

# RF LDMOS Wideband Integrated Power Amplifiers

The MMRF2010N is a 2-stage RFIC designed for IFF transponder applications operating from 1030 to 1090 MHz. These devices are suitable for use in pulse applications such as IFF and secondary radar transponders.

## Typical Wideband Performance: (52 Vdc, T<sub>A</sub> = 25°C)

Frequency (MHz) <sup>(1)</sup>	Signal Type	P <sub>out</sub> (W)	G <sub>ps</sub> (dB)	2nd Stage Eff. (%)
1030	Pulse (128 μsec, 10% Duty Cycle)	250 Peak	34.1	61.0
1090			33.4	61.9
1030	Pulse (2 msec, 20% Duty Cycle)	250 Peak	33.6	61.5
1090			32.6	62.9

## Narrowband Performance: (50 Vdc, T<sub>A</sub> = 25°C)

Frequency (MHz)	Signal Type	P <sub>out</sub> (W)	G <sub>ps</sub> (dB)	2nd Stage Eff. (%)
1090 <sup>(2)</sup>	Pulse (128 μsec, 10% Duty Cycle)	250 Peak	32.1	61.4

## Load Mismatch/Ruggedness

Frequency (MHz)	Signal Type	VSWR	P <sub>in</sub> (W)	Test Voltage	Result
1090 <sup>(1)</sup>	Pulse (2 msec, 20% Duty Cycle)	> 20:1 at all Phase Angles	0.316 W Peak (3 dB Overdrive)	52	No Device Degradation

1. Measured in 1030–1090 MHz reference circuit.
2. Measured in 1090 MHz narrowband test circuit.

## Features

- Characterized over 1030–1090 MHz
- On-chip input (50 ohm) and interstage matching
- Single ended
- Integrated ESD protection
- Low thermal resistance
- Integrated quiescent current temperature compensation with enable/disable function <sup>(3)</sup>

## Typical Applications

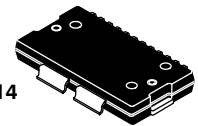
- Driver PA for high power pulse applications
- IFF and secondary radar

MMRF2010N  
MMRF2010GN

1030–1090 MHz, 250 W PEAK, 50 V  
RF LDMOS INTEGRATED  
POWER AMPLIFIERS

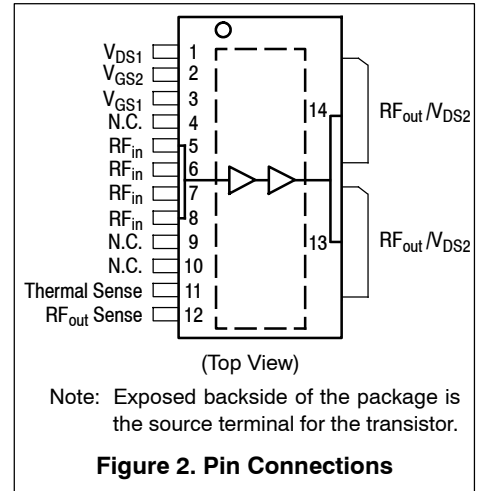
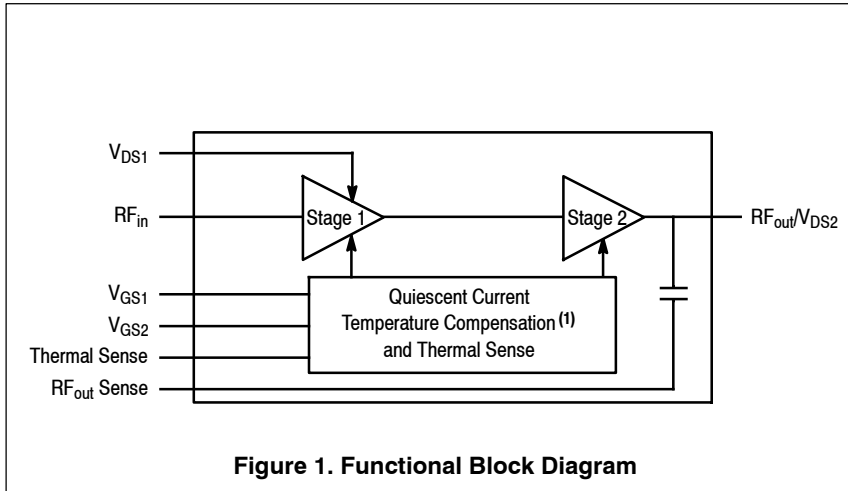


TO-270WB-14  
PLASTIC  
MMRF2010N



TO-270WBG-14  
PLASTIC  
MMRF2010GN

3. Refer to AN1977, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family*, and to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family*. Go to <http://www.nxp.com/RF> and search for AN1977 or AN1987.



**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	-0.5, +100	Vdc
Gate-Source Voltage	$V_{GS}$	-6, +10	Vdc
Operating Voltage	$V_{DD}$	50, +0	Vdc
Storage Temperature Range	$T_{stg}$	-65 to +150	°C
Case Operating Temperature Range	$T_C$	-55 to 150	°C
Operating Junction Temperature Range (2,3)	$T_J$	-55 to 225	°C
Input Power	$P_{in}$	25	dBm

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (3,4)	Unit
Thermal Impedance, Junction to Case Pulse: Case Temperature 81°C, 250 W Peak, 128 $\mu$ sec Pulse Width, 10% Duty Cycle, 1090 MHz Stage 1, 50 Vdc, $I_{DQ1} = 80$ mA Stage 2, 50 Vdc, $I_{DQ2} = 150$ mA	$Z_{\theta JC}$	1.1 0.15	°C/W

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	Class 2, passes 2500 V
Machine Model (per EIA/JESD22-A115)	Class A, passes 150 V
Charge Device Model (per JESD22-C101)	Class II, passes 200 V

**Table 4. Moisture Sensitivity Level**

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

1. Refer to AN1977, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family*, and to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family*. Go to <http://www.nxp.com/RF> and search for AN1977 or AN1987.
2. Continuous use at maximum temperature will affect MTTF.
3. MTTF calculator available at <http://www.nxp.com/RF/calculators>.
4. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.nxp.com/RF> and search for AN1955.

**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Stage 1 - Off Characteristics</b>					
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 100\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{A dc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 55\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{A dc}$
Gate-Source Leakage Current ( $V_{GS} = 1.5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{A dc}$

**Stage 1 - On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 52\ \mu\text{A dc}$ )	$V_{GS(th)}$	1.3	1.8	2.3	Vdc
Fixture Gate Quiescent Voltage ( $V_{DD} = 50\text{ Vdc}$ , $I_{DQ1} = 80\text{ mA dc}$ , Measured in Functional Test)	$V_{GG(Q)}$	6.0	7.0	8.0	Vdc

**Stage 2 - Off Characteristics**

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 100\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{A dc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 55\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{A dc}$
Gate-Source Leakage Current ( $V_{GS} = 1.5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{A dc}$

**Stage 2 - On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 528\ \mu\text{A dc}$ )	$V_{GS(th)}$	1.3	1.8	2.3	Vdc
Fixture Gate Quiescent Voltage ( $V_{DD} = 50\text{ Vdc}$ , $I_{DQ2} = 150\text{ mA dc}$ , Measured in Functional Test)	$V_{GG(Q)}$	2.2	2.7	3.2	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1.6\text{ A dc}$ )	$V_{DS(on)}$	—	0.25	—	Vdc

**Functional Tests** <sup>(1,2)</sup> (In NXP Test Fixture, 50 ohm system)  $V_{DD} = 50\text{ Vdc}$ ,  $I_{DQ1} = 80\text{ mA}$ ,  $I_{DQ2} = 150\text{ mA}$ ,  $P_{out} = 250\text{ W Peak}$  (25 W Avg.),  $f = 1090\text{ MHz}$ , 128  $\mu\text{sec}$  Pulse Width, 10% Duty Cycle

Power Gain	$G_{ps}$	30.5	32.1	34.0	dB
2nd Stage Drain Efficiency	$\eta_D$	57.0	61.4	—	%

