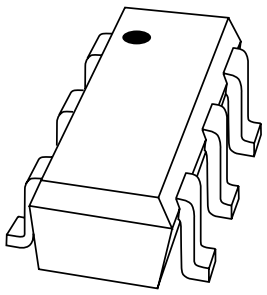
DATA SHEET



BGA2715
MMIC wideband amplifier

Preliminary specification

2004 Feb 02

Philips
Semiconductors

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MMIC wideband amplifier BGA2715

FEATURES

- Internally matched to 50 Ω
- Wide frequency range (3.3 GHz at 3 dB bandwidth)
- Flat 22 dB gain (± 1 dB up to 2.8 GHz)
- –5 dBm output power at 1dB compression point
- Good linearity for low current ($IP3_{(out)}$ = 2 dBm)
- Low second harmonic, –30 dBc at P_{Drive} = –40 dBm
- Unconditionally stable ($K \geq 2$).

APPLICATIONS

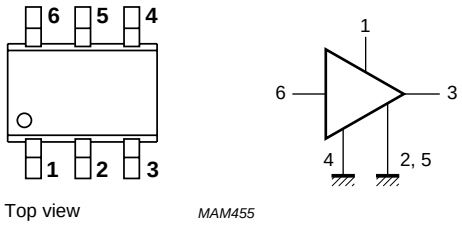
- LNB IF amplifiers
- Cable systems
- ISM
- General purpose.

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: B6-.

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		4.3	–	mA
$\|s_{21}\|^2$	insertion power gain	f = 1 GHz	22	–	dB
NF	noise figure	f = 1 GHz	2.6	–	dB
$P_{L(sat)}$	saturated load power	f = 1 GHz	–4	–	dBm

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		–	8	mA
P_{tot}	total power dissipation	$T_s \leq 90$ °C	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C
P_D	maximum drive power		–	–10	dBm

CAUTION
This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}s}$	thermal resistance from junction to solder point	P_{tot} = 200 mW; $T_s \leq 90$ °C	300	K/W

CHARACTERISTICS

V_S = 5 V; I_S = 4.3 mA; T_j = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_S	supply current		3.5	4.3	5.5	mA
$\|s_{21}\|^2$	insertion power gain	f = 100 MHz	11	13.3	15	dB
		f = 1 GHz	20	21.7	23	dB
		f = 1.8 GHz	21	23.2	25	dB
		f = 2.2 GHz	21	23.3	25	dB
		f = 2.6 GHz	20	22.1	24	dB
		f = 3 GHz	18	20.1	22	dB
$R_{L\ IN}$	return losses input	f = 1 GHz	10	12	–	dB
		f = 2.2 GHz	8	10	–	dB
$R_{L\ OUT}$	return losses output	f = 1 GHz	10	12	–	dB
		f = 2.2 GHz	7	8.5	–	dB
$\|s_{12}\|^2$	isolation	f = 1.6 GHz	53	54	–	dB
		f = 2.2 GHz	38	39	–	dB
NF	noise figure	f = 1 GHz	–	2.6	2.8	dB
		f = 2.2 GHz	–	3.1	3.3	dB
BW	bandwidth	at $\|s_{21}\|^2$ –3 dB below flat gain at 1 GHz	3	3.3	–	GHz
K	stability factor	f = 1 GHz	–	18	–	–
		f = 2.2 GHz	–	2.3	–	–
$P_{L(sat)}$	saturated load power	f = 1 GHz	–5	–4.0	–	dBm
		f = 2.2 GHz	–6	–5.0	–	dBm
$P_{L\ 1\ dB}$	load power	at 1 dB gain compression; f = 1 GHz	–9	–8.0	–	dBm
		at 1 dB gain compression; f = 2.2 GHz	–10	–8.5	–	dBm
IM2	second order intermodulation	at P_D = –40 dBm, f_0 = 1 GHz	29	30	–	dBc
$IP3_{(in)}$	input intercept point	f = 1 GHz	–21	–19.4	–	dBm
		f = 2.2 GHz	–24	–22.7	–	dBm
$IP3_{(out)}$	output intercept point	f = 1 GHz	0	2.3	–	dBm
		f = 2.2 GHz	–1	0.6	–	dBm

APPLICATION INFORMATION

Figure 2 shows a typical application circuit for the BGA2715 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 not be 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 22 nF supply decoupling capacitor C1 should be located as closely as possible to the MMIC.

The PCB top ground plane, connected to the pins 2,4 and 5 must be as close as possible to the MMIC, preferably also below the MMIC. When using via holes, use multiple via holes, as close as possible to the MMIC.

