T-33-05

NPN silicon planar epitaxial microwave power transistor

LEE1015TA

FEATURES

- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Interdigitated structure provides high emitter efficiency
- Gold metallization realizes very good stability of the characteristics and excellent lifetime
- Multicell geometry gives good balance of dissipated power and low thermal resistance.

PINNING - SOT122

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

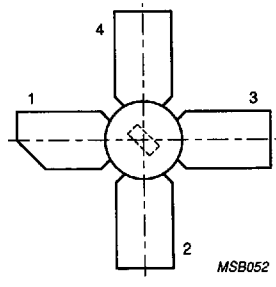
DESCRIPTION

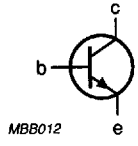
NPN silicon planar epitaxial microwave power transistor in a SOT122 metal ceramic package.

APPLICATIONS

Intended for use in common emitter, class A power amplifiers for applications that require a high level of linearity.

PIN CONFIGURATION





Marking code: 1015T

Fig.1 Simplified outline and symbol.

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 °C in a common base class C narrowband amplifier (guaranteed values).

MODE OF OPERATION	f (MHz)	V_{CC} (V)	I_C (mA)	P_{L1} (W)	G_p (dB)	d_{im} (dB)
class C (CW)	860	20	140	> 1	> 13	<–57 (note 1)

Note

1. The stated intermodulation distortion level is referred to the total output power of 18.25 dB, which corresponds to the sum of the power carried by each of the two equal amplitude tones at f_1 = 859 MHz and f_2 = 861 MHz.

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.

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LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	40	V
V_{CER}	collector-emitter voltage	R_{BE} = 10 Ω	–	40	V
V_{CEO}	collector-emitter voltage	open base	–	22	V
V_{EBO}	emitter-base voltage	open collector	–	3.0	V
I_C	collector current		–	500	mA
P_{tot}	total power dissipation	T_{mb} = 75 °C	–	7.5	W
T_{stg}	storage temperature range		−65	150	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	t ≤ 10 s note 1	–	235	°C

Note

1. Up to 0.2 mm from ceramic.

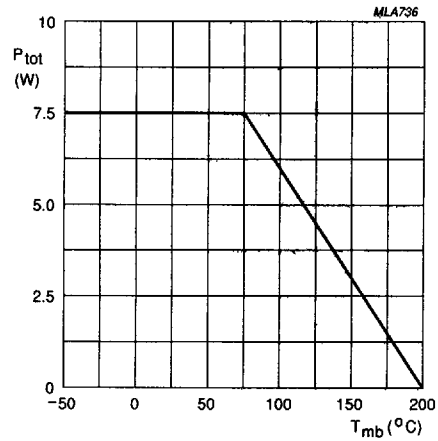
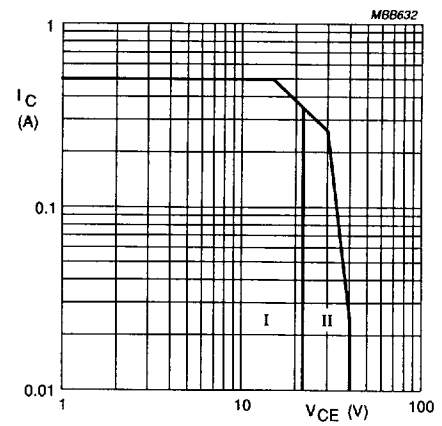


Fig.2 Maximum power dissipation derating as a function of mounting base temperature.



T_{mb} = 75 °C.

I Region of permissible DC operation.

II Possible extension provided R_{BE} = ≤10 Ω.

Fig.3 DC SOAR.