**Load Mismatch/Ruggedness** (In NXP Test Fixture, 50 ohm system)  $I_{DQ1} = 80\text{ mA}$ ,  $I_{DQ2} = 150\text{ mA}$

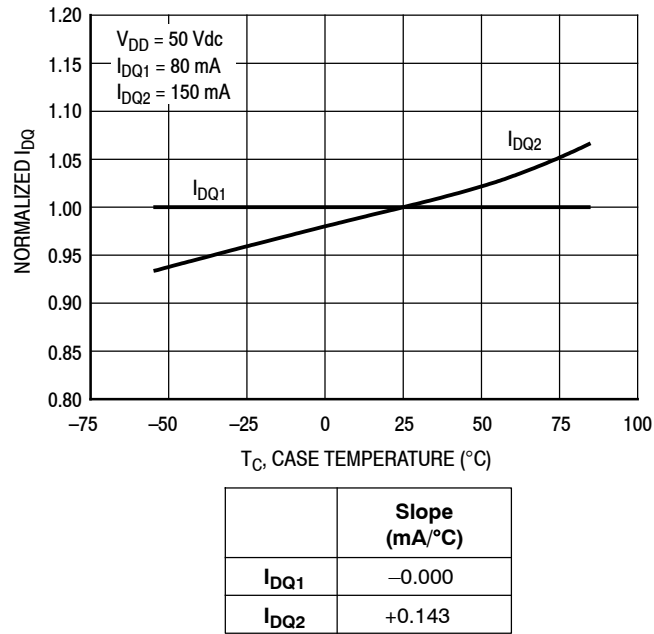
Frequency (MHz)	Signal Type	VSWR	$P_{in}$ (W)	Test Voltage, $V_{DD}$	Result
1090	Pulse (128 $\mu\text{sec}$ , 10% Duty Cycle)	> 10:1 at all Phase Angles	0.345 W Peak (3 dB Overdrive)	50	No Device Degradation

**Table 6. Ordering Information**

Device	Tape and Reel Information	Package
MMRF2010NR1	R1 Suffix = 500 Units, 44 mm Tape Width, 13-inch Reel	TO-270WB-14
MMRF2010GMR1		TO-270WBG-14

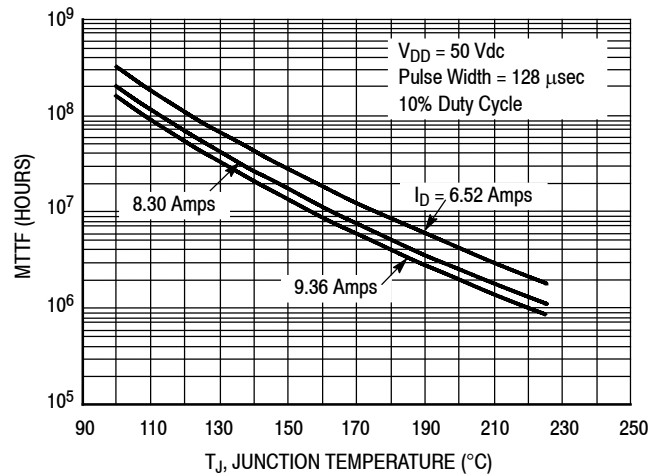
- Part internally input matched.
- Measurements made with device in straight lead configuration before any lead forming operation is applied. Lead forming is used for gull wing (GN) parts.

## TYPICAL CHARACTERISTICS



**Note:** Performance measured in reference circuit.

**Figure 3. Normalized  $I_{DQ}$  versus Case Temperature**



**Note:** MTTF value represents the total cumulative operating time under indicated test conditions.

MTTF calculator available at <http://www.nxp.com/RF/calculators>.

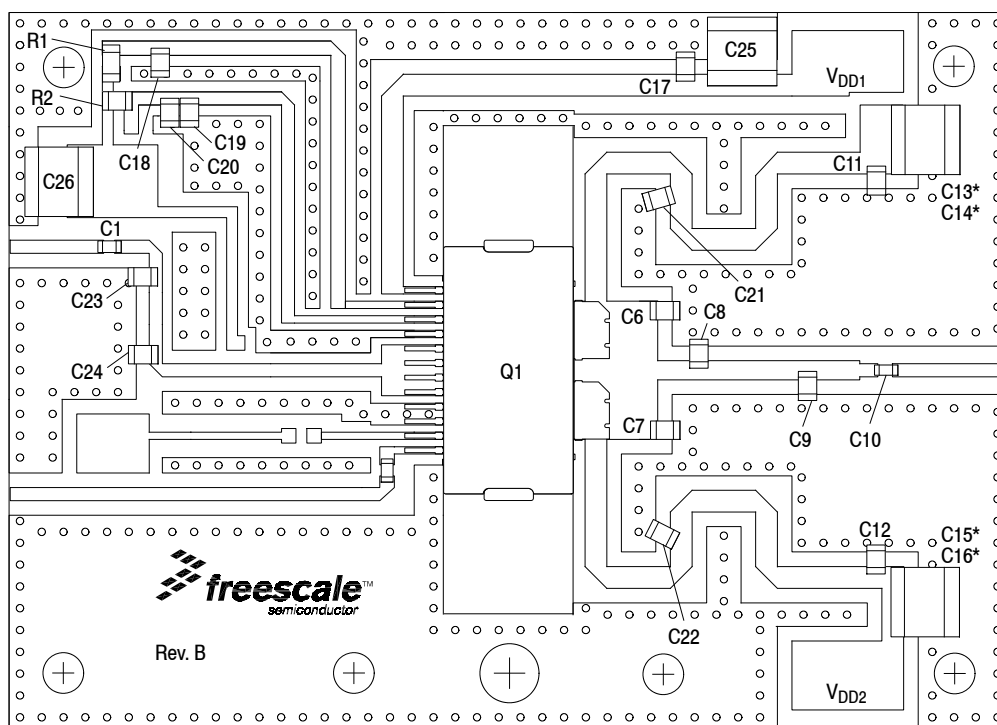
**Figure 4. MTTF versus Junction Temperature - Pulse**

## 1030–1090 MHz REFERENCE CIRCUIT — 1.97" x 2.76" (5.0 cm x 7.0 cm)

**Table 7. 1030–1090 MHz Performance** (In NXP Reference Circuit, 50 ohm system)  $V_{DD} = 52 \text{ Vdc}$ ,  $I_{DQ1} = 80 \text{ mA}$ ,  $I_{DQ2} = 150 \text{ mA}$

Frequency (MHz)	Signal Type	$G_{ps}$ (dB)	2nd Stage Eff. (%)	$P_{out}$ (W)
1030	Pulse (128 $\mu\text{sec}$ , 10% Duty Cycle)	34.1	61.0	250 Peak
1090		33.4	61.9	
1030	Pulse (2 msec, 20% Duty Cycle)	33.6	61.5	250 Peak
1090		32.6	62.9	

## 1030–1090 MHz REFERENCE CIRCUIT — 1.97" x 2.76" (5.0 cm x 7.0 cm)



\* Stacked components

Note: Component numbers C2, C3, C4, and C5 are not used.

**Figure 5. MRF2010N Reference Circuit Component Layout — 1030–1090 MHz**

**Table 8. MRF2010N Reference Circuit Component Designations and Values — 1030–1090 MHz**

Part	Description	Part Number	Manufacturer
C1, C10	56 pF Chip Capacitors	ATC600F560JT250XT	ATC
C11, C12, C17, C18, C19	51 pF Chip Capacitors	ATC600F510JT250XT	ATC
C6, C7	10 pF Chip Capacitors	ATC600F100JT250XT	ATC
C8	6.8 pF Chip Capacitor	ATC600F6R8BT250XT	ATC
C9	2.4 pF Chip Capacitor	ATC600F2R4BT250XT	ATC
C13, C14, C15, C16, C25, C26	10 $\mu$ F Chip Capacitors	C5750X7S2A106M	TDK
C20	1 $\mu$ F Chip Capacitor	GRM21BR71H105KA12L	Murata
C21, C22	8.2 pF Chip Capacitors	ATC600F8R2BT250XT	ATC
C23	2.7 pF Chip Capacitor	ATC600F2R7BT250XT	ATC
C24	1.5 pF Chip Capacitor	ATC600F1R5BT250XT	ATC
Q1	RF Power LD MOS Transistor	MMRF2010N	NXP
R1	3.9 k $\Omega$ , 1/16 W Chip Resistor	RR0816P-392-B-T5	Susumu
R2	1 k $\Omega$ , 1/16 W Chip Resistor	RR0816P-102-B-T5	Susumu
PCB	Taconic RF60A 0.025", $\epsilon_r = 6.15$	—	MTL

