DATA SHEET

BLV33F
VHF linear power transistor

Product specification

1996 Oct 10

Philips
Semiconductors

PHILIPS

VHF linear power transistor BLV33F

FEATURES

- Internally matched input for wideband operation and high power gain
- Diffused emitter ballasting resistors for an optimum temperature profile
- Gold metallization ensures excellent reliability.

APPLICATIONS

- Primarily intended for use in linear VHF amplifiers for television transmitters and transposers.

DESCRIPTION

NPN silicon planar epitaxial transistor encapsulated in a ½" 6 lead SOT119A capstan package with ceramic cap. All leads are isolated from the flange.

PINNING - SOT119A

PIN	SYMBOL	DESCRIPTION
1	e	emitter
2	e	emitter
3	b	base
4	c	collector
5	e	emitter
6	e	emitter

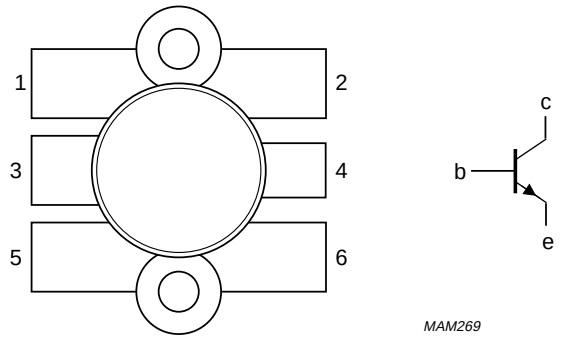


Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

RF performance in a common emitter push-pull test circuit.

MODE OF OPERATION	f_{vision} (MHz)	V_{CE} (V)	I_C, $I_{C(ZS)}$ (A)	T_h (°C)	d_{im}[1] (dB)	$P_{o\ sync}$ [1] (W)	G_P (dB)	sync compr.[2] sync in/sync out (%)
CW, class-A	224.25	25	3.2	70	–55	>13	>13.5	
				25	–55	typ. 19	typ. 14.8	
CW, class-AB	224.25	28	0.2	70	–	typ. 85	typ. 10.5	30/25

Notes

1. Three-tone test method (vision carrier –8 dB, sound carrier –7 dB, sideband signal –16 dB), zero dB corresponds to peak sync level.
2. Television service (negative modulation, C.C.I.R. system).

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

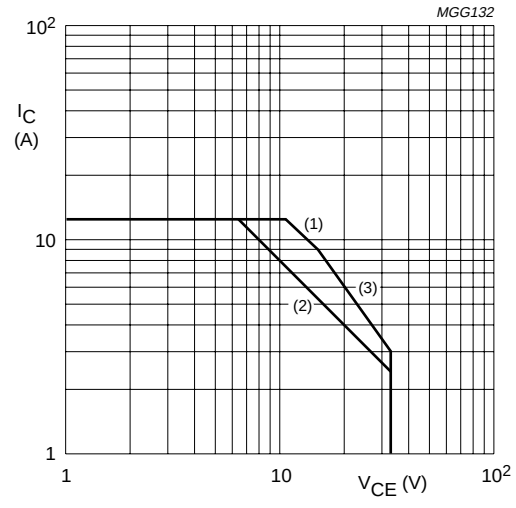
LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter voltage	V_{BE} = 0	–	65	V
V_{CEO}	collector-emitter voltage	open base	–	33	V
V_{EBO}	emitter-base voltage	open collector	–	4	V
I_C	collector current (DC)		–	12.5	A
$I_{C(AV)}$	average collector current		–	12.5	A
I_{CM}	peak collector current	f > 1 MHz	–	20	A
P_{tot}	total power dissipation (DC)	T_{mb} = 25 °C	–	133	W
P_{rf}	RF power dissipation	f > 1 MHz; T_{mb} = 25 °C	–	162	W
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	200	°C

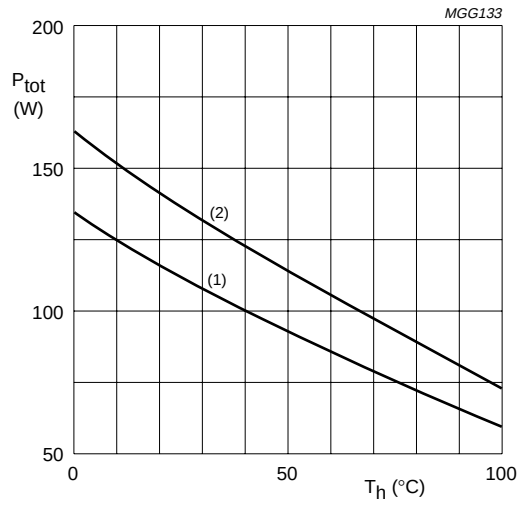
THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}mb(dc)}$	thermal resistance from junction to mounting base (DC dissipation)	P_{diss} = 80 W; T_{mb} = 82 °C; T_h = 70 °C	1.43	K/W
$R_{th\ j\text{-}mb(rf)}$	thermal resistance from junction to mounting base (RF dissipation)	P_{diss} = 80 W; T_{mb} = 82 °C; T_h = 70 °C	1.17	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	P_{diss} = 80 W; T_{mb} = 82 °C; T_h = 70 °C	0.2	K/W



