Freescale Semiconductor
Technical Data

Document Number: MMG20271H9
Rev. 0, 12/2011

RoHS

Enhancement Mode pHEMT Technology (E-pHEMT)

High Linearity Amplifier

MMG20271H9T1

1500-2700 MHz, 16 dB
27.5 dBm
E-pHEMT

CASE 2142-01
SOT-89
PLASTIC

The MMG20271H9 is a high dynamic range, single-stage, low noise amplifier MMIC, housed in a SOT-89 standard plastic package. With high OIP3 and low noise figure, it can be utilized as a driver amplifier in the transmit chain and as a second-stage LNA in the receive chain. It is ideal for cellular, PCS, LTE, TD-SCDMA, W-CDMA base station, wireless LAN and other systems in the 1500 to 2700 MHz frequency range.

Features

- Frequency: 1500-2700 MHz
- Noise Figure: 1.7 dB @ 2140 MHz
- P1dB: 27.5 dBm @ 2140 MHz
- Small-Signal Gain: 16 dB @ 2140 MHz
- Third Order Output Intercept Point: 43.1 dBm @ 2140 MHz
- Class 2 HBM ESD Immunity
- Single 5 Volt Supply
- Supply Current: 215 mA
- 50 Ohm Operation (some external matching required)
- Cost-effective SOT-89 Surface Mount Package
- In Tape and Reel. T1 Suffix = 1000 Units, 12 mm Tape Width, 7 inch Reel.

Table 1. Typical Performance (1)

Characteristic	Symbol	1500 MHz	1900 MHz	2140 MHz	2700 MHz	Unit
Noise Figure	NF	1.9	1.8	1.7	1.8	dB
Input Return Loss (S11)	IRL	-11	-12.1	-13.5	-18.5	dB
Output Return Loss (S22)	ORL	-24	-25.3	-35	-28	dB
Small-Signal Gain (S21)	G_p	18	16.6	16	14.3	dB
Power Output @ 1dB Compression	P1dB	27.5	27.5	27.5	27.6	dBm
Third Order Input Intercept Point	IIP3	23	25.2	27.1	29.9	dBm
Third Order Output Intercept Point	OIP3	41	41.8	43.1	44.2	dBm

1. V_{DD} = 5 Vdc, T_A = 25°C, 50 ohm system, application circuit tuned for specified frequency.

Table 2. Maximum Ratings

Rating	Symbol	Value	Unit
Supply Voltage	V_{DD}	6	V
Supply Current	I_{DD}	400	mA
RF Input Power	P_{in}	25	dBm
Storage Temperature Range	T_{stg}	-65 to +150	°C
Junction Temperature (2)	T_J	150	°C

2. For reliable operation, the junction temperature should not exceed 150°C.

Table 3. Thermal Characteristics

Characteristic	Symbol	Value (3)	Unit
Thermal Resistance, Junction to Case Case Temperature 91°C, 5 Vdc, 220 mA, no RF applied	$R_{\theta JC}$	29	°C/W

3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1955.

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Table 4. Electrical Characteristics (V_{DD} = 5 Vdc, 2140 MHz, T_A = 25°C, 50 ohm system, in Freescale Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Small-Signal Gain (S21)	G_p	13.4	16	—	dB
Input Return Loss (S11)	IRL	—	-13.5	—	dB
Output Return Loss (S22)	ORL	—	-35	—	dB
Power Output @ 1dB Compression	P1dB	—	27.5	—	dBm
Third Order Input Intercept Point	IIP3	—	27.1	—	dBm
Third Order Output Intercept Point	OIP3	—	43.1	—	dBm
Reverse Isolation (S12)	|S12|	—	-22	—	dB
Noise Figure	NF	—	1.7	—	dB
Supply Current (1)	I_{DD}	177	215	271	mA
Supply Voltage (1)	V_{DD}	—	5	—	V

Table 5. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2
Machine Model (per EIA/JESD22-A115)	A
Charge Device Model (per JESD22-C101)	IV

Table 6. Moisture Sensitivity Level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	1	260	°C

1. For reliable operation, the junction temperature should not exceed 150°C.

Table 7. Functional Pin Description

Pin Number	Pin Function
1	RF_{in}
2	Ground
3	RF_{out}/DC Supply

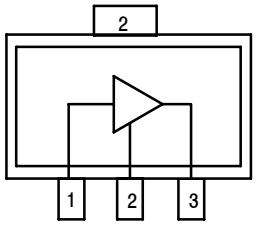
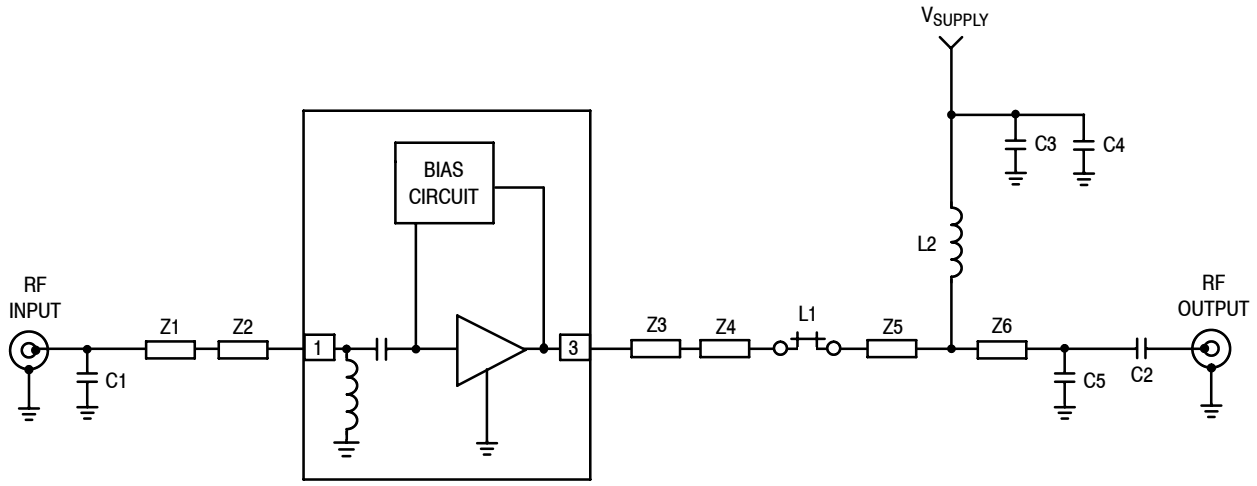


