

# RF LDMOS Wideband Integrated Power Amplifiers

The MD7IC2050N wideband integrated circuit is designed with on-chip matching that makes it usable from 1750- 2050 MHz. This multi-stage structure is rated for 26 to 32 Volt operation and covers all typical cellular base station modulation formats.

- Typical Doherty Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ1A} = I_{DQ1B} = 30$  mA,  $I_{DQ2A} = 230$  mA,  $V_{GS2B} = 1.4$  Vdc,  $P_{out} = 10$  Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

Frequency	$G_{ps}$ (dB)	PAE (%)	Output PAR (dB)	ACPR (dBc)
2025 MHz	30.5	34.7	8.7	-37.4

- Capable of Handling 5:1 VSWR, @ 32 Vdc, 2017.5 MHz, 79 Watts CW Output Power (3 dB Input Overdrive from Rated  $P_{out}$ )
- Stable into a 5:1 VSWR. All Spurs Below -60 dBc @ 20 Watts to 80 Watts CW  $P_{out}$
- Typical  $P_{out}$  @ 3 dB Compression Point = 74 Watts CW

## 1880 MHz

- Typical Doherty Single-Carrier W-CDMA Performance:  $V_{DD} = 28$  Volts,  $I_{DQ1A} = I_{DQ1B} = 30$  mA,  $I_{DQ2A} = 230$  mA,  $V_{GS2B} = 1.4$  Vdc,  $P_{out} = 10$  Watts Avg., IQ Magnitude Clipping, Channel Bandwidth = 3.84 MHz, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.

Frequency	$G_{ps}$ (dB)	PAE (%)	Output PAR (dB)	ACPR (dBc)
1880 MHz	30.3	35.2	8.6	-34.9
1900 MHz	30.2	34.9	8.6	-36.3
1920 MHz	30.1	34.8	8.7	-36.9

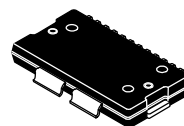
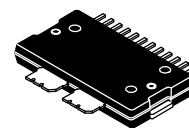
## Features

- 100% PAR Tested for Guaranteed Output Power Capability
- Production Tested in a Symmetrical Doherty Configuration
- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source S-Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function (1)
- Integrated ESD Protection
- 225°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel

**MD7IC2050NR1**  
**MD7IC2050GNR1**  
**MD7IC2050NBR1**

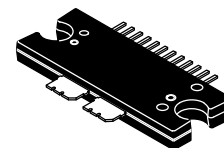
**1880-2100 MHz, 10 W AVG., 28 V**  
**SINGLE W-CDMA**  
**RF LDMOS WIDEBAND**  
**INTEGRATED POWER AMPLIFIERS**

CASE 1618-02  
 TO-270 WB-14  
 PLASTIC  
 MD7IC2050NR1

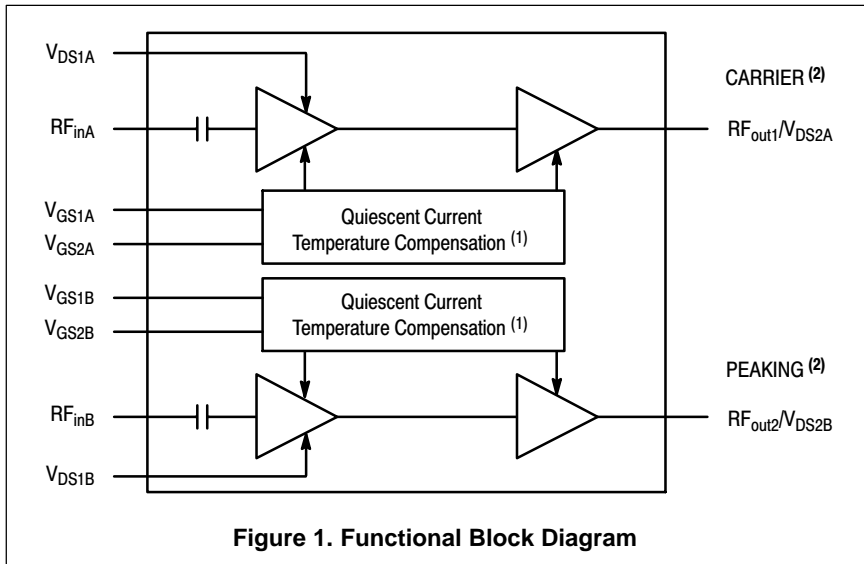


CASE 1621-02  
 TO-270 WB-14 GULL  
 PLASTIC  
 MD7IC2050GNR1

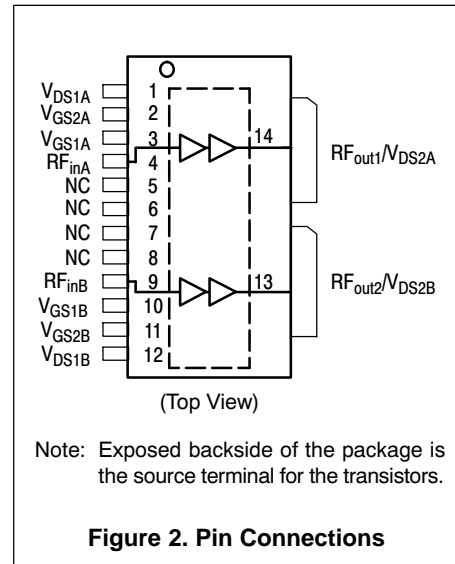
CASE 1617-02  
 TO-272 WB-14  
 PLASTIC  
 MD7IC2050NBR1



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.freescale.com/rf>. Select Documentation/Application Notes - AN1977 or AN1987.



**Figure 1. Functional Block Diagram**



**Figure 2. Pin Connections**

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.freescale.com/rf>. Select Documentation/Application Notes - AN1977 or AN1987.
2. Peaking and Carrier orientation is determined by the test fixture design.

**Table 1. Maximum Ratings**

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	-0.5, +65	Vdc
Gate-Source Voltage	$V_{GS}$	-0.5, +10	Vdc
Operating Voltage	$V_{DD}$	32, +0	Vdc
Storage Temperature Range	$T_{stg}$	-65 to +150	°C
Case Operating Temperature	$T_C$	150	°C
Operating Junction Temperature (1,2)	$T_J$	225	°C
Input Power	$P_{in}$	28	dBm

**Table 2. Thermal Characteristics**

Characteristic	Symbol	Value (2,3)	Unit
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**Final Doherty Application**

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$		°C/W
Case Temperature 81°C, $P_{out} = 50$ W CW			
Stage 1A, 28 Vdc, $I_{DQ1A} = 30$ mA		8.2	
Stage 1B, 28 Vdc, $I_{DQ1B} = 30$ mA		8.2	
Stage 2A, 28 Vdc, $I_{DQ2A} = 230$ mA		1.8	
Stage 2B, 28 Vdc, $V_{GS2B} = 1.4$ Vdc		1.8	
Case Temperature 73°C, $P_{out} = 10$ W CW			
Stage 1A, 28 Vdc, $I_{DQ1A} = 30$ mA		8.3	
Stage 1B, 28 Vdc, $I_{DQ1B} = 30$ mA		8.3	
Stage 2A, 28 Vdc, $I_{DQ2A} = 230$ mA		1.9	
Stage 2B, 28 Vdc, $V_{GS2B} = 1.4$ Vdc		1.9	

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.