TYPICAL CHARACTERISTICS — 1030–1090 MHz

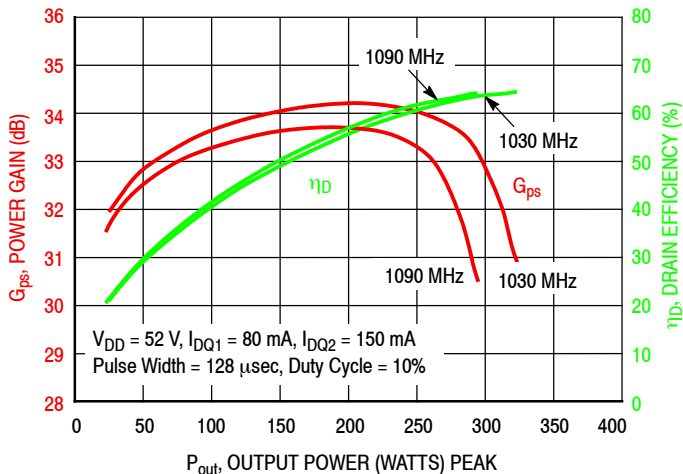


Figure 6. Power Gain and Drain Efficiency versus Output Power and Frequency

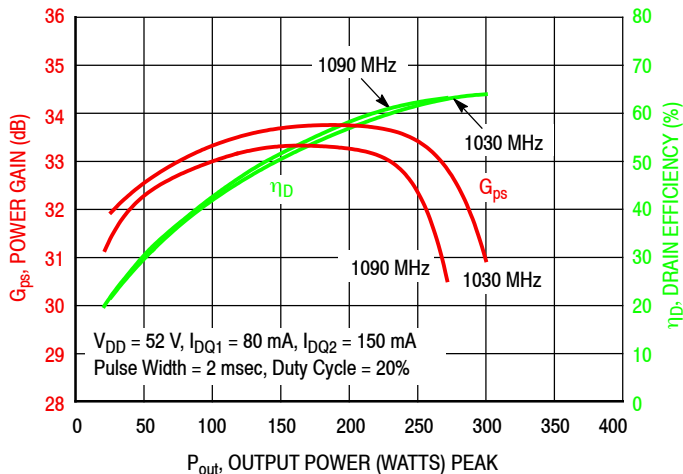


Figure 7. Power Gain and Drain Efficiency versus Output Power and Frequency — Long Pulse

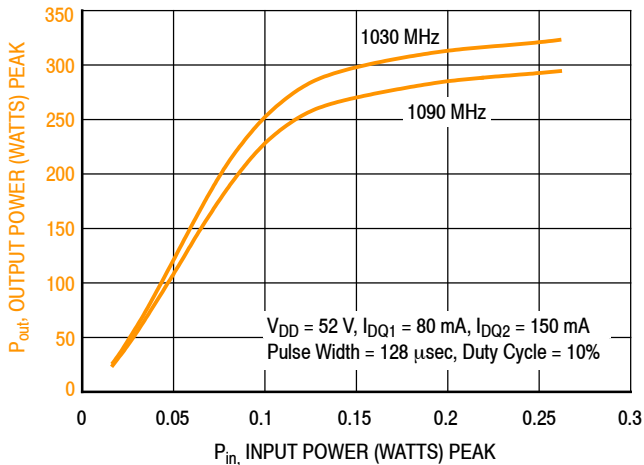


Figure 8. Output Power versus Input Power and Frequency

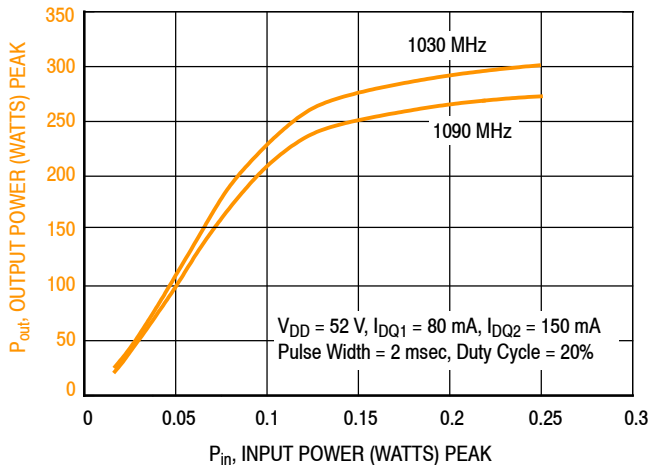
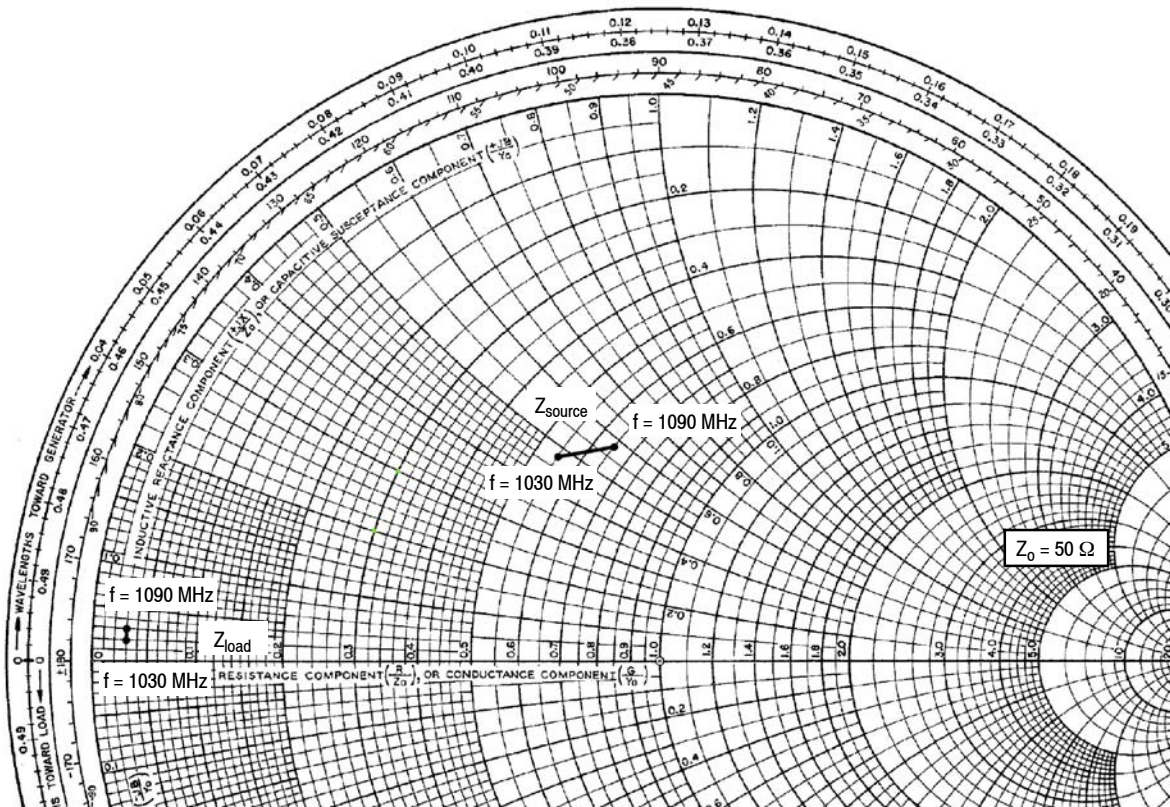


Figure 9. Output Power versus Input Power and Frequency — Long Pulse

## 1030–1090 MHz REFERENCE CIRCUIT



f MHz	Z <sub>source</sub> Ω	Z <sub>load</sub> Ω
1030	27.4 + j23.65	1.57 + j1.07
1090	32.5 + j29	1.35 + j1.5

Z<sub>source</sub> = Test circuit input impedance as measured from gate to ground.

Z<sub>load</sub> = Test circuit impedance as measured from drain to ground.