Figure 1. Functional Diagram

50 OHM APPLICATION CIRCUIT: 2140 MHz



Z1	0.120″ × 0.021″ Microstrip	Z4	0.020″ × 0.021″ Microstrip
Z2	0.030″ × 0.040″ Microstrip	Z5	0.010″ × 0.021″ Microstrip
Z3	0.030″ × 0.040″ Microstrip	Z6	0.165″ × 0.021″ Microstrip

Figure 2. MMG20271H9T1 Test Circuit Schematic

Table 8. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.2 pF Chip Capacitor	GRM1555C1H1R2BA01	Murata
L1 (1)	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

50 OHM APPLICATION CIRCUIT: 2140 MHz

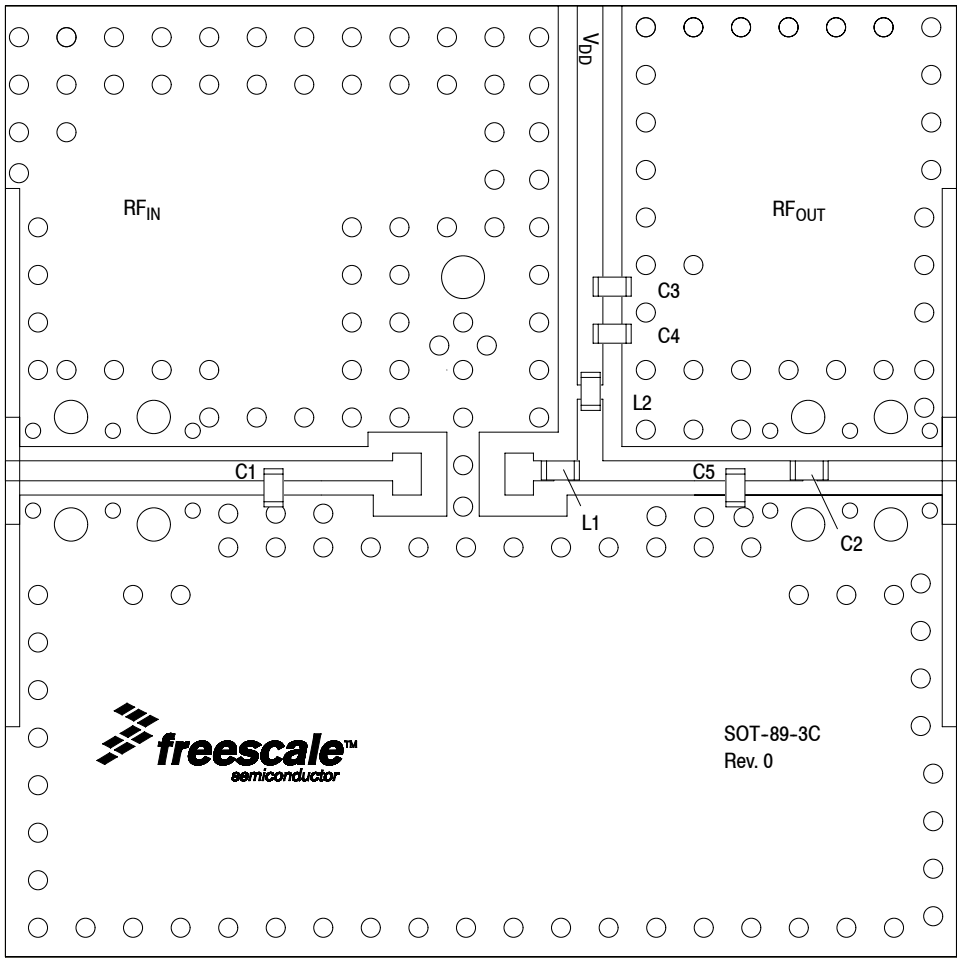


Figure 3. MMG20271H9T1 Test Circuit Component Layout

Table 8. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.2 pF Chip Capacitor	GRM1555C1H1R2BA01	Murata
L1 (1)	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

(Test Circuit Component Designations and Values table repeated for reference.)