**Table 3. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JESD22-A114)	0 (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	II (Minimum)

**Table 4. Moisture Sensitivity Level**

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
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**Stage 1 - Off Characteristics** <sup>(1)</sup>

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 1.5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

**Stage 1 - On Characteristics** <sup>(1)</sup>

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 23\text{ }\mu\text{Adc}$ )	$V_{GS(th)}$	1.2	1.9	2.7	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ Vdc}$ , $I_{DQ1A} = I_{DQ1B} = 30\text{ mAdc}$ )	$V_{GS(Q)}$	—	3	—	Vdc
Fixture Gate Quiescent Voltage ( $V_{DD} = 28\text{ Vdc}$ , $I_{DQ1A} = I_{DQ1B} = 30\text{ mAdc}$ , Measured in Functional Test)	$V_{GG(Q)}$	4.1	5.5	7.1	Vdc

**Stage 2 - Off Characteristics** <sup>(1)</sup>

Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 65\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	10	$\mu\text{Adc}$
Zero Gate Voltage Drain Leakage Current ( $V_{DS} = 28\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )	$I_{DSS}$	—	—	1	$\mu\text{Adc}$
Gate-Source Leakage Current ( $V_{GS} = 1.5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )	$I_{GSS}$	—	—	1	$\mu\text{Adc}$

**Stage 2 - On Characteristics** <sup>(1)</sup>

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 150\text{ }\mu\text{Adc}$ )	$V_{GS(th)}$	1.2	2	2.7	Vdc
Gate Quiescent Voltage ( $V_{DS} = 28\text{ Vdc}$ , $I_{DQ2A} = 230\text{ mAdc}$ )	$V_{GS(Q)}$	—	3	—	Vdc
Fixture Gate Quiescent Voltage ( $V_{DD} = 28\text{ Vdc}$ , $I_{DQ2A} = 230\text{ mAdc}$ , Measured in Functional Test)	$V_{GG(Q)}$	4.1	5.5	7.1	Vdc
Drain-Source On-Voltage ( $V_{GS} = 10\text{ Vdc}$ , $I_D = 1\text{ Adc}$ )	$V_{DS(on)}$	0.1	0.3	1.2	Vdc

**Functional Tests** <sup>(2,3,4)</sup> (In Freescale Doherty Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ1A} = I_{DQ1B} = 30\text{ mA}$ ,  $I_{DQ2A} = 230\text{ mA}$ ,  $V_{GS2B} = 1.4\text{ Vdc}$ ,  $P_{out} = 10\text{ W Avg.}$ ,  $f = 2025\text{ MHz}$ , Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

Power Gain	$G_{ps}$	28.5	30.5	33.0	dB
Power Added Efficiency	PAE	32.0	34.7	—	%
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF	PAR	8.0	8.7	—	dB
Adjacent Channel Power Ratio	ACPR	—	-37.4	-34.0	dBc

- Each side of device measured separately.
- Part internally matched both on input and output.
- Measurement made with device in a Symmetrical Doherty configuration.
- Measurement made with device in straight lead configuration before any lead forming operation is applied.

(continued)

**MD71C2050NR1 MD71C2050GNR1 MD71C2050NBR1**

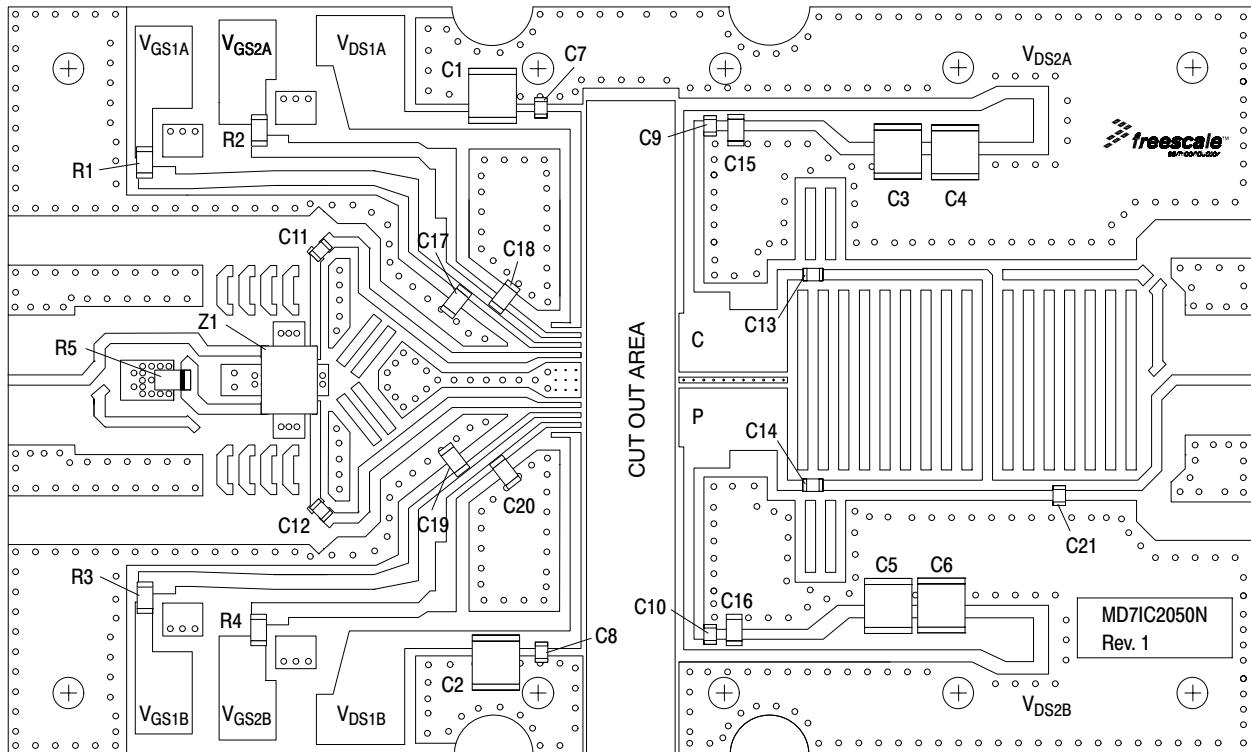
**Table 5. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Typical Performances</b> <sup>(1)</sup> (In Freescale Doherty Test Fixture, 50 ohm system) $V_{DD} = 28\text{ Vdc}$ , $I_{DQ1A} = I_{DQ1B} = 30\text{ mA}$ , $I_{DQ2A} = 230\text{ mA}$ , $V_{GS2B} = 1.4\text{ Vdc}$ , 2010-2025 MHz Bandwidth					
$P_{out}$ @ 1 dB Compression Point, CW	P1dB	—	60	—	W
$P_{out}$ @ 3 dB Compression Point, CW	P3dB	—	74	—	W
IMD Symmetry @ 30 W PEP, $P_{out}$ where IMD Third Order Intermodulation $\cong 30\text{ dBc}$ (Delta IMD Third Order Intermodulation between Upper and Lower Sidebands $> 2\text{ dB}$ )	IMD <sub>sym</sub>	—	55	—	MHz
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW <sub>res</sub>	—	70	—	MHz
Quiescent Current Accuracy over Temperature with 4.7 k $\Omega$ Gate Feed Resistors (-30 to 85°C) <sup>(2)</sup>	$\Delta I_{QT}$	—	2.64	—	%
Gain Flatness in 15 MHz Bandwidth @ $P_{out} = 10\text{ W Avg.}$	$G_F$	—	0.1	—	dB
Gain Variation over Temperature (-30 °C to +85°C)	$\Delta G$	—	0.033	—	dB/°C
Output Power Variation over Temperature (-30 °C to +85°C)	$\Delta P1\text{dB}$	—	0.008	—	dBm/°C

**Typical W-CDMA Broadband Performance — 1880 MHz** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 28\text{ Vdc}$ ,  $I_{DQ1A} = I_{DQ1B} = 30\text{ mA}$ ,  $I_{DQ2A} = 230\text{ mA}$ ,  $V_{GS2B} = 1.4\text{ Vdc}$ ,  $P_{out} = 10\text{ W Avg.}$ , Single-Carrier W-CDMA, IQ Magnitude Clipping, Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5\text{ MHz}$  Offset.

Frequency	$G_{ps}$ (dB)	PAE (%)	Output PAR (dB)	ACPR (dBc)	IRL (dB)
1880 MHz	30.3	35.2	8.6	-34.9	-21
1900 MHz	30.2	34.9	8.6	-36.3	-21
1920 MHz	30.1	34.8	8.7	-36.9	-22

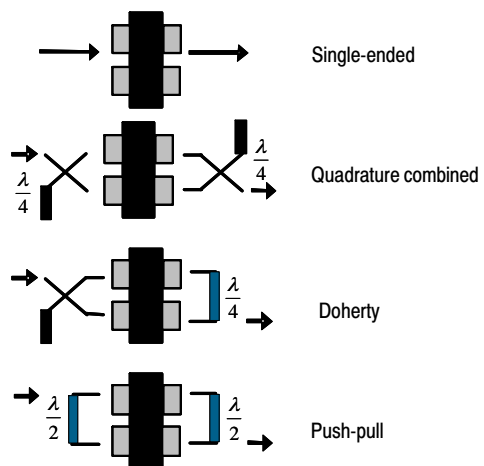
1. Measurement made with device in a Symmetrical Doherty configuration.
2. Refer to AN1977, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family* and to AN1987, *Quiescent Current Control for the RF Integrated Circuit Device Family*. Go to <http://www.freescale.com/rf.Select Documentation/Application Notes - AN1977 or AN1987>.