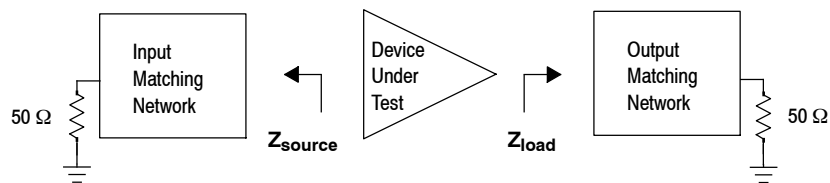
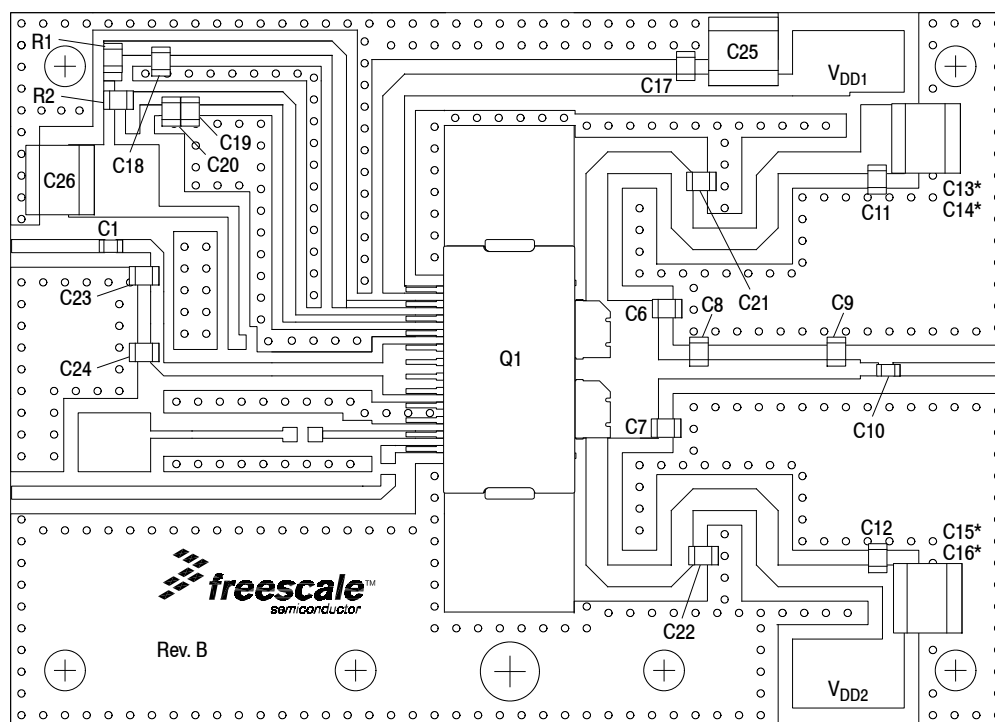


Figure 10. Series Equivalent Source and Load Impedance — 1030–1090 MHz



## 1090 MHz REFERENCE CIRCUIT — 1.97" x 2.76" (5.0 cm x 7.0 cm)



\* Stacked components

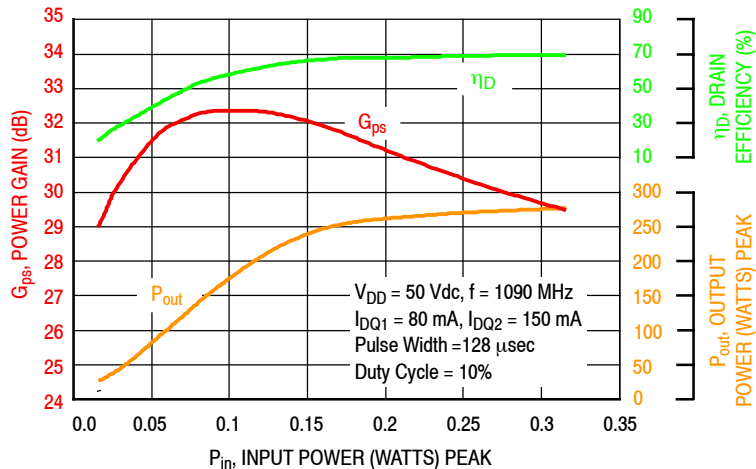
Note: Component numbers C2, C3, C4, and C5 are not used.

**Figure 11. MMRF2010N Reference Circuit Component Layout — 1090 MHz**

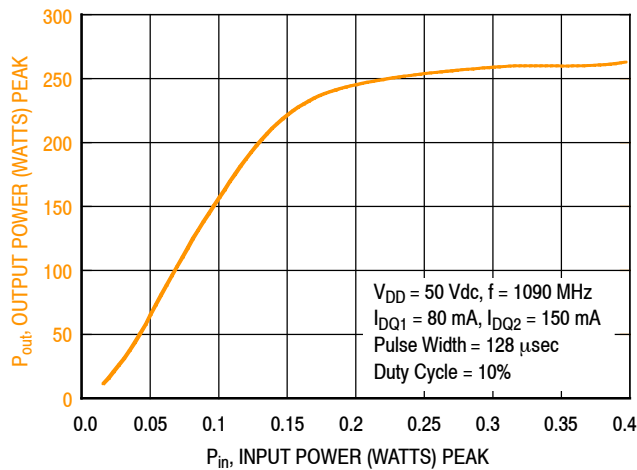
**Table 9. MMRF2010N Reference Circuit Component Designations and Values — 1090 MHz**

Part	Description	Part Number	Manufacturer
C1, C10	56 pF Chip Capacitors	ATC600F560JT250XT	ATC
C11, C12, C17, C18, C19	51 pF Chip Capacitors	ATC600F510JT250XT	ATC
C6, C7	10 pF Chip Capacitors	ATC600F100JT250XT	ATC
C8	6.8 pF Chip Capacitor	ATC600F6R8BT250XT	ATC
C9	2.4 pF Chip Capacitor	ATC600F2R4BT250XT	ATC
C13, C14, C15, C16, C25, C26	10 $\mu$ F Chip Capacitors	C5750X7S2A106M	TDK
C20	1 $\mu$ F Chip Capacitor	GRM21BR71H105KA12L	Murata
C21, C22	8.2 pF Chip Capacitors	ATC600F8R2BT250XT	ATC
C23	2.7 pF Chip Capacitor	ATC600F2R7BT250XT	ATC
C24	1.5 pF Chip Capacitor	ATC600F1R5BT250XT	ATC
Q1	RF Power LDMOS Transistor	MMRF2010N	NXP
R1	3.9 k $\Omega$ , 1/16 W Chip Resistor	RR0816P-392-B-T5	Susumu
R2	1 k $\Omega$ , 1/16 W Chip Resistor	RR0816P-102-B-T5	Susumu
PCB	Taconic RF60A 0.025", $\epsilon_r = 6.15$	—	MTL

## TYPICAL CHARACTERISTICS — 1090 MHz REFERENCE CIRCUIT



**Figure 12. Power Gain, Drain Efficiency and Output Power versus Input Power**

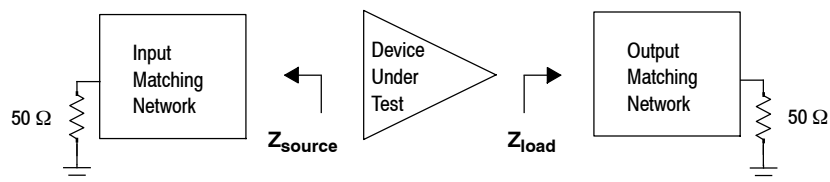


**Figure 13. Output Power versus Input Power**

<b>f MHz</b>	<b>Z<sub>source</sub> Ω</b>	<b>Z<sub>load</sub> Ω</b>
1090	36.7 – j29	1.3 + j0.60

$Z_{source}$  = Test circuit input impedance as measured from gate to ground.

$Z_{load}$  = Test circuit impedance as measured from drain to ground.



**Figure 14. Series Equivalent Source and Load Impedance — 1090 MHz**

## 1090 MHz NARROWBAND PRODUCTION TEST FIXTURE

**Table 10. 1090 MHz Narrowband Performance** <sup>(1,2)</sup> (In NXP Test Fixture, 50 ohm system)  $V_{DD} = 50$  Vdc,  $I_{DQ1} = 80$  mA,  $I_{DQ2} = 150$  mA,  $P_{out} = 250$  W Peak (25 W Avg.),  $f = 1090$  MHz, 128  $\mu$ sec Pulse Width, 10% Duty Cycle

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	$G_{ps}$	30.5	32.1	34.0	dB
2nd Stage Drain Efficiency	$\eta_D$	57.0	61.4	—	%

1. Part internally input matched.
2. Measurements made with device in straight lead configuration before any lead forming operation is applied. Lead forming is used for gull wing (GN) parts.