50 OHM TYPICAL CHARACTERISTICS: 2140 MHz

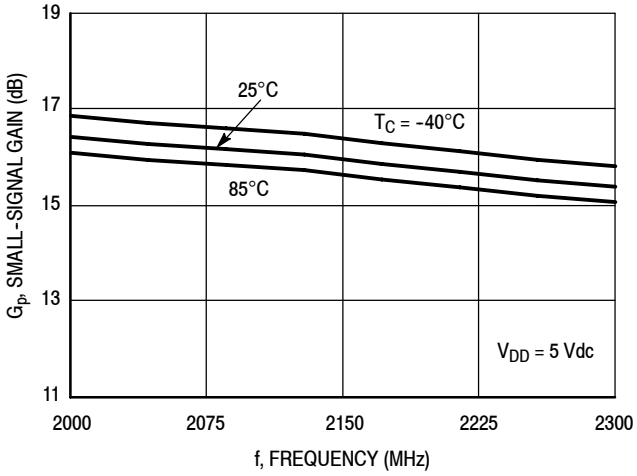


Figure 4. Small-Signal Gain (S21) versus Frequency versus Temperature

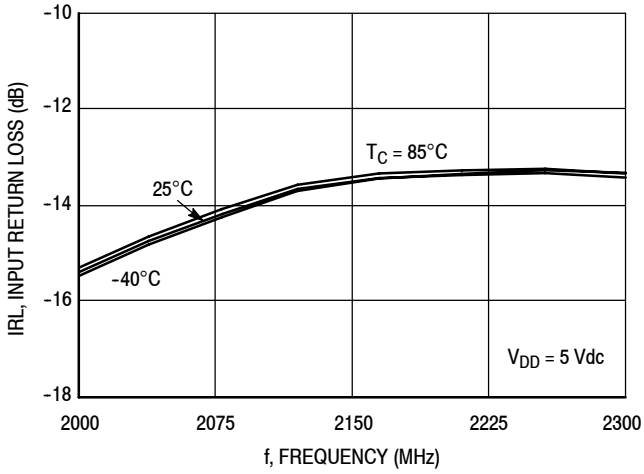


Figure 5. Input Return Loss (S11) versus Frequency versus Temperature

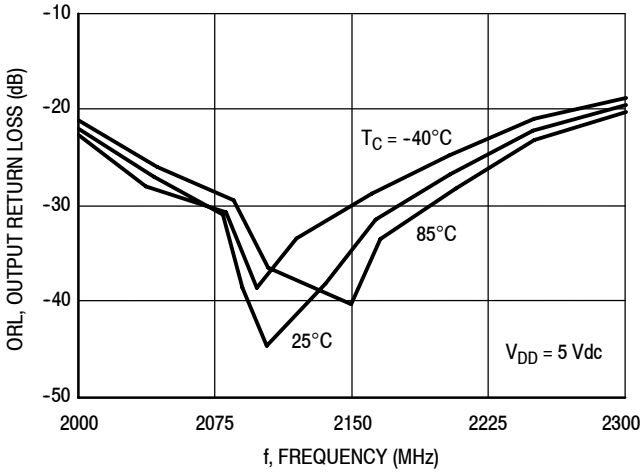


Figure 6. Output Return Loss (S22) versus Frequency versus Temperature

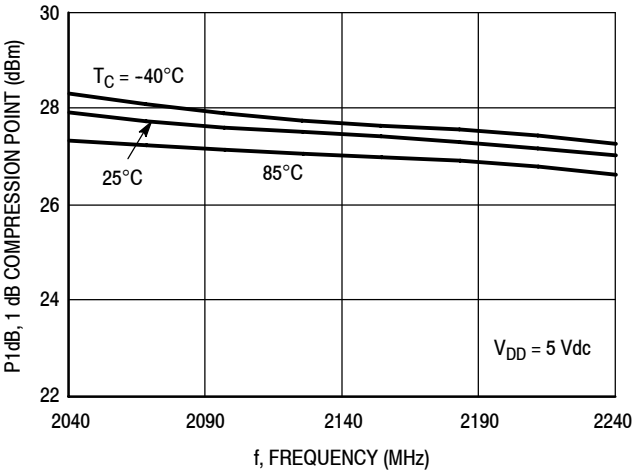


Figure 7. P1dB versus Frequency versus Temperature

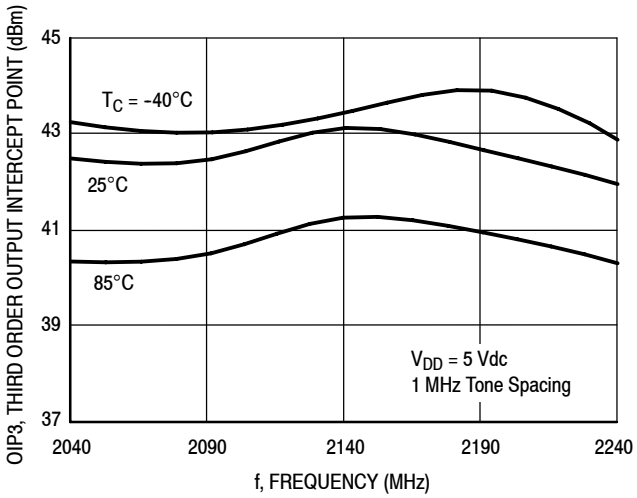


Figure 8. Third Order Output Intercept Point versus Frequency versus Temperature

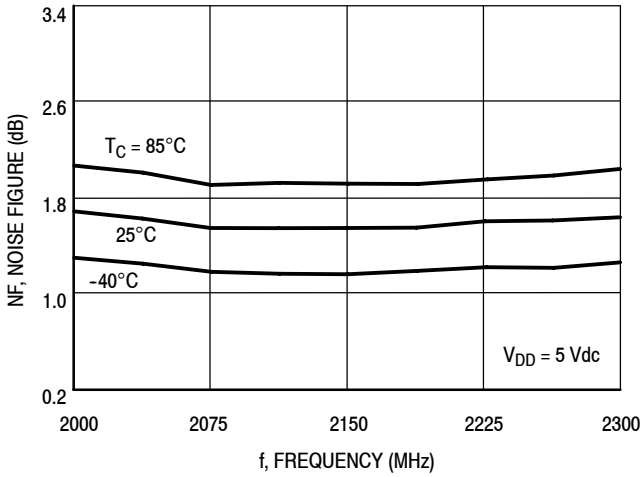


Figure 9. Noise Figure versus Frequency versus Temperature

50 OHM TYPICAL CHARACTERISTICS: 2140 MHz

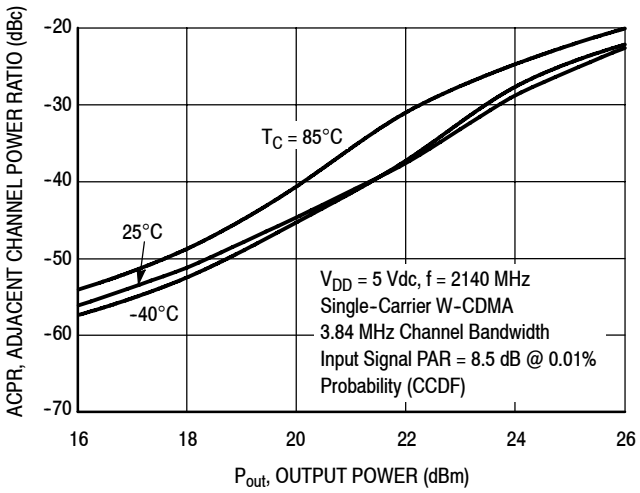
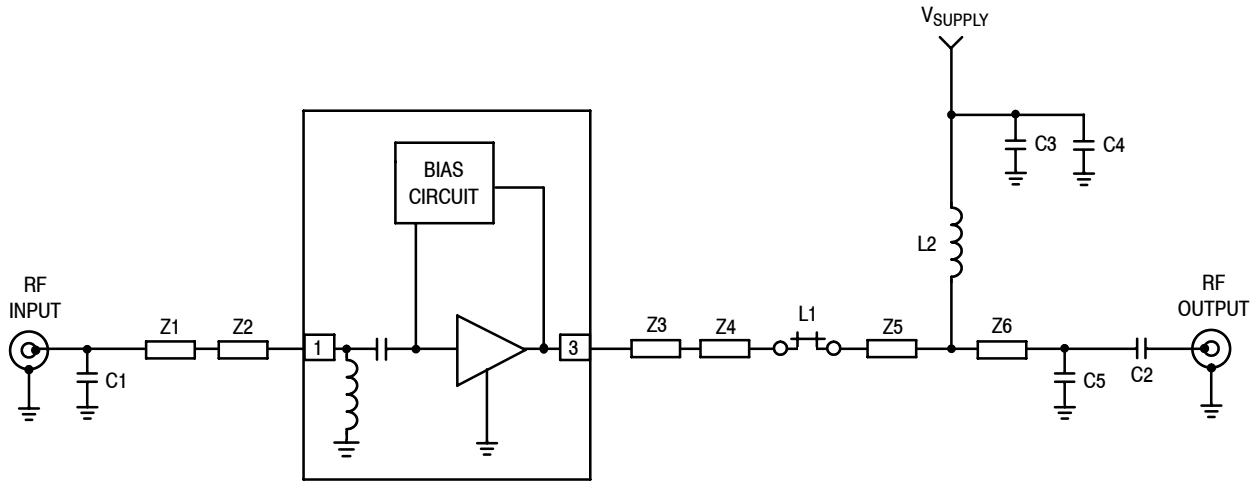


