

# RF LDMOS Wideband Integrated Power Amplifiers

The MW6IC2015N wideband integrated circuit is designed for base station applications. It uses Freescale's newest High Voltage (26 to 32 Volts) LDMOS IC technology and integrates a multi-stage structure. Its wideband on-chip design makes it usable from 1805 to 1990 MHz. The linearity performances cover all modulation formats for cellular applications: GSM, GSM EDGE, PHS, TDMA, CDMA, W-CDMA and TD-SCDMA.

## Final Application

- Typical Two-Tone Performance:  $V_{DD} = 26$  Volts,  $I_{DQ1} = 100$  mA,  $I_{DQ2} = 170$  mA,  $P_{out} = 15$  Watts PEP,  $f = 1930$  MHz  
Power Gain — 26 dB  
Power Added Efficiency — 28%  
IMD — -30 dBc

## Driver Application

- Typical GSM EDGE Performance:  $V_{DD} = 26$  Volts,  $I_{DQ1} = 130$  mA,  $I_{DQ2} = 170$  mA,  $P_{out} = 3$  Watts Avg., Full Frequency Band (1805-1880 MHz or 1930-1990 MHz)  
Power Gain — 27 dB  
Power Added Efficiency — 19%  
Spectral Regrowth @ 400 kHz Offset = -69 dBc  
Spectral Regrowth @ 600 kHz Offset = -78 dBc  
EVM — 0.8% rms
- Capable of Handling 3:1 VSWR, @ 26 Vdc, 1990 MHz, 15 Watts CW Output Power
- Stable into a 3:1 VSWR. All Spurs Below -60 dBc @ 100 mW to 8 W CW  $P_{out}$ .

## Features

- Characterized with Series Equivalent Large-Signal Impedance Parameters and Common Source Scattering Parameters
- On-Chip Matching (50 Ohm Input, DC Blocked, >5 Ohm Output)
- Integrated Quiescent Current Temperature Compensation with Enable/Disable Function (1)
- Integrated ESD Protection
- Designed for Lower Memory Effects and Wide Instantaneous Bandwidth Applications
- 225°C Capable Plastic Package
- RoHS Compliant
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel

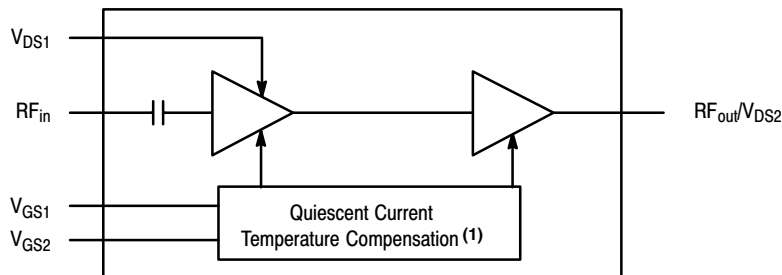
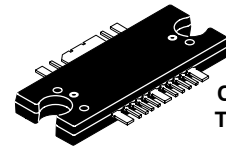


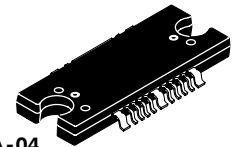
Figure 1. Functional Block Diagram

**MW6IC2015NBR1**  
**MW6IC2015GNBR1**

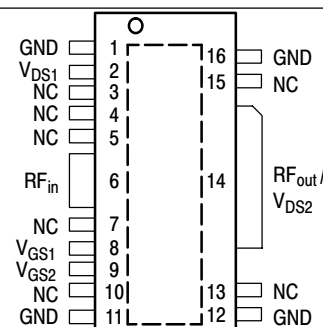
**1805-1990 MHz, 15 W, 26 V**  
**GSM/GSM EDGE, CDMA**  
**RF LDMOS WIDEBAND**  
**INTEGRATED POWER AMPLIFIERS**



**CASE 1329-09**  
**TO-272 WB-16**  
**PLASTIC**  
**MW6IC2015NBR1**



**CASE 1329A-04**  
**TO-272 WB-16 GULL**  
**PLASTIC**  
**MW6IC2015GNBR1**



(Top View)

Note: Exposed backside of the package is the source terminal for the transistors.

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.

**Table 1. Maximum Ratings**

| Characteristic                       | Symbol    | Value       | Unit |
|--------------------------------------|-----------|-------------|------|
| Drain-Source Voltage                 | $V_{DS}$  | -0.5, +68   | Vdc  |
| Gate-Source Voltage                  | $V_{GS}$  | -0.5, +6    | 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                          | $P_{in}$  | 20          | dBm  |

**Table 2. Thermal Characteristics**

| Characteristic                              | Symbol                                                                     | Value (2,3) | Unit |
|---------------------------------------------|----------------------------------------------------------------------------|-------------|------|
| Thermal Resistance, Junction to Case        | $R_{\theta JC}$                                                            |             | °C/W |
| Final Application<br>( $P_{out} = 15$ W CW) | Stage 1, 26 Vdc, $I_{DQ1} = 100$ mA<br>Stage 2, 26 Vdc, $I_{DQ2} = 170$ mA | 4.3<br>1.2  |      |
| Driver Application<br>( $P_{out} = 3$ W CW) | Stage 1, 26 Vdc, $I_{DQ1} = 130$ mA<br>Stage 2, 26 Vdc, $I_{DQ2} = 170$ mA | 4.3<br>1.3  |      |

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class         |
|---------------------------------------|---------------|
| Human Body Model (per JESD22-A114)    | 1A (Minimum)  |
| Machine Model (per EIA/JESD22-A115)   | A (Minimum)   |
| Charge Device Model (per JESD22-C101) | III (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** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

**Functional Tests** (In Freescale 1930-1990 MHz Test Fixture, 50 ohm system)  $V_{DD} = 26$  Vdc,  $I_{DQ1} = 100$  mA,  $I_{DQ2} = 170$  mA,  $P_{out} = 15$  W PEP,  $f_1 = 1930$  MHz,  $f_2 = 1930.1$  MHz, Two-Tone CW

|                            |          |    |     |     |     |
|----------------------------|----------|----|-----|-----|-----|
| Power Gain                 | $G_{ps}$ | 24 | 26  | —   | dB  |
| Power Added Efficiency     | PAE      | 26 | 28  | —   | %   |
| Intermodulation Distortion | IMD      | —  | -30 | -27 | dBc |
| Input Return Loss          | IRL      | —  | —   | -10 | dB  |

**Typical Two-Tone Performances** (In Freescale Test Fixture, 50 ohm system)  $V_{DD} = 26$  Vdc,  $I_{DQ1} = 100$  mA,  $I_{DQ2} = 170$  mA,  $P_{out} = 15$  W PEP, 1805-1880 MHz, Two-Tone CW, 100 kHz Tone Spacing

|                            |          |   |     |   |     |
|----------------------------|----------|---|-----|---|-----|
| Power Gain                 | $G_{ps}$ | — | 26  | — | dB  |
| Power Added Efficiency     | PAE      | — | 28  | — | %   |
| Intermodulation Distortion | IMD      | — | -30 | — | dBc |
| Input Return Loss          | IRL      | — | -10 | — | dB  |

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.

(continued)

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

| Characteristic                                                                                                                                                                            | Symbol           | Min | Typ      | Max | Unit |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----|----------|-----|------|
| <b>Typical Performances</b> (In Freescale Test Fixture, 50 ohm system) $V_{DD} = 26\text{ Vdc}$ , $I_{DQ1} = 100\text{ mA}$ , $I_{DQ2} = 170\text{ mA}$ , 1805-1880 MHz and 1930-1990 MHz |                  |     |          |     |      |
| Saturated Pulsed Output Power, CW<br>(8 $\mu\text{sec}$ (on), 1 msec(off))                                                                                                                | $P_{\text{sat}}$ | —   | 35       | —   | W    |
| Quiescent Current Accuracy over Temperature<br>with 1.8 k $\Omega$ Gate Feed Resistors (-10 to 85°C) (1)                                                                                  | $\Delta I_{QT}$  | —   | $\pm 3$  | —   | %    |
| Gain Flatness in 30 MHz Bandwidth @ $P_{\text{out}} = 3\text{ W CW}$                                                                                                                      | $G_F$            | —   | 0.3      | —   | dB   |
| Average Deviation from Linear Phase in 30 MHz Bandwidth<br>@ $P_{\text{out}} = 3\text{ W CW}$                                                                                             | $\Phi$           | —   | $\pm 1$  | —   | °    |
| Average Group Delay @ $P_{\text{out}} = 3\text{ W CW}$ Including Output Matching                                                                                                          | Delay            | —   | 2.7      | —   | ns   |
| Part-to-Part Insertion Phase Variation @ $P_{\text{out}} = 3\text{ W CW}$ ,<br>Six Sigma Window                                                                                           | $\Delta\Phi$     | —   | $\pm 15$ | —   | °    |

**Typical GSM EDGE Performances** (In Freescale GSM EDGE Test Fixture, 50 ohm system)  $V_{DD} = 26\text{ Vdc}$ ,  $I_{DQ1} = 130\text{ mA}$ ,  $I_{DQ2} = 170\text{ mA}$ ,  $P_{\text{out}} = 3\text{ W Avg.}$ , 1805-1990 MHz and 1930-1990 MHz EDGE Modulation

|                                     |          |   |     |   |     |
|-------------------------------------|----------|---|-----|---|-----|
| Power Gain                          | $G_{ps}$ | — | 27  | — | dB  |
| Power Added Efficiency              | PAE      | — | 19  | — | %   |
| Error Vector Magnitude              | EVM      | — | 0.8 | — | %   |
| Spectral Regrowth at 400 kHz Offset | SR1      | — | -69 | — | dBc |
| Spectral Regrowth at 600 kHz Offset | SR2      | — | -78 | — | dBc |

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.

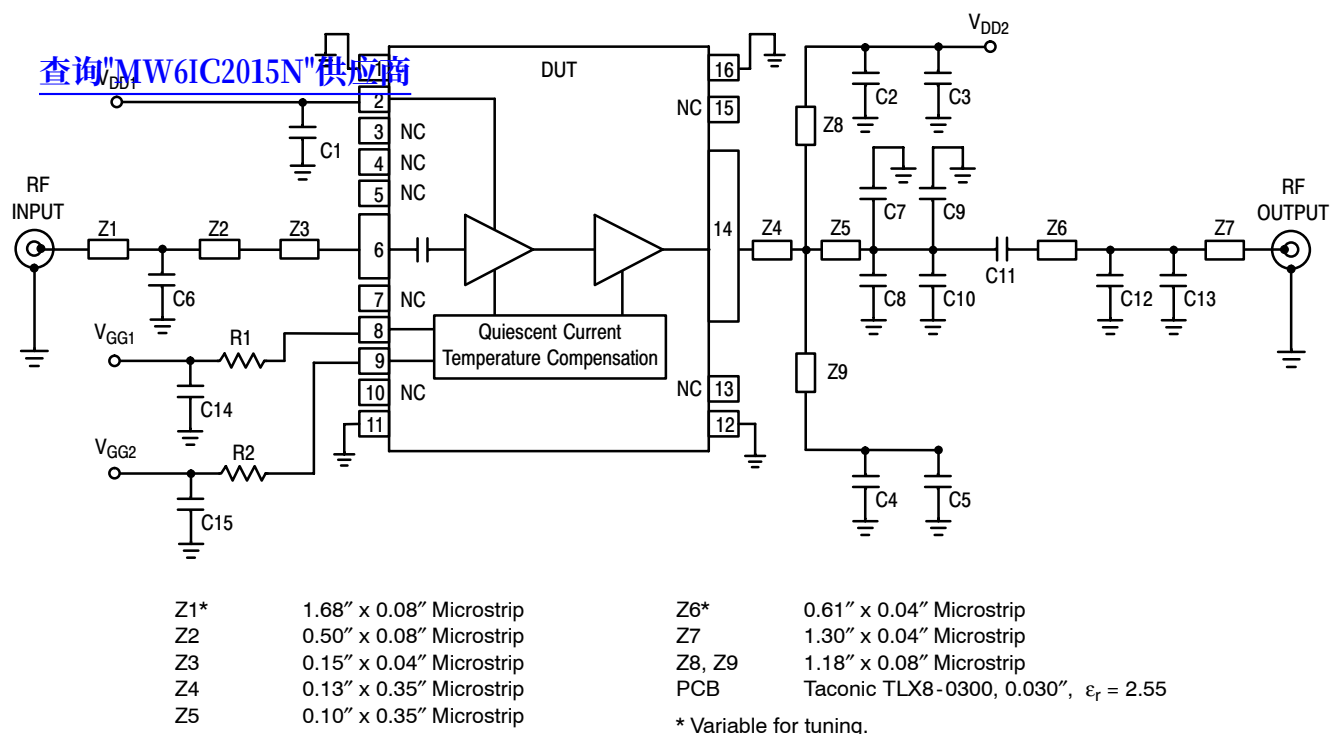


Figure 3. MW6IC2015NBR1(GNBR1) Test Circuit Schematic — 1930-1990 MHz

Table 6. MW6IC2015NBR1(GNBR1) Test Circuit Component Designations and Values — 1930-1990 MHz

