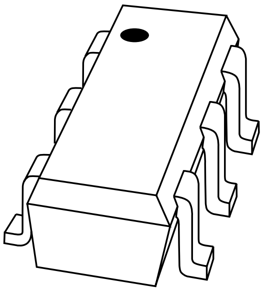
DATA SHEET



BGA2776
MMIC wideband amplifier

Product specification
Supersedes data of 2001 Oct 19

2002 Aug 06

Philips
Semiconductors

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FEATURES

- Internally matched
- Very wide frequency range
- Very flat gain
- High gain
- High output power
- Unconditionally stable.

APPLICATIONS

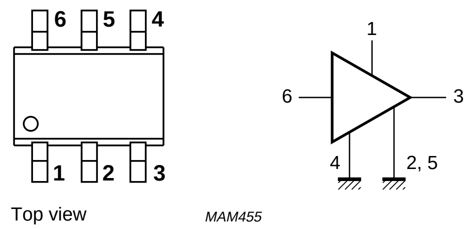
- Cable systems
- LNB IF amplifiers
- General purpose
- ISM.

DESCRIPTION

Silicon Monolithic Microwave Integrated Circuit (MMIC) wideband amplifier with internal matching circuit in a 6-pin SOT363 SMD plastic package.

PINNING

PIN	DESCRIPTION
1	V_S
2, 5	GND2
3	RF out
4	GND1
6	RF in



Marking code: G4-.

Fig.1 Simplified outline (SOT363) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_S	DC supply voltage		5	6	V
I_S	DC supply current		24.4	–	mA
$\|s_{21}\|^2$	insertion power gain	f = 1 GHz	23.2	–	dB
NF	noise figure	f = 1 GHz	4.9	–	dB
$P_{L(sat)}$	saturated load power	f = 1 GHz	10.5	–	dBm

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_S	DC supply voltage	RF input AC coupled	–	6	V
I_S	supply current		–	34	mA
P_{tot}	total power dissipation	$T_s \leq 80$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C
P_D	maximum drive power		–	10	dBm

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point	$P_{tot} = 200$ mW; $T_s \leq 80$ °C	300	K/W

CHARACTERISTICS

$V_S = 5$ V; $I_S = 24.4$ mA; f = 1 GHz; $T_j = 25$ °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current		19	24.4	34	mA
$\|s_{21}\|^2$	insertion power gain	f = 1 GHz	–	23.2	–	dB
		f = 2 GHz	–	23.2	–	dB
$R_{L\ IN}$	return losses input	f = 1 GHz	–	9	–	dB
		f = 2 GHz	–	7	–	dB
$R_{L\ OUT}$	return losses output	f = 1 GHz	–	17	–	dB
		f = 2 GHz	–	9	–	dB
NF	noise figure	f = 1 GHz	–	4.9	–	dB
		f = 2 GHz	–	5.3	–	dB
BW	bandwidth	at $\|s_{21}\|^2$ –3 dB below flat gain at 1 GHz	–	2.8	–	GHz
$P_{L(sat)}$	saturated load power	f = 1 GHz	–	10.5	–	dBm
		f = 2 GHz	–	8.1	–	dBm
$P_{L\ 1\ dB}$	load power	at 1 dB gain compression; f = 1 GHz	–	7.2	–	dBm
		at 1 dB gain compression; f = 2 GHz	–	6	–	dBm
$IP3_{(in)}$	input intercept point	f = 1 GHz	–	–4.6	–	dBm
		f = 2 GHz	–	–8.8	–	dBm
$IP3_{(out)}$	output intercept point	f = 1 GHz	–	18.6	–	dBm
		f = 2 GHz	–	14.4	–	dBm

APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2776 MMIC. The device is internally matched to 50 Ω, and therefore does not need any external matching. The value of the input and output DC blocking capacitors C2 and C3 should be not more than 100 pF for applications above 100 MHz. However, when the device is operated below 100 MHz, the capacitor value should be increased.

The nominal value of the RF choke L1 is 100 nH. At frequencies below 100 MHz this value should be increased to 220 nH. At frequencies above 1 GHz a much lower value must be used (e.g. 10 nH) to improve return losses. For optimal results, a good quality chip inductor such as the TDK MLG 1608 (0603), or a wire-wound SMD type should be chosen.

Both the RF choke L1 and the 22 nF supply decoupling capacitor C1 should be located as closely as possible to the MMIC.

Separate paths must be used for the ground planes of the ground pins GND1 and GND2, and these paths must be as short as possible. When using vias, use multiple vias per pin in order to limit ground path inductance.