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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	T_j = 75 °C	12 K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink		0.6 K/W

CHARACTERISTICS

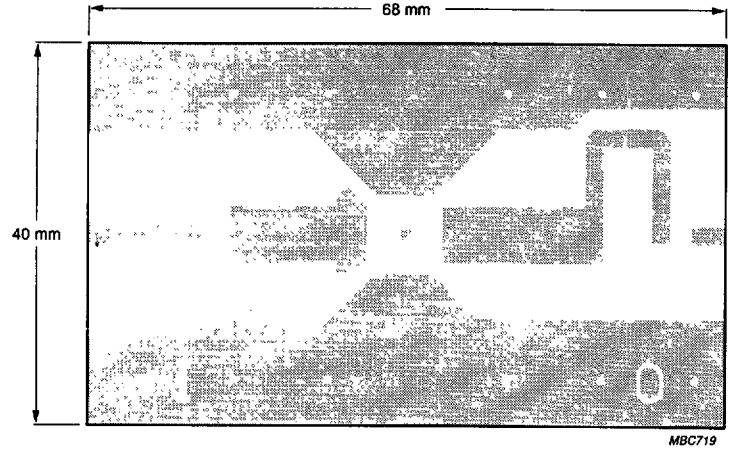
T_{mb} = 25 °C unless otherwise specified

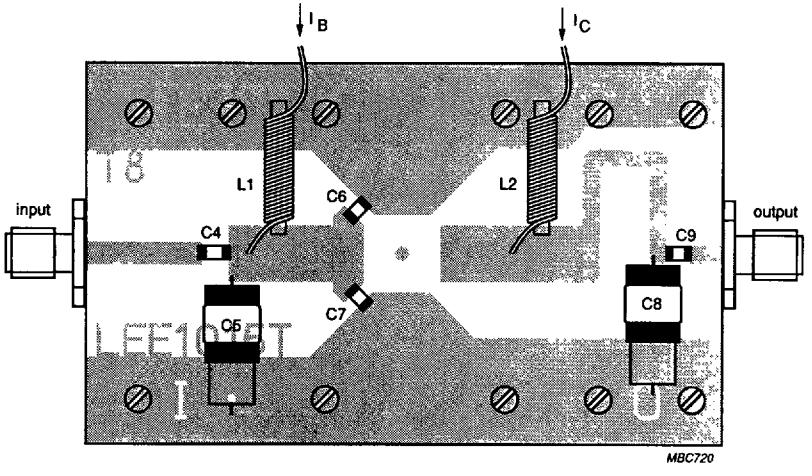
SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	400	µA
I_{CER}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 10 Ω	20	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	400	µA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C in the test circuit shown in Fig.4

MODE OF OPERATION	f (MHz)	V_{CC} (V)	I_C (mA)	P_{L1} (W)	G_{po} (dB)
class A	860	20	140	> 1.0; typ. 1.3	> 13; typ. 14.5





Dimensions in mm

Fig.4 860 MHz test circuit.

The circuit and the components are situated on the upper side of the PTFE fibreglass board, the other side being fully metallized to serve as ground. Ground connections are made by means of hollow rivets.

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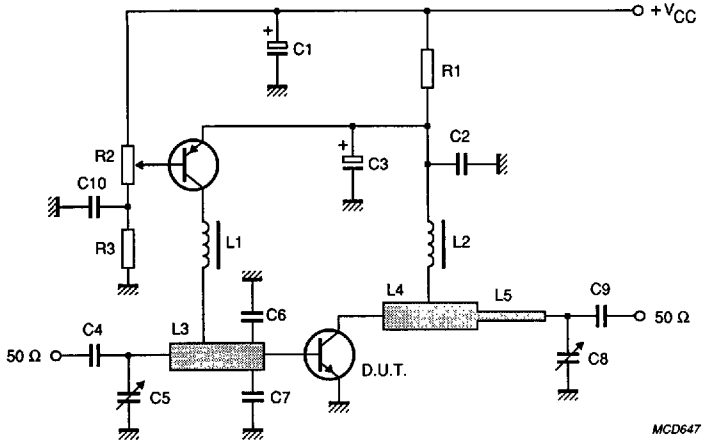

Fig.5 Bias circuit.

