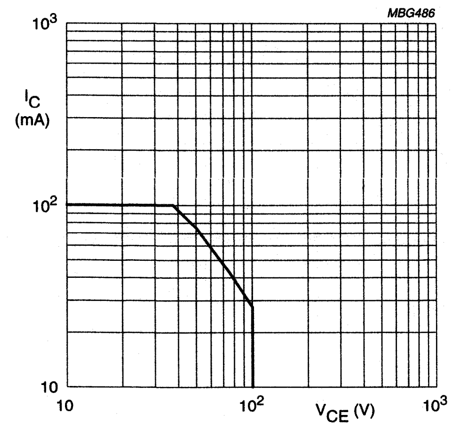
QUICK REFERENCE DATA

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 °C	–	3.75	W
f_T	transition frequency	I_C = 25 mA; V_{CE} = 10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

LIMITING VALUES

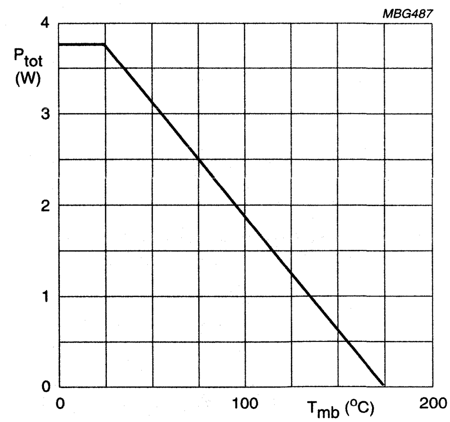
In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	100	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	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 °C; see Fig.3	–	3.75	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C



T_{mb} = 25 °C.

Fig.2 DC SOAR.



$V_{CE} \leq$ 50 V.

Fig.3 Power derating curve.

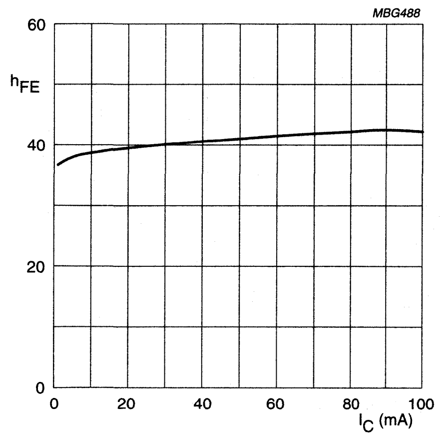
THERMAL CHARACTERISTICS

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

CHARACTERISTICS

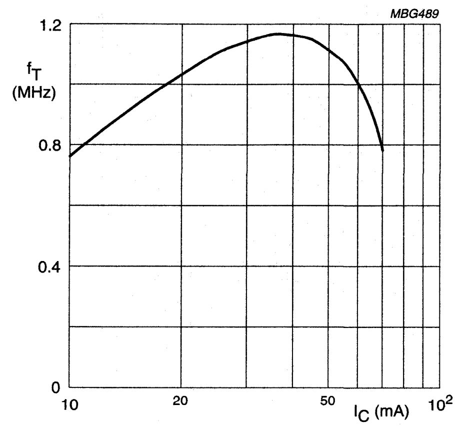
T_j = 25 °C unless otherwise specified.

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



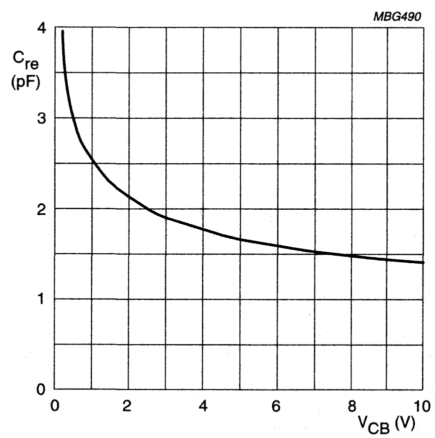
V_{CE} = 10 V; t_p = 500 μs.

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

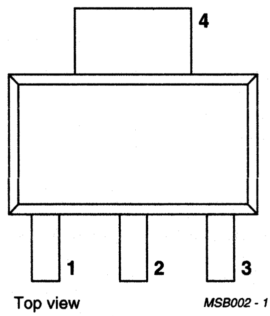


Fig.1 Simplified outline SOT223.

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 °C	–	3	W
f_T	transition frequency	I_C = 25 mA; V_{CE} = 10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = 10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

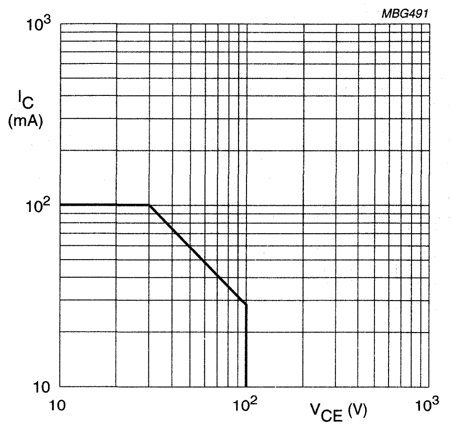
LIMITING VALUES

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 Ω	–	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 °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

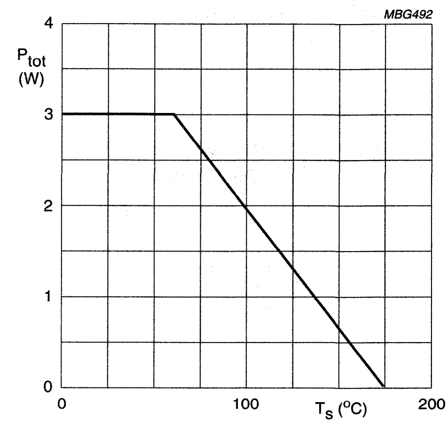
Note

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



T_s = 60 °C.

Fig.2 DC SOAR.



$V_{CE} \leq 50$ V.

Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

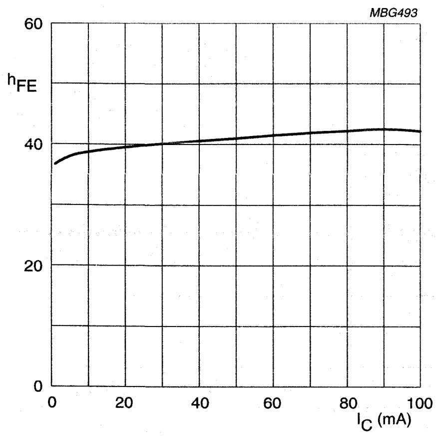
Note

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

CHARACTERISTICS

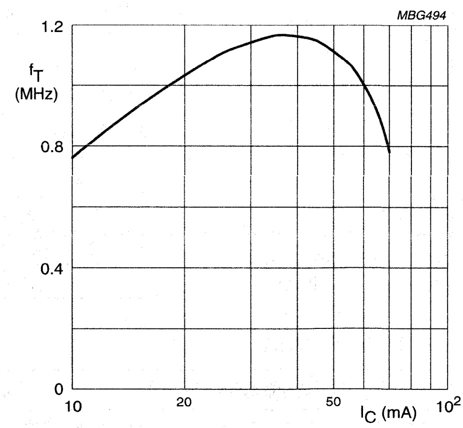
T_j = 25 °C unless otherwise specified.

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



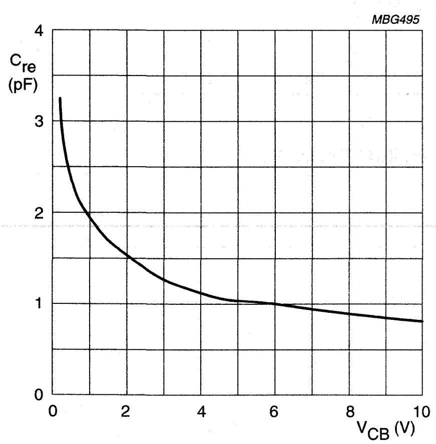
V_{CE} = 10 V; t_p = 500 μs.

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

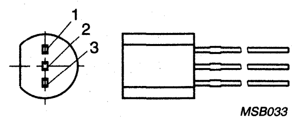


Fig.1 Simplified outline (SOT54; TO-92).

QUICK REFERENCE DATA

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

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			
	BFQ231		–	100	V
	BFQ231A		–	115	V
V_{CEO}	collector-emitter voltage	open base			
	BFQ231		–	65	V
	BFQ231A		–	95	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω			
	BFQ231		–	95	V
	BFQ231A		–	110	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	300	mA
P_{tot}	total power dissipation	$T_s \leq 65$ °C; notes 1 and 2; see Fig.3	–	1	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°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 mm^2.

THERMAL CHARACTERISTICS

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

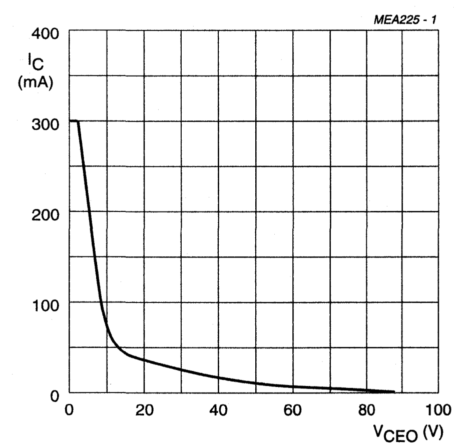
Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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



T_{amb} = 25 °C.

Fig.2 DC SOAR.

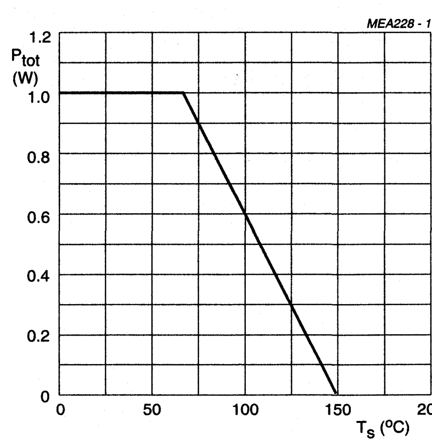
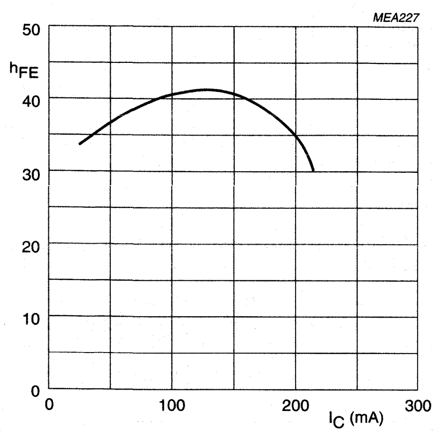
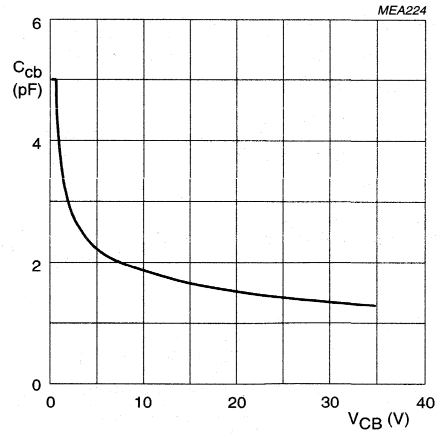


Fig.3 Power derating curve.



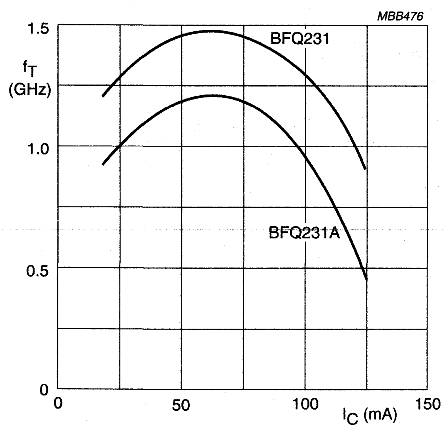
V_{CE} = 10 V; T_{amb} = 25 °C.

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

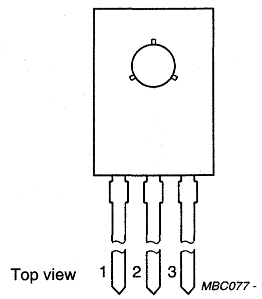


Fig.1 Simplified outline (SOT32; TO-126).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ232		–	–	100	V
	BFQ232A		–	–	115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ232		–	–	95	V
	BFQ232A		–	–	110	V
I_C	collector current (DC)		–	–	300	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1; see Fig.3	–	–	3	W
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C	20	35	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C				
	BFQ232		1	1.4	–	GHz
	BFQ232A		0.8	1.2	–	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			
	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	$T_s \leq 115$ °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 115$ °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 °C unless otherwise specified.

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

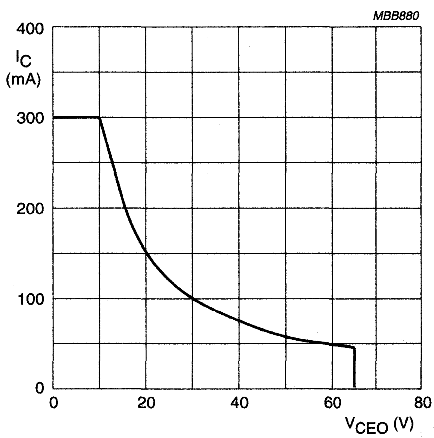


Fig.2 DC SOAR.

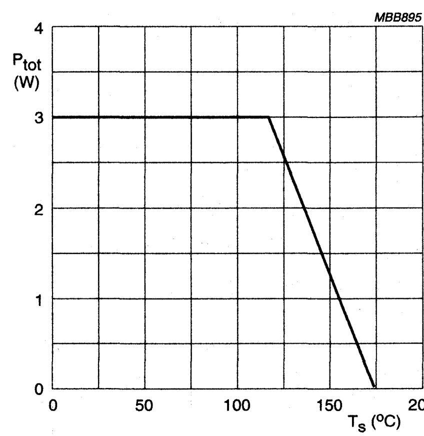
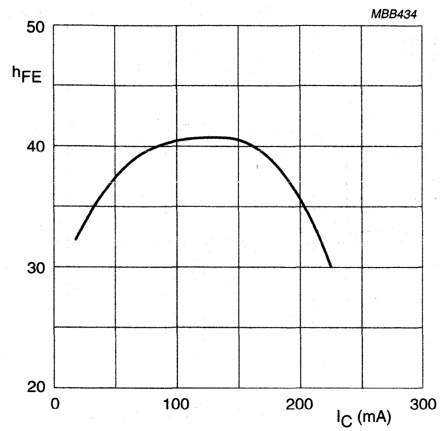
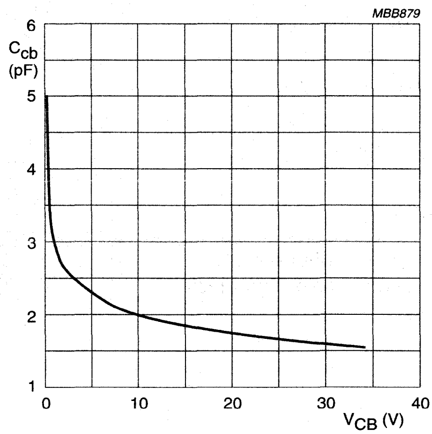


Fig.3 Power derating curve.



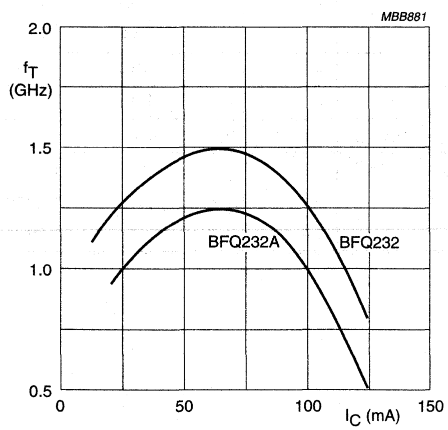
V_{CE} = 10 V; T_{amb} = 25 °C.

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

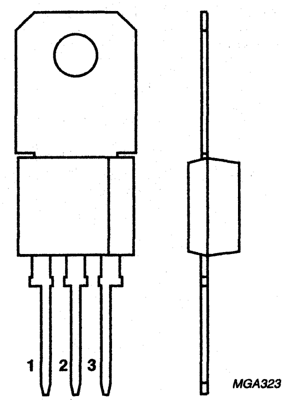


Fig.1 Simplified outline (SOT128B; TO-202).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ235		–	–	100	V
	BFQ235A		–	–	115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ235		–	–	95	V
	BFQ235A		–	–	110	V
I_C	collector current (DC)		–	–	300	mA
P_{tot}	total power dissipation	$T_s \leq 100$ °C; note 1	–	–	3	W
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C	20	35	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C				
	BFQ235		1	1.4	–	GHz
	BFQ235A		0.8	1.2	–	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			
	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 Ω			
	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	$T_s \leq 100$ °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	$T_s \leq 100$ °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_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; I_E = 0				
	BFQ235		100	–	–	V
	BFQ235A		115	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0				
	BFQ235		65	–	–	V
	BFQ235A		95	–	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 10 mA; R_{BE} = 100 Ω				
	BFQ235		95	–	–	V
	BFQ235A		110	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; I_C = 0	3	–	–	V
I_{CES}	collector cut-off current	I_B = 0; V_{CE} = 50 V	–	–	100	μA
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 50 V	–	–	20	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; T_{amb} = 25 °C; see Fig.4	20	35	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °C; see Fig.6				
	BFQ235		1	1.4	–	GHz
	BFQ235A		0.8	1.2	–	GHz
C_{cb}	collector-base capacitance	I_C = 0; V_{CB} = 10 V; f = 1 MHz; T_{amb} = 25 °C; see Fig.5	–	2	–	pF

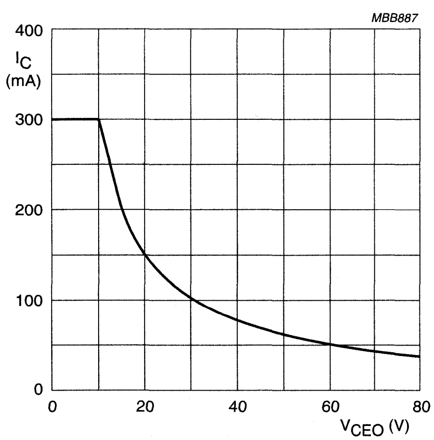


Fig.2 DC SOAR.

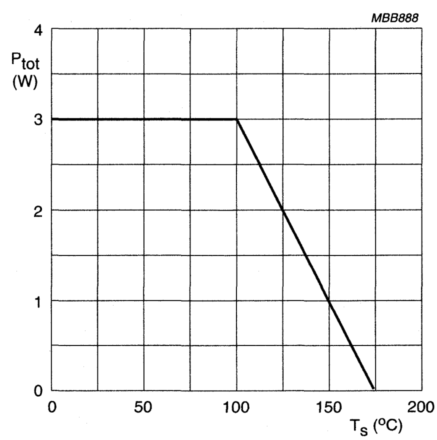
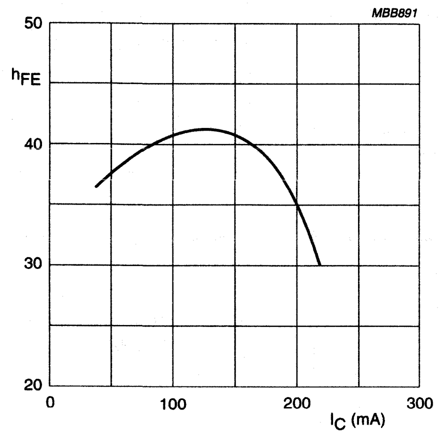
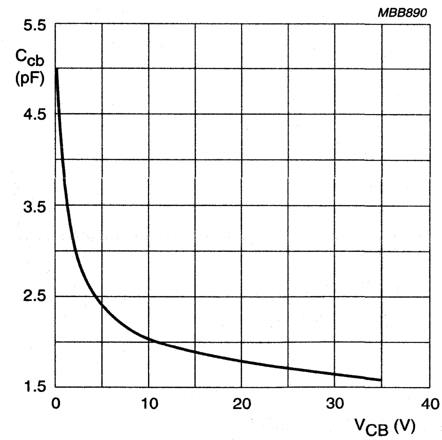


Fig.3 Power derating curve.



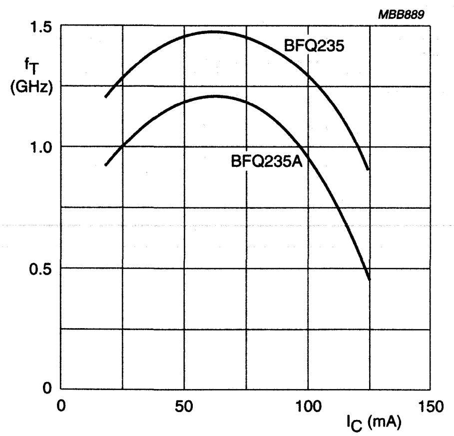
V_{CE} = 10 V; T_{amb} = 25 °C.

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

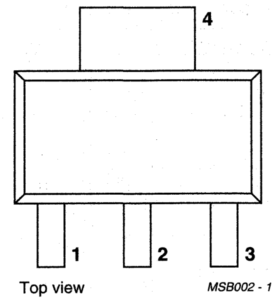


Fig.1 Simplified outline (SOT223).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ236		–	–	100	V
	BFQ236A		–	–	115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ236		–	–	95	V
	BFQ236A		–	–	110	V
I_C	collector current (DC)		–	–	300	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1	–	–	2	W
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; see Fig.4	20	35	–	
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz				
	BFQ236		1	1.4	–	GHz
	BFQ236A		0.8	1.2	–	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			
	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 Ω			
	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	$T_s \leq 115$ °C; note 1; see Fig.3	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

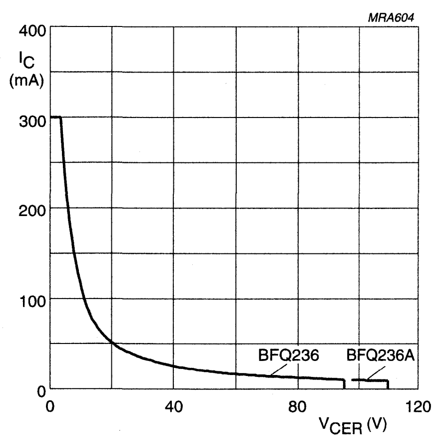
Notes

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 100 μA; I_E = 0				
	BFQ236		100	–	–	V
	BFQ236A		115	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0				
	BFQ236		65	–	–	V
	BFQ236A		95	–	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = 1 mA; R_{BE} = 100 Ω				
	BFQ236		95	–	–	V
	BFQ236A		110	–	–	V
I_{CES}	collector-emitter cut-off current	I_B = 0; V_{CE} = 50 V	–	–	100	μA
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = 50 V	–	–	20	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V; see Fig.4	20	35	–	
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 10 V; f = 1 MHz	–	1.8	–	pF
C_{cb}	collector-base capacitance	I_C = i_c = 0; V_{CB} = 10 V; f = 1 MHz; see Fig.6	–	1.5	–	pF
f_T	transition frequency	I_C = 50 mA; V_{CE} = 10 V; f = 100 MHz; see Fig.5				
	BFQ236		1	1.4	–	GHz
	BFQ236A		0.8	1.2	–	GHz



R_{BE} ≤ 100 Ω.