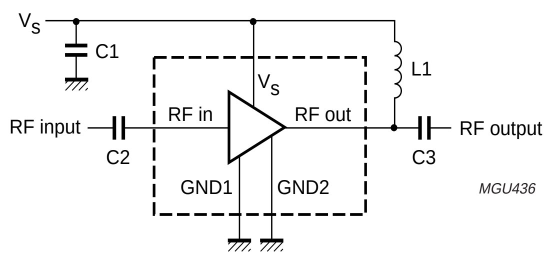


Fig.2 Typical application circuit.

Figure 3 shows two cascaded MMICs. This configuration doubles overall gain while preserving broadband characteristics. Supply decoupling and grounding conditions for each MMIC are the same as those for the circuit of Fig.2.

The excellent wideband characteristics of the MMIC make it and ideal building block in IF amplifier applications such as LBNs (see Fig.4).

As a buffer amplifier between an LNA and a mixer in a receiver circuit, the MMIC offers an easy matching, low noise solution (see Fig.5).

In Fig.6 the MMIC is used as a driver to the power amplifier as part of a transmitter circuit. Good linear performance and matched input and output offer quick design solutions in such applications.

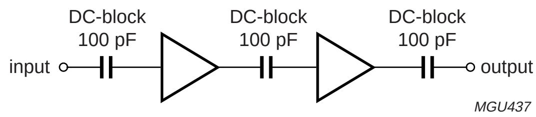


Fig.3 Simple cascade circuit.

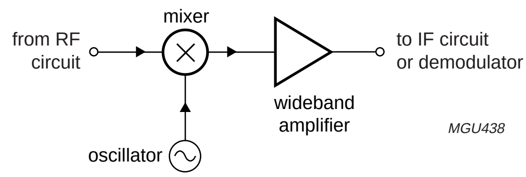


Fig.4 IF amplifier application.

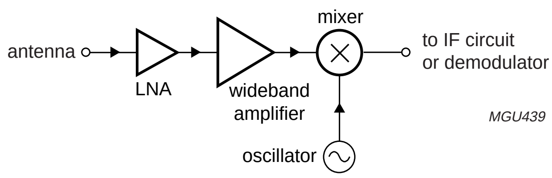


Fig.5 RF amplifier application.

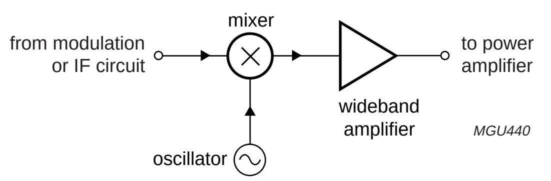
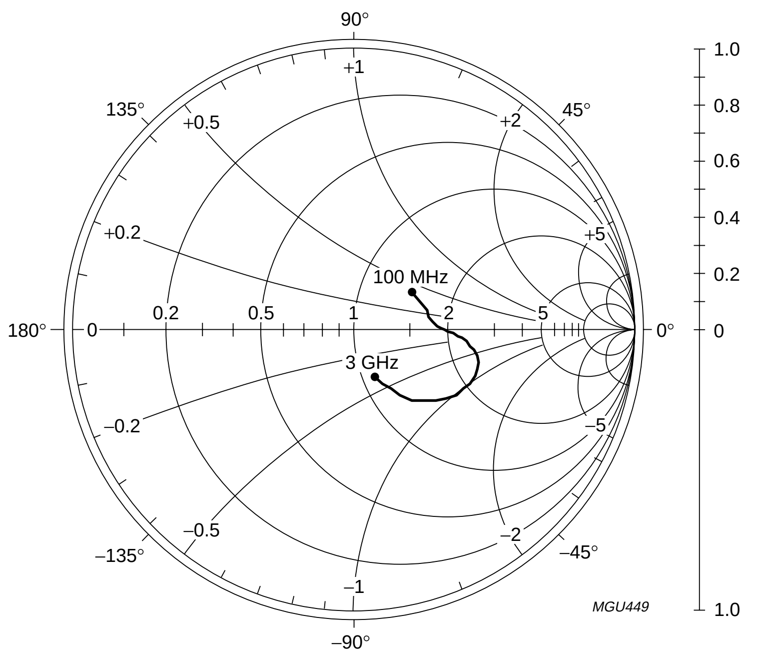
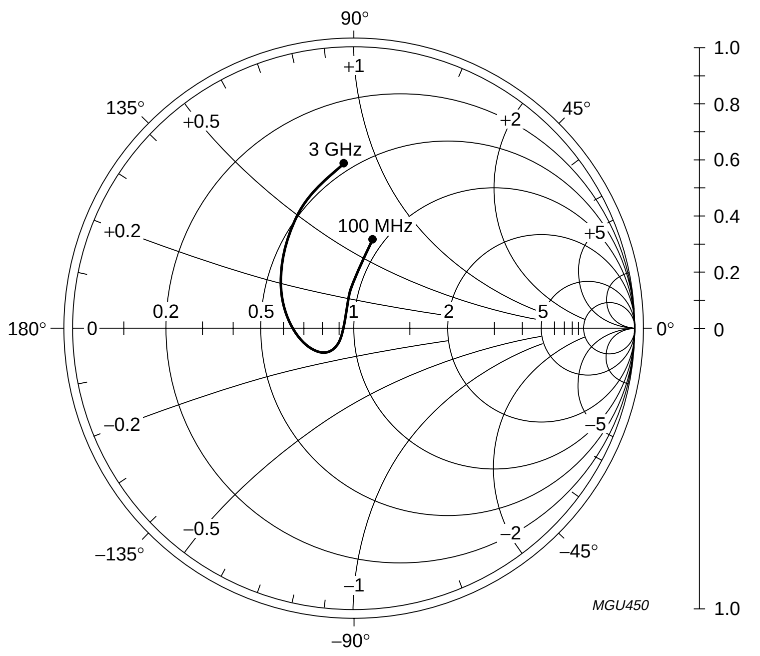