List of components (see bias circuit)

COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE NO.
C1	electrolytic capacitor	10 μF, 63 V		
C2, C10	ceramic capacitor	22 nF		
C3	tantalum capacitor	10 μF, 50 V		AT-3-7-271SL
C4, C9	chip capacitor (note 1)	1000 pF		
C5, C8	tuning capacitor (note 1)	0.8 to 10 pF		
C6, C7	chip capacitor (note 1)	4.7 pF		
L1, L2	Ferroxcube HF choke (note 1)			
L3	micro-stripline (note 2)		6 mm x 15.6 mm	
L4	micro-stripline (note 2)		6 mm x 17 mm	
L5	micro-stripline (note 2)		2.24 mm x 24 mm	
R1	carbon resistor	4.7 Ω, 0.25 W		
R2	carbon potentiometer	10 kΩ	10 turns	
R3	2 x carbon resistors (in parallel)	100 kΩ, 0.25 W		

Notes

1. These components are mounted on the 860 MHz test circuit; see Fig.4.
2. L3, L4 and L5 are micro-stripline on a printed circuit board with PTFE fibreglass dielectric.

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Common emitter scattering parameters; V_{CE} = 20 V; I_C = 140 mA; T_{case} = 25 °C; Z_O = 50 Ω

f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)
800	–1.240	167.000	7.900	56.200	–28.200	51.600	–7.200	–155.500
825	–1.252	166.417	7.679	55.283	–28.074	52.058	–7.179	–155.292
850	–1.265	165.833	7.452	54.367	–27.949	52.517	–7.158	–155.083
875	–1.282	165.321	7.213	53.336	–27.739	52.625	–7.117	–154.893
900	–1.301	164.857	6.962	52.229	–27.476	52.500	–7.063	–154.714
925	–1.321	164.393	6.704	51.121	–27.222	52.375	–7.009	–154.536
950	–1.341	163.929	6.438	50.014	–26.975	52.250	–6.956	–154.357
975	–1.360	163.464	6.163	48.907	–26.734	52.125	–6.903	–154.179
1000	–1.380	163.000	5.880	47.800	–26.500	52.000	–6.850	–154.000
1025	–1.395	162.475	5.782	46.818	–26.240	51.698	–6.822	–154.100
1050	–1.409	161.950	5.683	45.835	–25.989	51.395	–6.793	–154.200
1075	–1.424	161.425	5.583	44.853	–25.744	51.093	–6.765	–154.300
1100	–1.438	160.900	5.482	43.870	–25.505	50.790	–6.737	–154.400
1125	–1.453	160.375	5.380	42.888	–25.274	50.488	–6.709	–154.500
1150	–1.467	159.850	5.276	41.905	–25.048	50.185	–6.681	–154.600
1175	–1.482	159.325	5.171	40.923	–24.828	49.883	–6.653	–154.700
1200	–1.497	158.800	5.065	39.940	–24.613	49.580	–6.625	–154.800
1225	–1.511	158.275	4.957	38.958	–24.404	49.278	–6.597	–154.900
1250	–1.526	157.750	4.848	37.975	–24.199	48.975	–6.570	–155.000
1275	–1.541	157.225	4.738	36.993	–23.999	48.673	–6.542	–155.100
1300	–1.556	156.700	4.627	36.010	–23.804	48.370	–6.515	–155.200
1325	–1.570	156.175	4.513	35.028	–23.613	48.068	–6.488	–155.300
1350	–1.585	155.650	4.399	34.045	–23.426	47.765	–6.460	–155.400
1375	–1.600	155.125	4.283	33.063	–23.243	47.463	–6.433	–155.500
1400	–1.615	154.600	4.165	32.080	–23.064	47.160	–6.406	–155.600
1425	–1.630	154.075	4.046	31.098	–22.889	46.858	–6.379	–155.700
1450	–1.645	153.550	3.925	30.115	–22.716	46.555	–6.352	–155.800
1475	–1.660	153.025	3.802	29.133	–22.548	46.253	–6.325	–155.900
1500	–1.675	152.500	3.678	28.150	–22.382	45.950	–6.299	–156.000
1525	–1.690	151.975	3.551	27.168	–22.220	45.648	–6.272	–156.100
1550	–1.705	151.450	3.423	26.185	–22.060	45.345	–6.245	–156.200
1575	–1.720	150.925	3.293	25.203	–21.904	45.043	–6.219	–156.300
1600	–1.735	150.400	3.161	24.220	–21.750	44.740	–6.192	–156.400
1625	–1.750	149.875	3.027	23.238	–21.599	44.438	–6.166	–156.500
1650	–1.765	149.350	2.891	22.255	–21.450	44.135	–6.140	–156.600
1675	–1.780	148.825	2.753	21.273	–21.304	43.833	–6.114	–156.700
1700	–1.796	148.300	2.612	20.290	–21.160	43.530	–6.087	–156.800