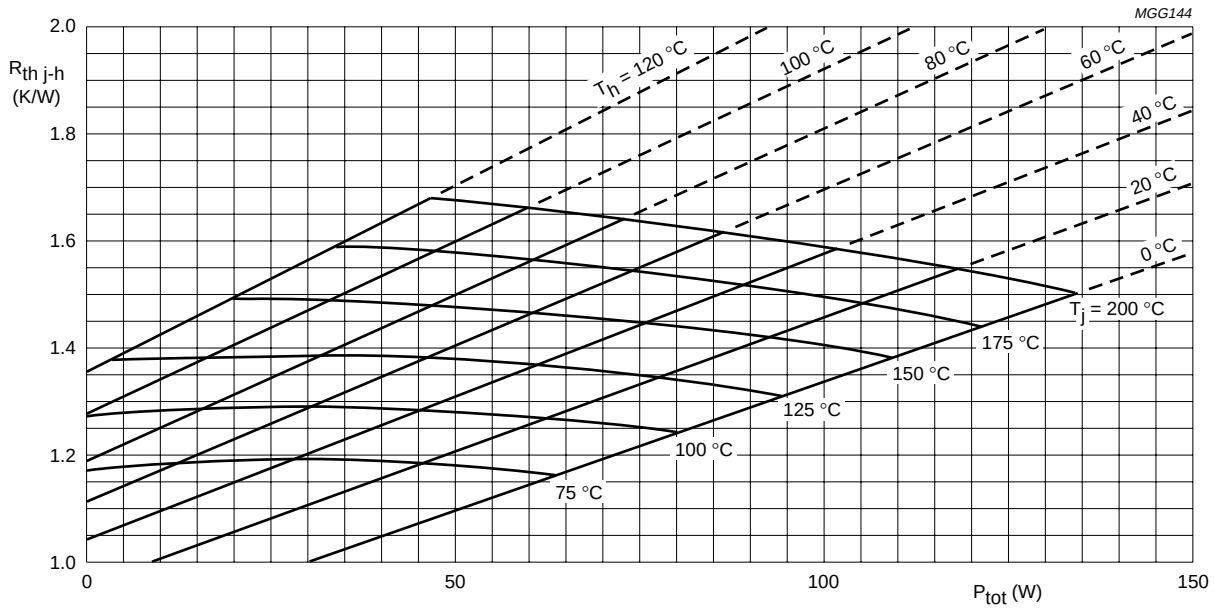
(1) T_{mb} = 25 °C.
(2) T_h = 70 °C.
(3) Second breakdown limit (independent of temperature).

Fig.2 DC SOAR.



(1) Continuous DC (including RF class-A) operation.
(2) Continuous RF operation.

Fig.3 Power derating curves.



$R_{th\ mb\text{-}h}$ = 0.2 K/W.

Fig.4 Maximum thermal resistance from junction to heatsink as a function of power dissipation, with heatsink and junction temperature as parameters.

Example

Nominal class-A operation (without RF signal): V_{CE} = 25 V; I_C = 3.2 A; T_h = 70 °C.

Figure 4 shows:

$R_{th\ j\text{-}h}$ = max. 1.63 K/W

T_j = max. 200 °C.

Typical device:

$R_{th\ j\text{-}h}$ = typ.1.53 K/W

T_j = typ. 192 °C.

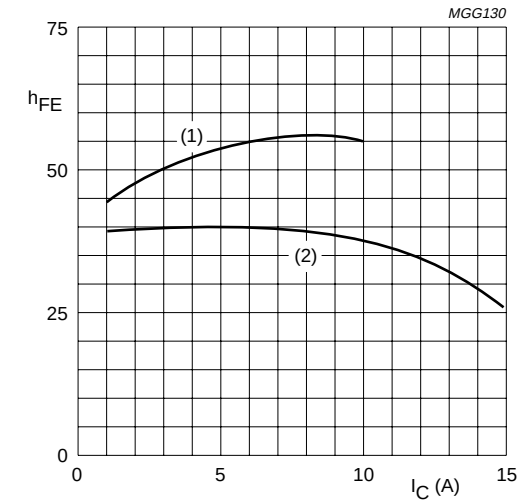
CHARACTERISTICS

T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CES}$	collector-emitter breakdown voltage	V_{BE} = 0; I_C = 25 mA	65	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	open base; I_C = 100 mA	33	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	open collector; I_E = 10 mA	4	–	–	V
I_{CES}	collector cut-off current	V_{BE} = 0; V_{CE} = 30 V	–	–	1	mA
h_{FE}	DC current gain	V_{CE} = 25 V; I_C = 3 A; note 1	15	50	100	
V_{CEsat}	collector-emitter saturation voltage	I_C = 6 A; I_B = 0.6 A; note 1	–	0.75	–	V
f_T	transition frequency	V_{CB} = 25 V; I_E = –3 A; f = 100 MHz; note 2	–	680	–	MHz
		V_{CB} = 25 V; I_E = –6 A; f = 100 MHz; note 2	–	750	–	MHz
C_c	collector capacitance	V_{CB} = 25 V; I_E = i_e = 0; f = 1 MHz	–	155	–	pF
C_{re}	feedback capacitance	I_C = 50 mA; V_{CE} = 25 V; f = 1 MHz	–	88	–	pF
C_{cf}	collector-flange capacitance		–	3	–	pF

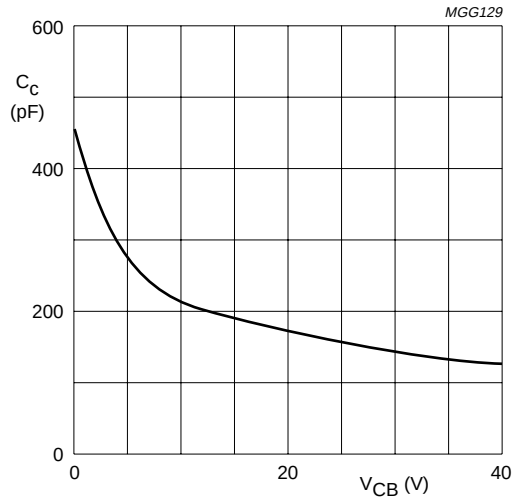
Notes

1. Measured under pulse conditions: $t_p \leq 300$ μs; $\delta \leq 0.02$.
2. Measured under pulse conditions: $t_p \leq 50$ μs; $\delta \leq 0.01$.