Fig.2 DC SOAR.

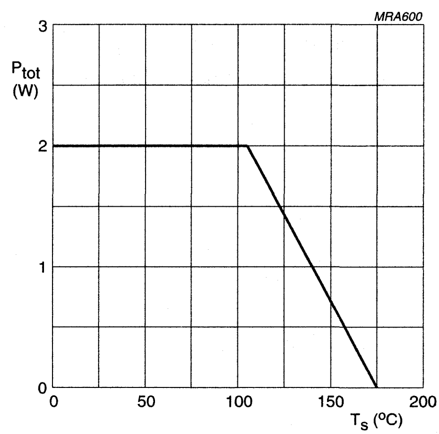
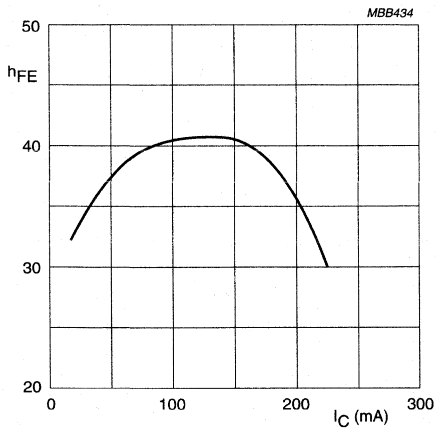
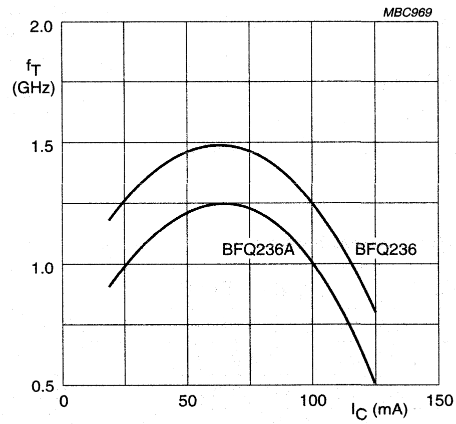


Fig.3 Power derating curve.



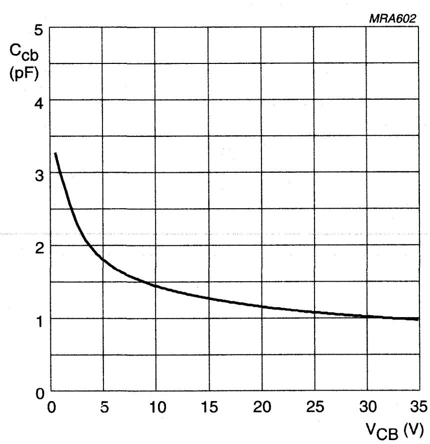
V_{CE} = 10 V.

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.

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

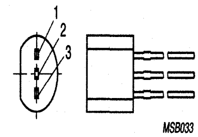


Fig.1 Simplified outline SOT54.

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 °C	–	1.15	W
f_T	transition frequency	I_C = –25 mA; V_{CE} = –10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = –10 V	1.7	–	pF
T_j	junction temperature		–	150	°C

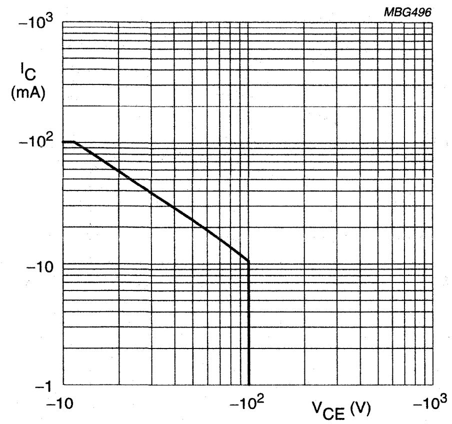
LIMITING VALUES

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 Ω	–	–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 °C; note 1; see Fig.3	–	1.15	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

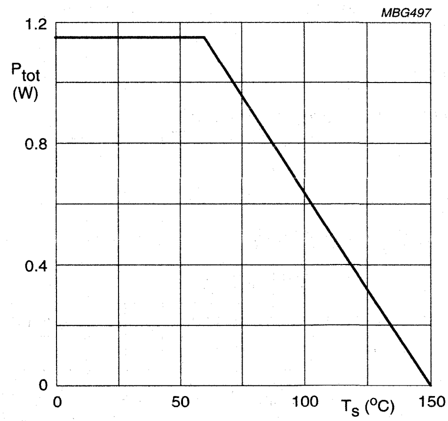
Note

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



T_s = 60 °C.

Fig.2 DC SOAR.



$V_{CE} \leq -50$ V.

Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

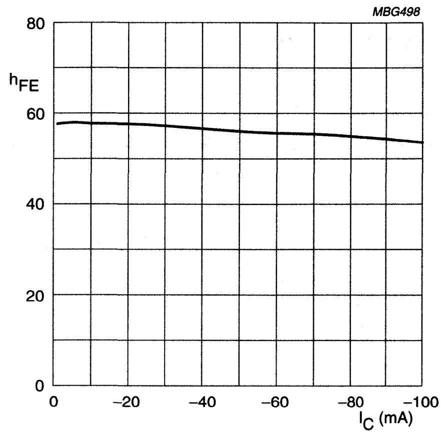
Note

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

CHARACTERISTICS

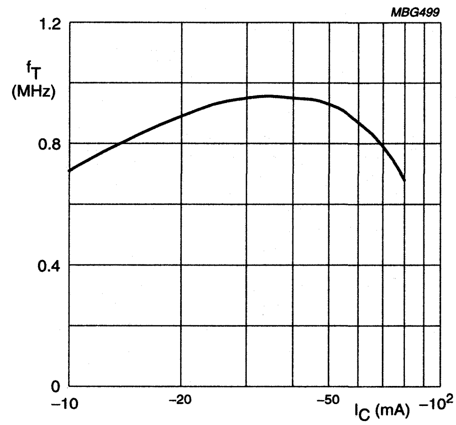
T_j = 25 °C unless otherwise specified.

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



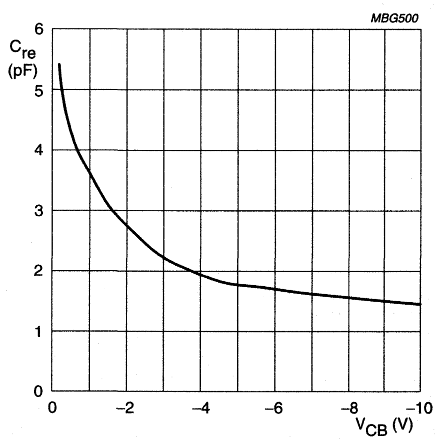
V_{CE} = −10 V; t_p = 500 μs.

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

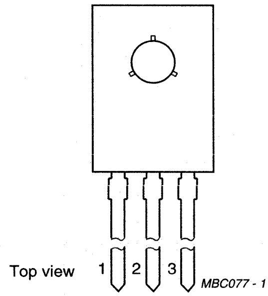


Fig.1 Simplified outline SOT32.

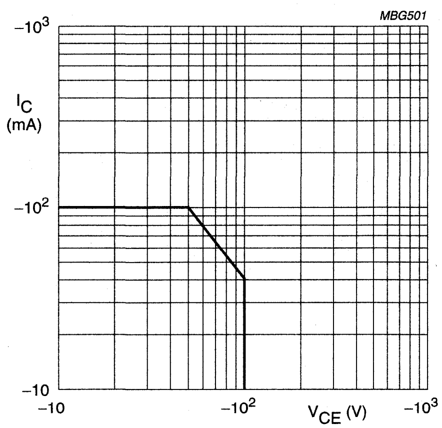
QUICK REFERENCE DATA

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 °C	–	5	W
f_T	transition frequency	I_C = –25 mA; V_{CE} = –10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = –10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

LIMITING VALUES

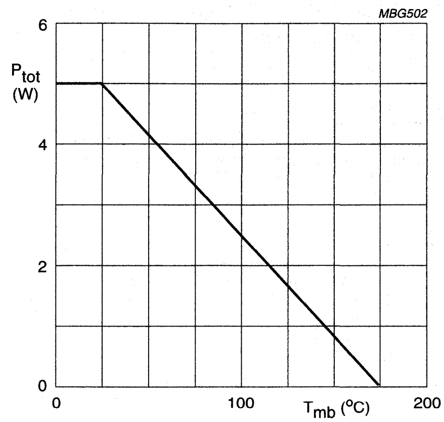
In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–100	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	–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 °C; see Fig.3	–	5	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C



T_{mb} = 25 °C.

Fig.2 DC SOAR.



$V_{CE} \leq -50$ V.

Fig.3 Power derating curve.

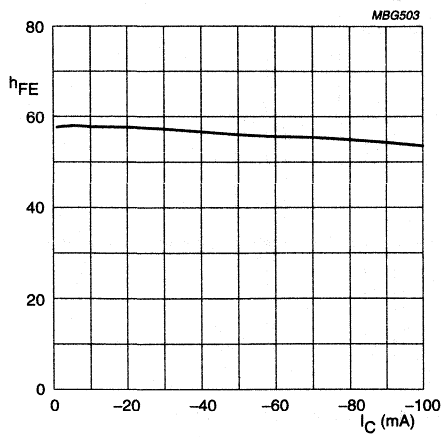
THERMAL CHARACTERISTICS

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

CHARACTERISTICS

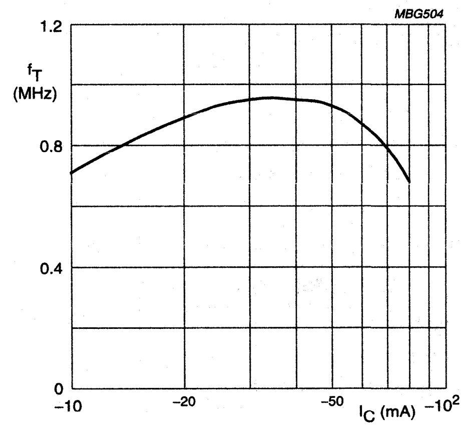
T_j = 25 °C unless otherwise specified.

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



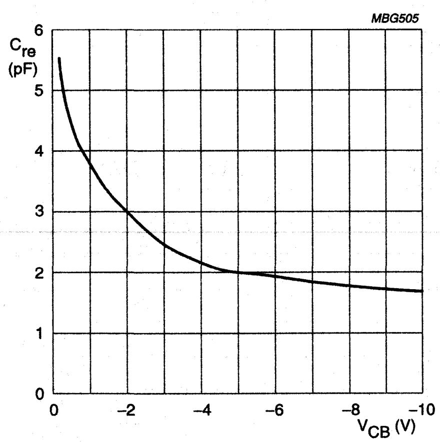
V_{CE} = −10 V; t_p = 500 µs.

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

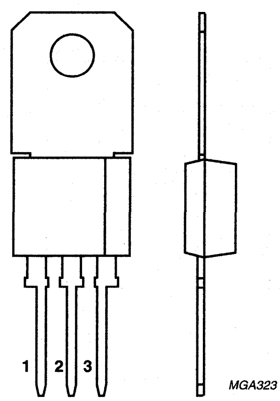


Fig.1 Simplified outline SOT128B.

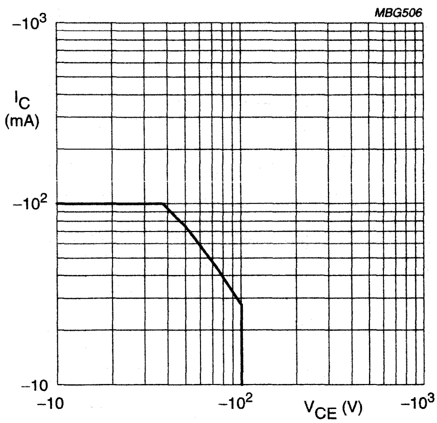
QUICK REFERENCE DATA

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 °C	–	3.75	W
f_T	transition frequency	I_C = –25 mA; V_{CE} = –10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = –10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

LIMITING VALUES

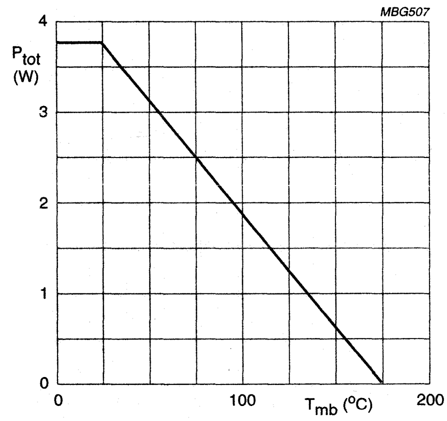
In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	–100	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω	–	–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 °C; see Fig.3	–	3.75	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C



$T_{mb} = 25$ °C.

Fig.2 DC SOAR.



$V_{CE} \leq -50$ V.

Fig.3 Power derating curve.

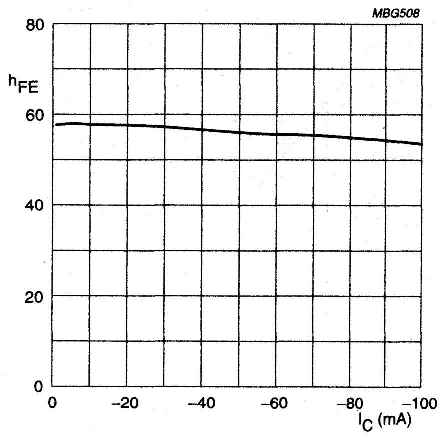
THERMAL CHARACTERISTICS

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

CHARACTERISTICS

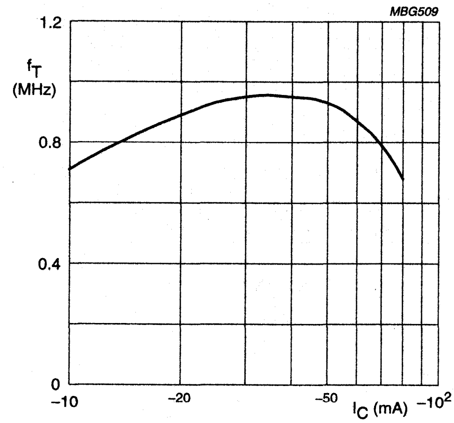
$T_j = 25$ °C unless otherwise specified.

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



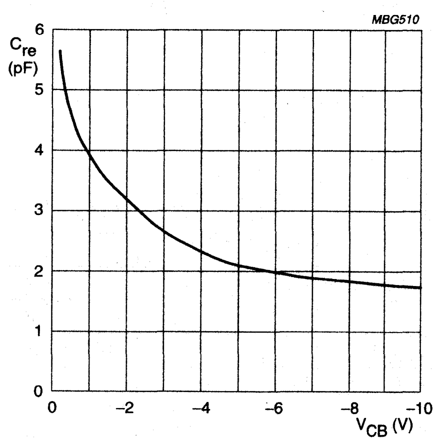
V_{CE} = −10 V; t_p = 500 μs.

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

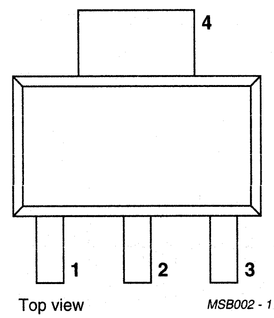


Fig.1 Simplified outline SOT223.

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 °C	–	3	W
f_T	transition frequency	I_C = –25 mA; V_{CE} = –10 V	1	–	GHz
C_{re}	feedback capacitance	I_C = 0; V_{CB} = –10 V	1.7	–	pF
T_j	junction temperature		–	175	°C

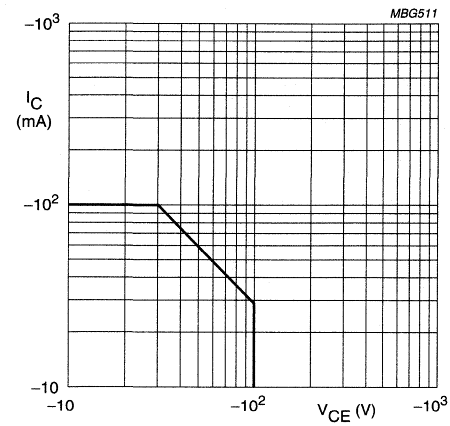
LIMITING VALUES

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 Ω	–	–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 °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	175	°C

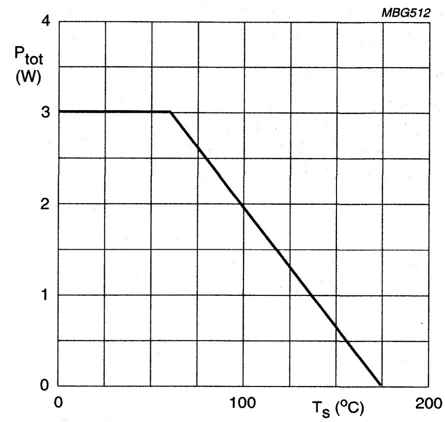
Note

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



T_s = 60 °C.

Fig.2 DC SOAR.



$V_{CE} \leq -50$ V.

Fig.3 Power derating curve.

THERMAL CHARACTERISTICS

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

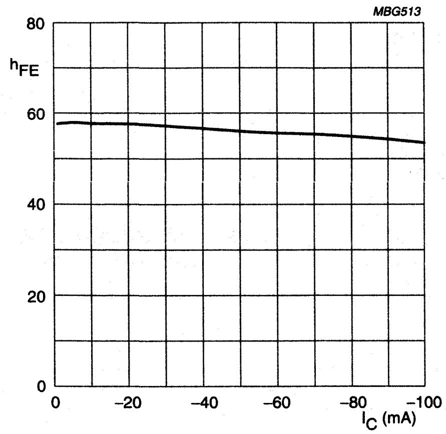
Note

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

CHARACTERISTICS

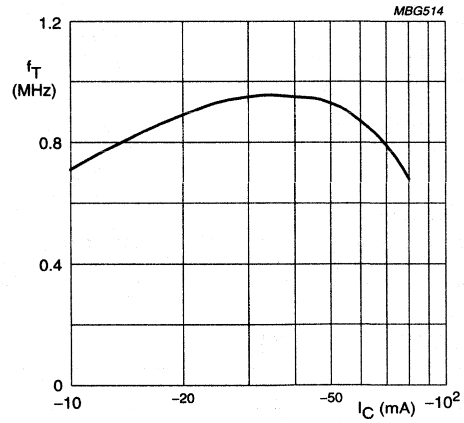
T_j = 25 °C unless otherwise specified.

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



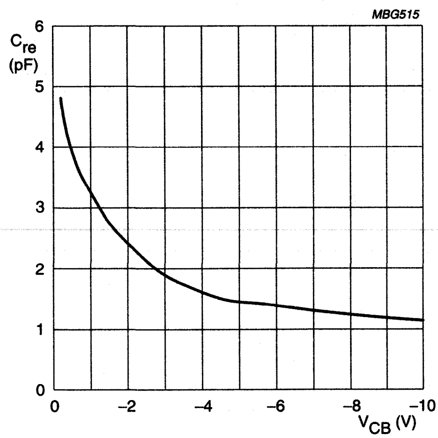
V_{CE} = −10 V; t_p = 500 µs.

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

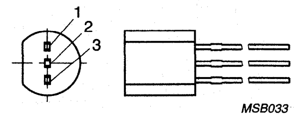


Fig.1 Simplified outline (SOT54; TO-92).

QUICK REFERENCE DATA

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

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 Ω			
	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	$T_s \leq 65$ °C; notes 1 and 2; see Fig.3	–	1	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°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 mm^2.

THERMAL CHARACTERISTICS

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

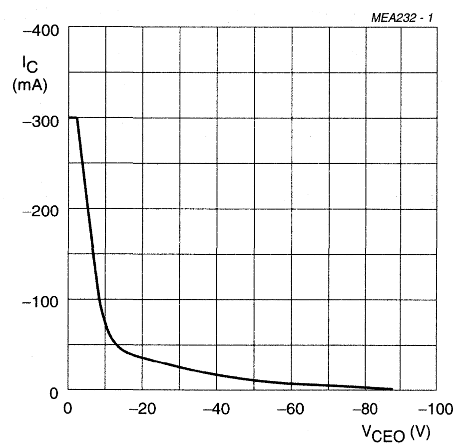
Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = −0.1 mA; I_E = 0				
	BFQ251		−100	–	–	V
	BFQ251A		−115	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = −10 mA; I_B = 0				
	BFQ251		−65	–	–	V
	BFQ251A		−95	–	–	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = −10 mA; R_{BE} = 100 Ω				
	BFQ251		−95	–	–	V
	BFQ251A		−110	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = −0.1 mA; I_C = 0	−3	–	–	V
I_{CES}	collector-emitter cut-off current	I_B = 0; V_{CE} = −50 V	–	–	−100	μA
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = −50 V	–	–	−20	μA
h_{FE}	DC current gain	I_C = −50 mA; V_{CE} = −10 V; see Fig.4	20	30	–	
C_{cb}	collector-base capacitance	$I_C = i_c$ = 0; V_{CB} = −10 V; f = 1 MHz; see Fig.5	–	2	–	pF
f_T	transition frequency	I_C = −50; V_{CE} = −10 V; see Fig.6				
	BFQ251		1	1.3	–	GHz
	BFQ251A		0.8	1.2	–	GHz



T_{amb} = 25 °C.

Fig.2 DC SOAR.