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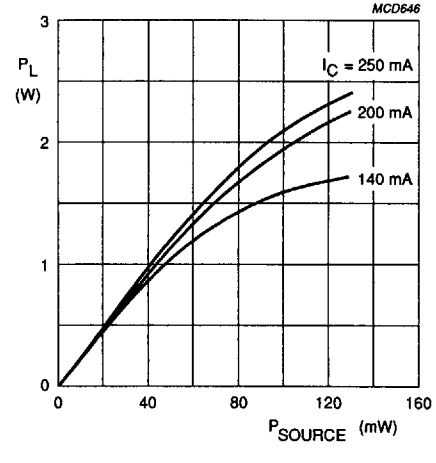
f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)	dB	ANG. (DEG)
1725	–1.811	147.775	2.469	19.307	–21.019	43.228	–6.061	–156.900
1750	–1.826	147.250	2.324	18.325	–20.880	42.925	–6.035	–157.000
1775	–1.841	146.725	2.176	17.343	–20.743	42.623	–6.010	–157.100
1800	–1.857	146.200	2.026	16.360	–20.609	42.320	–5.984	–157.200
1825	–1.872	145.675	1.873	15.378	–20.476	42.018	–5.958	–157.300
1850	–1.887	145.150	1.718	14.395	–20.345	41.715	–5.932	–157.400
1875	–1.903	144.625	1.559	13.412	–20.217	41.413	–5.907	–157.500
1900	–1.918	144.100	1.398	12.430	–20.090	41.110	–5.881	–157.600
1925	–1.934	143.575	1.233	11.448	–19.965	40.808	–5.856	–157.700
1950	–1.949	143.050	1.065	10.465	–19.841	40.505	–5.830	–157.800
1975	–1.964	142.525	0.894	9.483	–19.720	40.203	–5.805	–157.900
2000	–1.980	142.000	0.720	8.500	–19.600	39.900	–5.780	–158.000



V_{CE} = 20 V; T_{mb} = 25 °C.
In the test circuit as shown in Fig.4.

Fig.6 Load power as a function of source power.

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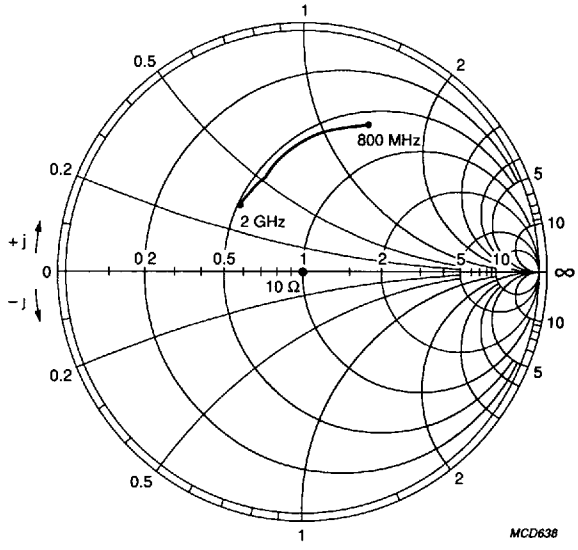
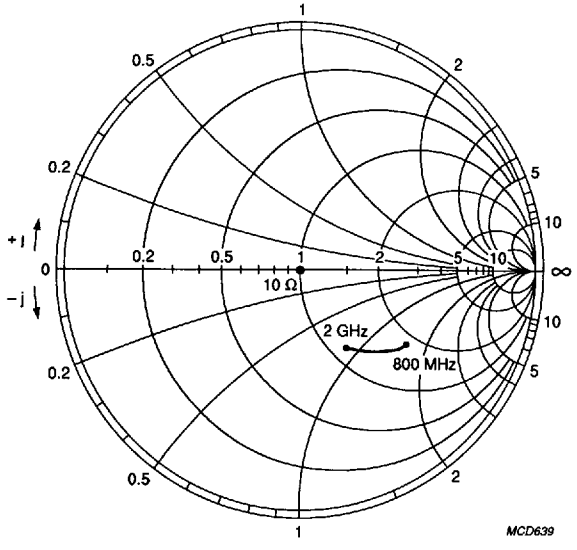


$Z_o = 10\ \Omega$;

Fig.7 Input reflection coefficient (S_{11}).