| Part         | Description                         | Part Number       | Manufacturer |
|--------------|-------------------------------------|-------------------|--------------|
| C1, C14, C15 | 2.2 $\mu$ F Chip Capacitors         | C3225X5R1H225MT   | TDK          |
| C2, C4, C11  | 5.6 pF Chip Capacitors              | ATC100B5R6CT500XT | ATC          |
| C3, C5       | 10 $\mu$ F Chip Capacitors          | C5750X5R1H106MT   | TDK          |
| C6           | 1 pF Chip Capacitor                 | ATC100B1R0BT500XT | ATC          |
| C7, C8       | 2.2 pF Chip Capacitors              | ATC100B2R2BT500XT | ATC          |
| C9, C10      | 0.5 pF Chip Capacitors              | ATC100B0R5BT500XT | ATC          |
| C12          | 0.2 pF Chip Capacitor               | ATC100B0R2BT500XT | ATC          |
| C13          | 0.1 pF Chip Capacitor               | ATC100B0R1BT500XT | ATC          |
| R1           | 10 k $\Omega$ , 1/4 W Chip Resistor | CRCW12061002FKEA  | Vishay       |
| R2           | 18 $\Omega$ , 1/4 W Chip Resistor   | CRCW120618R0FKEA  | Vishay       |

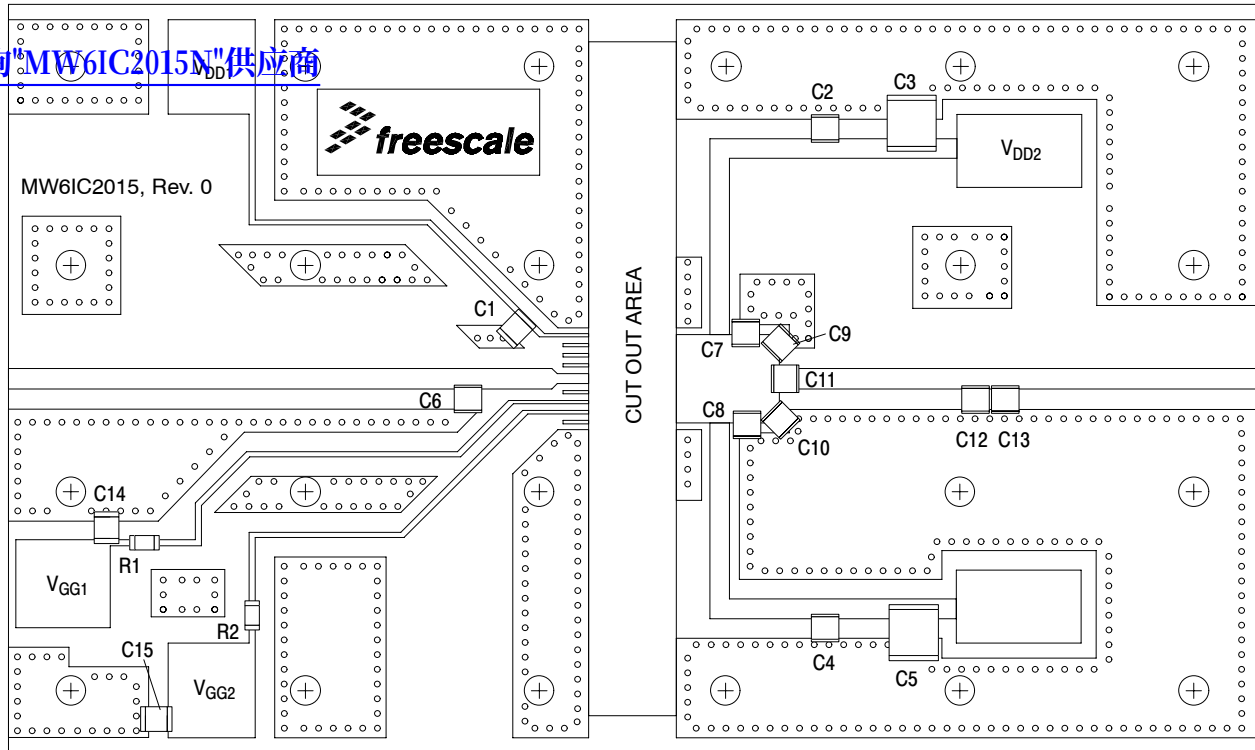
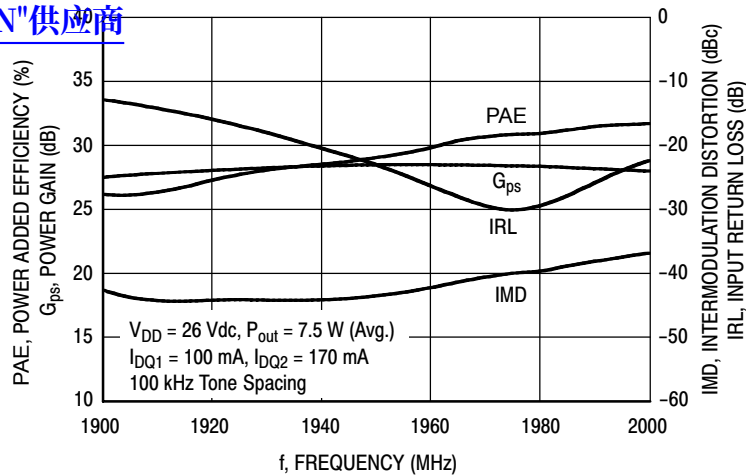


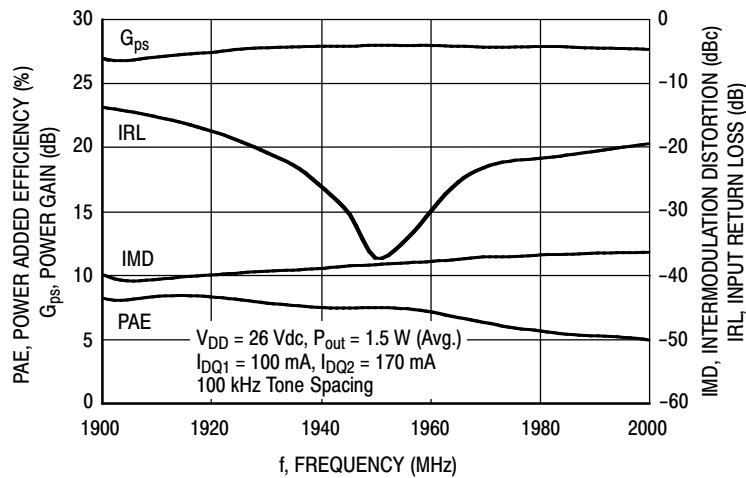
Figure 4. MW6IC2015NBR1(GNBR1) Test Circuit Component Layout — 1930-1990 MHz

# TYPICAL CHARACTERISTICS — 1930-1990 MHz

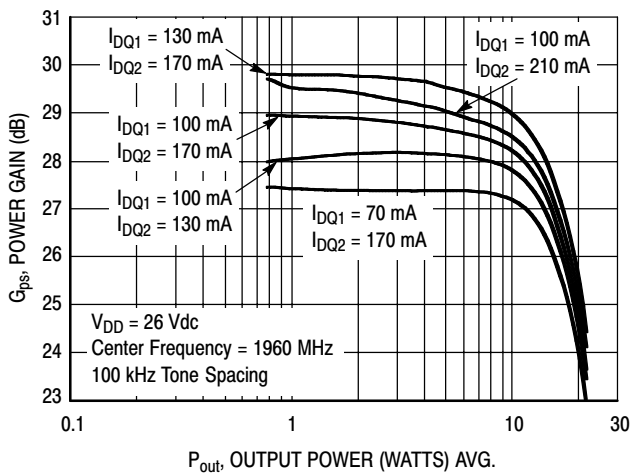
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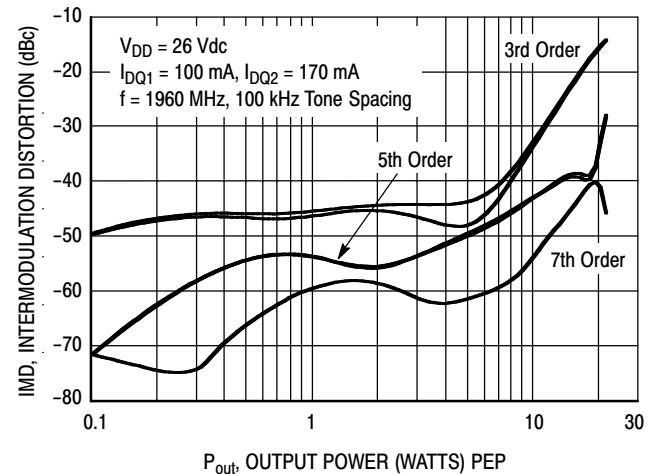
**Figure 5. Two-Tone Wideband Performance  
@  $P_{out} = 7.5$  Watts Avg.**



**Figure 6. Two-Tone Wideband Performance  
@  $P_{out} = 1.5$  Watts Avg.**



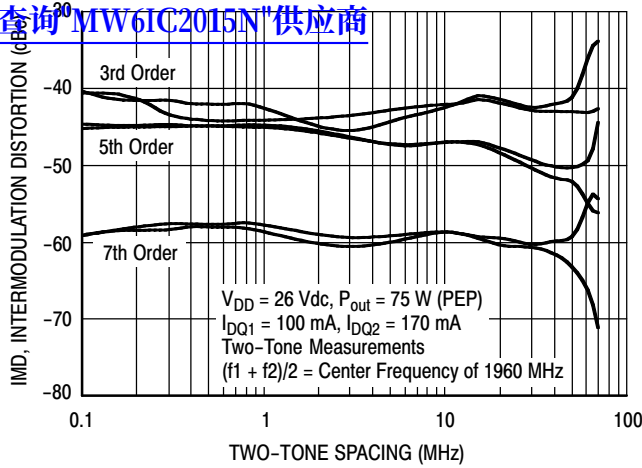
**Figure 7. Two-Tone Power Gain versus  
Output Power**



