Freescale Semiconductor
Technical Data

MW4IC001N
Rev. 5, 5/2006

RoHS

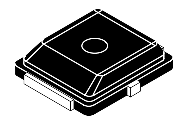
RF LDMOS Wideband Integrated Power Amplifier

MW4IC001NR4

The MW4IC001N wideband integrated circuit is designed for use as a distortion signature device in analog predistortion systems. It uses Freescale's newest High Voltage (26 to 28 Volts) LDMOS IC technology. Its wideband On Chip design makes it usable from 800 MHz to 2170 MHz. The linearity performances cover all modulations for cellular applications: GSM EDGE, TDMA, CDMA and W-CDMA.

- Typical CW Performance at 2170 MHz, 28 Volts, I_{DQ} = 12 mA
  Output Power — 900 mW PEP
  Power Gain — 13 dB
  Efficiency — 38%

800-2170 MHz, 900 mW, 28 V
W-CDMA
RF LDMOS WIDEBAND
INTEGRATED POWER AMPLIFIER



CASE 466-03, STYLE 1
PLD-1.5
PLASTIC

Features

- High Gain, High Efficiency and High Linearity
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- N Suffix Indicates Lead-Free Terminations. RoHS Compliant.
- In Tape and Reel. R4 Suffix = 100 Units per 12 mm, 7 inch Reel.

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
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	4.58 0.037	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +150	°C
Operating Junction Temperature	T_J	150	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case @ 85°C	$R_{\theta JC}$	27.3	°C/W

Table 3. ESD Protection Characteristics

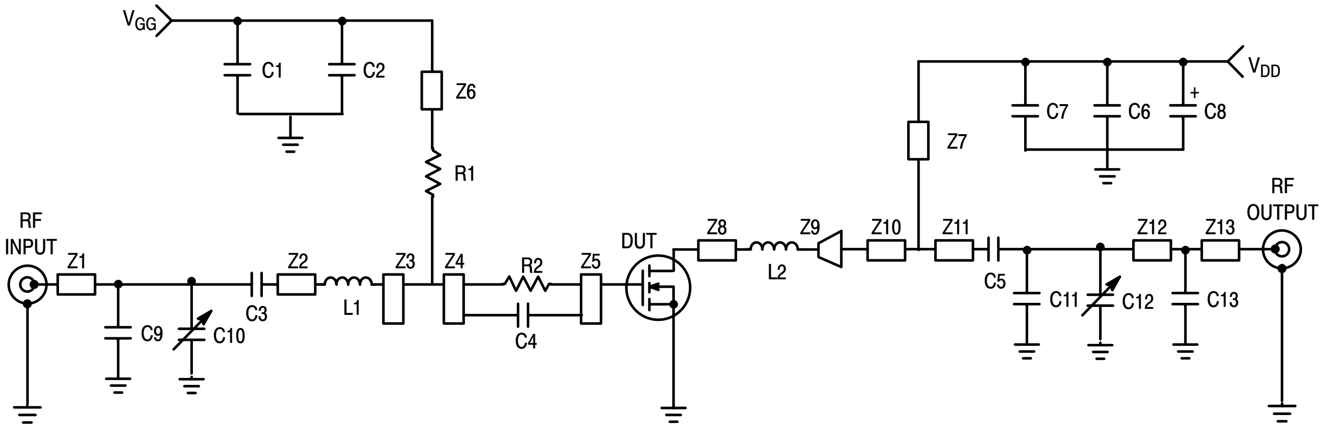
Test Conditions	Class
Human Body Model	0 (Minimum)
Machine Model	M1 (Minimum)
Charge Device Model	C2 (Minimum)

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
Off Characteristics					
Zero Gate Voltage Drain Current (V_{DS} = 65 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	µAdc
Zero Gate Voltage Drain Current (V_{DS} = 28 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	10	µAdc
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	µAdc
On Characteristics					
Gate Threshold Voltage (V_{DS} = 10 V, I_D = 50 µA)	$V_{GS(th)}$	2	3	5	Vdc
Gate Quiescent Voltage (V_{DS} = 28 V, I_D = 10 mA)	$V_{GS(Q)}$	2	3.7	5	Vdc
Drain-Source On-Voltage (V_{GS} = 10 V, I_D = 0.05 A)	$V_{DS(on)}$	—	0.48	0.9	Vdc
Forward Transconductance (V_{DS} = 10 V, I_D = 0.1 A)	g_{fs}	—	0.05	—	S
Dynamic Characteristics					
Output Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	45	—	pF
Reverse Transfer Capacitance (V_{DS} = 28 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	0.62	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system)					
Two-Tone Common Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 0.9 W PEP, I_{DQ} = 12 mA, f = 2170 MHz, Tone Spacing = 100 kHz)	G_{ps}	—	13	—	dB
Two-Tone Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 0.9 W PEP, I_{DQ} = 12 mA, f = 2170 MHz, Tone Spacing = 100 kHz)	η_D	—	29	—	%
Third Order Intermodulation Distortion (V_{DD} = 28 Vdc, P_{out} = 0.9 W PEP, I_{DQ} = 12 mA, f = 2170 MHz, Tone Spacing = 100 kHz)	IMD	—	-28	—	dBc
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 0.9 W PEP, I_{DQ} = 12 mA, f = 2170 MHz, Tone Spacing = 100 kHz)	IRL	—	-18	—	dB
Output Power, 1 dB Compression Point, CW (V_{DD} = 28 Vdc, I_{DQ} = 12 mA, f = 2170 MHz)	P1dB	—	0.85	—	W
Common-Source Amplifier Power Gain (V_{DD} = 28 Vdc, P_{out} = 0.9 W CW, I_{DQ} = 12 mA, f = 2170 MHz)	G_{ps}	12	13	—	dB
Drain Efficiency (V_{DD} = 28 Vdc, P_{out} = 0.9 W CW, I_{DQ} = 12 mA, f = 2170 MHz)	η_D	35	38	—	%
Input Return Loss (V_{DD} = 28 Vdc, P_{out} = 0.9 W CW, I_{DQ} = 12 mA, f = 2170 MHz)	IRL	-10	-16	—	dB