$Z_o = 10\ \Omega$;

Fig.8 Output reflection coefficient (S_{22}).

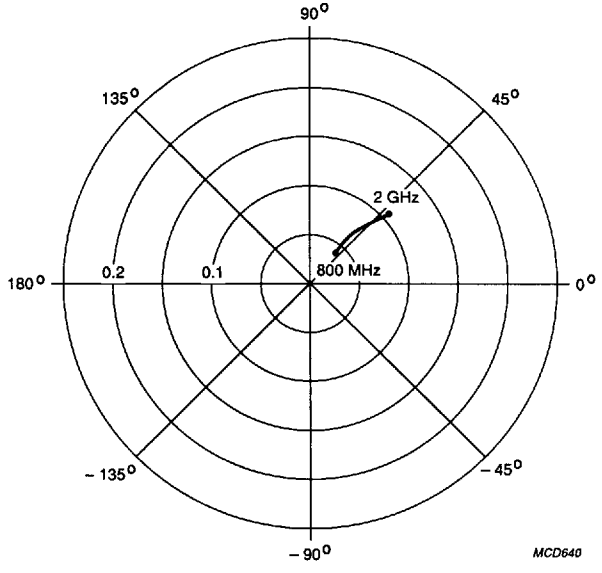


Fig.9 Reverse transmission coefficient (S_{12}).

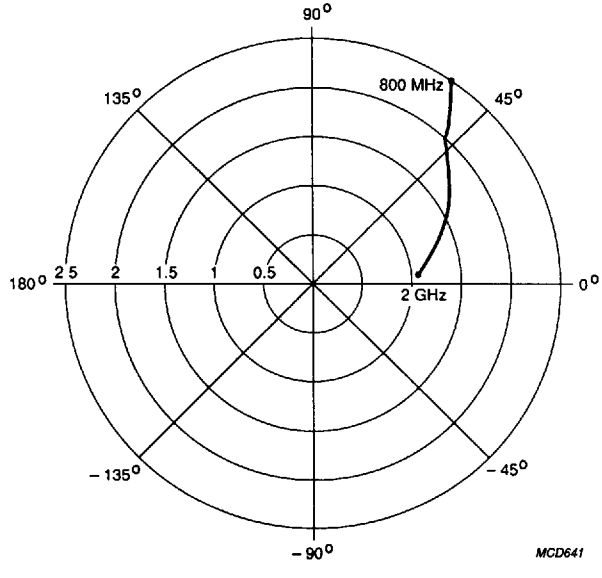


Fig.10 Forward transmission coefficient (S_{21}).

