MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

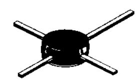
MWA0304
MWA0311L
MWA0370

Monolithic Microwave Integrated Circuit

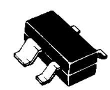
MONOLITHIC MICROWAVE INTEGRATED CIRCUIT

. . . designed for narrow or wideband IF and RF applications in industrial and commercial systems up to 3 GHz.

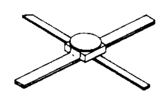
- 12 dB Gain at 500 MHz (Typ)
- Fully Cascadable
- 50 Ω Input and Output Impedance
- Choice of Package Types
  - Low Cost
  - Surface Mount
  - Hermetic
- Available In Both Standard Profile (MWA0311) and Low Profile (MWA0311L)
- Tape and Reel Packaging Options
- 10.5 dBm P_O 1 dB at 500 MHz (Typ)
- Unconditionally Stable



CASE 317-01, STYLE 3
MWA0304



CASE 318A-05, STYLE 4
MWA0311L



CASE 303A-01, STYLE 3
MWA0370

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Parameters		Symbol	Ratings	Unit
Circuit Current (Note 1)		I_{CC}	40	mAdc
Input Power, RF		P_{in}	+16	dBm
Bias Voltage		V_{CC}	6	Vdc
Storage Temperature	0304/0311L 0370	T_{stg}	−65 to +150 −65 to +200	°C
Junction Temperature	0304/0311L 0370	T_J	150 200	°C

RECOMMENDED OPERATING CONDITIONS

Parameters	Symbol	Ratings	Unit
Operating Current	I_{CC}	35	mA
Source Impedance	Z_S	50 to 75	Ω
Load Impedance	Z_L	50 to 75	Ω

THERMAL CHARACTERISTICS

Thermal Resistance, Die to Case	MWA0304 MWA0311L MWA0370	$R_{\theta JC}$	150 200 130	°C/W

DEVICE MARKING

MWA0311L = 14

ELECTRICAL CHARACTERISTICS (T_A = 25°C, I_{CC} = 35 mA, Z_S = Z_L = 50 Ω, unless specified otherwise)

Characteristic	Symbol	Min	Typ	Max	Unit
Gain (f = 500 MHz)	G_T	10	12	—	dB
Gain Flatness (f = DC to 800 MHz — MWA0304/0311L) (f = DC to 1600 MHz — MWA0370)	—	 — —	 1 1	 — —	dB
Noise Figure (f = 100–1500 MHz)	NF	—	5.5	—	dB
Third Order Intercept Output Power (f_1 = 480 MHz, f_2 = 500 MHz)	ITO_1	—	24	—	dBm
Third Order Intercept Output Power (f_1 = 980 MHz, f_2 = 1000 MHz)	ITO_2	—	22	—	dBm
Second Order Intercept Output Power (F_1 = 480 MHz, f_2 = 500 MHz)	ISO_1	—	32.5	—	dBm
Second Order Intercept Output Power (f_1 = 980 MHz, f_2 = 1000 MHz)	ISO_2	—	29.5	—	dBm

Note 1: Based on maximum junction temperature and assumed MTBF of at least 10 years.