Figure 10. Single-Carrier W-CDMA Adjacent Channel Power Ratio versus Output Power

50 OHM APPLICATION CIRCUIT: 1900 MHz



Z1	0.097″ × 0.021″ Microstrip	Z4	0.020″ × 0.021″ Microstrip
Z2	0.030″ × 0.040″ Microstrip	Z5	0.010″ × 0.021″ Microstrip
Z3	0.030″ × 0.040″ Microstrip	Z6	0.122″ × 0.021″ Microstrip

Figure 11. MMG20271H9T1 Test Circuit Schematic

Table 9. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.8 pF Chip Capacitor	GRM1555C1H1R8BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
L1 (1)	1.2 nH Inductor	0402CS-1N2XJL	Coilcraft
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

50 OHM APPLICATION CIRCUIT: 1900 MHz

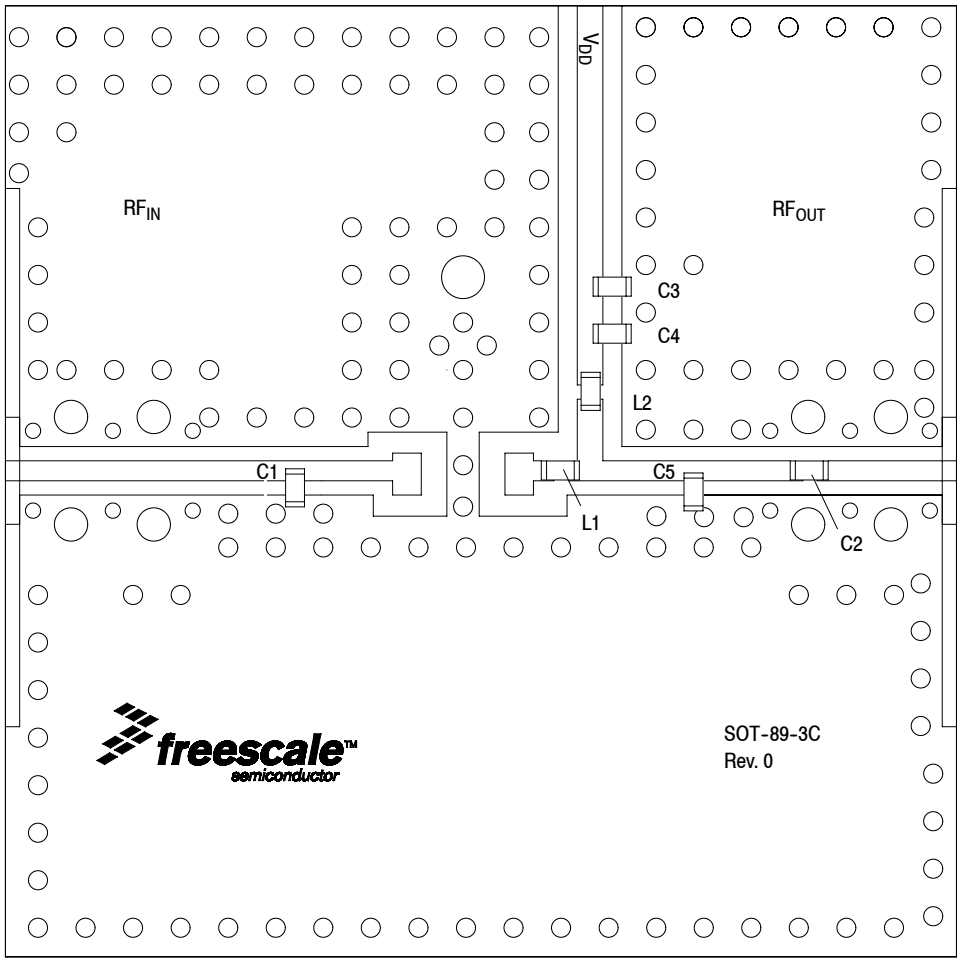


Figure 12. MMG20271H9T1 Test Circuit Component Layout

Table 9. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.8 pF Chip Capacitor	GRM1555C1H1R8BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
L1 (1)	1.2 nH Inductor	0402CS-1N2XJL	Coilcraft
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

(Test Circuit Component Designations and Values table repeated for reference.)