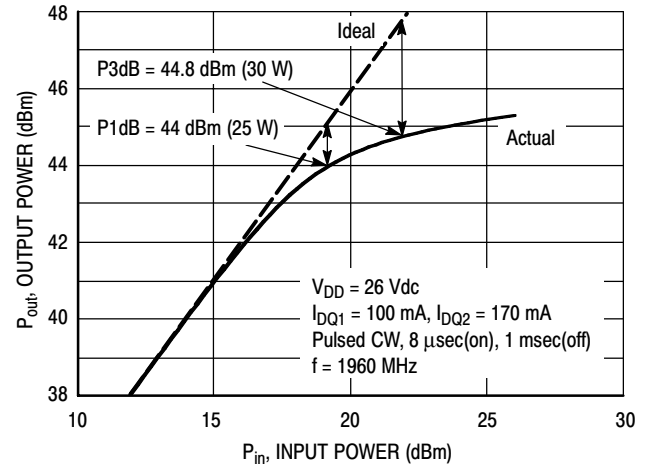
**Figure 8. Intermodulation Distortion Products  
versus Output Power**

# TYPICAL CHARACTERISTICS — 1930-1990 MHz

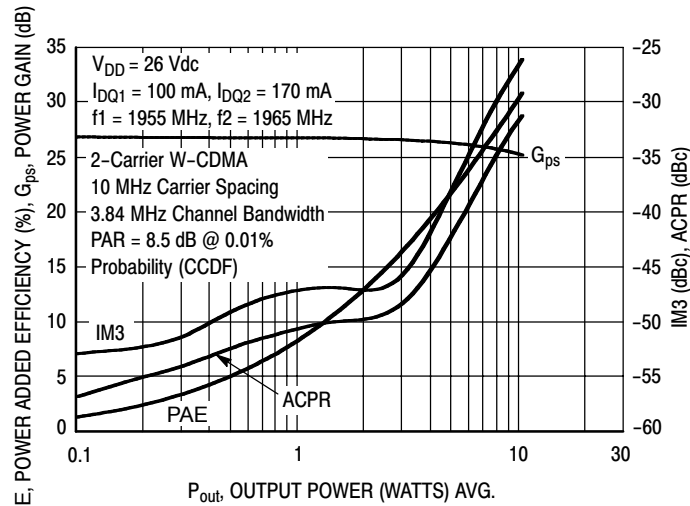
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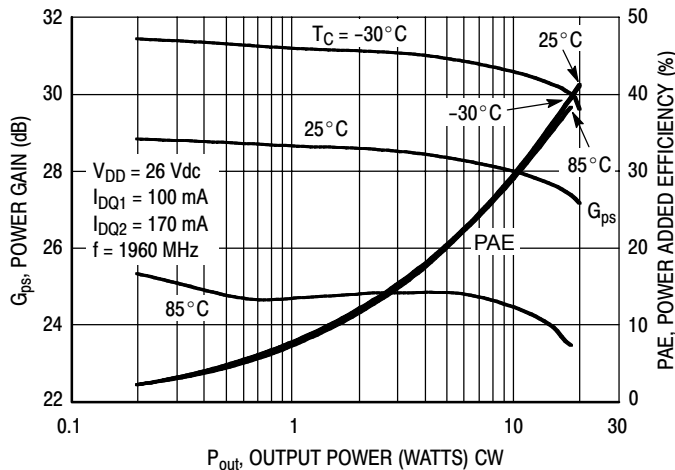
**Figure 9. Intermodulation Distortion Products versus Tone Spacing**



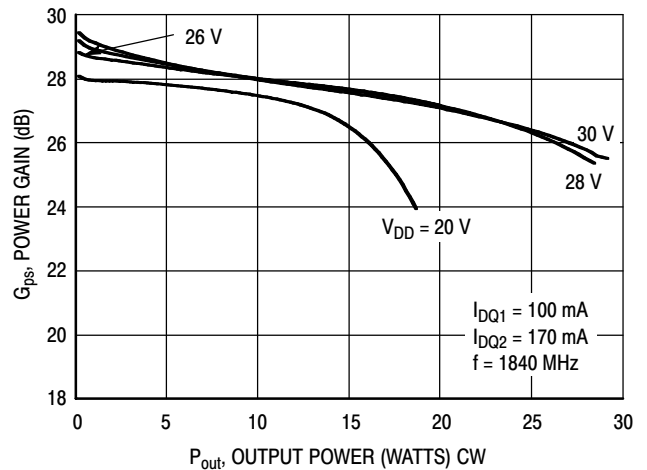
**Figure 10. Pulsed CW Output Power versus Input Power**



**Figure 11. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Power Added Efficiency versus Output Power**



**Figure 12. Power Gain and Power Added Efficiency versus CW Output Power**



**Figure 13. Power Gain versus Output Power**

MW6IC2015NBR1 MW6IC2015GNBR1

# TYPICAL CHARACTERISTICS — 1930-1990 MHz

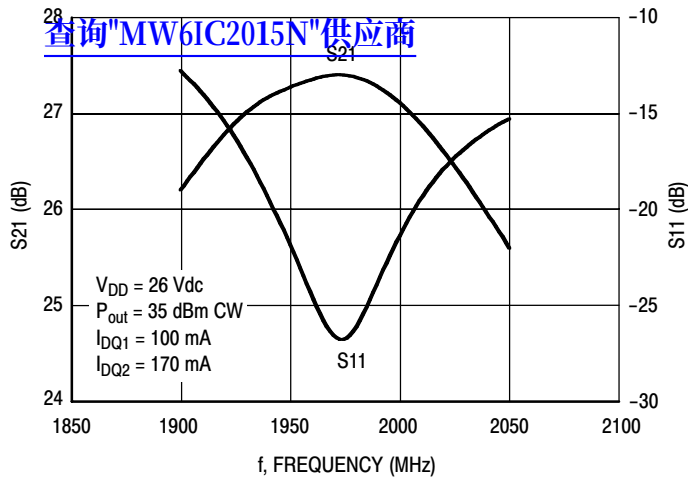


Figure 14. Broadband Frequency Response

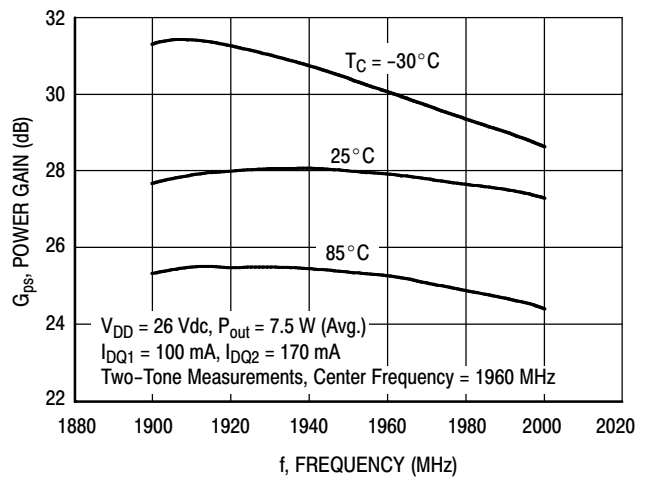


Figure 15. Power Gain versus Frequency

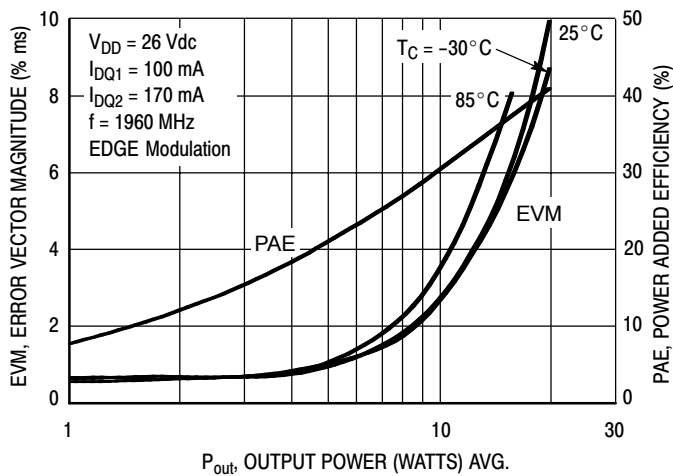


Figure 16. EVM and Power Added Efficiency versus Output Power

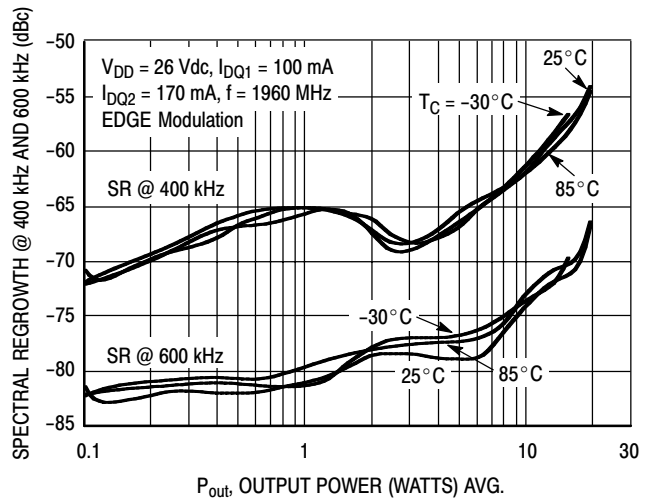
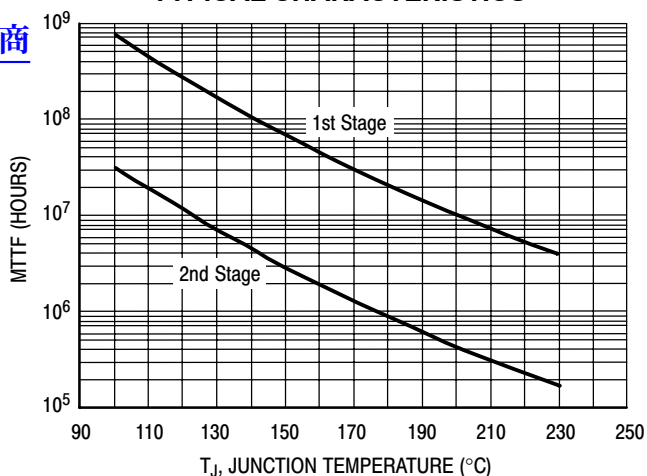