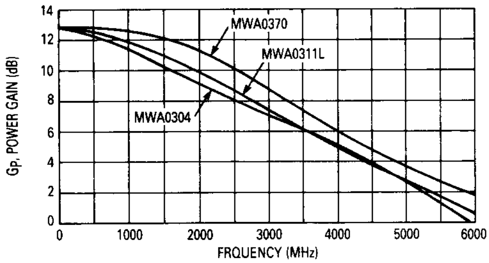


Figure 1. Gain versus Frequency

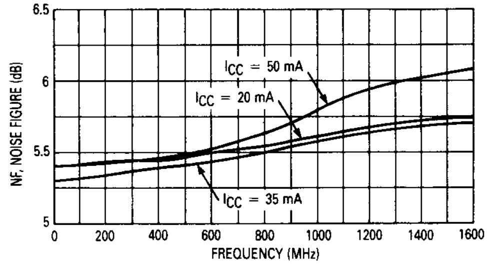


Figure 2. Noise Figure versus Frequency

MWA0304

Frequency (MHz)	S_{11} (mag)	S_{11} (ang)	S_{21} (dB)	S_{21} (mag)	S_{21} (ang)	S_{12} (mag)	S_{12} (ang)	S_{22} (mag)	S_{22} (ang)	K
100	0.059	168.5	12.61	4.27	172.9	0.123	3.2	0.169	−10.3	1.18
200	0.052	156.9	12.57	4.25	166.3	0.124	2.9	0.173	−18.8	1.18
400	0.044	125.1	12.35	4.15	153.3	0.124	6.1	0.183	−35.6	1.19
600	0.034	72.6	12.11	4.03	140.7	0.131	9.2	0.199	−49	1.18
800	0.052	19.1	11.75	3.87	128.5	0.134	11.5	0.21	−58.2	1.19
1000	0.08	−4.8	11.37	3.7	116.9	0.144	13.2	0.219	−66.9	1.17
1500	0.155	−41.1	10.23	3.25	90.3	0.162	14.8	0.243	−78	1.16
2000	0.185	−61.7	9.08	2.84	67.2	0.185	13	0.244	−87.9	1.16
2500	0.153	−83	8.03	2.52	45.9	0.207	10.1	0.235	−100.1	1.16
3000	0.085	−122	7.03	2.25	25.9	0.229	5.4	0.23	−114.1	1.17
3500	0.077	140.5	6.09	2.01	7.25	0.243	−1	0.231	−133	1.19
4000	0.186	93.7	5.08	1.79	−11	0.258	−6.7	0.23	−149.4	1.19
5000	0.443	62.4	2.7	1.36	−43.7	0.279	−17.4	0.236	173.2	1.14
6000	0.648	44.6	−0.22	0.97	−70.7	0.287	−31	0.274	127.6	1.09

Figure 3. Typical S S-Parameters and Stability Factor K

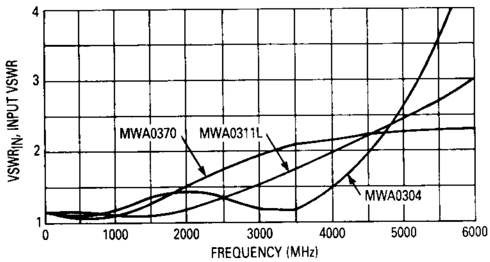


Figure 4. Input VSWR versus Frequency

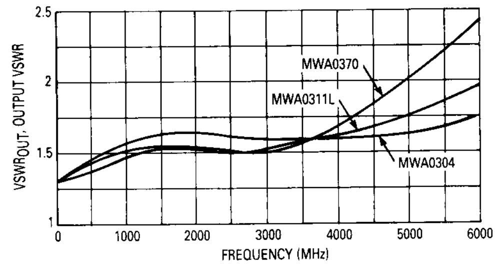


Figure 5. Output VSWR versus Frequency

MWA0311L

Frequency (MHz)	S_{11} (mag)	S_{11} (ang)	S_{21} (dB)	S_{21} (mag)	S_{21} (ang)	S_{12} (mag)	S_{12} (ang)	S_{22} (mag)	S_{22} (ang)	K
100	0.092	173.7	12.8	4.37	174.3	0.119	1.5	0.134	−12.8	1.19
200	0.089	166.7	12.77	4.35	168.8	0.119	5	0.139	−21.3	1.19
400	0.078	155.4	12.62	4.27	158.3	0.127	7.3	0.149	−42	1.16
600	0.074	143.6	12.47	4.2	147.9	0.129	13.4	0.165	−58.5	1.16
800	0.06	135.7	12.19	4.07	137.9	0.132	16.6	0.176	−72	1.17
1000	0.05	133.2	11.85	3.91	128.5	0.139	19.1	0.192	−84.9	1.16
1500	0.035	176.3	10.97	3.53	105.4	0.162	24.1	0.221	−107.3	1.12
2000	0.083	−159.1	9.88	3.12	84.4	0.184	25.9	0.209	−127	1.1
2500	0.15	−171.1	8.64	2.7	66.3	0.198	26	0.199	−139.8	1.12
3000	0.214	173.4	7.38	2.34	50.2	0.22	23.5	0.215	−146.9	1.11
3500	0.276	161.7	6.1	2.02	36.8	0.233	22.7	0.226	−148.7	1.13
4000	0.334	150.7	4.9	1.76	24.7	0.238	22.3	0.234	−145.3	1.16
5000	0.414	131.5	2.64	1.36	5.24	0.259	19.6	0.277	−140.5	1.17
6000	0.5	113.2	0.56	1.07	−10.5	0.284	17.3	0.327	−151.2	1.14