50 OHM TYPICAL CHARACTERISTICS: 1900 MHz

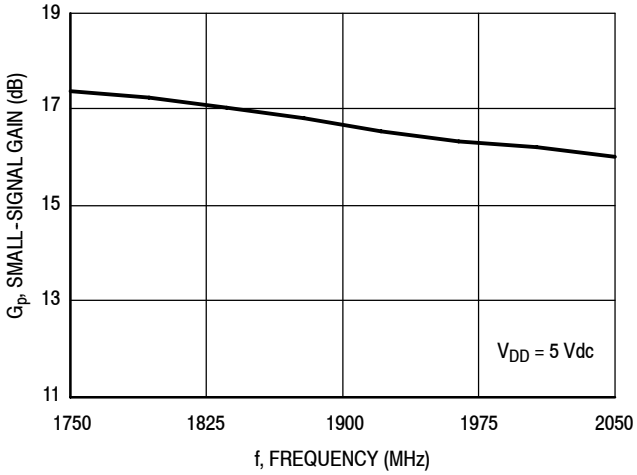


Figure 13. Small-Signal Gain (S21) versus Frequency

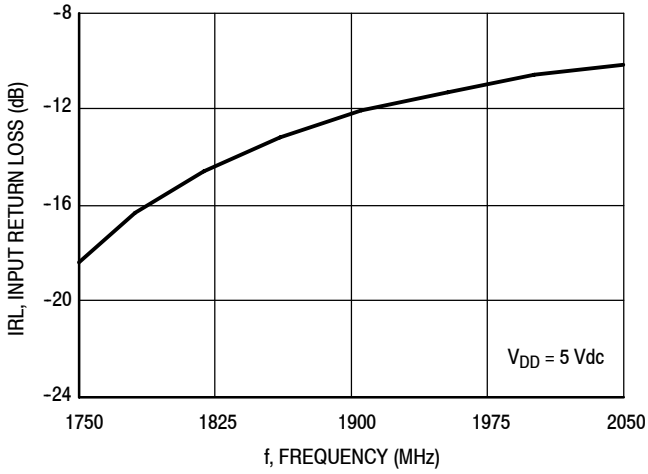


Figure 14. Input Return Loss (S11) versus Frequency

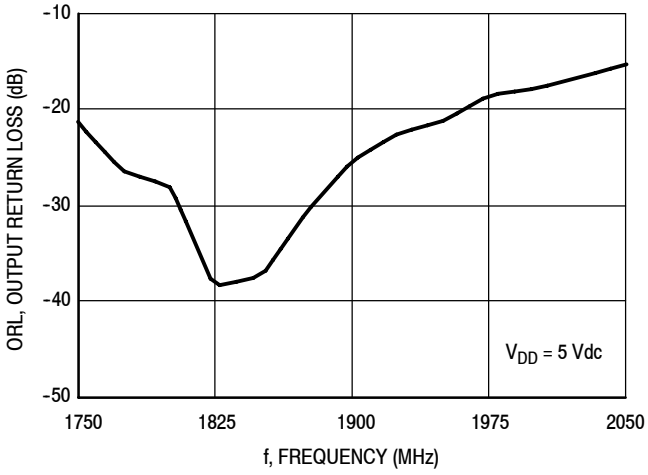


Figure 15. Output Return Loss (S22) versus Frequency

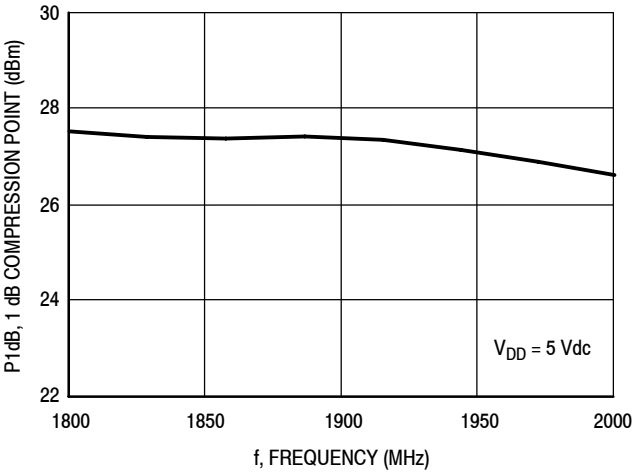


Figure 16. P1dB versus Frequency

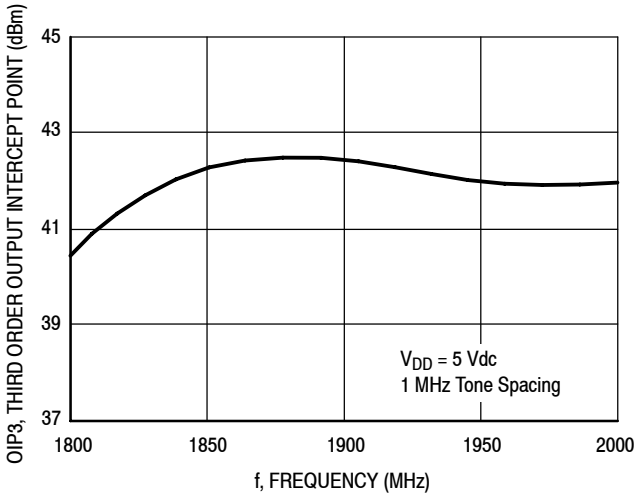


Figure 17. Third Order Output Intercept Point versus Frequency

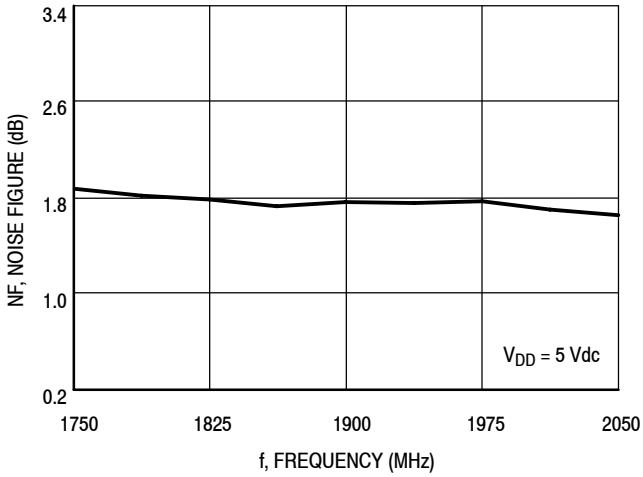
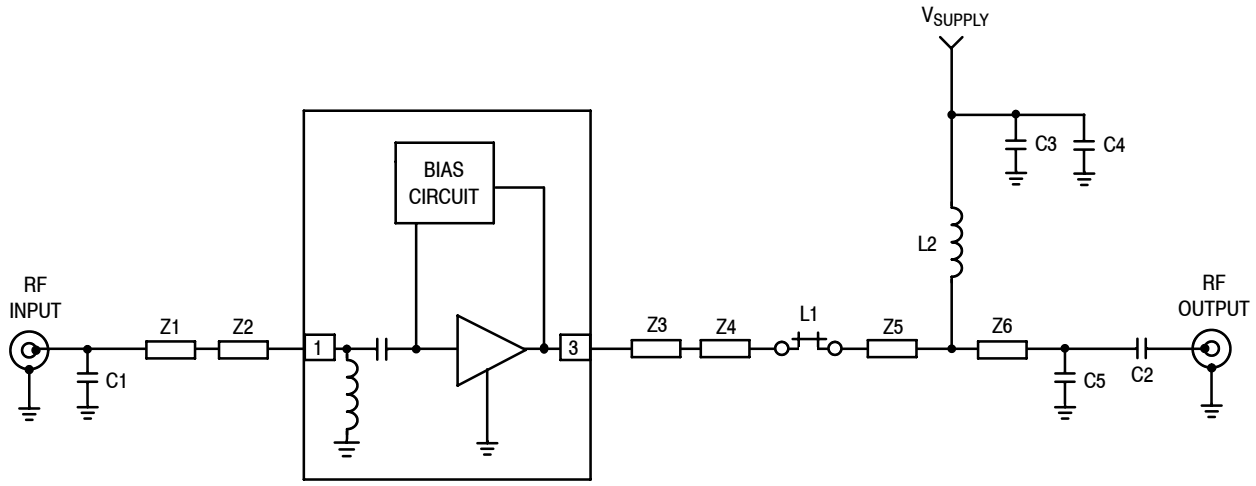