Figure 17. Spectral Regrowth at 400 and 600 kHz versus Output Power



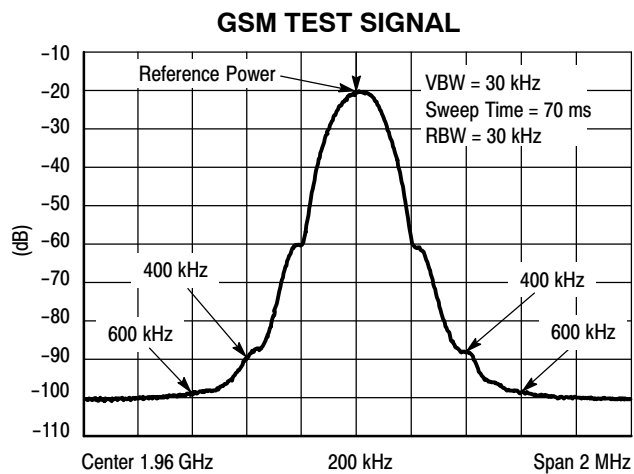
## TYPICAL CHARACTERISTICS



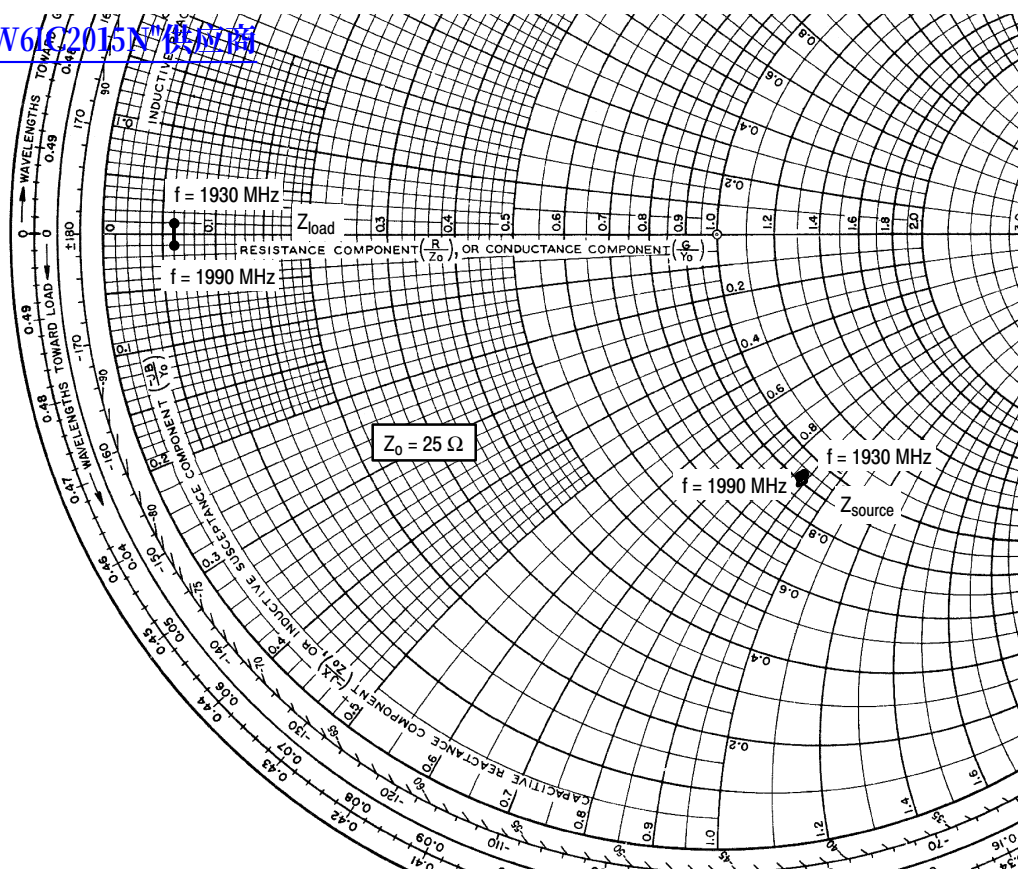
This above graph displays calculated MTTF in hours when the device is operated at  $V_{DD} = 26 \text{ Vdc}$ ,  $P_{out} = 15 \text{ W PEP}$ , and  $\text{PAE} = 28\%$ .

MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

**Figure 18. MTTF versus Junction Temperature**



**Figure 19. EDGE Spectrum**



$V_{DD} = 26 \text{ Vdc}$ ,  $I_{DQ1} = 100 \text{ mA}$ ,  $I_{DQ2} = 170 \text{ mA}$ ,  $P_{out} = 15 \text{ W CW}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1930     | $23.37 - j21.93$         | $1.62 + j0.26$         |
| 1950     | $22.77 - j22.53$         | $1.59 + j0.04$         |
| 1970     | $22.19 - j22.20$         | $1.57 - j0.16$         |
| 1990     | $22.64 - j21.84$         | $1.54 - j0.36$         |

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

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

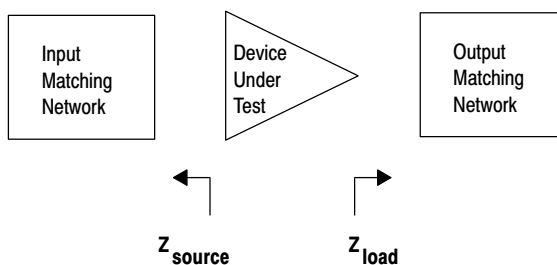
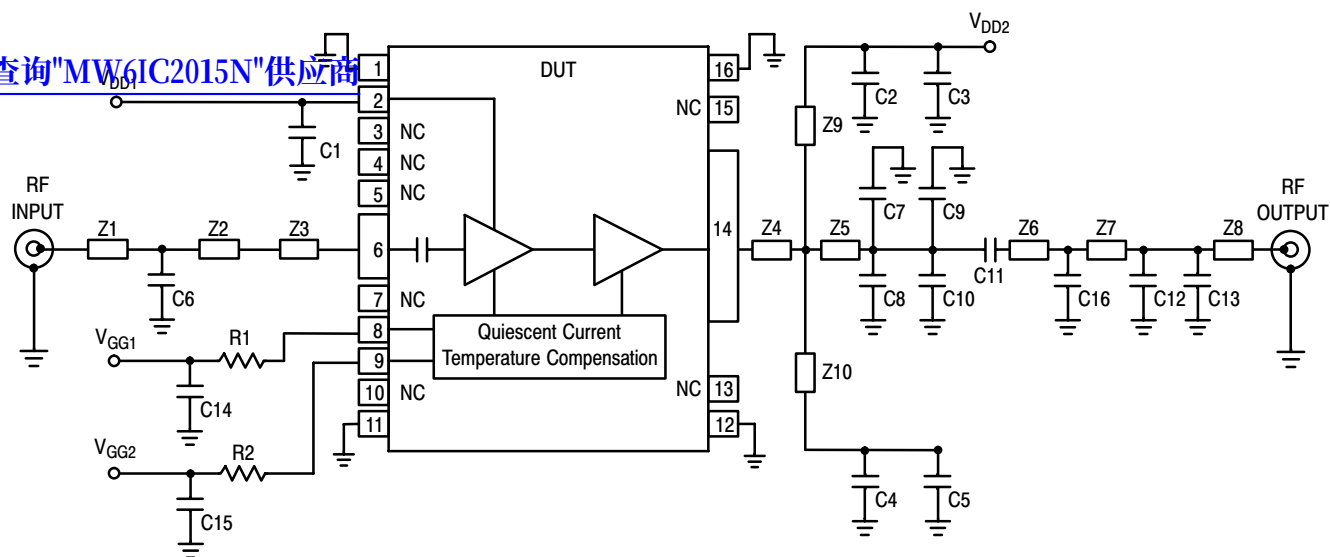


Figure 20. Series Equivalent Source and Load Impedance — 1930-1990 MHz



Z1\* 1.64" x 0.08" Microstrip  
 Z2 0.54" x 0.08" Microstrip  
 Z3 0.15" x 0.04" Microstrip  
 Z4 0.13" x 0.35" Microstrip  
 Z5 0.10" x 0.35" Microstrip  
 Z6\* 0.26" x 0.04" Microstrip

Z7\* 0.41" x 0.04" Microstrip  
 Z8 1.18" x 0.04" Microstrip  
 Z9, Z10 1.18" x 0.08" Microstrip  
 PCB Taconic TLX8-0300, 0.030",  $\epsilon_r = 2.55$   
 \* Variable for tuning.

Figure 21. MW6IC2015NBR1 (GNBR1) Test Circuit Schematic — 1805-1880 MHz

Table 7. MW6IC2015NBR1 (GNBR1) Test Circuit Component Designations and Values — 1805-1880 MHz

| Part         | Description                         | Part Number       | Manufacturer |
|--------------|-------------------------------------|-------------------|--------------|
| C1, C14, C15 | 2.2 $\mu$ F Chip Capacitors         | C3225X5R1H225MT   | TDK          |
| C2, C4, C11  | 5.6 pF Chip Capacitors              | ATC100B5R6CT500XT | ATC          |
| C3, C5       | 10 $\mu$ F Chip Capacitors          | C5750X5R1H106MT   | TDK          |
| C6           | 1.5 pF Chip Capacitor               | ATC100A1R5BT500XT | ATC          |
| C7, C8       | 2.7 pF Chip Capacitors              | ATC100B2R7BT500XT | ATC          |
| C9, C10, C12 | 0.8 pF Chip Capacitors              | ATC100B0R8BT500XT | ATC          |
| C13          | 0.1 pF Chip Capacitor               | ATC100B0R1BT500XT | ATC          |
| C16          | 1 pF Chip Capacitor                 | ATC100B1R0BT500XT | ATC          |
| R1           | 10 k $\Omega$ , 1/4 W Chip Resistor | CRCW12061002FKEA  | Vishay       |
| R2           | 18 $\Omega$ , 1/4 W Chip Resistor   | CRCW120618R0FKEA  | Vishay       |

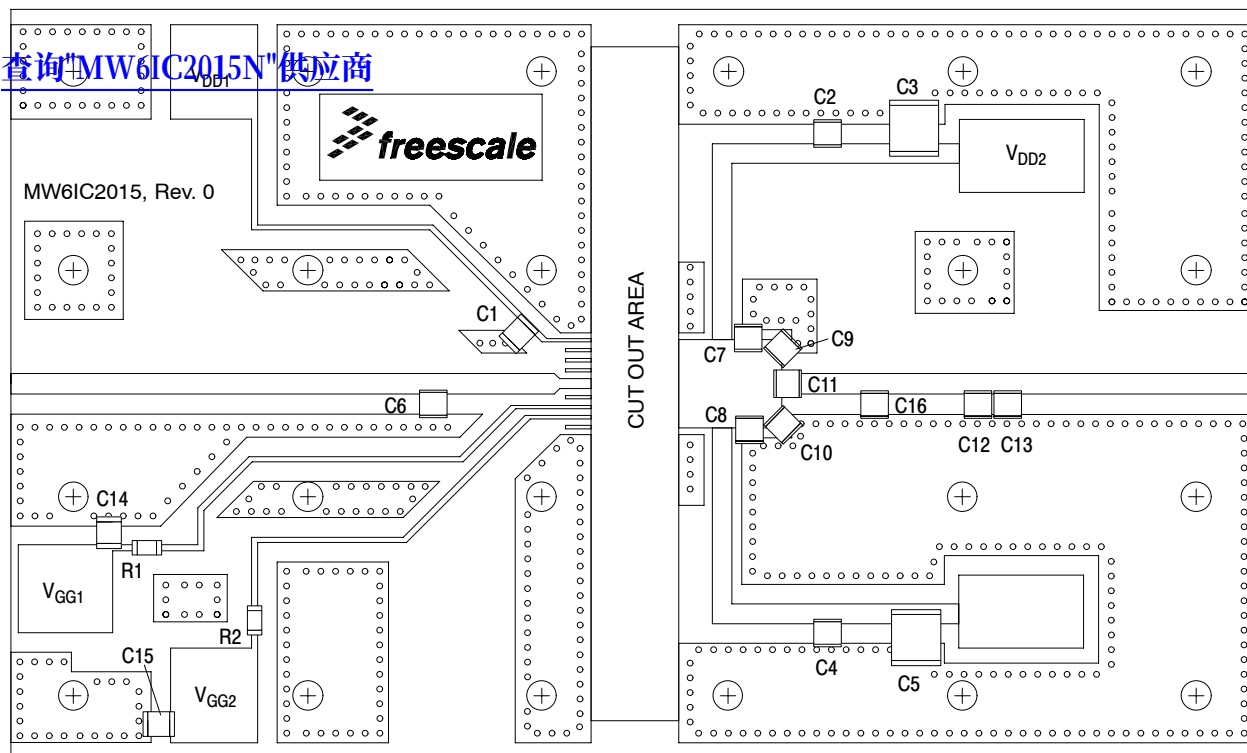
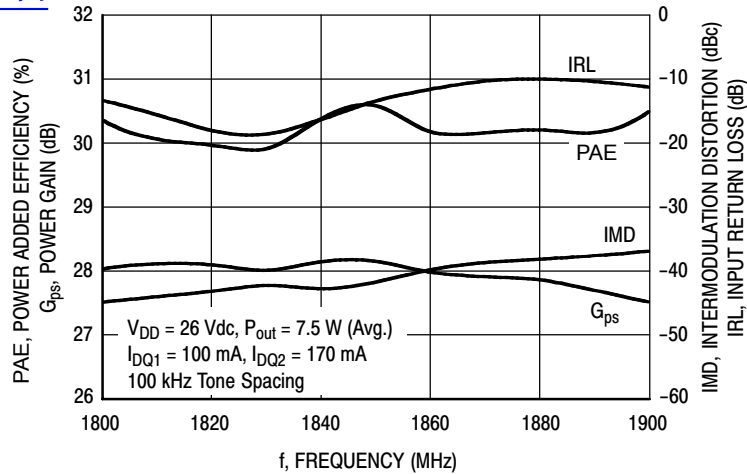