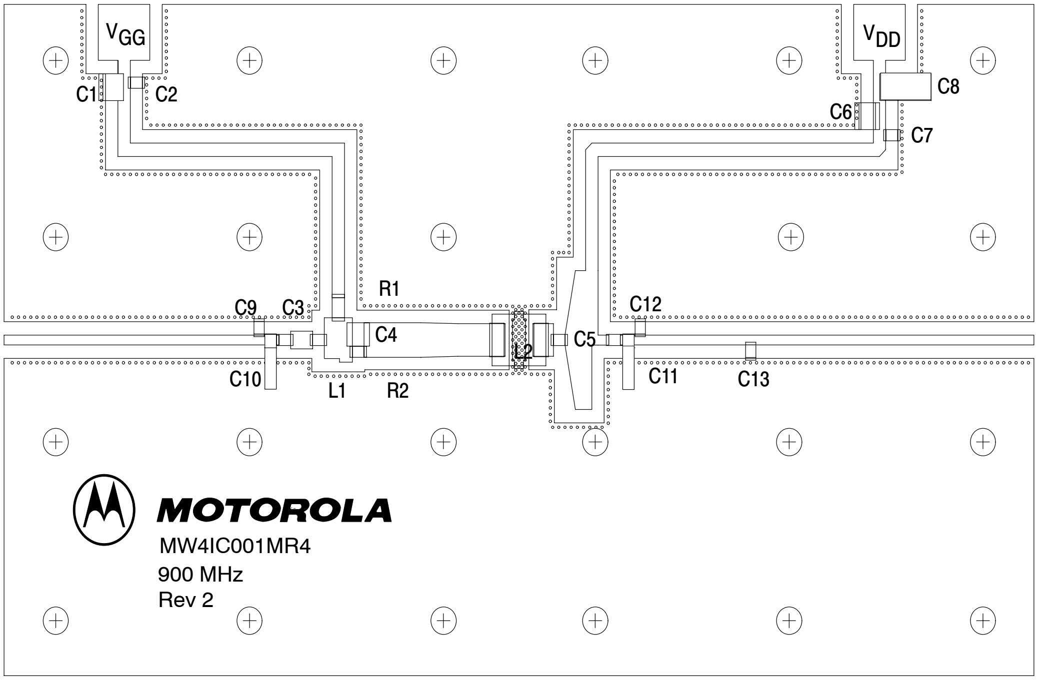


Z1	1.331″ x 0.044″ Microstrip	Z9	0.062″ x 0.044″ to 0.615″ Taper
Z2	0.126″ x 0.076″ Microstrip	Z10	0.082″ x 0.615″ Microstrip
Z3	0.065″ x 0.175″ Microstrip	Z11	0.075″ x 0.044″ Microstrip
Z4	0.065″ x 0.195″ Microstrip	Z12	0.625″ x 0.044″ Microstrip
Z5	0.680″ x 0.145″ Microstrip	Z13	1.375″ x 0.044″ Microstrip
Z6, Z7	1.915″ x 0.055″ Microstrip	PCB	Rogers RO4350, 0.020″, ε_r = 3.5
Z8	0.120″ x 0.141″ Microstrip		

Figure 1. MW4IC001NR4 900 MHz Test Circuit Schematic

Table 6. MW4IC001NR4 900 MHz Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C6	0.1 µF, 100 V Chip Capacitors	C1210C104K5RACTR	Kemet
C2, C3, C5, C7	43 pF, 500 V Chip Capacitors	100B430JP500X	ATC
C4	12 pF, 500 V Chip Capacitor	100B120JP500X	ATC
C8	22 µF, 35 V Tantalum Chip Capacitor	T491X226K035AS	Kemet
C9	4.7 pF, 500 V Chip Capacitor	100B4R7CP500X	ATC
C10, C11	0.6-4.5 pF, 500 V Variable Capacitors	27271SL	Johanson
C12	2.7 pF, 500 V Chip Capacitor	100B2R7CP500X	ATC
C13	3.3 pF, 500 V Chip Capacitor	100B3R3CP500X	ATC
L1	5.6 nH Chip Inductor	0805 Series	AVX
L2	10 nH Chip Inductor	1008 Series	ATC
R1	100 Ω Chip Resistor	CRCW12061001F100	Dale
R2	20 Ω Chip Resistor	CRCW120620R0F100	Dale



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 2. MW4IC001NR4 900 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS - 900 MHz