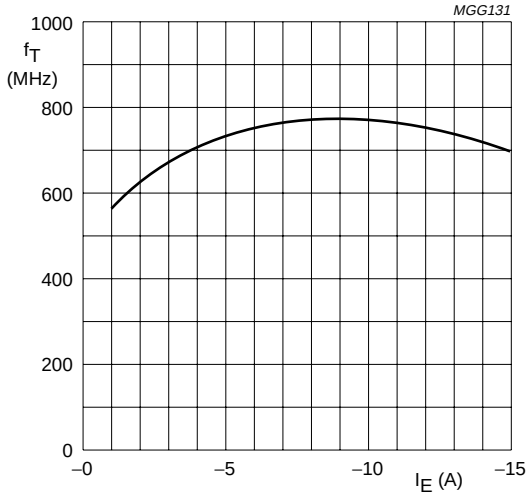
T_j = 25 °C.
(1) V_{CE} = 25 V.
(2) V_{CE} = 5 V.

Fig.5 DC current gain as a function of collector current; typical values.



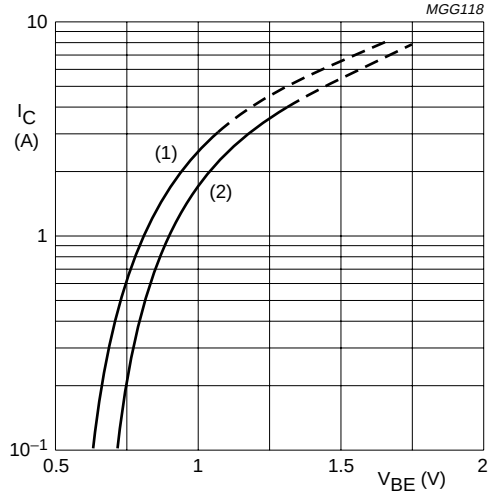
$I_E = i_e$ = 0; f = 1 MHz; T_j = 25 °C.

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



V_{CB} = 25 V; f = 100 MHz; T_j = 25 °C.

Fig.7 Transition frequency as a function of emitter current; typical values.



V_{CE} = 25 V.
(1) T_h = 70 °C.
(2) T_h = 25 °C.

Fig.8 Collector current as a function of base-emitter voltage; typical values.

APPLICATION INFORMATION

RF performance in VHF class-A operation (linear power amplifier)

MODE OF OPERATION	f_{vision} (MHz)	V_{CE} (V)	I_C (A)	T_h (°C)	d_{im}[1] (dB)	$P_{o\ sync}$[1] (W)	G_P (dB)
CW, class-A	224.25	25	3.2	70	–55	>13	>13.5
				70	–55	typ. 14.5	typ. 14.5
				70	–52	typ. 22	typ. 14.5
				25	–55	typ. 19	typ. 14.8