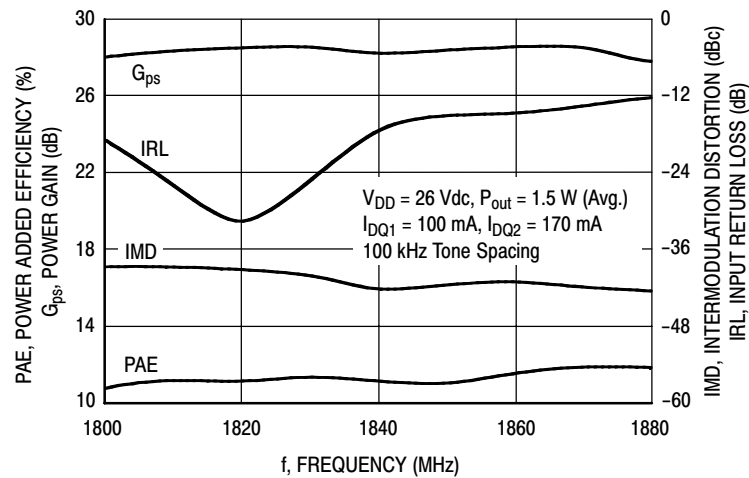
Figure 22. MW6IC2015NBR1 (GNBR1) Test Circuit Component Layout — 1805-1880 MHz

# TYPICAL CHARACTERISTICS — 1805-1880 MHz

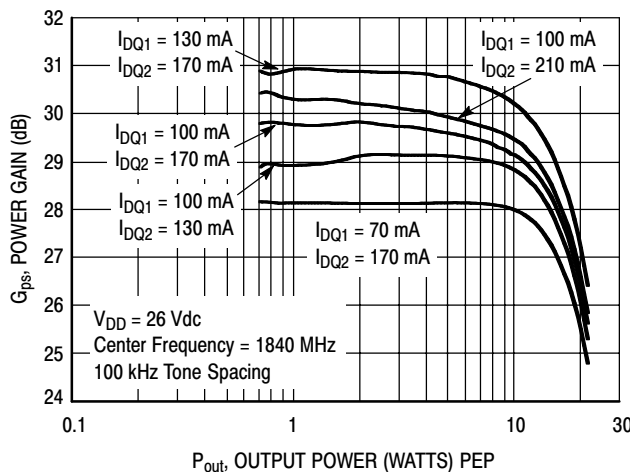
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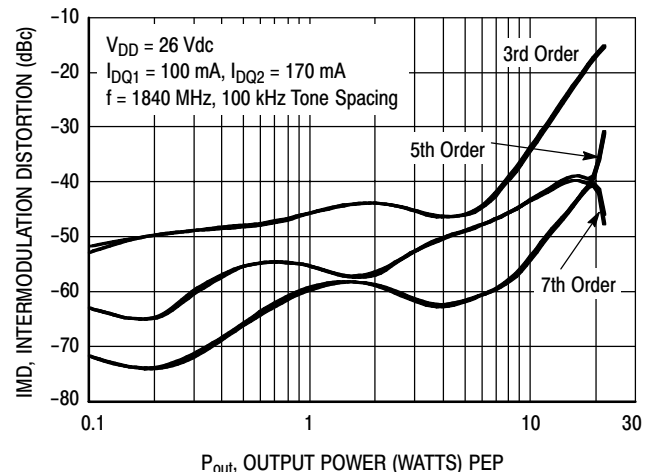
**Figure 23. Two-Tone Wideband Performance  
@  $P_{out} = 7.5$  Watts Avg.**



**Figure 24. Two-Tone Wideband Performance  
@  $P_{out} = 1.5$  Watts Avg.**



**Figure 25. Two-Tone Power Gain versus  
Output Power**



**Figure 26. Intermodulation Distortion  
Products versus Output Power**

# TYPICAL CHARACTERISTICS — 1805-1880 MHz

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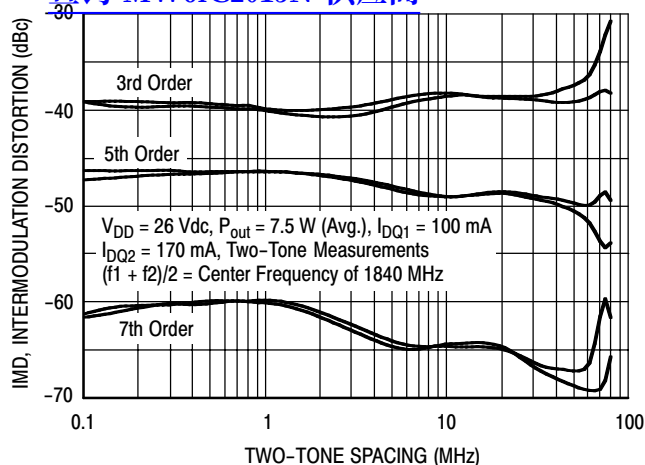


Figure 27. Intermodulation Distortion Products versus Tone Spacing

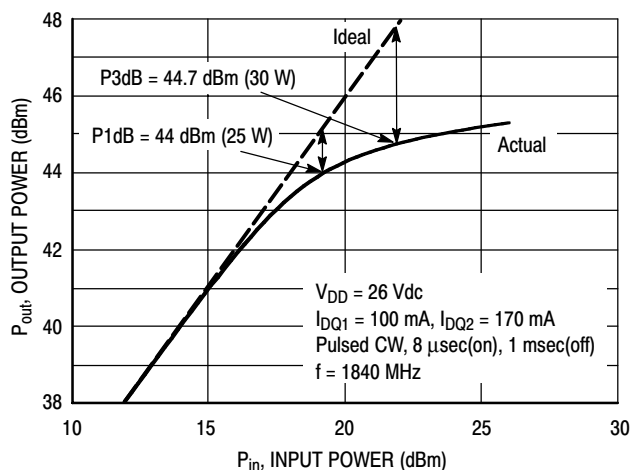


Figure 28. Pulsed CW Output Power versus Input Power

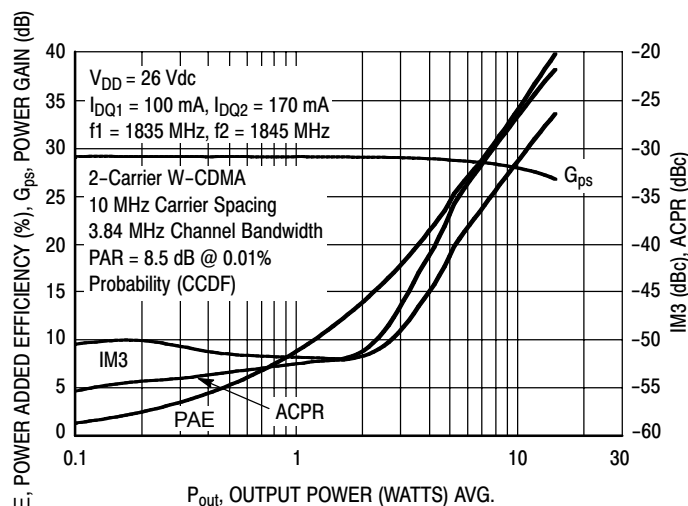


Figure 29. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Power Added Efficiency versus Output Power