**Figure 3. MD7IC2050NR1(GNR1)(NBR1) Test Circuit Component Layout**

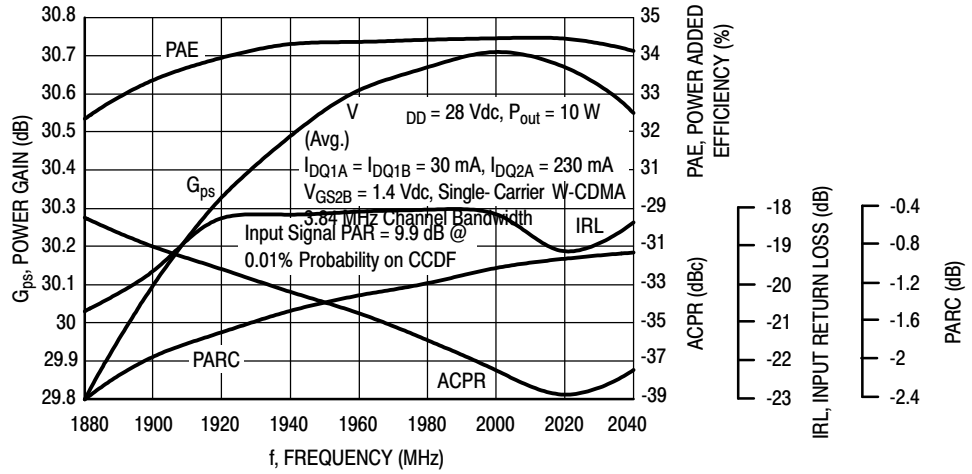
**Table 6. MD7IC2050NR1(GNR1)(NBR1) Test Circuit Component Designations and Values**

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6	10 $\mu$ F, 50 V Chip Capacitors	GRM55DR61H106KA88L	Murata
C7, C8	4.7 pF Chip Capacitors	ATC600F4R7BT250XT	ATC
C9, C10	5.6 pF Chip Capacitors	ATC600F5R6BT250XT	ATC
C11, C12, C13, C14	39 pF Chip Capacitors	ATC600F390JT250XT	ATC
C15, C16, C17, C18, C19, C20	4.7 $\mu$ F, 50 V Chip Capacitors	GRM31CR71H475KA12L	Murata
C21	1.0 pF Chip Capacitor	ATC600F1R0BT250XT	ATC
R1, R2, R3, R4	4.7 k $\Omega$ , 1/4 W Chip Resistors	CRCW12064701KEA	Vishay
R5	50 $\Omega$ , 1/4 W Thick Film Chip Resistor	RK73B2BTDD510J	KOA Speer
Z1	1900 MHz Band 90°, 3 dB Hybrid Coupler	GSC351-HYB1900	Soshin
PCB	0.020", $\epsilon_r = 3.5$	RF-35	Taconic