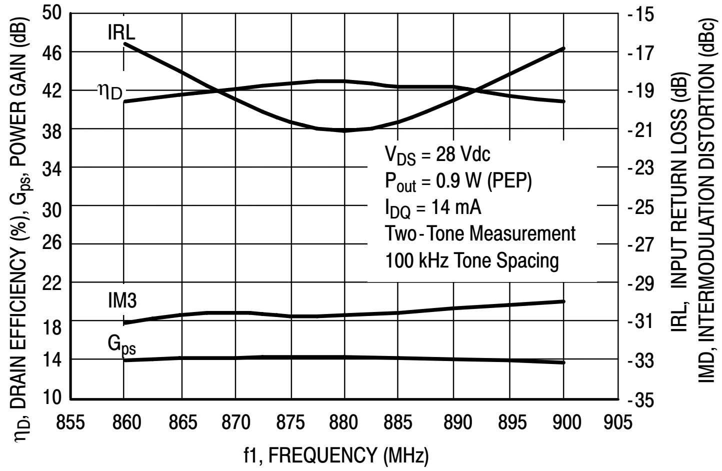


Figure 3. Two-Tone Performance versus Frequency

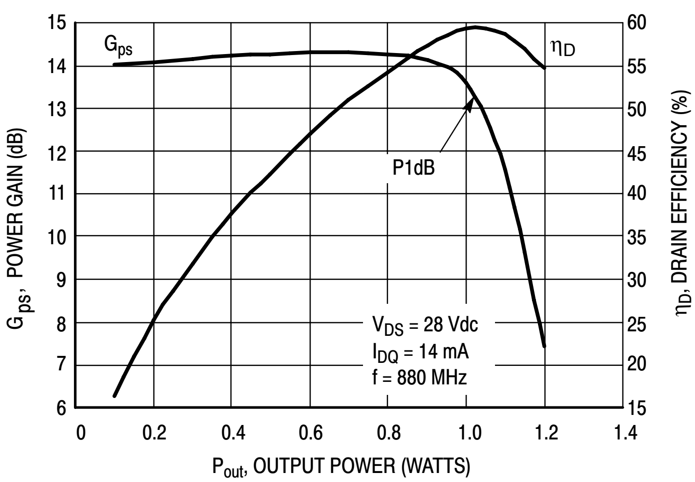


Figure 4. CW Performance versus Output Power

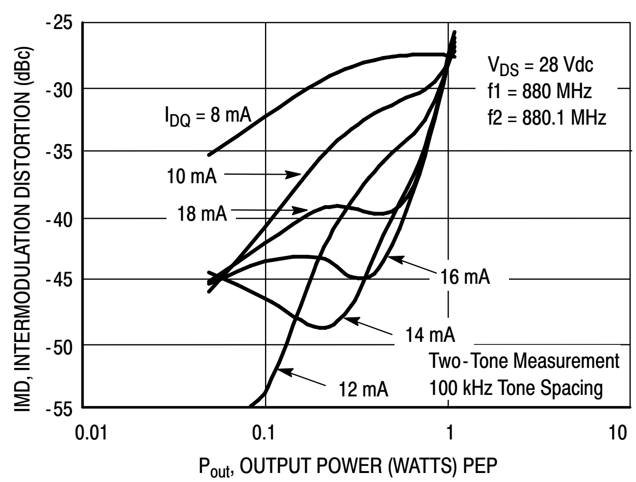


Figure 5. Intermodulation Distortion versus Output Power

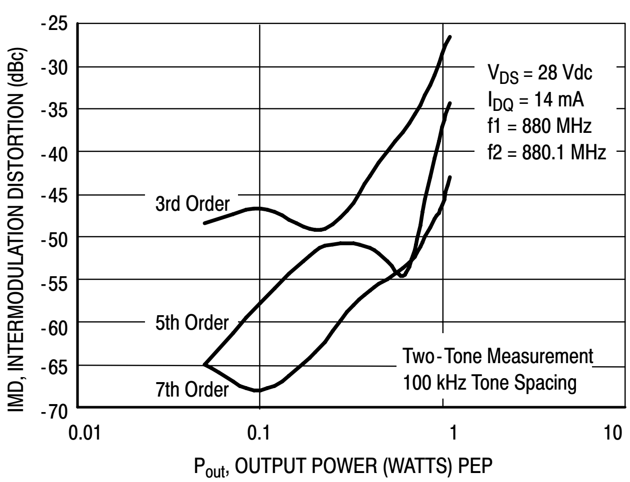


Figure 6. Intermodulation Distortion Products versus Output Power

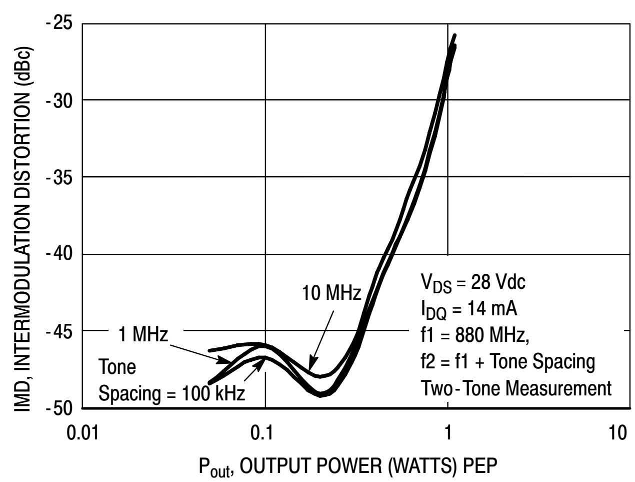
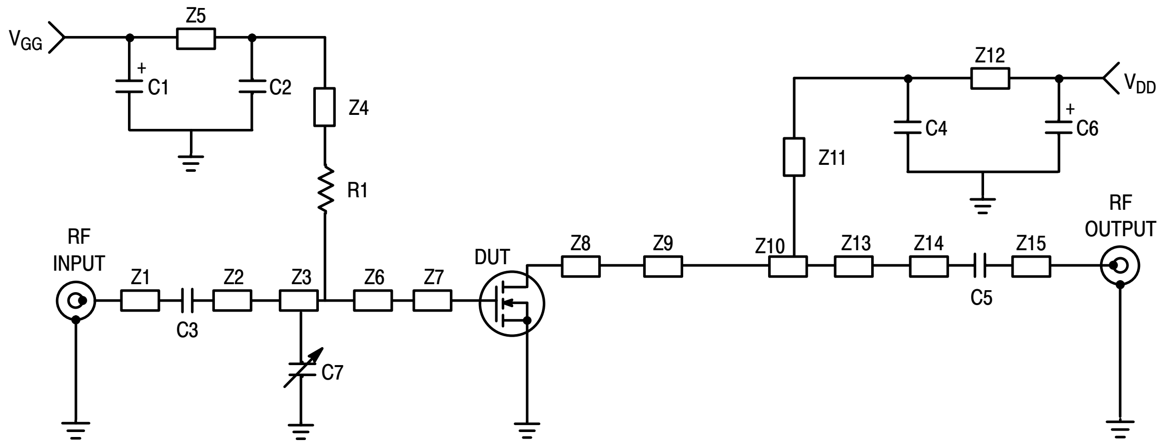


Figure 7. Third Order Intermodulation Distortion versus Output Power



Z1	1.018″ x 0.044″ Microstrip	Z9	0.067″ x 0.264″ Microstrip
Z2	0.495″ x 0.296″ Microstrip	Z10	0.457″ x 0.492″ Microstrip
Z3	0.893″ x 0.500″ Microstrip	Z11	0.719″ x 0.022″ Microstrip
Z4	1.340″ x 0.022″ Microstrip	Z12	1.149″ x 0.022″ Microstrip
Z5	0.912″ x 0.022″ Microstrip	Z13	0.677″ x 0.434″ Microstrip
Z6	0.241″ x 0.500″ Microstrip	Z14	0.095″ x 0.264″ Microstrip
Z7	0.076″ x 0.150″ Microstrip	Z15	0.772″ x 0.044″ Microstrip
Z8	0.294″ x 0.150″ Microstrip	PCB	Rogers RO4350, 0.020″, $\varepsilon_r = 3.5$

