Replaced by MW4IC915NBR1(GNBR1). There are no form, fit or function changes with this part replacement. N suffix added to part number to indicate transition to lead-free terminations.

RF LDMOS Wideband Integrated Power Amplifiers

MW4IC915MBR1
MW4IC915GMBR1

860 - 960 MHz, 15 W, 26 V
GSM/GSM EDGE, N-CDMA
RF LDMOS WIDEBAND
INTEGRATED POWER AMPLIFIERS

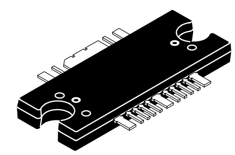
The MW4IC915MB/GMB wideband integrated circuit is designed for GSM and GSM EDGE base station applications. It uses Freescale's newest High Voltage (26 to 28 Volts) LDMOS IC technology and integrates a multi-stage structure. Its wideband On-Chip design makes it usable from 750 to 1000 MHz. The linearity performances cover all modulations for cellular applications: GSM, GSM EDGE, TDMA, N-CDMA and W-CDMA.

Final Application

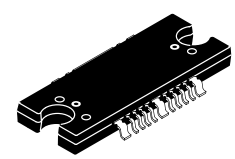
- Typical Performance: V_{DD} = 26 Volts, I_{DQ1} = 60 mA, I_{DQ2} = 240 mA, P_{out} = 15 Watts CW, Full Frequency Band (860-960 MHz)
  Power Gain — 30 dB
  Power Added Efficiency — 44%

Driver Application

- Typical GSM/GSM EDGE Performances: V_{DD} = 26 Volts, I_{DQ1} = 60 mA, I_{DQ2} = 240 mA, P_{out} = 3 Watts Avg., Full Frequency Band (869-894 MHz and 921-960 MHz)
  Power Gain — 31 dB
  Power Added Efficiency — 19%
  Spectral Regrowth @ 400 kHz Offset = -65 dBc
  Spectral Regrowth @ 600 kHz Offset = -83 dBc
  EVM — 1.5%
- Capable of Handling 5:1 VSWR, @ 26 Vdc, 921 MHz, 15 Watts CW Output Power
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >3 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function
- On-Chip Current Mirror g_m Reference FET for Self Biasing Application(1)
- Integrated ESD Protection
- 200°C Capable Plastic Package
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel.



CASE 1329-09
TO-272 WB-16
PLASTIC
MW4IC915MBR1



CASE 1329A-03
TO-272 WB-16 GULL
PLASTIC
MW4IC915GMBR1

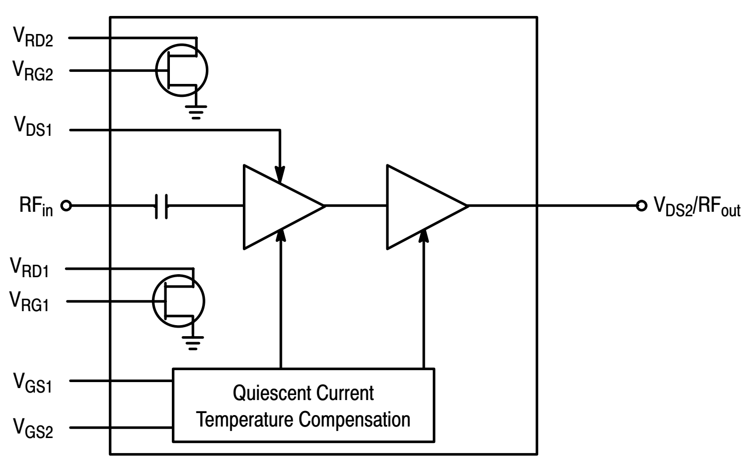
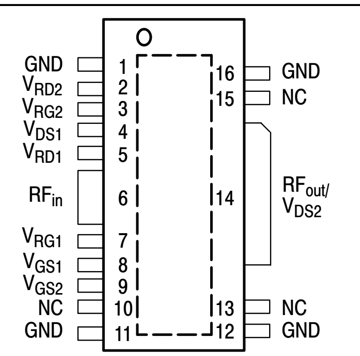


Figure 1. Functional Block Diagram



(Top View)

Note: Exposed backside flag is source terminal for transistors.

Figure 2. Pin Connections

1. Refer to AN1987/D, *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

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	-0.5. +65	Vdc
Gate-Source Voltage	V_{GS}	-0.5. +15	Vdc
Storage Temperature Range	T_{stg}	-65 to +175	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic		Symbol	Value [(1)]	Unit
Thermal Resistance, Junction to Case		$R_{\theta JC}$		°C/W
GSM Application	Stage 1, 26 Vdc, I_{DQ} = 60 mA		7.3	
(P_{out} = 15 W CW)	Stage 2, 26 Vdc, I_{DQ} = 240 mA		1.7	
GSM EDGE Application	Stage 1, 26 Vdc, I_{DQ} = 60 mA		7.3	
(P_{out} = 7.5 W CW)	Stage 2, 26 Vdc, I_{DQ} = 240 mA		1.8	
CDMA Application	Stage 1, 26 Vdc, I_{DQ} = 60 mA		7.4	
(P_{out} = 3.75 W CW)	Stage 2, 26 Vdc, I_{DQ} = 240 mA		1.9	

Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C2 (Minimum)

Table 4. Moisture Sensitivity Level

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

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DS} = 26 Vdc, I_{DQ1} = 90 mA, I_{DQ2} = 240 mA, P_{out} = 15 W PEP, f1 = 869 MHz, f2 = 869.1 MHz and f1 = 960 MHz and f2 = 960.1 MHz, Two-Tone					
Power Gain	G_{ps}	29	31	—	dB
Power Added Efficiency	PAE	29	31	—	%
Intermodulation Distortion	IMD	—	-40	-29	dBc
Input Return Loss	IRL	—	-15	-10	dB

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

(continued)

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Typical Performances (In Freescale Reference Board) V_{DS} = 26 V, I_{DQ1} = 60 mA, I_{DQ2} = 240 mA, 869 MHz<Frequency>960 MHz					
Quiescent Current Accuracy over Temperature with 1.8 kΩ Gate Feed Resistors (-10 to 85°C) (1)	ΔI_{QT}	—	±5	—	%
Gain Flatness in 40 MHz Bandwidth @ P_{out} = 3 W CW	G_F	—	0.2	—	dB
Deviation from Linear Phase in 40 MHz Bandwidth @ P_{out} = 3 W CW	Φ	—	±0.6	—	°
Delay @ P_{out} = 3 W CW Including Output Matching	Delay	—	2.5	—	ns
Part-to-Part Phase Variation @ P_{out} = 3 W CW	ΔΦ	—	±15	—	°
Typical GSM/GSM EDGE Performances (In Freescale Reference Board) V_{DS} = 26 V, I_{DQ1} = 60 mA, I_{DQ2} = 240 mA, 869 MHz<Frequency<960 MHz					
Output Power, 1dB Compression Point	P1dB	—	20	—	Watts
Power Gain @ P_{out} = 15 W CW	G_{ps}	—	30	—	dB
Power Added Efficiency @ P_{out} = 15 W CW	PAE	—	44	—	%
Input Return Loss @ P_{out} = 15 W CW	IRL	—	-15	—	dB
Error Vector Magnitude @ P_{out} = 3 W Avg. including 0.6% rms source EVM	EVM	—	1.5	—	% rms
Spectral Regrowth at 400 kHz Offset @ P_{out} = 3 W Avg.	SR1	—	-65	—	dBc
Spectral Regrowth at 600 kHz Offset @ P_{out} = 3 W Avg.	SR2	—	-83	—	dBc

1. Refer to AN1977/D, *Quiescent Current Thermal Tracking Circuit in the RF Integrated Circuit Family.* Go to http://www.freescale.com/rf. Select Documentation/Application Notes - AN1977.