1090 MHz NARROWBAND PRODUCTION TEST FIXTURE — 4" x 5" (10.2 cm x 12.7 cm)

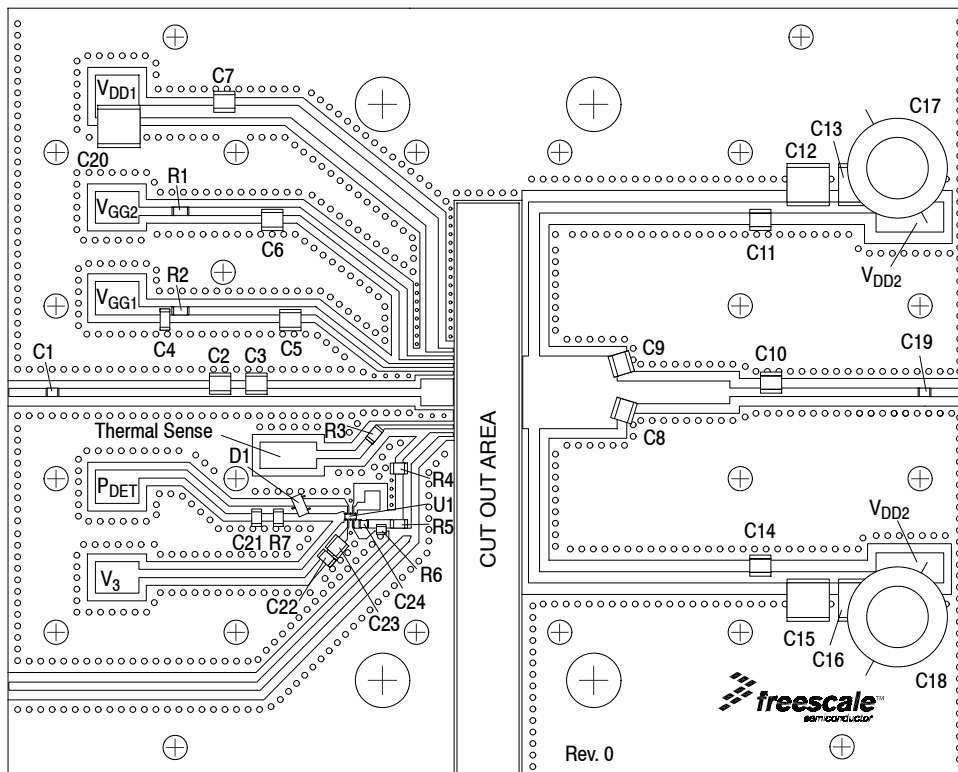
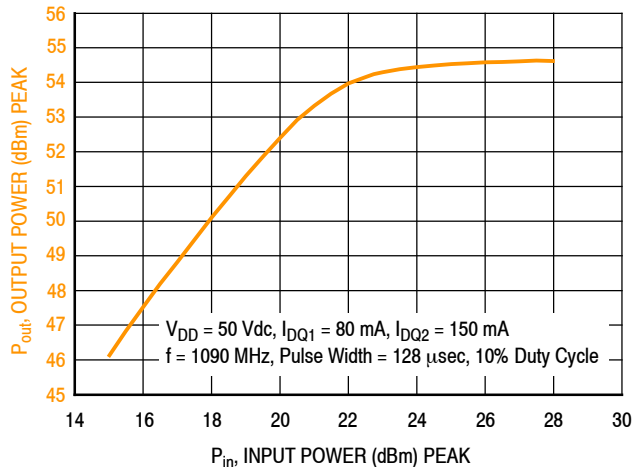


Figure 15. MMRF2010N Narrowband Test Circuit Component Layout — 1090 MHz

Table 11. MMRF2010N Narrowband Test Circuit Component Designations and Values — 1090 MHz

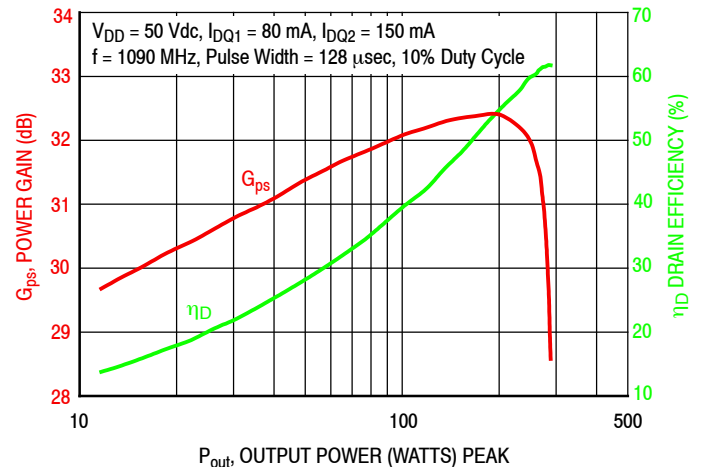
Part	Description	Part Number	Manufacturer
C1	47 pF Chip Capacitor	ATC600F470JT250XT	ATC
C2	2.7 pF Chip Capacitor	ATC100B2R7CT500XT	ATC
C3	2.0 pF Chip Capacitor	ATC100B2R0BW500XT	ATC
C4	1 $\mu$ F Chip Capacitor	GRM31MR71H105KA88L	Murata
C5, C6, C7, C11, C14	43 pF Chip Capacitors	ATC100B430JT500XT	ATC
C8, C9	10 pF Chip Capacitors	ATC100B100JT500XT	ATC
C10	4.7 pF Chip Capacitor	ATC100B4R7CT500XT	ATC
C12, C13, C15, C16, C20	10 $\mu$ F Chip Capacitors	C5750X752A106M230KB	TDK
C17, C18	220 $\mu$ F, 100 V Electrolytic Capacitors	MCGPR100V227M16X26-RH	Multicomp
C19	30 pF Chip Capacitor	ATC600F300JT250XT	ATC
C21	10 nF Chip Capacitor	C0805C103J5RAC-TU	Kemet
C22	0.1 $\mu$ F Chip Capacitor	C1206C104K1RAC-TU	Kemet
C23	47 pF Chip Capacitor	ATC800B470JT500XT	ATC
C24	1000 pF Chip Capacitor	C2012X7R2E102K085AA	TDK
D1	Diode Schottky RF SGL 70 V SOT-23	HSMS-2800-TR1G	Avago Technologies
R1	2.2 k $\Omega$ , 1/8 W Chip Resistor	CRCW08052K20JNEA	Vishay
R2	0 $\Omega$ , 1 A Chip Resistor	CWCR08050000Z0EA	Vishay
R3	1 k $\Omega$ , 1/10 W Chip Resistor	RR1220P-102-D	Susumu
R4	50 $\Omega$ , 10 W Chip Resistor	060120A25X50-2	Anaren
R5	15 k $\Omega$ , 1/10 W Chip Resistor	RR1220P-153-D	Susumu
R6	51 $\Omega$ , 1/8 W Chip Resistor	RK73B2ATTD510J	KOA Speer
R7	470 k $\Omega$ , 1/4 W Chip Resistor	CRCW1206470KFKEA	Vishay
U1	IC Detector RF PWR 3GHZ SC70-6	LT5534ESC6#TRMPBF	Linear Technology
PCB	Rogers, RO4350B, 0.020", $\epsilon_r = 3.66$	—	MTL

## TYPICAL CHARACTERISTICS — 1090 MHz NARROWBAND PRODUCTION TEST FIXTURE

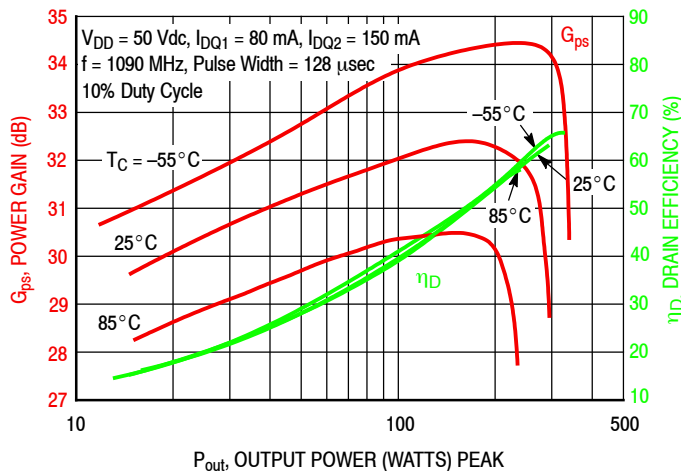


f (MHz)	P1dB (W)	P3dB (W)
1090	265	284

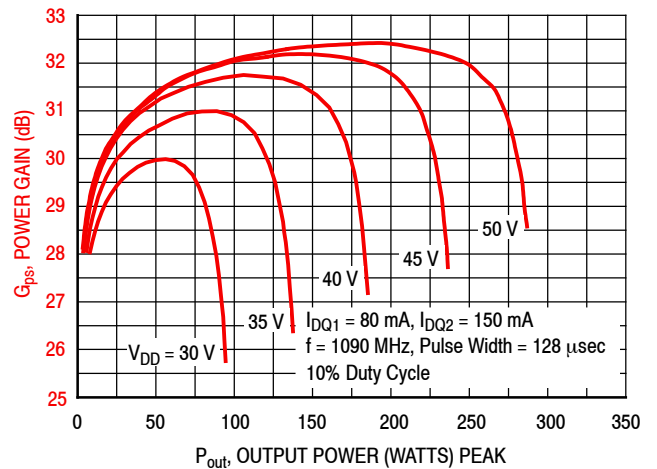
**Figure 16. Output Power versus Input Power**



**Figure 17. Power Gain and Drain Efficiency versus Output Power and Quiescent Current**



**Figure 18. Power Gain and Drain Efficiency versus Output Power**



**Figure 19. Power Gain versus Output Power and Drain-Source Voltage**

## 1090 MHz NARROWBAND PRODUCTION TEST FIXTURE

f MHz	Z <sub>source</sub> Ω	Z <sub>load</sub> Ω
1090	13.6 – j24.4	1.3 + j0.4

Z<sub>source</sub> = Test circuit impedance as measured from gate to ground.

