### Freescale Semiconductor

**Technical Data** 

# 查询"MW4IC2230N"供应商 RF LDMOS Wideband Integrated **Power Amplifiers**

The MW4IC2230N wideband integrated circuit is designed for W-CDMA base station applications. It uses Freescale's newest High Voltage (26 to 28 Volts) LDMOS IC technology and integrates a multi-stage structure. Its wideband on-chip design makes it usable from 1600 to 2400 MHz. The linearity performances cover all modulations for cellular applications: GSM, GSM EDGE, TDMA, CDMA and W-CDMA.

## **Final Application**

 Typical Single-Carrier W-CDMA Performance: V<sub>DD</sub> = 28 Volts, I<sub>DQ1</sub> = 60 mA,  $I_{DQ2}$  = 350 mA,  $P_{out}$  = 5 Watts Avg., f = 2140 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF. Power Gain — 31 dB

Drain Efficiency — 15%

ACPR @ 5 MHz = -45 dBc in 3.84 MHz Bandwidth

### **Driver Application**

Typical Single-Carrier W-CDMA Performance: V<sub>DD</sub> = 28 Volts, I<sub>DQ1</sub> = 60 mA, I<sub>DQ2</sub> = 350 mA, P<sub>out</sub> = 0.4 Watts Avg., f = 2140 MHz, Channel Bandwidth = 3.84 MHz, PAR = 8.5 dB @ 0.01% Probability on CCDF. Power Gain — 31.5 dB

ACPR @ 5 MHz = -53.5 dBc in 3.84 MHz Bandwidth

- Capable of Handling 3:1 VSWR, @ 28 Vdc, 2170 MHz, 5 Watts CW **Output Power**
- Stable into a 3:1 VSWR. All Spurs Below -60 dBc @ 10 mW to 5 W CW Pout

### **Features**

- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function
- On-Chip Current Mirror g<sub>m</sub> Reference FET for Self Biasing Application (1)
- Integrated ESD Protection
- 200°C Capable Plastic Package
- N Suffix Indicates Lead-Free Terminations. RoHS Compliant.
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel

 $V_{RD1}$  $V_{RG1}$  $V_{DS2}$  $V_{DS1}$ 3 Stages I<sub>C</sub> RF: V<sub>DS3</sub>/RF<sub>out</sub>  $V_{GS1}$ Quiescent Current  $V_{GS2}$ **Temperature Compensation**  $V_{GS3}$ 

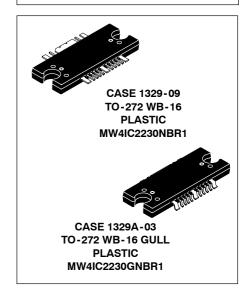
Figure 1. Functional Block Diagram

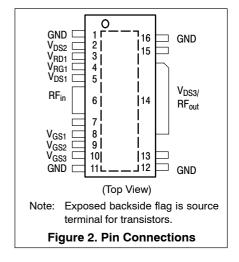
Document Number: MW4IC2230N Rev. 6. 5/2006

**√RoHS** 

# MW4IC2230NBR1 MW4IC2230GNBR1

2110-2170 MHz, 30 W, 28 V SINGLE W-CDMA **RF LDMOS WIDEBAND** INTEGRATED POWER AMPLIFIERS





1. Refer to AN1987, Quiescent Current Control for the RF Integrated Circuit Device Family. Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1987.



### **Table 1. Maximum Ratings**

查询"MW4IC2230N"供应槽g	Symbol	Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>	-0.5, +65	Vdc
Gate-Source Voltage	V <sub>GS</sub>	-0.5, +8	Vdc
Storage Temperature Range	T <sub>stg</sub>	-65 to +175	°C
Operating Channel Temperature	TJ	200	°C
Input Power	P <sub>in</sub>	20	dBm

### **Table 2. Thermal Characteristics**

Characteristic	Symbol	Value <sup>(1)</sup>	Unit
Thermal Resistance, Junction to Case	$R_{ heta JC}$		°C/W
Stage 1		10.5	
Stage 2		5.1	
Stage 3		2.3	

### **Table 3. ESD Protection Characteristics**

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C5 (Minimum)