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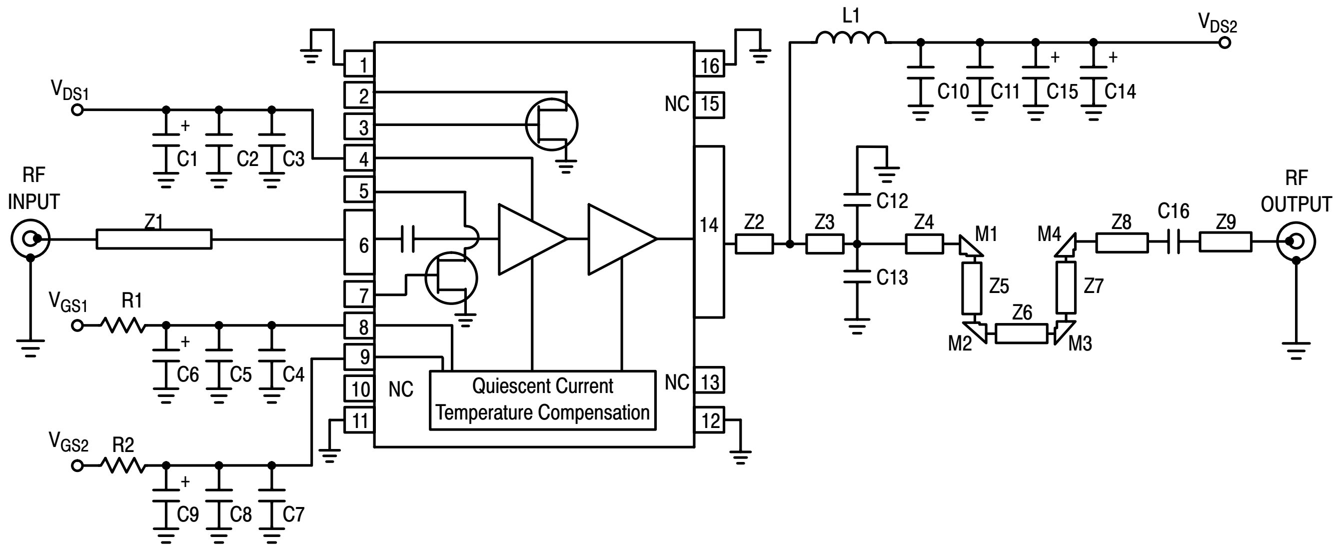


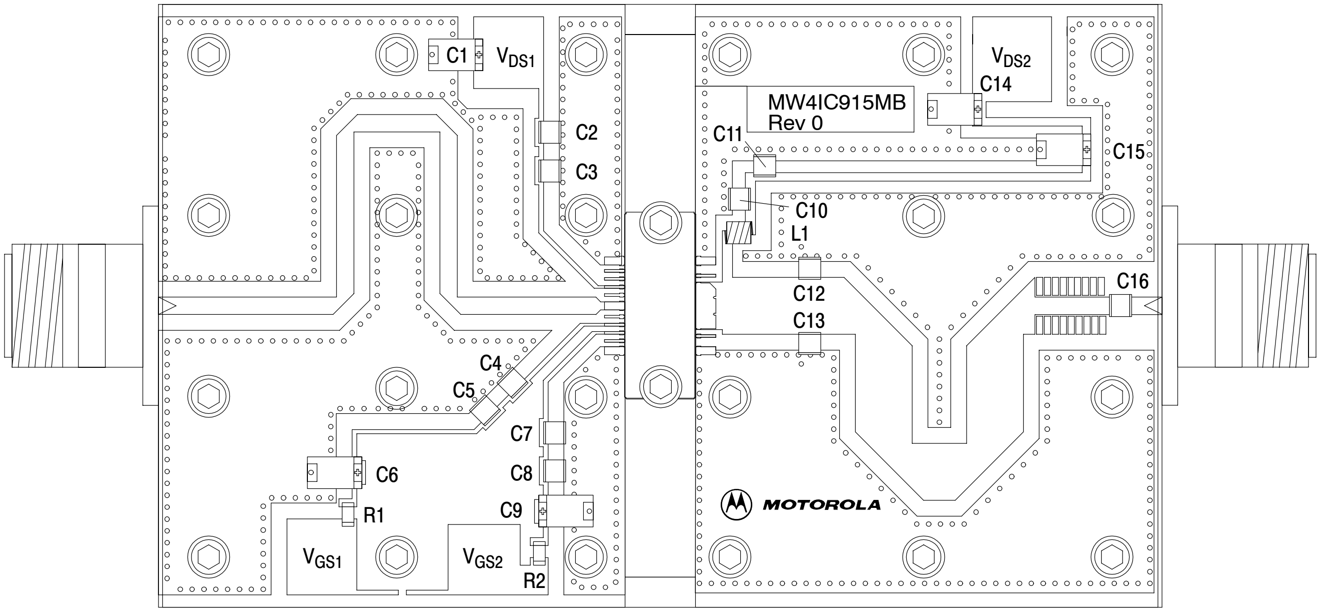
Z1	0.086″, 50 Ω Microstrip	Z6	0.157″ x 0.283″ Microstrip
Z2	0.133″ x 0.236″ Microstrip	Z7	0.429″ x 0.283″ Microstrip
Z3	0.435″ x 0.283″ Microstrip	Z8	0.394″ x 0.088″ Microstrip
Z4	0.171″ x 0.283″ Microstrip	Z9	0.181″ x 0.088″ Microstrip
Z5	0.429″ x 0.283″ Microstrip	PCB	Taconic TLX8, 0.030″, ε_r = 2.55