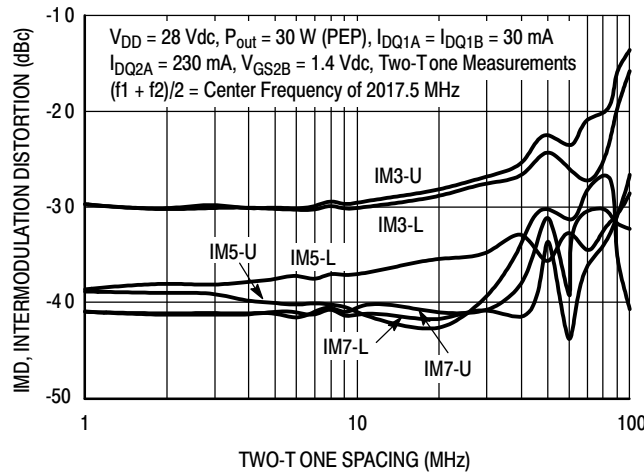


**Figure 4. Possible Circuit Topologies**

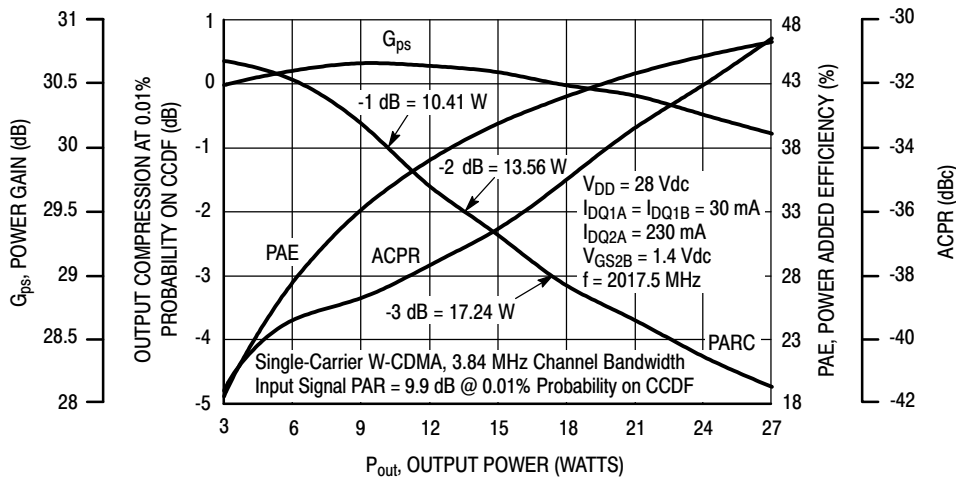
### TYPICAL CHARACTERISTICS



**Figure 5. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 10$  Watts Avg.**

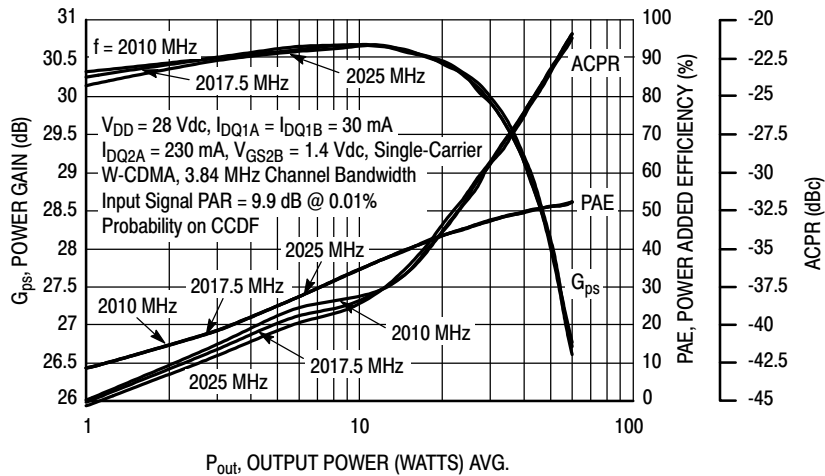


**Figure 6. Intermodulation Distortion Products versus Two-Tone Spacing**

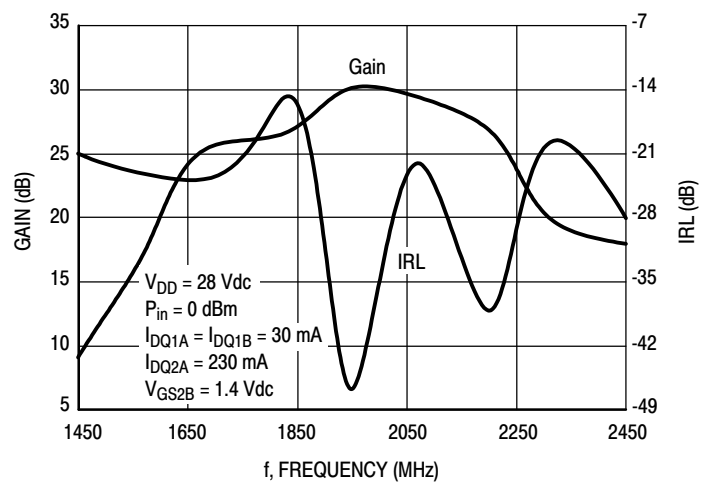


**Figure 7. Output Peak-to-Average Ratio Compression (PARC) versus Output Power**

### TYPICAL CHARACTERISTICS

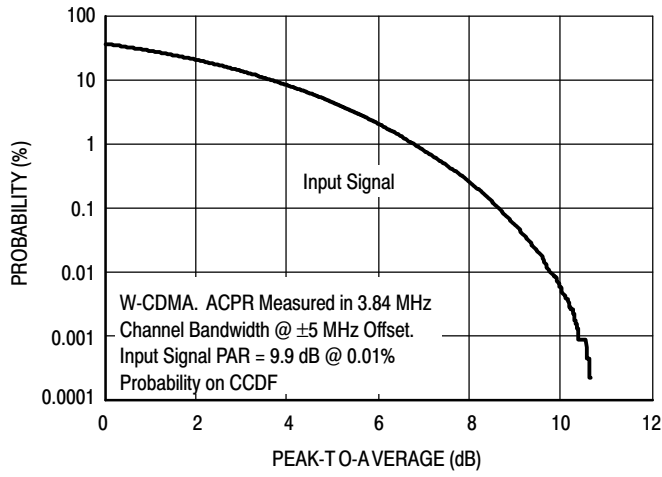


**Figure 8. Single-Carrier W-CDMA Power Gain, Power Added Efficiency and ACPR versus Output Power**

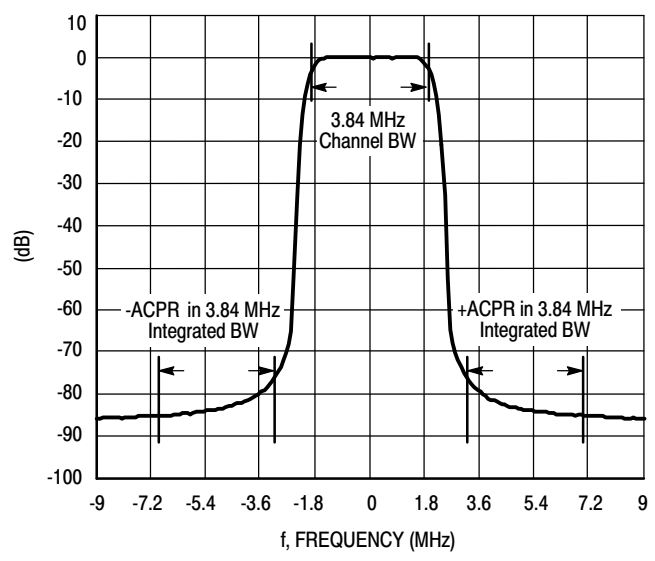


**Figure 9. Broadband Frequency Response**

### W-CDMA TEST SIGNAL



**Figure 10. CCDF W-CDMA IQ Magnitude Clipping, Single-Carrier Test Signal**



**Figure 11. Single-Carrier W-CDMA Spectrum**



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1A} = I_{DQB} = 30 \text{ mA}$ ,  $I_{DQ2A} = 230 \text{ mA}$ ,  $V_{GS2B} = 1.4 \text{ Vdc}$ ,  $P_{out} = 10 \text{ W Avg.}$

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
1995	60.12 - j33.28	11.79 - j6.72
2000	59.30 - j32.57	11.78 - j6.78
2005	58.41 - j32.06	11.78 - j6.85
2010	57.41 - j31.31	11.78 - j6.92
2015	56.31 - j30.27	11.79 - j7.00
2020	55.94 - j29.62	11.81 - j7.08
2025	55.28 - j28.90	11.81 - j7.16
2030	54.75 - j28.12	11.84 - j7.24
2035	54.39 - j27.55	11.80 - j7.33

Note: Measured with Peaking side open.

$Z_{in}$  = Device input impedance as measured from gate to ground.

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

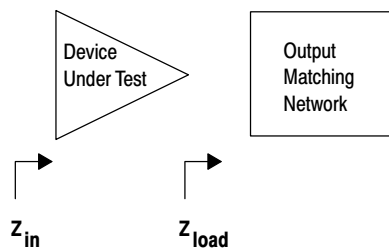


Figure 12. Series Equivalent Input and Load Impedance — Carrier Side

$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1A} = I_{DQB} = 30 \text{ mA}$ ,  $I_{DQ2A} = 230 \text{ mA}$ ,  $V_{GS2B} = 1.4 \text{ Vdc}$ ,  $P_{out} = 10 \text{ W Avg.}$

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
1995	60.12 - j33.28	1.86 - j11.38
2000	59.30 - j32.57	1.80 - j11.24
2005	58.41 - j32.06	1.71 - j11.12
2010	57.41 - j31.31	1.64 - j11.00
2015	56.31 - j30.27	1.58 - j10.91
2020	55.94 - j29.62	1.51 - j10.78
2025	55.28 - j28.90	1.45 - j10.66
2030	54.75 - j28.12	1.38 - j10.56
2035	54.39 - j27.55	1.33 - j10.40

Note: Measured with Carrier side open.

$Z_{in}$  = Device input impedance as measured from gate to ground.

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

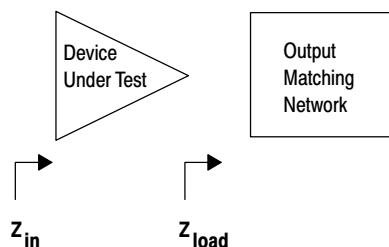
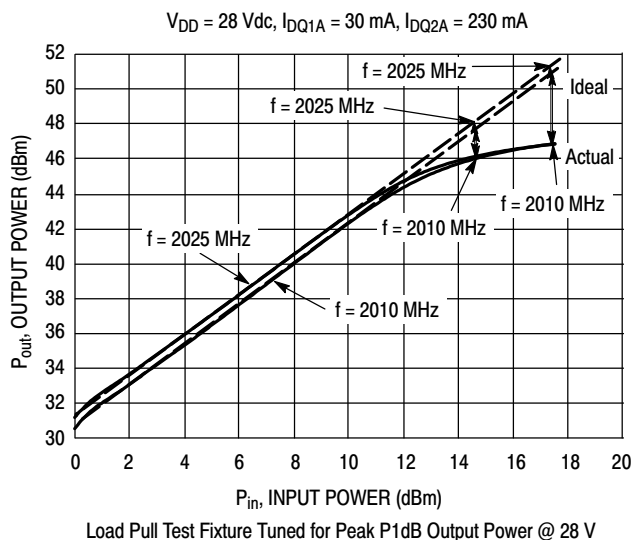


Figure 13. Series Equivalent Input and Load Impedance — Peaking Side

## ALTERNATIVE PEAK TUNE LOAD PULL CHARACTERISTICS



f (MHz)	P1dB		P3dB	
	Watts	dBm	Watts	dBm
2010	40	46	49	46.9
2025	38.9	45.9	47.9	46.8

Test Impedances per Compression Level

f (MHz)		$Z_{source}$ $\Omega$	$Z_{load}$ $\Omega$
2010	P1dB	$73.6 + j31.1$	$6.8 - j13.7$
2025	P1dB	$68.9 + j26.7$	$8.3 - j14.3$

Figure 14. CW Output Power versus Input Power @ 28 V

NOTE: Measurement made on the Class AB, carrier side of the device.