Note

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

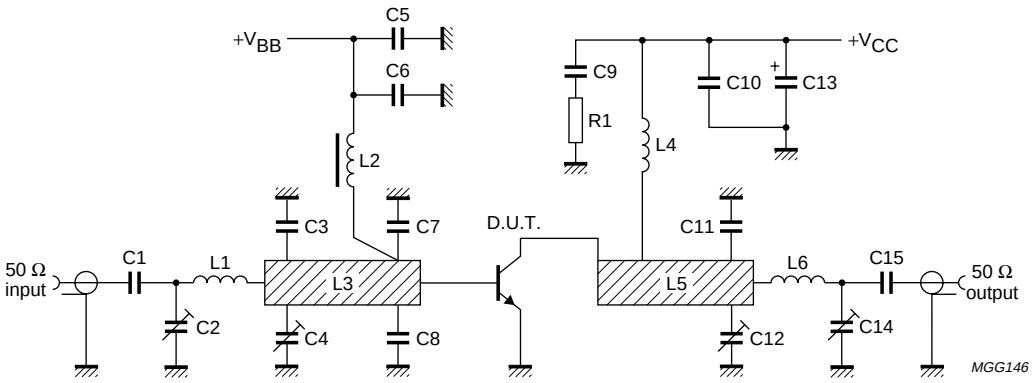


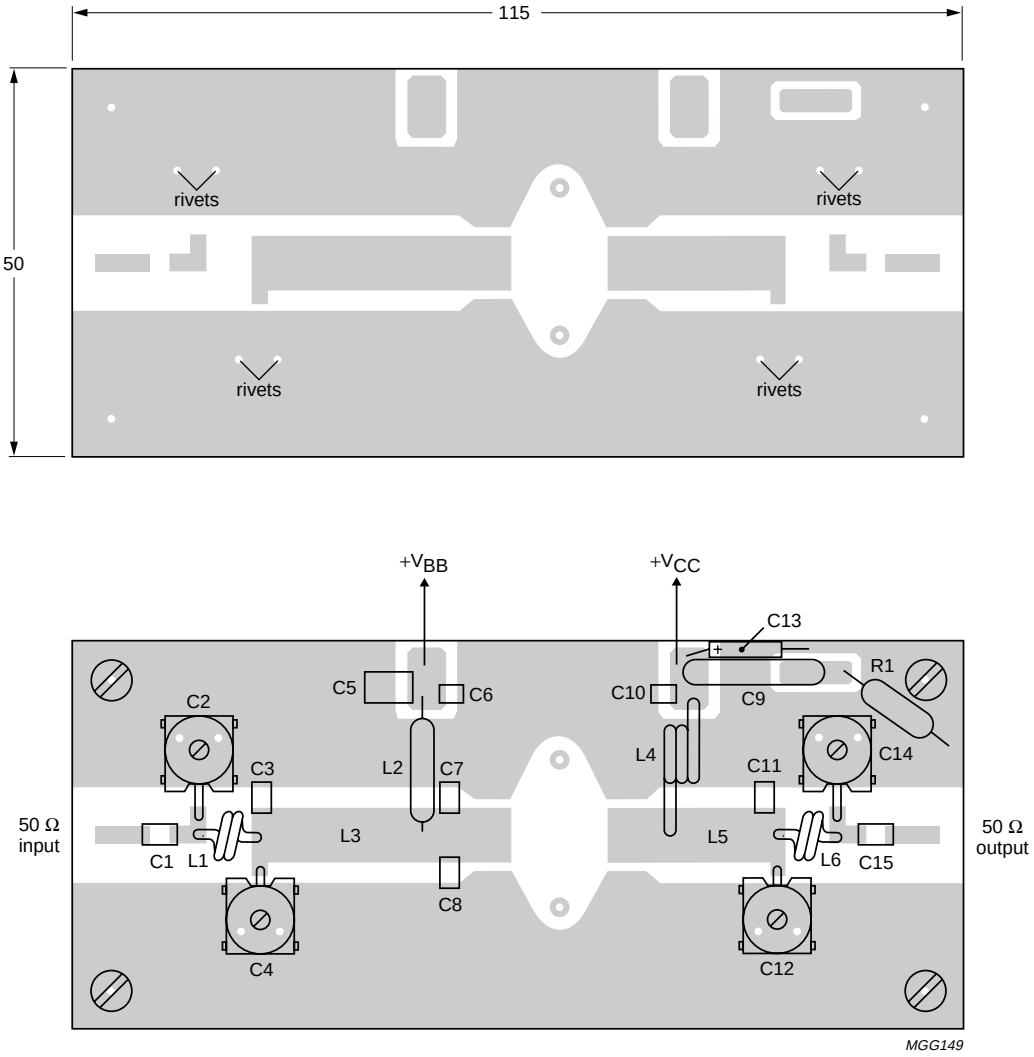
Fig.9 Class-A test circuit at f_{vision} = 224.25 MHz.

List of components used in test circuit (see Figs 9 and 10)**.**

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C15	multilayer ceramic chip capacitor; note 1	560 pF, 500 V		
C2, C4, C12, C14	film dielectric trimmer	4 to 40 pF		2222 809 08002
C3	multilayer ceramic chip capacitor; note 1	10 pF, 500 V		
C5	multilayer ceramic chip capacitor	470 nF, 50 V		2222 856 48474
C6, C10	multilayer ceramic chip capacitor	680 pF, 50 V		2222 852 13681
C7, C8	multilayer ceramic chip capacitor; note 1	47 pF, 500 V	placed 8 mm from transistor edge	
C9	polyester capacitor	330 nF		
C11	multilayer ceramic chip capacitor; note 1	68 pF, 500 V		
C13	solid tantalum capacitor	6.8 μF, 35 V		
L1	2 turns of 1.6 mm enamelled Cu wire		int. diameter 5 mm length 5 mm leads 2 × 3 mm	
L2	microchoke	1 μH		4322 057 01080
L3	stripline; note 2	30 Ω	6 mm × 32.7 mm	
L4	2 turns of closely wound 1 mm enamelled Cu wire		int. diameter 5 mm leads 2 × 10 mm	
L5	stripline; note 2	30 Ω	6 mm × 24 mm	
L6	2 turns of 1.6 mm enamelled Cu wire		int. diameter 4 mm length 4.5 mm leads 2 × 3 mm	
R1	carbon resistor	10 Ω		

Notes

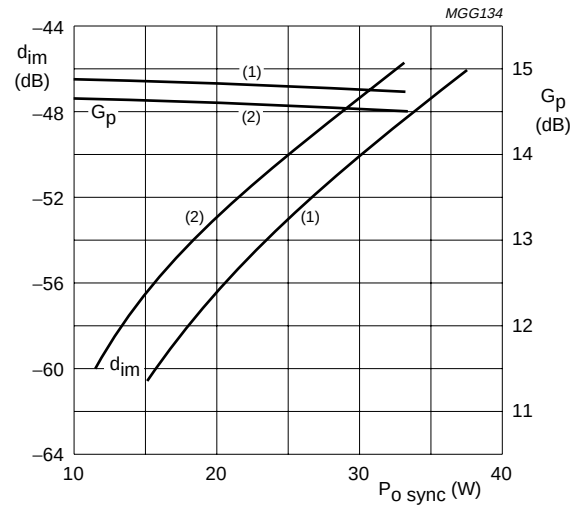
1. American Technical Ceramics type 100B or capacitor of same quality.
2. The striplines are on a double Cu-clad printed-circuit board, with epoxy fibre-glass dielectric (ε_r = 4.5); thickness $^1/_{16}$".