Figure 3. MW4IC915MBR1(GMBR1) Test Fixture Schematic

Table 6. MW4IC915MBR1(GMBR1) Test Fixture Component Designations and Values

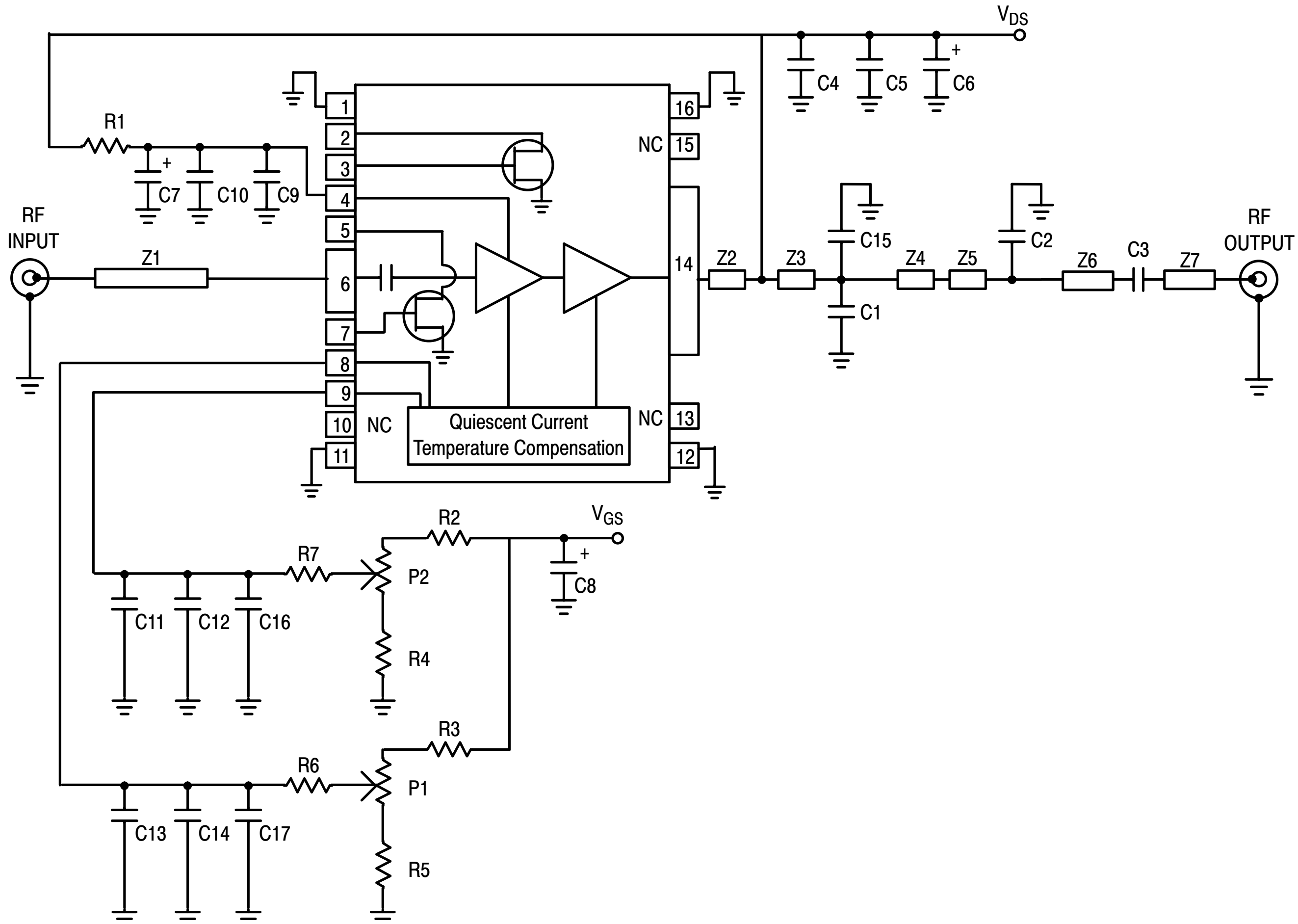
Part	Description	Part Number	Manufacturer
C1, C6, C9, C14	22 μF, 35 V Tantalum Chip Capacitors	TAJE226M035R	AVX
C2, C5, C8, C11	1000 pF Chip Capacitors	100B102JCA500X	ATC
C3, C4, C7, C10, C16	22 pF Chip Capacitors	100B220JCA500X	ATC
C12, C13	10 pF Chip Capacitors	100B100JCA500X	ATC
C15	10 μF Tantalum Chip Capacitor	T491X226K035AS4394	Kemet
L1	12.5 nH Inductor		
M1, M2, M3, M4	0.283″, 90° Mitered Microstrip Bends		
R1, R2	10 kΩ, 1/4 W Chip Resistor (1206)		

ARCHIVE INFORMATION



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. MW4IC915MBR1(GMBR1) Test Fixture Component Layout