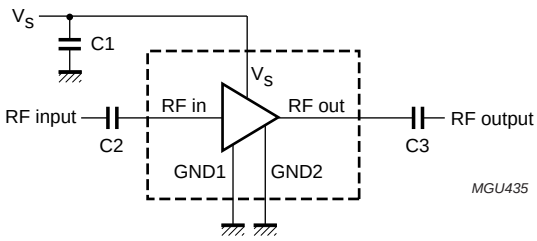
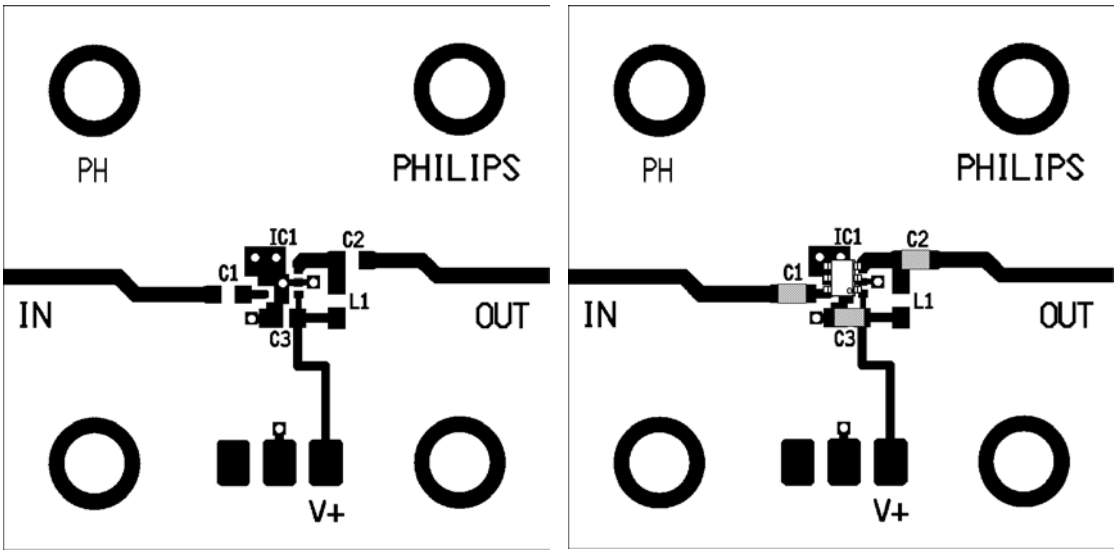


Fig.2 Typical application circuit.

Figure 3 show the PCB layout, used for the standaard demo board.



PCB layout, true size = 30 X 30 mm

Demo board with components

Fig.3 PCB layout.

Grounding and output impedance

If the grounding is not optimal, the gain becomes less flat and the 50 Ω output matching becomes worse. If a better output matching to 50 Ω is required, a 12 Ω resistor (R1) can be placed in series with C3, see figure 4. This will significantly improve the output impedance, at the cost of 1 dB gain and 1 dB output power.

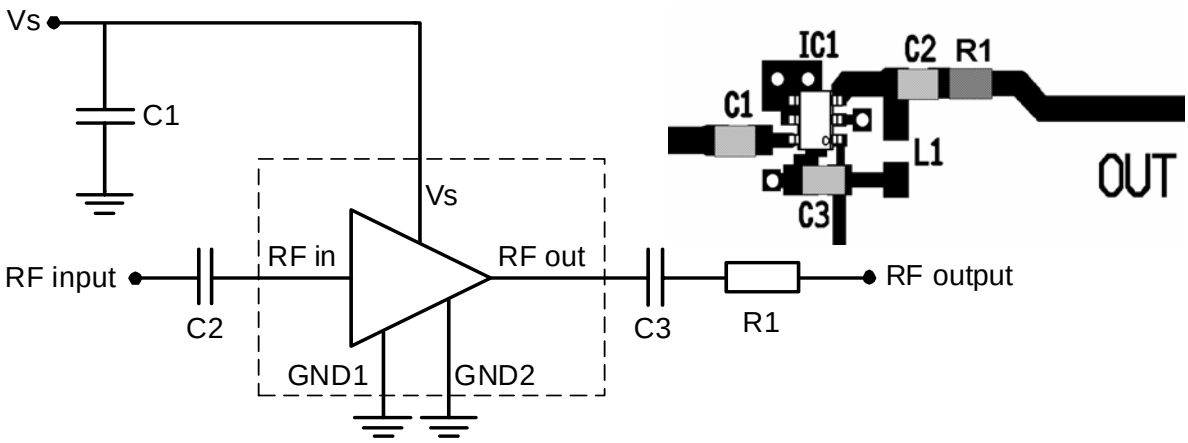


Fig.4 Application circuit for better output impedance into 50 Ω.