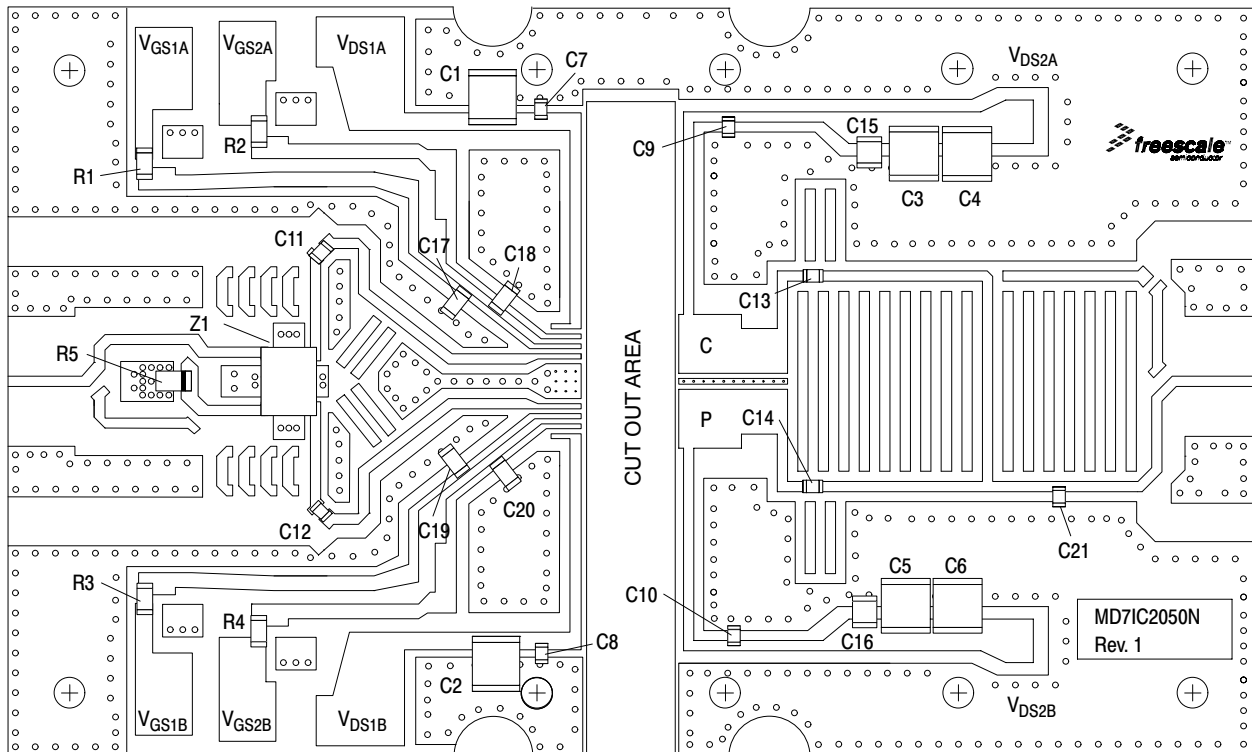
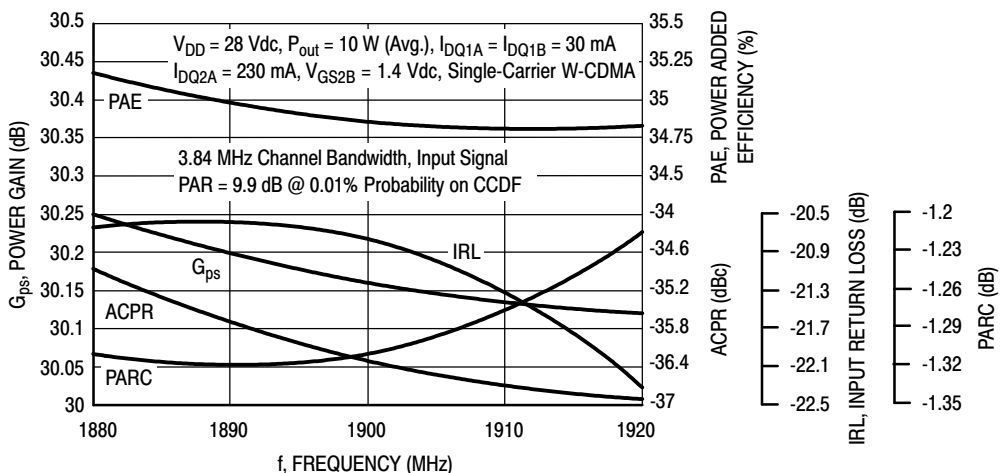


Figure 15. MD7IC2050NR1(GNR1)(NBR1) Test Circuit Component Layout — 1880 MHz

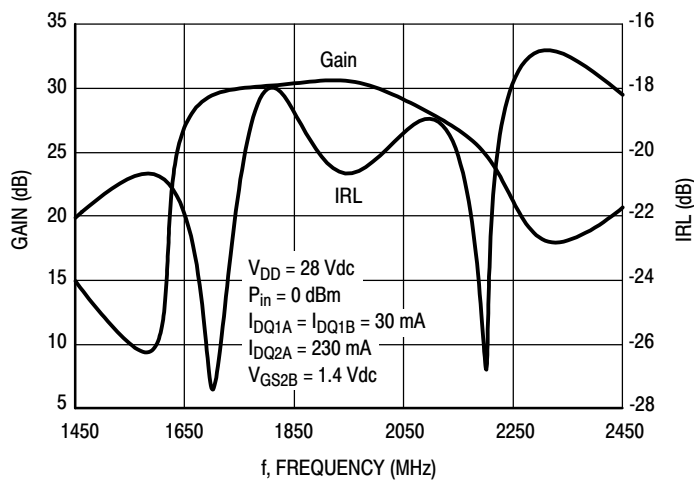
Table 7. MD7IC2050NR1(GNR1)(NBR1) Test Circuit Component Designations and Values — 1880 MHz

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4, C5, C6	10 $\mu$ F, 50 V Chip Capacitors	GRM55DR61H106KA88L	Murata
C7, C8	6.8 pF Chip Capacitors	ATC600F6R8BT250XT	ATC
C9, C10	15 pF Chip Capacitors	ATC600F150JT250XT	ATC
C11, C12, C13, C14	33 pF Chip Capacitors	ATC600F330JT250XT	ATC
C15, C16	6.8 $\mu$ F, 50 V Chip Capacitors	GRM32CF51H685ZA01L	Murata
C17, C18, C19, C20	2.2 $\mu$ F, Chip Capacitors	GRM31CR61H225KA88L	Murata
C21	0.9 pF Chip Capacitor	ATC600F0R9BT250XT	ATC
R1, R2, R3, R4	4.7 k $\Omega$ , 1/4 W Chip Resistors	CRCW12064701FKEA	Vishay
R5	50 $\Omega$ , 1/4 W Thick Film Chip Resistor	RK73B2BTDD510J	KOA Speer
Z1	1900 MHz Band 90°, 3 dB Hybrid Coupler	GSC351-HYB1900	Soshin
PCB	0.020", $\epsilon_r = 3.5$	RO4350B	Rogers

### TYPICAL CHARACTERISTICS



**Figure 16. Output Peak-to-Average Ratio Compression (PARC) Broadband Performance @  $P_{out} = 10$  Watts Avg. — 1880 MHz**



**Figure 17. Broadband Frequency Response — 1880 MHz**

$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1A} = I_{DQB} = 30 \text{ mA}$ ,  $I_{DQ2A} = 230 \text{ mA}$ ,  
 $V_{GS2B} = 1.4 \text{ Vdc}$ ,  $P_{out} = 10 \text{ W Avg.}$

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
1725	24.58 + j28.09	13.68 - j7.83
1750	30.62 + j35.84	14.09 - j7.95
1775	39.80 + j43.59	14.42 - j8.13
1800	53.16 + j51.72	14.72 - j8.33
1825	75.48 + j54.32	15.02 - j8.57
1850	101.49 + j44.03	15.26 - j8.91
1875	127.43 + j11.39	15.47 - j9.29
1900	113.52 - j23.46	15.59 - j9.67
1925	92.03 - j36.95	15.66 - j10.15
1950	74.95 - j38.10	15.64 - j10.65
1975	64.95 - j35.67	15.59 - j11.22
2000	59.30 - j32.57	15.41 - j11.76
2025	55.28 - j28.90	15.20 - j12.36
2050	52.85 - j26.07	14.84 - j12.97
2075	51.34 - j23.91	14.42 - j13.56

Note: Measured with Peaking side open.

$Z_{in}$  = Device input impedance as measured from gate to ground.

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

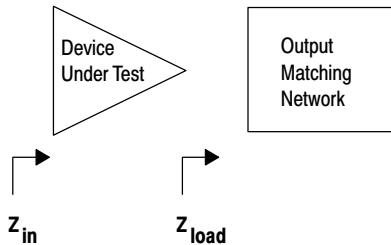


Figure 18. Series Equivalent Input and Load Impedance — Carrier Side — 1880 MHz

$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1A} = I_{DQB} = 30 \text{ mA}$ ,  $I_{DQ2A} = 230 \text{ mA}$ ,  
 $V_{GS2B} = 1.4 \text{ Vdc}$ ,  $P_{out} = 10 \text{ W Avg.}$

f MHz	$Z_{in}$ $\Omega$	$Z_{load}$ $\Omega$
1725	24.58 + j28.09	4.10 - j18.22
1750	30.62 + j35.84	3.61 - j17.55
1775	39.80 + j43.59	3.09 - j16.79
1800	53.16 + j51.72	2.61 - j16.00
1825	75.48 + j54.32	2.31 - j15.22
1850	101.49 + j44.03	1.99 - j14.46
1875	127.43 + j11.39	1.71 - j13.71
1900	113.52 - j23.46	1.47 - j12.96
1925	92.03 - j36.95	1.27 - j12.19
1950	74.95 - j38.10	1.15 - j11.44
1975	64.95 - j35.67	1.04 - j10.70
2000	59.30 - j32.57	1.00 - j9.97
2025	55.28 - j28.90	0.98 - j9.28
2050	52.85 - j26.07	1.05 - j8.57
2075	51.34 - j23.91	1.16 - j7.91

Note: Measured with Carrier side open.

$Z_{in}$  = Device input impedance as measured from gate to ground.

