

HF/VHF power transistor

BLW78

DESCRIPTION

N-P-N silicon planar epitaxial transistor intended for use in class-A, AB or B operated mobile, industrial and military transmitters in the h.f. and v.h.f. bands. It is resistance stabilized and is guaranteed to withstand severe load mismatch conditions.

It has a 1/2" flange envelope with a ceramic cap. All leads are isolated from the flange.

QUICK REFERENCE DATA

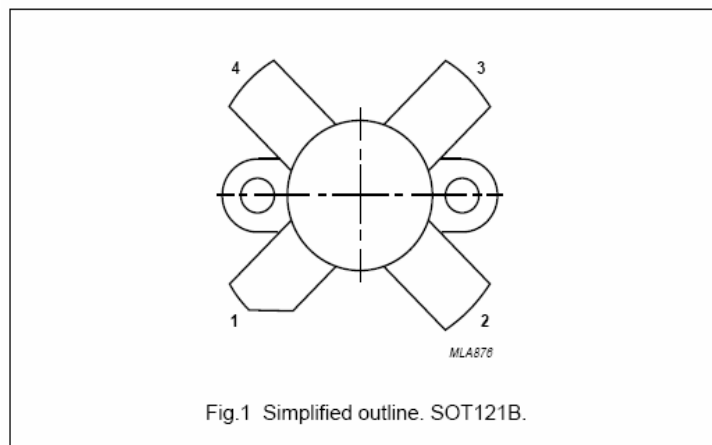
R.F. performance up to $T_h = 25\text{ }^\circ\text{C}$

MODE OF OPERATION	V_{CE} V	I_C $I_{C(ZS)}$ A	f MHz	P_L W	G_p dB	η %	$d_3^{(1)}$ dB
c.w. (class-B)	28	–	150	100	> 6	> 70	–
s.s.b. (class-A)	26	3	28	35 (P.E.P.)	typ. 19,5	–	typ. –40
s.s.b. (class-AB)	28	0,05	28	100 (P.E.P.)	typ. 19,0	typ. 42	typ. –30

Note

1. Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.

PIN CONFIGURATION



PINNING - SOT121B.

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

PRODUCT SAFETY This device incorporates beryllium oxide, the dust of which is toxic. The device is entirely safe provided that the BeO disc is not damaged.

RATINGS

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

Collector-emitter voltage ($V_{BE} = 0$) peak value	V_{CESM}	max.	70 V
Collector-emitter voltage (open base)	V_{CEO}	max.	35 V
Emitter-base voltage (open collector)	V_{EBO}	max.	4 V
Collector current (average)	$I_{C(AV)}$	max.	10 A
Collector current (peak value); $f > 1$ MHz	I_{CM}	max.	25 A
R.F. power dissipation ($f > 1$ MHz); $T_{mb} = 25$ °C	P_{rf}	max.	160 W
Storage temperature	T_{stg}		-65 to +150 °C
Operating junction temperature	T_j	max.	200 °C

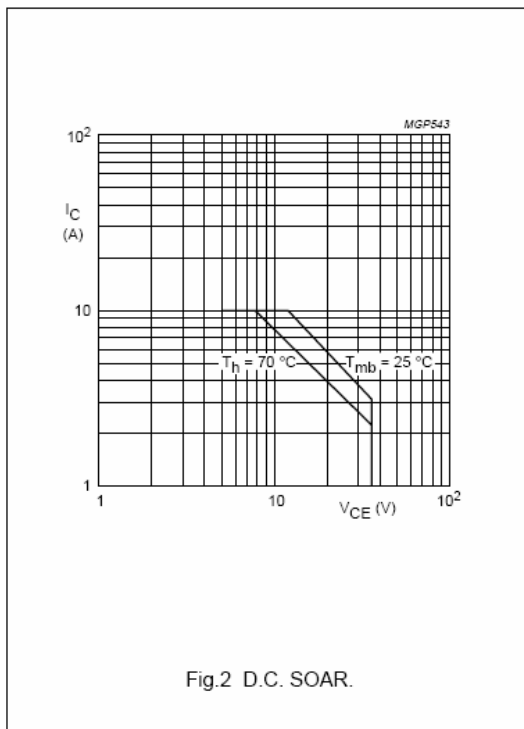


Fig.2 D.C. SOAR.

