Freescale Semiconductor
Technical Data

Document Number: MML09212H
Rev. 2, 9/2014

RoHS

Enhancement Mode pHEMT Technology (E-pHEMT)

Low Noise Amplifier

MML09212HT1

400-1400 MHz, 37.5 dB
22.8 dBm, 0.52 dB NF
E-pHEMT LNA



QFN 3 × 3

The MML09212H is a 2-stage low noise amplifier (LNA) with active bias and high isolation for use in cellular infrastructure applications. It is designed for a range of low noise, high linearity applications such as picocell, femtocell, tower mounted amplifiers (TMA) and receiver front-end circuits. It operates from a single voltage supply and is suitable for applications with frequencies from 400 to 1400 MHz such as ISM, GSM, W-CDMA and LTE.

Features

- Low Noise Figure: 0.52 dB @ 900 MHz
- Frequency: 400-1400 MHz
- Unconditionally Stable Over Temperature
- High Reverse Isolation: -58 dB @ 900 MHz
- P1dB: 22.8 dBm @ 900 MHz
- Small-Signal Gain: 37.5 dB @ 900 MHz
- Third Order Output Intercept Point: 37.5 dBm @ 900 MHz
- Active Bias Control (On-chip)
- Single 5 V Supply
- Supply Current: 150 mA
- 50 Ohm Operation (some external matching required)
- Cost-effective 12-pin, 3 mm QFN Surface Mount Plastic Package
- In Tape and Reel. T1 Suffix = 1,000 Units, 12 mm Tape Width, 7-inch Reel.

Table 1. Typical Performance (1)

Characteristic	Symbol	400 MHz	900 MHz	1400 MHz	Unit
Noise Figure (2)	NF	0.52	0.52	0.74	dB
Input Return Loss (S11)	IRL	-19	-24	-17	dB
Output Return Loss (S22)	ORL	-15	-14	-13.5	dB
Small-Signal Gain (S21)	G_p	40.0	37.5	35.0	dB
Power Output @ 1dB Compression	P1dB	22.6	22.8	22.5	dBm
Third Order Input Intercept Point	IIP3	-2	-0.5	3	dBm
Third Order Output Intercept Point	OIP3	37	37	38	dBm

1. V_{DD} = 5 Vdc, T_A = 25°C, 50 ohm system, application circuit tuned for specified frequency.
2. Noise figure value calculated with connector losses removed.

Table 2. Maximum Ratings

Rating	Symbol	Value	Unit
Supply Voltage	V_{DD}	6	V
Supply Current	I_{DD}	300	mA
RF Input Power	P_{in}	20	dBm
Storage Temperature Range	T_{stg}	-65 to +150	°C
Junction Temperature	T_J	175	°C

Table 3. Thermal Characteristics

Characteristic	Symbol	Value (3)	Unit
Thermal Resistance, Junction to Case Case Temperature 83°C, 5 Vdc, 150 mA, no RF applied	$R_{\theta JC}$	37	°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, 900 MHz, T_A = 25°C, 50 ohm system, in Freescale Application Circuit)

Characteristic	Symbol	Min	Typ	Max	Unit
Small-Signal Gain (S21)	G_p	35.0	37.5	—	dB
Input Return Loss (S11)	IRL	—	-24	—	dB
Output Return Loss (S22)	ORL	—	-14	—	dB
Power Output @ 1dB Compression	P1dB	—	22.8	—	dBm
Third Order Input Intercept Point	IIP3	—	-0.5	—	dBm
Third Order Output Intercept Point	OIP3	—	37	—	dBm
Reverse Isolation (S12)	|S12|	—	-58	—	dBm
Noise Figure (1)	NF	—	0.52	—	dB
Supply Current (2)	I_{DD}	128	150	178	mA
Supply Voltage	V_{DD}	—	5	—	V

Table 5. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	0
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. Noise figure value calculated with connector losses removed.
2. DC current measured with no RF signal applied.

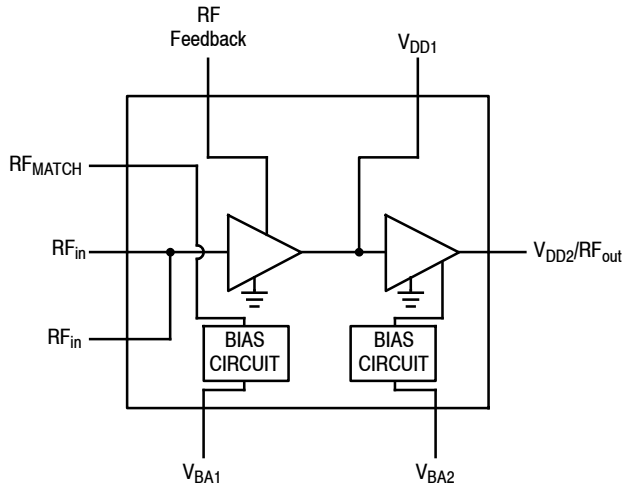
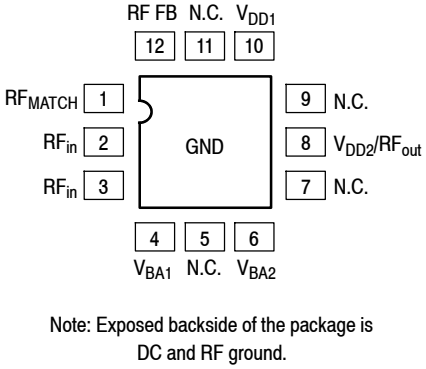


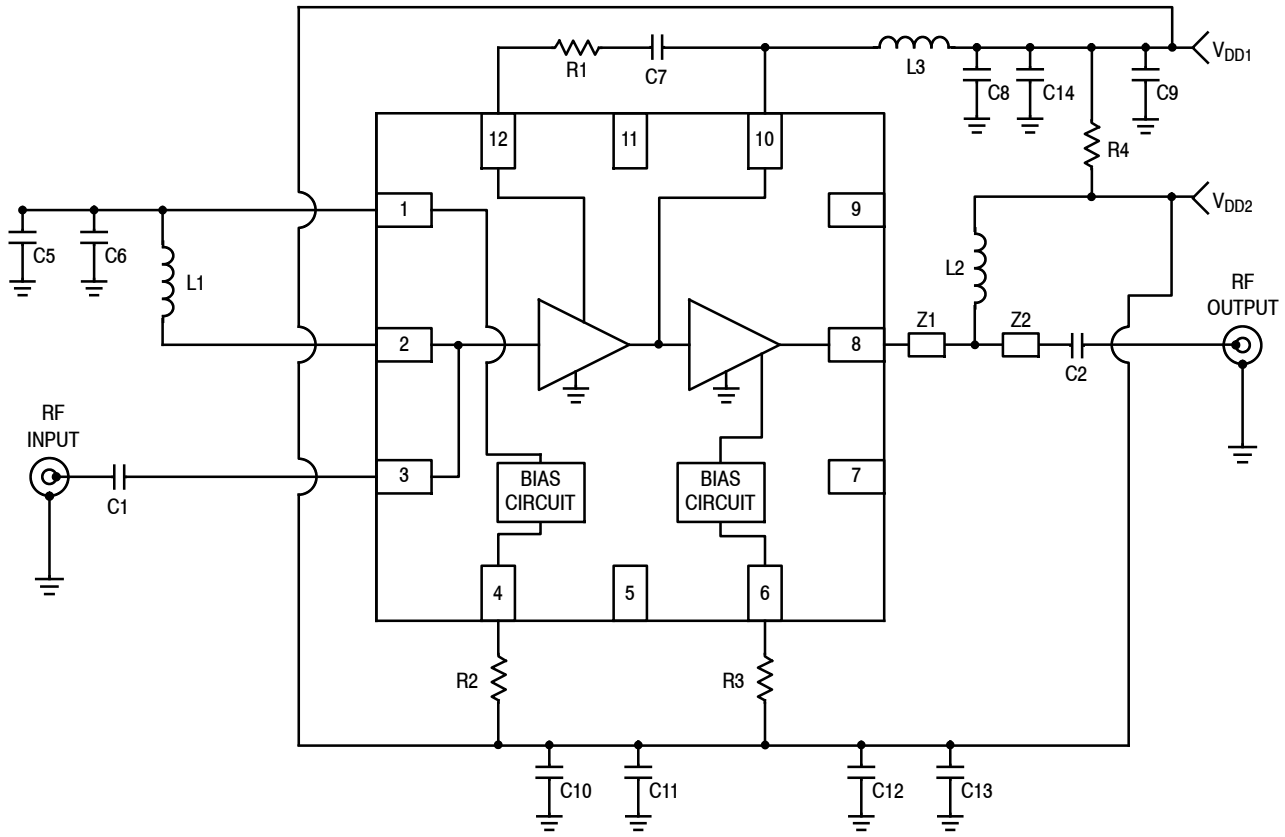
Figure 1. Functional Block Diagram



Note: Exposed backside of the package is DC and RF ground.

Figure 2. Pin Connections

50 OHM APPLICATION CIRCUIT: 900 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

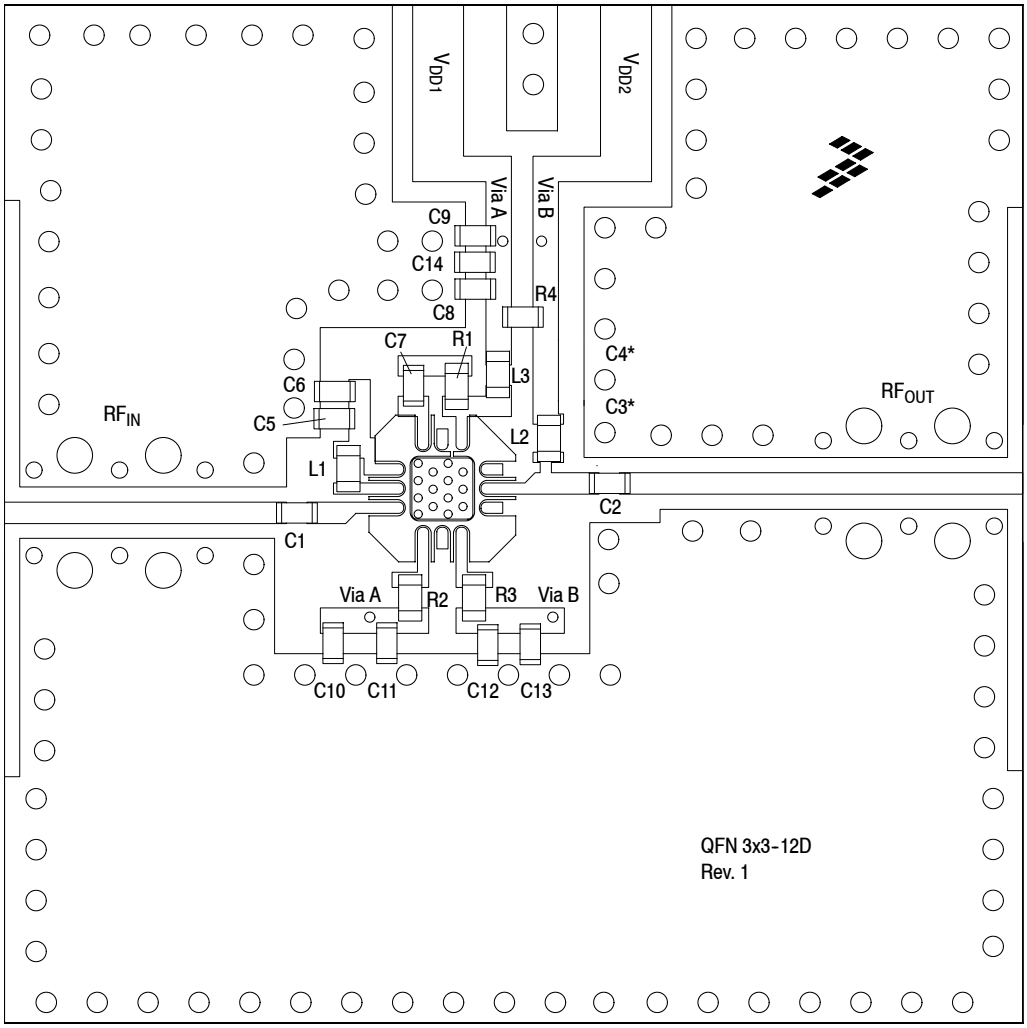
Figure 3. MML09212HT1 Test Circuit Schematic