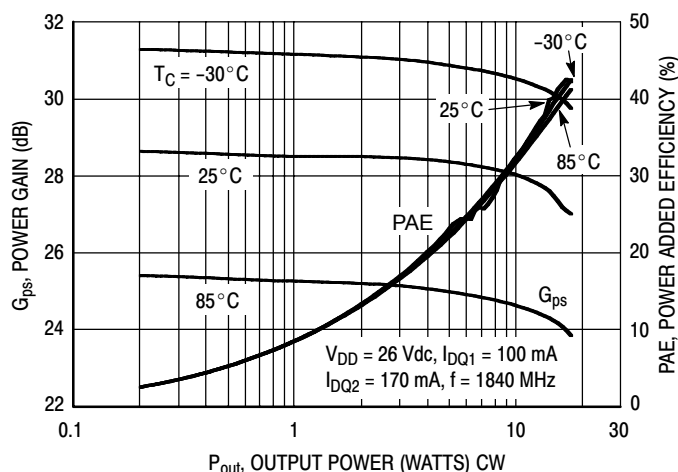


Figure 30. Power Gain and Power Added Efficiency versus CW Output Power

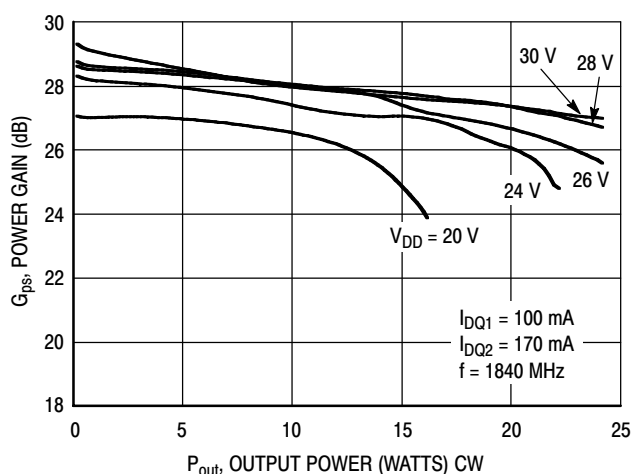


Figure 31. Power Gain versus Output Power

# TYPICAL CHARACTERISTICS — 1805-1880 MHz

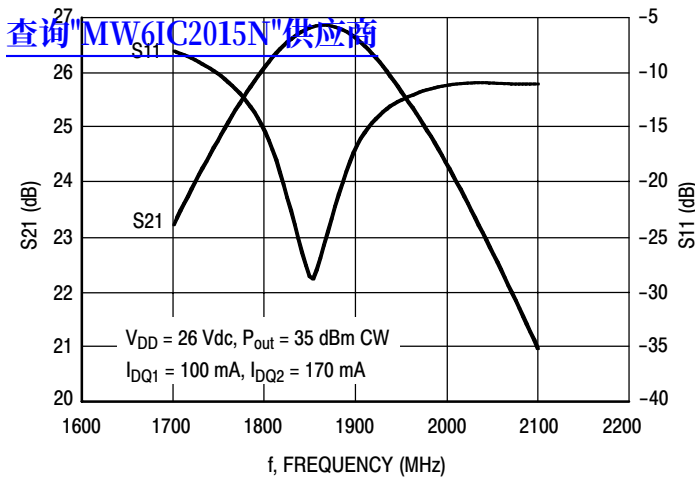


Figure 32. Broadband Frequency Response

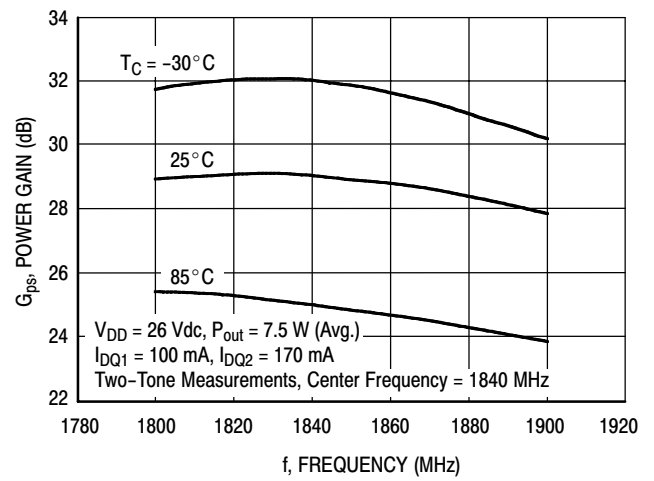


Figure 33. Power Gain versus Frequency

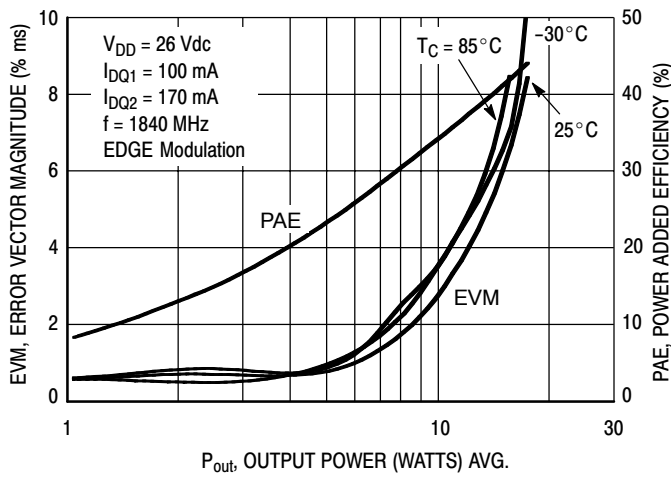


Figure 34. EVM and Power Added Efficiency versus Output Power

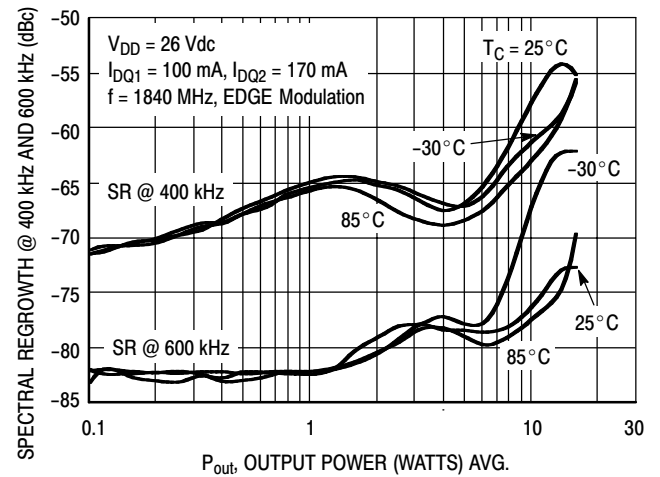
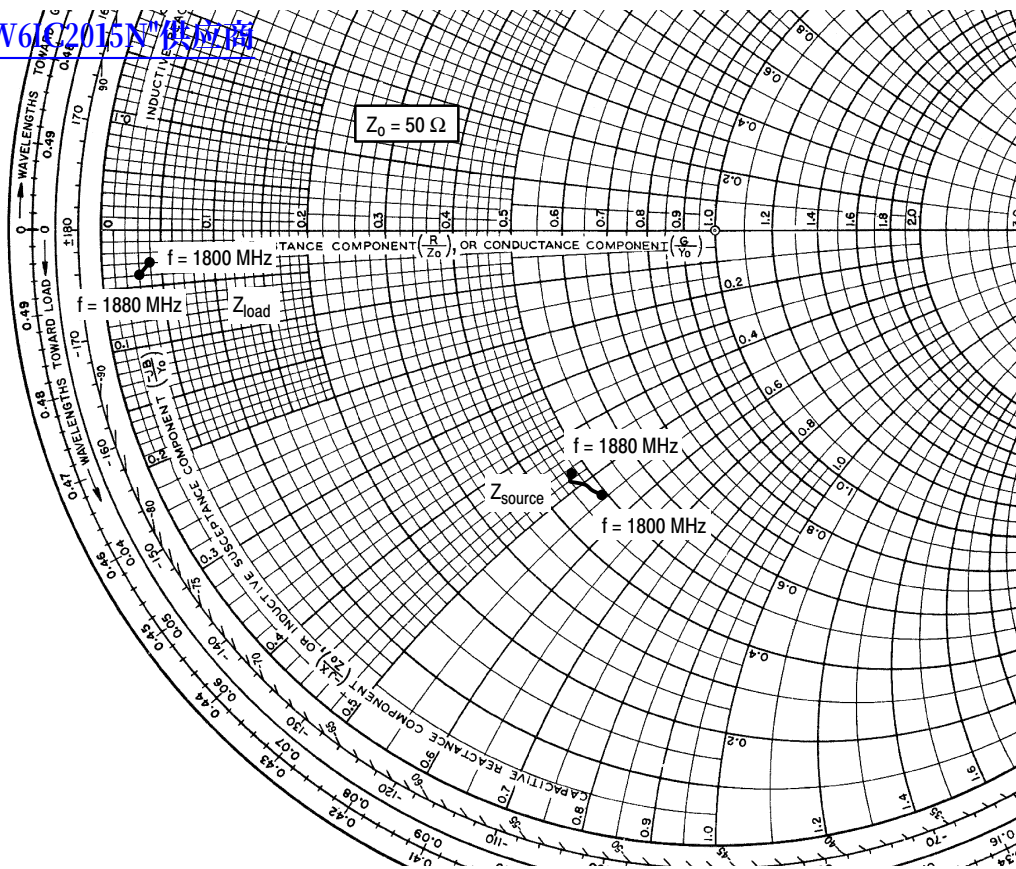


Figure 35. Spectral Regrowth at 400 and 600 kHz versus Output Power



$V_{DD} = 26 \text{ Vdc}$ ,  $I_{DQ1} = 130 \text{ mA}$ ,  $I_{DQ2} = 170 \text{ mA}$ ,  $P_{out} = 3 \text{ W Avg.}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 1800     | $24.32 - j26.99$         | $1.94 - j1.29$         |
| 1820     | $23.96 - j25.93$         | $1.88 - j1.42$         |
| 1840     | $23.86 - j25.63$         | $1.83 - j1.54$         |
| 1860     | $23.01 - j24.23$         | $1.79 - j1.64$         |
| 1880     | $23.55 - j23.33$         | $1.74 - j1.75$         |

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

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

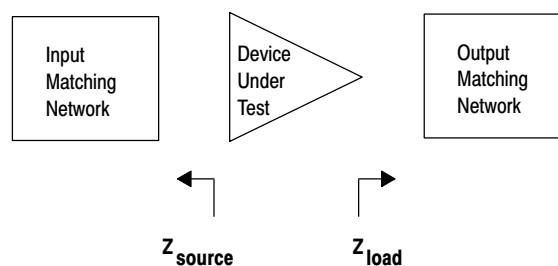


Figure 36. Series Equivalent Source and Load Impedance — 1805-1880 MHz



## TD-SCDMA CHARACTERIZATION

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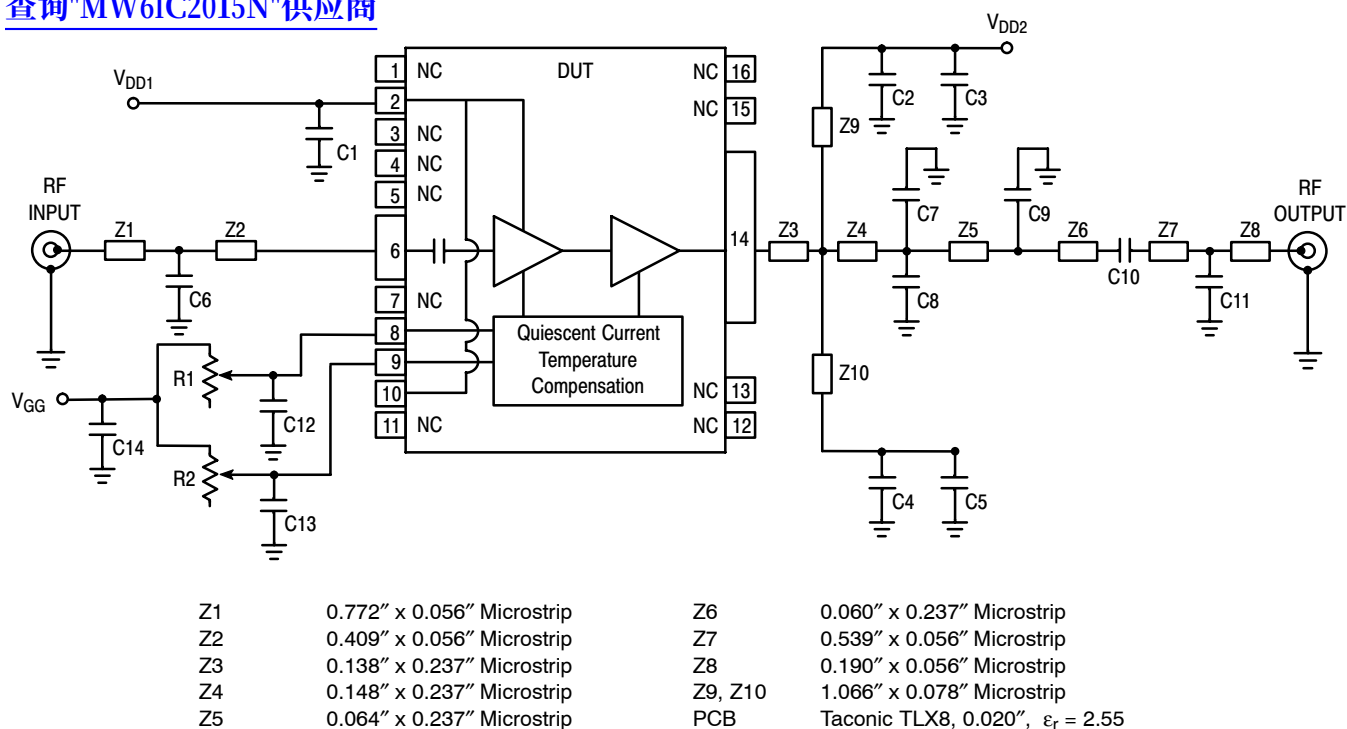


Figure 37. MW6IC2015NBR1(GNBR1) Test Circuit Schematic — TD-SCDMA

Table 8. MW6IC2015NBR1(GNBR1) Test Circuit Component Designations and Values — TD-SCDMA

| Part            | Description                                      | Part Number     | Manufacturer |
|-----------------|--------------------------------------------------|-----------------|--------------|
| C1, C3, C5, C14 | 2.2 $\mu$ F Chip Capacitors                      | C3225X5R1H225MT | TDK          |
| C2, C4, C10     | 5.6 pF Chip Capacitors                           | 08051J5R6CBS    | AVX          |
| C6              | 1 pF Chip Capacitor                              | 08051J1R0BBS    | AVX          |
| C7, C8          | 2.7 pF Chip Capacitors                           | 08051J2R7CBS    | AVX          |
| C9, C11         | 0.5 pF Chip Capacitors                           | 08051J0R5BBS    | AVX          |
| C12, C13        | 100 nF Chip Capacitors                           | C1206CK104K5RC  | Kemet        |
| R1, R2          | 5 k $\Omega$ Potentiometer CMS Cermet Multi-turn | 3224W           | Bourns       |