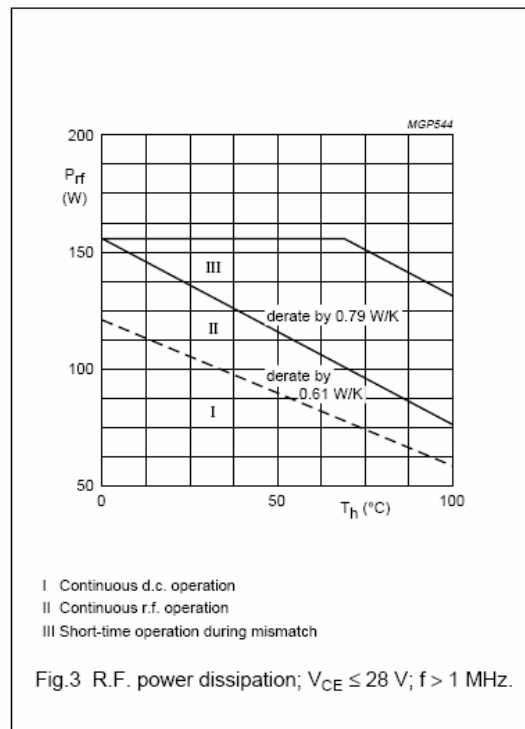


Fig.3 R.F. power dissipation; $V_{CE} \leq 28$ V; $f > 1$ MHz.

THERMAL RESISTANCE

(dissipation = 80 W; $T_{mb} = 86$ °C; i.e. $T_h = 70$ °C)

- From junction to mounting base (d.c. dissipation)
- From junction to mounting base (r.f. dissipation)
- From mounting base to heatsink

$R_{th\ j-mb(dc)}$	=	1,45 K/W
$R_{th\ j-mb(rf)}$	=	1,06 K/W
$R_{th\ mb-h}$	=	0,2 K/W