Table 7. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C7, C14	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
L1	12 nH Chip Inductor	0402CS-12NXGL	Coilcraft
L2	30 nH Chip Inductor	0402CS-30NXGL	Coilcraft
L3	8.2 nH Chip Inductor	0402CS-8N2XGL	Coilcraft
R1	82 Ω Chip Resistor	RC0402JR-07-82RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 900 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

Figure 4. MML09212HT1 Test Circuit Component Layout

Table 7. MML09212HT1 Test Circuit Component Designations and Values

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C1, C2, C7, C14	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
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C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
L1	12 nH Chip Inductor	0402CS-12NXGL	Coilcraft
L2	30 nH Chip Inductor	0402CS-30NXGL	Coilcraft
L3	8.2 nH Chip Inductor	0402CS-8N2XGL	Coilcraft
R1	82 Ω Chip Resistor	RC0402JR-07-82RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

50 OHM TYPICAL CHARACTERISTICS: 900 MHz

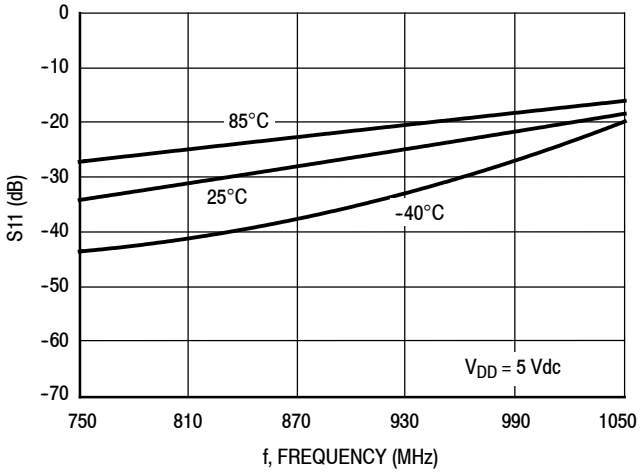


Figure 5. S11 versus Frequency versus Temperature

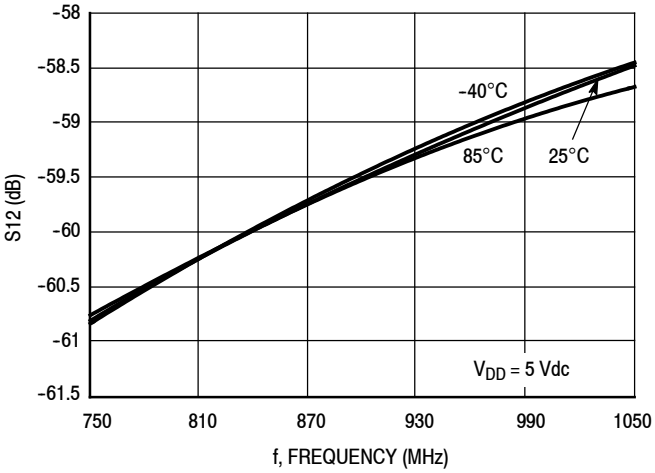


Figure 6. S12 versus Frequency versus Temperature

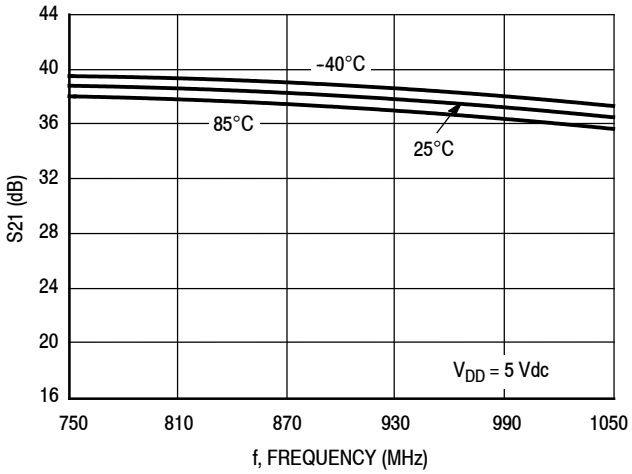


Figure 7. S21 versus Frequency versus Temperature

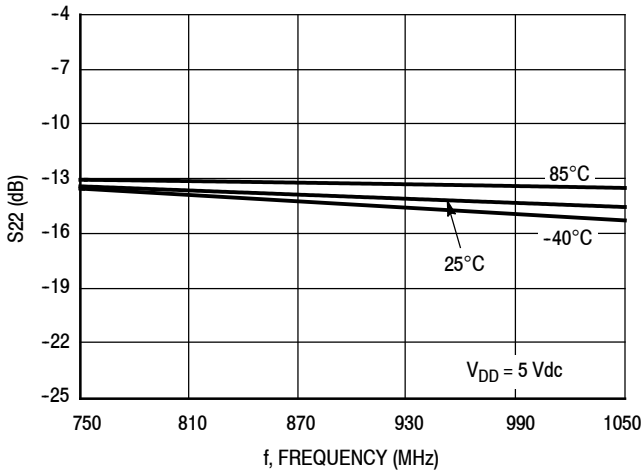


Figure 8. S22 versus Frequency versus Temperature

50 OHM TYPICAL CHARACTERISTICS: 900 MHz

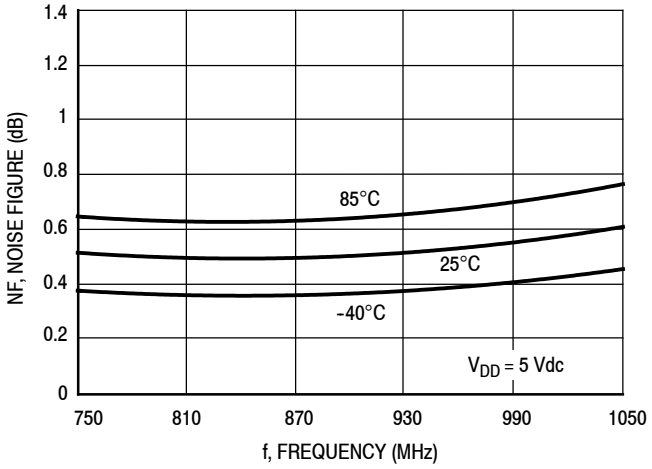


Figure 9. Noise Figure versus Frequency versus Temperature

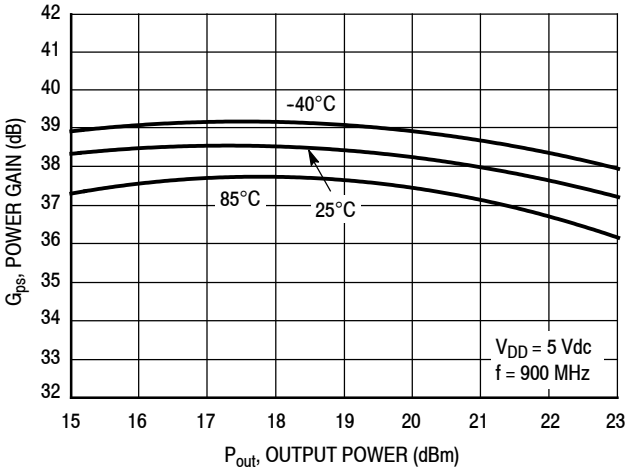


Figure 10. Power Gain versus Output Power versus Temperature, CW

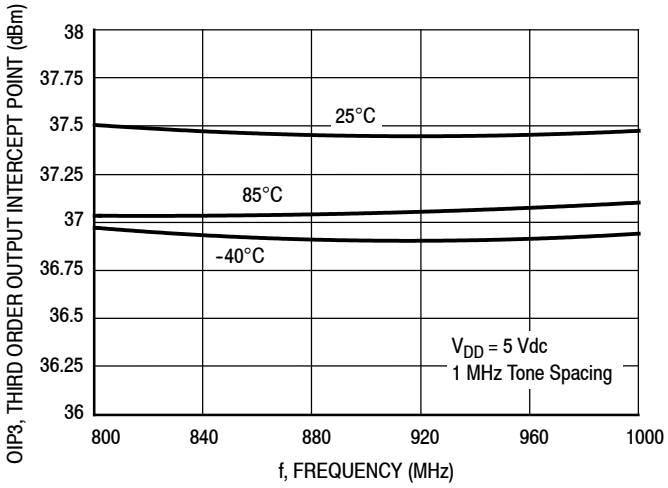


Figure 11. Third Order Output Intercept Point (Two-Tone) versus Frequency versus Temperature