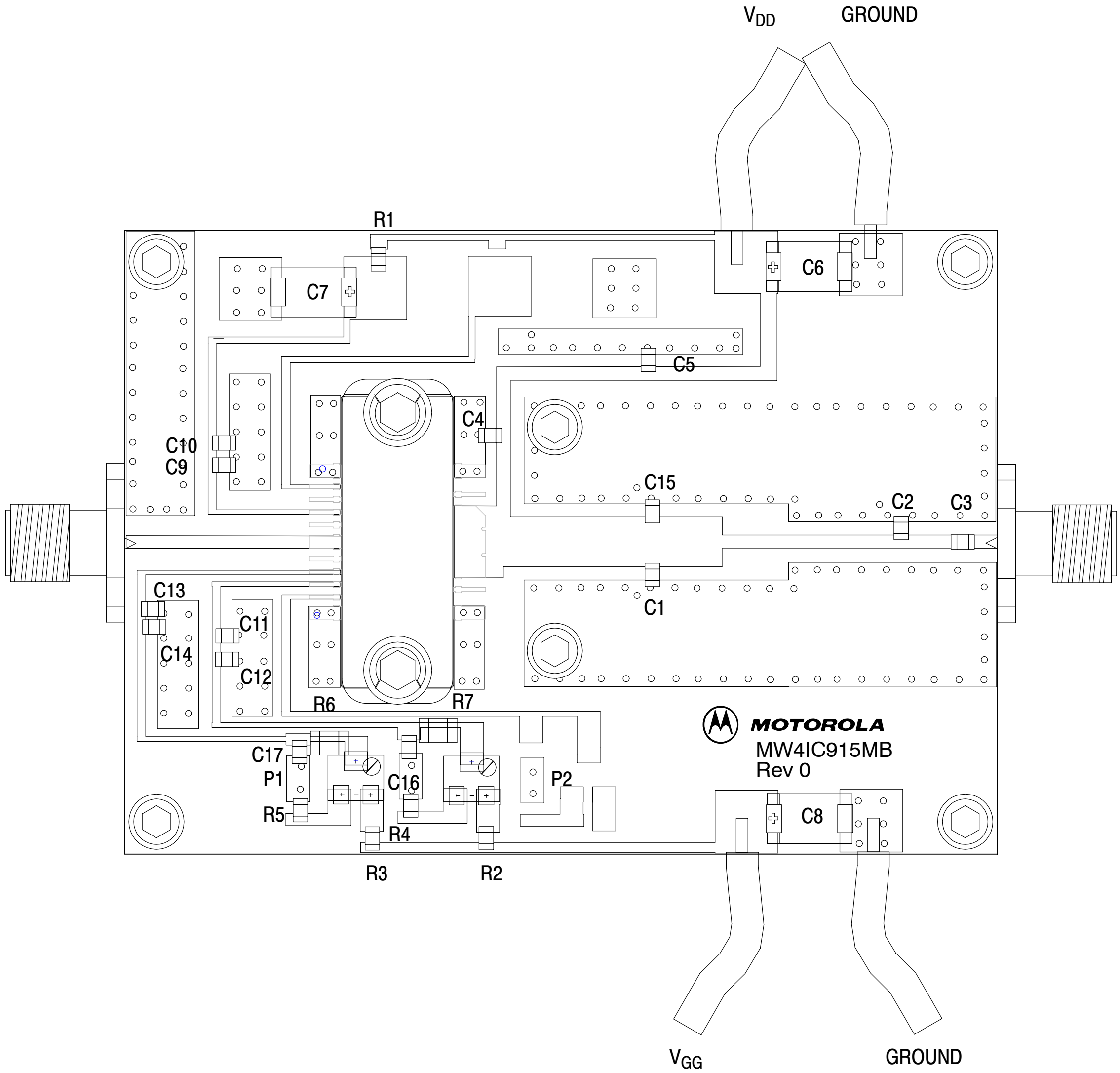


Z1	0.681″ x 0.039″, 50 Ω Microstrip	Z5	0.566″ x 0.043″ Microstrip
Z2	0.157″ x 0.228″ Microstrip	Z6	0.165″ x 0.043″ Microstrip
Z3	0.468″ x 0.157″ Microstrip	Z7	0.078″ x 0.043″ Microstrip
Z4	0.220″ x 0.157″ Microstrip	PCB	Taconic RF35, 0.02″, ε_r = 3.5

Figure 5. MW4IC915MBR1(GMBR1) Reference Board Schematic

Table 7. MW4IC915MBR1(GMBR1) Reference Board Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C15	10 pF Chip Capacitors (0805), ACCU-P	08051J100GBT	AVX
C2	5.6 pF Chip Capacitor (0805), ACCU-P	08051J5R6BBT	AVX
C3, C4, C9, C11, C13	33 pF Chip Capacitors (0805), ACCU-P	08051J330GB	AVX
C5, C10, C12, C14	10 nF Chip Capacitors (0805)	08055C103KAT	AVX
C6, C7, C8	22 μF, 35 V Tantalum Capacitors	TAJE226MO35R	AVX
C16, C17	100 nF Chip Capacitors (0805)	08055C104KAT	AVX
P1, P2	5 kΩ Potentiometer CMS Cermet Multi-turn	3224W	Bourns
R1, R2, R3, R4, R5	0 Ω, 1/8 W Chip Resistors (0805)		
R6, R7	10 kΩ, 1/4 W 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 6. MW4IC915MBR1(GMBR1) Reference Board Component Layout

TYPICAL CHARACTERISTICS (FREESCALE TEST FIXTURE, 50 OHM SYSTEM)

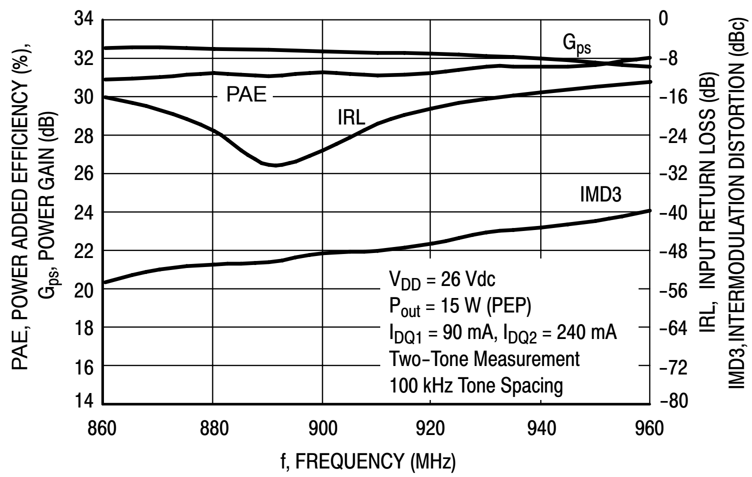


Figure 7. Two-Tone Wideband Circuit Performance @ P_{out} = 15 Watts PEP

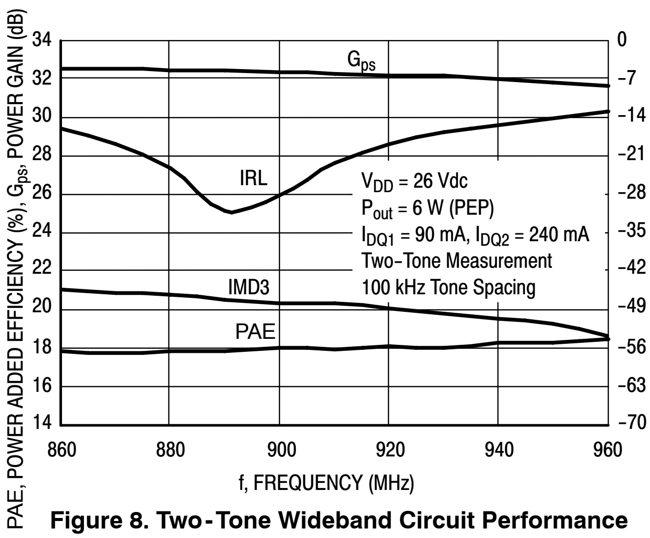


Figure 8. Two-Tone Wideband Circuit Performance @ P_{out} = 6 Watts

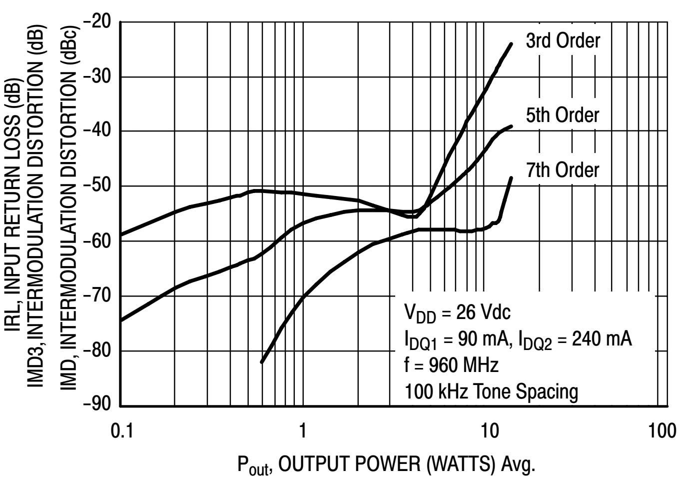


Figure 9. Intermodulation Distortion Products versus Output Power

TYPICAL CHARACTERISTICS (FREESCALE REFERENCE BOARD)