CHARACTERISTICS

$T_j = 25\text{ °C}$

Collector-emitter breakdown voltage

$V_{BE} = 0; I_C = 50\text{ mA}$

$V_{(BR)CES} > 70\text{ V}$

Collector-emitter breakdown voltage

open base; $I_C = 100\text{ mA}$

$V_{(BR)CEO} > 35\text{ V}$

Emitter-base breakdown voltage

open collector; $I_E = 5\text{ mA}$

$V_{(BR)EBO} > 4\text{ V}$

Collector cut-off current

$V_{BE} = 0; V_{CE} = 35\text{ V}$

$I_{CES} < 5\text{ mA}$

D.C. current gain⁽¹⁾

$I_C = 5\text{ A}; V_{CE} = 5\text{ V}$

$h_{FE} 20\text{ to }85$

Collector-emitter saturation voltage

$I_C = 15\text{ A}; I_B = 3\text{ A}$

$V_{CEsat} \text{ typ. } 2\text{ V}$

Transition frequency at $f = 100\text{ MHz}$ ⁽²⁾

$-I_E = 5\text{ A}; V_{CB} = 28\text{ V}$

$f_T \text{ typ. } 370\text{ MHz}$

$-I_E = 15\text{ A}; V_{CB} = 28\text{ V}$

$f_T \text{ typ. } 350\text{ MHz}$

Collector capacitance at $f = 1\text{ MHz}$

$I_E = I_e = 0; V_{CB} = 28\text{ V}$