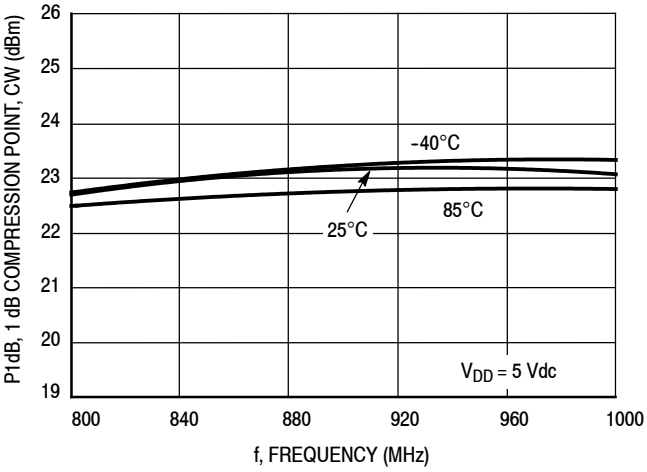
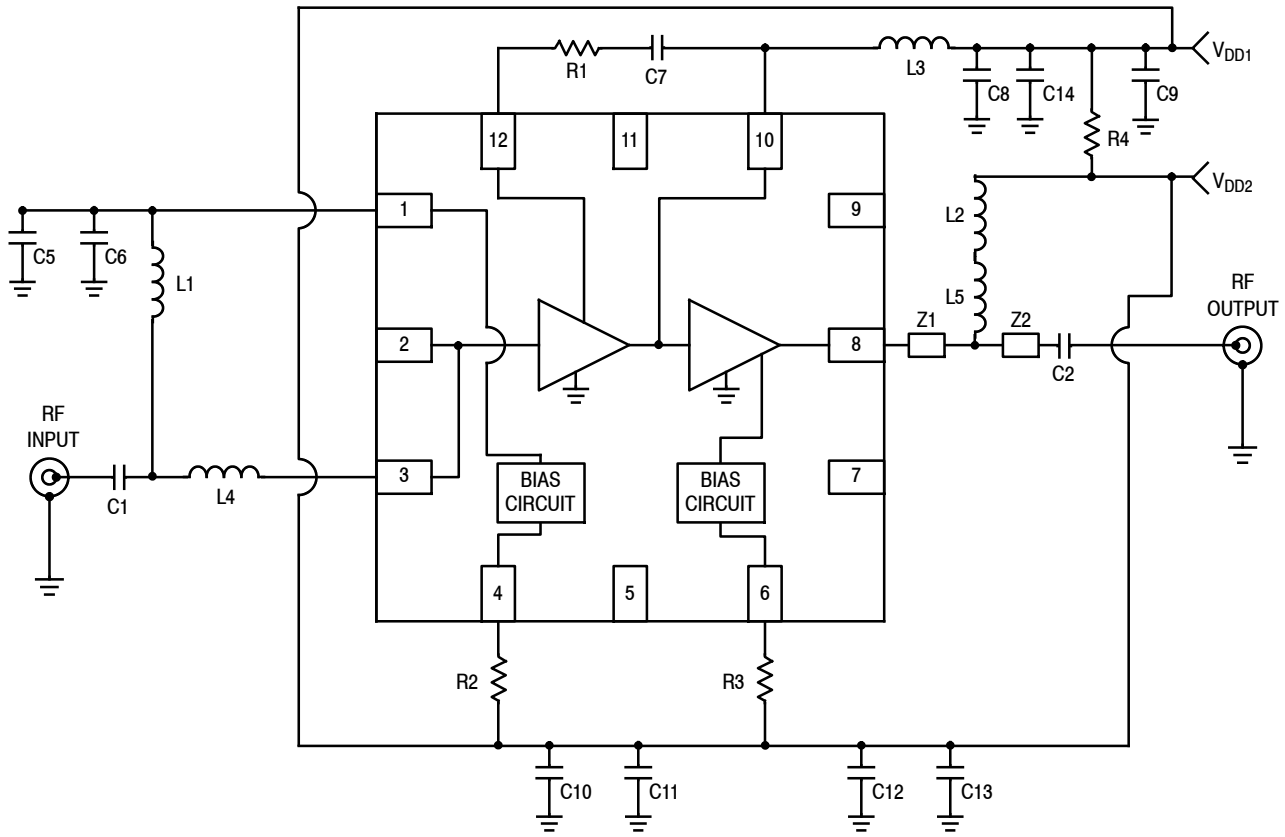


Figure 12. P1dB versus Frequency versus Temperature, CW

50 OHM APPLICATION CIRCUIT: 400 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

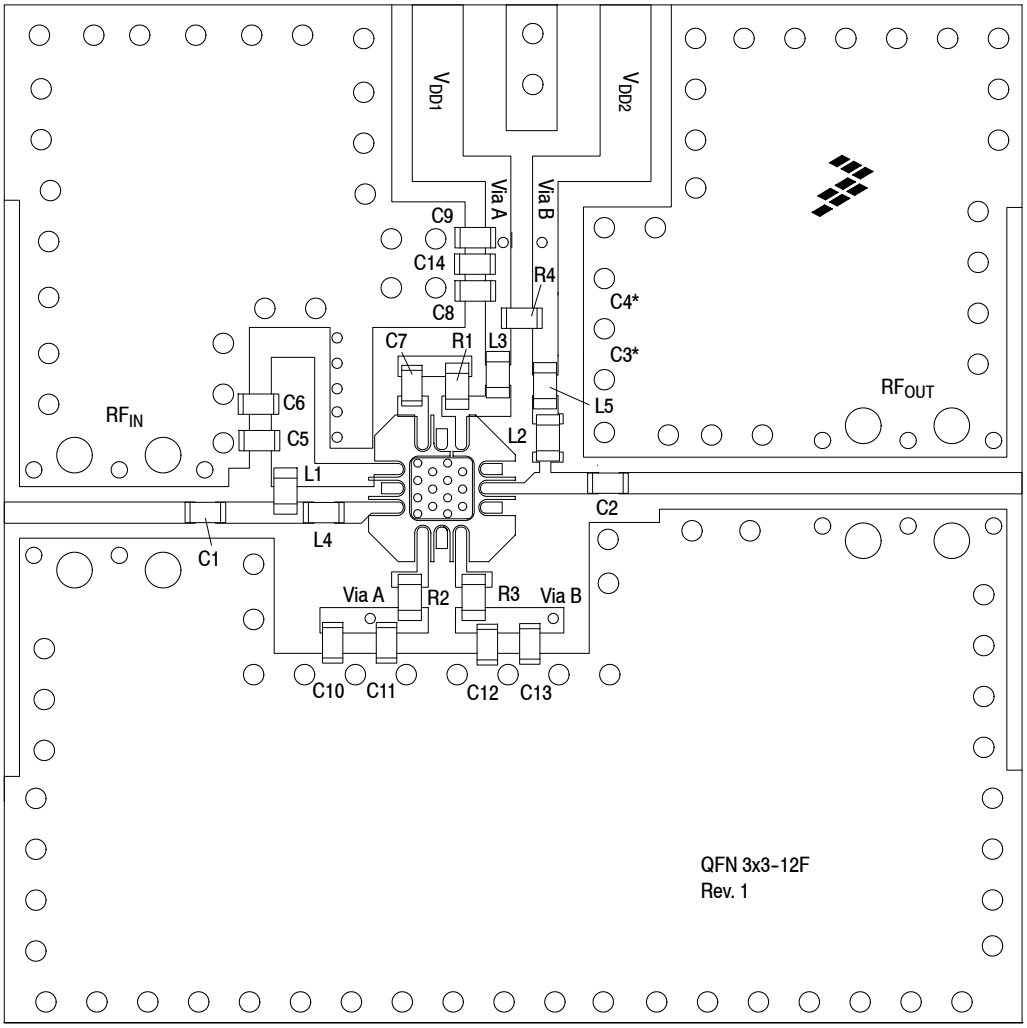
Figure 13. MML09212HT1 Test Circuit Schematic

Table 8. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C3, C4	Components Not Placed		
C5, C7, C8, C11, C12	390 pF Chip Capacitors	GRM1555C1H391JZ01	Murata
C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C14	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
L1	20 nH Chip Inductor	0402CS-20NXGL	Coilcraft
L2, L5	30 nH Chip Inductors	0402CS-30NXGL	Coilcraft
L3	16 nH Chip Inductor	0402CS-16NNXGL	Coilcraft
L4	1.2 nH Chip Inductor	0402CS-1N2XJL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 400 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

Figure 14. MML09212HT1 Test Circuit Component Layout

Table 8. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C3, C4	Components Not Placed		
C5, C7, C8, C11, C12	390 pF Chip Capacitors	GRM1555C1H391JZ01	Murata
C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C14	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
L1	20 nH Chip Inductor	0402CS-20NXGL	Coilcraft
L2, L5	30 nH Chip Inductors	0402CS-30NXGL	Coilcraft
L3	16 nH Chip Inductor	0402CS-16NNXGL	Coilcraft
L4	1.2 nH Chip Inductor	0402CS-1N2XJL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