Dimensions in mm.

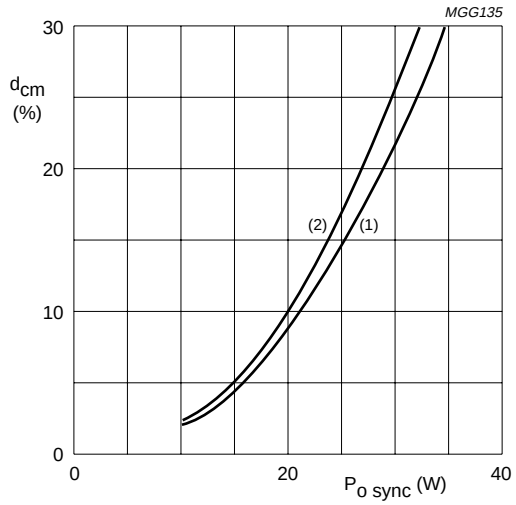
The circuit and the components are on one side of the epoxy fibre-glass board, the other side is unetched copper to serve as earth. Earth connections are made by hollow rivets. Additionally copper straps are used under the emitters and at the input and output to provide direct contact between the copper on the component side and the ground-plane.

Fig.10 Component layout and printed-circuit board for 224.25 MHz class-A test circuit.



V_{CE} = 25 V; I_C = 3.2 A; f_{vision} = 224.25 MHz.
(1) T_h = 25 °C.
(2) T_h = 70 °C.

Fig.11 Intermodulation distortion and power gain as a functions of output power.



V_{CE} = 25 V; I_C = 3.2 A; f_{vision} = 224.25 MHz.
(1) T_h = 25 °C.
(2) T_h = 70 °C.

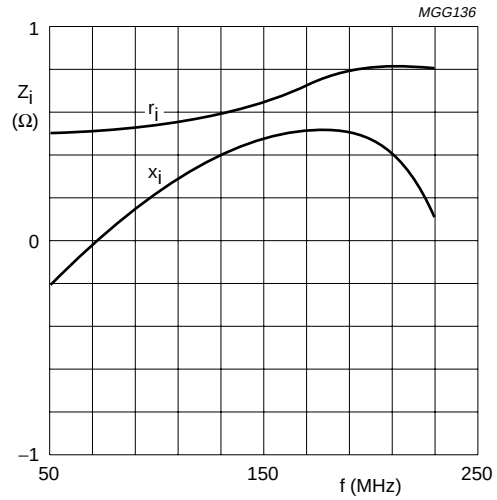
Fig.12 Cross-modulation distortion as a function of output power.

Three-tone test method (vision carrier −8 dB, sound carrier −7 dB, sideband signal −16 dB), zero dB corresponds to peak sync level (see Fig.11). Intermodulation distortion of input signal ≤−70 dB.

Two-tone test method (vision carrier 0 dB, sound carrier −7 dB), zero dB corresponds to peak sync level. Cross-modulation distortion (d_{cm}) is the voltage variation (%) of sound carrier when vision carrier is switched from 0 dB to −20 dB (see Fig.12).

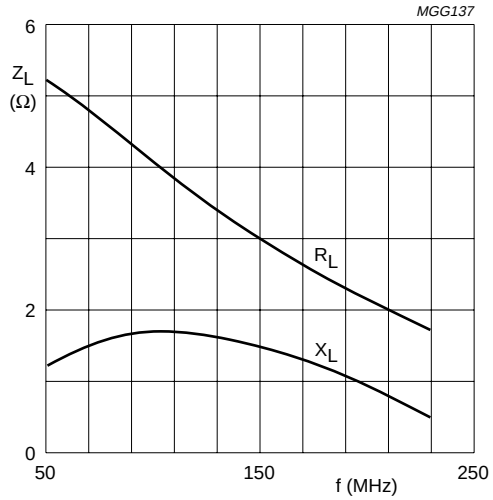
Ruggedness in class-A operation

The BLV33F is capable of withstanding a full load mismatch corresponding to VSWR = 50 : 1 through all phases up to 30 W (RMS) or 40 W (PEP) under the following conditions: V_{CE} = 25 V; I_C = 3.2 A; T_h = 70 °C; f = 224.25 MHz; $R_{th\ mb\text{-}h}$ = 0.2 K/W.



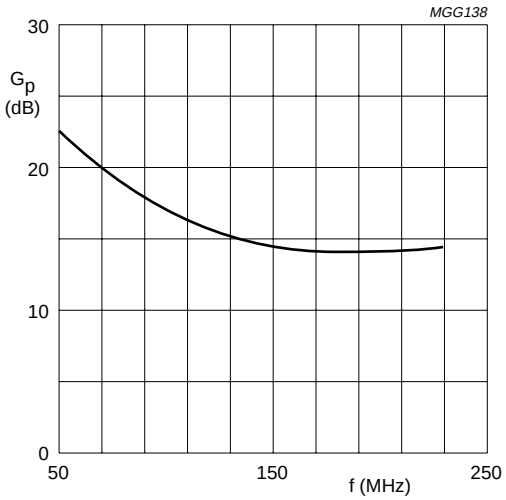
Class-A operation; V_{CE} = 25 V; I_C = 3.2 A; T_h = 70 °C.

Fig.13 Input impedance as a function of frequency (series components); typical values.



Class-A operation; V_{CE} = 25 V; I_C = 3.2 A; T_h = 70 °C.

Fig.14 Load impedance as a function of frequency (series components); typical values.