Fig.6 Power amplifier driver application.



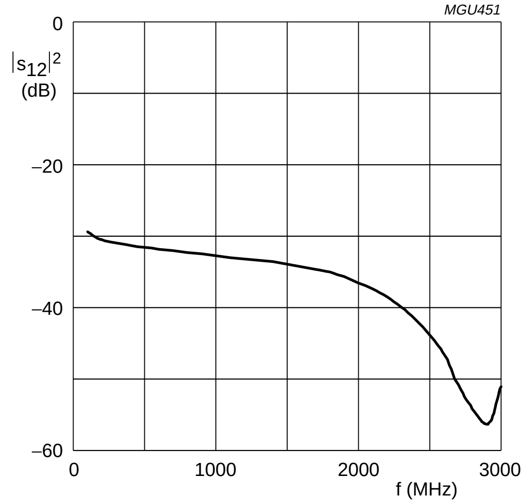
I_S = 23.8 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.7 Input reflection coefficient (s_{11}); typical values.



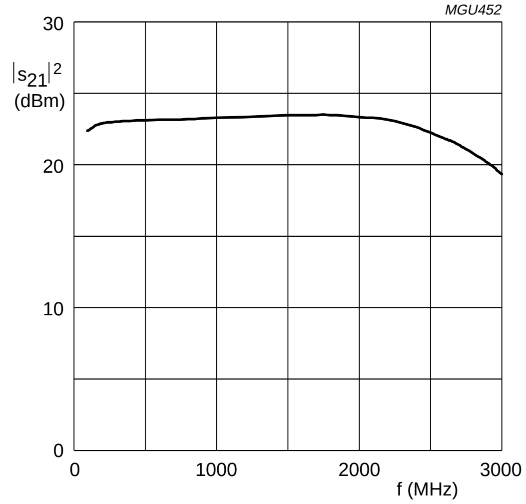
I_S = 23.8 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.8 Output reflection coefficient (s_{22}); typical values.



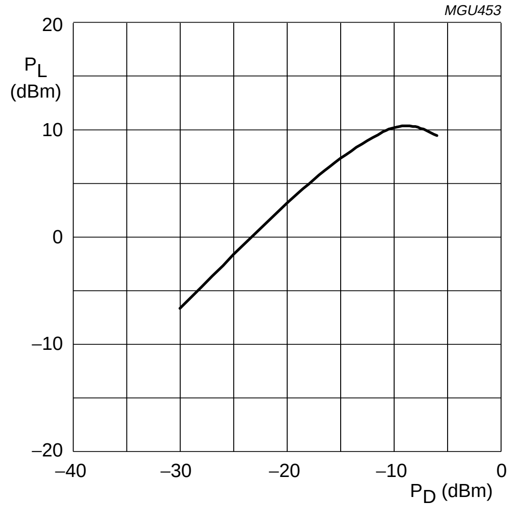
I_S = 23.8 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.9 Isolation ($|s_{12}|^2$) as a function of frequency; typical values.