Figure 18. Noise Figure versus Frequency

50 OHM APPLICATION CIRCUIT: 2700 MHz



Z1	0.080″ × 0.021″ Microstrip	Z4	0.020″ × 0.021″ Microstrip
Z2	0.030″ × 0.040″ Microstrip	Z5	0.010″ × 0.021″ Microstrip
Z3	0.030″ × 0.040″ Microstrip	Z6	0.048″ × 0.021″ Microstrip

Figure 19. MMG20271H9T1 Test Circuit Schematic

Table 10. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.0 pF Chip Capacitor	GRM1555C1H1R0BA01	Murata
L1 (1)	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

50 OHM APPLICATION CIRCUIT: 2700 MHz

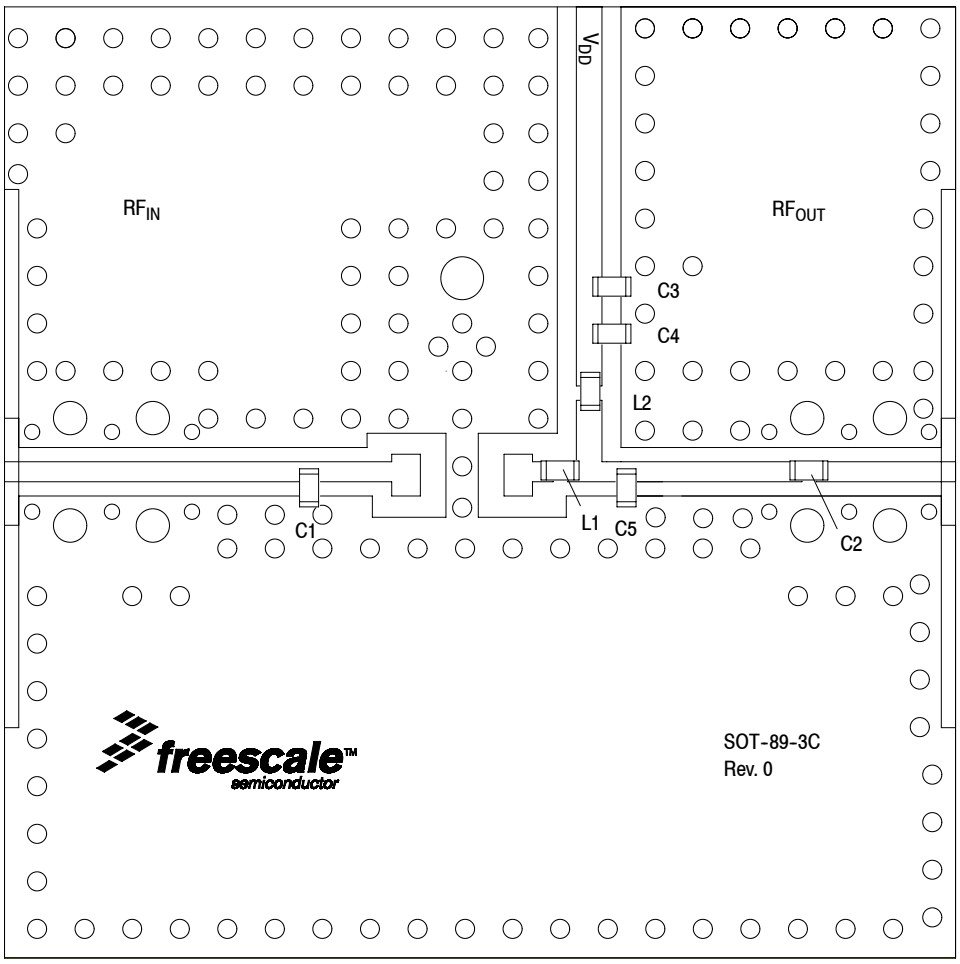


Figure 20. MMG20271H9T1 Test Circuit Component Layout

Table 10. MMG20271H9T1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	1.5 pF Chip Capacitor	GRM1555C1H1R5BA01	Murata
C2, C3	18 pF Chip Capacitors	GRM1555C1H180GA01	Murata
C4	0.1 μF Chip Capacitor	GRM155R61A104K01D	Murata
C5	1.0 pF Chip Capacitor	GRM1555C1H1R0BA01	Murata
L1 (1)	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
L2	23 nH Inductor	0402CS-23NXGL	Coilcraft
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

1. Location L1 can be an inductor, resistor or jumper depending on frequency.

(Test Circuit Component Designations and Values table repeated for reference.)