### **Table 4. Moisture Sensitivity Level**

Test Methodology	Rating	Unit	
Per JESD 22-A113, IPC/JEDEC J-STD-020	3	260	°C

# **Table 5. Electrical Characteristics** (T<sub>C</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Тур	Max	Unit
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Functional Tests (In Freescale Test Fixture, 50 ohm system)  $V_{DD}$  = 28 Vdc,  $I_{DQ1}$  = 60 mA,  $I_{DQ2}$  = 350 mA,  $I_{DQ3}$  = 265 mA,  $P_{out}$  = 0.4 W Avg., f = 2110 MHz, f = 2170 MHz, Single-carrier W-CDMA. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm$ 5 MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	G <sub>ps</sub>	29	31.5	_	dB
Input Return Loss	IRL	_	-25	-10	dB
Adjacent Channel Power Ratio	ACPR				dBc
$P_{out} = 0.4 \text{ W Avg}.$		_	-53.5	-50	
$P_{out} = 1.26 \text{ W Avg.}$		_	-52		

Typical Performances (In Freescale Test Fixture tuned for 0.4 W Avg. W-CDMA driver)  $V_{DD}$  = 28 Vdc,  $I_{DQ1}$  = 60 mA,  $I_{DQ2}$  = 350 mA,  $I_{DQ3}$  = 265 mA, 2110 MHz<br/>
Frequency <2170 MHz

Saturated Pulsed Output Power (f = 1 kHz, Duty Cycle 10%)	P <sub>sat</sub>	_	43	_	W
Quiescent Current Accuracy over Temperature (-10 to 85°C) (2)	$\Delta I_{QT}$	_	±5	_	%
Gain Flatness in 30 MHz Bandwidth	G <sub>F</sub>	_	0.13	_	dB
Deviation from Linear Phase in 30 MHz Bandwidth	Φ	_	±1	_	٥
Delay @ P <sub>out</sub> = 0.4 W CW Including Output Matching	Delay	_	1.6	_	ns
Part-to-Part Phase Variation	ΔΦ	_	±15	_	٥

- Refer to AN1955, Thermal Measurement Methodology of RF Power Amplifiers. Go to <a href="http://www.freescale.com/rf">http://www.freescale.com/rf</a>.
   Select Documentation/Application Notes AN1955.
- 2. Refer to AN1977, Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family. Go to <a href="http://www.freescale.com/rf">http://www.freescale.com/rf</a>. Select Documentation/Application Notes AN1977.

(continued)

### Table 5. Electrical Characteristics (T<sub>C</sub> = 25°C unless otherwise noted) (continued)

查询"MW4IC2230N"供应商teristic	Symbol	Min	Тур	Max	Unit	I
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**Typical Performances** (In Freescale Reference Application Circuit tuned for 2-carrier W-CDMA signal)  $V_{DD} = 28$  Vdc,  $P_{out} = 0.4$  W Avg.,  $I_{DQ1} = 60$  mA,  $I_{DQ2} = 400$  mA,  $I_{DQ3} = 245$  mA, f1 = 2112.5 MHz, f2 = 2122.5 MHz and f1 = 2157.5 MHz, f2 = 2167.5 MHz, 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers. ACPR measured in 3.84 MHz Channel Bandwidth @  $\pm 5$  MHz Offset. IM3 measured in 3.84 MHz Channel Bandwidth @  $\pm 10$  MHz Offset. PAR = 8.5 dB @ 0.01% Probability on CCDF.

Power Gain	G <sub>ps</sub>	_	31.5	_	dB
Intermodulation Distortion	IM3	_	-52	_	dBc
Adjacent Channel Power Ratio	ACPR	_	-55	_	dBc
Input Return Loss	IRL	_	-26	_	dB