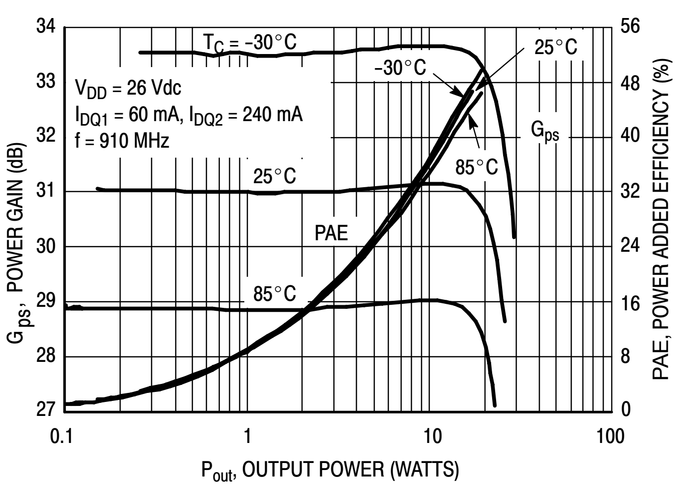


Figure 10. Power Gain and Power Added Efficiency versus Output Power

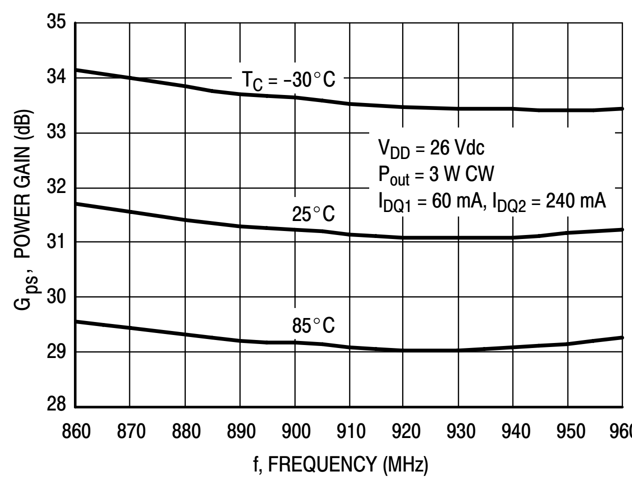


Figure 11. Power Gain versus Frequency

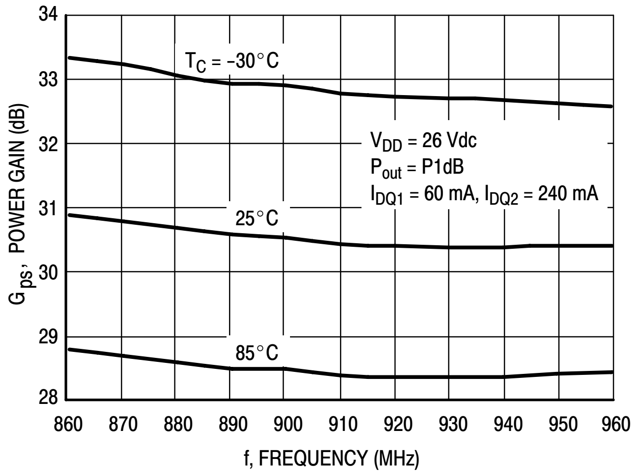


Figure 12. Power Gain versus Frequency

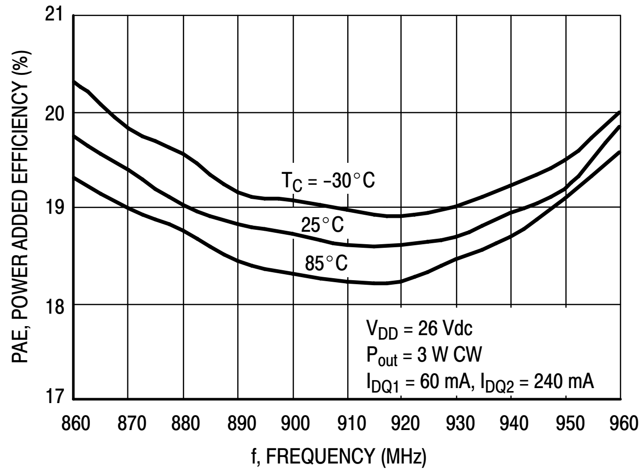


Figure 13. Power Added Efficiency versus Frequency

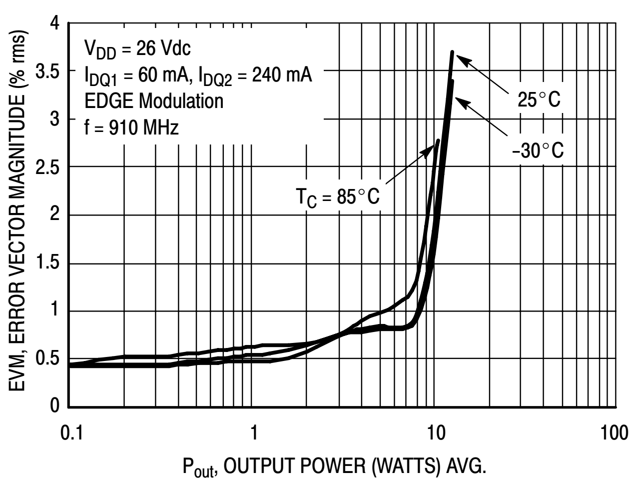


Figure 14. Error Vector Magnitude versus Output Power

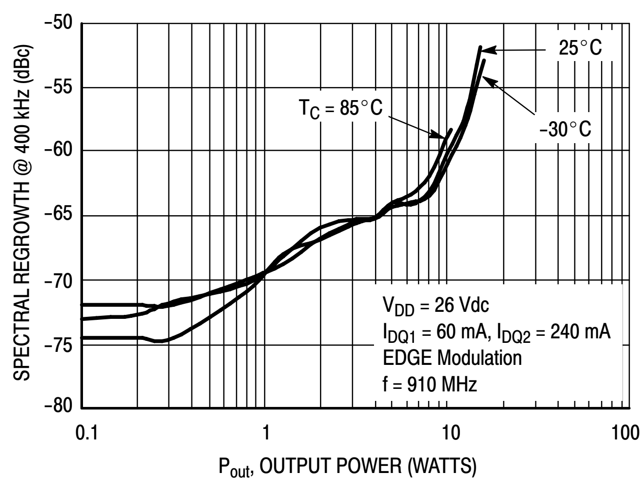


Figure 15. Spectral Regrowth at 400 kHz versus Output Power

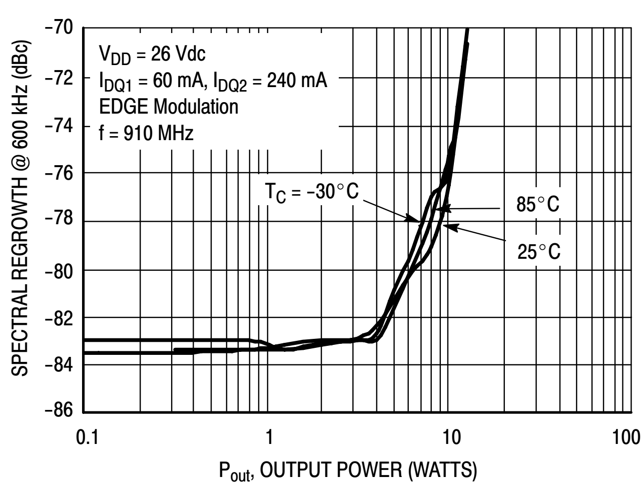