$C_c \text{ typ. } 155\text{ pF}$

Feedback capacitance at $f = 1\text{ MHz}$

$I_C = 100\text{ mA}; V_{CE} = 28\text{ V}$

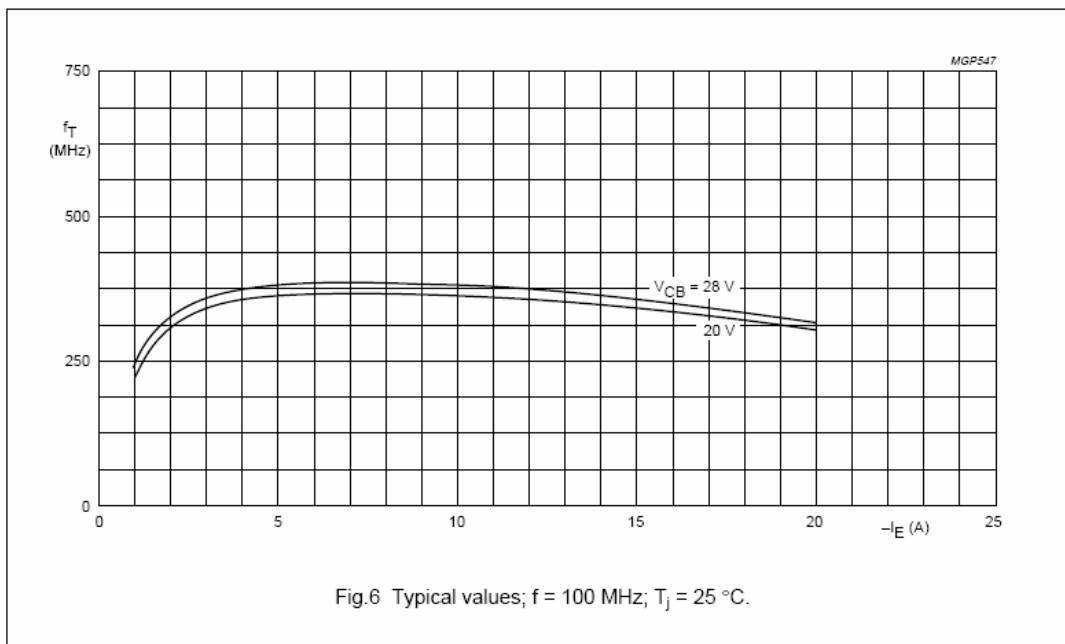
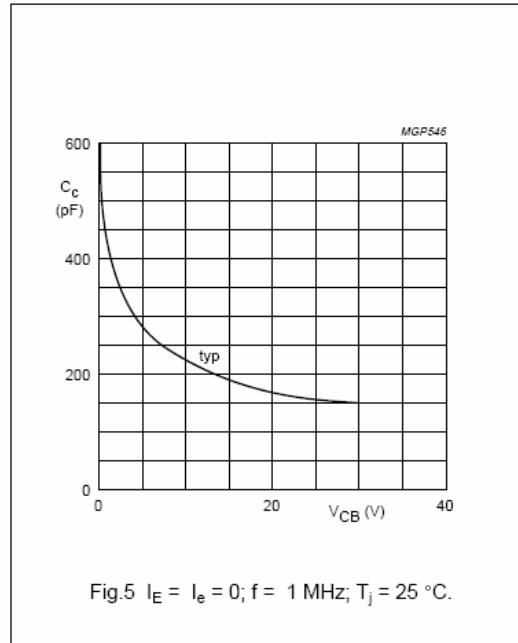
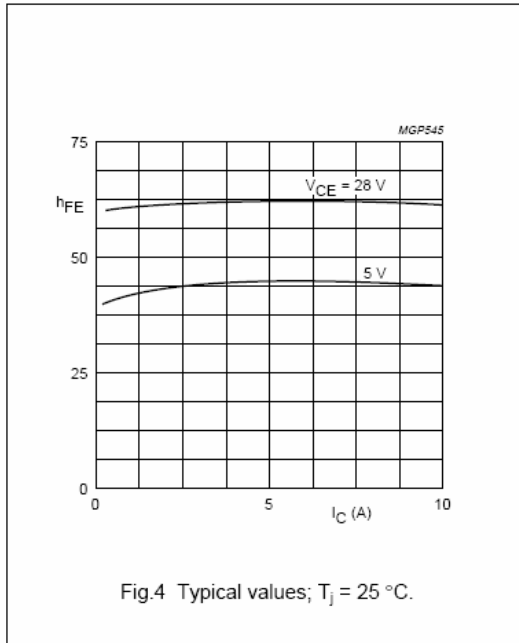
$C_{re} \text{ typ. } 102\text{ pF}$

Collector-flange capacitance

$C_{cf} \text{ typ. } 3\text{ pF}$

Notes

1. Measured under pulse conditions: $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0,02$.
2. Measured under pulse conditions: $t_p \leq 50\text{ }\mu\text{s}; \delta \leq 0,01$.



APPLICATION INFORMATION

R.F. performance in c.w. operation (unneutralized common-emitter class-B circuit); $T_h = 25\text{ }^\circ\text{C}$

f (MHz)	V_{CE} (V)	P_L (W)	P_D (W)	η (%)	\bar{z}_i (Ω)	\bar{Z}_L (Ω)
150	28	100	≤ 25	≥ 70	$0,74 + j1,35$	$4,30 + j0,60$

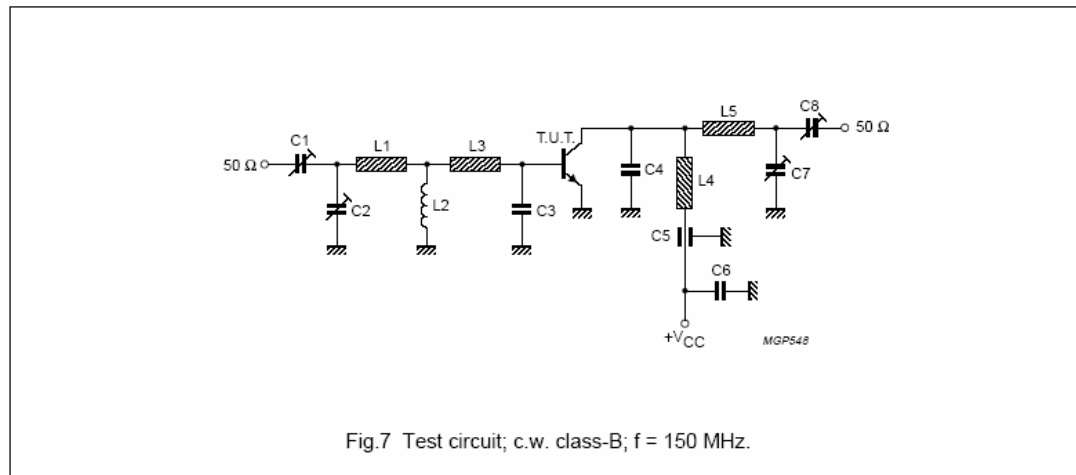


Fig.7 Test circuit; c.w. class-B; f = 150 MHz.