Figure 8. MW4IC001NR4 1990 MHz Test Circuit Schematic

Table 7. MW4IC001NR4 1990 MHz Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C6	22 µF, 35 V Tantalum Capacitors	T491X226K035AS	Kemet
C2, C4	10 pF, 500 V Chip Capacitors	100B100JCA500X	ATC
C3, C5	10 pF, 500 V Chip Capacitor	600S100JW	ATC
C7	0.6-4.5 pF, 500 V Variable Capacitor	27271SL	Johanson
R1	1 kΩ Chip Resistor	CRCW12061021F100	Dale

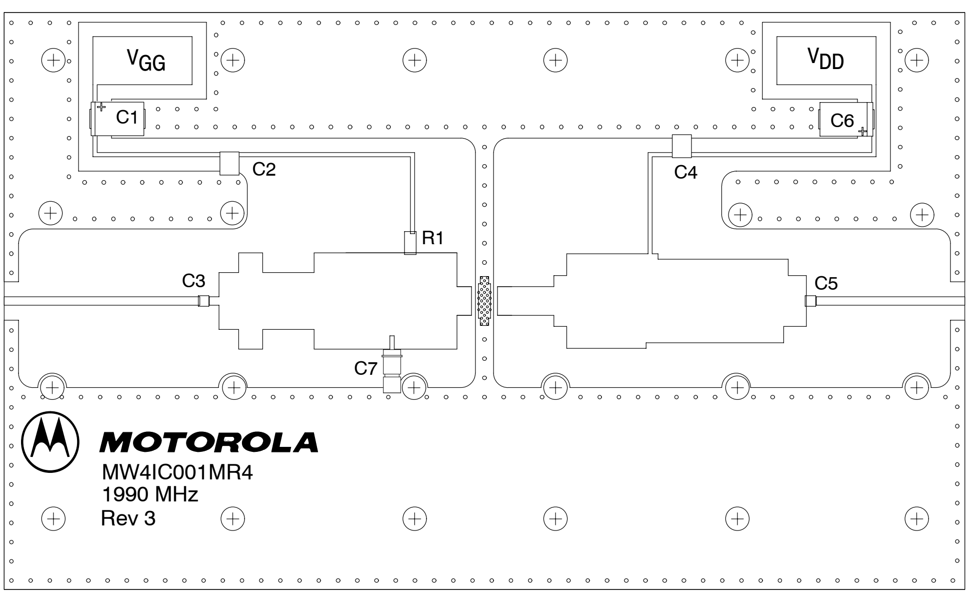


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Figure 9. MW4IC001NR4 1990 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS - 1990 MHz