50 OHM TYPICAL CHARACTERISTICS: 400 MHz

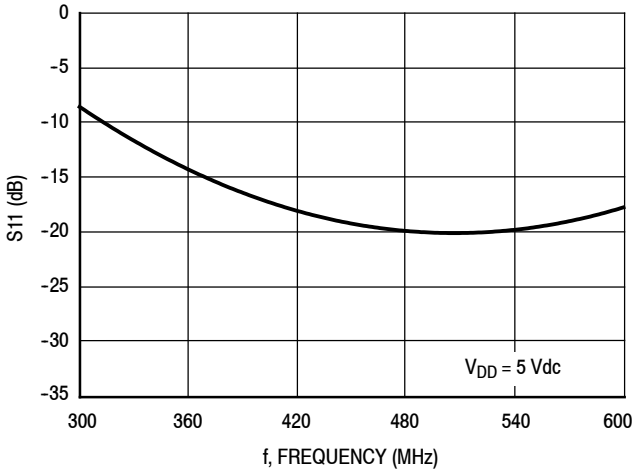


Figure 15. S11 versus Frequency

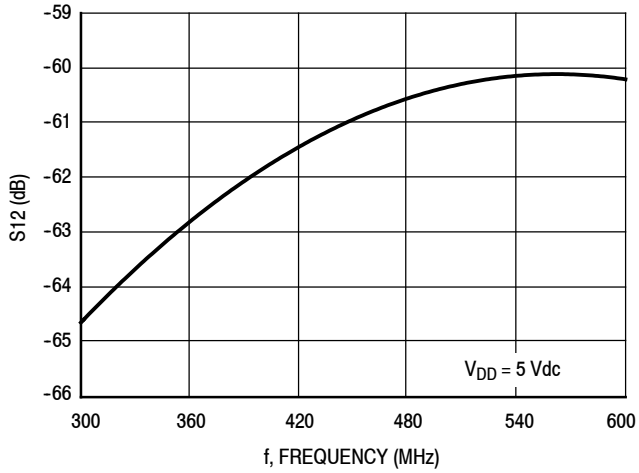


Figure 16. S12 versus Frequency

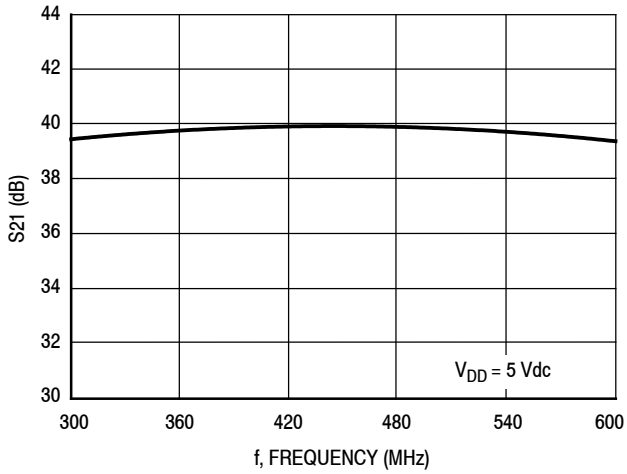


Figure 17. S21 versus Frequency

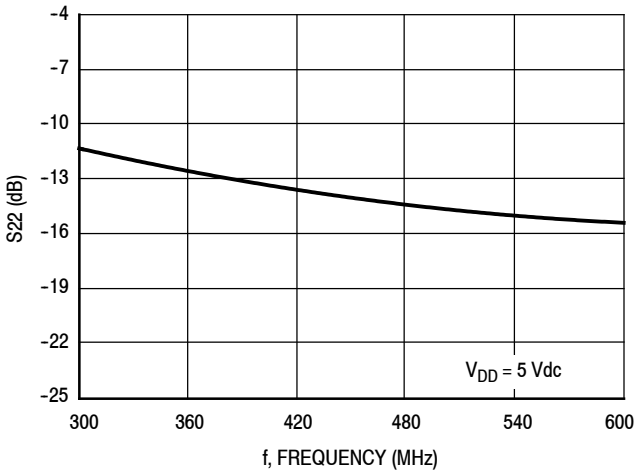


Figure 18. S22 versus Frequency

50 OHM TYPICAL CHARACTERISTICS: 400 MHz

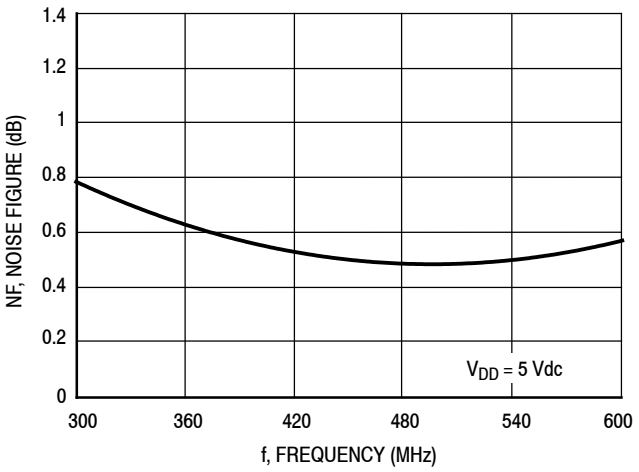


Figure 19. Noise Figure versus Frequency

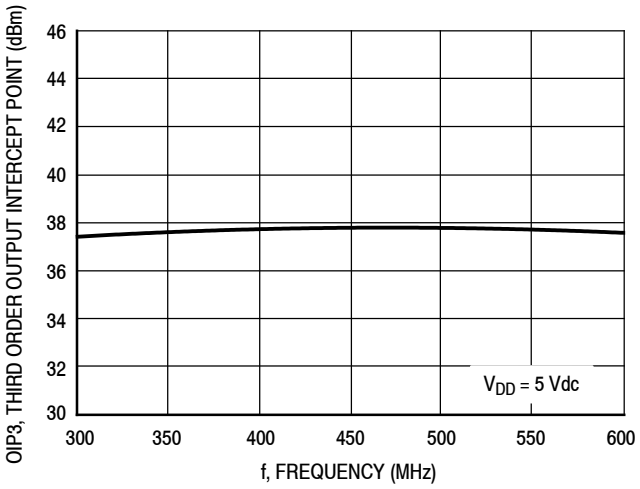
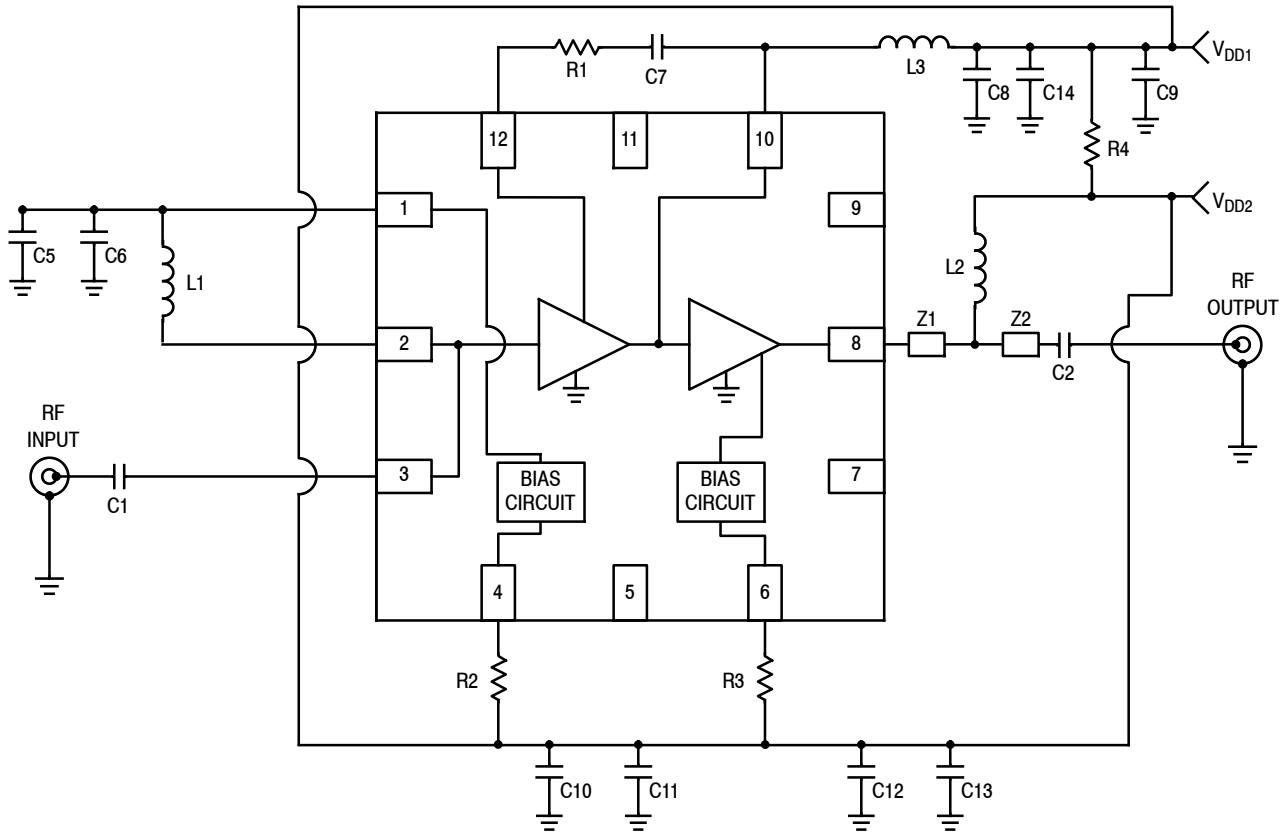


Figure 20. Third Order Output Intercept Point (Two-Tone) versus Frequency

50 OHM APPLICATION CIRCUIT: 1400 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

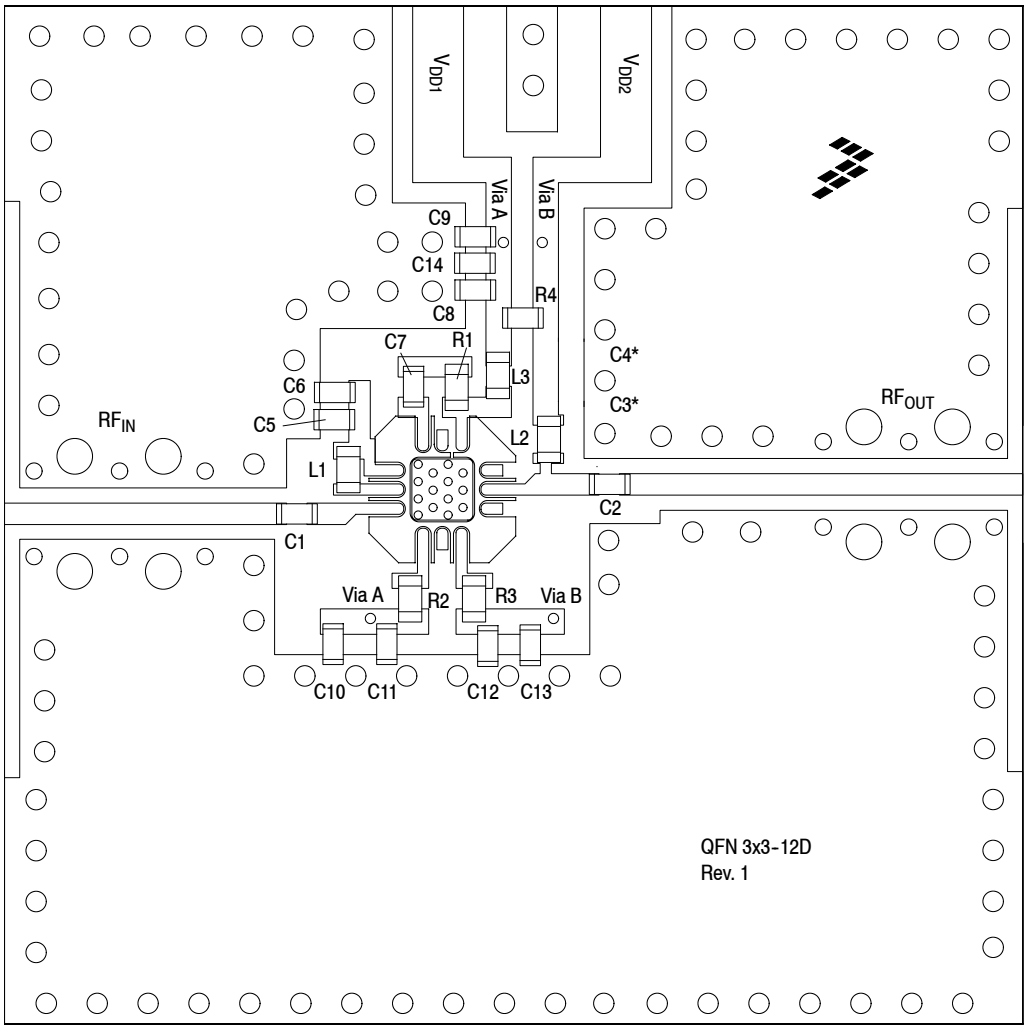
Figure 21. MML09212HT1 Test Circuit Schematic

Table 9. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	220 pF Chip Capacitor	GRM1555C1H221JZ01	Murata
C2, C7	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C14	68 pF Chip Capacitor	GRM1555C1H680JZ01	Murata
L1	6.8 nH Chip Inductor	0402CS-6N8XGL	Coilcraft
L2	23 nH Chip Inductor	0402CS-23NXGL	Coilcraft
L3	4.3 nH Chip Inductor	0402CS-4N3XGL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 1400 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

Figure 22. MML09212HT1 Test Circuit Component Layout

Table 9. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	220 pF Chip Capacitor	GRM1555C1H221JZ01	Murata
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C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8	1000 pF Chip Capacitor	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C14	68 pF Chip Capacitor	GRM1555C1H680JZ01	Murata
L1	6.8 nH Chip Inductor	0402CS-6N8XGL	Coilcraft
L2	23 nH Chip Inductor	0402CS-23NXGL	Coilcraft
L3	4.3 nH Chip Inductor	0402CS-4N3XGL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
R4	0 Ω, 1 A Chip Resistor	ERJ2GE0R00X	Panasonic
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