List of components:

C1 = C2 = C7 = C8 = 5 to 100 pF film dielectric trimmer

C3 = 203 pF; 2×82 pF and 39 pF multilayer ceramic chip capacitors (500 V, ATC⁽¹⁾) in parallel

C4 = 39 pF multilayer ceramic chip capacitor (500 V, ATC⁽¹⁾)

C5 = 1 nF feed-through capacitor

C6 = 100 nF polyester capacitor

L1 = strip (30 mm \times 8 mm); bent to form inverted 'U' shape with top 15 mm above heatsink, and bottom 5 mm above heatsink

L2 = 1 μH r.f. choke

L3 = strip; shape as shown in Fig.8; 5 mm above heatsink

L4 = strip (40 mm \times 8 mm); bent in form \perp , 25 mm at 15 mm above heatsink, 5 mm at 5 mm above heatsink

L5 = strip (75 mm long; width 8 mm); 5 mm above base

L1, L3, L4, and L5 are copper strips with a thickness of 0,6 mm.

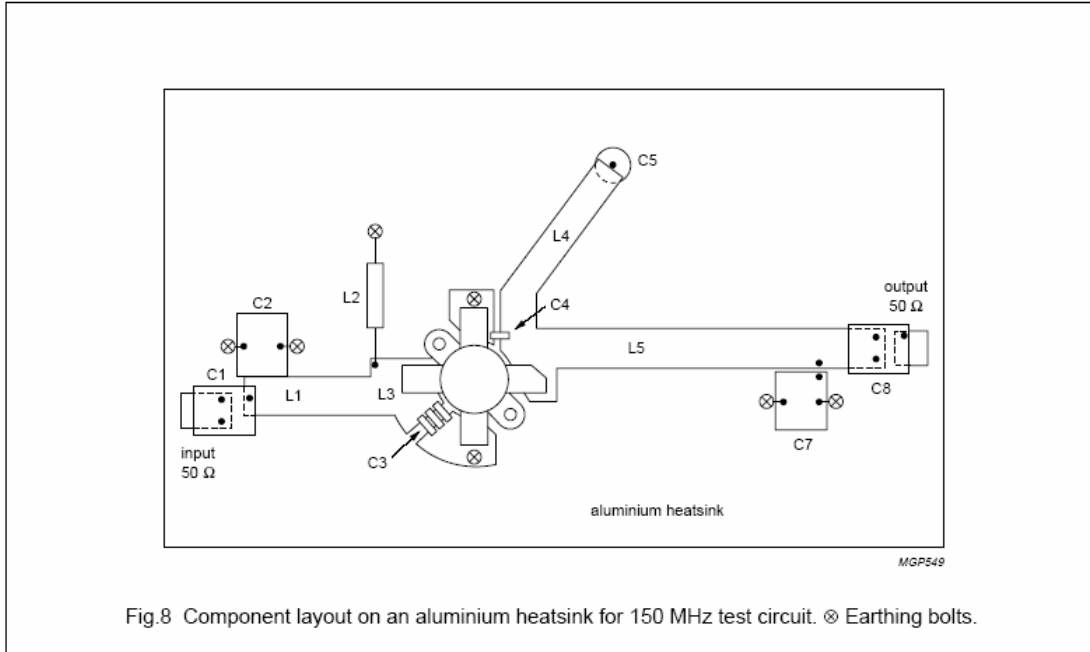
Heatsink: aluminium; 0,9 K/W

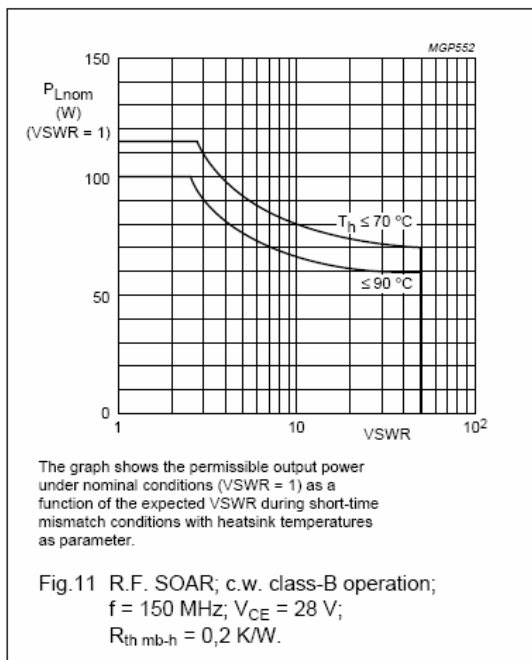
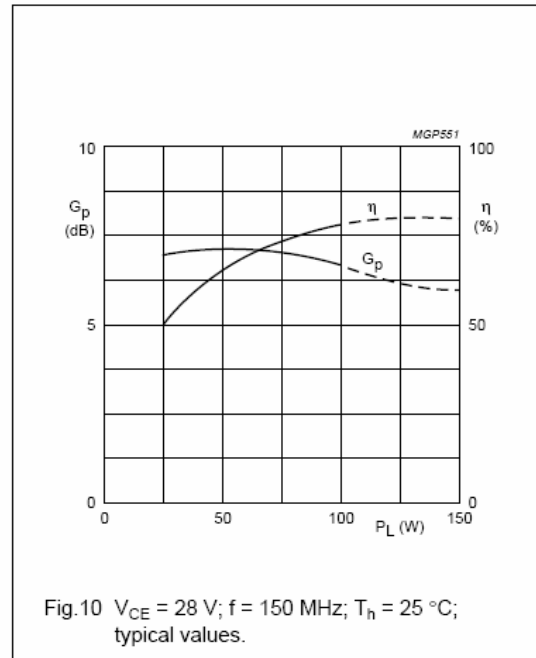
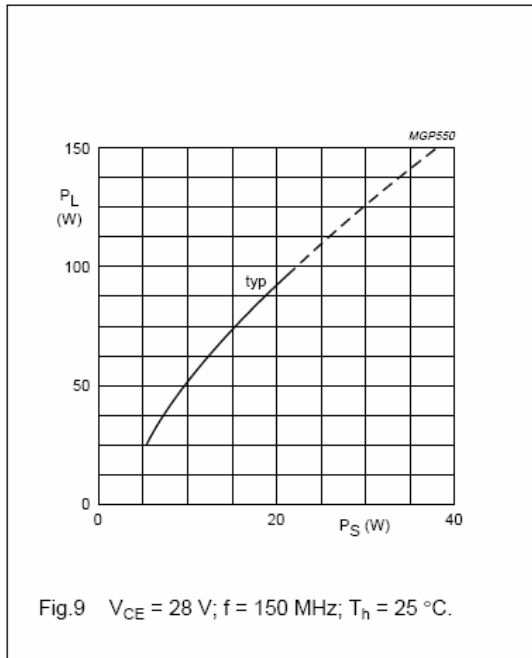
At $P_L = 100$ W and $V_{CE} = 28$ V, the output power at heatsink temperatures between 25 $^\circ\text{C}$ and 90 $^\circ\text{C}$ relative to that at 25 $^\circ\text{C}$ is diminished by typ. 0,12 W/K.

Component layout on an aluminium heatsink for 150 MHz test circuit is shown in Fig.8.