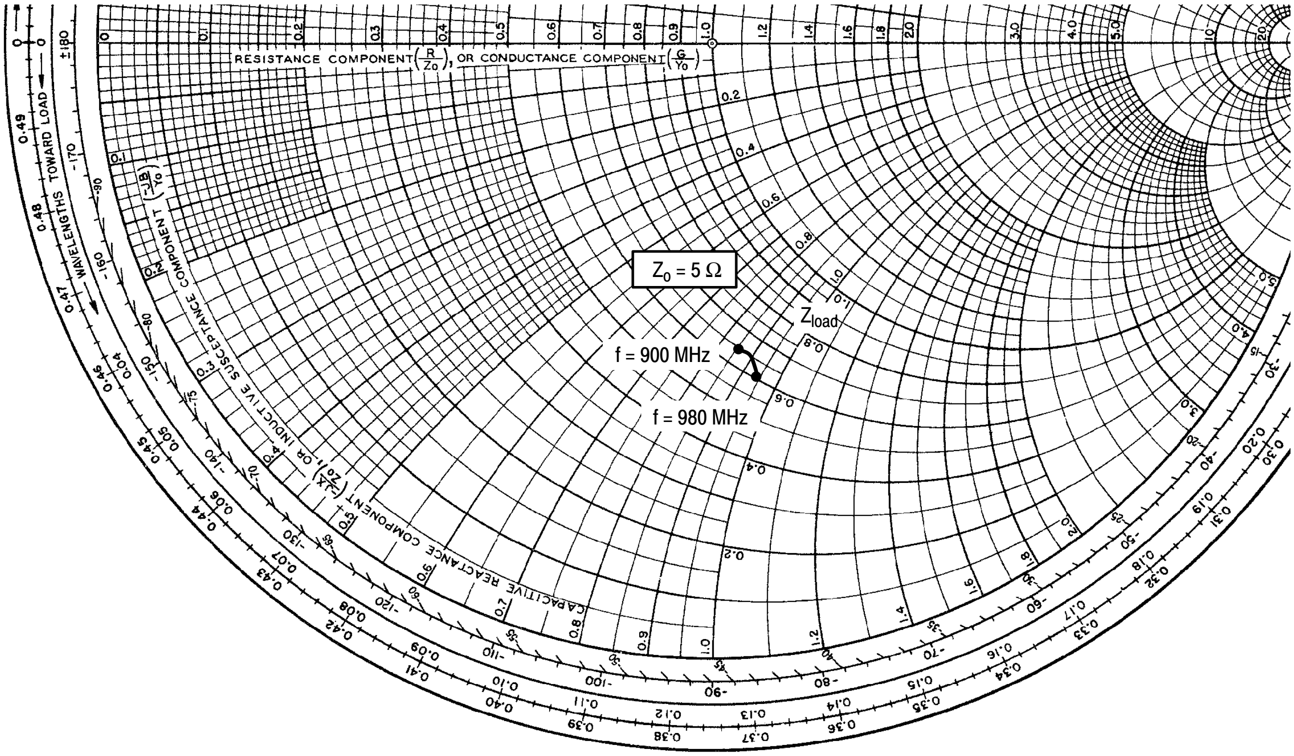


Figure 16. Spectral Regrowth at 600 kHz versus Output Power



V_{DD} = 26 V, I_{DQ1} = 60 mA, I_{DQ2} = 240 mA, P_{out} = P1dB

f MHz	Z_{load} Ω
900	3.23 - j4.30
910	3.24 - j4.36
920	3.25 - j4.42
930	3.25 - j4.47
940	3.23 - j4.52
950	3.21 - j4.56
960	3.16 - j4.60
970	3.11 - j4.65
980	3.04 - j4.70

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

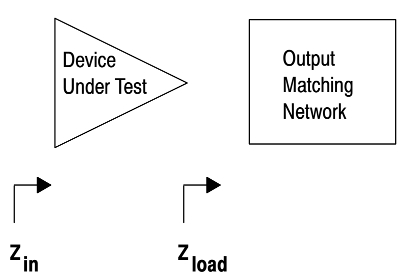


Figure 17. Series Equivalent Input and Load Impedance

ARCHIVE INFORMATION

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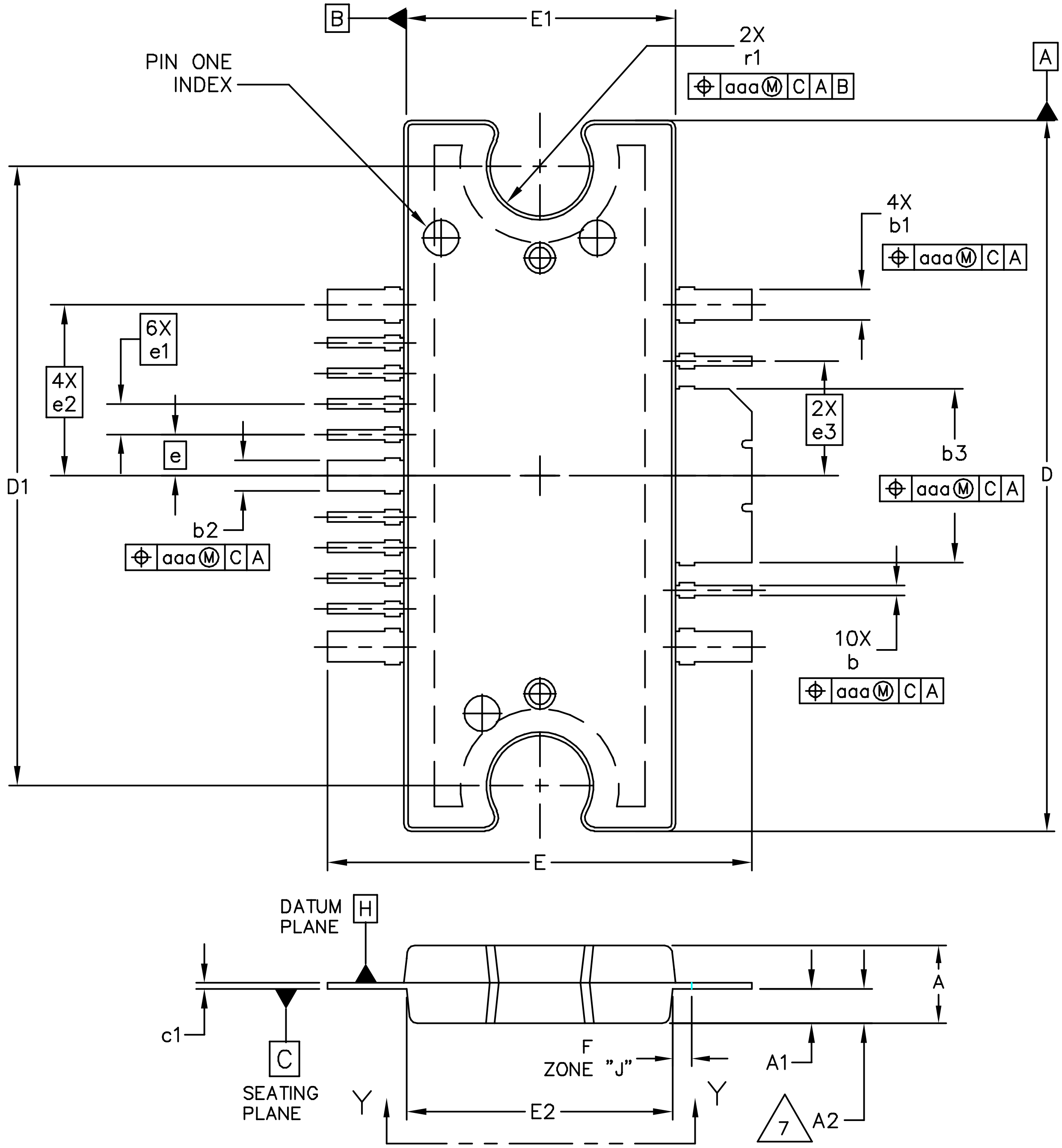
ARCHIVE INFORMATION