50 OHM TYPICAL CHARACTERISTICS: 1400 MHz

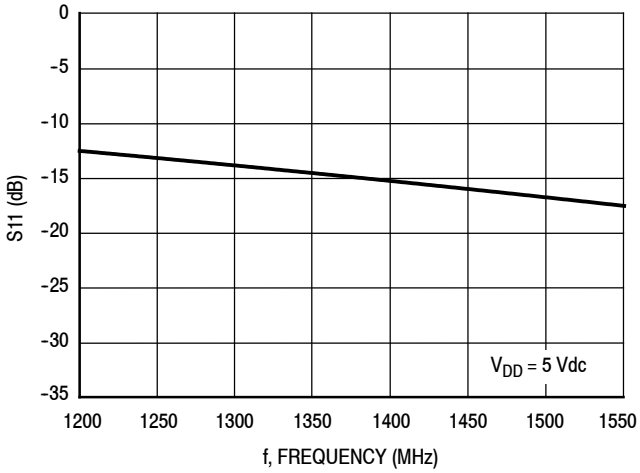


Figure 23. S11 versus Frequency

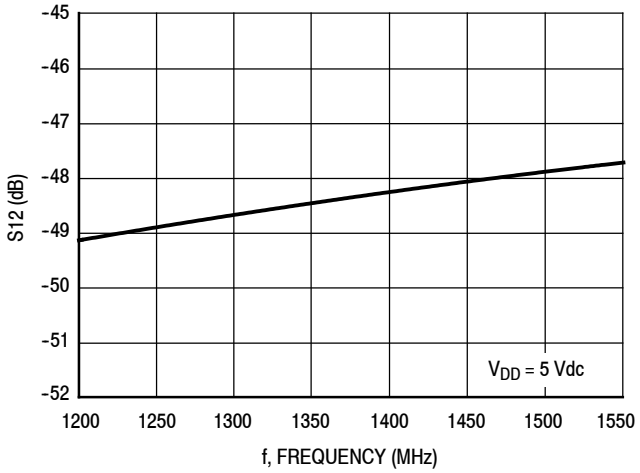


Figure 24. S12 versus Frequency

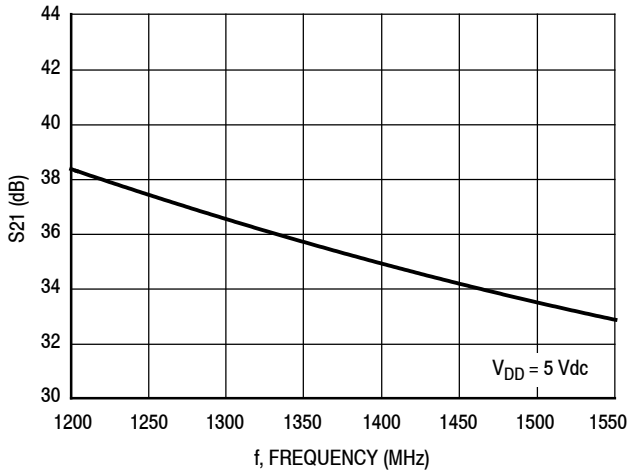


Figure 25. S21 versus Frequency

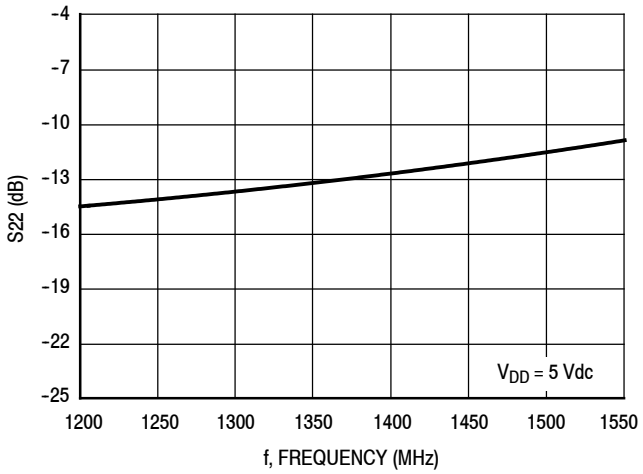


Figure 26. S22 versus Frequency

50 OHM TYPICAL CHARACTERISTICS: 1400 MHz

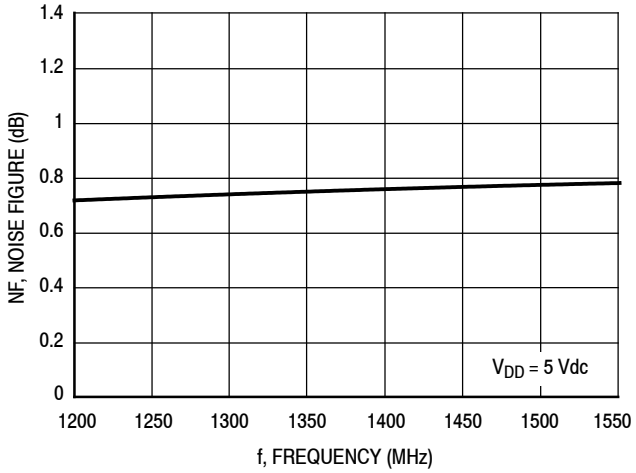


Figure 27. Noise Figure versus Frequency

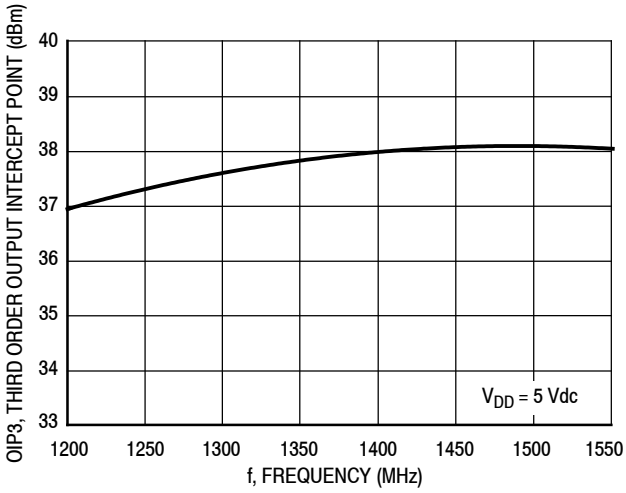


Figure 28. Third Order Output Intercept Point (Two-Tone) versus Frequency

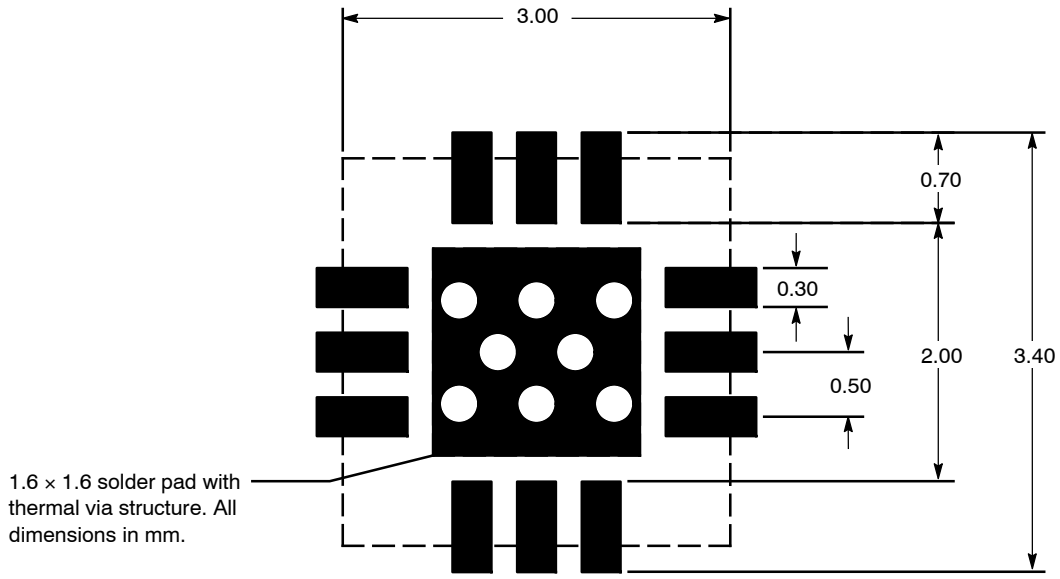
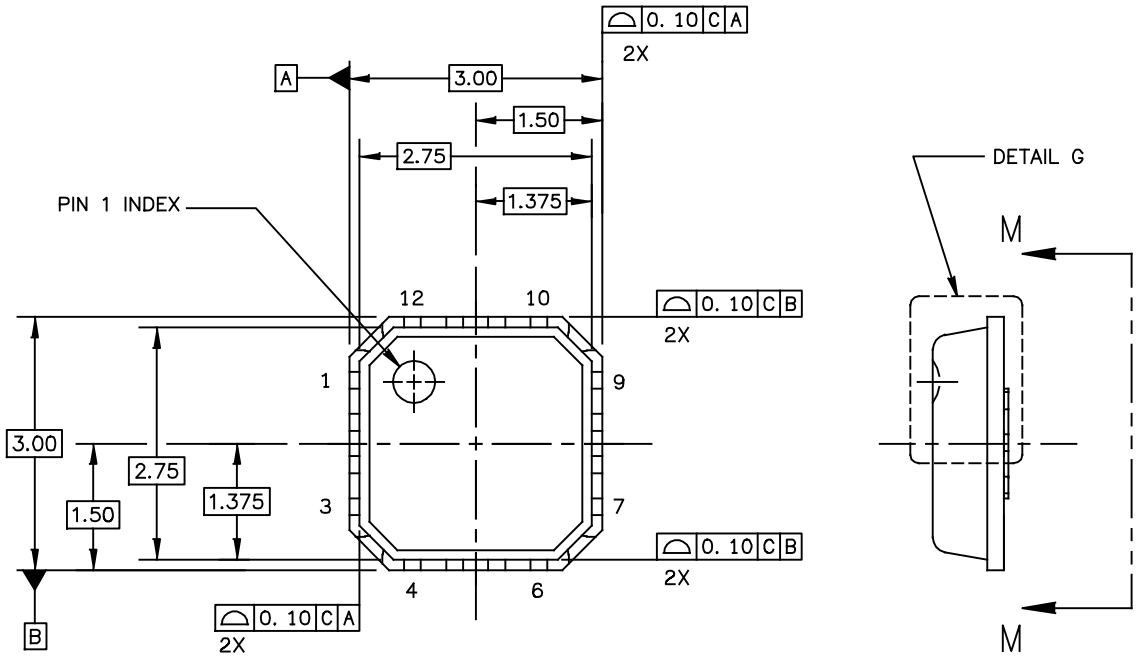