Note

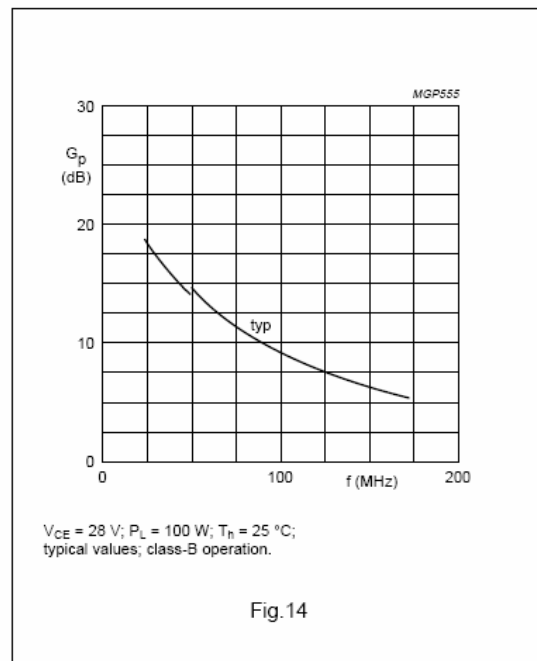
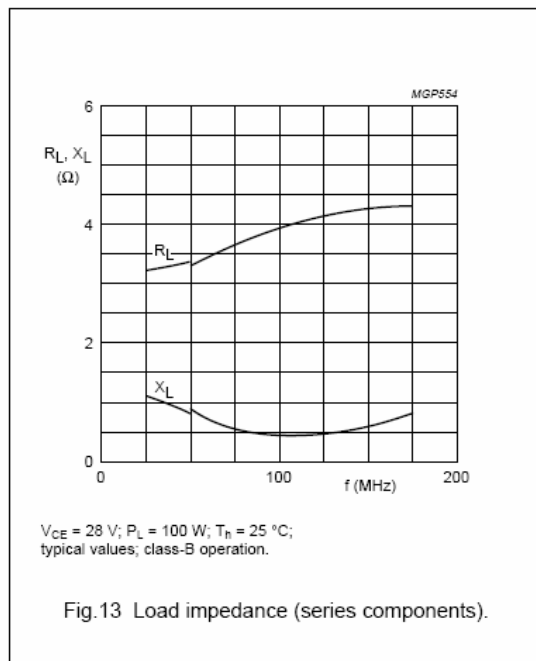
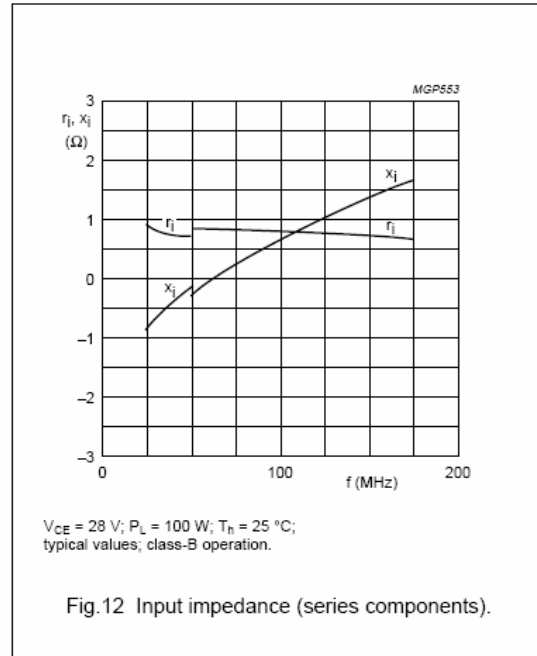
1. ATC means American Technical Ceramics.





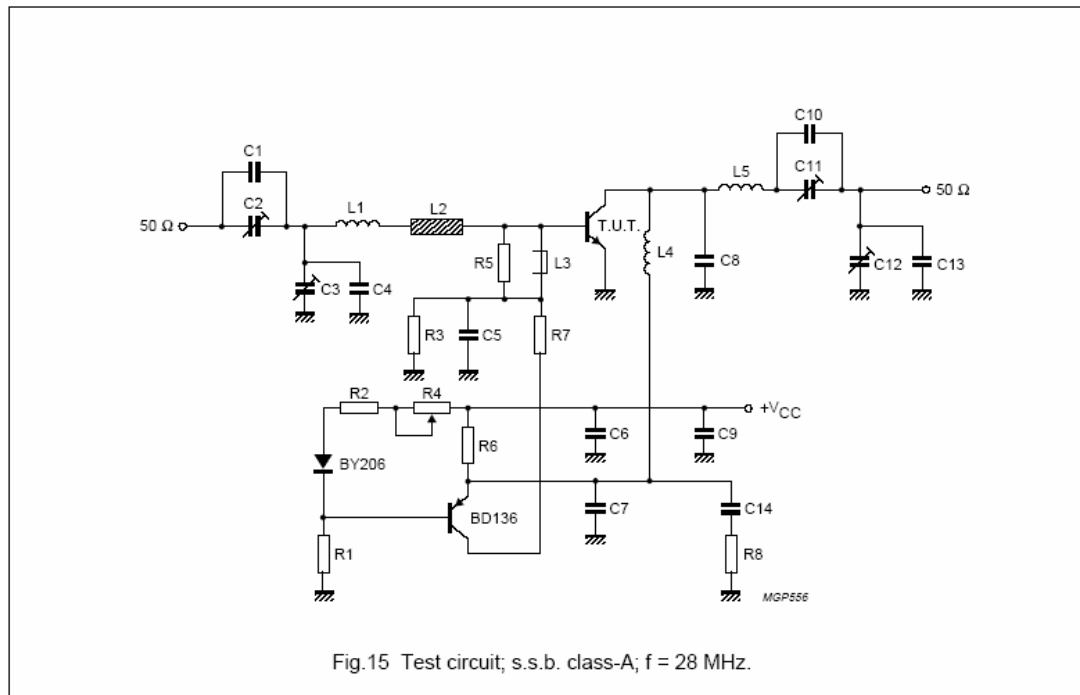
OPERATING NOTE

Below 50 MHz a base-emitter resistor of 4,7 Ω is recommended to avoid oscillation. This resistor must be effective for r.f. only.