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

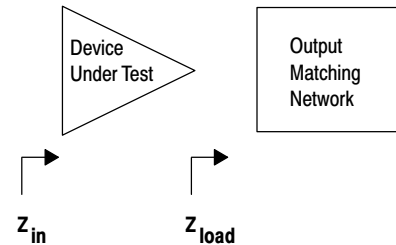
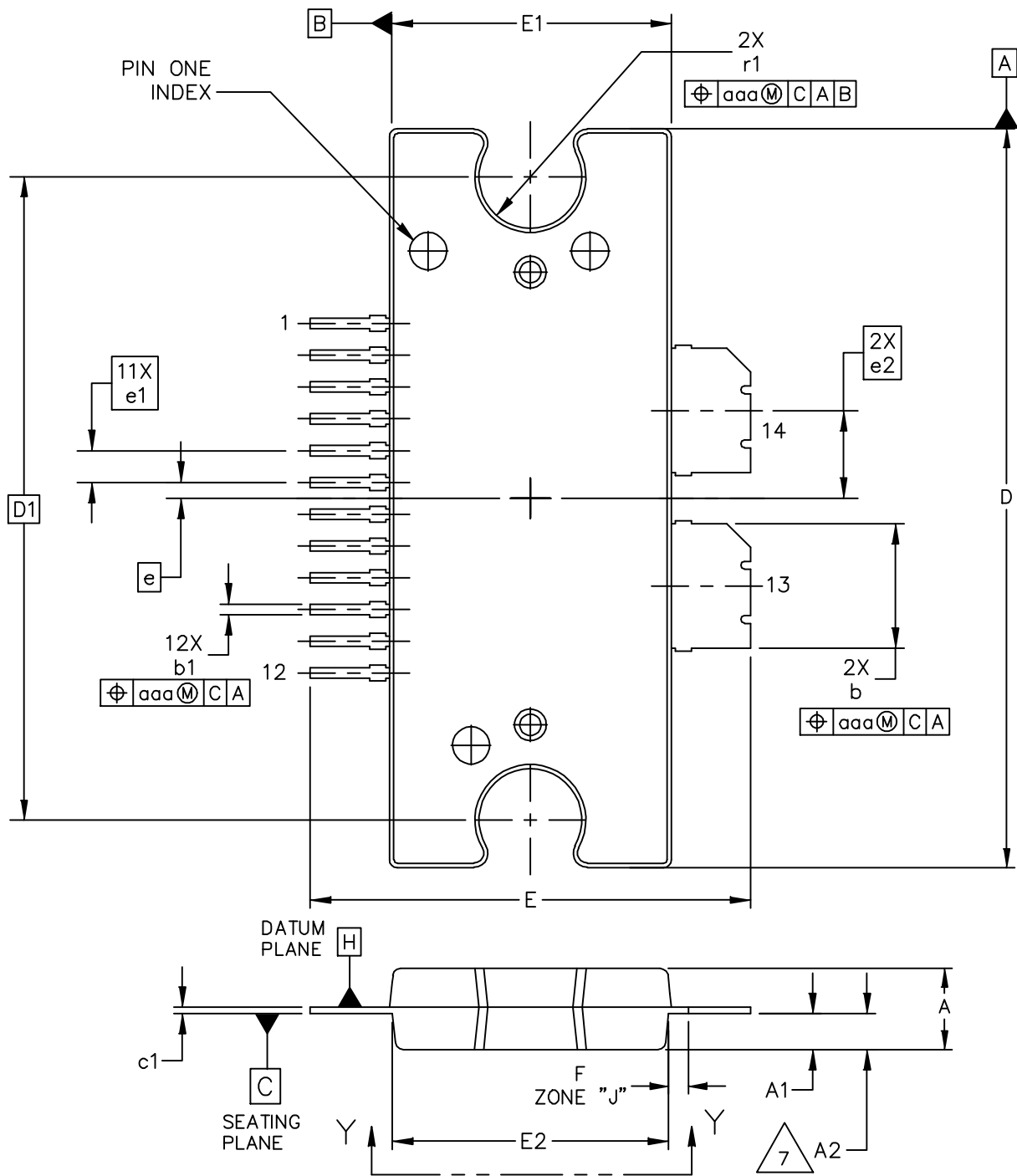
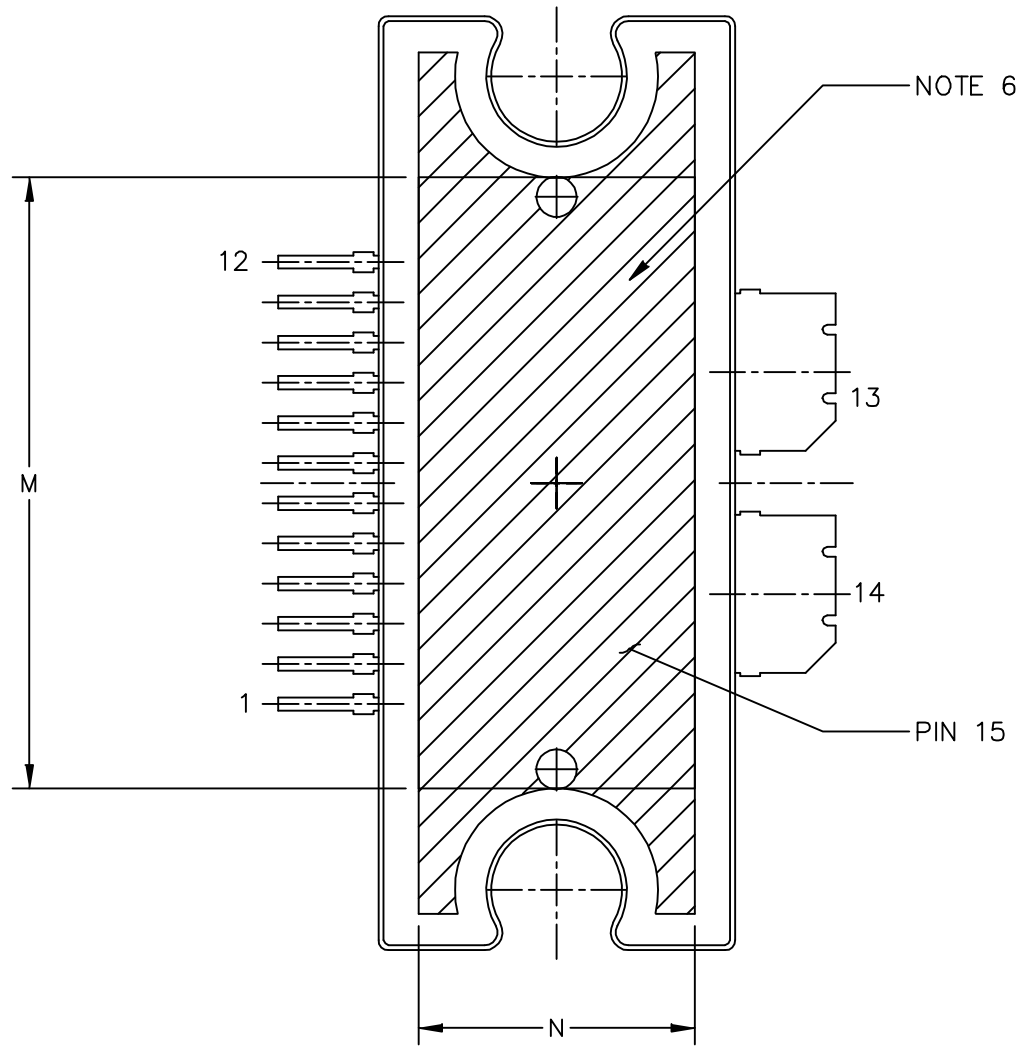