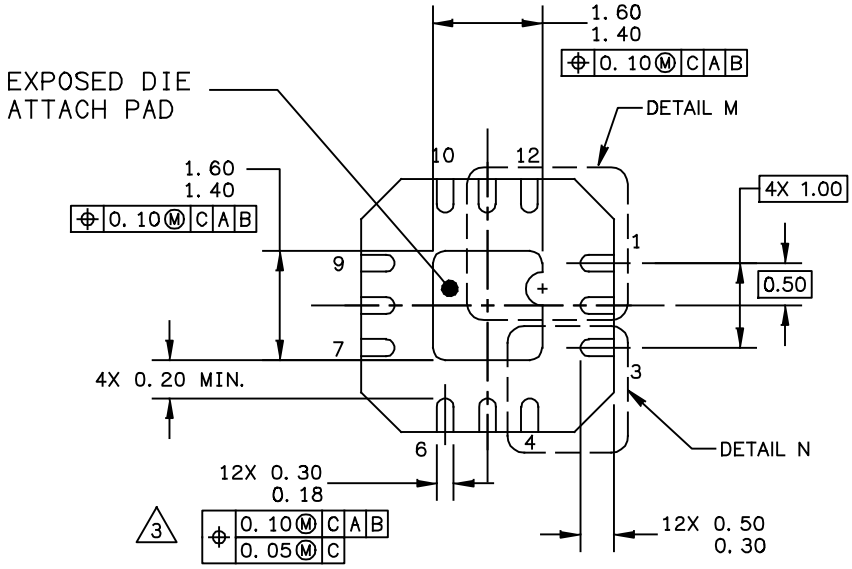
Figure 29. PCB Pad Layout for QFN 3 × 3



Figure 30. Product Marking

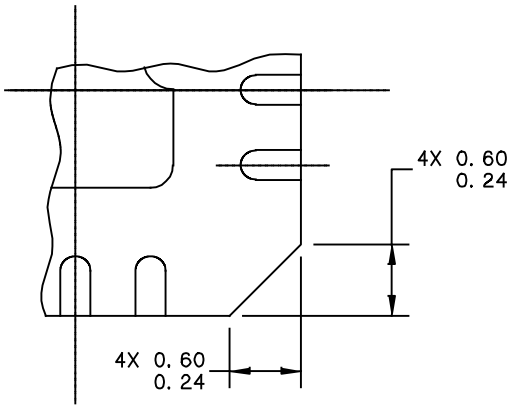
PACKAGE DIMENSIONS



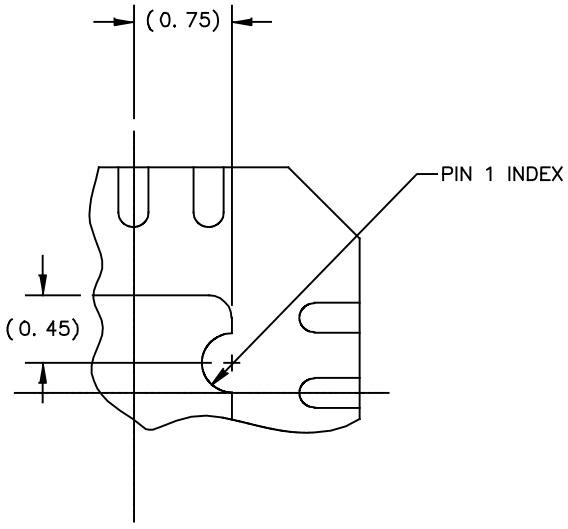


VIEW M–M

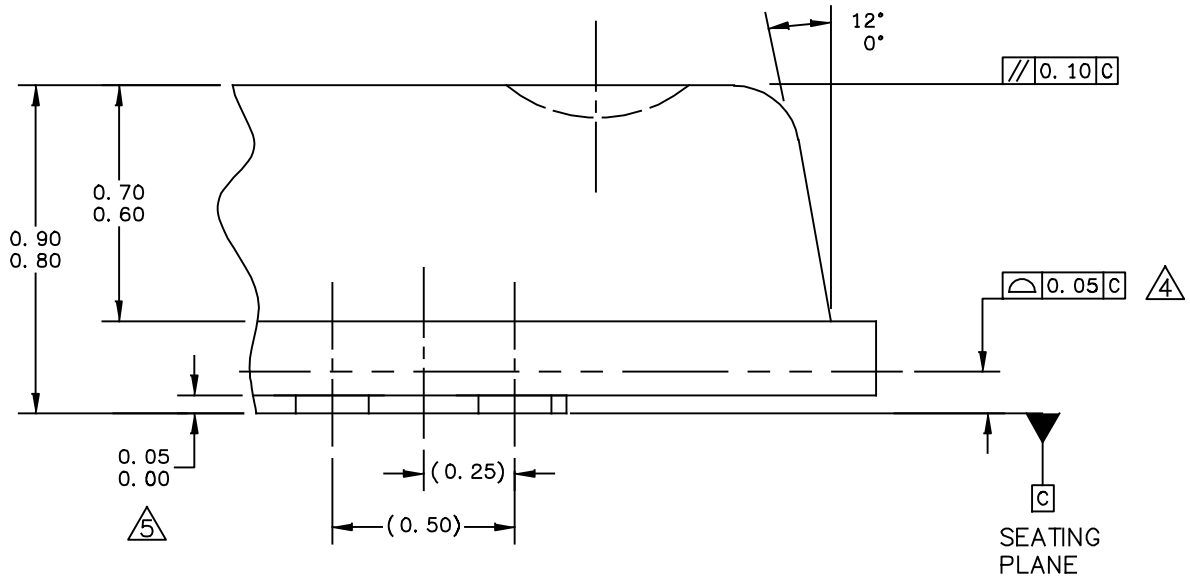
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	CASE NUMBER: 2131–01	14 MAY 2010
	STANDARD: NON–JEDEC	



DETAIL N
CORNER CONFIGURATION



DETAIL M
PIN 1 BACKSIDE INDEX



DETAIL G
VIEW ROTATED 90° CW

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TITLE: THERMALLY ENHANCED QUAD FLAT NON-LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	DOCUMENT NO: 98ASA00227D	REV: O
	CASE NUMBER: 2131-01	14 MAY 2010
	STANDARD: NON-JEDEC	

NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.

2. DIMENSIONING & TOLERANCING PER ASME Y14.5 – 2009.

3. THIS DIMENSION APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.

4. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

5. THIS DIMENSION APPLIED ONLY FOR TERMINALS.

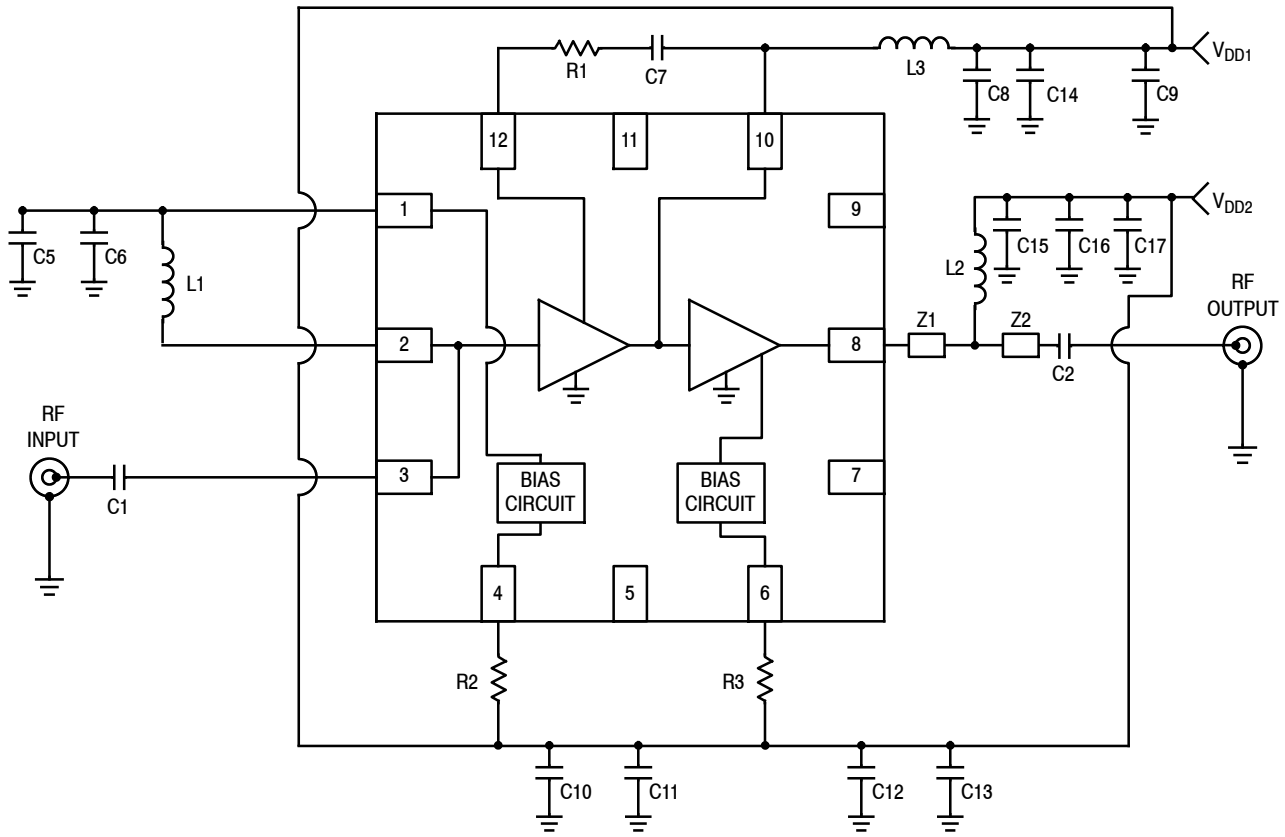
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MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASA00227D	REV: O
THERMALLY ENHANCED QUAD FLAT NON–LEADED PACKAGE (QFN) 12 TERMINAL, 0.5 PITCH (3X3X0.85)	CASE NUMBER: 2131–01	14 MAY 2010
	STANDARD: NON–JEDEC	

APPENDIX: APPLICATION CIRCUITS WITH TWO-SUPPLY VOLTAGE

50 OHM APPLICATION CIRCUIT: 900 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

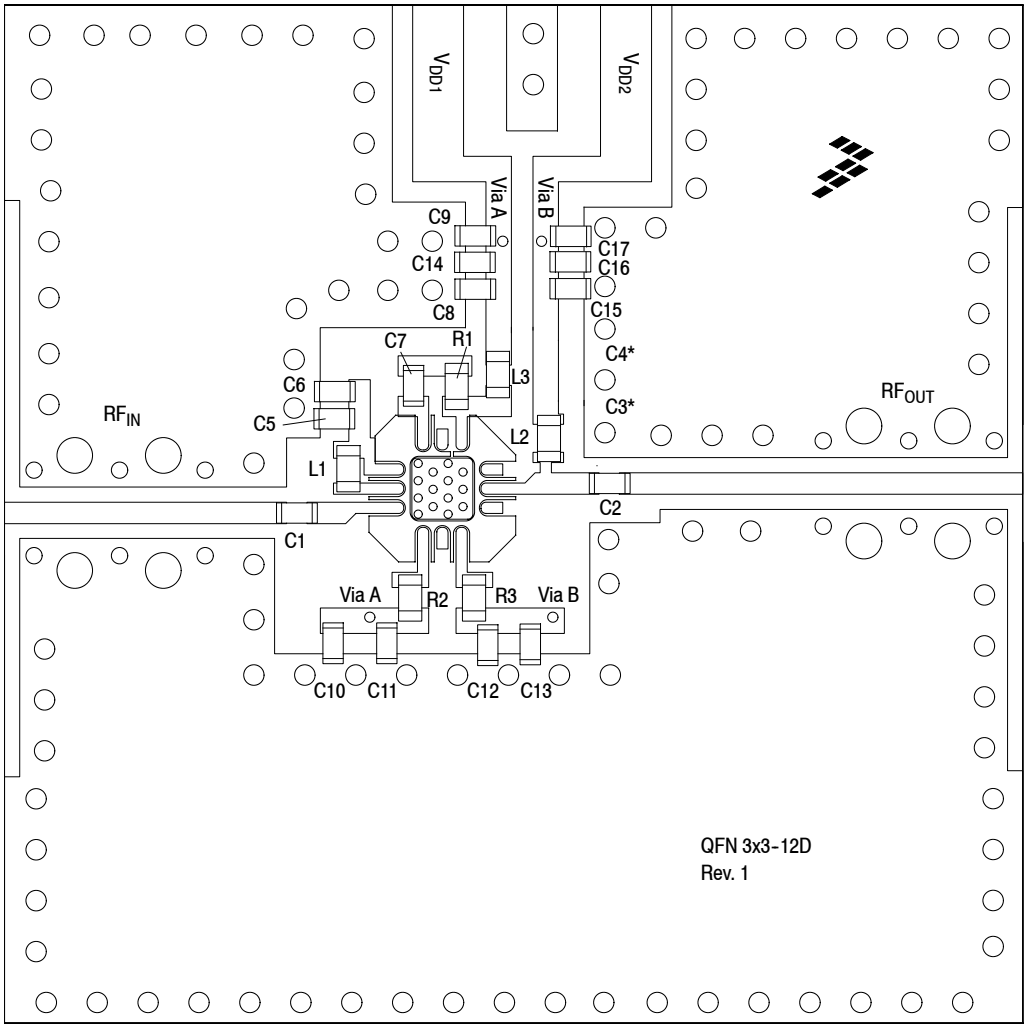
Figure A-1. MML09212HT1 Test Circuit Schematic