APPLICATION EXAMPLES

The MMIC is very suitable as IF amplifier in e.g. LNB's. The excellent wideband characteristics make it an ideal building block (figure 5).

As second amplifier after an LNA, the MMIC offers an easy matching, low noise solution (figure 6).

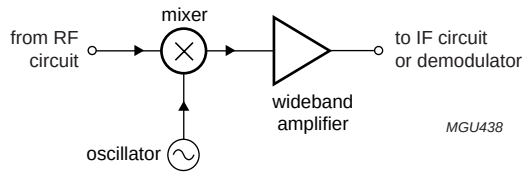


Fig.5 Application as IF amplifier.

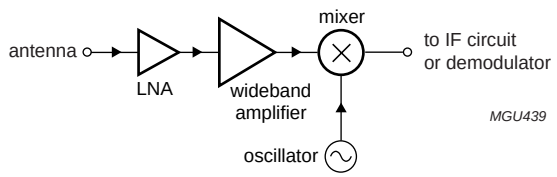
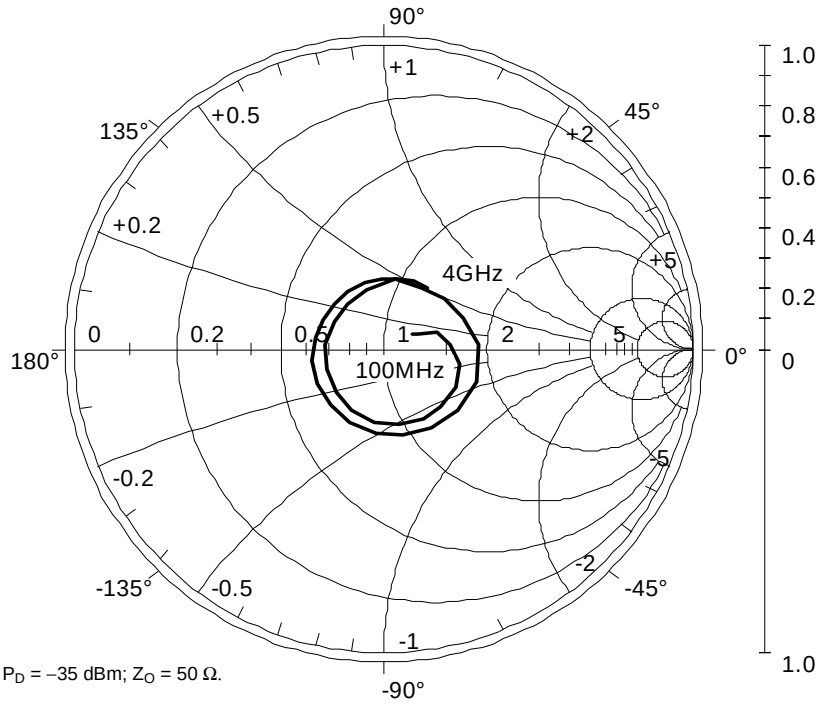
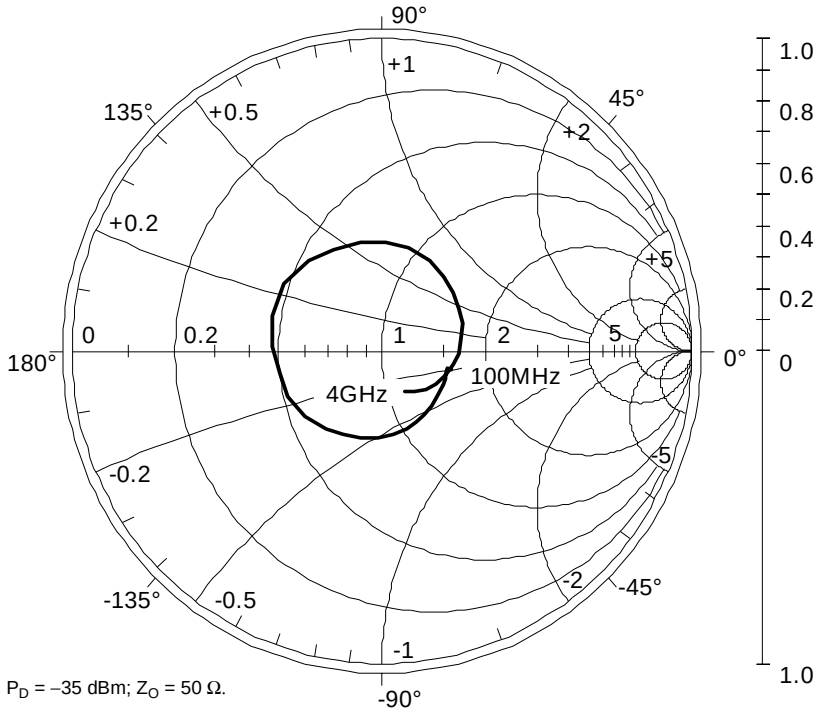