Figure 6. Typical S-Parameters and Stability Factor K

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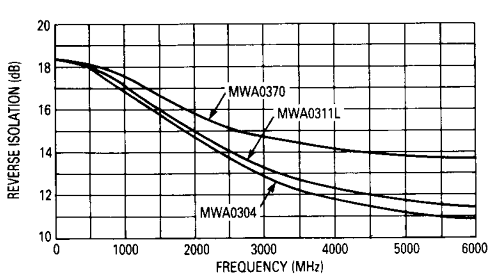

Figure 7. Reverse Isolation versus Frequency

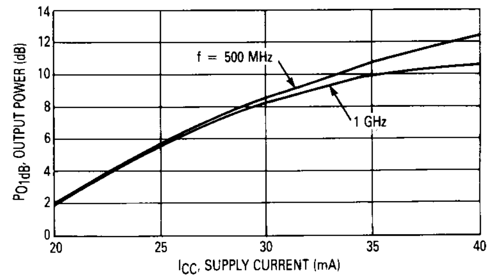

Figure 8. Output Power At 1 dB Gain Compression versus Bias Current

MWA0370

Frequency (MHz)	S_{11} (mag)	S_{11} (ang)	S_{21} (dB)	S_{21} (mag)	S_{21} (ang)	S_{12} (mag)	S_{12} (ang)	S_{22} (mag)	S_{22} (ang)	K
100	0.046	−178.6	12.84	4.39	175.2	0.12	1.1	0.181	−8.8	1.17
200	0.045	−178.4	12.84	4.38	170.5	0.121	2.2	0.178	−15.6	1.17
400	0.037	−174.5	12.8	4.37	161.3	0.122	4.6	0.185	−29.7	1.17
600	0.028	−156.5	12.76	4.34	151.9	0.125	6.7	0.191	−44	1.15
800	0.031	−125.5	12.68	4.31	142.7	0.129	8.4	0.198	−56.9	1.14
1000	0.047	−104.5	12.59	4.26	133.2	0.133	10.4	0.205	−68.5	1.12
1500	0.122	−99.6	12.11	4.03	109.5	0.147	12.1	0.216	−92.8	1.07
2000	0.201	−114.8	11.24	3.65	86.8	0.162	11	0.213	109.7	1.04
2500	0.27	−134	10.09	3.2	65.5	0.176	8.4	0.203	−117.5	1.03
3000	0.32	−151.4	8.73	2.73	47.4	0.185	5.3	0.2	−117.6	1.06
3500	0.354	−166.1	7.34	2.33	31.2	0.19	1.9	0.221	−116.8	1.11
4000	0.366	−179.6	6.02	2	18.2	0.196	−0.4	0.256	−118.1	1.16
5000	0.389	158.3	3.68	1.53	−3.4	0.205	−5.1	0.335	−126.2	1.26
6000	0.394	137.8	1.73	1.22	−21.9	0.214	−9.2	0.414	−137.1	1.33