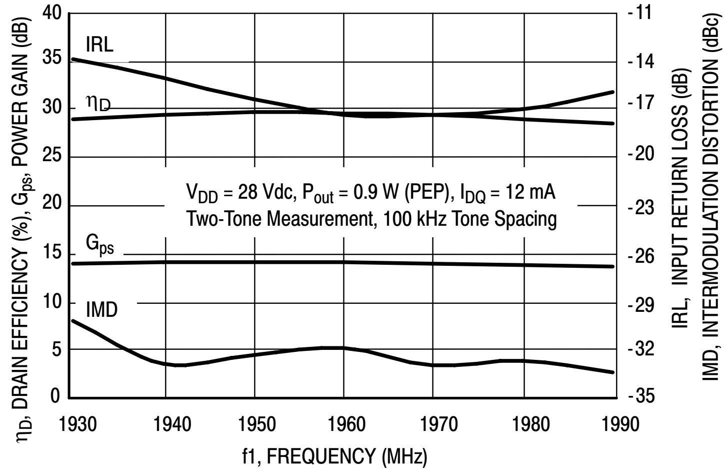


Figure 10. Two-Tone Performance versus Frequency

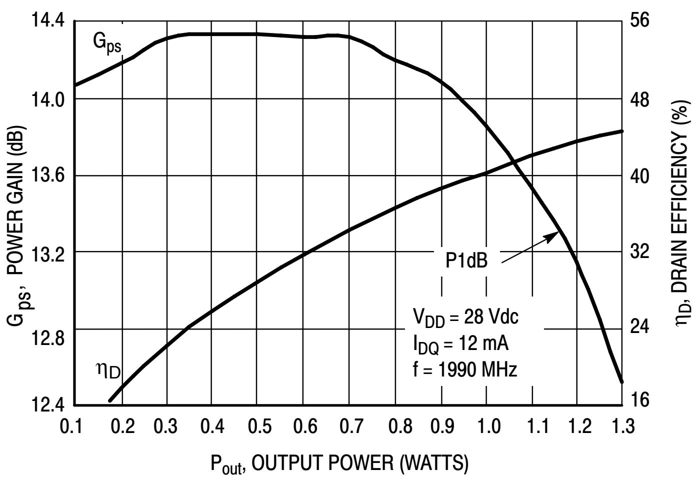


Figure 11. CW Performance versus Output Power

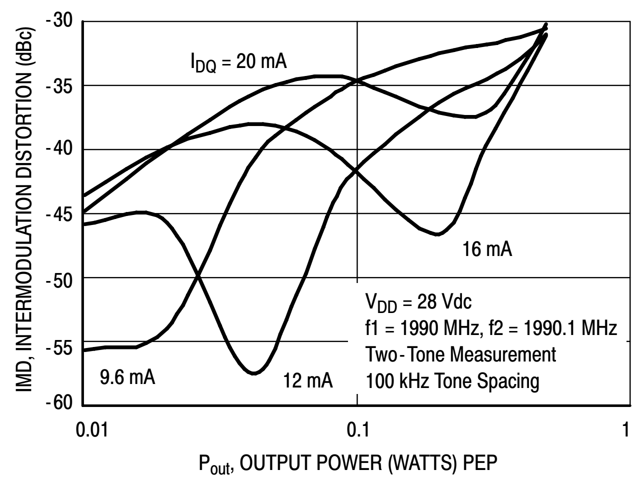


Figure 12. Intermodulation Distortion versus Output Power

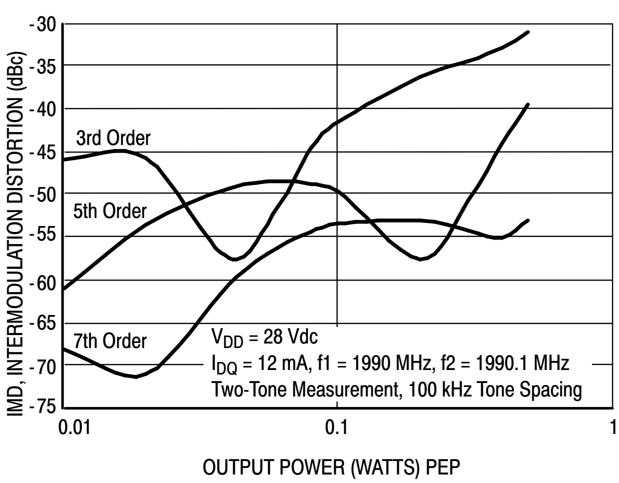


Figure 13. Intermodulation Distortion Products versus Output Power

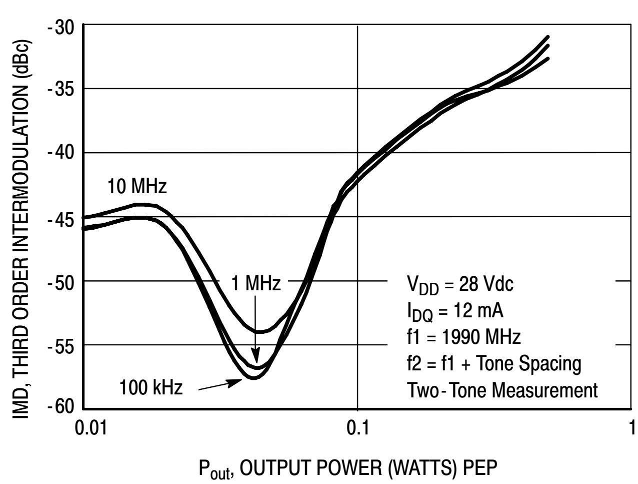
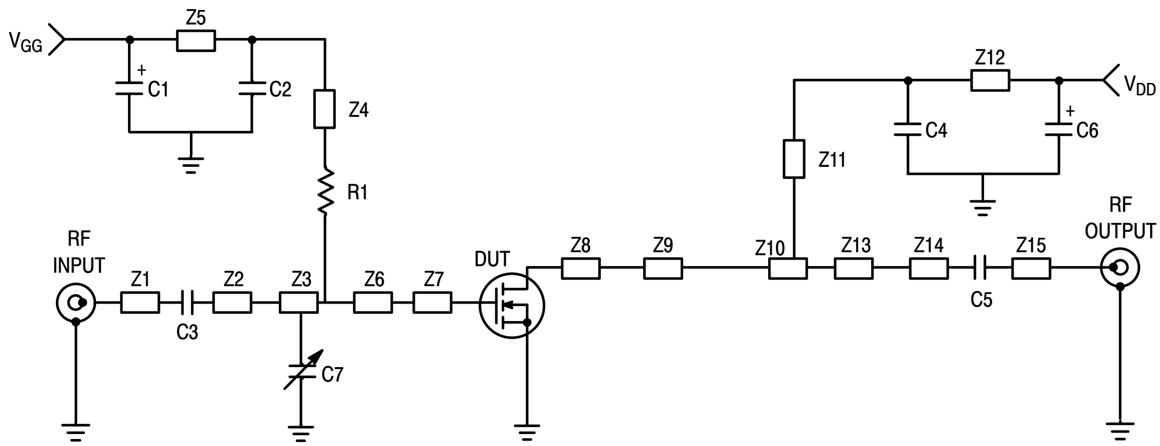


Figure 14. Third Order Intermodulation Distortion versus Output Power



Z1	1.267″ x 0.044″ Microstrip	Z9	0.106″ x 0.344″ Microstrip
Z2	0.058″ x 0.044″ Microstrip	Z10	0.783″ x 0.500″ Microstrip
Z3	0.758″ x 0.256″ Microstrip	Z11	0.847″ x 0.022″ Microstrip
Z4	1.073″ x 0.022″ Microstrip	Z12	1.055″ x 0.022″ Microstrip
Z5	1.361″ x 0.022″ Microstrip	Z13	0.291″ x 0.387″ Microstrip
Z6	0.205″ x 0.332″ Microstrip	Z14	0.050″ x 0.287″ Microstrip
Z7	0.109″ x 0.150″ Microstrip	Z15	0.950″ x 0.044″ Microstrip
Z8	0.210″ x 0.150″ Microstrip	PCB	Rogers RO4350, 0.020″, ε_r = 3.5

Figure 15. MW4IC001NR4 2170 MHz Test Circuit Schematic

Table 8. MW4IC001NR4 2170 MHz Test Circuit Component Designations and Values

Part	Description	Part Number	Manufacturer
C1, C6	22 μF, 35 V Tantalum Capacitors	T491X226K035AS	Kemet
C2, C4	10 pF, 500 V Chip Capacitors	100B100JCA500X	ATC
C3, C5	10 pF, 500 V Chip Capacitor	600S100JW	ATC
C7	0.6-4.5 pF, 500 V Variable Capacitor	27271SL	Johanson
R1	1 kΩ Chip Resistor	CRCW12061021F100	Dale