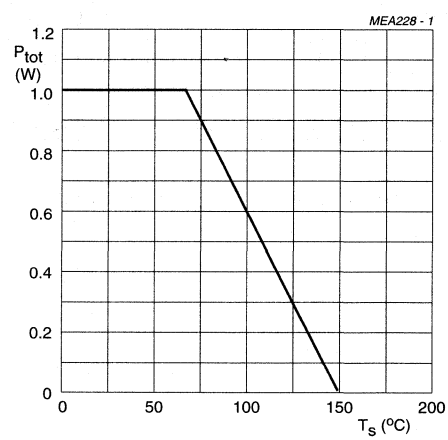
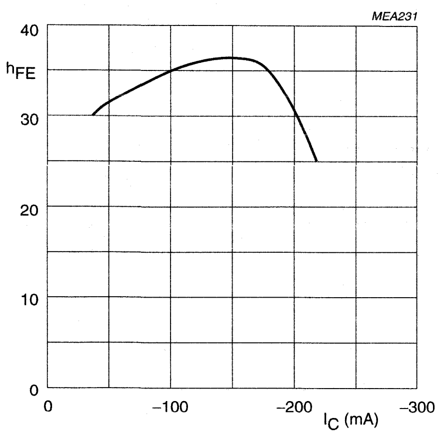
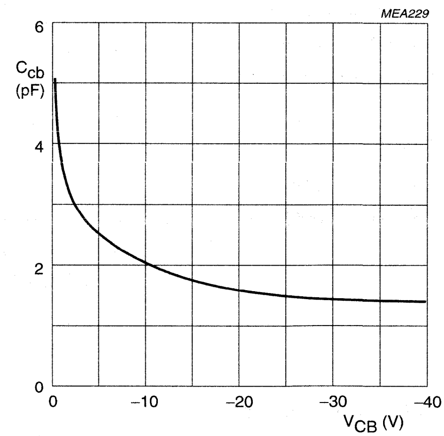


Fig.3 Power derating curve.



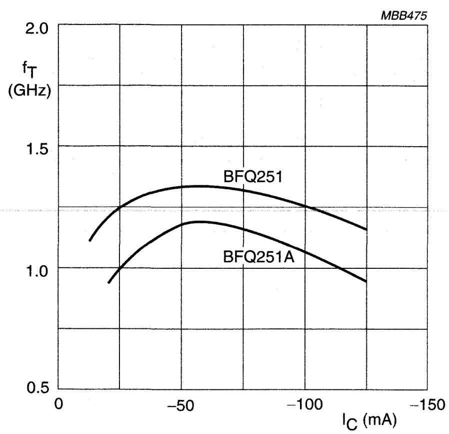
V_{CE} = −10 V; T_{amb} = 25 °C.

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

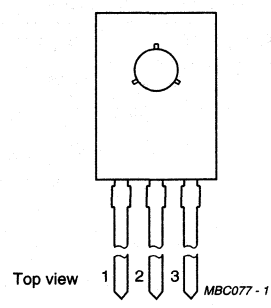


Fig.1 Simplified outline (SOT32; TO-126).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ252		–	–	–100	V
	BFQ252A		–	–	–115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ252		–	–	–95	V
	BFQ252A		–	–	–110	V
I_C	collector current (DC)		–	–	–300	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1	–	–	3	W
h_{FE}	DC current gain	I_C = –50 mA; V_{CE} = –10 V; T_{amb} = 25 °C	20	30	–	
f_T	transition frequency	I_C = –50 mA; V_{CE} = –10 V; f = 100 MHz; T_{amb} = 25 °C				
	BFQ252		1	1.3	–	GHz
	BFQ252A		0.8	1.2	–	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			
	BFQ252		–	–100	V
	BFQ252A		–	–115	V
V_{CEO}	collector-emitter voltage	open base			
	BFQ252		–	–65	V
	BFQ252A		–	–95	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω			
	BFQ252		–	–95	V
	BFQ2552A		–	–110	V
V_{EBO}	emitter-base voltage	open collector	–	–3	V
I_C	collector current (DC)		–	–300	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°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	$T_s \leq 115$ °C; note 1	20	K/W

Note

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

PNP video transistors BFQ252; BFQ252A

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = −0.1 mA; I_E = 0				
	BFQ252		−100	−	−	V
	BFQ252A		−115	−	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = −10 mA; I_B = 0				
	BFQ252		−65	−	−	V
	BFQ252A		−95	−	−	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = −10 mA; R_{BE} = 100 Ω				
	BFQ252		−95	−	−	V
	BFQ252A		−110	−	−	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = −0.1 mA; I_C = 0	−3	−	−	V
I_{CES}	collector-emitter cut-off current	I_B = 0; V_{CE} = −50 V	−	−	−100	μA
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = −50 V	−	−	−20	μA
h_{FE}	DC current gain	I_C = −50 mA; V_{CE} = −10 V; T_{amb} = 25 °C; see Fig.4	20	30	−	
C_{cb}	collector-base capacitance	$I_C = i_c$ = 0; V_{CB} = −10 V; f = 1 MHz; T_{amb} = 25 °C; see Fig.5	−	2.5	−	pF
f_T	transition frequency	I_C = −50 mA; V_{CE} = −10 V; f = 100 MHz; T_{amb} = 25 °C; see Fig.6				
	BFQ252		1	1.3	−	GHz
	BFQ252A		0.8	1.2	−	GHz

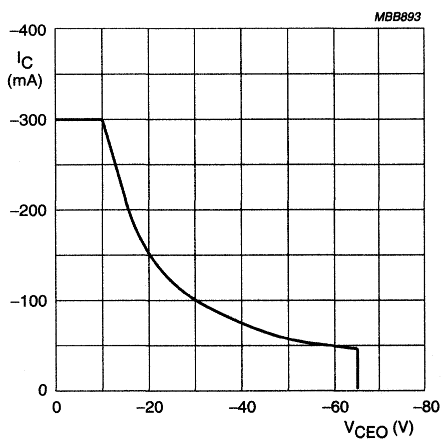


Fig.2 DC SOAR.

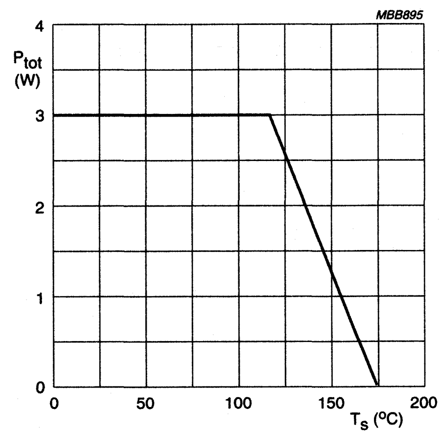
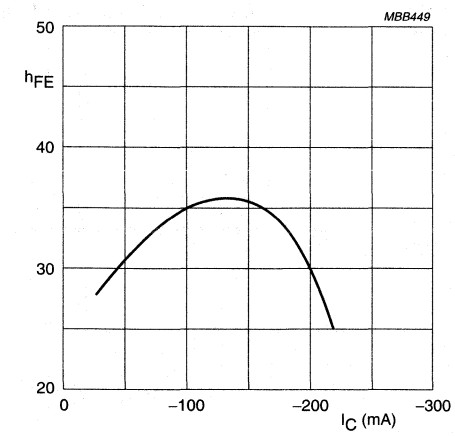
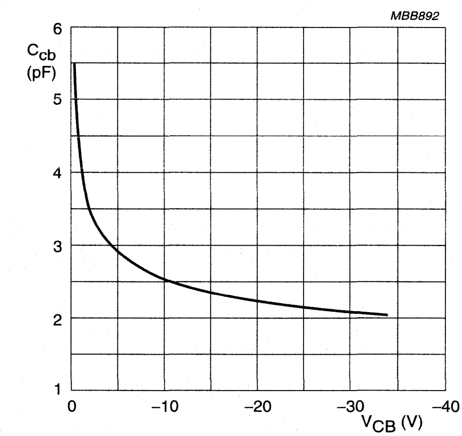


Fig.3 Power derating curve.



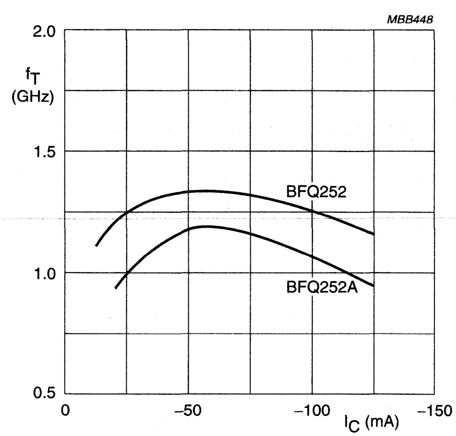
V_{CE} = −10 V; T_{amb} = 25 °C.

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

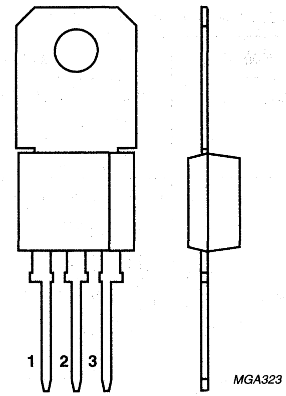


Fig.1 Simplified outline (SOT128B; TO-202).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ255		–	–	–100	V
	BFQ255A		–	–	–115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ255		–	–	–95	V
	BFQ255A		–	–	–110	V
I_C	collector current (DC)		–	–	–300	mA
P_{tot}	total power dissipation	$T_s \leq 100$ °C; note 1	–	–	3	W
h_{FE}	DC current gain	I_C = –50 mA; V_{CE} = –10 V; T_{amb} = 25 °C	20	30	–	
f_T	transition frequency	I_C = –50 mA; V_{CE} = –10 V; f = 100 MHz; T_{amb} = 25 °C				
	BFQ255		1	1.3	–	GHz
	BFQ255A		0.8	1.2	–	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			
	BFQ255		–	–100	V
	BFQ255A		–	–115	V
V_{CEO}	collector-emitter voltage	open base			
	BFQ255		–	–65	V
	BFQ255A		–	–95	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω			
	BFQ255		–	–95	V
	BFQ255A		–	–110	V
V_{EBO}	emitter-base voltage	open collector	–	–3	V
I_C	collector current (DC)		–	–300	mA
P_{tot}	total power dissipation	$T_s \leq 100$ °C; note 1; see Fig.3	–	3	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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

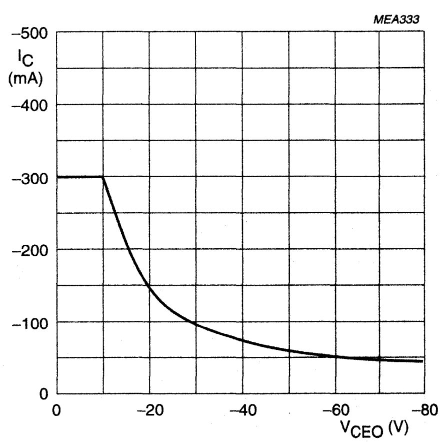


Fig.2 DC SOAR.

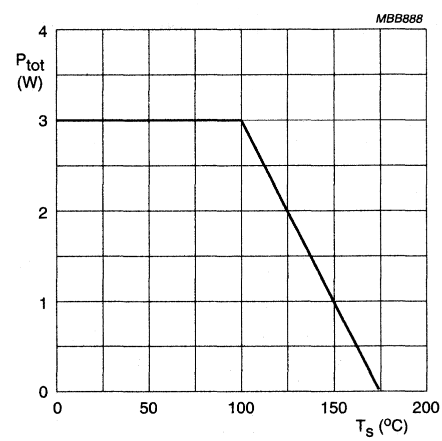
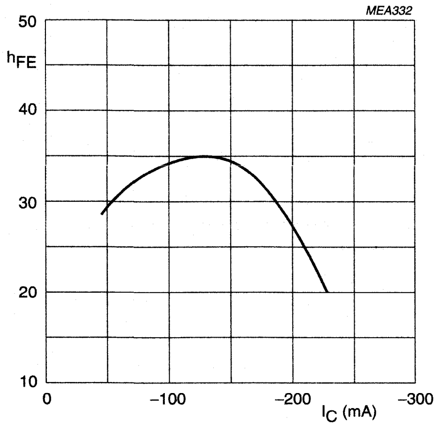
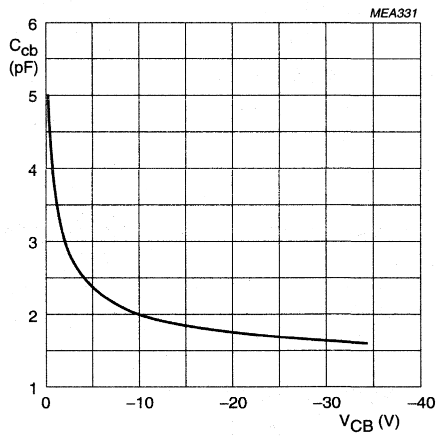


Fig.3 Power derating curve.



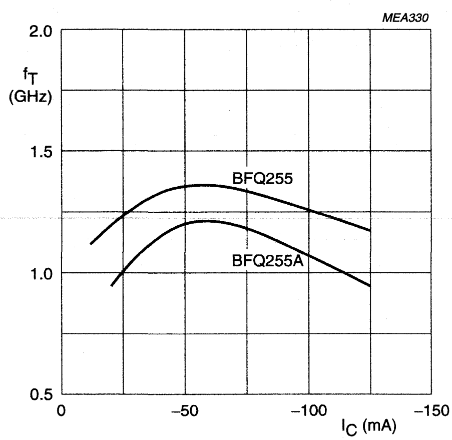
V_{CE} = −10 V; T_{amb} = 25 °C.

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

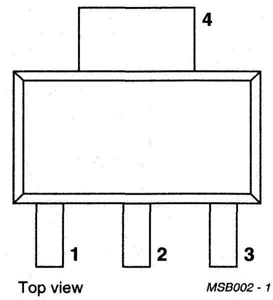


Fig.1 Simplified outline (SOT223).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter				
	BFQ256		–	–	–100	V
	BFQ256A		–	–	–115	V
V_{CER}	collector-emitter voltage	R_{BE} = 100 Ω				
	BFQ256		–	–	–95	V
	BFQ256A		–	–	–110	V
I_C	collector current (DC)		–	–	–300	mA
P_{tot}	total power dissipation	$T_s \leq 115$ °C; note 1	–	–	2	W
h_{FE}	DC current gain	I_C = –50 mA; V_{CE} = –10 V	20	30	–	
f_T	transition frequency	I_C = –50 mA; V_{CE} = –10 V; f = 100 MHz				
	BFQ256		1	1.3	–	GHz
	BFQ256A		0.8	1.2	–	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			
	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 Ω			
	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	$T_s \leq 115$ °C; note 1; see Fig.3	–	2	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

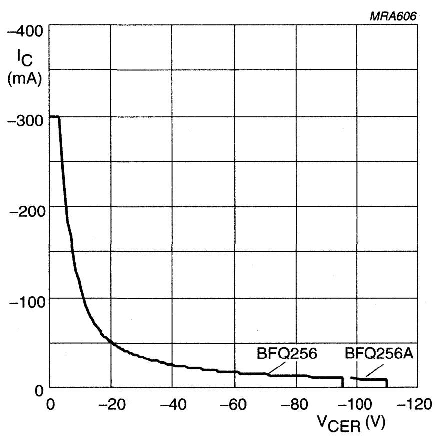
Notes

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = −100 μA; I_E = 0				
	BFQ256		−100	−	−	V
	BFQ256A		−115	−	−	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = −10 mA; I_B = 0				
	BFQ256		−65	−	−	V
	BFQ256A		−95	−	−	V
$V_{(BR)CER}$	collector-emitter breakdown voltage	I_C = −1 mA; R_{BE} = 100 Ω				
	BFQ256		−95	−	−	V
	BFQ256A		−110	−	−	V
I_{CES}	collector-emitter cut-off current	I_B = 0; V_{CE} = −50 V	−	−	−100	μA
I_{CBO}	collector-base cut-off current	I_E = 0; V_{CB} = −50 V	−	−	−20	μA
h_{FE}	DC current gain	I_C = −50 mA; V_{CE} = −10 V; see Fig.4	20	30	−	
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = −10 V; f = 1 MHz	−	1.9	−	pF
C_{cb}	collector-base capacitance	$I_C = i_c$ = 0; V_{CB} = −10 V; f = 1 MHz; see Fig.6	−	1.6	−	pF
f_T	transition frequency	I_C = −50 mA; V_{CE} = −10 V; f = 100 MHz; see Fig.5				
	BFQ256		1	1.3	−	GHz
	BFQ256A		0.8	1.2	−	GHz



R_{BE} ≤ 100 Ω.

Fig.2 DC SOAR.

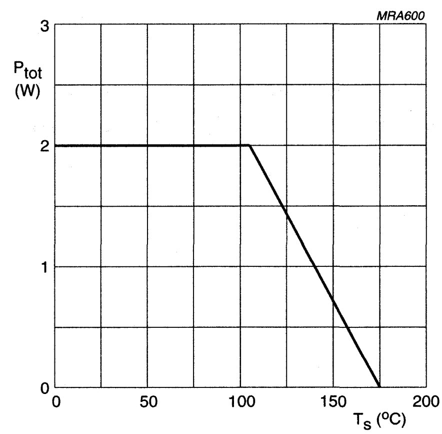
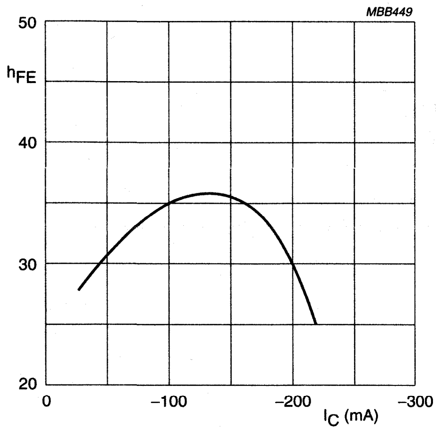
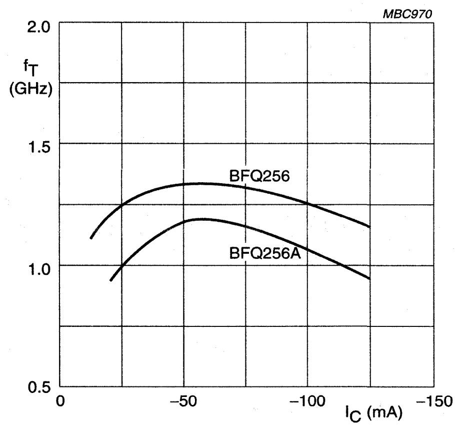


Fig.3 Power derating curve.



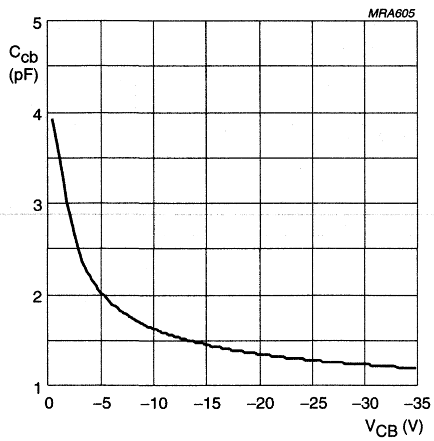
V_{CE} = −10 V.

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

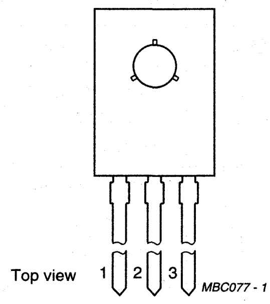


Fig.1 Simplified outline (SOT32; TO-126).

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 Ω				
	BFQ262		–	–	95	V
	BFQ262A		–	–	110	V
I_C	collector current (DC)		–	–	400	mA
P_{tot}	total power dissipation	$T_s \leq 85$ °C; note 1	–	–	5	W
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 10 V; T_{amb} = 25 °C				
	BFQ262		50	60	–	
	BFQ262A		20	35	–	
f_T	transition frequency	I_C = 100 mA; V_{CE} = 10 V; f = 100 MHz; T_{amb} = 25 °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.

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 Ω			
	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	$T_s \leq 85$ °C; note 1; see Fig.3	–	5	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	175	°C

Note

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

THERMAL CHARACTERISTICS

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

Note

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

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

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

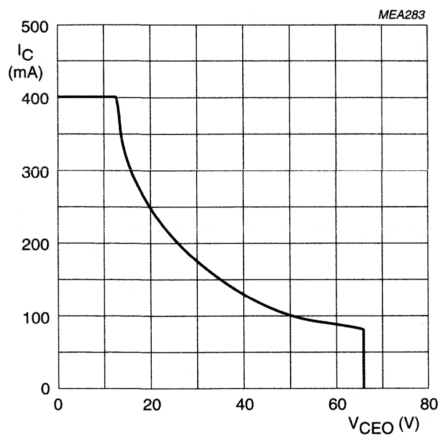


Fig.2 DC SOAR.

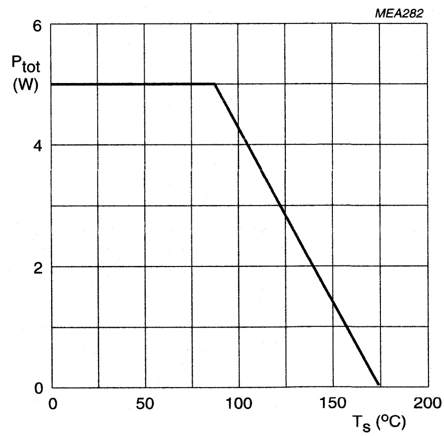
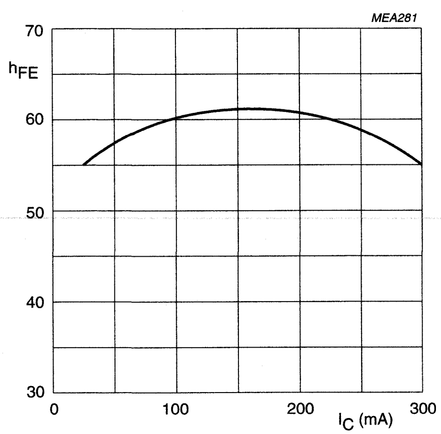
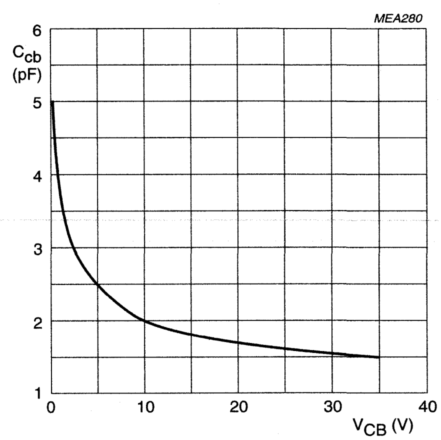


Fig.3 Power derating curve.



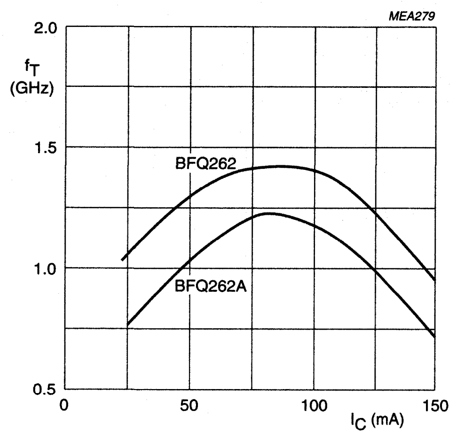
V_{CE} = 10 V; T_{amb} = 25 °C.