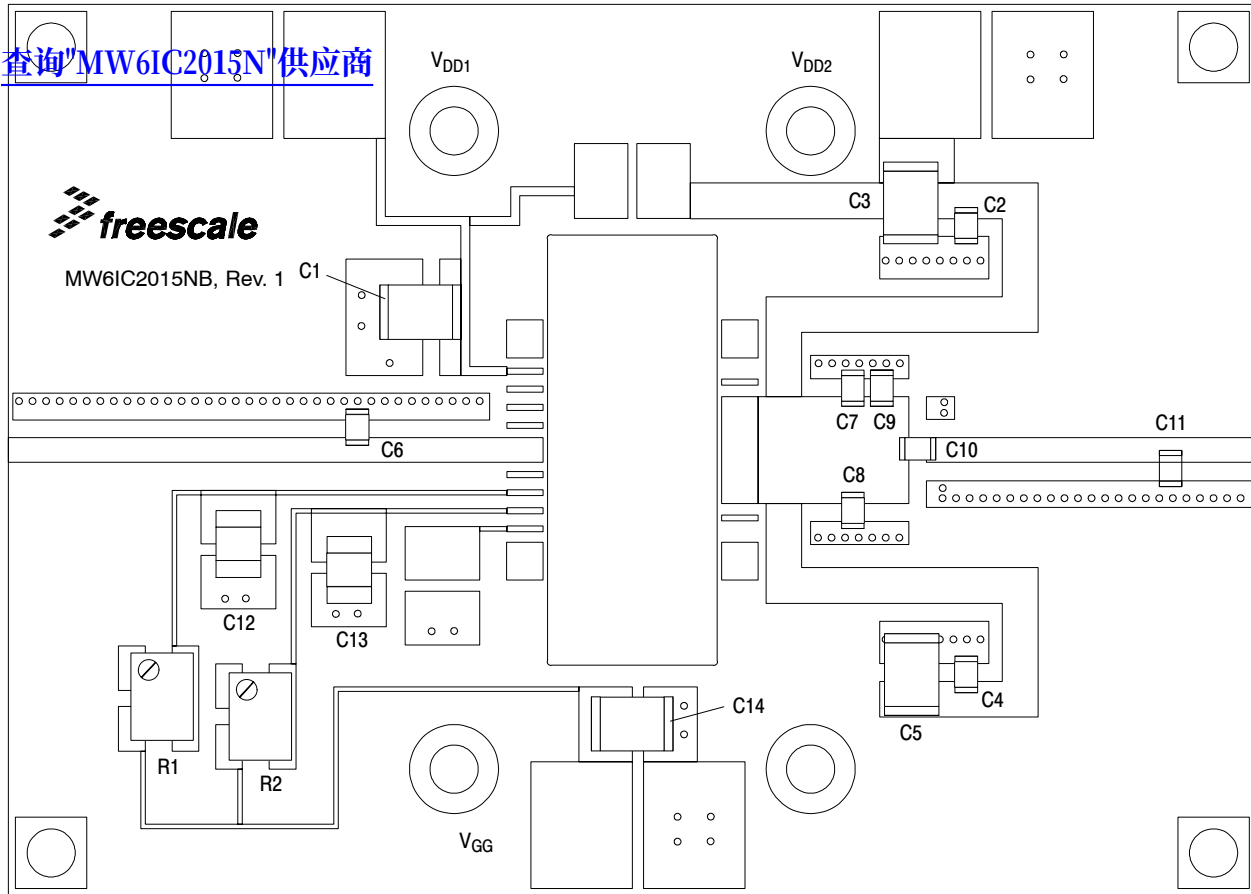


Figure 38. MW6IC2015NBR1(GNBR1) Test Circuit Component Layout — TD-SCDMA

## TYPICAL CHARACTERISTICS

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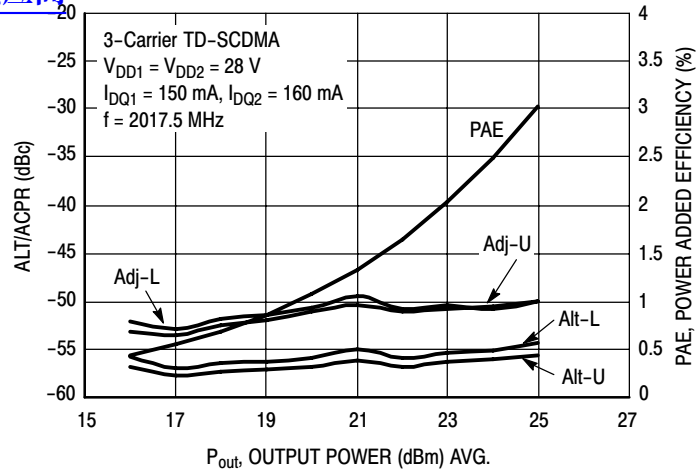


Figure 39. 3-Carrier TD-SCDMA ACPR, ALT and Power Added Efficiency versus Output Power

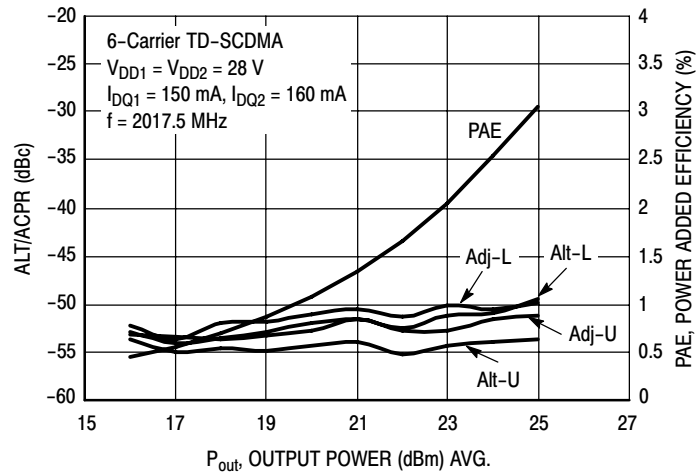


Figure 40. 6-Carrier TD-SCDMA ACPR, ALT and Power Added Efficiency versus Output Power

## TD-SCDMA TEST SIGNAL

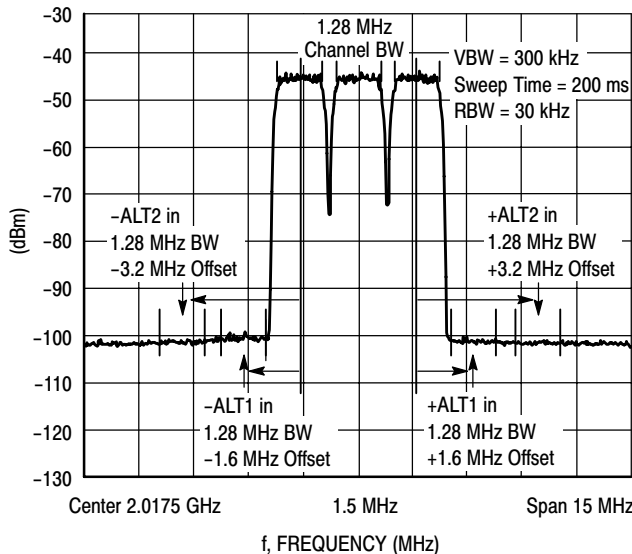


Figure 41. 3-Carrier TD-SCDMA Spectrum

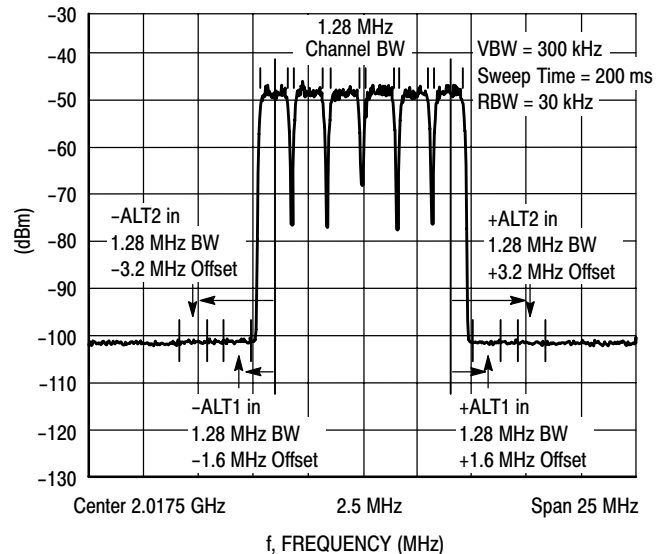
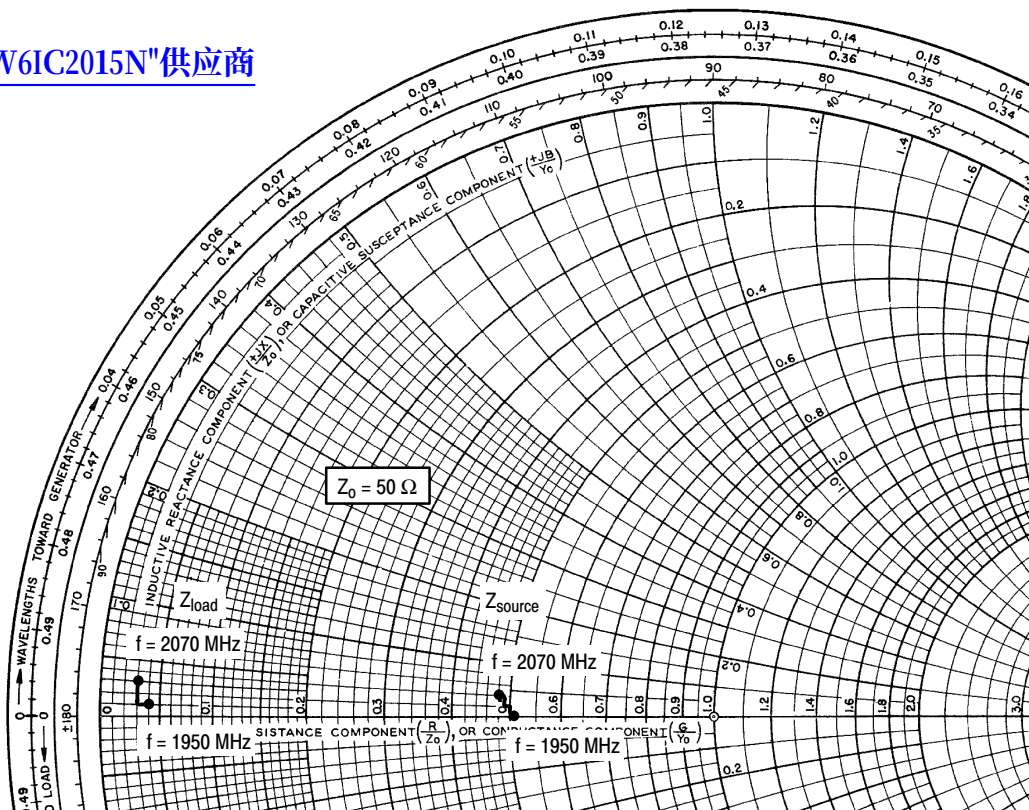


Figure 42. 6-Carrier TD-SCDMA Spectrum

MW6IC2015NBR1 MW6IC2015GNBR1



$V_{DD} = 28 \text{ Vdc}$ ,  $I_{DQ1} = 150 \text{ mA}$ ,  $I_{DQ2} = 160 \text{ mA}$

| f<br>MHz | $Z_{\text{source}}$<br>$\Omega$ | $Z_{\text{load}}$<br>$\Omega$ |
|----------|---------------------------------|-------------------------------|
| 1950     | $25.25 + j0.19$                 | $1.78 + j0.33$                |
| 1960     | $25.16 + j0.34$                 | $1.75 + j0.43$                |
| 1970     | $25.07 + j0.49$                 | $1.72 + j0.54$                |
| 1980     | $24.98 + j0.64$                 | $1.68 + j0.67$                |
| 1990     | $24.89 + j0.79$                 | $1.65 + j0.78$                |
| 2000     | $24.80 + j0.94$                 | $1.63 + j0.89$                |
| 2010     | $24.71 + j1.09$                 | $1.62 + j1.00$                |
| 2020     | $24.63 + j1.25$                 | $1.61 + j1.09$                |
| 2030     | $24.54 + j1.40$                 | $1.58 + j1.19$                |
| 2040     | $24.45 + j1.56$                 | $1.55 + j1.31$                |
| 2050     | $24.37 + j1.71$                 | $1.50 + j1.43$                |
| 2060     | $24.28 + j1.87$                 | $1.48 + j1.62$                |
| 2070     | $24.20 + j2.03$                 | $1.46 + j1.65$                |