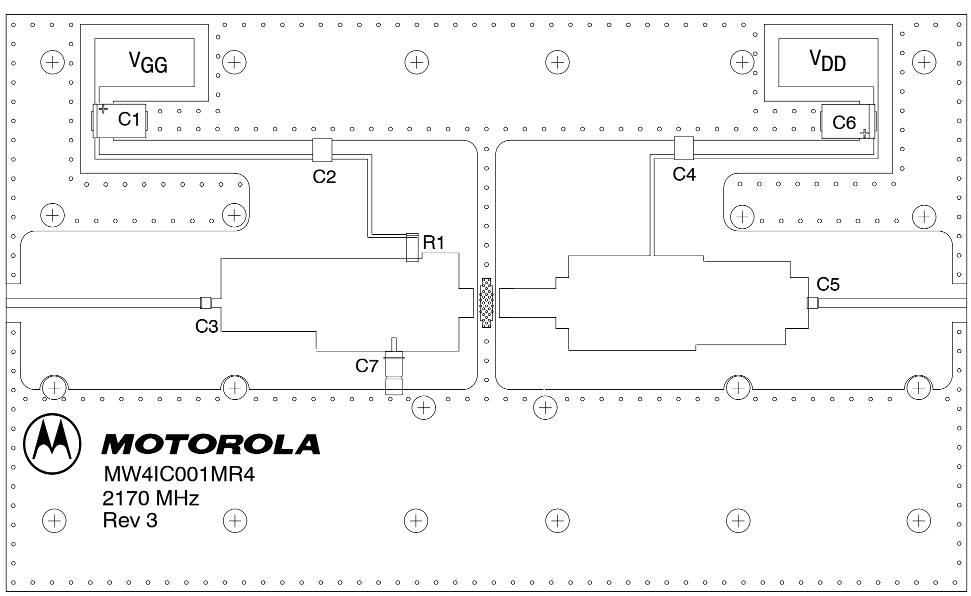


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Figure 16. MW4IC001NR4 2170 MHz Test Circuit Component Layout