R.F. performance in s.s.b. class-A operation
 $V_{CE} = 26 \text{ V}$; $T_h = 40 \text{ }^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

OUTPUT POWER W	G_p dB	I_c A	d_3 dB
35 (P.E.P.)	typ. 19,5	3	typ. -40



List of components:

- C1 = 33 pF ceramic capacitor (500 V)
- C2 = 100 pF air dielectric trimmer (single insulated rotor type)
- C3 = 280 pF air dielectric trimmer (single non-insulated rotor type)
- C4 = 180 pF polystyrene capacitor
- C5 = C6 = C7 = 3,9 nF ceramic capacitor
- C8 = 2 × 33 pF ceramic capacitors in parallel (500 V)
- C9 = 330 nF polyester capacitor
- C10 = 82 pF ceramic capacitor (500 V)
- C11 = 100 pF air dielectric trimmer (single insulated rotor type)
- C12 = 180 pF air dielectric trimmer (single non-insulated rotor type)
- C13 = 150 pF polystyrene capacitor
- C14 = 390 nF polyester capacitor
- L1 = 72 nH; 3 turns Cu wire (1,0 mm); int. dia. 7 mm; length 4,8 mm; leads 2 × 5 mm
- L2 = Cu strip (28 mm × 5 mm × 0,2 mm); 18 mm at 3 mm above printed-circuit board
- L3 = Ferroxcube choke coil (cat. no. 4312 020 36640)
- L4 = 300 nH; 6 turns Cu wire (1,5 mm); int. dia. 12 mm; length 16 mm; leads 2 × 5 mm
- L5 = 330 nH; 7 turns Cu wire (1,5 mm); int. dia. 12 mm; length 20,8 mm; leads 2 × 5 mm
- R1 = 1,5 k Ω (\pm 5%) carbon resistor (0,5 W)
- R2 = 100 Ω (\pm 5%) carbon resistor (0,5 W)
- R3 = 68 Ω (\pm 5%) carbon resistor (0,5 W)
- R4 = 100 Ω wirewound potentiometer
- R5 = 33 Ω (\pm 5%) carbon resistor (0,5 W)
- R6 = 0,68 Ω (\pm 10%) wirewound resistor (7 W)
- R7 = 120 Ω wirewound resistor (8 W)
- R8 = 10 Ω (\pm 10%) carbon resistor (0,5 W)

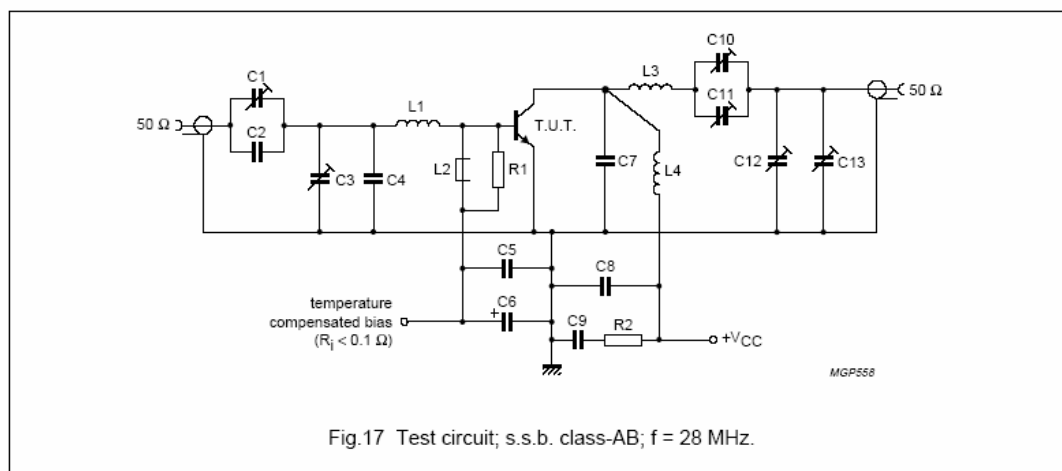
R.F. performance in s.s.b. class-AB operation (linear power amplifier)

$V_{CE} = 28 \text{ V}$; $T_h = 25 \text{ }^\circ\text{C}$; $f_1 = 28,000 \text{ MHz}$; $f_2 = 28,001 \text{ MHz}$

OUTPUT POWER W	G_p dB	η_{dt} %	I_C A	$d_3^{(1)}$ dB	$d_5^{(1)}$ dB	$I_{C(ZS)}$ mA
100 (P.E.P.)	typ. 19	typ. 42	typ. 4,3	typ. -30	typ. -37	50