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 = 500 MHz; T_{amb} = 25 °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

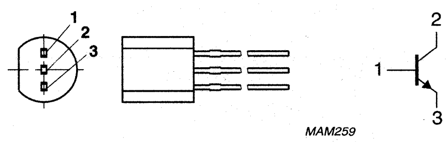


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	150	–	MHz

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	$T_{amb} \leq 25$ °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
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	150	K/W

Note

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

CHARACTERISTICS

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

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

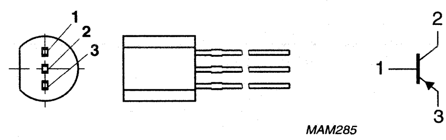


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	$T_{amb} \leq 25$ °C	–	830	mW
h_{FE}	DC current gain	$I_C = -10$ mA; $V_{CE} = -10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CE} = -25$ V; f = 1 MHz	–	2.3	pF
f_T	transition frequency	$I_C = -20$ mA; $V_{CE} = -20$ V; f = 100 MHz	150	–	MHz

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	$T_{amb} \leq 25$ °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
$R_{th\ j\text{-}a}$	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 × 10 mm.

CHARACTERISTICS

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

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

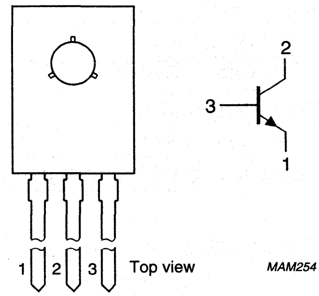


Fig.1 Simplified outline (TO-126; SOT32) and symbol.

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	$T_{amb} \leq 25$ °C	–	2	W
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 10$ V	150	–	
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	150	–	MHz

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	$T_{amb} \leq 25$ °C; note 1	–	2	W
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
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	100	K/W
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base		10	K/W

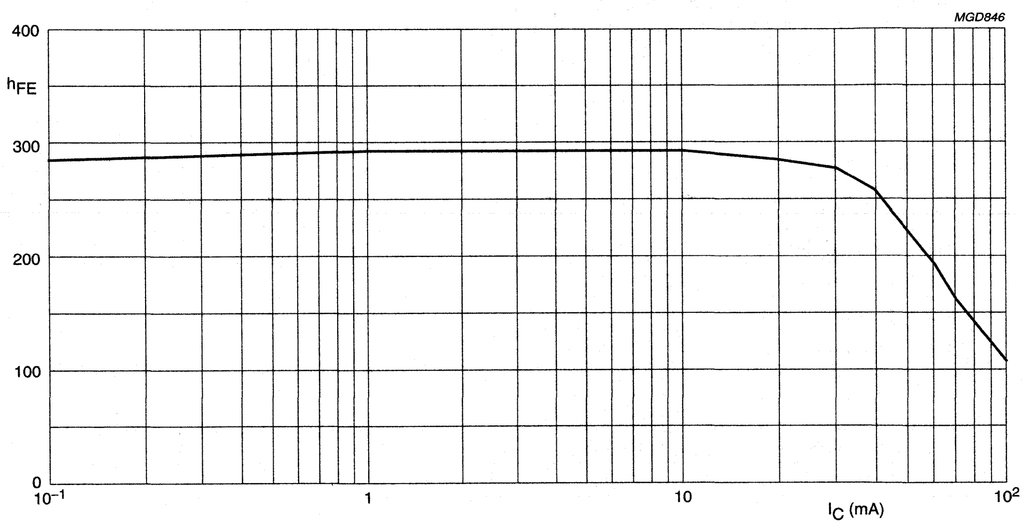
Note

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

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 100$ V	–	100	nA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 10$ V; see Fig.2			
		$I_C = 10$ mA	150	–	
		$I_C = 50$ mA	20	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 30$ mA; $I_B = 5$ mA	–	200	mV
C_{re}	feedback capacitance	$I_C = i_c = 0$; $V_{CB} = 25$ V; f = 1 MHz	–	1.5	pF
f_T	transition frequency	$I_C = 20$ mA; $V_{CE} = 20$ V; f = 100 MHz	150	–	MHz



V_{CE} = 10 V.

Fig.2 DC current gain; typical values.

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

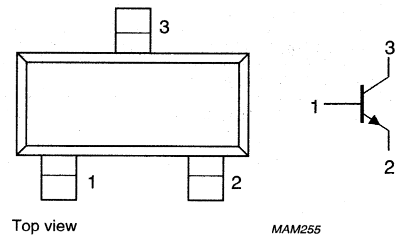


Fig.1 Simplified outline (SOT23) and symbol.

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	$T_{amb} \leq 25$ °C	–	–	250	mW
h_{FE}	DC current gain	$I_C = 10$ mA; $V_{CE} = 1$ V	40	–	120	
		$I_C = 50$ mA; $V_{CE} = 1$ V	25	–	–	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	400	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ 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	$T_{amb} \leq 25$ °C	–	250	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
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	500	K/W

Note

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

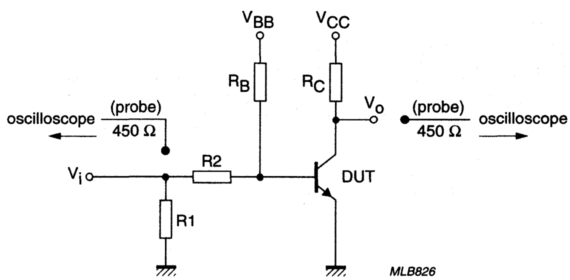
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CBO}	collector cut-off current	$I_E = 0$; $V_{CB} = 20$ V	–	–	400	nA
		$I_E = 0$; $V_{CB} = 20$ V; $T_j = 125$ °C	–	–	30	μA
I_{EBO}	emitter cut-off current	$I_C = 0$; $V_{EB} = 4$ V	–	–	100	nA
h_{FE}	DC current gain	$V_{CE} = 1$ V				
		$I_C = 1$ mA	25	–	–	
		$I_C = 10$ mA	40	–	120	
		$I_C = 50$ mA	25	–	–	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 10$ mA; $I_B = 300$ μA	–	–	300	mV
		$I_C = 10$ mA; $I_B = 1$ mA	–	–	250	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	–	400	mV
V_{BEsat}	base-emitter saturation voltage	$I_C = 10$ mA; $I_B = 1$ mA	700	–	850	mV
		$I_C = 50$ mA; $I_B = 5$ mA	–	–	1.2	V
C_c	collector capacitance	$I_E = i_e = 0$; $V_{CB} = 5$ V; f = 1 MHz	–	–	4	pF
C_e	emitter capacitance	$I_C = i_c = 0$; $V_{EB} = 1$ V; f = 1 MHz	–	–	4.5	pF
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 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 mA; I_{Bon} = 3 mA; I_{Boff} = −1.5 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 V to 4.2 V; T = 500 µs; t_p = 10 µs; $t_r = t_s \le$ 3 ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

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 $V_{(p-p}$ 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)

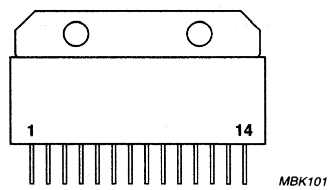


Fig.1 Simplified outline (SOT454A).

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.

CHARACTERISTICS

$V_{S1} = V_{S2} = 8$ V; $V_{S3} = 80$ V; $T_{mb} = 25$ °C; $C_L = 10$ pF; output swing = 50 $V_{(p-p)}$ with 45 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 to 75 V	–	2	5	%
A_V	DC voltage gain		14	15	16	

Notes

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

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.

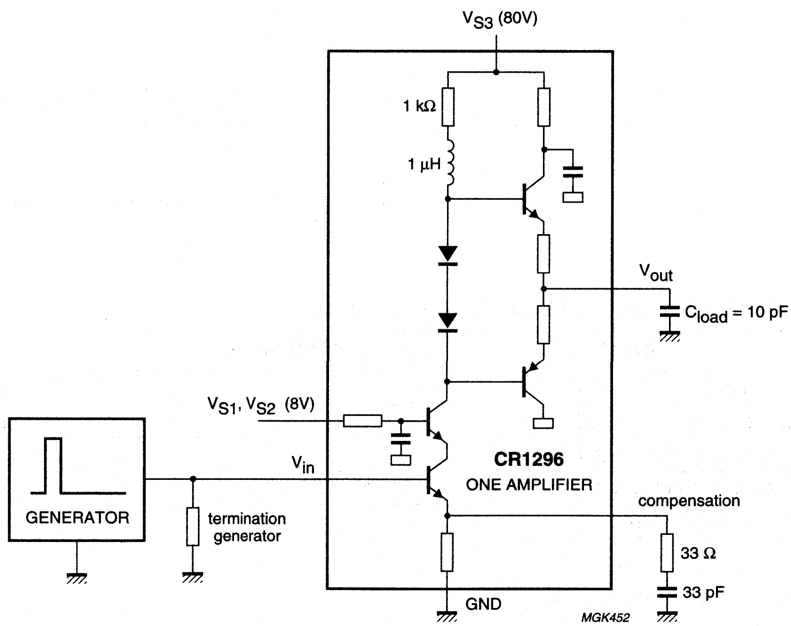
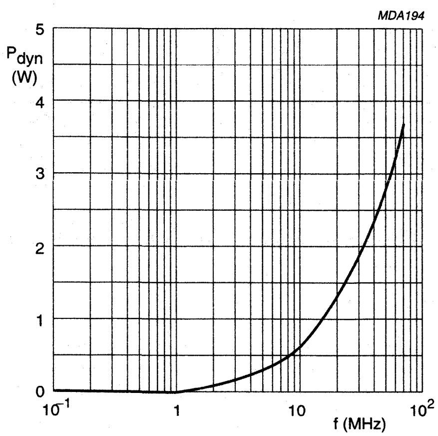
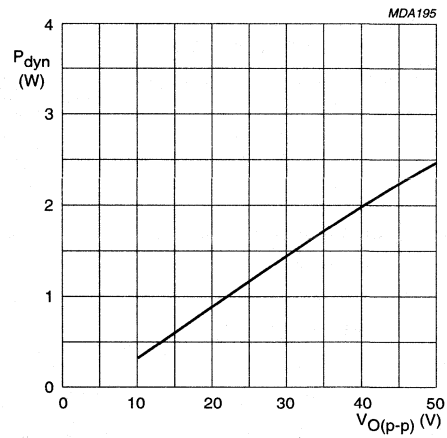


Fig.2 Test circuit.



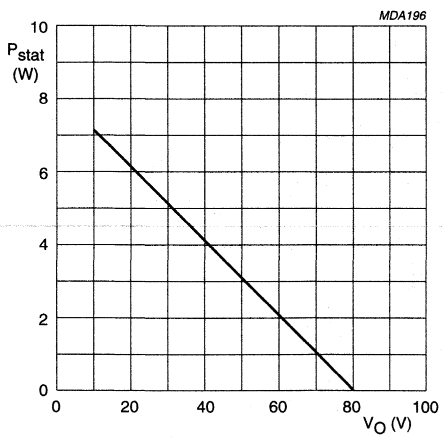
V_S = 80 V; $V_{O\,(p-p)}$ = 40 V; $V_{O\,(mean)}$ = 40 V.

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.

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/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 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

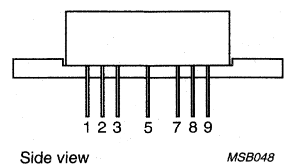


Fig.1 SOT115L.

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

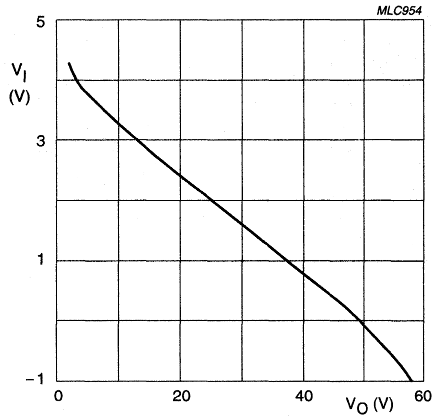
CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_S = 60 V; output swing = 40 V (p-p) with 30 V (DC) offset; unless otherwise specified						
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
V_S = 65 V; output swing = 50 V (p-p) with 32.5 V (DC) offset; unless otherwise specified						
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
V_S = 60 or 65 V; output swing = 40 or 50 V (p-p) with 30 or 32.5 V (DC) offset; unless otherwise specified						
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 to 55 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 4	11.2	12.4	13.2	
V_G	insertion gain	50 Ω source; note 5	160	180	200	

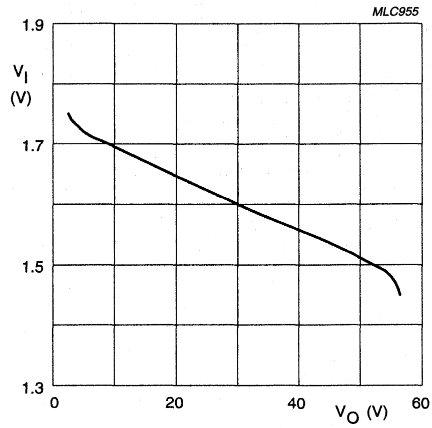
Notes

1. Input signal is a 100 kHz square wave of 3.25 V (p-p), with 1.5 V (DC) offset (50 Ω source).
2. Input signal is a 100 kHz square wave of 3.4 V (p-p), with 1.65 V (DC) offset (50 Ω 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).



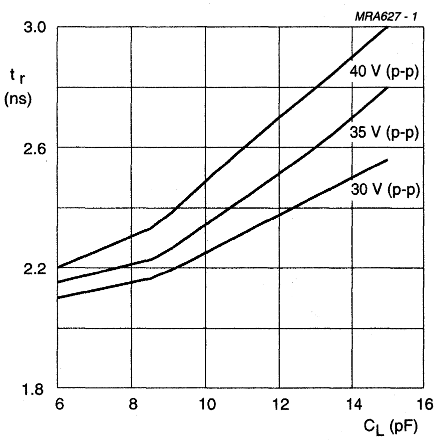
V_S = 60 V; T_{mb} = 25 °C; C_L = 8.5 pF; output swing = 40 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

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



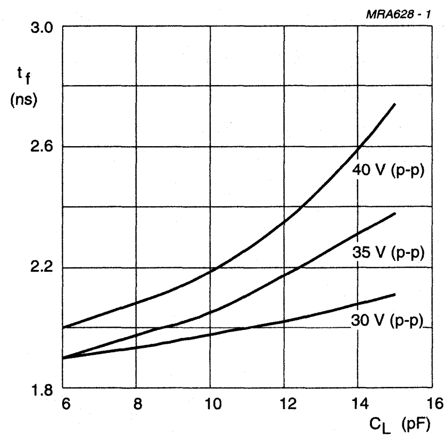
V_S = 60 V; T_{mb} = 25 °C; C_L = 8.5 pF; output swing = 40 V (p-p) with 30 V (DC) offset; measured in test circuit (see Fig.10).

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



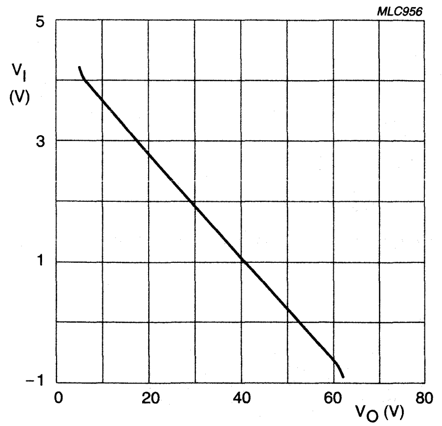
V_S = 60 V; T_{mb} = 25 °C; C_L = 8.5 pF;
output swing = 40, 35, 30 V (p-p) with 30 V (DC) offset;
measured in test circuit (see Fig.10).

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



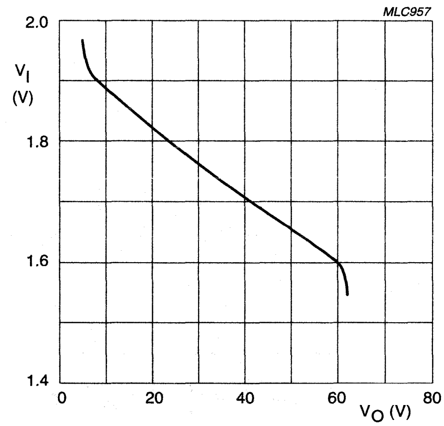
V_S = 60 V; T_{mb} = 25 °C; C_L = 8.5 pF;
output swing = 40, 35, 30 V (p-p) with 30 V (DC) offset;
measured in test circuit (see Fig.10).

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



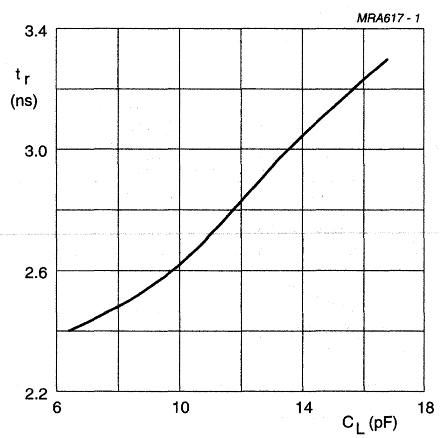
V_S = 65 V; T_{mb} = 25 °C; C_L = 8.5 pF; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

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



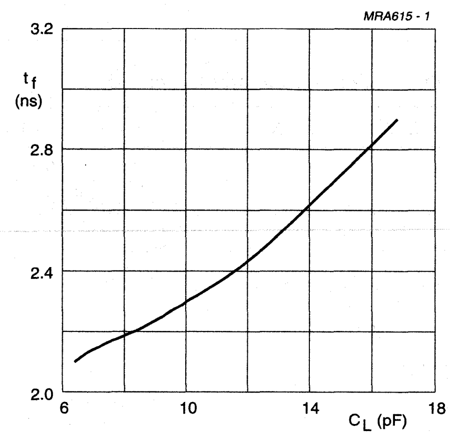
V_S = 65 V; T_{mb} = 25 °C; C_L = 8.5 pF; output swing = 50 V (p-p) with 32.5 V (DC) offset; measured in test circuit (see Fig.10).

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



V_S = 65 V; T_{mb} = 25 °C; C_L = 8.5 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 V; T_{mb} = 25 °C; C_L = 8.5 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.

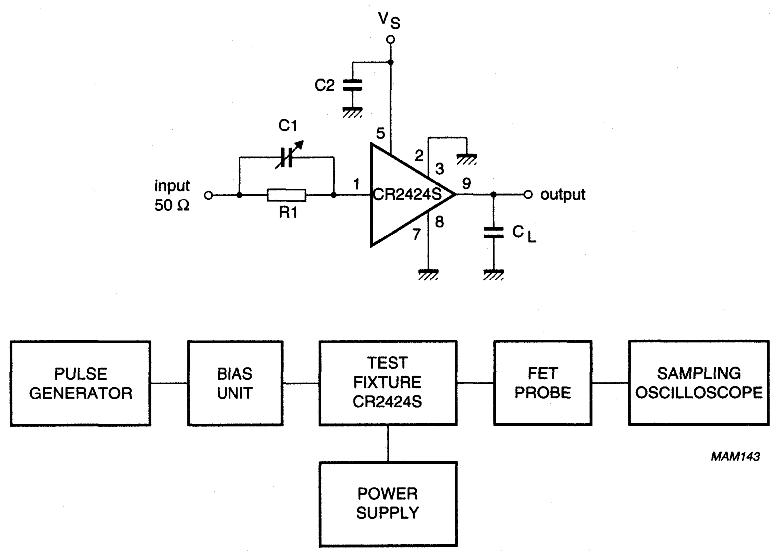


Fig.10 CRT amplifier test circuit and block diagram.

Components used in test circuit (see Fig.10)

DESIGNATION	DESCRIPTION	VALUE
C_1	variable capacitor	10 to 120 pF (typ. 50 pF)
C_2	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

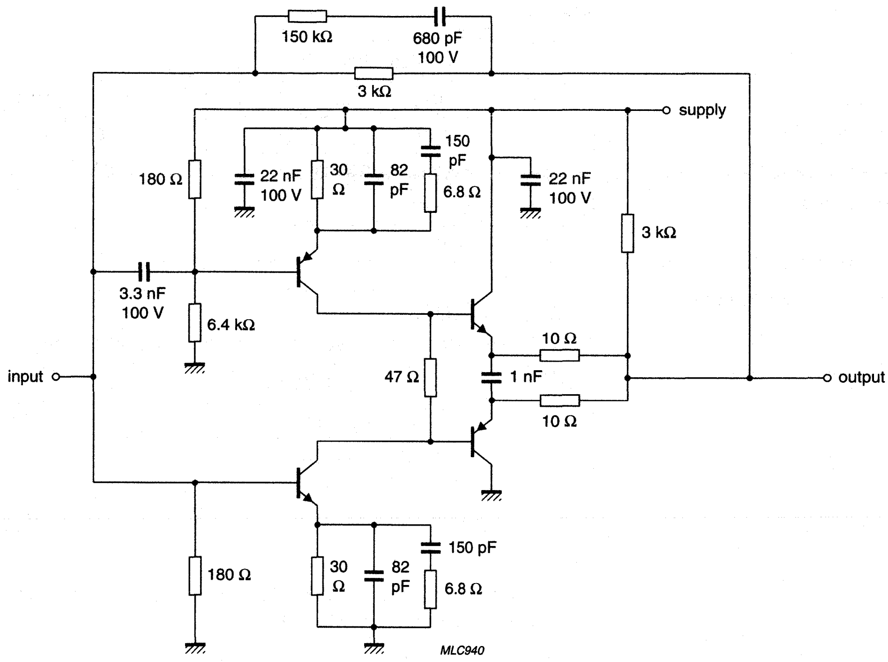


Fig.11 Internal circuit.

Video driver hybrid amplifier | CR2427S

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/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 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

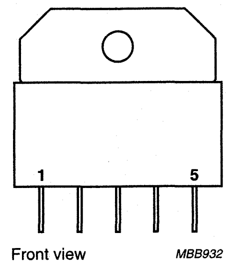


Fig.1 SOT348.

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.