Table A-1. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C7, C14, C16	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13, C17	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8, C15	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
L1	12 nH Chip Inductor	0402CS-12NXGL	Coilcraft
L2	30 nH Chip Inductor	0402CS-30NXGL	Coilcraft
L3	8.2 nH Chip Inductor	0402CS-8N2XGL	Coilcraft
R1	82 Ω Chip Resistor	RC0402JR-07-82RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 900 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

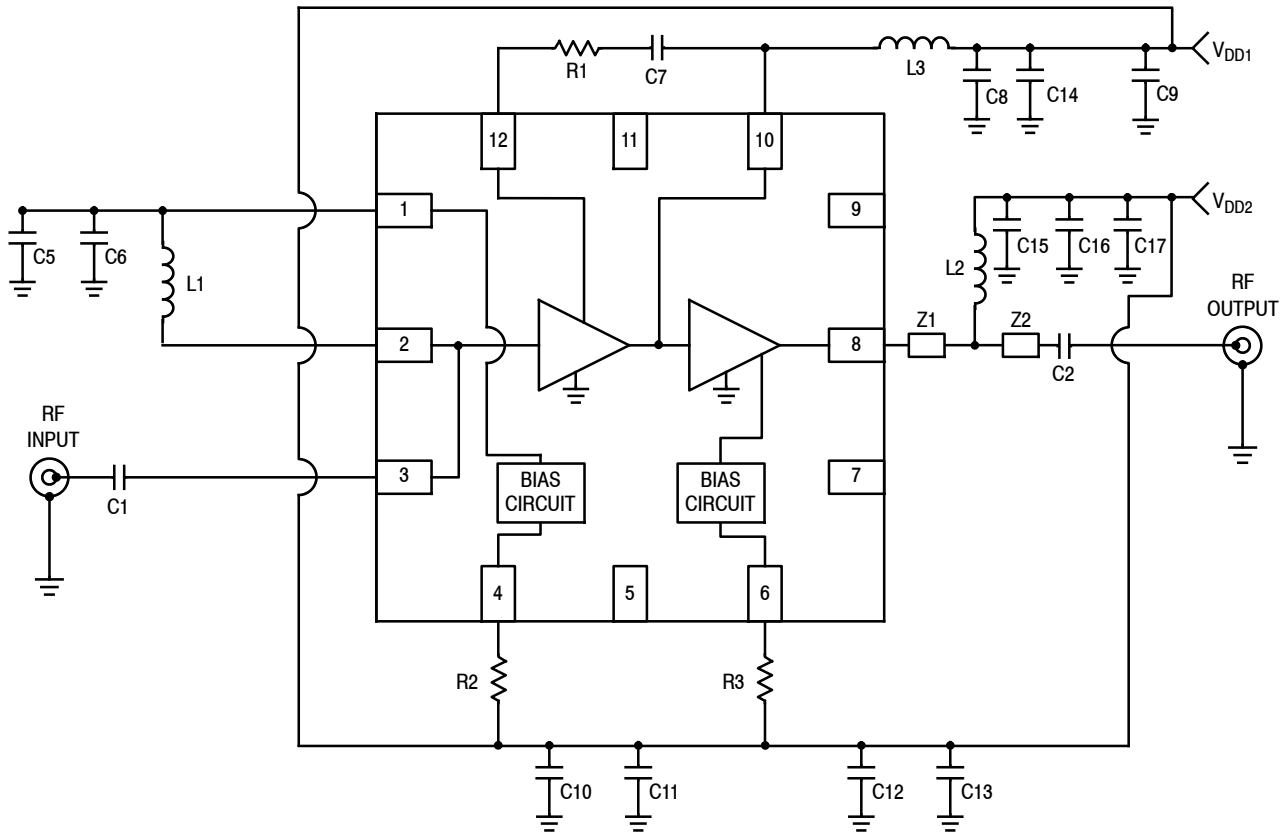
Figure A-2. MML09212HT1 Test Circuit Component Layout

Table A-1. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C7, C14, C16	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13, C17	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8, C15	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
L1	12 nH Chip Inductor	0402CS-12NXGL	Coilcraft
L2	30 nH Chip Inductor	0402CS-30NXGL	Coilcraft
L3	8.2 nH Chip Inductor	0402CS-8N2XGL	Coilcraft
R1	82 Ω Chip Resistor	RC0402JR-07-82RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

50 OHM APPLICATION CIRCUIT: 400 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

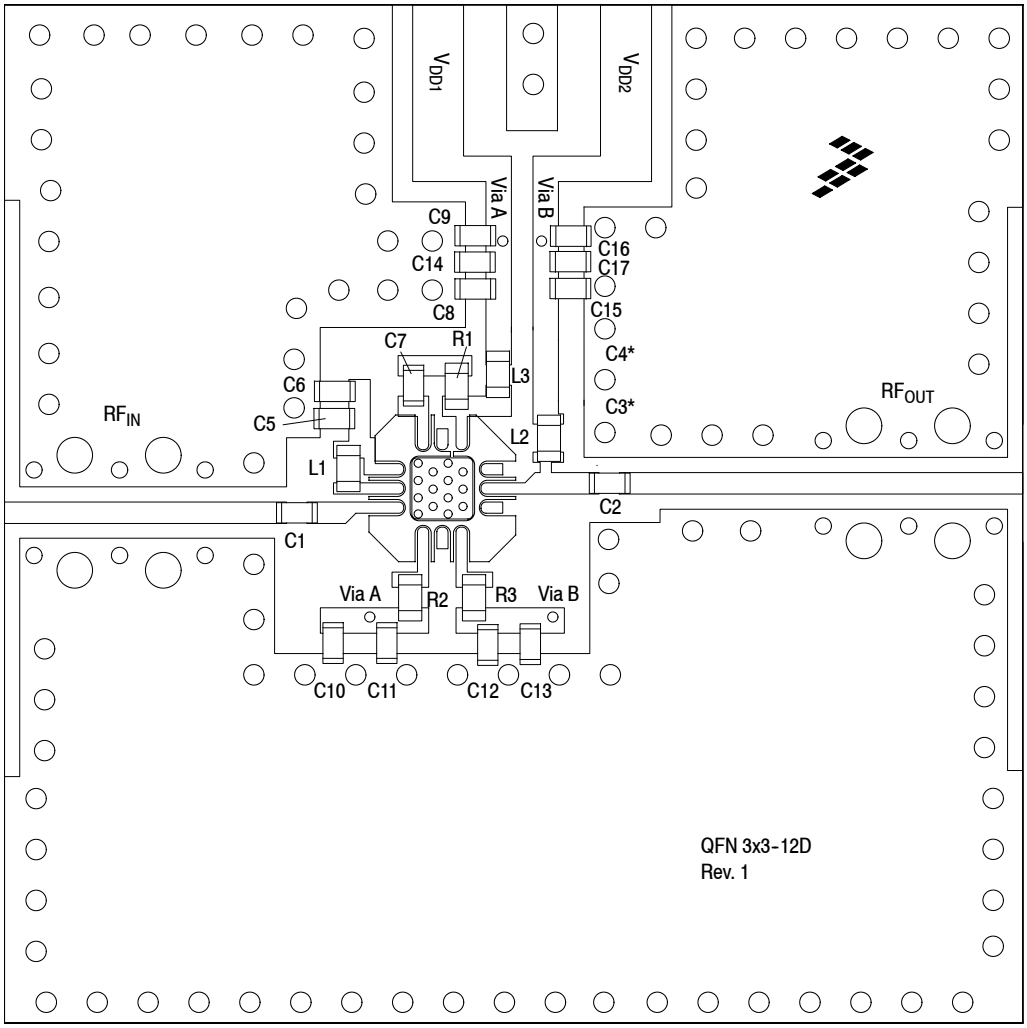
Figure A-3. MML09212HT1 Test Circuit Component Layout

Table A-2. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C3, C4	Components Not Placed		
C5, C7, C8,C11, C12, C15	390 pF Chip Capacitors	GRM1555C1H391JZ01	Murata
C6, C9, C10, C13, C16	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C14, C17	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
L1	20 nH Chip Inductor	0402CS-20NXGL	Coilcraft
L2, L5	30 nH Chip Inductors	0402CS-30NXGL	Coilcraft
L3	16 nH Chip Inductor	0402CS-16NNXGL	Coilcraft
L4	1.2 nH Chip Inductor	0402CS-1N2XJL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 400 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