Z<sub>load</sub> = Test circuit impedance as measured from drain to ground.

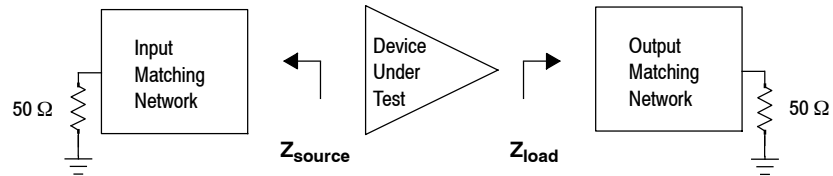
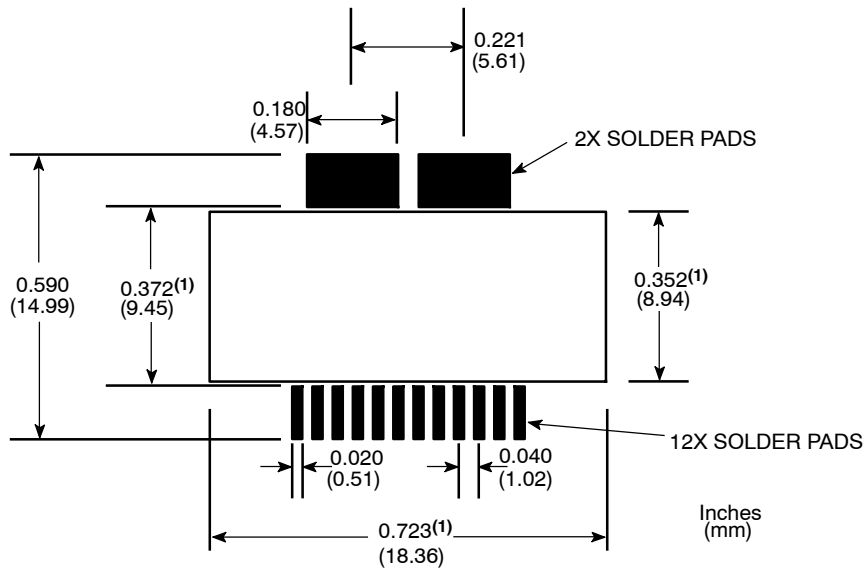
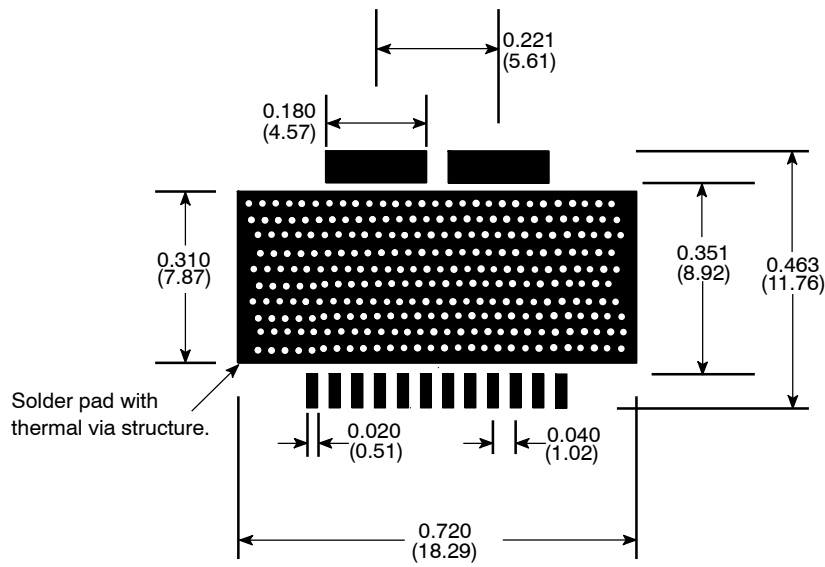


Figure 20. Narrowband Series Equivalent Source and Load Impedance — 1090 MHz



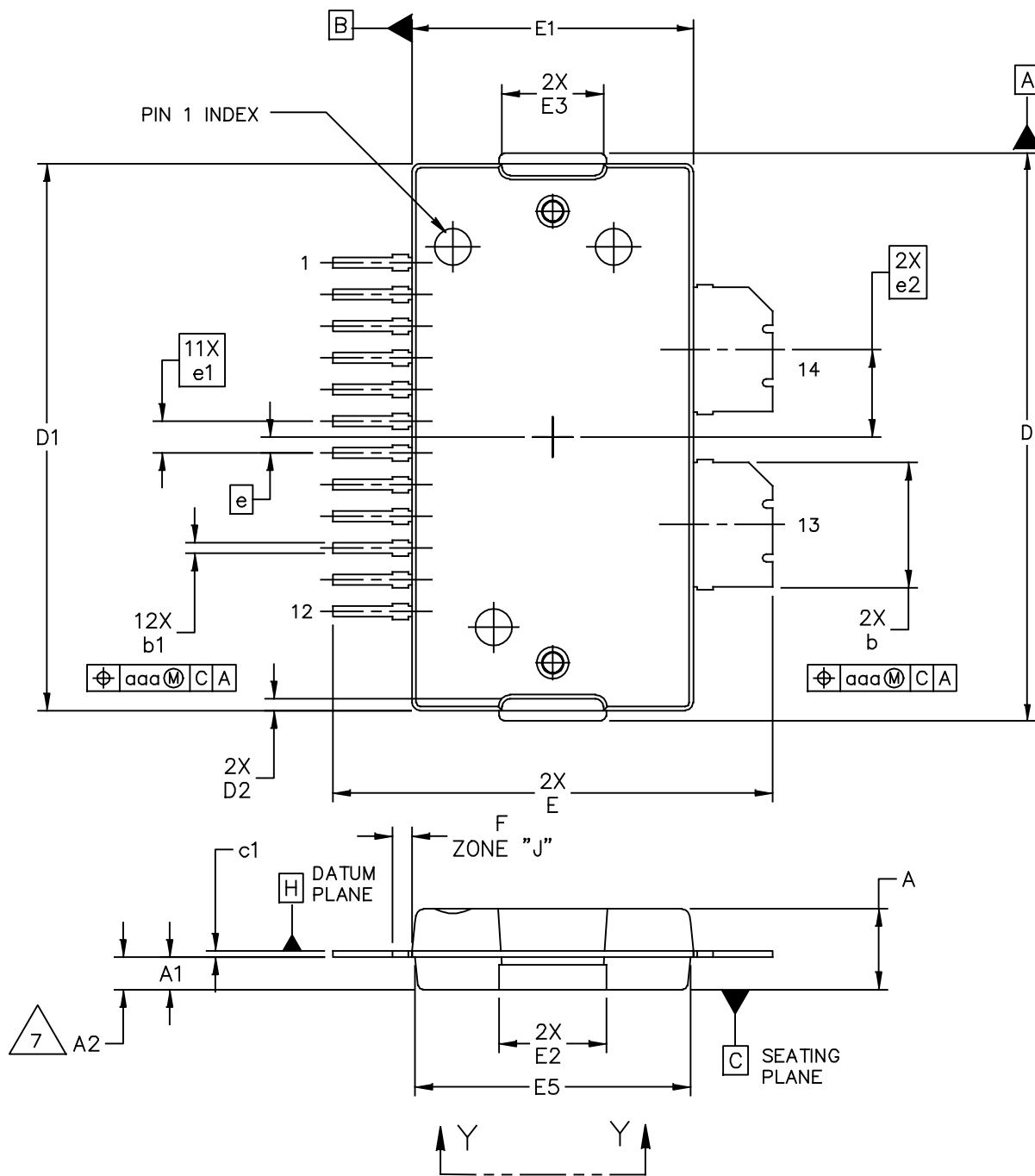
1. Slot dimensions are minimum dimensions and exclude milling tolerances.