Figure 19. Series Equivalent Input and Load Impedance — Peaking Side — 1880 MHz

### PACKAGE DIMENSIONS



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VIEW Y-Y

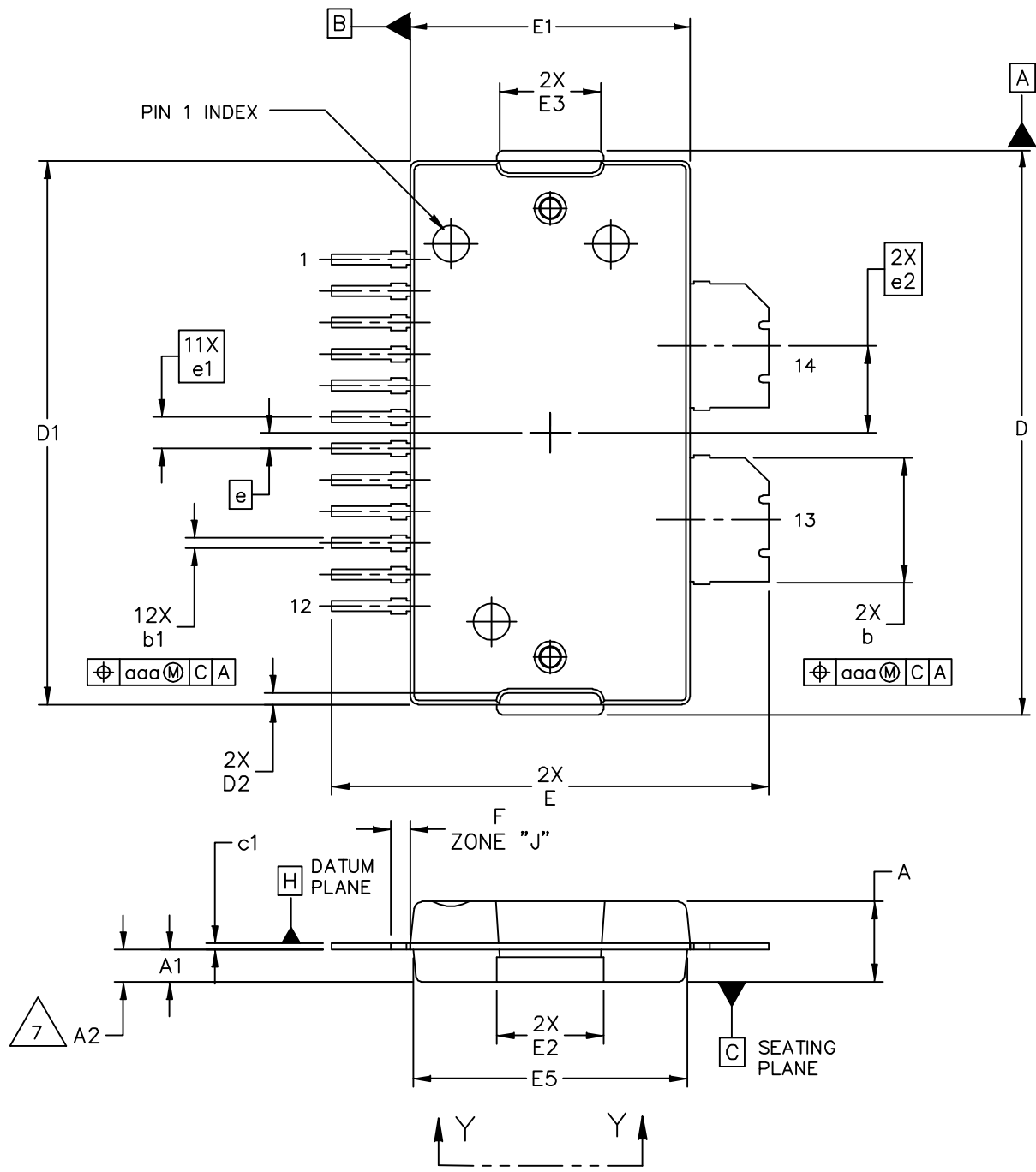
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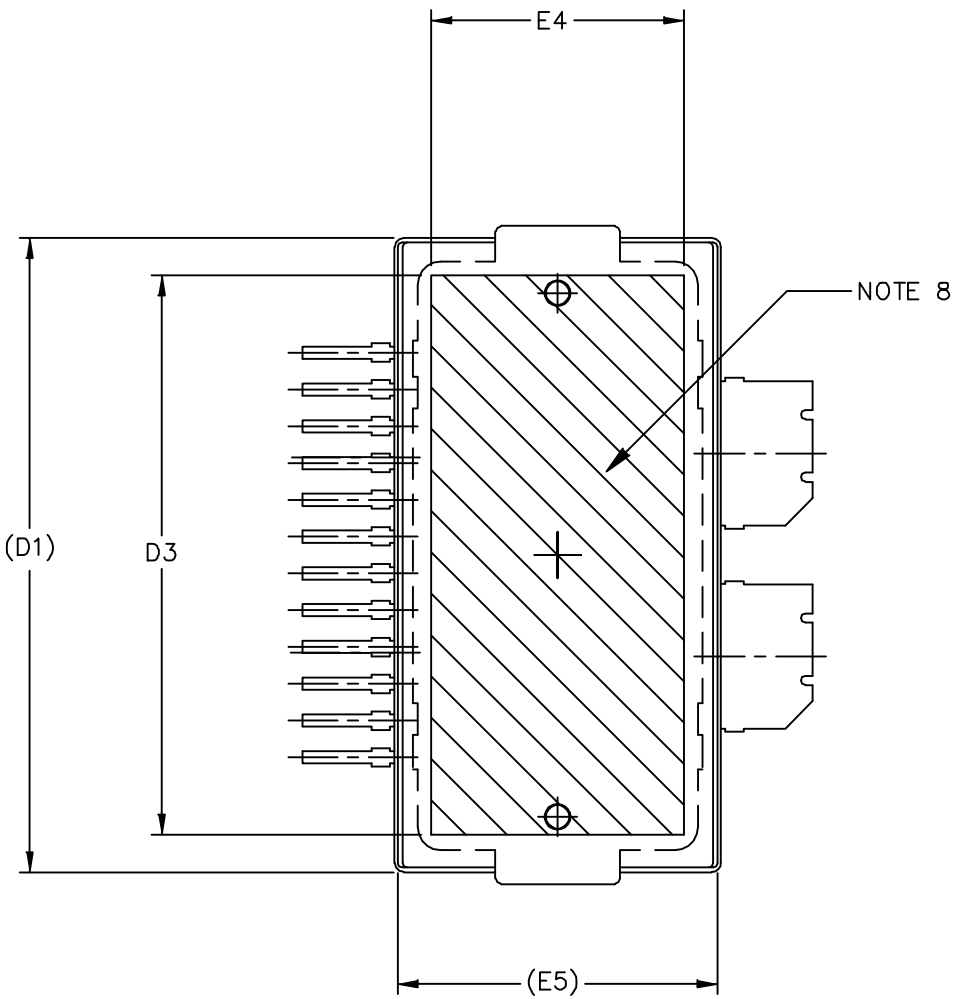
1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DATUM PLANE -H- IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 (0.15) PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS "b" AND "b1" DO NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 (0.13) TOTAL IN EXCESS OF THE "b" AND "b1" DIMENSIONS AT MAXIMUM MATERIAL CONDITION.
6. HATCHING REPRESENTS THE EXPOSED AREA OF THE HEAT SLUG.
7. DIM A2 APPLIES WITHIN ZONE "J" ONLY.