Fig.6 Application as RF amplifier.



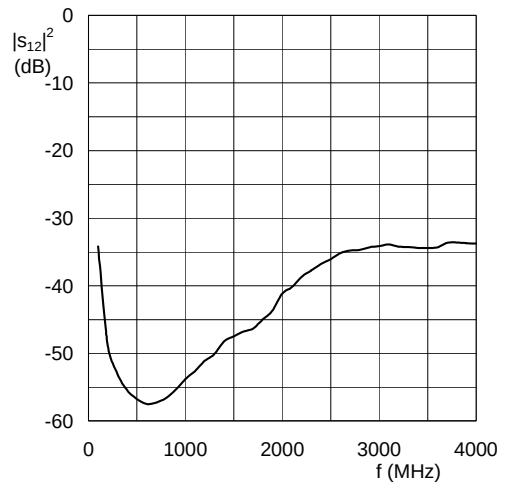
I_S = 4.3 mA; V_S = 5.0 V; P_D = −35 dBm; Z_O = 50 Ω.

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



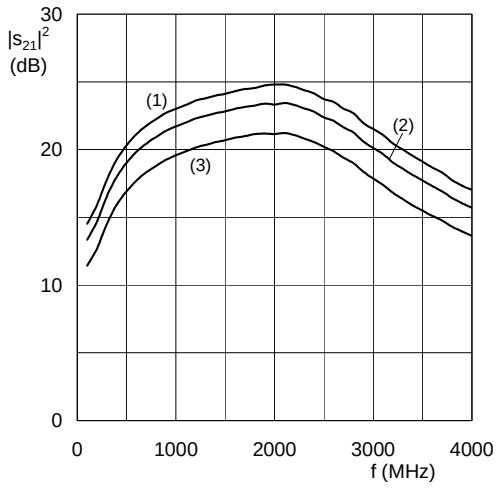
I_S = 4.3 mA; V_S = 5.0 V; P_D = −35 dBm; Z_O = 50 Ω.

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



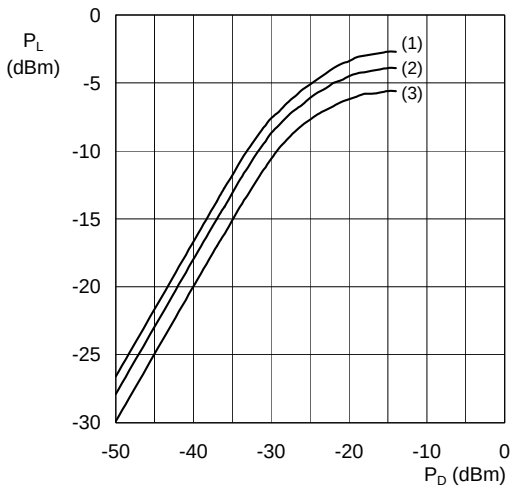
I_S = 4.3 mA; V_S = 5.0 V; P_D = –35 dBm; Z_O = 50 Ω.

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



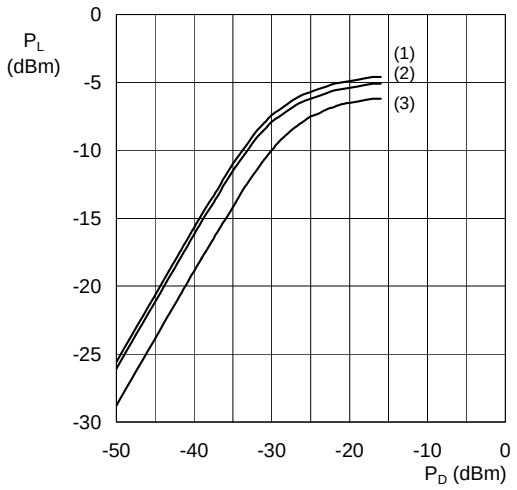
P_D = –35 dBm; Z_O = 50 Ω.
(1) I_S = 4.7 mA; V_S = 5.5 V.
(2) I_S = 4.3 mA; V_S = 5 V.
(3) I_S = 3.9 mA; V_S = 4.5 V.