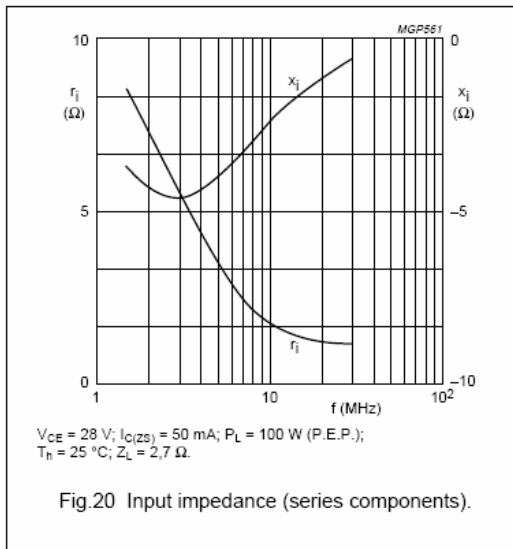
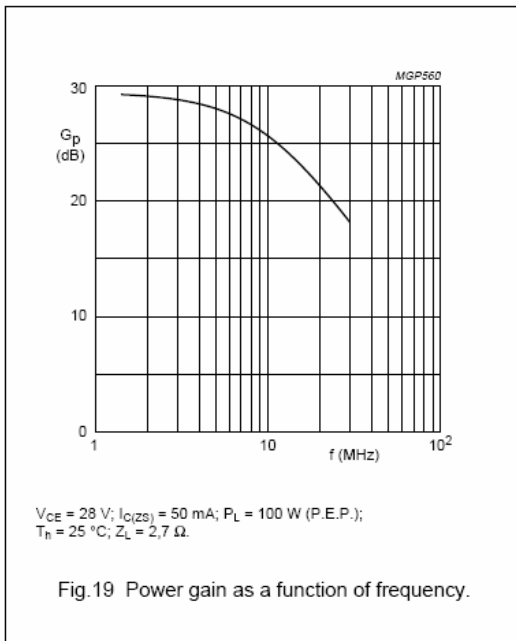
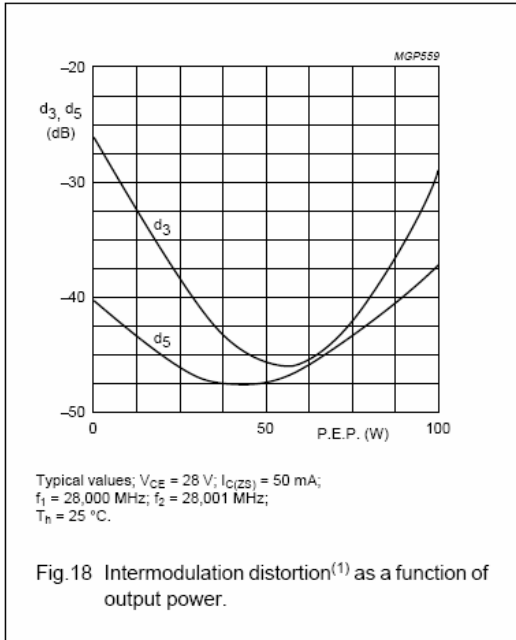
Note

1. Stated intermodulation distortion figures are referred to the according level of either of the equal amplified tones. Relative to the according peak envelope powers these figures should be increased by 6 dB.



List of components:

- C1 = C11 = 150 pF air dielectric trimmer (single insulated rotor type)
- C2 = 27 pF ceramic capacitor (500 V)
- C3 = C12 = 150 pF air dielectric trimmer (single non-insulated rotor type)
- C4 = 180 pF ceramic capacitor (500 V)
- C5 = C8 = 3,9 nF ceramic capacitor
- C6 = 150 $\mu\text{F}/6 \text{ V}$ solid tantalum capacitor
- C7 = 150 pF ceramic capacitor (500 V)
- C9 = 100 nF polyester capacitor
- C10 = 750 pF mica dielectric trimmer (single insulated rotor type)
- C13 = 750 pF mica dielectric trimmer (single non-insulated rotor type)
- L1 = 3 turns enamelled Cu wire (1,0 mm); int. dia. 12 mm; length 12 mm
- L2 = Ferroxcube wide-band h.f. choke, grade 3B (cat. no. 4312 020 36640)
- L3 = 3 turns enamelled Cu wire (2,0 mm); int. dia. 12 mm; length 12 mm
- L4 = 2 turns enamelled Cu wire (2,0 mm); int. dia. 12 mm; length 8 mm
- R1 = 27 Ω ($\pm 10\%$) carbon resistor (0,5 W)
- R2 = 4,7 Ω ($\pm 10\%$) carbon resistor (0,5 W)



Figs 19 and 20 are typical curves and hold for an unneutralized amplifier in s.s.b. class-AB operation.



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