Figure A-4. MML09212HT1 Test Circuit Component Layout

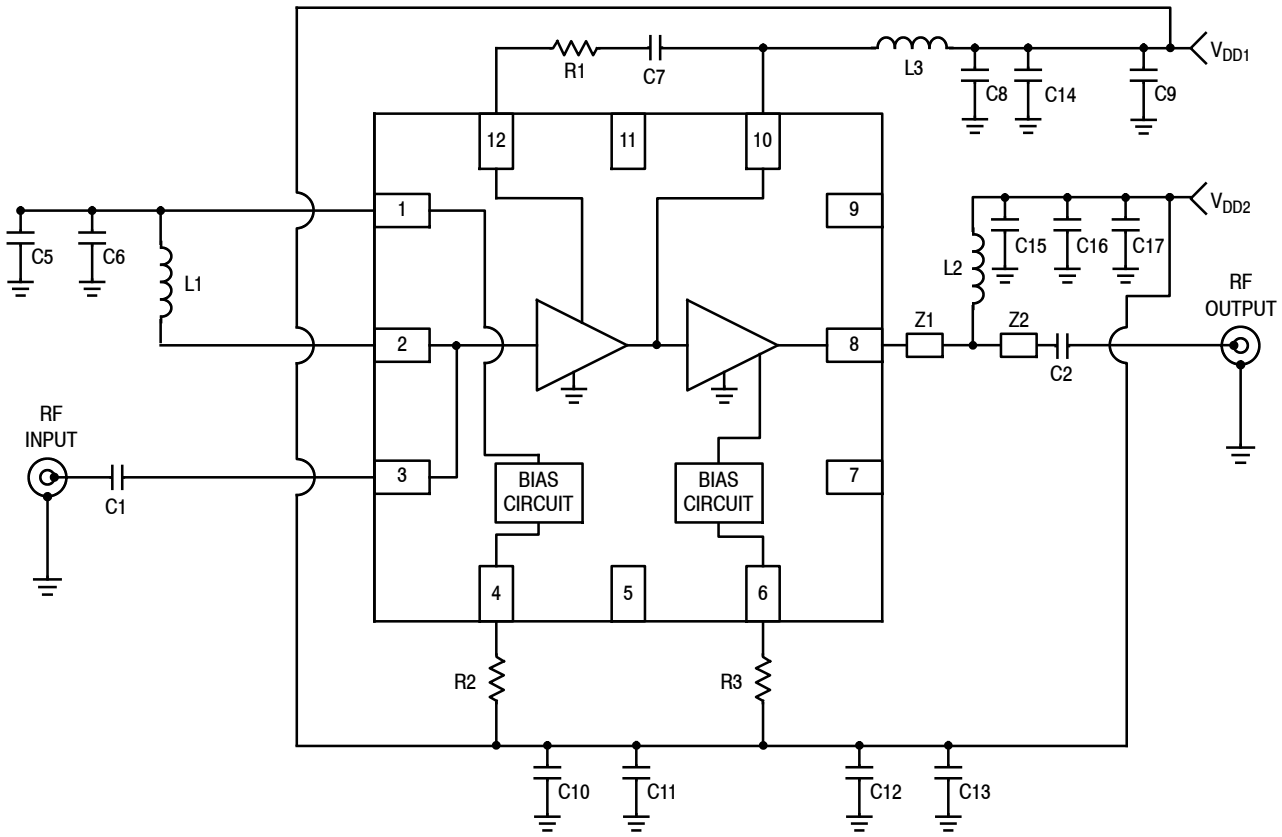
Table A-2. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C3, C4	Components Not Placed		
C5, C7, C8,C11, C12, C15	390 pF Chip Capacitors	GRM1555C1H391JZ01	Murata
C6, C9, C10, C13, C16	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C14, C17	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
L1	20 nH Chip Inductor	0402CS-20NXGL	Coilcraft
L2, L5	30 nH Chip Inductors	0402CS-30NXGL	Coilcraft
L3	16 nH Chip Inductor	0402CS-16NNXGL	Coilcraft
L4	1.2 nH Chip Inductor	0402CS-1N2XJL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

Appendix: Application Circuits with Two-Supply Voltage (continued)

50 OHM APPLICATION CIRCUIT: 1400 MHz



Z1 0.050″ × 0.021″ Microstrip
Z2 0.030″ × 0.021″ Microstrip

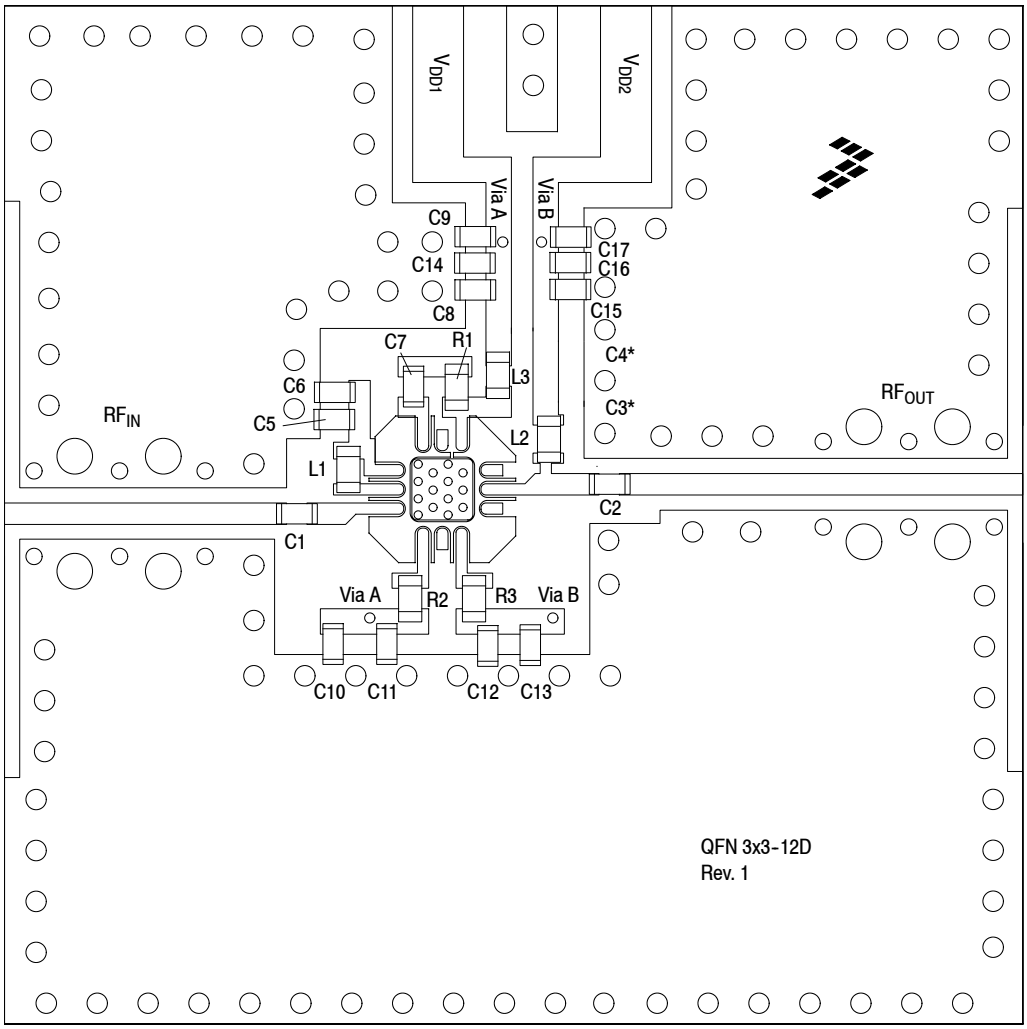
Figure A-5. MML09212HT1 Test Circuit Component Layout

Table A-3. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	220 pF Chip Capacitor	GRM1555C1H221JZ01	Murata
C2, C7	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13, C17	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8, C15	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C14, C16	68 pF Chip Capacitors	GRM1555C1H680JZ01	Murata
L1	6.8 nH Chip Inductor	0402CS-6N8XGL	Coilcraft
L2	23 nH Chip Inductor	0402CS-23NXGL	Coilcraft
L3	4.3 nH Chip Inductor	0402CS-4N3XGL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

Note: Component numbers C3 and C4 are labeled on board but not placed.

50 OHM APPLICATION CIRCUIT: 1400 MHz



Note: Component numbers C3* and C4* are labeled on board but not placed.

Figure A-6. MML09212HT1 Test Circuit Component Layout

Table A-3. MML09212HT1 Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1	220 pF Chip Capacitor	GRM1555C1H221JZ01	Murata
C2, C7	56 pF Chip Capacitors	GRM1555C1H560JZ01	Murata
C3, C4	Components Not Placed		
C5	180 pF Chip Capacitor	GRM1555C1H181JZ01	Murata
C6, C9, C10, C13, C17	0.01 μF Chip Capacitors	GRM155R71E103KA01	Murata
C8, C15	1000 pF Chip Capacitors	GRM155R71E101KA01	Murata
C11, C12	100 pF Chip Capacitors	GRM1555C1H101JZ01	Murata
C14, C16	68 pF Chip Capacitors	GRM1555C1H680JZ01	Murata
L1	6.8 nH Chip Inductor	0402CS-6N8XGL	Coilcraft
L2	23 nH Chip Inductor	0402CS-23NXGL	Coilcraft
L3	4.3 nH Chip Inductor	0402CS-4N3XGL	Coilcraft
R1	100 Ω Chip Resistor	RC0402JR-07-100RL	Yageo
R2	1100 Ω Chip Resistor	RC0402FR-07-1K1L	Yageo
R3	910 Ω Chip Resistor	RC0402FR-07-910RL	Yageo
PCB	0.010″, ε_r = 3.48, Multilayer	RO4350B	Rogers

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

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources 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 Software & Tools on the part’s Product Summary page to download the respective tool.

FAILURE ANALYSIS

At this time, because of the physical characteristics of the part, failure analysis is limited to electrical signature analysis. In cases where Freescale is contractually obligated to perform failure analysis (FA) services, full FA may be performed by third party vendors with moderate success. For updates contact your local Freescale Sales Office.

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Oct. 2012	• Initial Release of Data Sheet
1	Apr. 2013	• Table 1, Typical Performance: changed 400 MHz Application Circuit Third Order Output Intercept Point value from 38 dBm to 37 dBm to reflect the true capability of the device, p. 1 • Added 900 MHz, 50 Ohm Operation, application circuit figures as follows: – Figure 5, S11 versus Frequency versus Temperature, p. 5 – Figure 6, S12 versus Frequency versus Temperature, p. 5 – Figure 7, S21 versus Frequency versus Temperature, p. 5 – Figure 8, S22 versus Frequency versus Temperature, p. 5 – Figure 9, Noise Figure versus Frequency versus Temperature, p. 6 – Figure 10, Power Gain versus Output Power versus Temperature, CW, p. 6 – Figure 11, Third Order Output Intercept Point (Two–Tone) versus Frequency versus Temperature, p. 6 – Figure 12, P1dB versus Frequency versus Temperature, CW, p. 6 • Added 400 MHz, 50 Ohm Operation, application circuit figures as follows: – Figure 15, S11 versus Frequency, p. 9 – Figure 16, S12 versus Frequency, p. 9 – Figure 17, S21 versus Frequency, p. 9 – Figure 18, S22 versus Frequency, p. 9 – Figure 19, Noise Figure versus Frequency, p. 10 – Figure 20, Third Order Output Intercept Point (Two–Tone) versus Frequency, p. 10 • Added 1400 MHz, 50 Ohm Operation, application circuit figures as follows: – Figure 23, S11 versus Frequency, p. 13 – Figure 24, S12 versus Frequency, p. 13 – Figure 25, S21 versus Frequency, p. 13 – Figure 26, S22 versus Frequency, p. 13 – Figure 27, Noise Figure versus Frequency, p. 14 – Figure 28, Third Order Output Intercept Point (Two–Tone) versus Frequency, p. 14 • Added Appendix: Application Circuits with Two–Supply Voltage, pp. 19–24
2	Sept. 2014	• Table 2, Maximum Ratings: updated Junction Temperature from 150°C to 175°C to reflect recent test results of the device, p. 1 • Added Failure Analysis information, p. 25

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