DIM	INCH		MILLIMETER		DIM	INCH		MILLIMETER	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.100	.104	2.54	2.64	b	.154	.160	3.91	4.06
A1	.039	.043	0.99	1.09	b1	.010	.016	0.25	0.41
A2	.040	.042	1.02	1.07	c1	.007	.011	0.18	0.28
D	.928	.932	23.57	23.67	e	.020 BSC		0.51 BSC	
D1	.810 BSC		20.57 BSC		e1	.040 BSC		1.02 BSC	
E	.551	.559	14.00	14.20	e2	.1105 BSC		2.807 BSC	
E1	.353	.357	8.97	9.07	r1	.063	.068	1.6	1.73
E2	.346	.350	8.79	8.89					
F	.025 BSC		0.64 BSC		aaa	.004		0.10	
M	.600	----	15.24	----					
N	.270	----	6.86	----					
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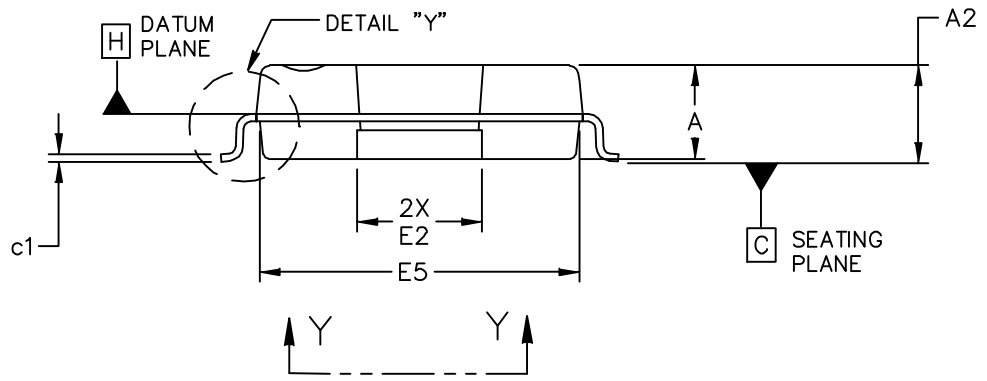
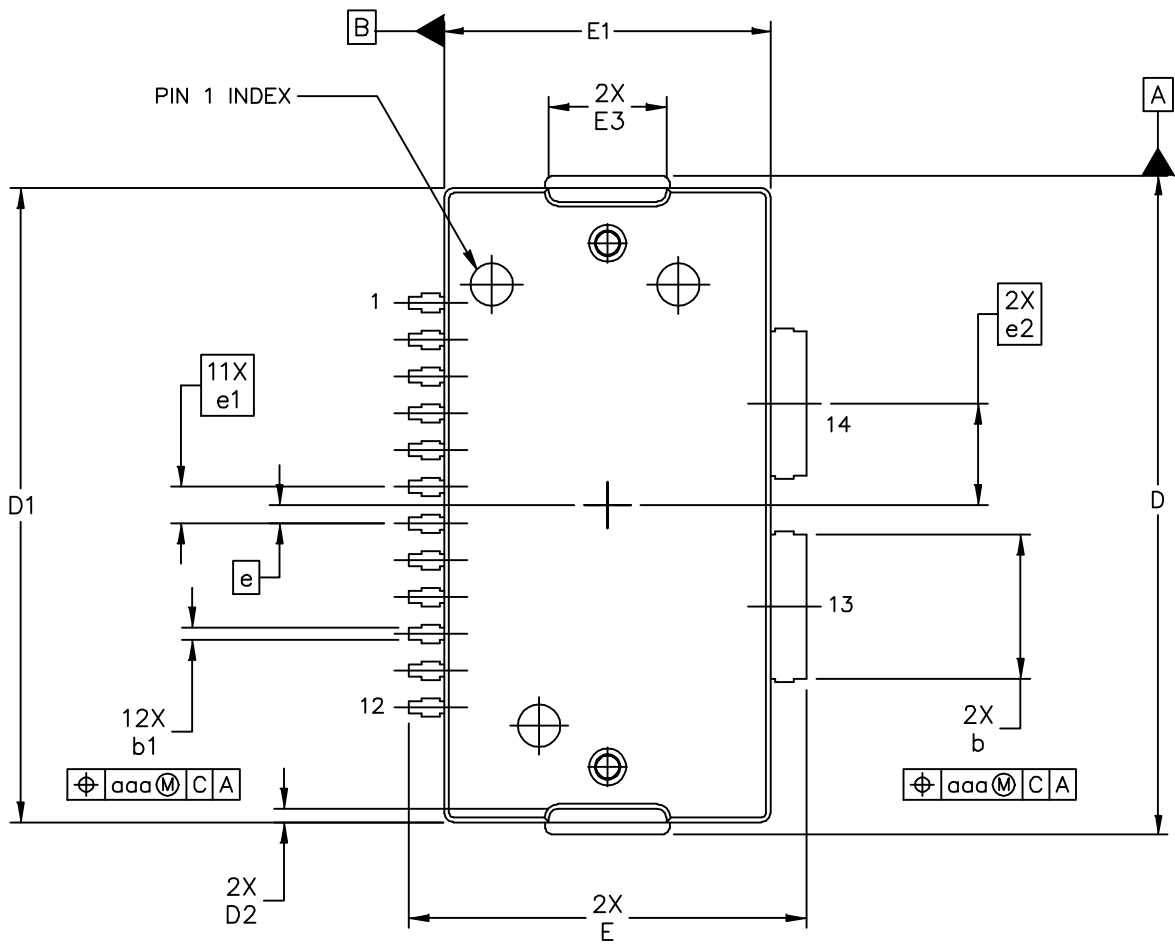
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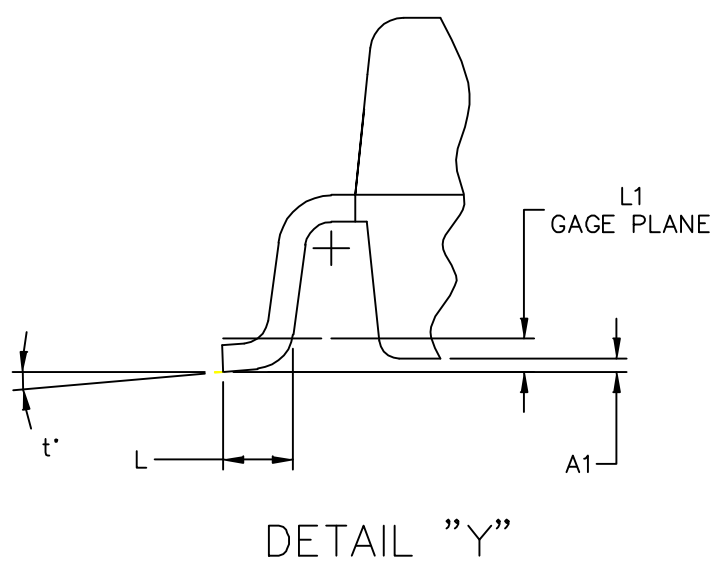
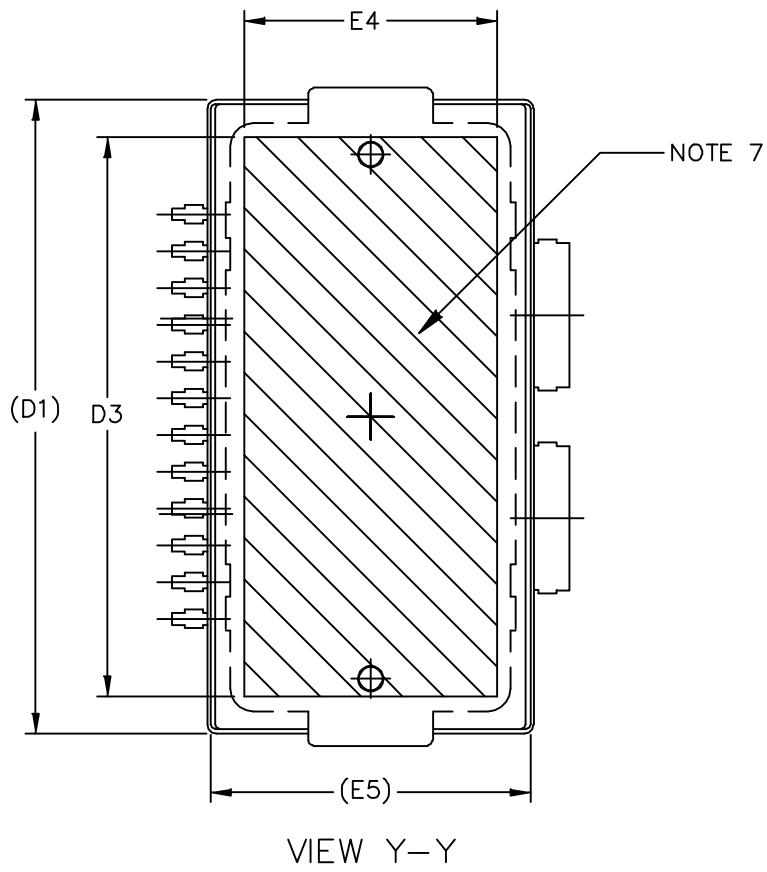
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5. DIMENSIONS "b" AND "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b" AND "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-.
7. DIMENSION 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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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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Refer to the following documents 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
- AN3263: Bolt Down Mounting Method for High Power RF Transistors and RFICs in Over-Molded Plastic Packages
- AN3789: Clamping of High Power RF Transistors and RFICs in Over-Molded Plastic Packages

**Engineering Bulletins**

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

**Software**

- Electromigration MTTF Calculator
- RF High Power Model
- .s2p File

For Software, 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.

**REVISION HISTORY**

The following table summarizes revisions to this document.

Revision	Date	Description
0	Aug. 2009	<ul style="list-style-type: none"> <li>• Initial Release of Data Sheet</li> </ul>
1	May 2010	<ul style="list-style-type: none"> <li>• Corrected Thermal Characteristics table values for thermal resistance as follows: 50 W CW <math>I_{DQ1B}</math> changed from 6.1 to 8.2 °C/W and <math>V_{GS2B}</math> changed from 1.4 to 1.8 °C/W; 10 W CW <math>I_{DQ1B}</math> changed from 3.6 to 8.3 °C/W and <math>V_{GS2B}</math> changed from *Stage 2B is turned off to 1.9 °C/W. Thermal values now reflect the symmetrical Doherty nature of the device, p. 2</li> <li>• Changed ESD Human Body Model rating from Class 1B to Class 0 to reflect recent ESD test results of the device, p. 3</li> <li>• Added RF High Power Model availability to Product Software, p. 23</li> </ul>

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