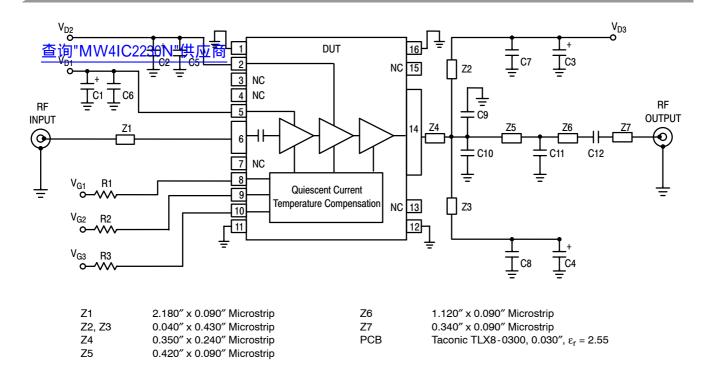
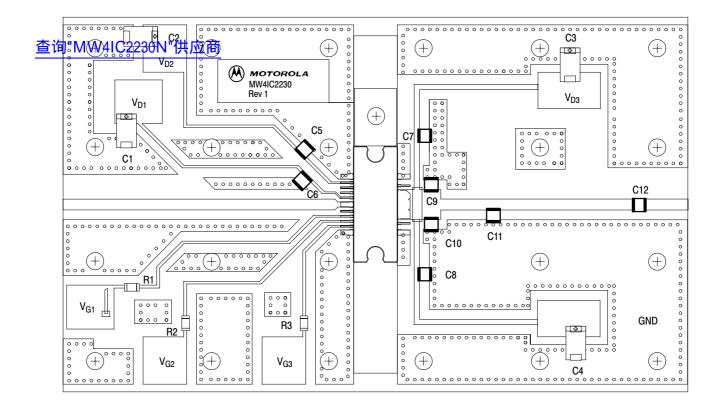


Figure 3. MW4IC2230NBR1(GNBR1) Test Circuit Schematic

Table 6. MW4IC2230NBR1(GNBR1) Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C2, C3, C4	10 μF, 35 V Tantalum Capacitors	TAJD106K035	AVX
C5, C6, C7, C8, C12	8.2 pF 100B Chip Capacitors	100B8R2CW	ATC
C9, C10	1.8 pF 100B Chip Capacitors	100B1R8BW	ATC
C11	0.3 pF 100B Chip Capacitor	100B0R3BW	ATC
R1, R2, R3	1.8 kΩ Chip Resistors (1206)		



Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 4. MW4IC2230NBR1(GNBR1) Test Circuit Component Layout

### TYPICAL CHARACTERISTICS

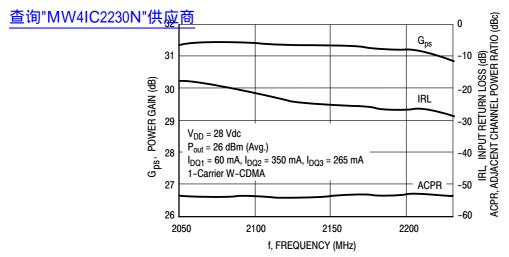


Figure 5. Single-Carrier W-CDMA Wideband Performance @ P<sub>out</sub> = 26 dBm

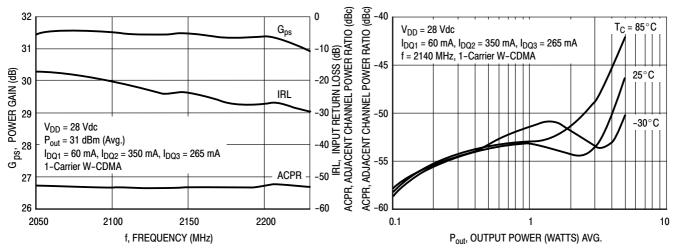


Figure 6. Single-Carrier W-CDMA Wideband Performance @ P<sub>out</sub> = 31 dBm

Figure 7. Adjacent Channel Power Ratio versus Output Power

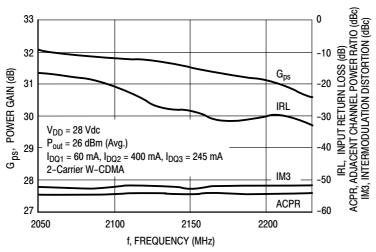
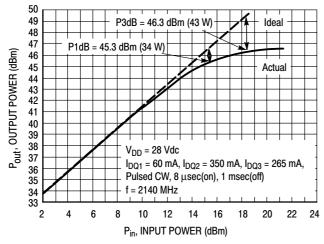