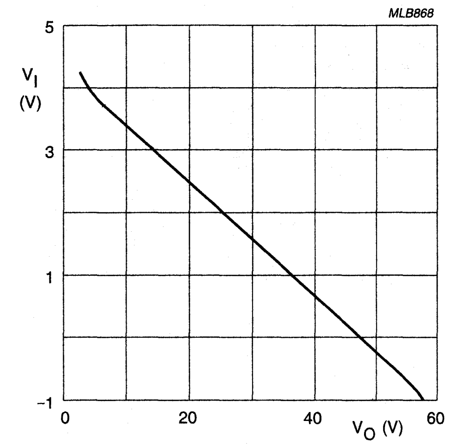
CHARACTERISTICS

T_{mb} = 25 °C; C_L = 8.5 pF; R1 = 215 Ω; C1 = 50 pF (see Fig.10); unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_S = 60 V; 40 V (p-p) output swing with 30 V (DC) offset; unless otherwise specified						
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
V_S = 65 V; 50 V (p-p) output swing with 32.5 V (DC) offset; unless otherwise specified						
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
V_S = 60 V or 65 V; 40 V (p-p) or 50 V (p-p) output swing with 30 V (DC) or 32.5 V (DC) offset; unless otherwise specified						
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 C1; see Fig.10	–	3	10	%
NLN	non-linearity	V_O = 5 to 55 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 4	11.2	12.4	13.2	
V_G	insertion gain	50 Ω source; note 5	160	180	200	

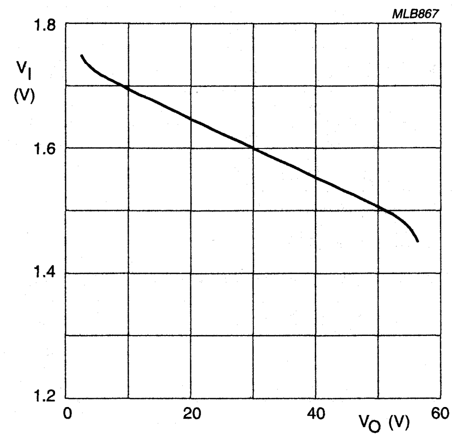
Notes

1. Input signal is a nominal 100 kHz square wave of 3.25 V (p-p), with 1.5 V (DC) offset (50 Ω source).
2. Input signal is a nominal 100 kHz square wave of 3.4 V (p-p), with 1.65 V (DC) offset (50 Ω 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).



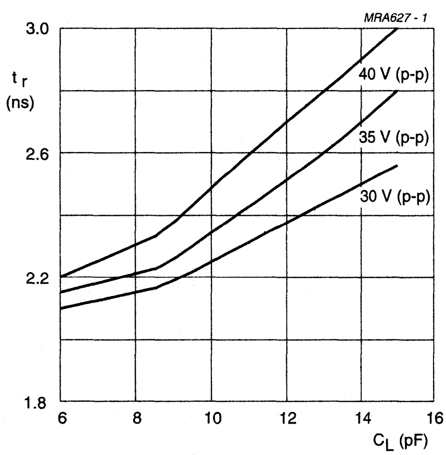
$\mathbf{V_S = 60\ V}$; $T_{mb} = 25\ °C$; $C_L = 8.5\ pF$; R1 = 215 Ω; C1 = 50 pF;
40 V (p-p) output swing with 30 V (DC) offset (see Fig.10).

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



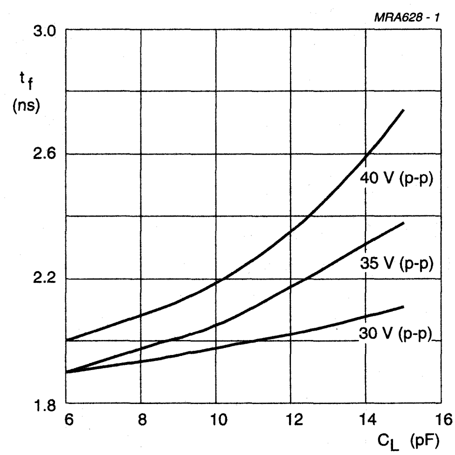
$\mathbf{V_S = 60\ V}$; $T_{mb} = 25\ °C$; $C_L = 8.5\ pF$; R1 = 215 Ω; C1 = 50 pF;
40 V (p-p) output swing with 30 V (DC) offset (see Fig.10).

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



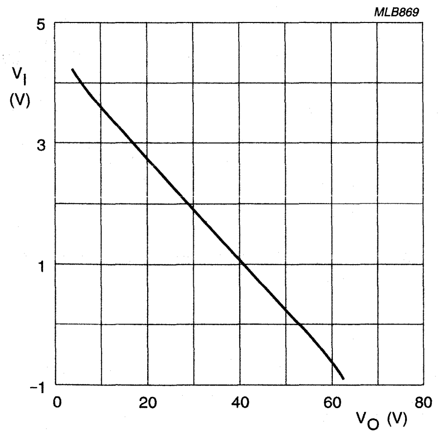
$\mathbf{V_S = 60\ V}$; $T_{mb} = 25\ °C$; $C_L = 8.5\ pF$; R1 = 215 Ω; C1 = 50 pF;
40, 35, 30 V (p-p) output swing with 30 V (DC) offset.

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



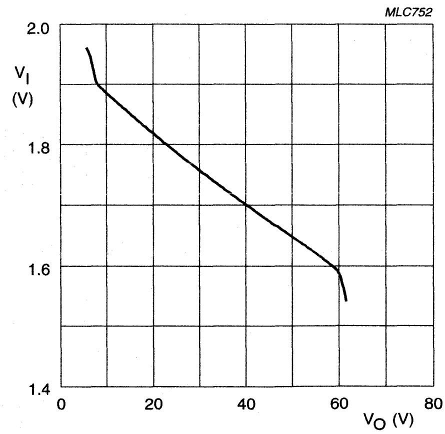
$\mathbf{V_S = 60\ V}$; $T_{mb} = 25\ °C$; $C_L = 8.5\ pF$; R1 = 215 Ω; C1 = 50 pF;
40, 35, 30 V (p-p) output swing with 30 V (DC) offset.

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



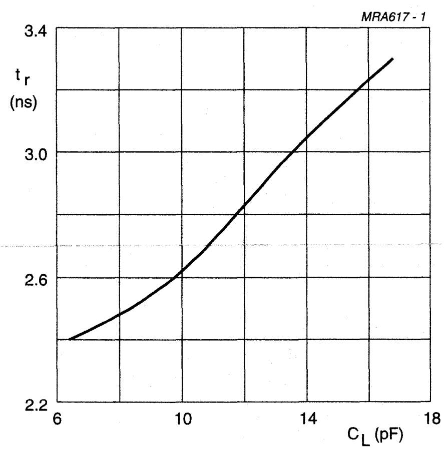
V_S = 65 V; T_{mb} = 25 °C; C_L = 8.5 pF; R1 = 215 Ω; C1 = 50 pF;
50 V (p-p) output swing with 32.5 V (DC) offset (see Fig.10).

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



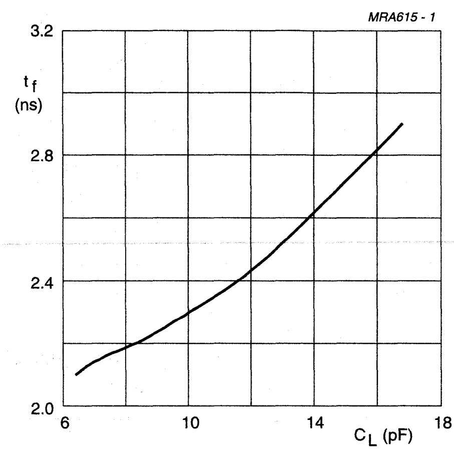
V_S = 65 V; T_{mb} = 25 °C; C_L = 8.5 pF; R1 = 215 Ω; C1 = 50 pF;
50 V (p-p) output swing with 32.5 V (DC) offset (see Fig.10).

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; R1 = 215 Ω; C1 = 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; R1 = 215 Ω; C1 = 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.

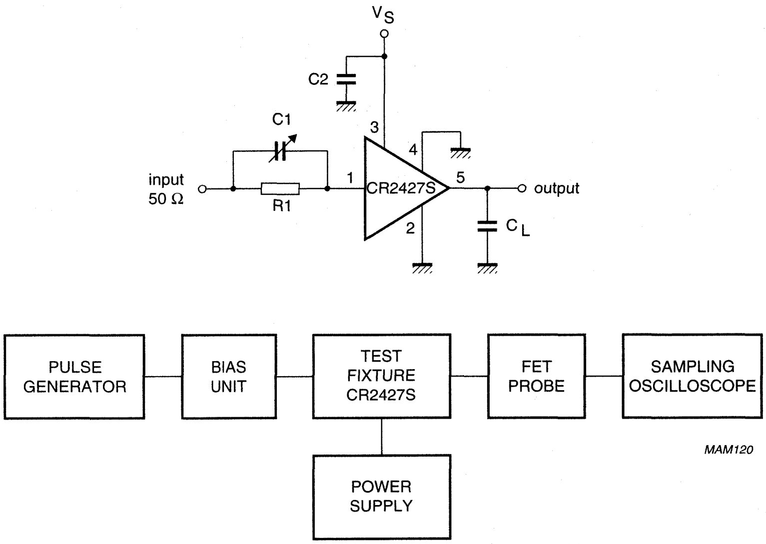


Fig.10 CRT amplifier test-circuit and block diagram.

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

DESIGNATION	DESCRIPTION	VALUE
C_1	variable capacitor	10 to 120 pF (typ. 50 pF)
C_2	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

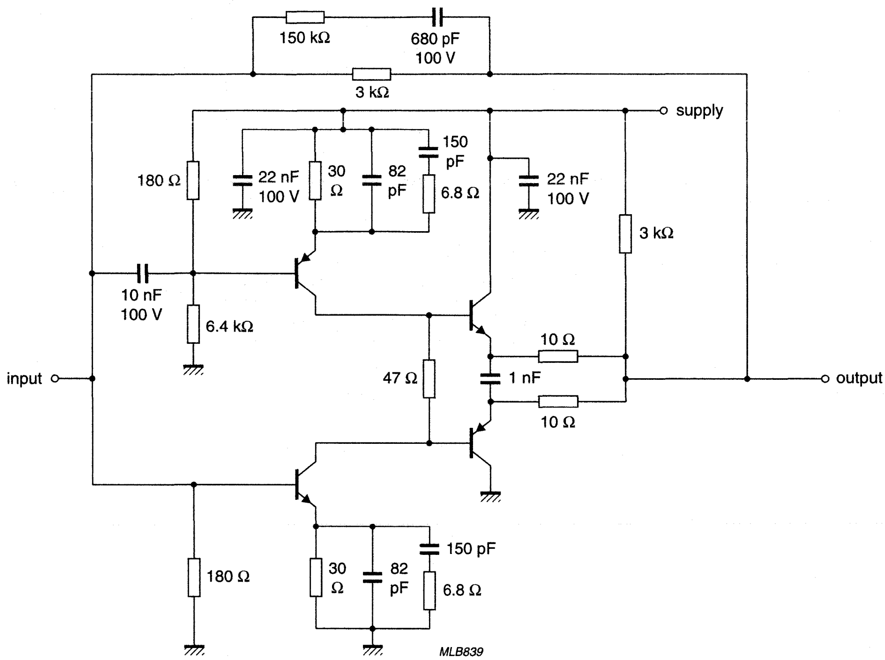


Fig.11 Internal circuit.

Video driver hybrid amplifier CR3424

FEATURES

- Typical transition times (10 to 90%) with C_L = 10 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/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 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

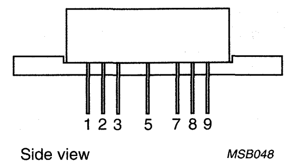


Fig.1 SOT115L.

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.

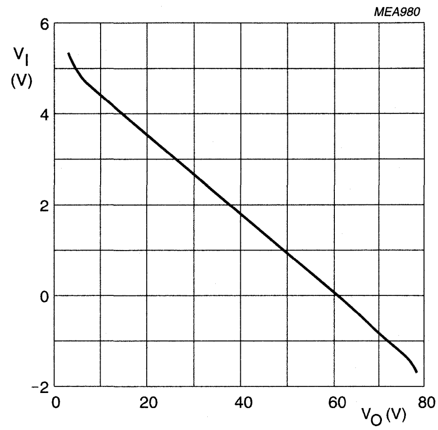
CHARACTERISTICS

V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 287 Ω; C1 = 60 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 C1; see Fig.6	–	3	10	%
NLN	non-linearity	V_O = 5 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11.2	12.4	13.2	
V_G	insertion gain	50 Ω source; note 4	160	180	200	

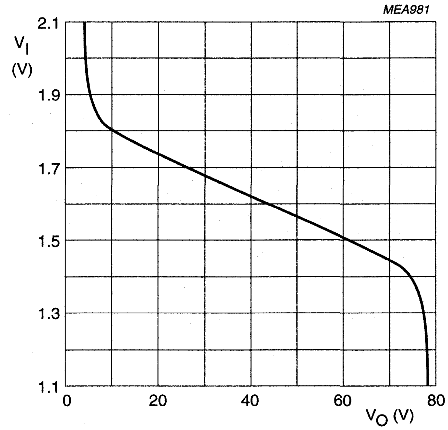
Notes

1. Input signal is a 100 kHz square wave of 3.25 V (p-p), with 1.5 V DC offset (50 Ω 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).



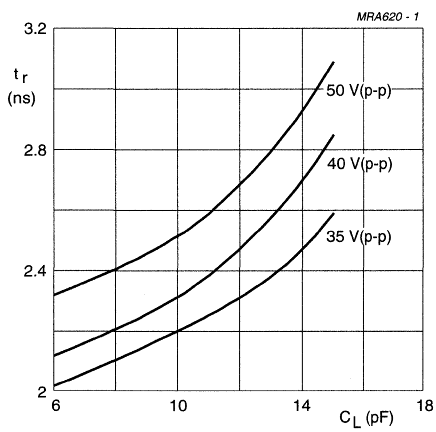
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 287 Ω; C1 = 60 pF;
40 V (p-p) output swing with 40 V DC offset.

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



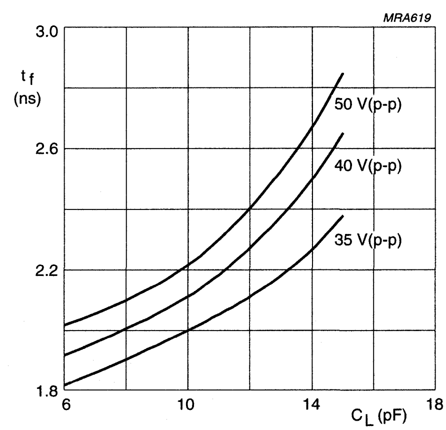
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 287 Ω; C1 = 60 pF;
40 V (p-p) output swing with 40 V DC offset.

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



V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 287 Ω; C1 = 60 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 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 287 Ω; C1 = 60 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.

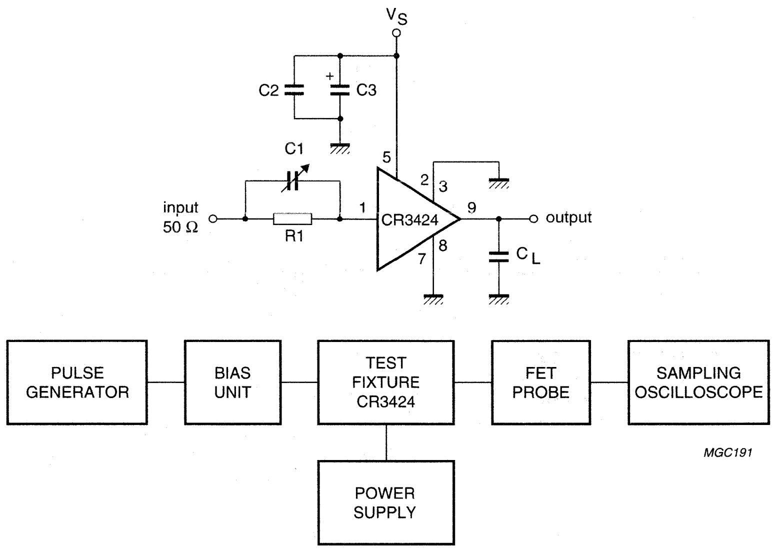


Fig.6 CRT amplifier test-circuit and block diagram.

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

DESIGNATION	DESCRIPTION	VALUE
C_1	variable capacitor	10 to 120 pF (typ. 60 pF)
C_2	chip capacitor	10 nF
C_3	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

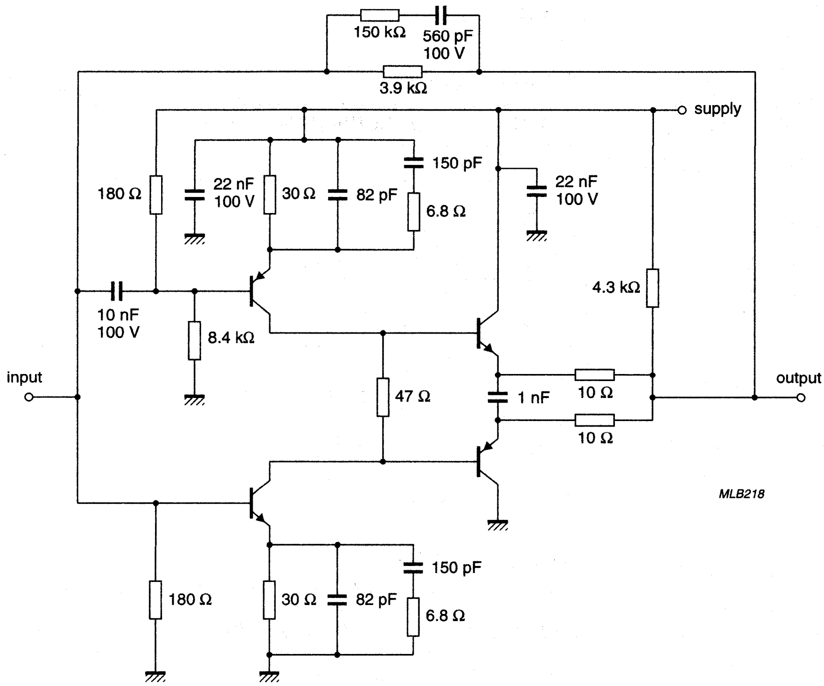


Fig.7 Internal circuit.

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/µs
- 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

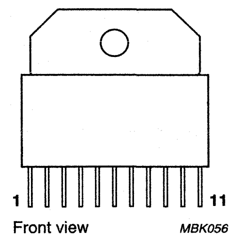


Fig.1 Simplified outline.

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
Per amplifier				
V_S	supply voltage (DC)	–	80	V
T_{mb}	operating mounting base temperature	–20	+100	°C
T_{stg}	storage temperature	–40	+125	°C

CHARACTERISTICS

V_S = 75 V; T_C = 25 °C; C_L = 10 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 to 60 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11	12.5	14	
V_G	insertion gain	50 Ω 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 Ω 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

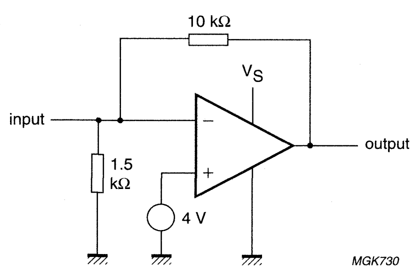
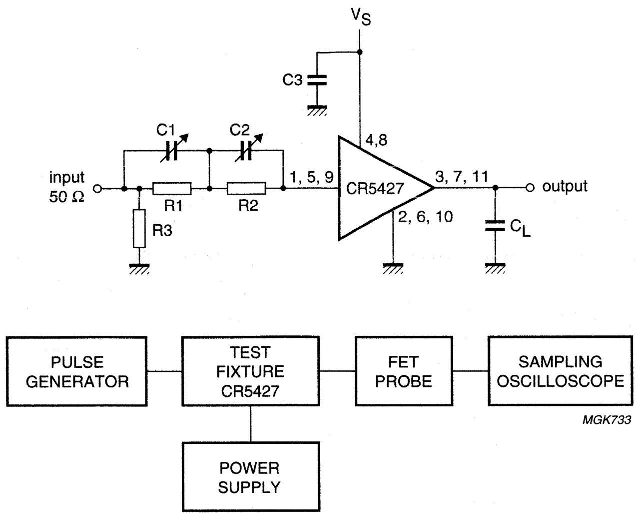


Fig.2 Block diagram; single amplifier.



Speed-up circuit (R1, C1; R2, C2) ensures flat gain over the whole frequency range.

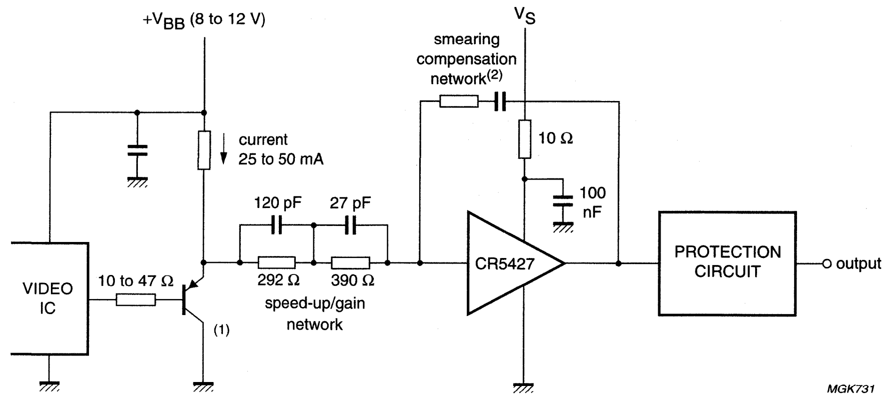
Fig.3 Application test circuit and block diagram.

Components used in test circuit (see Fig.3)

COMPONENT	DESCRIPTION	VALUE
C1	variable capacitor	10 to 160 pF (typ. 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

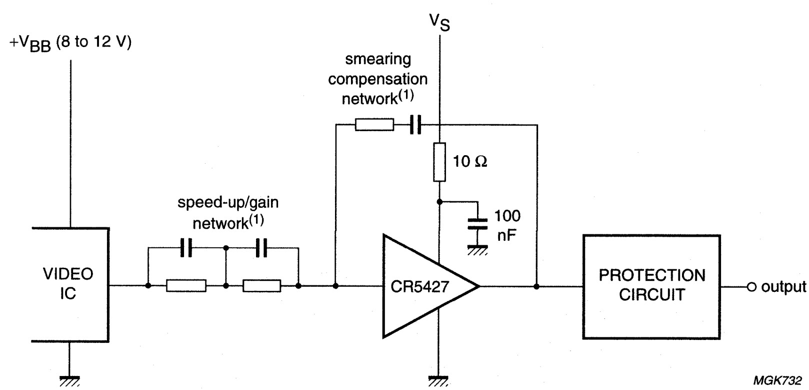


t_r, t_f < 4 ns (determined by current drive capability of the video IC).