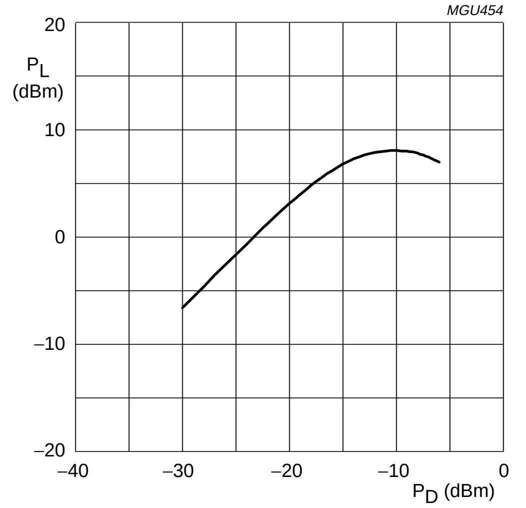
I_S = 23.8 mA; V_S = 5 V; P_D = −30 dBm; Z_O = 50 Ω.

Fig.10 Insertion gain ($|s_{21}|^2$) as a function of frequency; typical values.



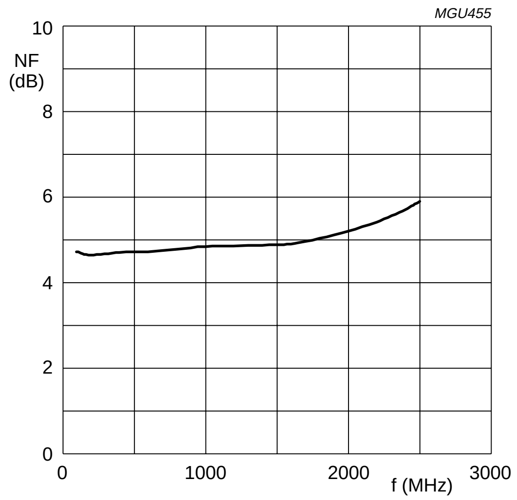
V_S = 5 V; f = 1 GHz; Z_O = 50 Ω.

Fig.11 Load power as a function of drive power at 1 GHz; typical values.



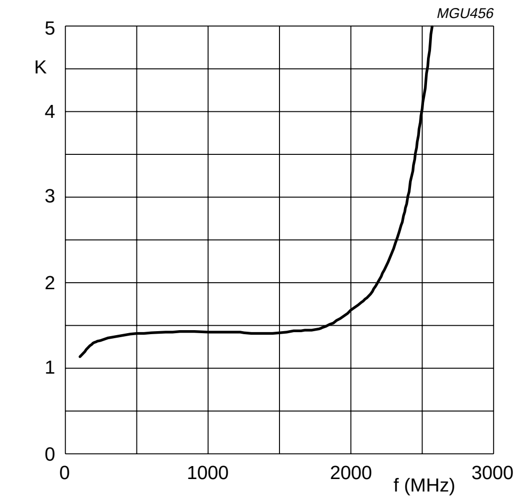
V_S = 5 V; f = 2 GHz; Z_O = 50 Ω.

Fig.12 Load power as a function of drive power at 2 GHz; typical values.



I_S = 23.8 mA; V_S = 5 V; Z_O = 50 Ω.

Fig.13 Noise figure as a function of frequency; typical values.



I_S = 23.8 mA; V_S = 5 V; Z_O = 50 Ω.

Fig.14 Stability factor as a function of frequency; typical values.