Figure 8. 2-Carrier W-CDMA Wideband Performance

### **TYPICAL CHARACTERISTICS**

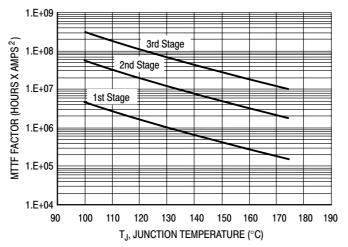
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2.00 V<sub>DD</sub> = 28 Vdc, Small Signal 1.95  $I_{DQ1} = 60 \text{ mA}, I_{DQ2} = 350 \text{ mA}, I_{DQ3} = 265 \text{ mA}$ 1.90 1.85 1.80 DELAY (ns) 1.75 1.70 1.65 1.60 1.55 1.50 1950 2000 2050 2100 2150 2200 2250 2300 f, FREQUENCY (MHz)

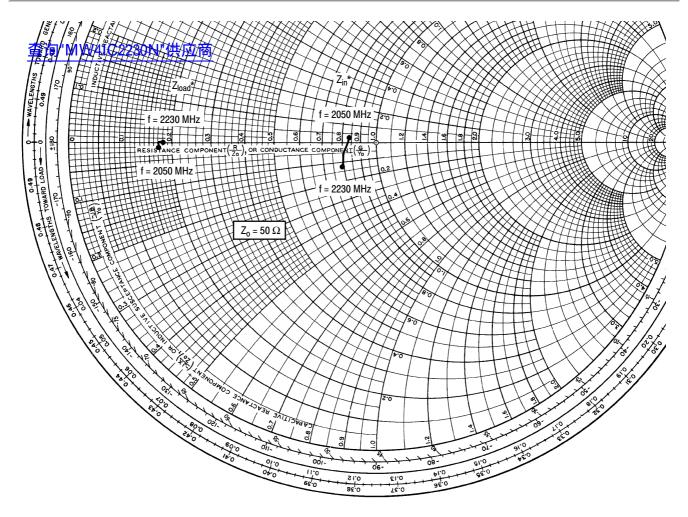
Figure 9. Output Power versus Input Power

Figure 10. Delay versus Frequency



This above graph displays calculated MTTF in hours x ampere<sup>2</sup> drain current. Life tests at elevated temperatures have correlated to better than  $\pm 10\%$  of the theoretical prediction for metal failure. Divide MTTF factor by  $l_D{}^2$  for MTTF in a particular application.

Figure 11. MTTF Factor versus Temperature Junction



 $V_{DD}$  = 28 V,  $I_{DQ1}$  = 60 mA,  $I_{DQ2}$  = 350 mA,  $I_{DQ3}$  = 265 mA,  $P_{out}$  = 26 dBm

DD - 7 DQ1 - 1 7 DQ2 - 1 7 DQ0 - 1 7 Out				
f MHz	$oldsymbol{z_{in}}{\Omega}$	$oldsymbol{Z_{load}}{\Omega}$		
2050	42.18 + j1.49	8.52 - j0.46		
2110	41.06 - j1.30	8.58 - j0.20		
2140	40.49 - j2.42	8.63 - j0.09		
2170	40.05 - j3.45	8.69 - j0.01		
2230	39.29 - j6.31	8.81 + j0.04		

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

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

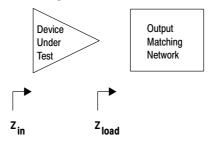
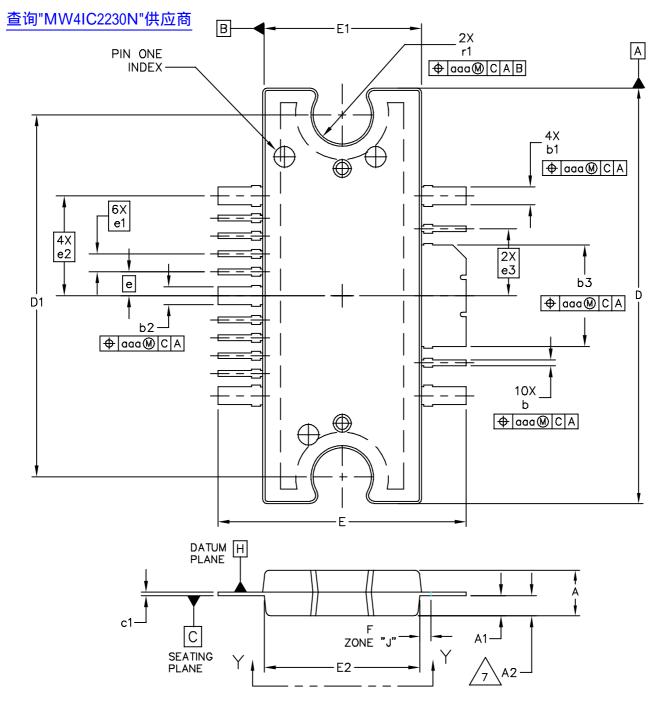