(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 pF:
  - at 50 V (p-p) swing t_r = 3 ns; t_f = 2.2 ns
- Low power consumption
- Minimum small signal bandwidth 100 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_{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

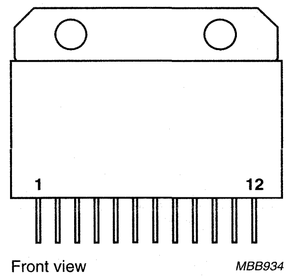


Fig.1 SOT347.

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.

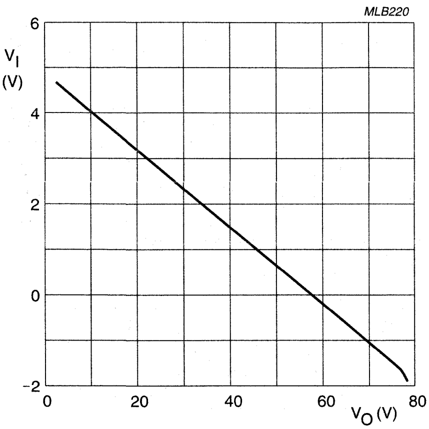
CHARACTERISTICS

V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 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
Per amplifier						
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 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11	12	13	
V_G	insertion gain	50 Ω source; note 4	350	370	390	

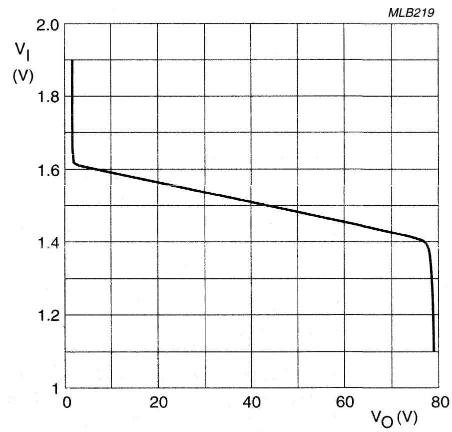
Notes

1. Input signal is a 100 kHz square wave of 4.15 V (p-p), with 1.5 V DC offset (50 Ω 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).



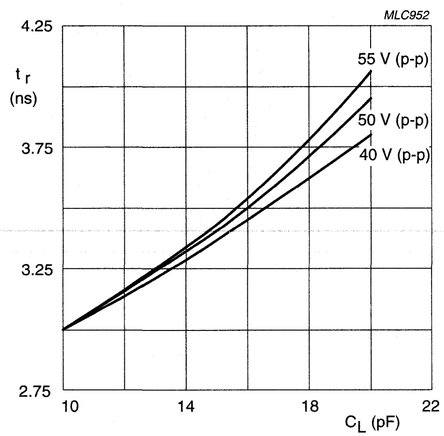
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 pF; 50 V (p-p) output swing with 40 V DC offset.

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



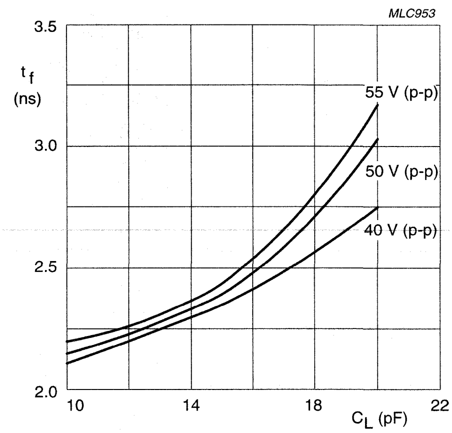
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 pF; 50 V (p-p) output swing with 40 V DC offset.

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



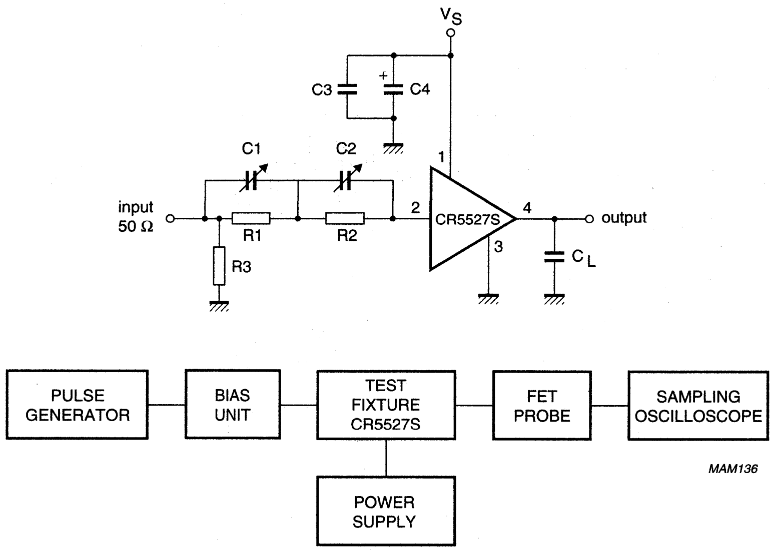
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 pF; 55, 50, 40 V (p-p) output swing with 40 V DC offset.

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



V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 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.



Test-circuit for one of the three CRT amplifiers.

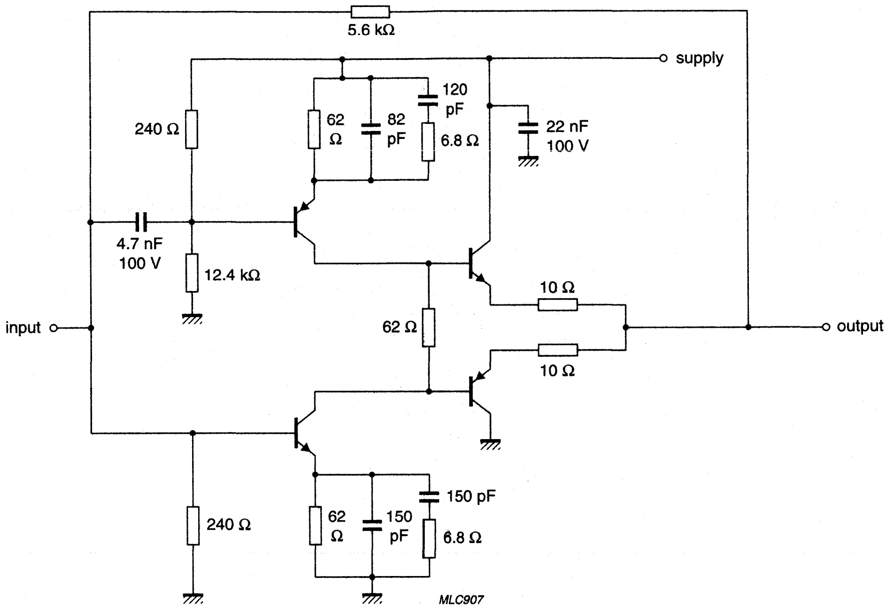
Fig.6 CRT amplifier test-circuit and block diagram.

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

DESIGNATION	DESCRIPTION	VALUE
C_1	variable capacitor	10 to 160 pF (typ. 90 pF)
C_2	variable capacitor	10 to 160 pF (typ. 100 pF)
C_3	chip capacitor	10 nF
C_4	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



Supply voltage V_{S1}, V_{S2} and V_{S3} are internally connected.

Fig.7 Internal circuit.

FEATURES

- Transition times (10 to 90%): 3.5 ns rise and 2.7 ns fall with 50 V (p-p) swing and C_L 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_{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

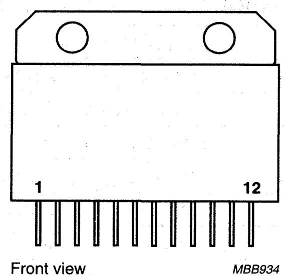


Fig.1 SOT347.

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	–20	+100	°C
T_{stg}	storage temperature	–40	+125	°C

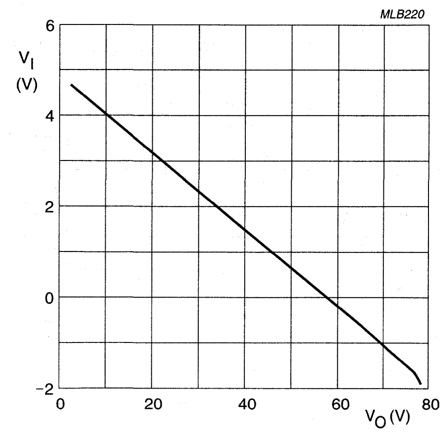
CHARACTERISTICS

V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; output swing = 50 V (p-p) with 40 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 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11	12	13	
V_G	insertion gain	50 Ω source; note 4	350	370	390	

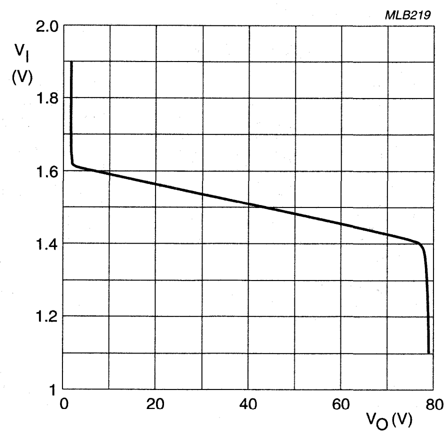
Notes

1. Input signal is a 100 kHz square wave of 4.15 V (p-p) with 1.5 V DC offset (50 Ω 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).



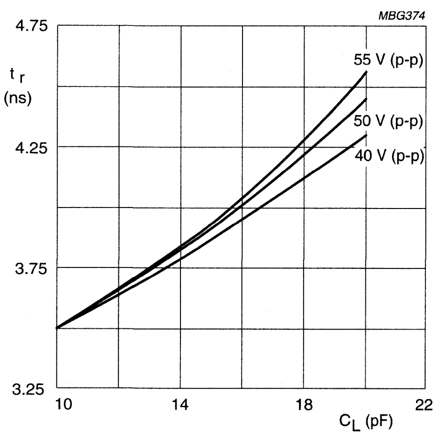
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; output swing = 50 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

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



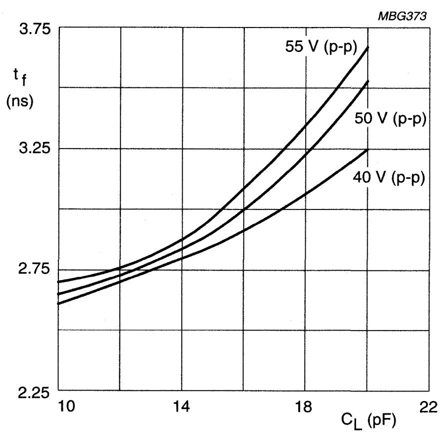
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; output swing = 50 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

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



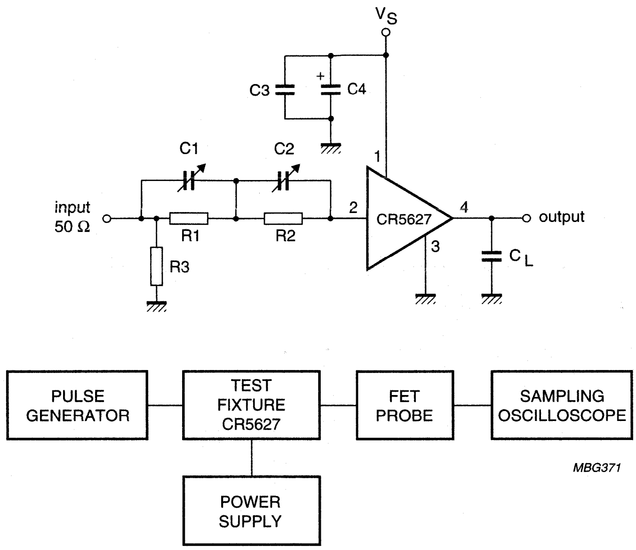
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; output swing = 55, 50, 40 V (p-p) with 40 V DC offset; measured in test circuit (see Fig.6).

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



V_S = 80 V; T_{mb} = 25 °C; C_L = 10 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.



Test-circuit for one of the three CRT amplifiers.

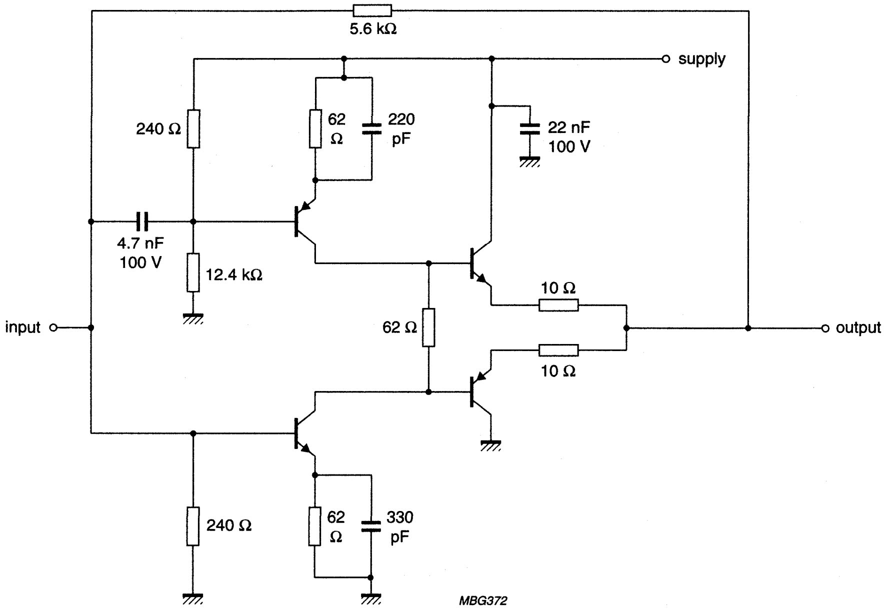
Fig.6 CRT amplifier test-circuit and block diagram.

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



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 pF:
  - at 50 V (p-p) swing t_r = 2.7 ns; t_f = 2.2 ns
- Low power consumption
- Minimum small signal bandwidth 110 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_{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

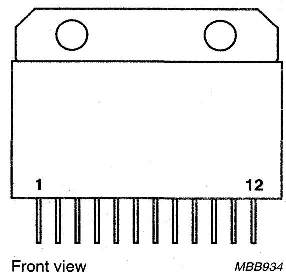


Fig.1 SOT347.

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.

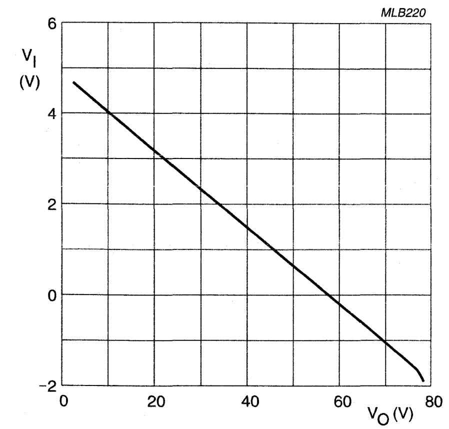
CHARACTERISTICS

V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF; R2 = 82 Ω; C2 = 100 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
Per amplifier						
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 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11	12	13	
V_G	insertion gain	50 Ω source; note 4	350	370	390	

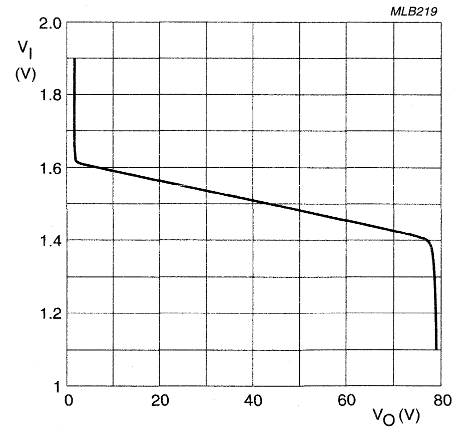
Notes

1. Input signal is a 100 kHz square wave of 4.15 V (p-p), with 1.5 V DC offset (50 Ω 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).



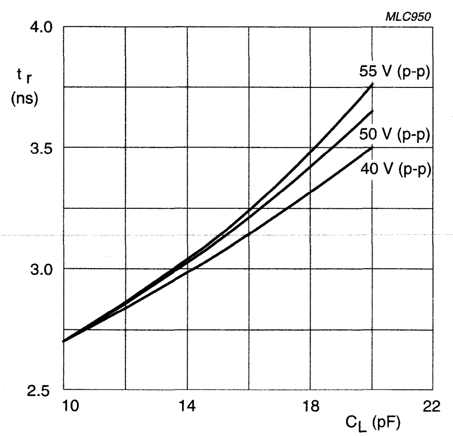
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF;
R2 = 82 Ω; C2 = 100 pF; 50 V (p-p) output swing with 40 V DC offset.

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



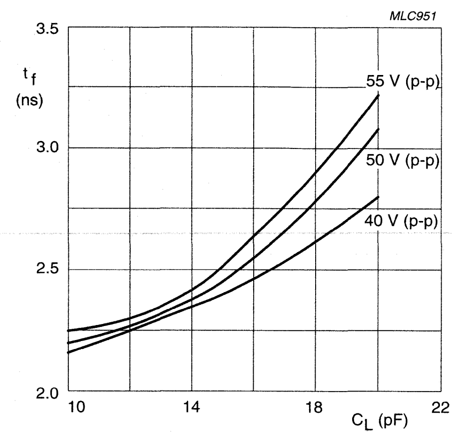
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF;
R2 = 82 Ω; C2 = 100 pF; 50 V (p-p) output swing with 40 V DC offset.

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



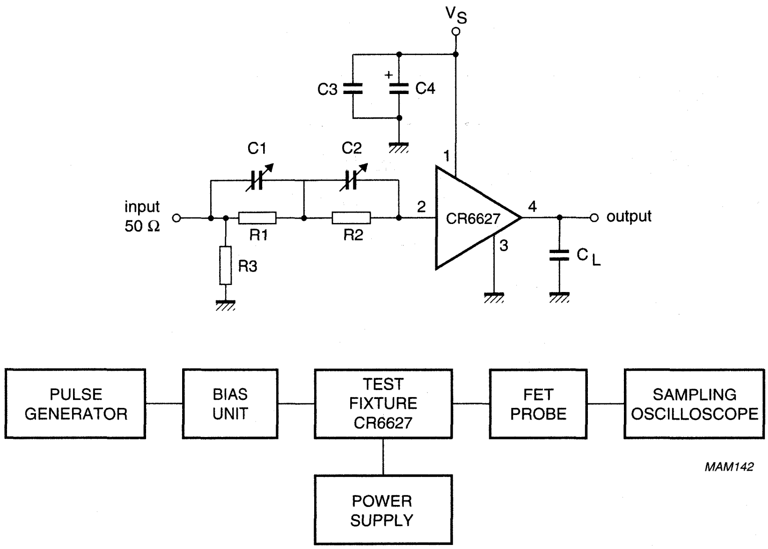
V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF;
R2 = 82 Ω; C2 = 100 pF; 55, 50, 40 V (p-p) output swing
with 40 V DC offset.

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



V_S = 80 V; T_{mb} = 25 °C; C_L = 10 pF; R1 = 348 Ω; C1 = 90 pF;
R2 = 82 Ω; C2 = 100 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.



Test-circuit for one of the three CRT amplifiers.

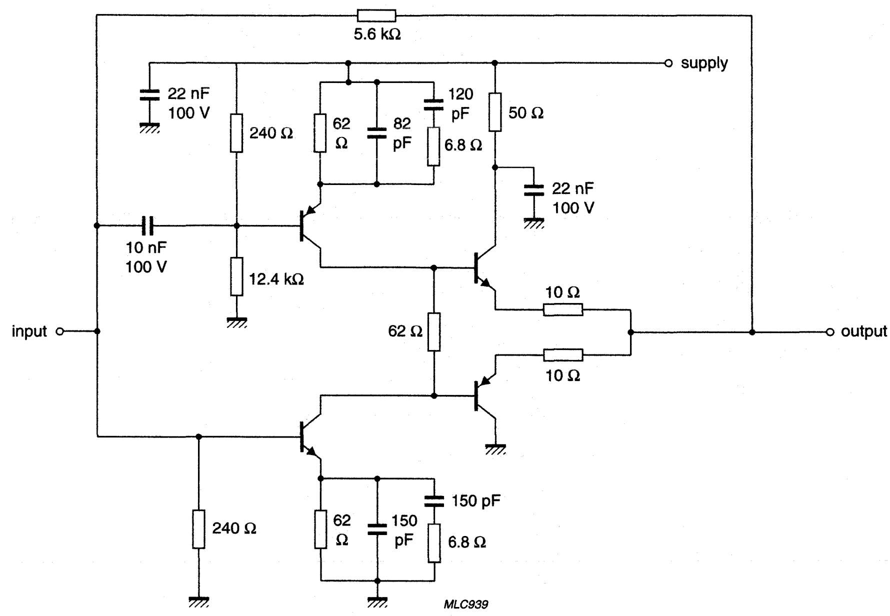
Fig.6 CRT amplifier test-circuit and block diagram.

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

DESIGNATION	DESCRIPTION	VALUE
C_1	variable capacitor	10 to 160 pF (typ. 90 pF)
C_2	variable capacitor	10 to 160 pF (typ. 100 pF)
C_3	chip capacitor	10 nF
C_4	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



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/μs
- 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

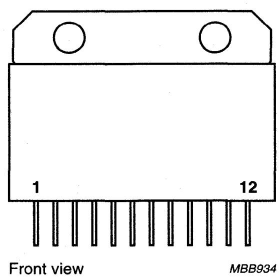


Fig.1 Simplified outline.

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
Per amplifier				
V_S	supply voltage (DC)	60	70	V
T_{mb}	operating mounting base temperature	−20	+100	°C
T_{stg}	storage temperature	−40	+125	°C

CHARACTERISTICS

V_S = 65 V; T_C = 25 °C; C_L = 10 pF; output swing = 45 V (p-p) with 32 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_{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_{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 = 5 to 55 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11.2	12.4	13.6	
V_G	insertion gain	50 Ω 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 Ω 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

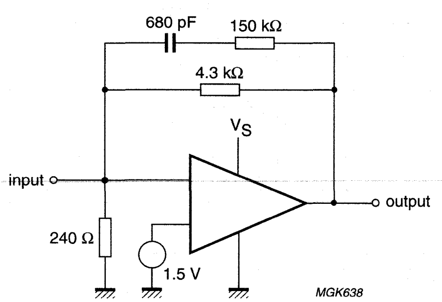
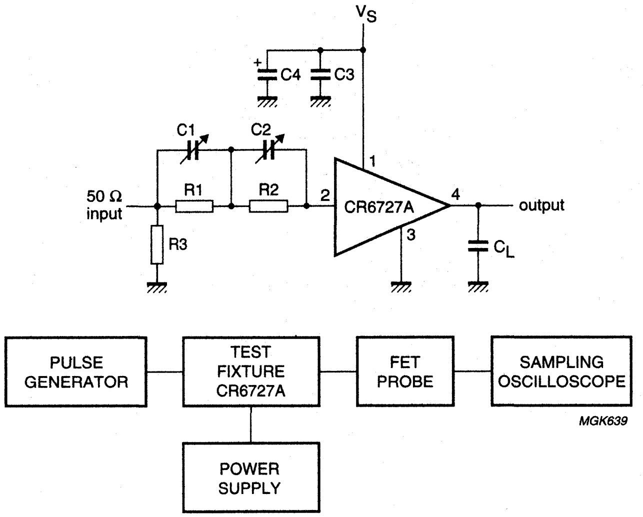


Fig.2 Block diagram; single amplifier.