50 OHM TYPICAL CHARACTERISTICS: 2700 MHz

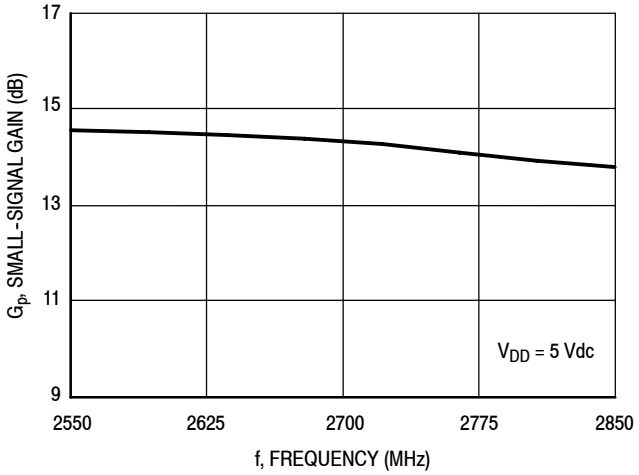


Figure 21. Small-Signal Gain (S21) versus Frequency

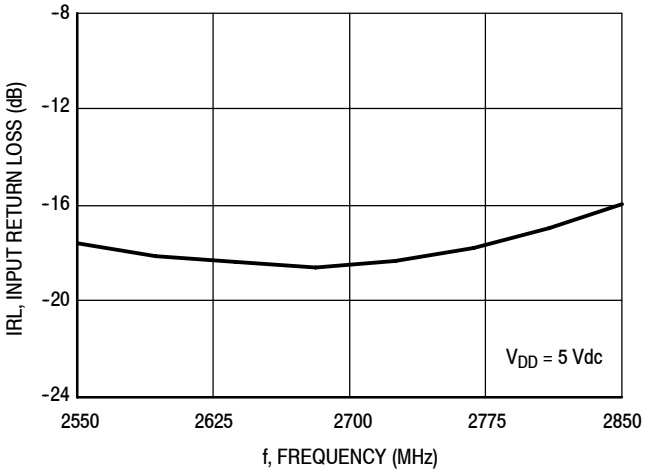


Figure 22. Input Return Loss (S11) versus Frequency

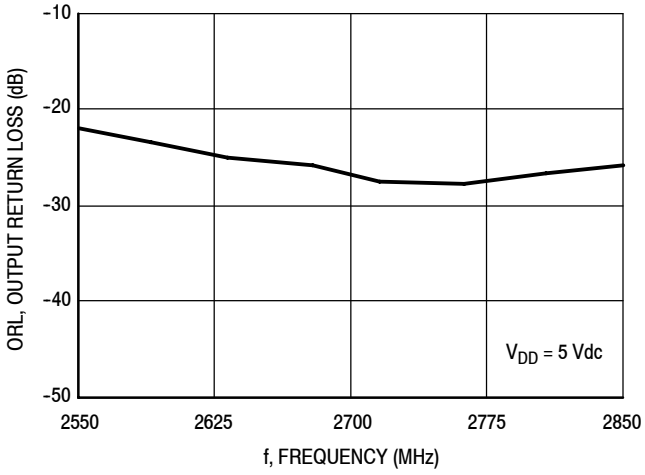


Figure 23. Output Return Loss (S22) versus Frequency

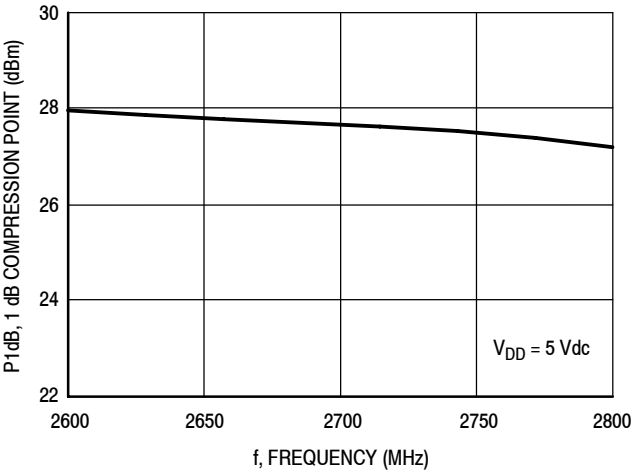


Figure 24. P1dB versus Frequency

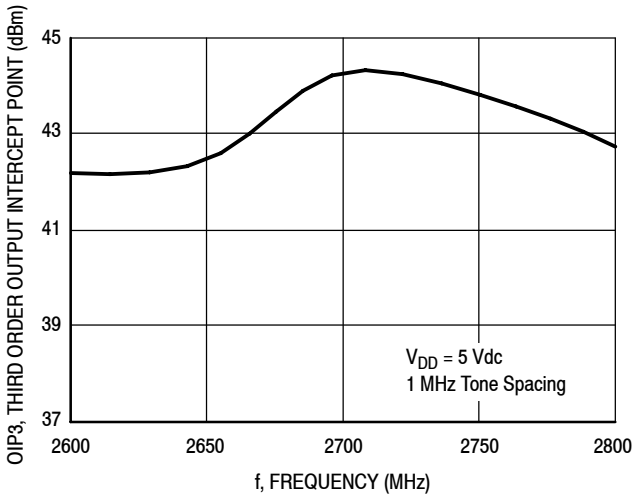


Figure 25. Third Order Output Intercept Point versus Frequency

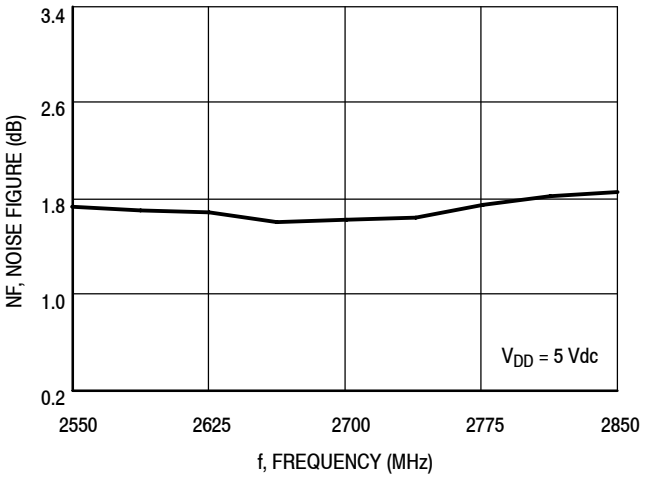


Figure 26. Noise Figure versus Frequency

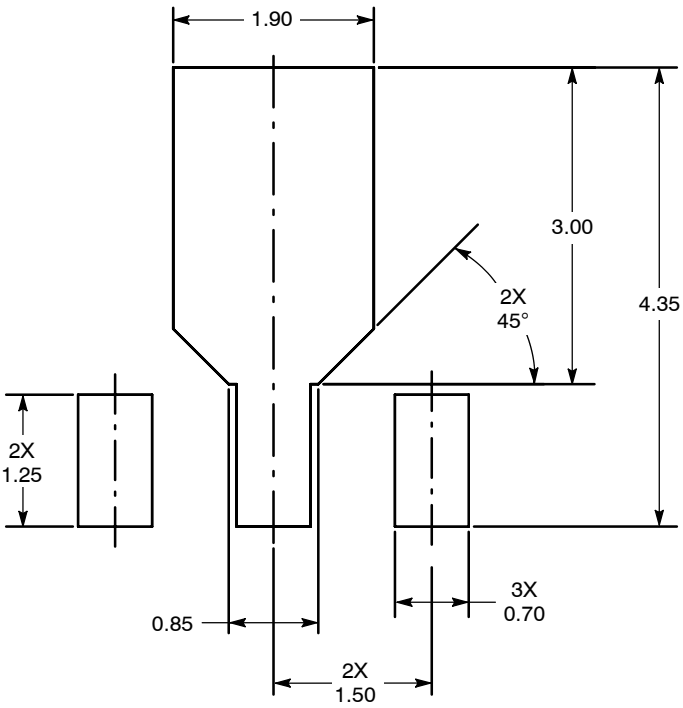
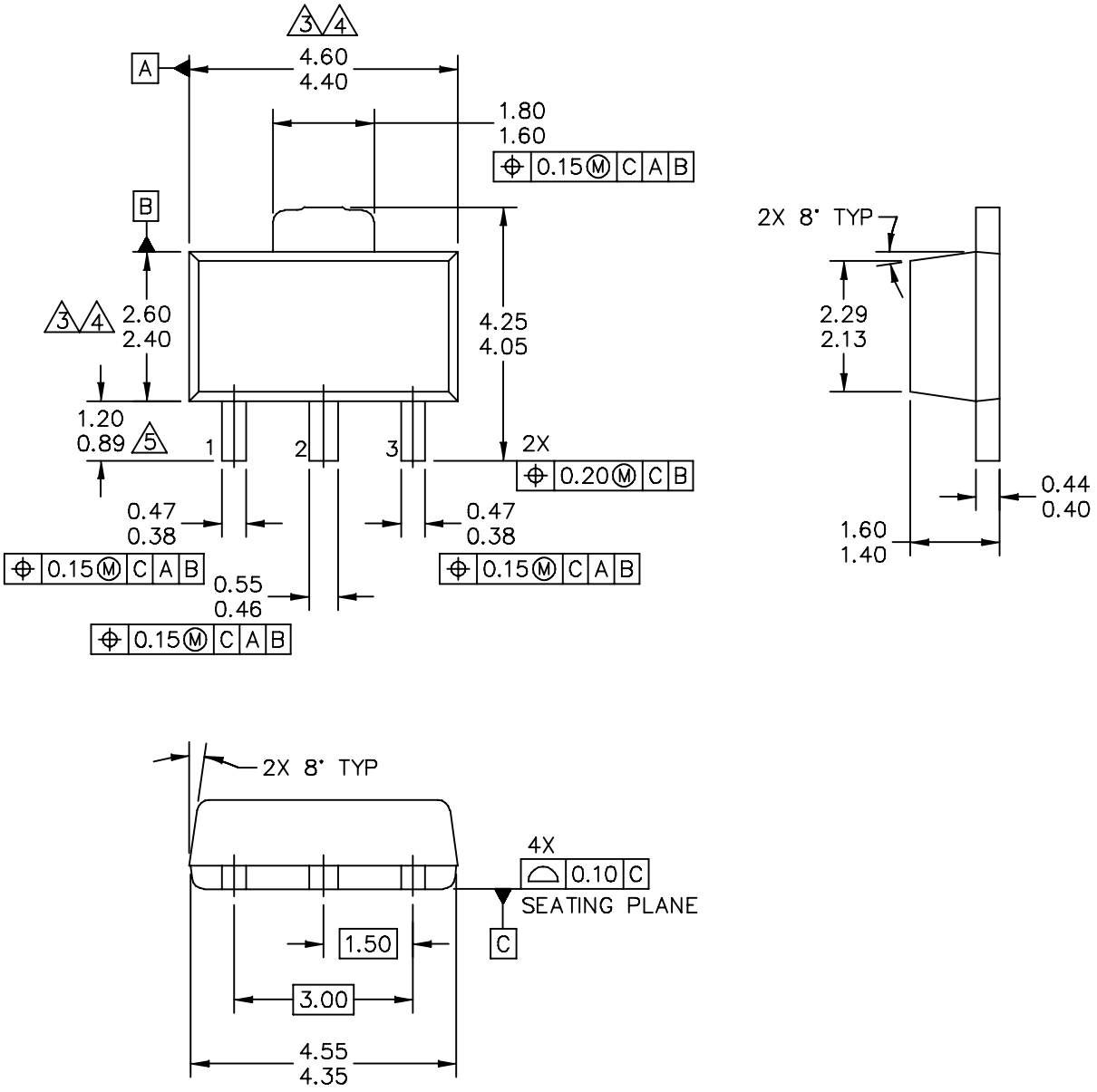


Figure 27. PCB Pad Layout for SOT-89A

Figure 28. Product Marking

PACKAGE DIMENSIONS



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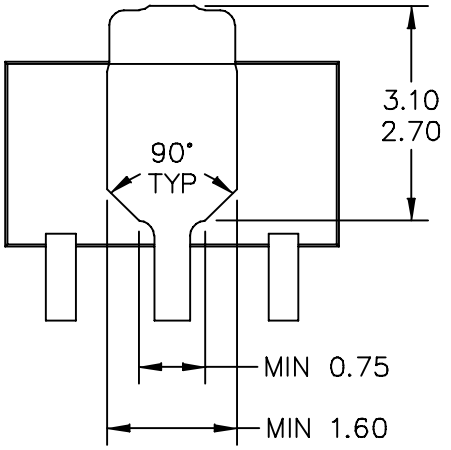
TITLE: SOT-89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH	DOCUMENT NO: 98ASA00241D	REV: O
	CASE NUMBER: 2142-01	15 JUL 2010
	STANDARD: NON-JEDEC	



BOTTOM VIEW

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: SOT−89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH	DOCUMENT NO: 98ASA00241D	REV: O
	CASE NUMBER: 2142−01	15 JUL 2010
	STANDARD: NON−JEDEC	

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.

2. ALL DIMENSIONS ARE IN MILLIMETERS.

3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.5 MM PER END. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.5 MM PER SIDE.

4. DIMENSION ARE DETERMINED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.

5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASA00241D	REV: O
SOT–89A, 3 LEAD, 4.5 X 2.5 PKG, 1.5 MM PITCH	CASE NUMBER: 2142–01	15 JUL 2010
	STANDARD: NON–JEDEC	

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following documents, software and tools to aid your design process.

Application Notes

- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN3100: General Purpose Amplifier and MMIC Biasing

Software

- .s2p File

Development Tools

- Printed Circuit Boards

For Software and Tools, do a Part Number search at http://www.freescale.com, and select the “Part Number” link. Go to the Software & Tools tab on the part’s Product Summary page to download the respective tool.

FAILURE ANALYSIS

At this time failure analysis is limited to electrical signature analysis. For updates contact your local Freescale Sales Office.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Dec. 2011	• Initial Release of Data Sheet

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+46 8 52200080 (English)
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Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
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