Figure 12. Series Equivalent Input and Load Impedance

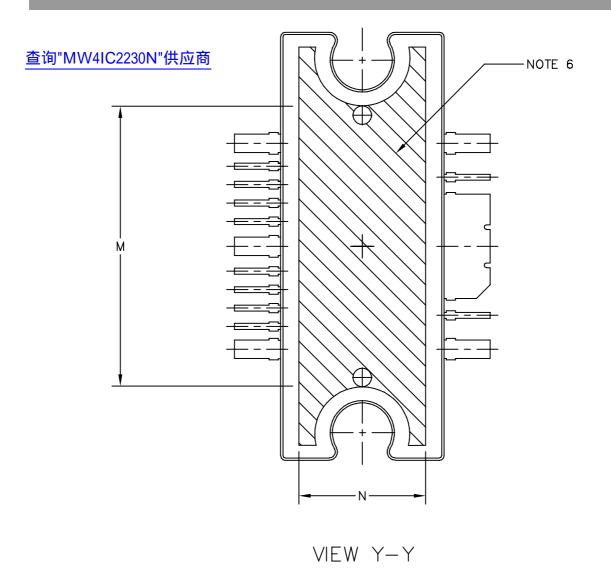
# **NOTES**

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TO-272 WIDE BODY  MULTI-LEAD		CASE NUMBER	<del>?</del> : 1329–09	13 MAR 2006
		STANDARD: NO	N-JEDEC	



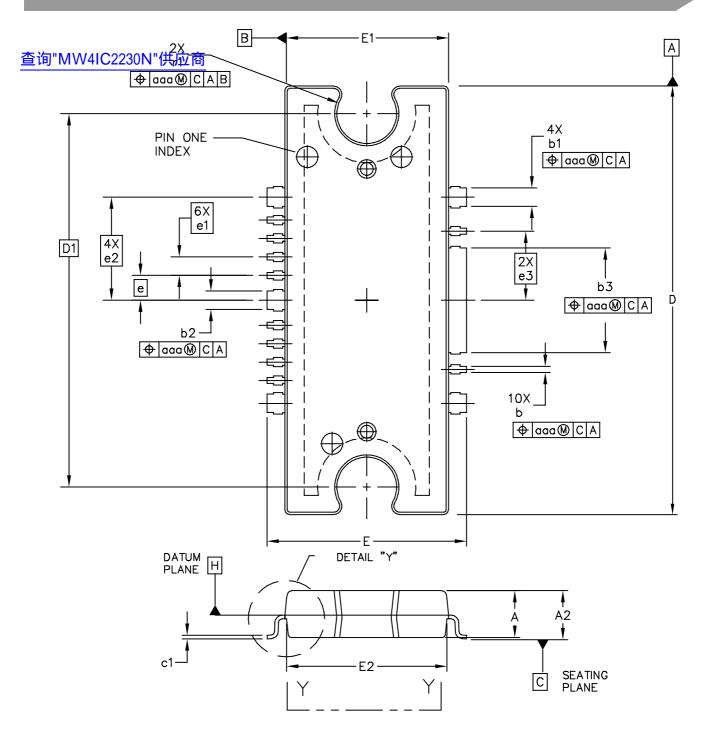
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### NOTES:

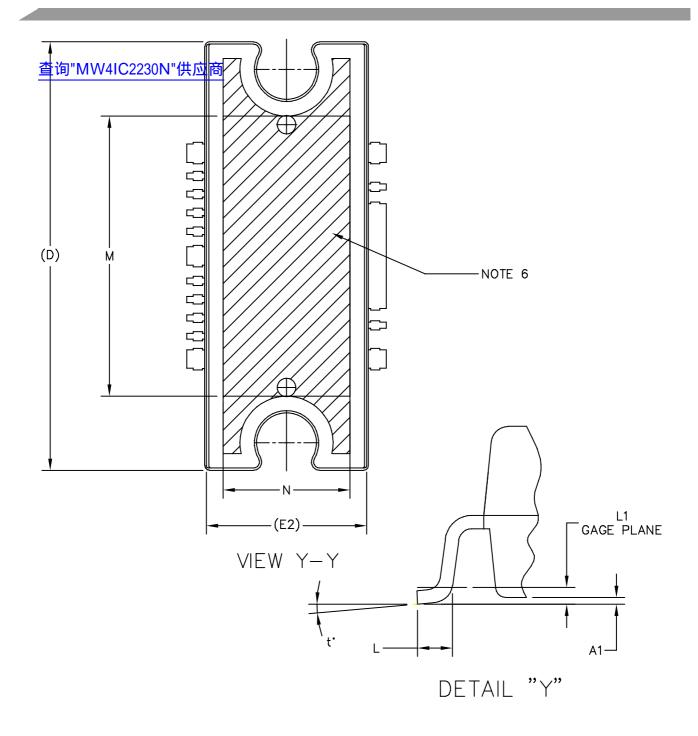
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- 3. DATUM PLANE -H- IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
- 4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 (0.15) PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE —H—.
- 5. DIMENSIONS "b", "b1", "b2" AND "b3" DO NOT INCLUDE DAMBAR PROTRUSION.
  ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 (0.13) TOTAL IN EXCESS OF THE
  "b", "b1", "b2" AND "b3" DIMENSIONS AT MAXIMUM MATERIAL CONDITION.
- 6. HATCHING REPRESENTS THE EXPOSED AREA OFTHE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.
- 7. DIM A2 APPLIES WITHIN ZONE "J" ONLY.

	INCH		MILLIMETER			INCH		MILLIMETER		
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX	
Α	.100	.104	2.54	2.64	Ф	.011	.017	0.28	0.43	
A1	.038	.044	0.96	1.12	b1	.037	.043	0.94	1.09	
A2	.040	.042	1.02	1.07	b2	.037	.043	0.94	1.09	
D	.928	.932	23.57	23.67	b3	.225	.231	5.72	5.87	
D1	.810	BSC	20	.57 BSC	c1	.007	.011	.18	.28	
E	.551	.559	14.00	14.20	е	.054 BSC		1	1.37 BSC	
E1	.353	.357	8.97	9.07	e1	.040 BSC		1.02 BSC		
E2	.346	.350	8.79	8.89	e2	.224 BSC		5.69 BSC		
F	F .025 BSC C		0.	0.64 BSC e		.1:	50 BSC	;	3.81 BSC	
M	.600		15.24		r1	.063	.068	1.6	1.73	
N	.270		6.86							
					aaa	.004		.10		
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GULL WING	CASE NUMBER: 1329A-03 3 APR 2006			
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### NOTES:

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- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
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- 6. HATCHING REPRESENTS EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

	INCH		MIL	LIMETER		INCH		MILLIMETER		
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX	
Α	.100	.104	2.54	2.64	b	.011	.017	0.28	0.43	
A1	.001	.004	0.02	0.10	b1	.037	.043	0.94	1.09	
A2	.099	.110	2.51	2.79	b2	.037	.043	0.94	1.09	
D	.928	.932	23.57	23.67	b3	.225	.231	5.72	5.87	
D1	.810	BSC	20.	57 BSC	c1	.007	.011	.18	.28	
Ε	.429	.437	10.9	11.1	е	.054 BSC		1.	1.37 BSC	
E1	.353	.357	8.97	9.07	e1	.04	.040 BSC		1.02 BSC	
E2	.346	.350	8.79	8.89	<b>e</b> 2	.224 BSC		5.69 BSC		
L	.018	.024	4.90	5.06	e3	.150 BSC		3.81 BSC		
L1	.01	.01 BSC .025 BSC		25 BSC	r1	.063	.068	1.6	1.73	
М	.600		15.24		t	2.	8.	2.	8.	
N	.270		6.86							
					aaa	.004			.10	
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PLASTIC				STANDARD: NON-JEDEC						

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