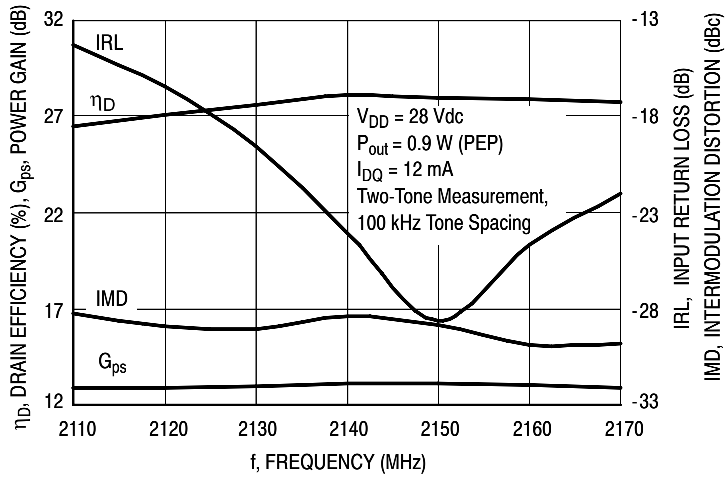


Figure 17. Two-Tone Performance versus Frequency

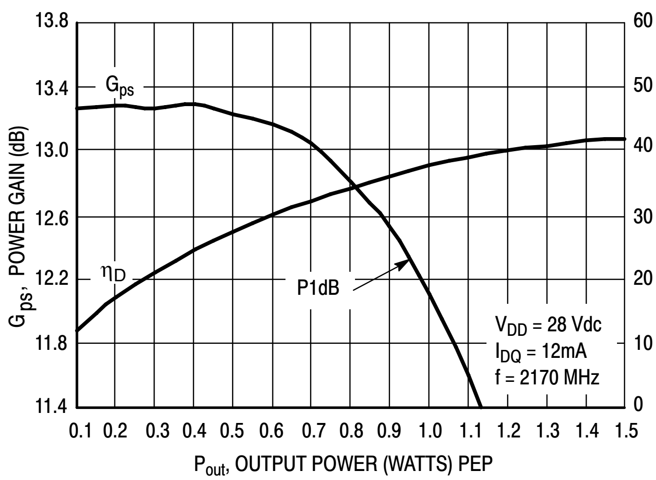


Figure 18. CW Performance versus Output Power

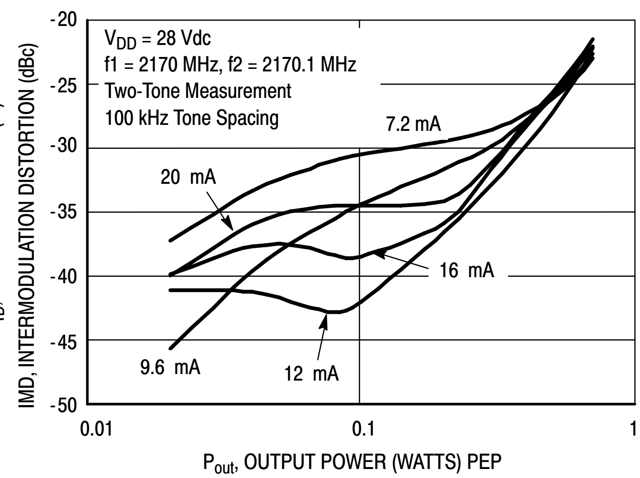


Figure 19. Intermodulation Distortion versus Output Power

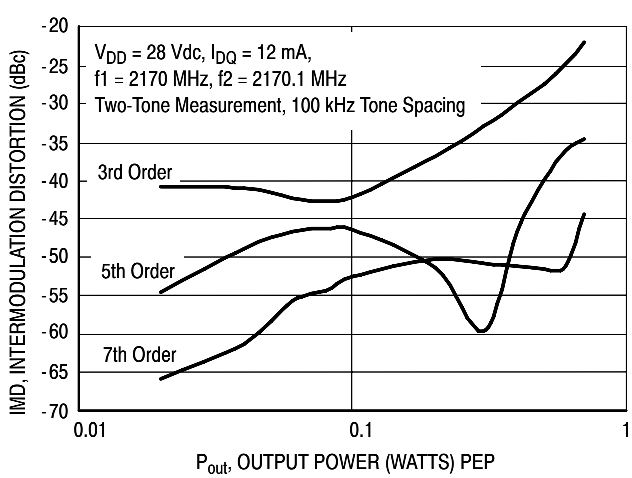


Figure 20. Intermodulation Distortion Products versus Output Power

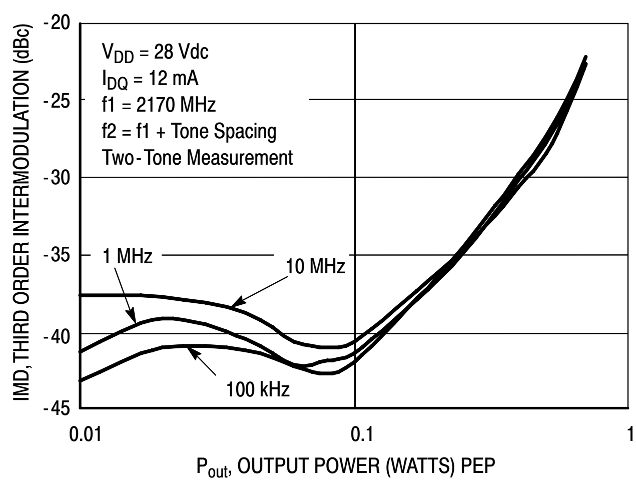
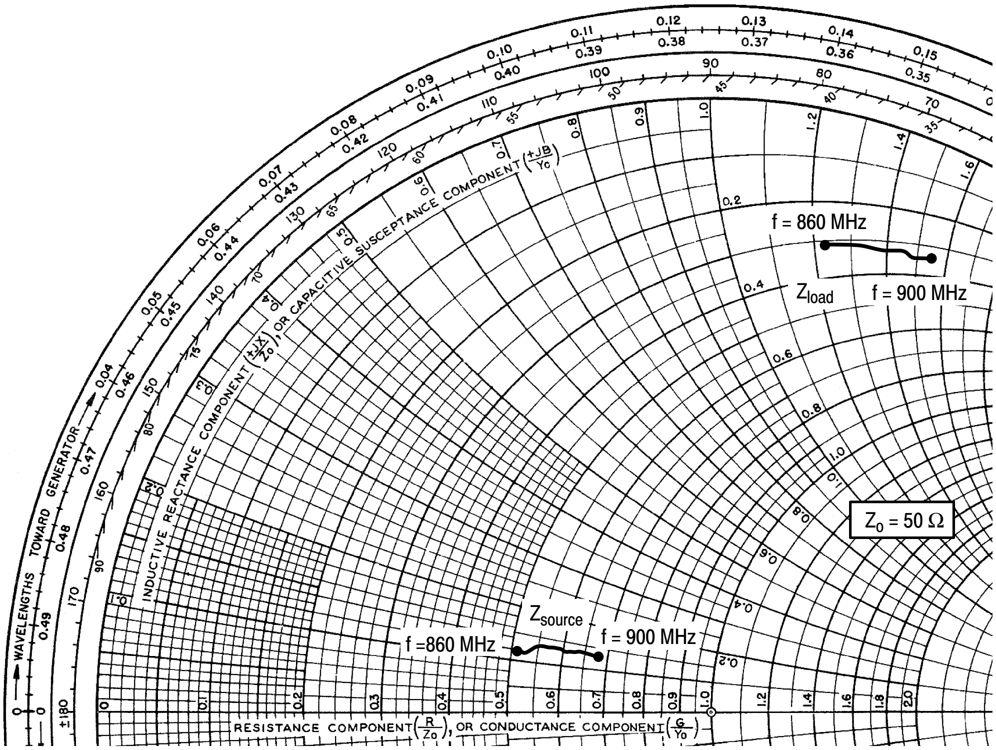


Figure 21. Third Order Intermodulation Distortion versus Output Power



V_{DD} = 28 V, I_{DQ} = 14 mA, P_{out} = 0.9 W PEP

f MHz	Z_{source} Ω	Z_{load} Ω
860	27.853 + j5.908	15.492 + j63.669
865	28.617 + j6.078	15.592 + j68.687
870	29.458 + j6.285	15.788 + j69.799
875	30.306 + j6.422	15.835 + j70.863
880	31.223 + j6.567	15.975 + j71.920
885	32.194 + j6.660	16.094 + j73.091
890	33.228 + j6.656	16.286 + j74.159
895	34.293 + j6.624	16.344 + j75.236
900	35.424 + j6.508	16.628 + j76.283

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

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

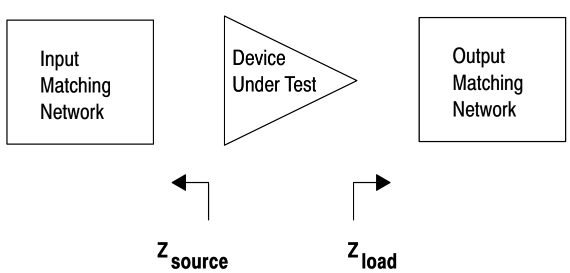
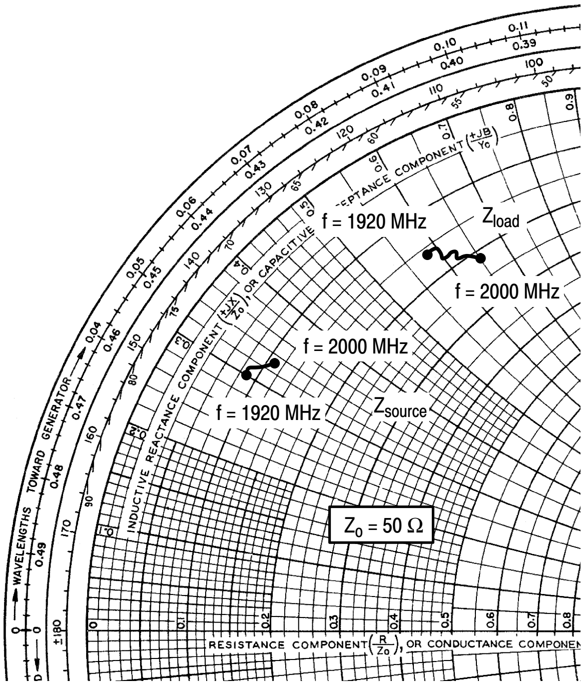