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



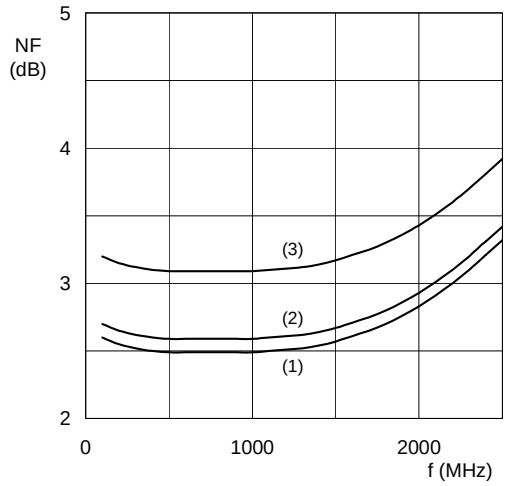
f = 1 GHz; Z_O = 50 Ω.
(1) V_S = 5.5 V.
(2) V_S = 5 V.
(3) V_S = 4.5 V.

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



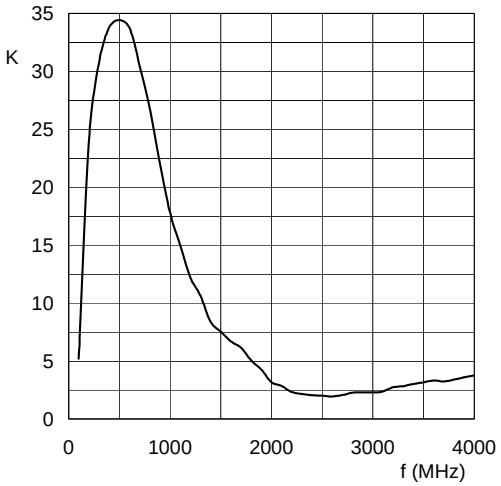
f = 2.2 GHz; Z_O = 50 Ω.
(1) V_S = 5.5 V.
(2) V_S = 5 V.
(3) V_S = 4.5 V.

Fig.12 Load power as a function of drive power at 2.2 GHz; typical values.



Z_O = 50 Ω.
(1) I_S = 4.7 mA; V_S = 5.5 V.
(2) I_S = 4.3 mA; V_S = 5 V.
(3) I_S = 3.9 mA; V_S = 4.5 V.

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



I_S = 4.3 mA; V_S = 5.0 V; Z_O = 50 Ω.