PACKAGE DIMENSIONS



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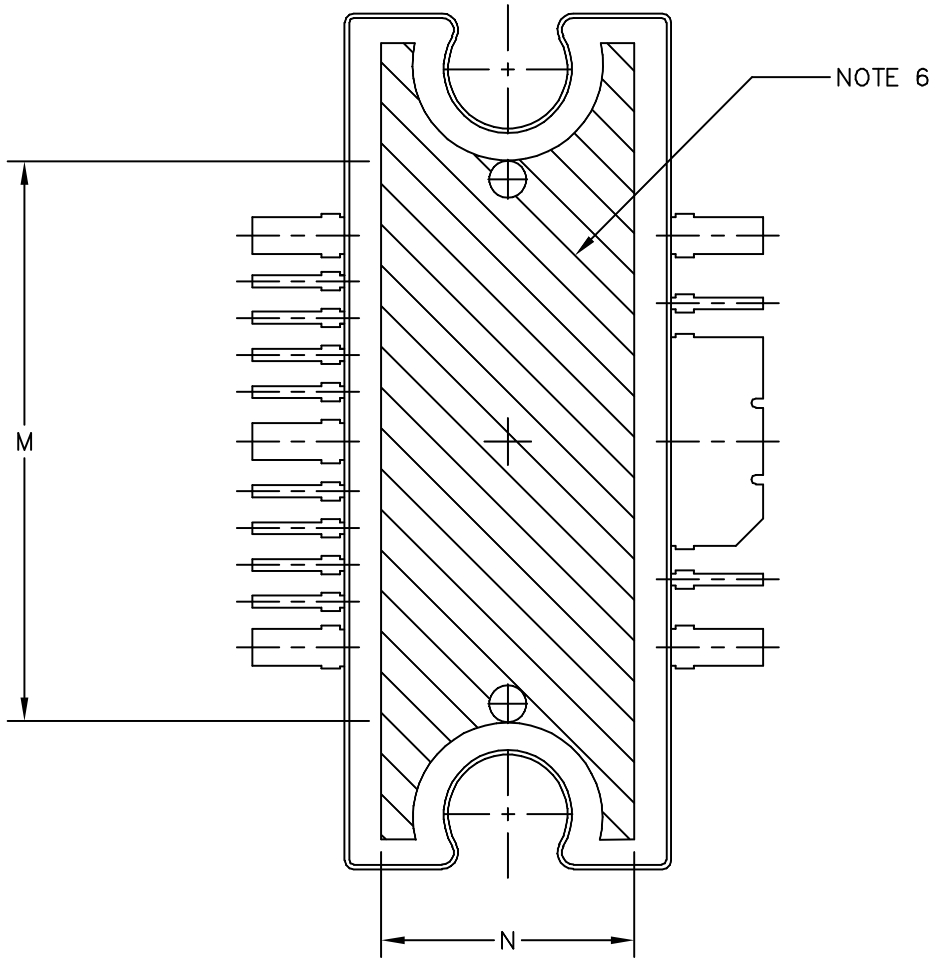
	CASE NUMBER: 1329–09	13 MAR 2006
	STANDARD: NON–JEDEC	



VIEW Y–Y

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	CASE NUMBER: 1329–09	13 MAR 2006
	STANDARD: NON–JEDEC	

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 (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
A	.100	.104	2.54	2.64	b	.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	e	.054 BSC		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	.025 BSC		0.64 BSC		e3	.150 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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DOCUMENT NO: 98ARH99164A | REV: L