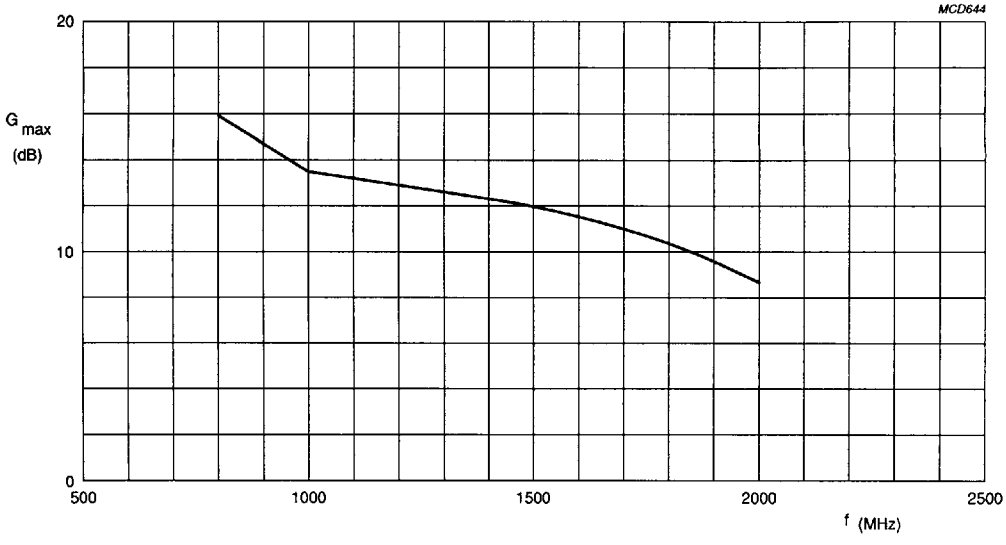
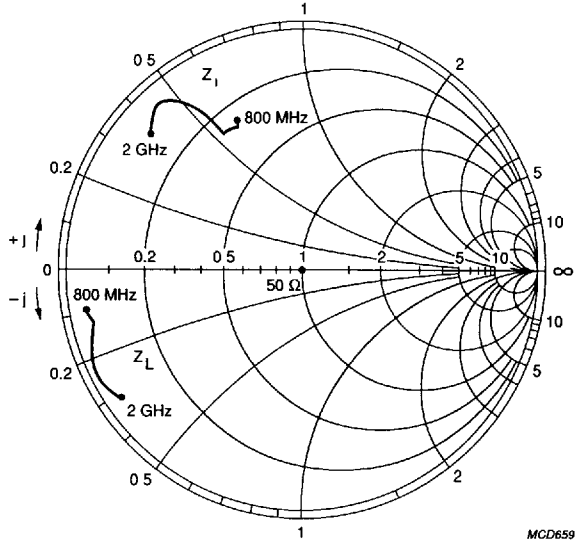


Fig.11 Maximum available gain as a function of frequency.



V_{CE} = 20 V;
I_C = 140 mA;
Z_O = 50 Ω;

Fig.12 Input impedance and optimum output impedance as a function of frequency.

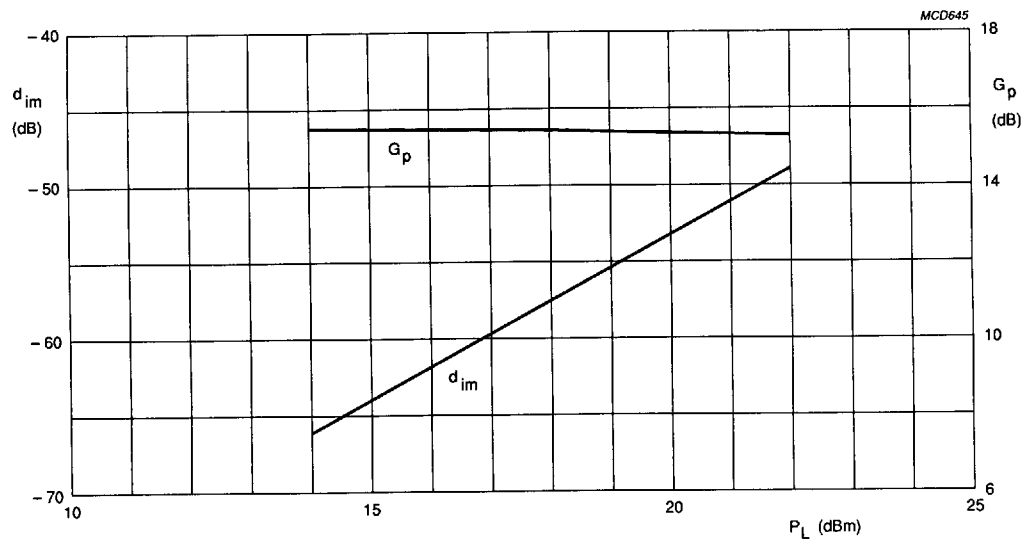


Fig.13 Intermodulation distortion and power gain; typical values.

INTERMODULATION DISTORTION

f (MHz)	V_{CE} (V)	I_C (mA)	P_{OUT} (dBm)	d_{im} (dB)
$f_1 = 859$ $f_2 = 861$	20	140	18.25	<–57 (note 1)

Note

1. The stated intermodulation distortion level is referred to the total output power which corresponds to the sum of the power carried by each of the two equal amplitude tones.