Figure 9. Typical S-Parameters and Stability Factor K

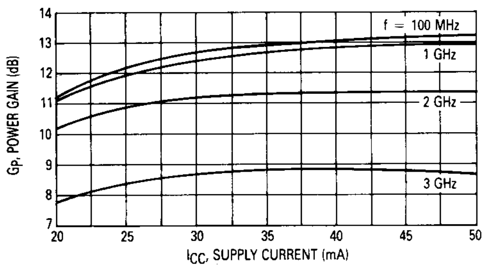

Figure 10. Power Gain versus Bias Current

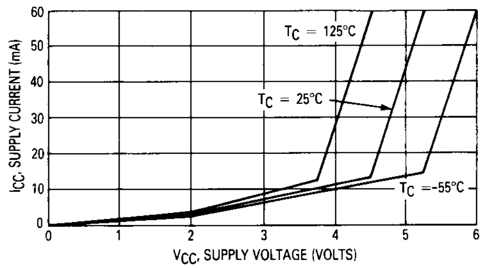

Figure 11. Bias Current versus Bias Voltage

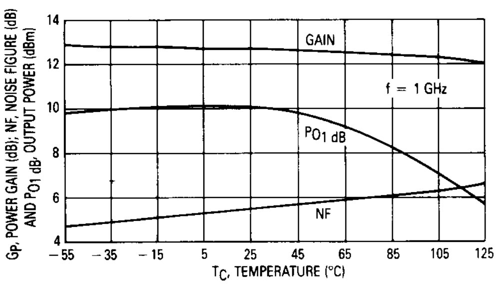

Figure 12. Output Power at 1 dB Gain Compression, Noise Figure and Gain versus Temperature

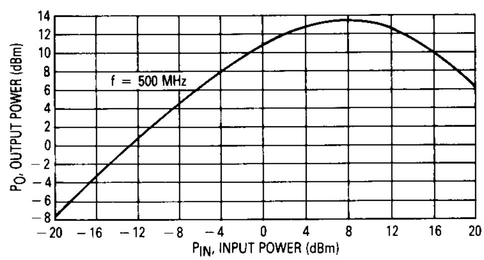

Figure 13. Output Power versus Input Power

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MMIC AMPLIFIER APPLICATIONS INFORMATION

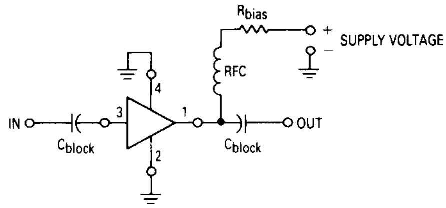

Figure 14. Typical Biasing Configuration

Operation

Operation of the Monolithic Microwave Integrated Circuit as an amplifier is achieved by simply connecting it to 50 ohm driving source and load impedances with dc blocking capacitors at both input and output.

DC Bias

A positive current must be supplied to the device output terminal. Power supply decoupling elements must include resistive current limiting. Device output voltage at the recommended operating current of 35 mA is typically 5 Vdc (see Fig. 11) R_{bias} (Figure 9) is selected to permit the device to draw 35 mA. For example, when operating with a 12 Vdc supply:

$$R_{bias} = \frac{(12-5)}{0.035} = 200 \text{ ohms}$$

External Decoupling Impedance

In all cases the external bias (decoupling elements) must present an impedance which is large compared to the 50 Ω load impedance to minimize RF gain reduction. The loss in gain due to the decoupling impedance is given by the equation:

$$\text{Loss} = -20 \text{ Log} \frac{Z_D}{Z_D + 25} \text{ dB}$$

Where Z_D = decoupling impedance in ohms. For example, if Z_D = 1 kΩ, Loss = 0.214 dB.

The RF choke is not mandatory, but including it improves gain by raising the dc supply voltage decoupling impedance. 4 turns of #26 AWG enameled wire would on a ferrite bead is suggested for the choke.

Low Frequency Response

The value of the blocking capacitors determines the low frequency response of the amplifier. The following expression is used to determine the blocking capacitor value to yield a desired 3 dB low frequency corner (f_{LFC}).

$$C_{Block}(\text{Farads}) = \frac{1}{100 \tau f_{LFC}(\text{Hz})}$$

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