CASE NUMBER: 1329−09 | 13 MAR 2006

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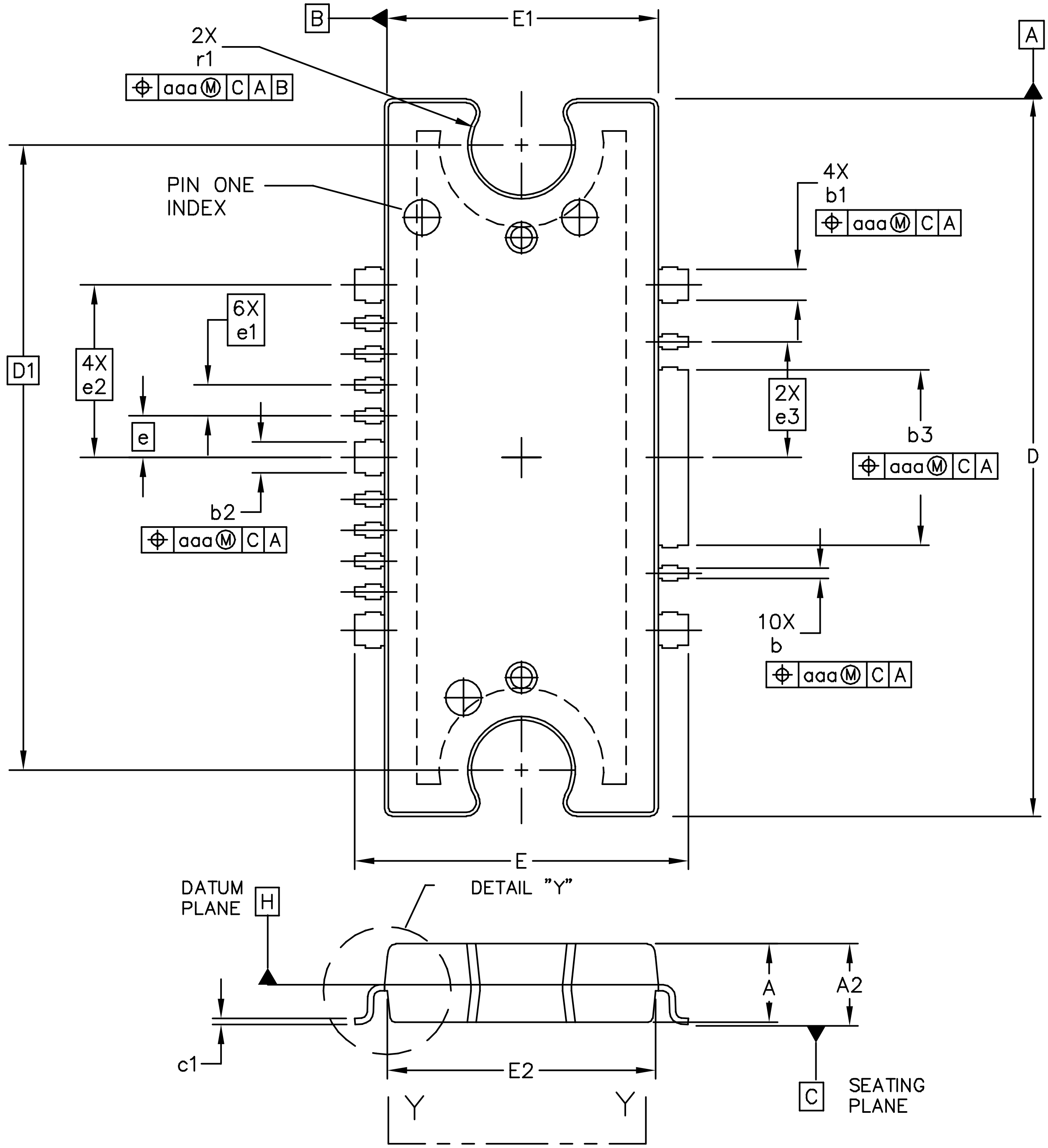

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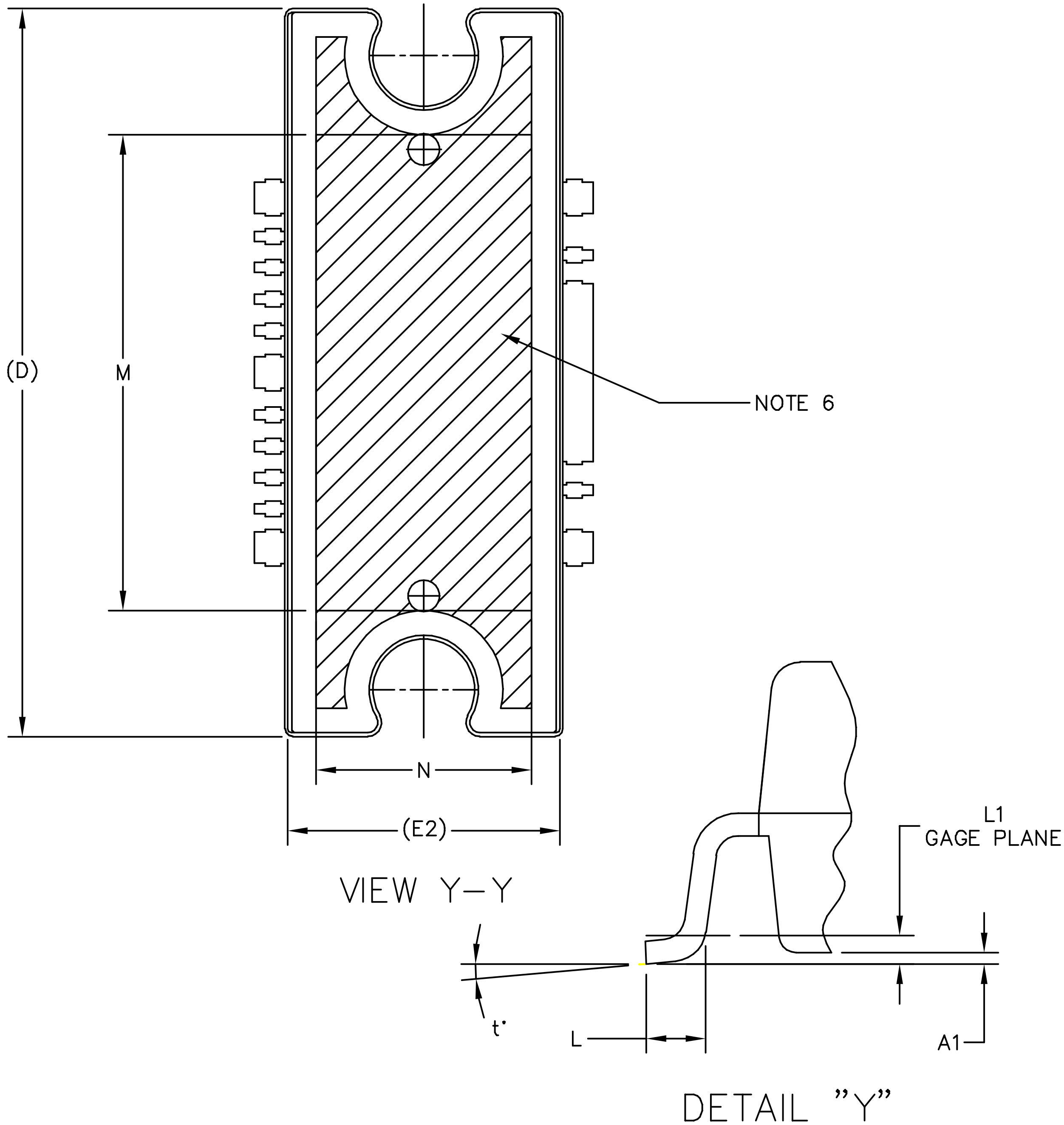
	CASE NUMBER: 1329A–03	3 APR 2006
	STANDARD: NON–JEDEC	



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		CASE NUMBER: 1329A-03	3 APR 2006
		STANDARD: NON-JEDEC	

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 (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 EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
A	.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
E	.429	.437	10.9	11.1	e	.054 BSC		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	
L	.018	.024	4.90	5.06	e3	.150 BSC		3.81 BSC	
L1	.01 BSC		.025 BSC		r1	.063	.068	1.6	1.73
M	.600	----	15.24	----	t	2°	8°	2°	8°
N	.270	----	6.86						
				----	aaa	.004		.10	

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	CASE NUMBER: 1329A–03	3 APR 2006
	STANDARD: NON–JEDEC	

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