Class-A operation; V_{CE} = 25 V; I_C = 3.2 A; T_h = 70 °C.

Fig.15 Power gain as a function of frequency; typical values.

RF performance in VHF class-AB operation (C.W.).

MODE OF OPERATION	f (MHz)	V_{CE} (V)	I_C, $I_{C(ZS)}$ (A)	T_h (°C)	P_L (W)	I_C (A)	η_C (%)	G_P (dB)(1)
CW, class-AB	224.25	28	0.2	70	40	typ. 2.75	typ. 52	typ. 11.5
					85	typ. 4.25	typ. 71	typ. 10.5

Note

1. Gain compression point of 1 dB is at typical 85 W (minimum 75 W). Using a 3rd-order amplitude transfer characteristic, 1 dB compression corresponds with 30 % sync input / 25 % sync output compression in television service (negative modulation, C.C.I.R. system).

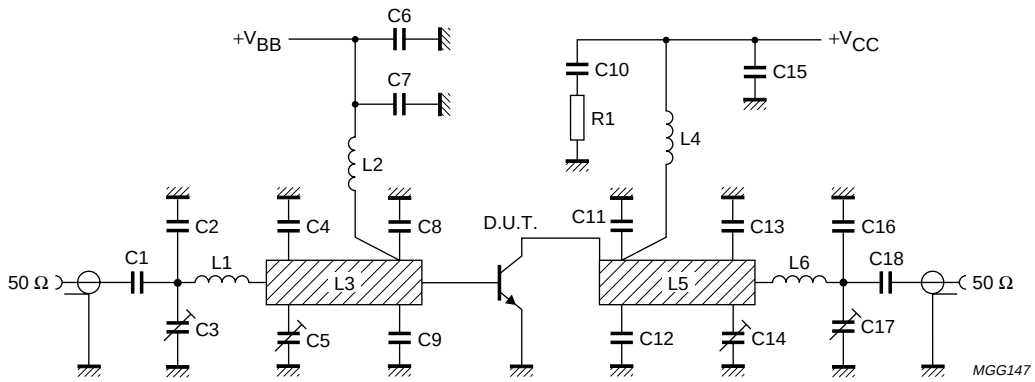


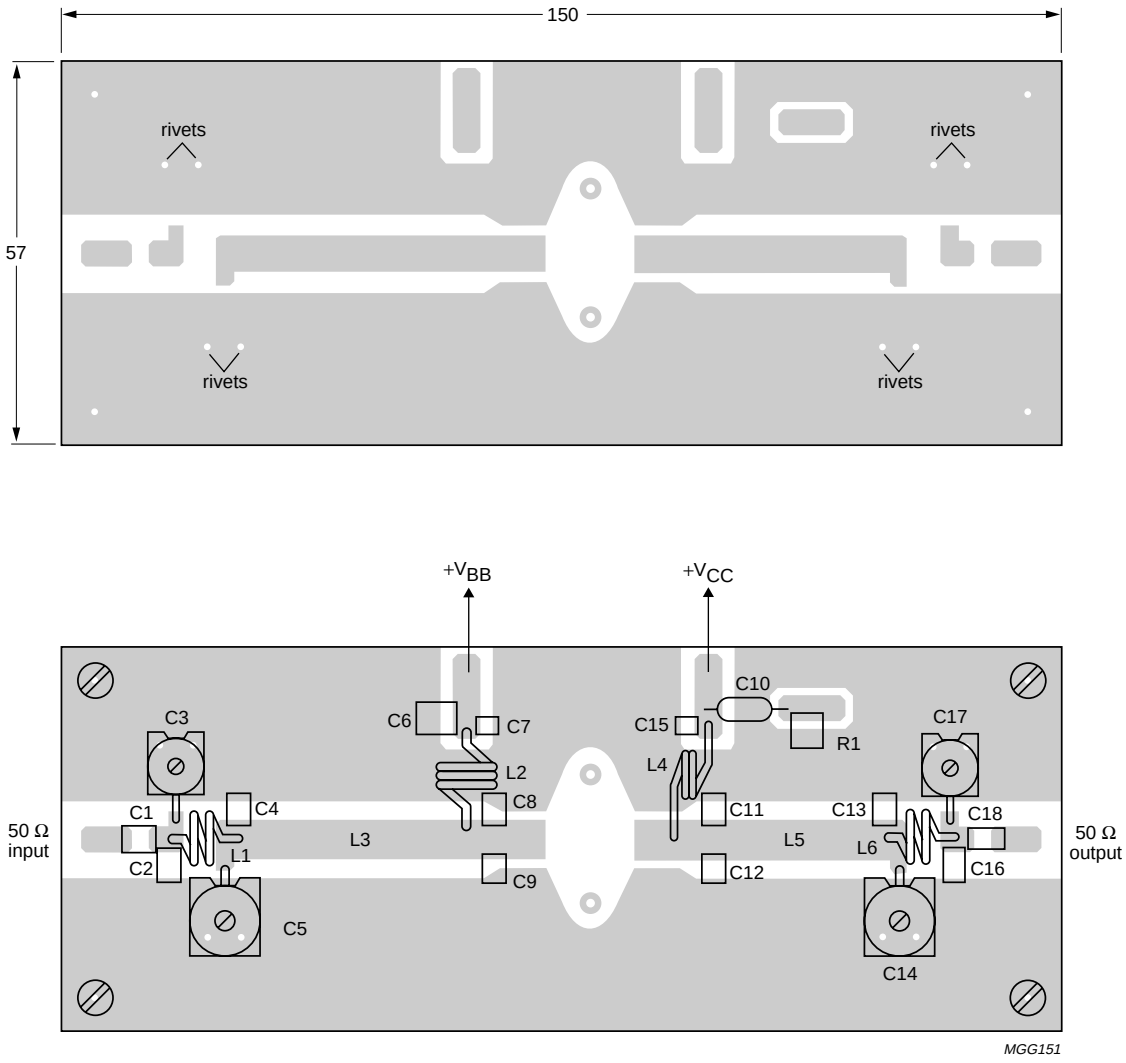
Fig.16 Class-AB test circuit at f_{vision} = 224.25 MHz.