**Figure 21. PCB Pad Layout for TO-270WB-14**



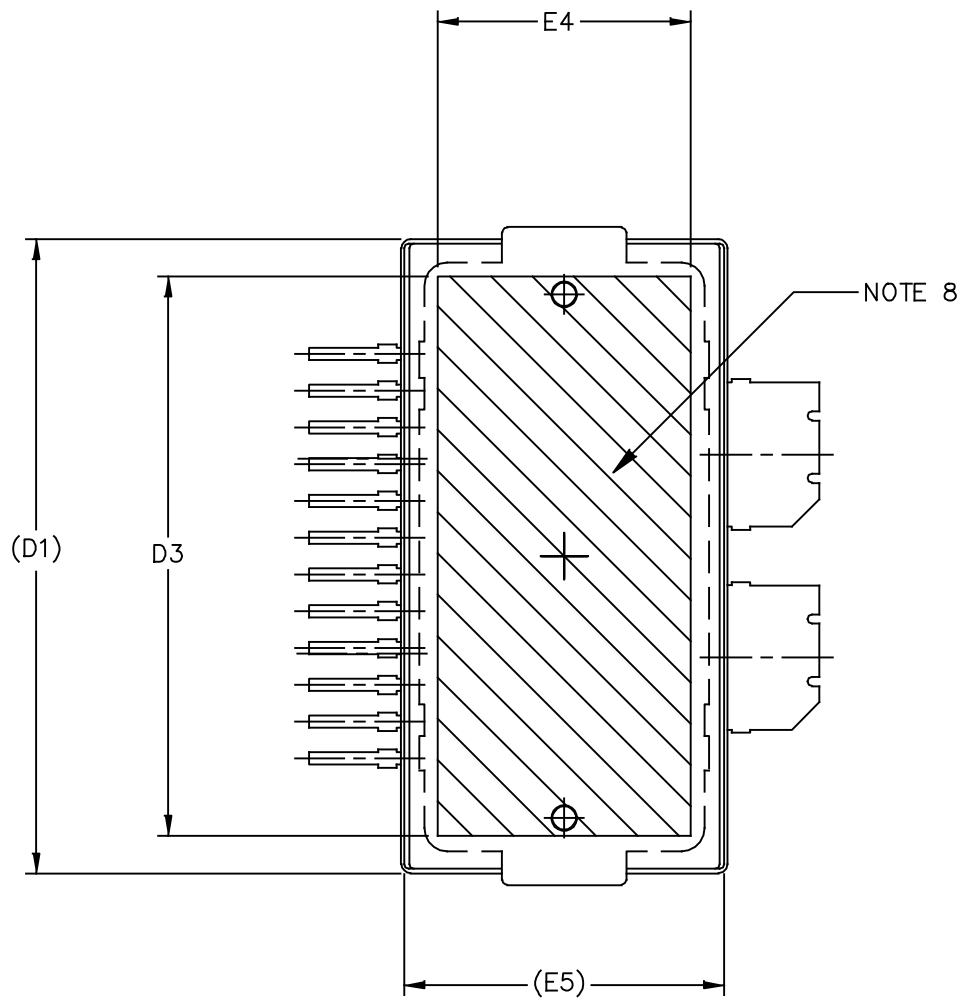
**Figure 22. PCB Pad Layout for TO-270WBG-14**

### PACKAGE DIMENSIONS



© NXP SEMICONDUCTORS N.V. ALL RIGHTS RESERVED	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: TO-270 WIDE BODY 14 LEAD	DOCUMENT NO: 98ASA10650D	REV: B
	STANDARD: NON-JEDEC	
	SOT1720-2	20 JAN 2016





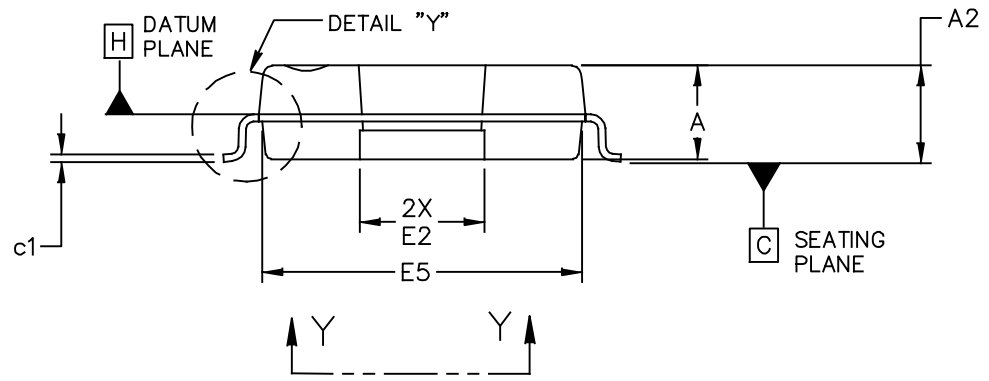
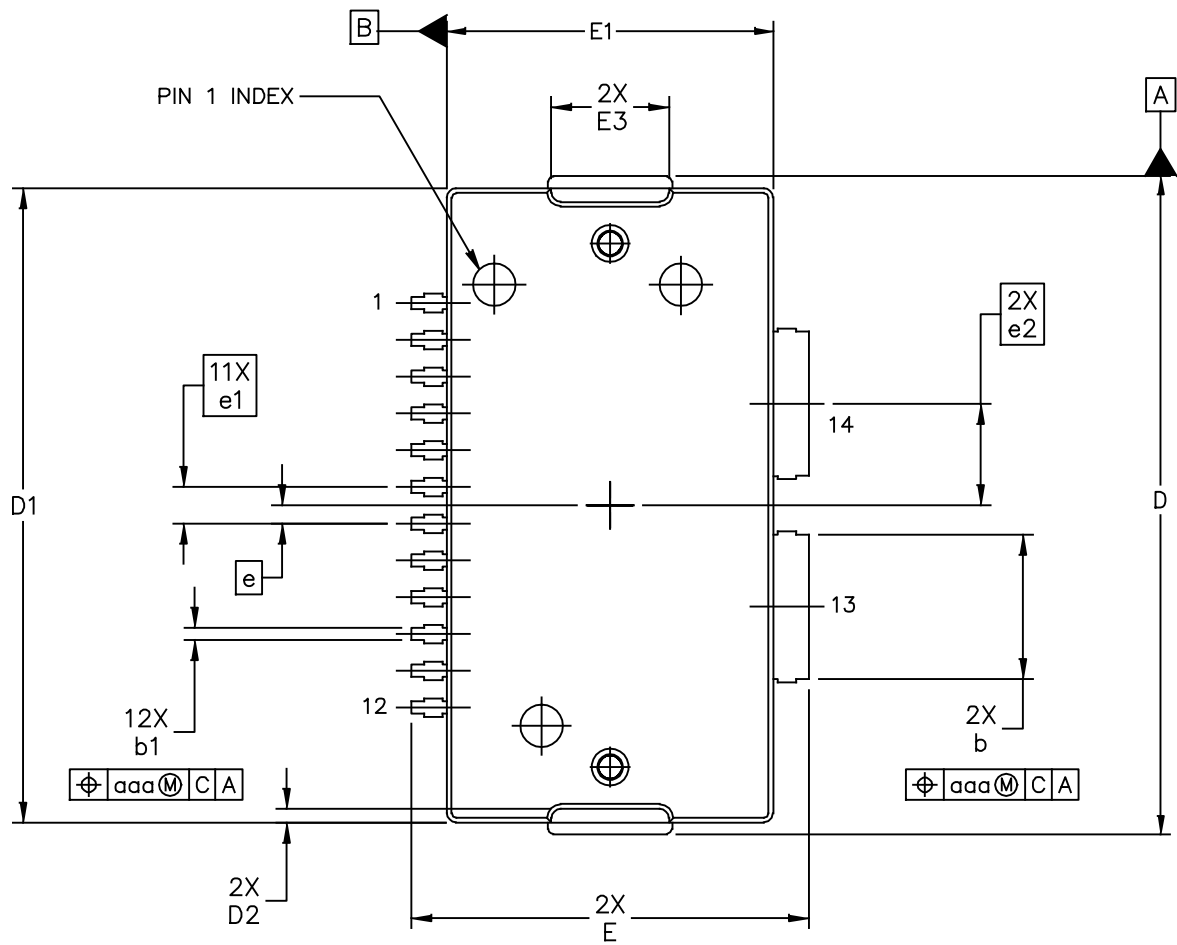
VIEW Y-Y