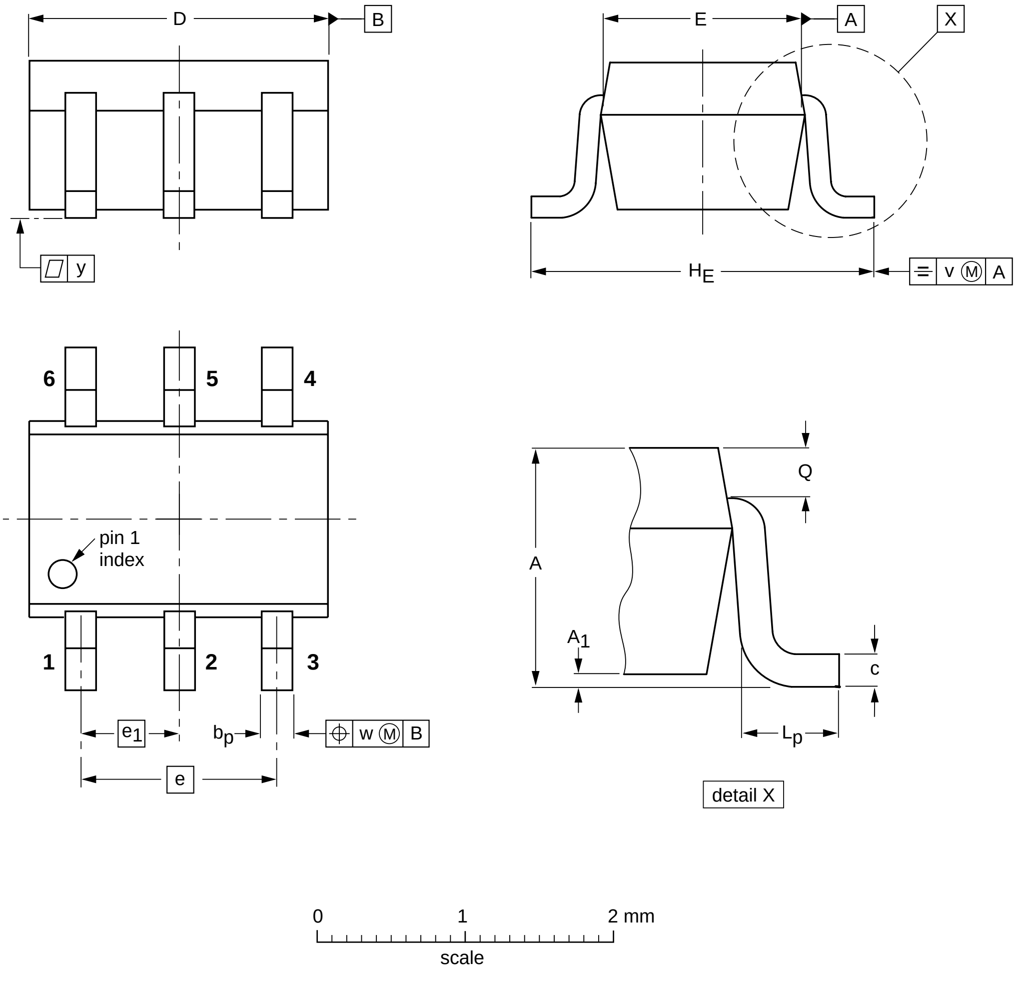
Scattering parameters

I_S = 23.8 mA; V_S = 5 V; P_D = –30 dBm; Z_O = 50 Ω; T_{amb} = 25 °C.

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
100	0.24807	33.20	13.128	18.88	0.03393	18.97	0.33203	77.92
200	0.27028	15.23	13.939	1.305	0.02979	7.840	0.16144	92.47
400	0.28518	5.613	14.233	–16.20	0.02720	–3.208	0.04702	127.5
600	0.30074	1.998	14.370	–29.60	0.02573	–8.356	0.05168	–147.7
800	0.32672	0.099	14.418	–42.25	0.02434	–11.95	0.09810	–134.1
1000	0.35611	–1.702	14.566	–54.66	0.02310	–14.59	0.13562	–139.8
1200	0.38865	–4.465	14.683	–67.44	0.02189	–17.14	0.16792	–152.8
1400	0.41966	–7.778	14.828	–80.86	0.02100	–20.38	0.19808	–169.9
1600	0.44966	–12.12	14.911	–94.49	0.01929	–24.40	0.23691	171.6
1800	0.46509	–17.78	14.941	–109.4	0.01774	–29.44	0.28834	153.5
2000	0.45980	–24.85	14.688	–124.9	0.01494	–36.30	0.34770	137.6
2200	0.43684	–32.59	14.389	–140.7	0.01193	–41.31	0.40964	124.2
2400	0.38779	–40.66	13.533	–157.9	0.00828	–43.81	0.46607	113.1
2600	0.32424	–50.49	12.355	–174.5	0.00477	–48.94	0.51421	105.9
2800	0.25311	–57.33	11.049	169.3	0.00146	–17.41	0.56131	98.30
3000	0.18665	–65.52	9.2745	154.9	0.00279	94.00	0.59748	93.63

PACKAGE OUTLINE

Plastic surface mounted package; 6 leads **SOT363**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1 max	b_p	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT363			SC-88			97-02-28

DATA SHEET STATUS

DATA SHEET STATUS[1]	PRODUCT STATUS[2]	DEFINITIONS
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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Contact information

For additional information please visit **http://www.semiconductors.philips.com**. Fax: **+31 40 27 24825**
For sales offices addresses send e-mail to: **sales.addresses@www.semiconductors.philips.com**.

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