List of components used in test circuit (see Figs 16 and 17).

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C18	multilayer ceramic chip capacitor; note 1	620 pF, 100 V		
C2	multilayer ceramic chip capacitor; note 1	27 pF, 500 V		
C3	film dielectric trimmer	2 to 18 pF		2222 809 09003
C4	multilayer ceramic chip capacitor; note 1	30 pF, 500 V		
C5, C14	film dielectric trimmer	4 to 40 pF		2222 809 08002
C6, C10	multilayer ceramic chip capacitor	470 nF, 50 V		2222 856 48474
C7, C15	multilayer ceramic chip capacitor	680 pF, 50 V		2222 852 13681
C8, C9	multilayer ceramic chip capacitor; note 1	68 pF, 500 V	placed 6.4 mm from transistor edge	
C11, C12	multilayer ceramic chip capacitor; note 1	43 pF, 500 V	placed 10 mm from transistor edge	
C13	multilayer ceramic chip capacitor; note 1	39 pF, 500 V		
C16	multilayer ceramic chip capacitor; note 1	3.3 pF, 500 V		
C17	film dielectric trimmer	1.4 to 5.5 pF		2222 809 09001
L1	2 turns of 1.6 mm enamelled Cu wire		int. diameter 4.5 mm length 4 mm leads 2 × 4 mm	
L2	3 turns of 1 mm closely wound enamelled Cu wire		int. diameter 5 mm leads 2 × 7 mm	
L3	stripline; note 2	30 Ω	6 mm × 47.8 mm	
L4	2 turns of 1 mm closely wound enamelled Cu wire		int. diameter 5 mm leads 2 × 8 mm	
L5	stripline; note 2	30 Ω	6 mm × 42.9 mm	
L6	2 turns of 1.6 mm enamelled Cu wire		int. diameter 4 mm length 4 mm leads 2 × 3 mm	
R1	carbon resistor	10 Ω		

Notes

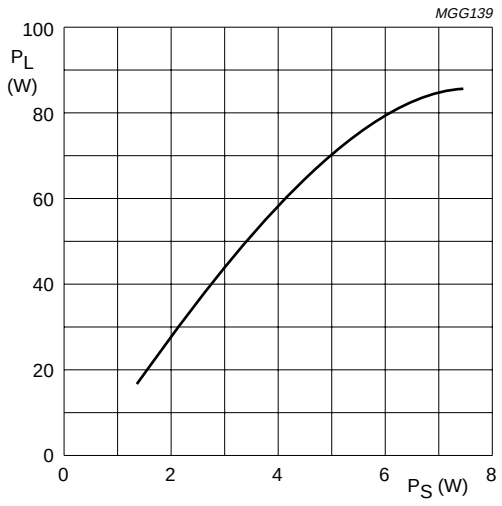
1. American Technical Ceramics type 100B or capacitor of same quality.
2. The striplines are on a double Cu-clad printed-circuit board, with epoxy fibre-glass dielectric (ε_r = 4.5); thickness $\frac{1}{16}$".



Dimensions in mm.

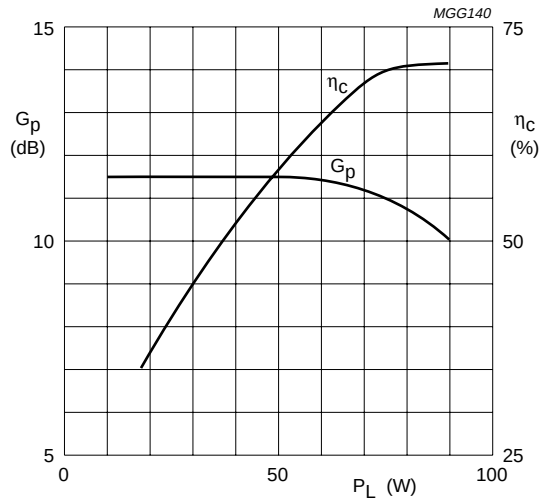
The circuit and the components are on one side of the epoxy fibre-glass board, the other side is unetched copper to serve as earth. Earth connections are made by hollow rivets. Additionally copper straps are used under the emitters and at the input and output to provide direct contact between the copper on the component side and the ground-plane.

Fig.17 Component layout and printed-circuit board for 224.25 MHz class-AB test circuit.



V_{CE} = 28 V; $I_{C(ZS)}$ = 0.2 A; T_h = 70 °C; f_{vision} = 224.25 MHz.

Fig.18 Load power as a function of source power; typical values.