Figure 22. Series Equivalent Source and Load Impedance

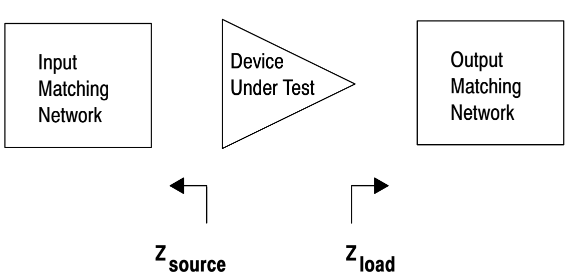


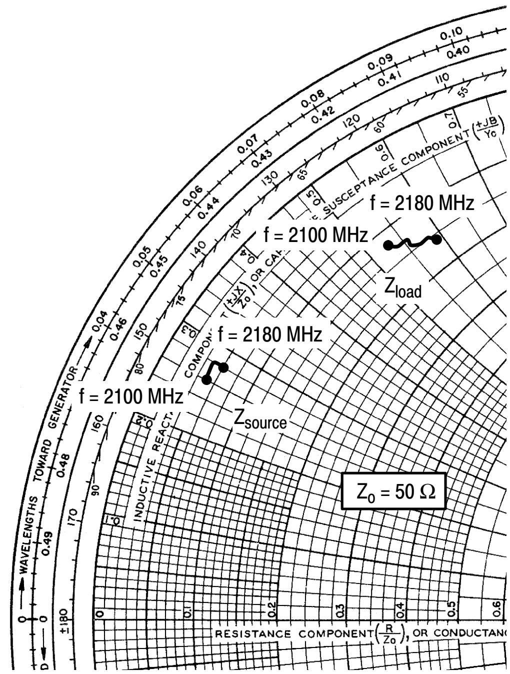
V_{DD} = 28 V, I_{DQ} = 12 mA, P_{out} = 0.9 W PEP

f MHz	Z_{source} Ω	Z_{load} Ω
1920	4.238 + j15.142	7.764 + j28.829
1930	4.322 + j15.362	8.056 + j29.352
1940	4.490 + j15.466	8.436 + j29.727
1950	4.605 + j15.711	8.809 + j30.249
1960	4.752 + j15.904	9.183 + j30.763
1970	4.905 + j16.050	9.598 + j31.213
1980	5.071 + j16.236	10.030 + j31.690
1990	5.262 + j16.446	10.546 + j32.237
2000	5.487 + j16.632	11.054 + j32.726

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

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





V_{DD} = 28 V, I_{DQ} = 12 mA, P_{out} = 0.9 W PEP

f MHz	Z_{source} Ω	Z_{load} Ω
2100	2.667 + j12.903	5.892 + j26.374
2110	2.671 + j13.070	6.092 + j26.739
2120	2.664 + j13.224	6.281 + j27.094
2130	2.694 + j13.431	6.540 + j27.510
2140	2.703 + j13.511	6.748 + j27.795
2150	2.702 + j13.700	6.996 + j28.182
2160	2.745 + j13.952	7.300 + j28.678
2170	2.754 + j14.026	7.562 + j28.987
2180	2.784 + j14.206	7.862 + j29.411

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

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

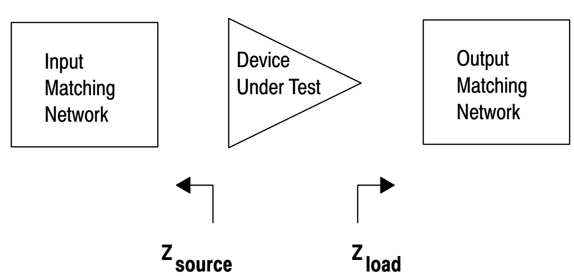


Figure 23. Series Equivalent Source and Load Impedance

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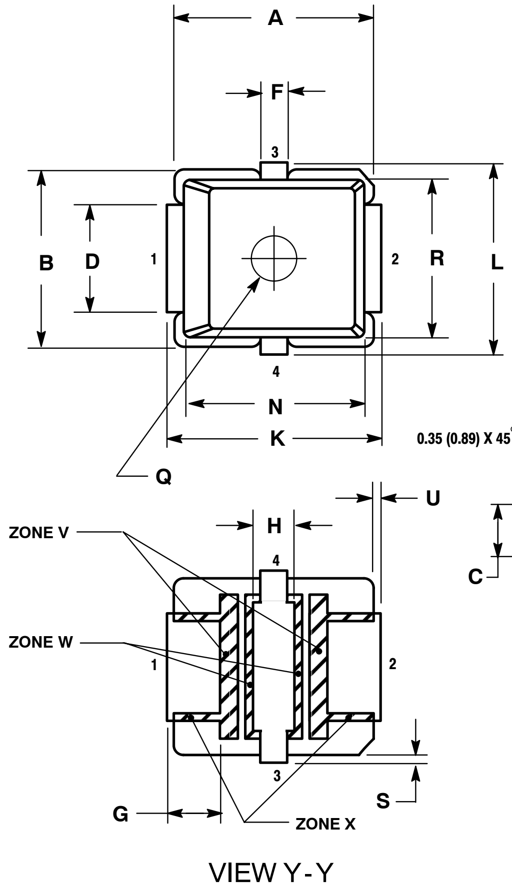
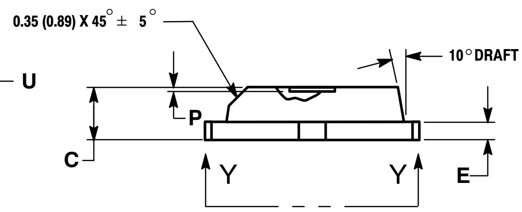
PACKAGE DIMENSIONS





NOTES:
1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1984.
2. CONTROLLING DIMENSION: INCH
3. RESIN BLEED/FLASH ALLOWABLE IN ZONE V, W, AND X.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.255	0.265	6.48	6.73
B	0.225	0.235	5.72	5.97
C	0.065	0.072	1.65	1.83
D	0.130	0.150	3.30	3.81
E	0.021	0.026	0.53	0.66
F	0.026	0.044	0.66	1.12
G	0.050	0.070	1.27	1.78
H	0.045	0.063	1.14	1.60
J	0.160	0.180	4.06	4.57
K	0.273	0.285	6.93	7.24
L	0.245	0.255	6.22	6.48
N	0.230	0.240	5.84	6.10
P	0.000	0.008	0.00	0.20
Q	0.055	0.063	1.40	1.60
R	0.200	0.210	5.08	5.33
S	0.006	0.012	0.15	0.31
U	0.006	0.012	0.15	0.31
ZONE V	0.000	0.021	0.00	0.53
ZONE W	0.000	0.010	0.00	0.25
ZONE X	0.000	0.010	0.00	0.25

STYLE 1:
PIN 1. DRAIN
2. GATE
3. SOURCE
4. SOURCE

CASE 466-03
ISSUE D
PLD-1.5
PLASTIC

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+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:
Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
support@freescale.com

Japan:
Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:
Freescale Semiconductor Hong Kong Ltd.
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