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TITLE: TO-270 WIDE BODY 14 LEAD		DOCUMENT NO: 98ASA10650D	REV: B
		STANDARD: NON-JEDEC	
		SOT1720-2	20 JAN 2016

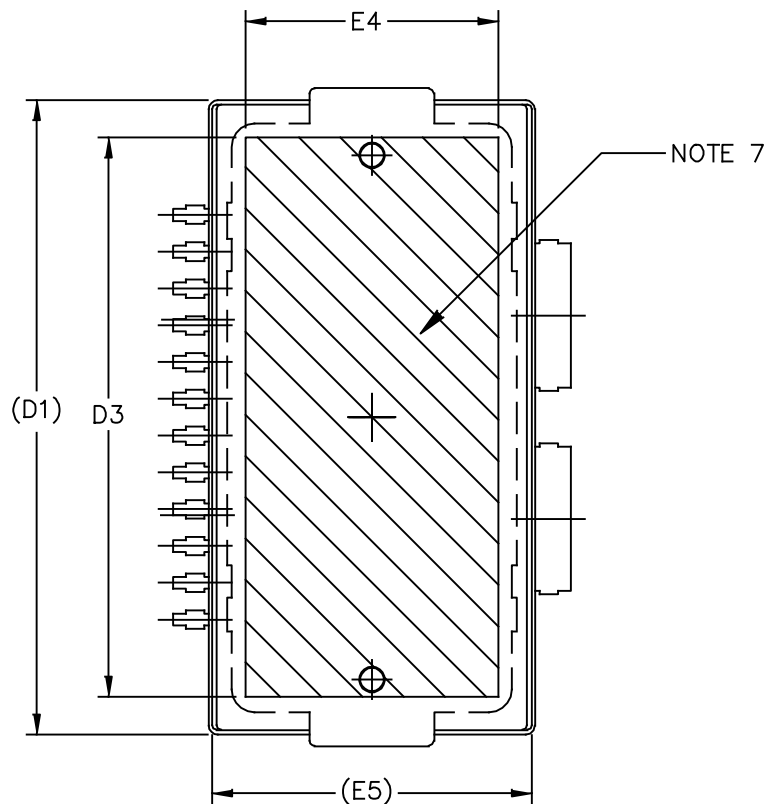
NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE -H- IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS "b" AND "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b" AND "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.
8. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.

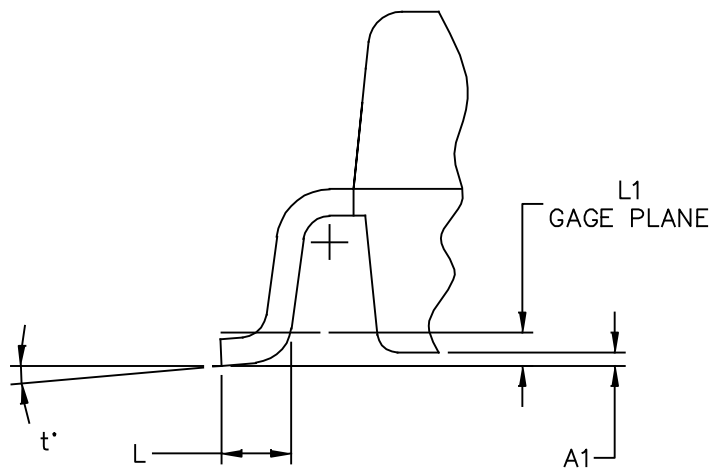
DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64	F	.025 BSC		0.64 BSC	
A1	.039	.043	0.99	1.09	b	.154	.160	3.91	4.06
A2	.040	.042	1.02	1.07	b1	.010	.016	0.25	0.41
D	.712	.720	18.08	18.29	c1	.007	.011	.18	.28
D1	.688	.692	17.48	17.58	e	.020 BSC		0.51 BSC	
D2	.011	.019	0.28	0.48	e1	.040 BSC		1.02 BSC	
D3	.600	---	15.24	---	e2	.1105 BSC		2.807 BSC	
E	.551	.559	14	14.2					
E1	.353	.357	8.97	9.07	aaa	.004		.10	
E2	.132	.140	3.35	3.56					
E3	.124	.132	3.15	3.35					
E4	.270	---	6.86	---					
E5	.346	.350	8.79	8.89					
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VIEW Y-Y



DETAIL "Y"

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	STANDARD: NON-JEDEC	
	SOT1720-3	29 JAN 2016

NOTES:

1. CONTROLLING DIMENSION: INCH
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3. DATUM PLANE -H- IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS "b" AND "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b" AND "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64	L	.018	.024	0.46	0.61
A1	.001	.004	0.02	0.10	L1	.010 BSC		0.25 BSC	
A2	.099	.110	2.51	2.79	b	.154	.160	3.91	4.06
D	.712	.720	18.08	18.29	b1	.010	.016	0.25	0.41
D1	.688	.692	17.48	17.58	c1	.007	.011	.18	.28
D2	.011	.019	0.28	0.48	e	.020 BSC		0.51 BSC	
D3	.600	---	15.24	---	e1	.040 BSC		1.02 BSC	
E	.429	.437	10.9	11.1	e2	.1105 BSC		2.807 BSC	
E1	.353	.357	8.97	9.07	t	2°	8°	2°	8°
E2	.132	.140	3.35	3.56					
E3	.124	.132	3.15	3.35	aaa	.004		.10	
E4	.270	---	6.86	---					
E5	.346	.350	8.79	8.89					
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TITLE: TO-270 WIDE BODY 14 LEAD GULL WING					DOCUMENT NO: 98ASA10653D REV: B				
					STANDARD: NON-JEDEC				
					SOT1720-3		29 JAN 2016		

## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

### Application Notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers
- AN1977: Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family
- AN1987: Quiescent Current Control for the RF Integrated Circuit Device Family

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

- Electromigration MTTF Calculator

### To Download Resources Specific to a Given Part Number:

1. Go to <http://www.nxp.com/RF>
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

## REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	Oct. 2015	<ul style="list-style-type: none"><li>• Initial Release of Data Sheet</li></ul>
1	Apr. 2017	<ul style="list-style-type: none"><li>• Typical Wideband Performance table: added 2 msec, 20% duty cycle operating conditions and data, p. 1</li><li>• Table 1, Maximum Ratings: over-temperature range extended to cover case operation from <math>-55^{\circ}\text{C}</math> to <math>+150^{\circ}\text{C}</math> and operating junction range from <math>-55^{\circ}\text{C}</math> to <math>+225^{\circ}\text{C}</math> from the previous lower limit of <math>-40^{\circ}\text{C}</math> to allow for a cold start after temperature soak at the minimum case operating temperature, p. 2</li><li>• Figure 3, Normalized <math>I_{DQ}</math> versus Case Temperature: updated to reflect performance measured in reference circuit, p. 4</li><li>• Table 7, 1030–1090 MHz Performance table: added 2 msec, 20% duty cycle operating conditions and data, p. 5</li><li>• 1030–1090 MHz reference circuit: added performance data and graphs, reference circuit component layout and component designations, pp. 5–8</li><li>• Figure 5, 1030–1090 MHz Series Equivalent Source and Load Impedances: impedance data updated to reflect 1030–1090 MHz reference circuit addition to data sheet, p. 8 (renumbered as Figure 10 after new Figures 5–9 added)</li><li>• Figure 6, 1090 MHz MMRF2010N Reference Circuit Component Layout: layout updated to reflect actual circuit, p. 9 (renumbered as Figure 11 after new Figures 5–9 added)</li><li>• Table 8, 1090 MHz reference circuit component designations and values: R1 and R2 chip resistors replaced to support changes made to the <math>I_{DQ}</math> compensation circuit to extend the over-temperature range to cover <math>-55^{\circ}\text{C}</math> to <math>+85^{\circ}\text{C}</math> from the previous lower limit of <math>-40^{\circ}\text{C}</math>, p. 9 (renumbered as Table 9 after new Table 8 added)</li><li>• Figure 18, Power Gain and Drain Efficiency versus Output Power: <math>T_C = -40^{\circ}\text{C}</math> changed <math>-55^{\circ}\text{C}</math> to show current <math>T_C</math> operation of fixture, p. 13</li></ul>