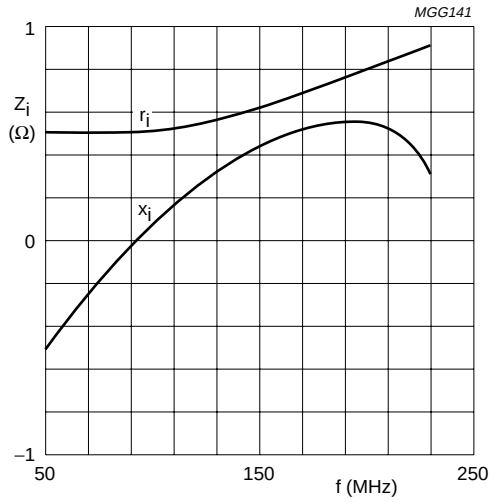


V_{CE} = 28 V; $I_{C(ZS)}$ = 0.2 A; T_h = 70 °C; f_{vision} = 224.25 MHz.

Fig.19 Power gain and efficiency as functions of load power; typical values.

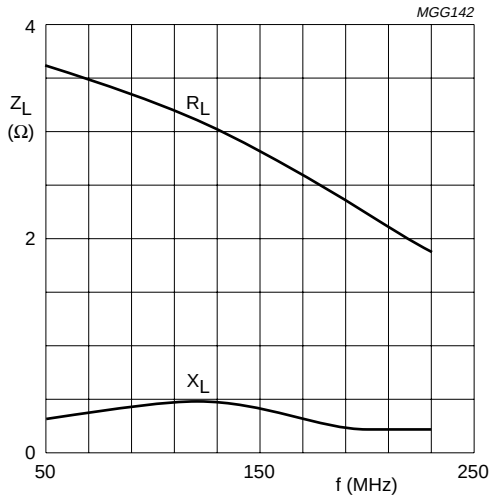
Ruggedness in class-AB operation

The BLV33F is capable of withstanding a full load mismatch corresponding to VSWR ≤2 through all phases) up to 60 W (RMS) and 85 W (PEP) under the following conditions:V_{CE} = 28 V; T_h = 70 °C; f = 224.25 MHz; $R_{th\ mb\text{-}h}$ = 0.2 K/W.



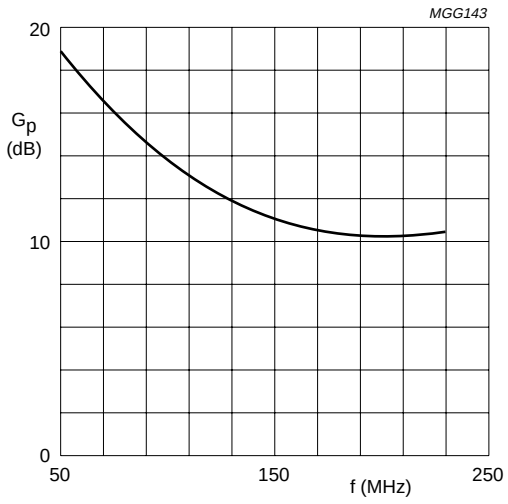
Class-AB operation; V_{CE} = 28 V; P_L = 80 W (PEP); T_h = 70 °C.

Fig.20 Input impedance as a function of frequency (series components); typical values.



Class-AB operation; V_{CE} = 28 V; P_L = 80 W (PEP); T_h = 70 °C.

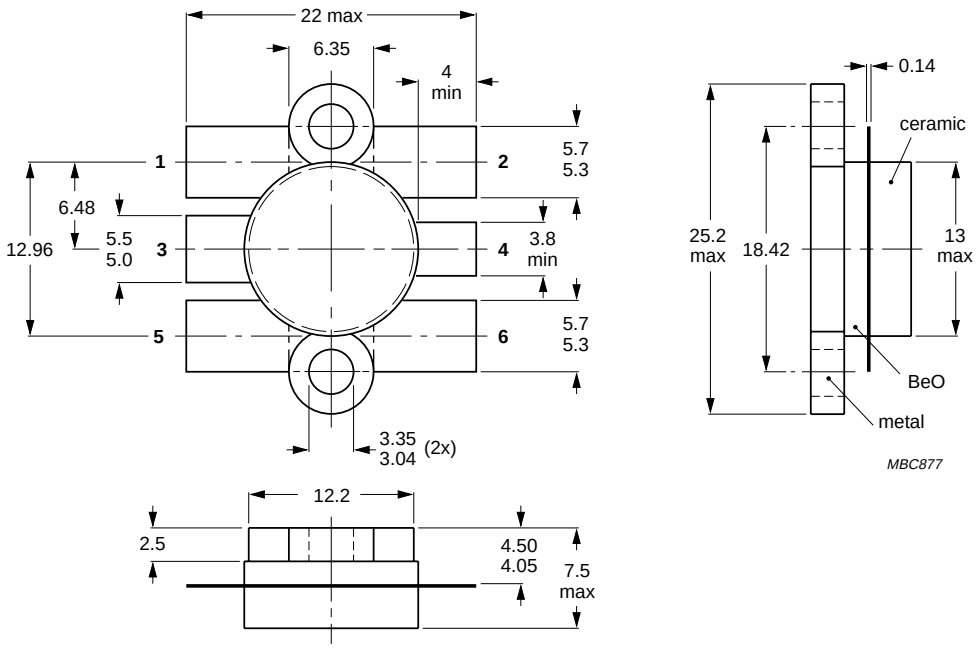
Fig.21 Load impedance as a function of frequency (series components); typical values.



Class-AB operation; V_{CE} = 28 V; P_L = 80 W (PEP); T_h = 70 °C.

Fig.22 Power gain as a function of frequency; typical values.

PACKAGE OUTLINE



Dimensions in mm.

Torque on screw: min. 0.6 Nm; max. 0.75 Nm.

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

Heatsink compound must be applied sparingly and evenly distributed.

Fig.23 SOT119A.

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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