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 μF; 160 V
R1	resistor	275 Ω
R2	resistor	62 Ω
R3	resistor	50 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 CR6927

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/µs
- 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

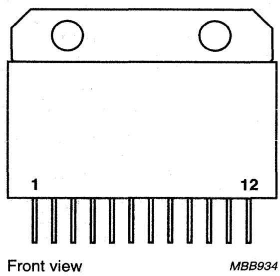


Fig.1 Simplified outline.

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
Per amplifier				
V_S	supply voltage (DC)	80	90	V
T_{mb}	operating mounting base temperature	−20	+100	°C
T_{stg}	storage temperature	−40	+125	°C

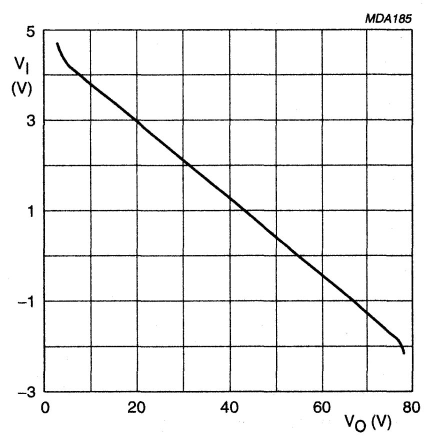
CHARACTERISTICS

V_S = 85 V; T_C = 25 °C; C_L = 10 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 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11.2	12.4	13.6	
V_G	insertion gain	50 Ω source; note 4	160	180	200	

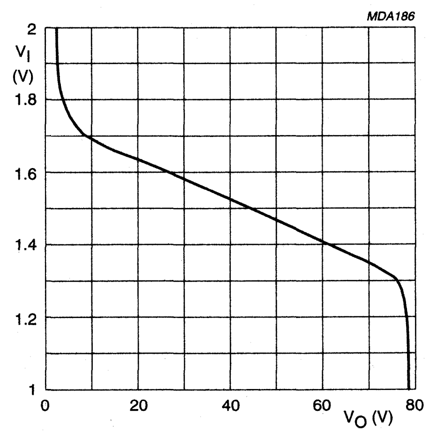
Notes

1. Input signal is a 100 kHz square wave of 3.8 V (p-p) with 1.5 V DC offset (50 Ω 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.



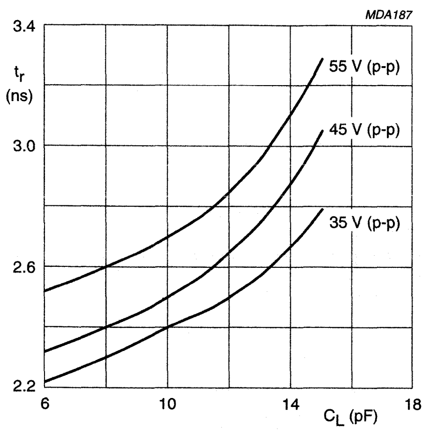
V_S = 85 V; T_C = 25 °C; C_L = 10 pF; (R1 + R2) = 330 Ω; output swing = 45 V (p-p) with 42 V DC offset.

Fig.2 Test circuit input voltage as a function of output voltage; typical values.



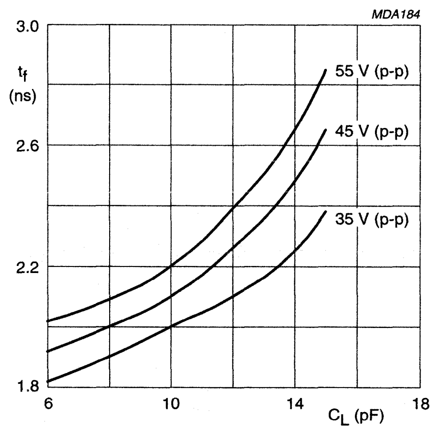
V_S = 85 V; T_C = 25 °C; C_L = 10 pF; (R1 + R2) = 330 Ω; output swing = 45 V (p-p) with 42 V DC offset.

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



V_S = 85 V; T_C = 25 °C; C_L = 10 pF; (R1 + R2) = 330 Ω;
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; (R1 + R2) = 330 Ω;
output swing = 45 V (p-p) with 42 V DC offset.

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

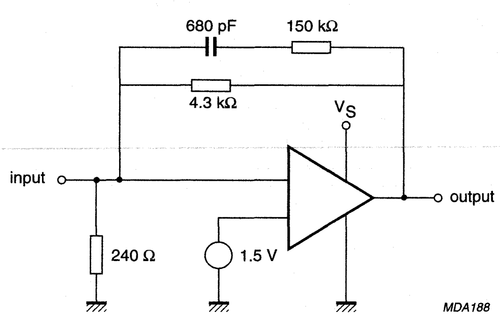
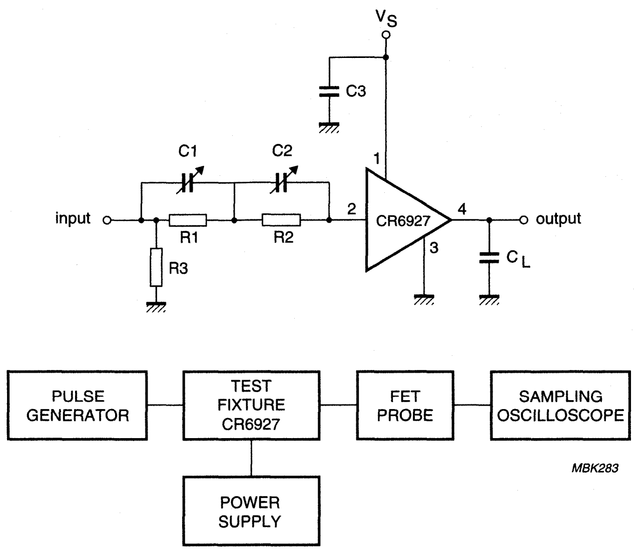


Fig.6 Block diagram; single amplifier.



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 μF; 160 V
R1	resistor	270 Ω
R2	resistor	62 Ω
R3	resistor	50 Ω

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/µs
- 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

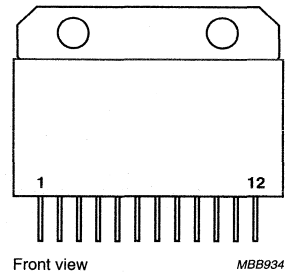


Fig.1 SOT347.

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	−20	+100	°C
T_{stg}	storage temperature	−40	+125	°C

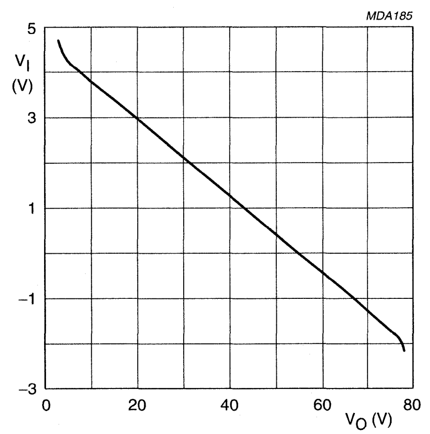
CHARACTERISTICS

V_S = 85 V; T_C = 25 °C; C_L = 10 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	105	120	135	mA
P_{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 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 to 75 V	–	2	5	%
A_V	DC voltage gain	50 Ω source; note 3	11.2	12.4	13.6	
V_G	insertion gain	50 Ω source; note 4	160	180	200	

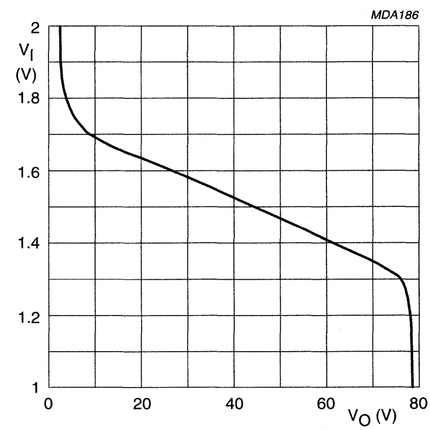
Notes

1. Input signal is a 100 kHz square wave of 3.8 V (p-p) with 1.5 V DC offset (50 Ω 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.



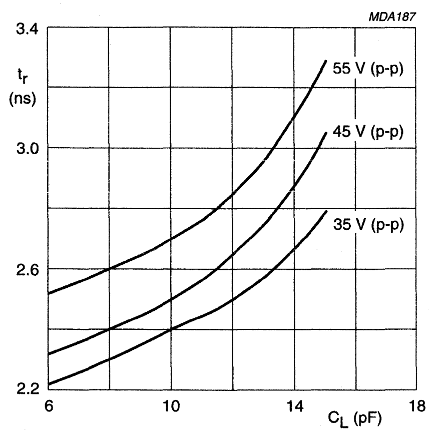
V_S = 85 V; T_C = 25 °C; C_L = 10 pF; (R1 + R2) = 330 Ω; output swing = 45 V (p-p) with 42 V DC offset.

Fig.2 Test-circuit input voltage as a function of output voltage; typical values.



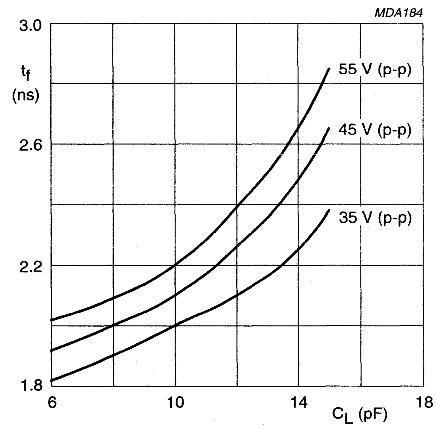
V_S = 85 V; T_C = 25 °C; C_L = 10 pF; output swing = 45 V (p-p) with 42 V DC offset.

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



V_S = 85 V; T_C = 25 °C; C_L = 10 pF; (R1 + R2) = 330 Ω; 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; (R1 + R2) = 330 Ω; output swing = 45 V (p-p) with 42 V DC offset.

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

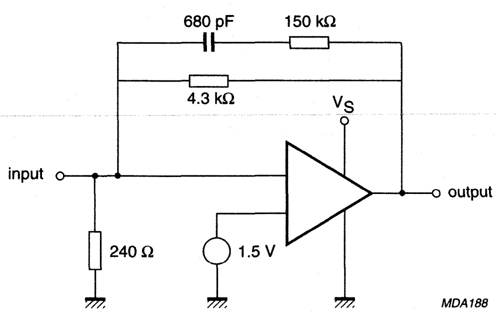
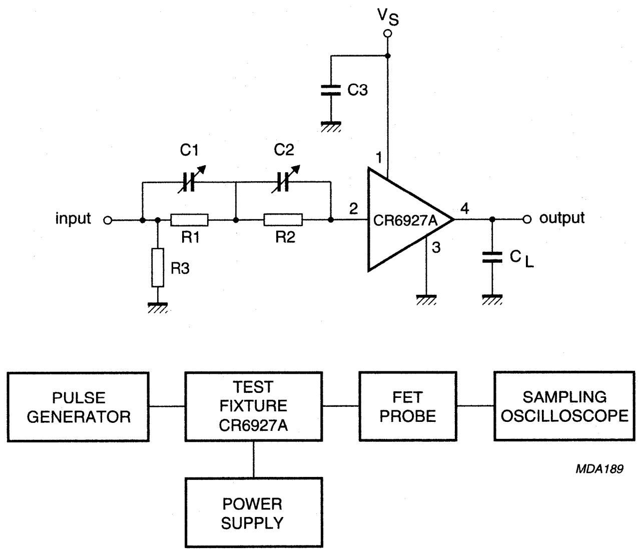


Fig.6 Block diagram.



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 μF; 160 V
R1	resistor	275 Ω
R2	resistor	62 Ω
R3	resistor	50 Ω

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

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

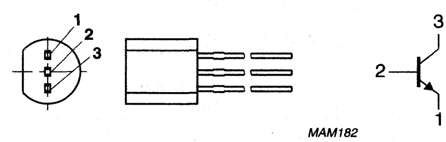


Fig.1 Simplified outline (TO-92; SOT54) and symbol.

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	$T_{amb} \leq 25$ °C	–	500	mW
h_{FE}	DC current gain				
	PH2369	$I_C = 10$ mA; $V_{CE} = 1$ V	40	120	
	PH2369A	$I_C = 10$ mA; $V_{CE} = 350$ mV	40	120	
f_T	transition frequency	$I_C = 10$ mA; $V_{CE} = 10$ V; f = 100 MHz	500	–	MHz
t_{off}	turn-off time	$I_{Con} = 10$ mA; $I_{Bon} = 3$ mA; $I_{Boff} = -1.5$ mA	–	30	ns
		$I_{Con} = 100$ mA; $I_{Bon} = 40$ mA; $I_{Boff} = -20$ mA	–	35	ns

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	$T_{amb} \leq 25$ °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
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1	250	K/W

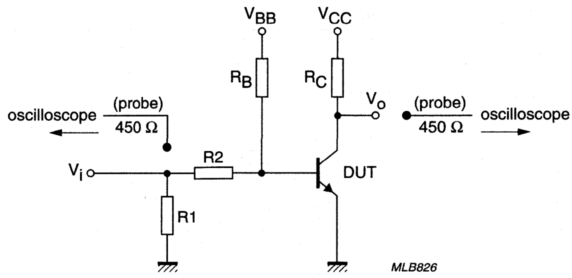
Note

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

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	I_E = 0; V_{CB} = 20 V	–	400	nA
		I_E = 0; V_{CB} = 20 V; T_j = 125 °C	–	30	μA
I_{EBO}	emitter cut-off current	I_C = 0; V_{EB} = 4 V	–	100	nA
h_{FE}	DC current gain				
	PH2369	I_C = 10 mA; V_{CE} = 1 V	40	120	
		I_C = 10 mA; V_{CE} = 1 V; T_{amb} = –55 °C	20	–	
		I_C = 100 mA; V_{CE} = 2 V	20	–	
h_{FE}	DC current gain				
	PH2369A	I_C = 10 mA; V_{CE} = 350 mV	40	120	
		I_C = 10 mA; V_{CE} = 350 mV; T_{amb} = –55 °C	20	–	
		I_C = 30 mA; V_{CE} = 400 mV	30	–	
		I_C = 100 mA; V_{CE} = 1 V	20	–	
V_{CEsat}	collector-emitter saturation voltage PH2369	I_C = 10 mA; I_B = 1 mA	–	250	mV
V_{CEsat}	collector-emitter saturation voltage				
	PH2369A	I_C = 10 mA; I_B = 1 mA	–	200	mV
		I_C = 10 mA; I_B = 10 mA	–	300	mV
		I_C = 30 mA; I_B = 3 mA	–	250	mV
		I_C = 100 mA; I_B = 10 mA	–	500	mV
V_{BEsat}	base-emitter saturation voltage	I_C = 10 mA; I_B = 1 mA	700	850	mV
C_c	collector capacitance	I_E = i_e = 0; V_{CB} = 5 V; f = 1 MHz	–	4	pF
C_e	emitter capacitance	I_C = i_c = 0; V_{EB} = 1 V; f = 1 MHz	–	4.5	pF
f_T	transition frequency	I_C = 10 mA; V_{CE} = 10 V; f = 100 MHz	500	–	MHz
Switching times (between 10% and 90% levels)					
t_{on}	turn-on time	I_{Con} = 10 mA; I_{Bon} = 3 mA; I_{Boff} = –1.5 mA; 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 mA; I_{Bon} = 40 mA; I_{Boff} = –20 mA; see Fig.2 test conditions B	–	13	ns
t_{off}	turn-off time		–	35	ns



Test conditions A.
V_i = 0.5 to 4.2 V; T = 500 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 56 Ω; R2 = 1 kΩ; R_B = 1 kΩ; R_C = 270 Ω.
V_{BB} = 0.2 V; V_{CC} = 2.7 V.
Oscilloscope: input impedance Z_i = 50 Ω.

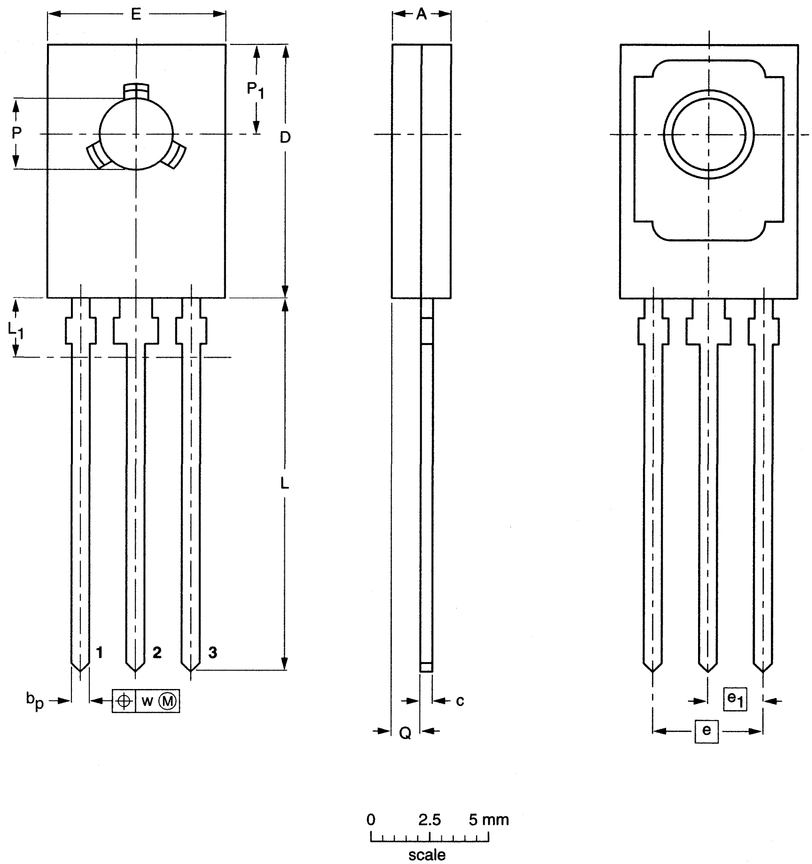
Test conditions B.
V_i = 0.5 to 4.52 V; T = 200 µs; t_p = 10 µs; $t_r = t_f \leq 3$ ns.
R1 = 100 Ω; R2 = 68 Ω; R_B = 390 Ω; R_C = 47 Ω.
V_{BB} = −3 V; V_{CC} = 4.6 V.
Oscilloscope: input impedance Z_i = 50 Ω.

Fig.2 Test circuit for switching times.

PACKAGE INFORMATION

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_p	c	D	E	e	e_1	L	L_1(1) max	Q	P	P_1	w
mm	2.7 2.3	0.88 0.65	0.60 0.45	11.1 10.5	7.8 7.2	4.58	2.29	16.5 15.3	2.54	1.5 0.9	3.2 3.0	3.9 3.6	0.254

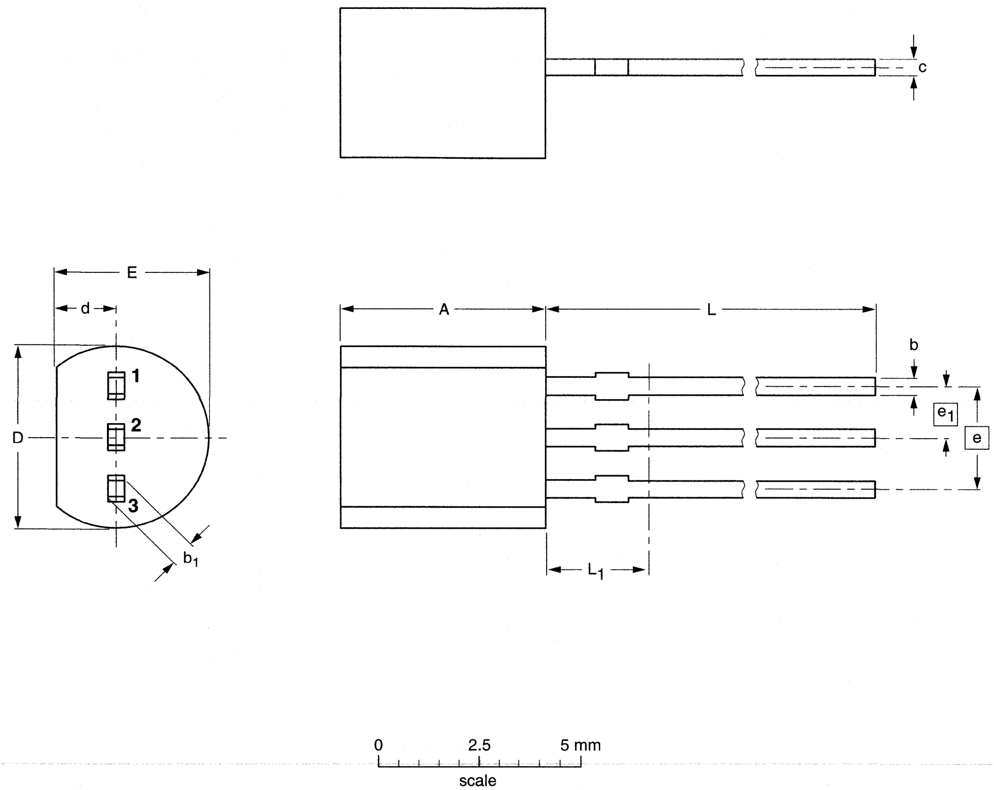
Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN 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_1	c	D	d	E	e	e_1	L	L_1(1)
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