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

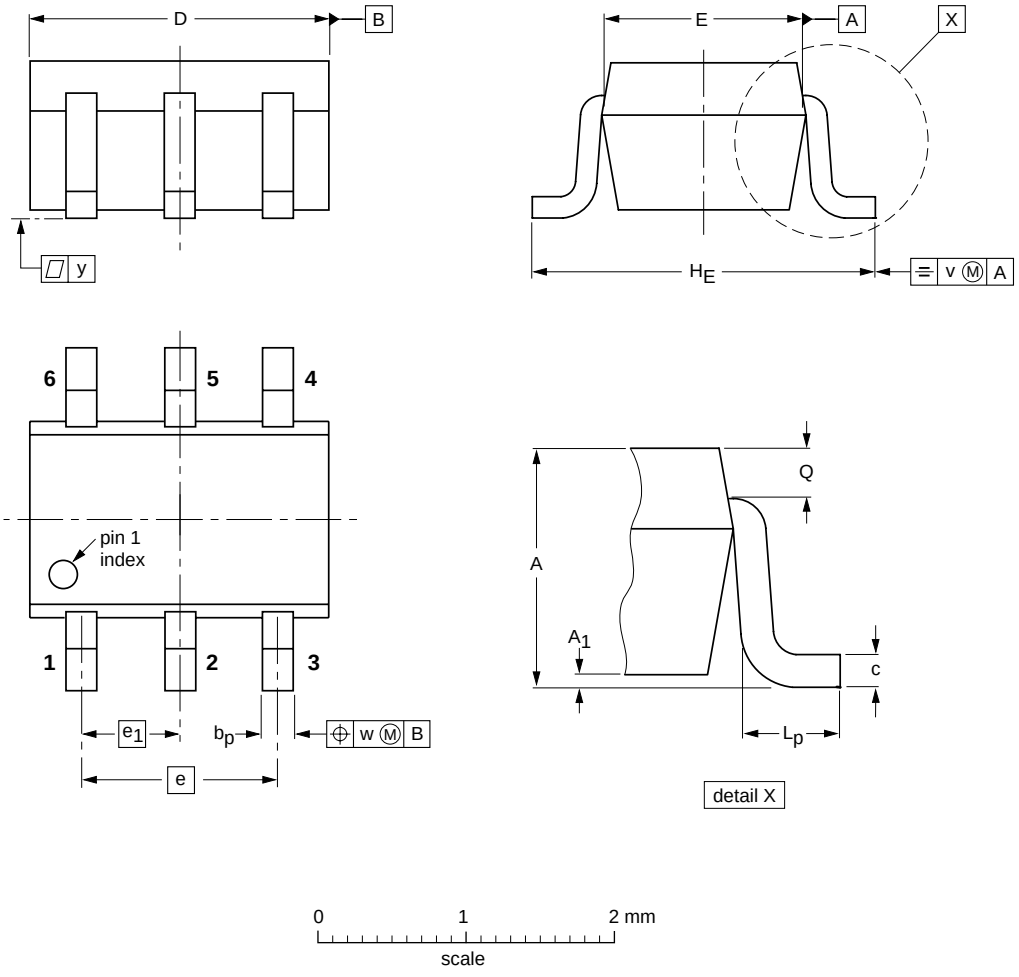
Scattering parameters

V_S = 5.0 V; I_S = 4.3 mA; P_D = –35 dBm; Z_O = 50 Ω; T_{amb} = 25 °C;

f (MHz)	s_{11}		s_{21}		s_{12}		s_{22}		K-FACTOR
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	
100	0.100503	27.76918	4.641604	13.82793	0.01958	–110.345	0.231889	–14.37137	5.2
200	0.121228	24.6812	5.427784	7.997073	0.003611	–114.8849	0.219504	–14.09179	23.9
400	0.217855	3.974108	7.924499	–7.594877	0.001688	–77.39562	0.223868	–23.69087	33.8
600	0.26219	–28.08926	9.807075	–30.92853	0.001336	–170.6765	0.22656	–34.95361	33.8
800	0.26297	–61.21535	11.13563	–55.31486	0.001473	124.9044	0.237554	–48.11004	26.8
1000	0.241089	–96.9469	12.17817	–80.09316	0.002036	155.3396	0.25378	–63.76927	17.8
1200	0.211289	–136.4953	13.02575	–104.2842	0.002785	147.5162	0.271479	–82.31896	12.2
1400	0.18828	1754377	13.60797	–128.89	0.003866	138.7051	0.287623	–104.1092	8.4
1600	0.187898	128.6387	14.14423	–153.3766	0.004588	124.9325	0.307361	–125.9161	6.7
1800	0.231527	80.79592	14.54321	–179.671	0.005641	120.4153	0.338893	–154.6072	5.1
2000	0.257172	40.08414	14.65137	154.6647	0.008743	103.0426	0.352132	177.7152	3.2
2200	0.303945	2.249913	14.61385	127.2237	0.011662	94.4722	0.378963	145.8774	2.3
2400	0.311735	–39.67469	13.78165	100.012	0.014471	54.07247	0.359508	115.0129	2.0
2600	0.288113	–77.37179	12.75107	74.12332	0.017402	33.11605	0.349807	88.0727	1.9
2800	0.265404	–114.1115	11.55715	48.40486	0.016703	7.697541	0.327615	61.52393	2.3
3000	0.24479	–151.8463	10.12992	25.3978	0.019651	–11.0858	0.296875	39.00544	2.3
3200	0.225353	170.8795	8.961976	3.789364	0.018743	–28.17932	0.27147	18.63863	2.8
3400	0.219366	136.6841	8.061087	–16.85382	0.019.73	–45.60266	0.247253	–1.617895	3.0
3600	0.226203	106.1421	7.318683	–37.20896	0.019248	–60.69421	0.217973	–21.22008	3.3
3800	0.23349	78.62692	6.619309	–56.90074	0.020895	–72.89823	0.184766	–40.71164	3.4
4000	0.244216	54.63669	6.105669	–75.98154	0.020531	–85.18773	0.150082	–60.81328	3.8

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

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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