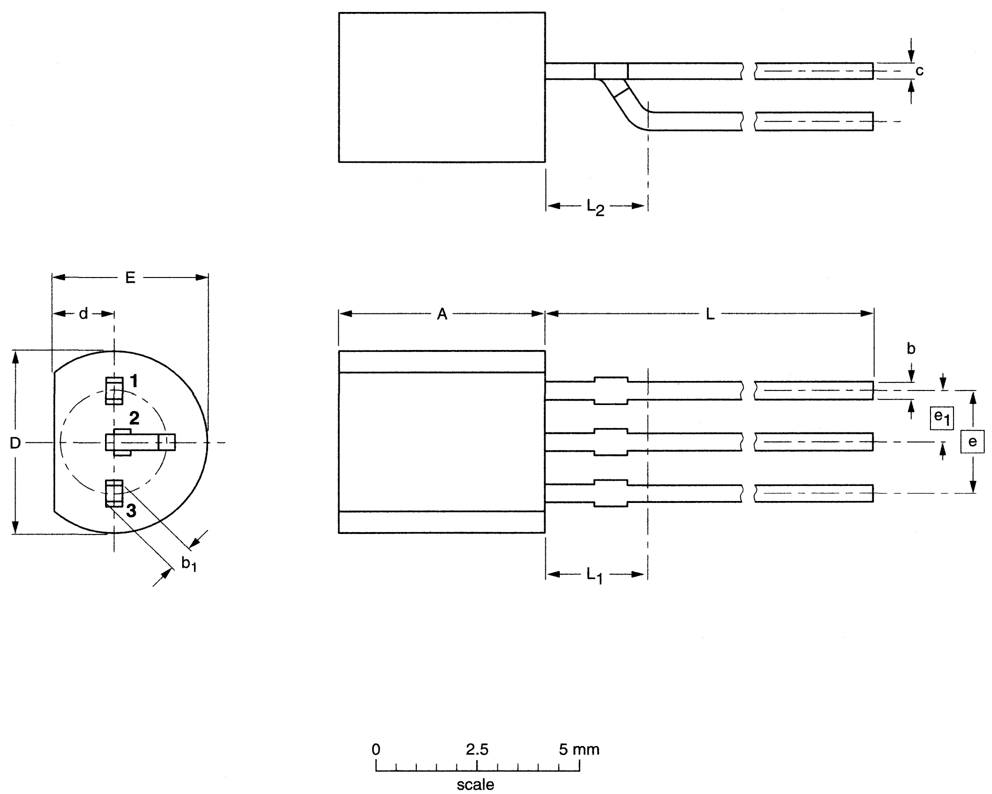
Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN 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_1	c	D	d	E	e	e_1	L	L_1(1) max	L_2 max
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5	2.5

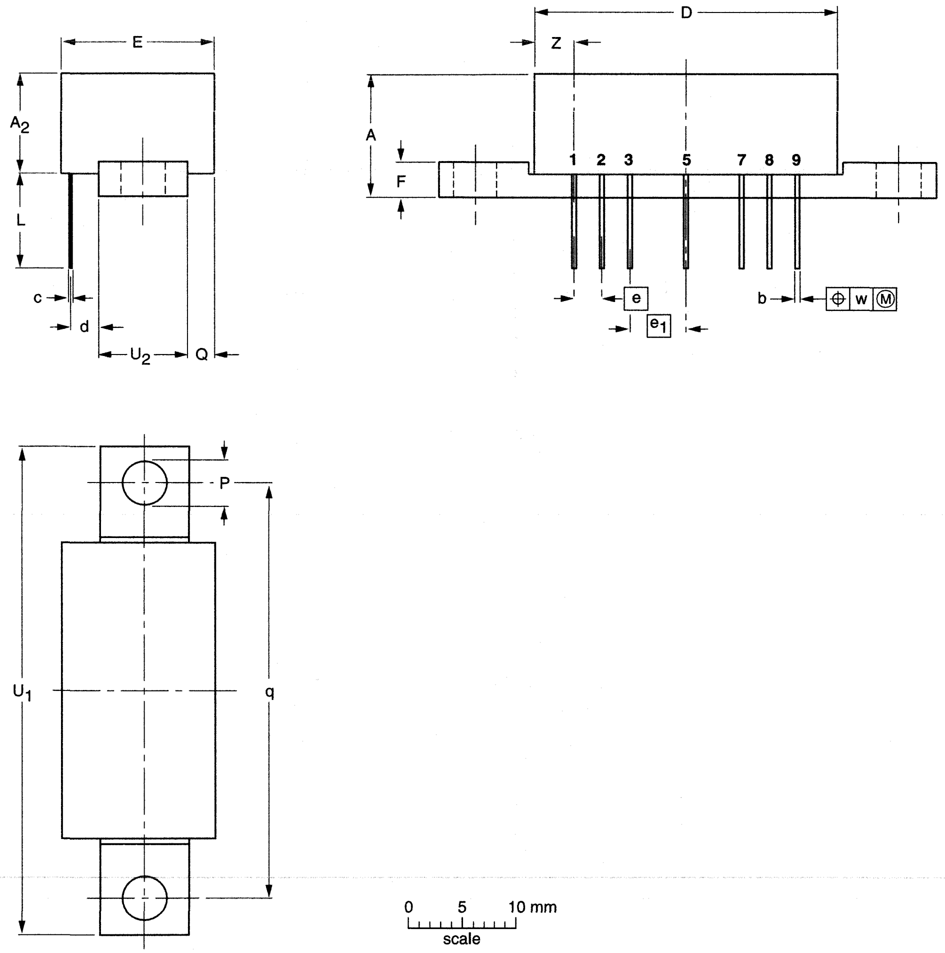
Notes

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT54 variant		TO-92	SC-43			97-04-14

SOT115L

Rectangular single-ended package; aluminium flange; 2 vertical mounting holes; 7 gold-plated in-line leads **SOT115L**



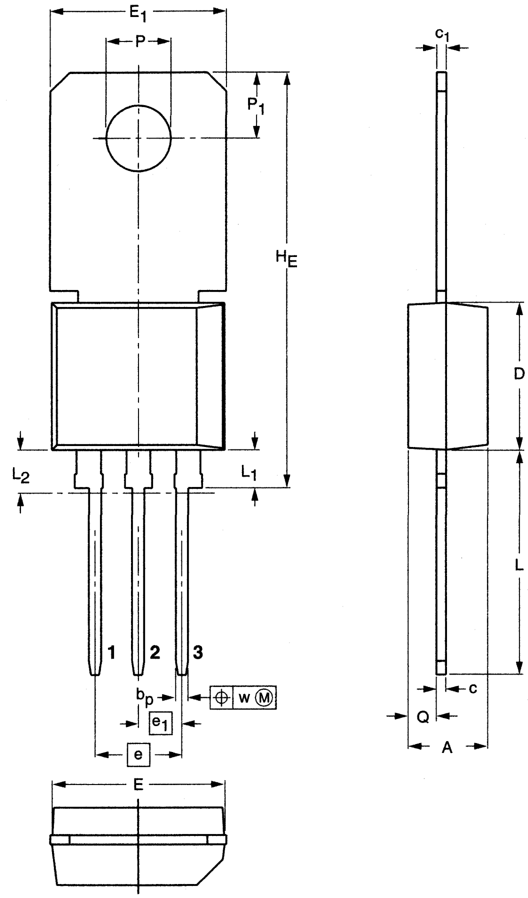
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_2 max.	b	c	D max.	d max.	E max.	e	e_1	F	L min.	∅P	Q max.	q	U_1 max.	U_2	w	Z max.
mm	11.5	9.1	0.51 0.38	0.25	27.2	2.54	13.75	2.54	5.08	3.2	8.8	4.15 3.85	2.4	38.1	44.75	8	0.25	3.8

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT115L						97-06-05

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_p	c	c_1	D	E	E_1	e	e_1	H_E	L	L_1	$L_2^{(1)}$ max	P	P_1	Q	w
mm	4.6 4.4	0.8 0.6	0.65 0.5	0.56 0.46	8.6 8.4	10.1 9.9	10.4 10.0	5.08	2.54	24.2 23.8	13.3 12.2	2.4 2.0	2.5	3.8 3.6	3.9 3.7	1.7 1.5	0.25

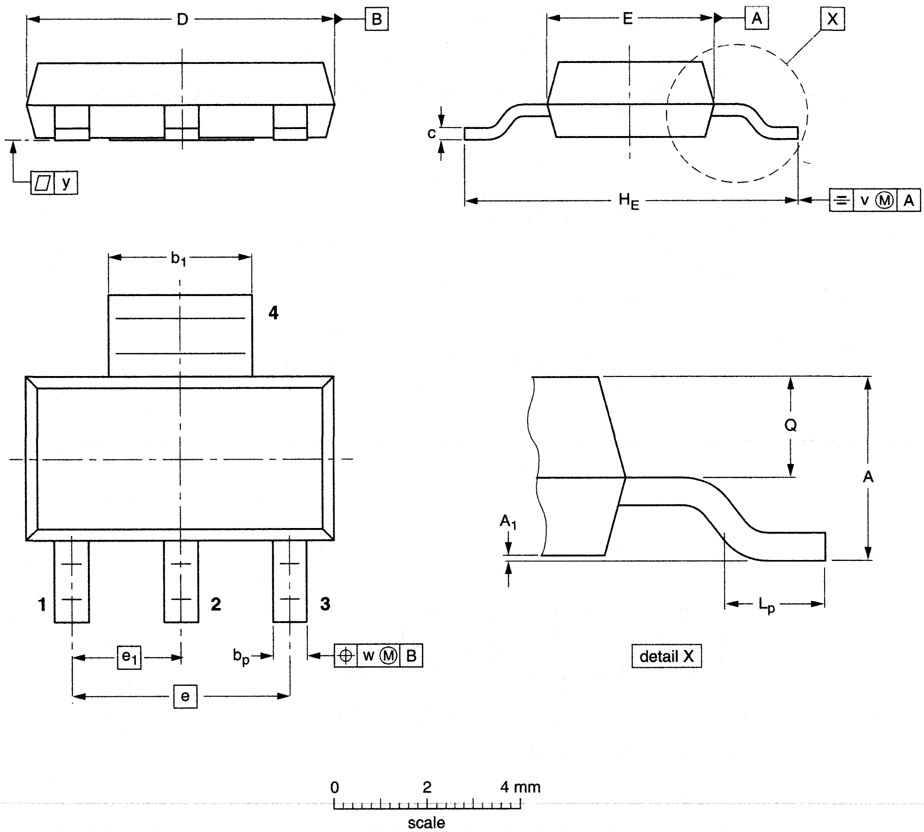
Note

1. Plastic flash allowed within this zone

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT128B		TO-202				97-02-28

SOT223

Plastic surface mounted package; collector pad for good heat transfer; 4 leads **SOT223**



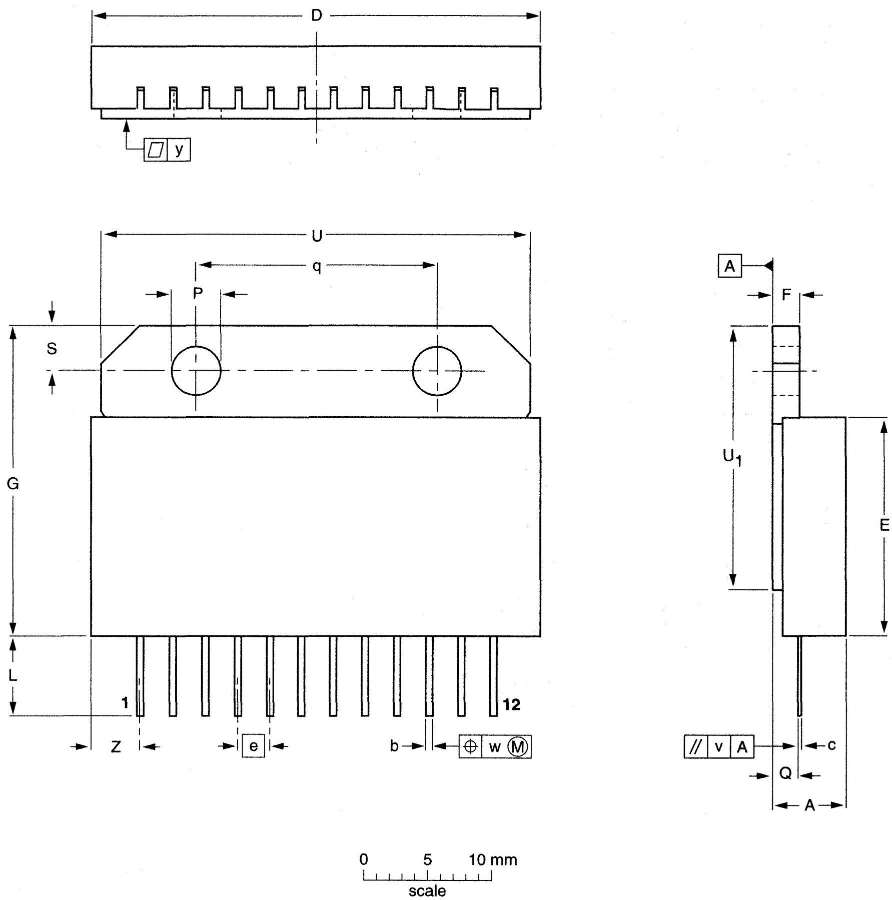
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT223						~~96-11-11~~ 97-02-28

SOT347

Ceramic single-ended flat package; heatsink mounted; 2 mounting holes; 12 in-line tin (Sn) plated leads **SOT347**



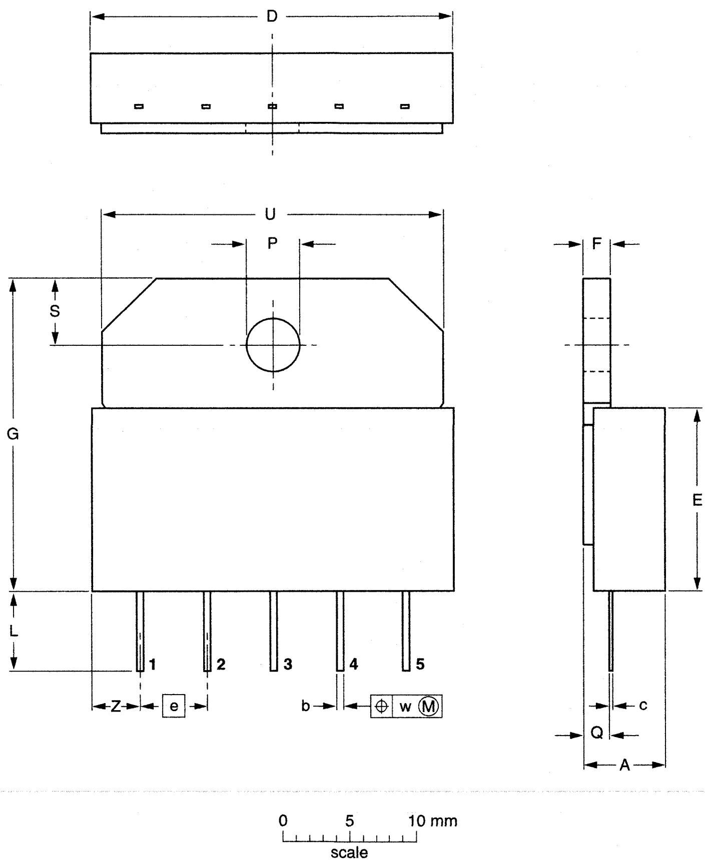
DIMENSIONS (mm are the original dimensions)

UNIT	A	b	c	D	E	e	F	G	L min.	P	Q	q	S	U	U_1	v	w	y	Z max.
mm	6.0 5.6	0.51 0.38	0.25	36.2 35.8	18.2 17.8	2.54	2.0	25.5 24.5	6	4.15 3.85	1.8	19	3.5 3.4	34.4 34.0	22.2 21.8	0.3	0.25	0.1	4.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT347						97-06-28

SOT348

Rectangular single-ended flat package;plastic cap; heatsink mounted; 1 mounting hole; 5 in-line gold-metallized leads **SOT348**



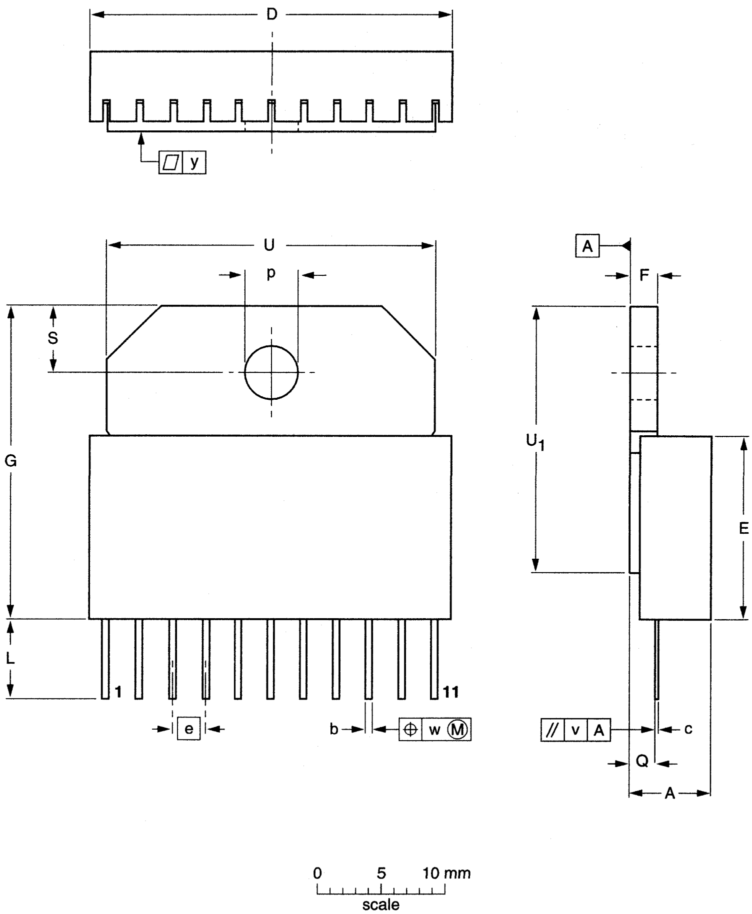
DIMENSIONS (mm are the original dimensions)

UNIT	A max.	b	c	D max.	E max.	e	F	G max.	L min.	P	Q	S	U	w	Z max.
mm	6.0	0.51 0.38	0.25	27.2	13.8	5.08	2.0	23.5	6	4.15 3.85	1.8	5	25.5	0.25	3.8

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT348						97-04-14

SOT451A

Ceramic single-ended flat package; heatsink mounted; 1 mounting hole; 11 in-line gold-metallized leads **SOT451A**



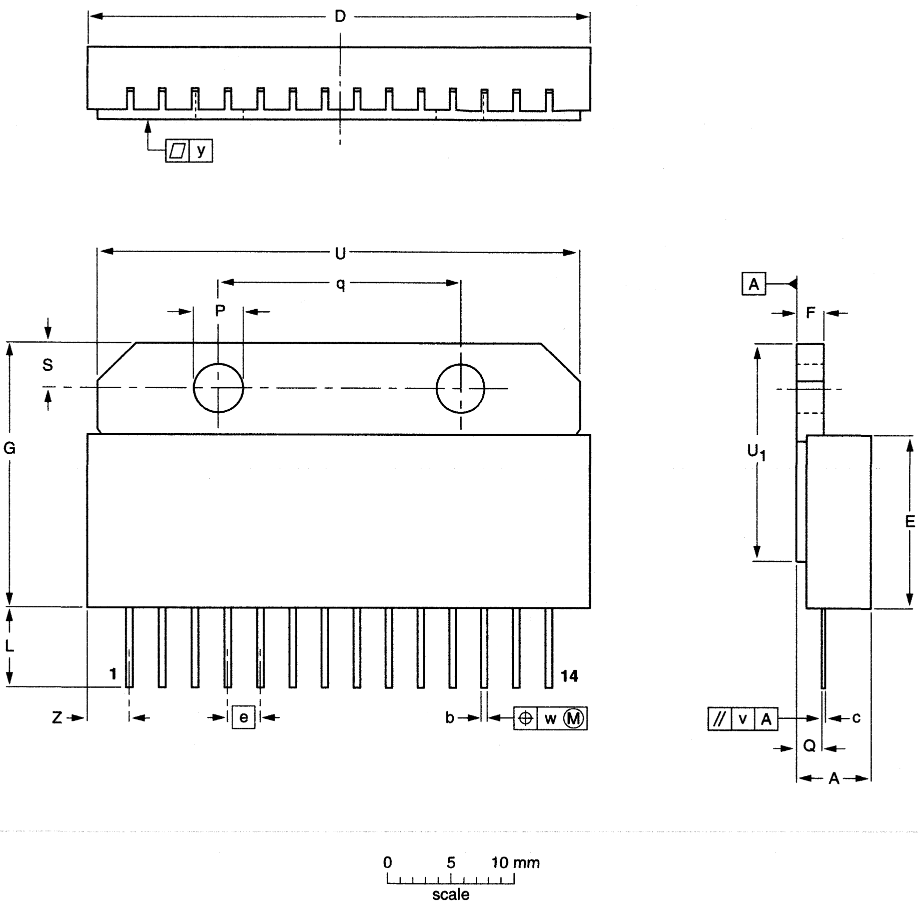
DIMENSIONS (mm are the original dimensions)

UNIT	A	b	c	D	E	e	F	G	L	p	Q	S	U	U_1	v	w	y
mm	5.9 5.5	0.56 0.46	0.25	28.3 27.9	13.9 13.5	2.54	2.2 1.8	23.8 23.4	6.2 5.8	4.2 3.8	2.0 1.6	5.2 4.8	25.4 25.0	20.4 20.0	0.3	0.25	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT451A						97-06-26

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 max.	E	e	F	G max.	L min.	P	Q	q	S	U max.	U_1	v	w	y	Z
mm	5.9 5.5	0.5	0.25	39.6	13.7	2.54	2.1 1.9	21.2	6	4.15 3.85	2.9 2.5	19	3.5	37.8	18.3	0.3	0.25	0.1	3.4 3.0

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT454A						97-07-01

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Data handbook system

DATA HANDBOOK SYSTEM

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IC03	Semiconductors for Wired Telecom Systems
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IC05	Advanced Low-power Schottky (ALS) Logic
IC06	High-speed CMOS Logic Family
IC11	General-purpose/Linear ICs
IC12	I^2C Peripherals
IC13	Programmable Logic Devices (PLD)
IC14	8048-based 8-bit Microcontrollers
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Discrete semiconductors

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SC04	Small-signal Transistors
SC05	Video Transistors and Modules for Monitors
SC06	High-voltage and Switching NPN Power Transistors
SC07	Small-signal Field-effect Transistors
SC13a	PowerMOS Transistors including TOPFETs and IGBTs
SC13b	Small-signal and Medium-power MOS Transistors
SC14	RF Wideband Transistors
SC16	Wideband Hybrid IC Modules
SC17	Semiconductor Sensors
SC18	Discrete Semiconductor Packages
SC19	RF & Microwave Power Transistors, RF Power Modules and Circulators/Isolators

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Data handbook system

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Display components

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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 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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Benelux: EINDHOVEN, Tel. (+31 40) 2783 749, Fax. (+31 40) 2788 399.
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