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

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

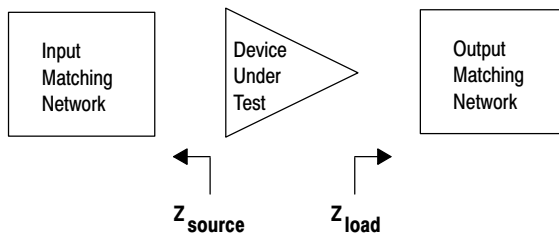
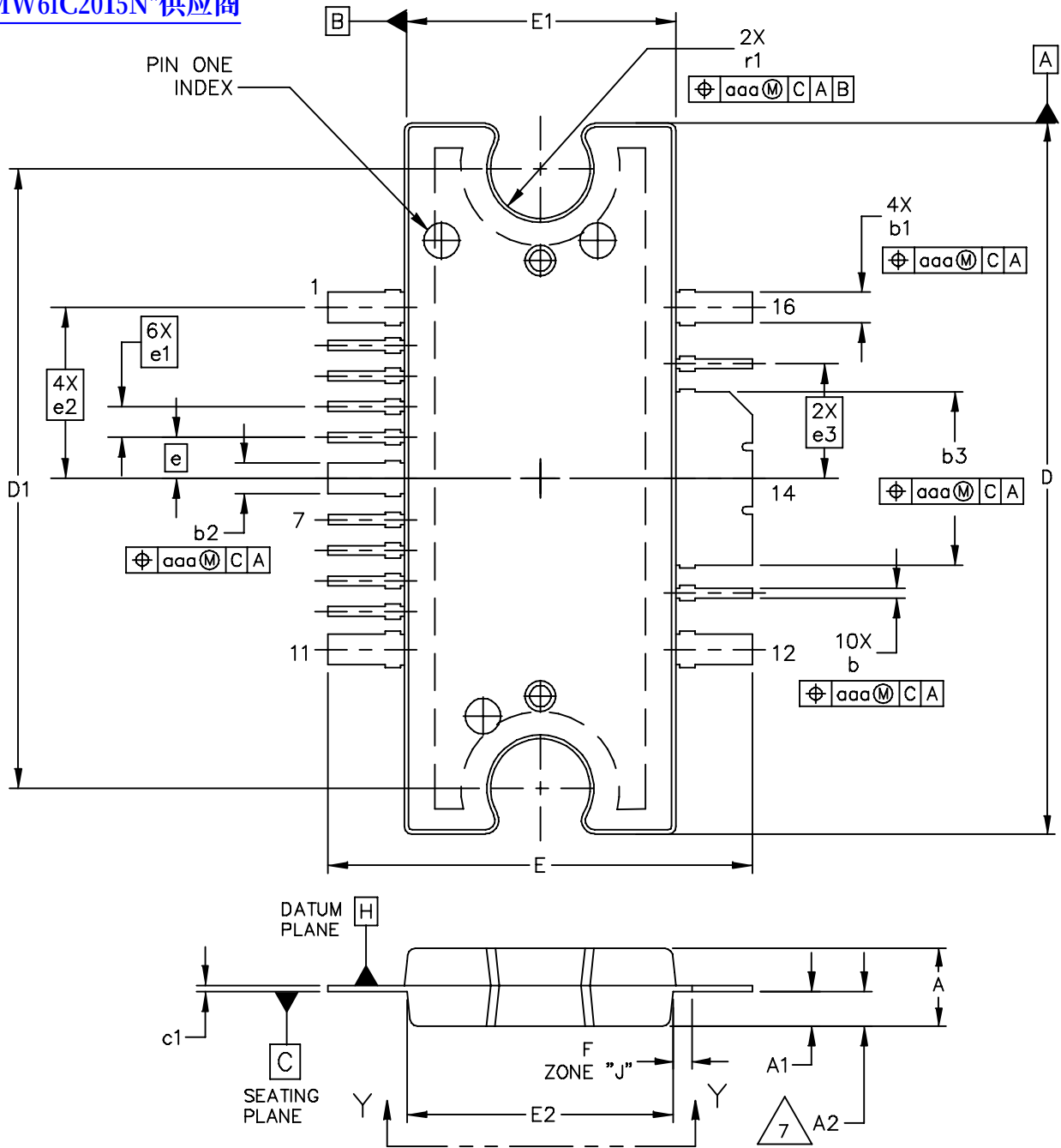


Figure 43. Series Equivalent Input and Load Impedance — TD-SCDMA

# PACKAGE DIMENSIONS

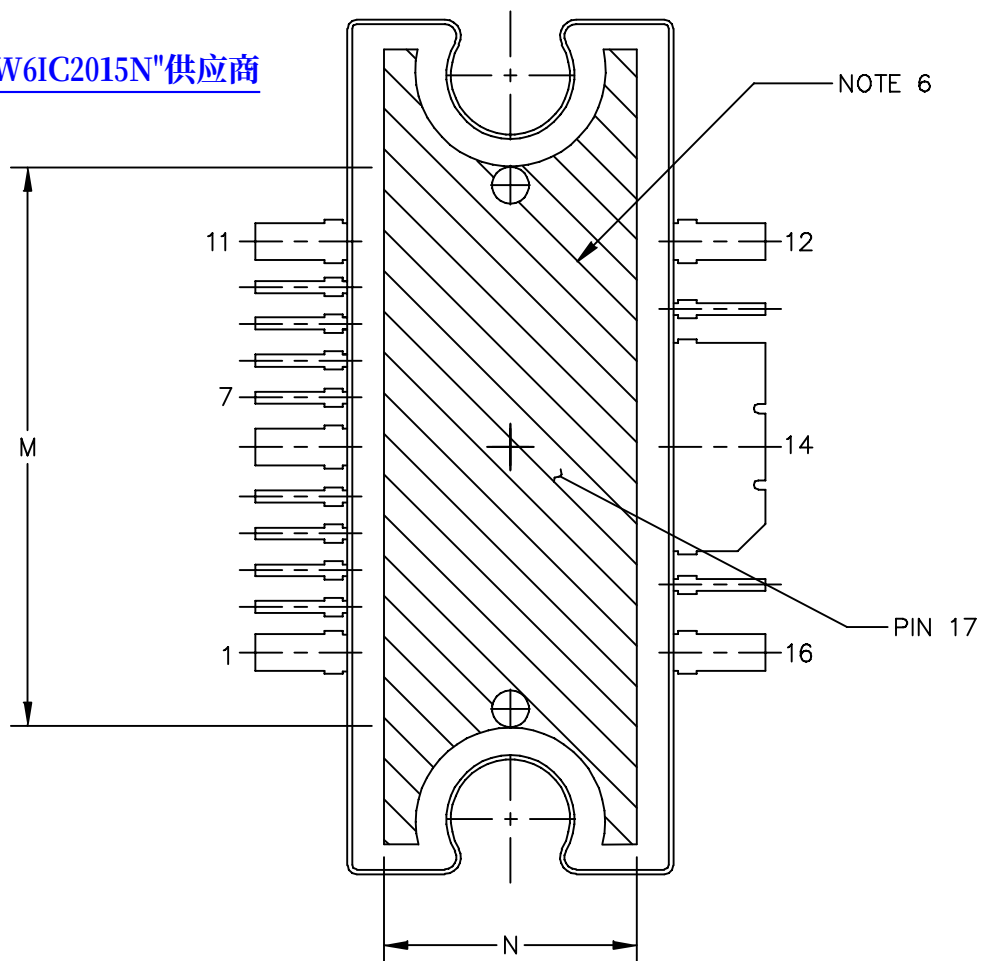
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|                                                         |  |                    | CASE NUMBER: 1329-09     |                            | 23 AUG 2007 |
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|                                                         | CASE NUMBER: 1329-09     |                            | 23 AUG 2007 |
|                                                         | STANDARD: NON-JEDEC      |                            |             |

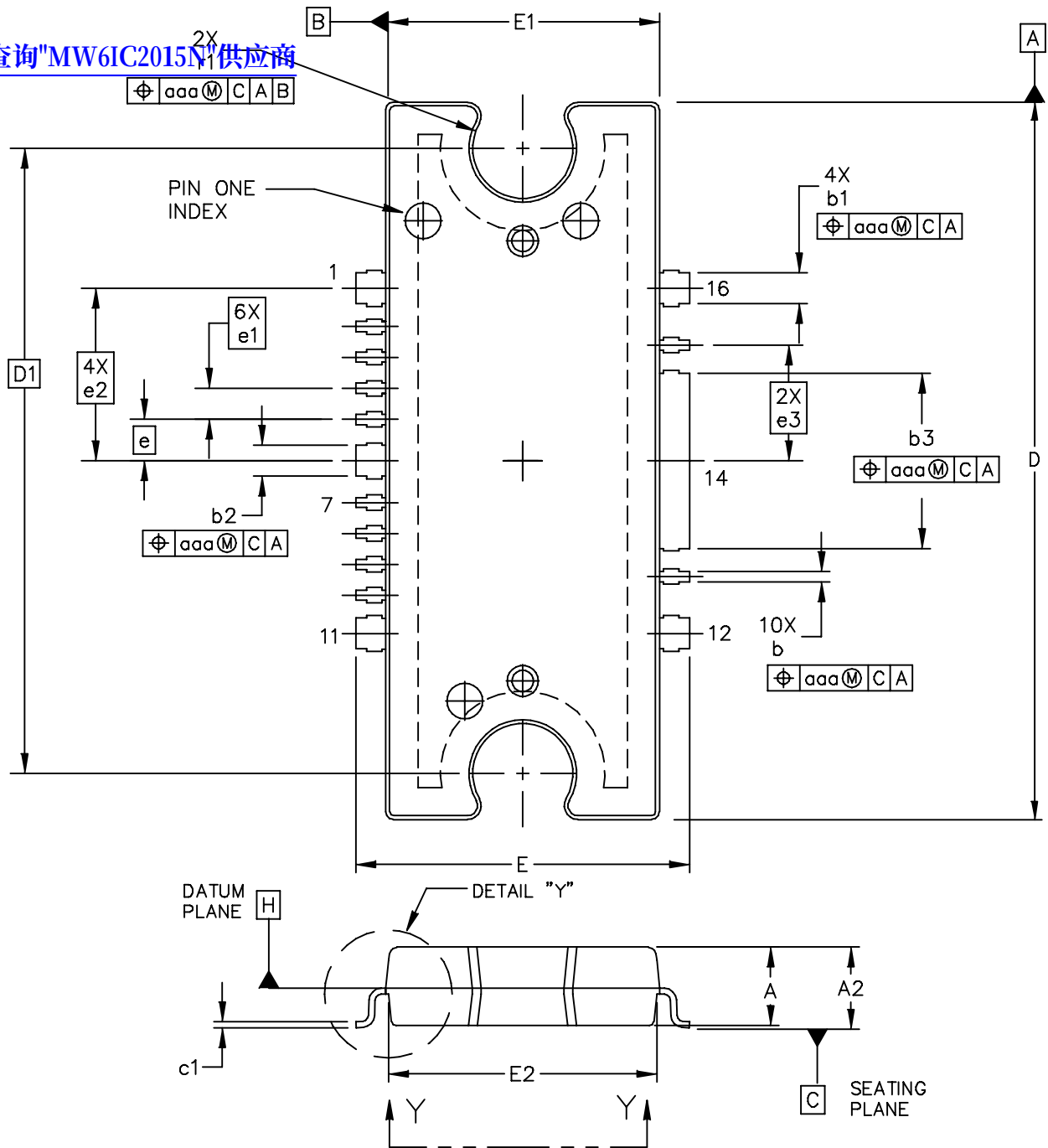
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4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 (0.15) PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -H-.
5. DIMENSIONS "b", "b1", "b2" AND "b3" DO NOT INCLUDE DAMBAR 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 OF THE 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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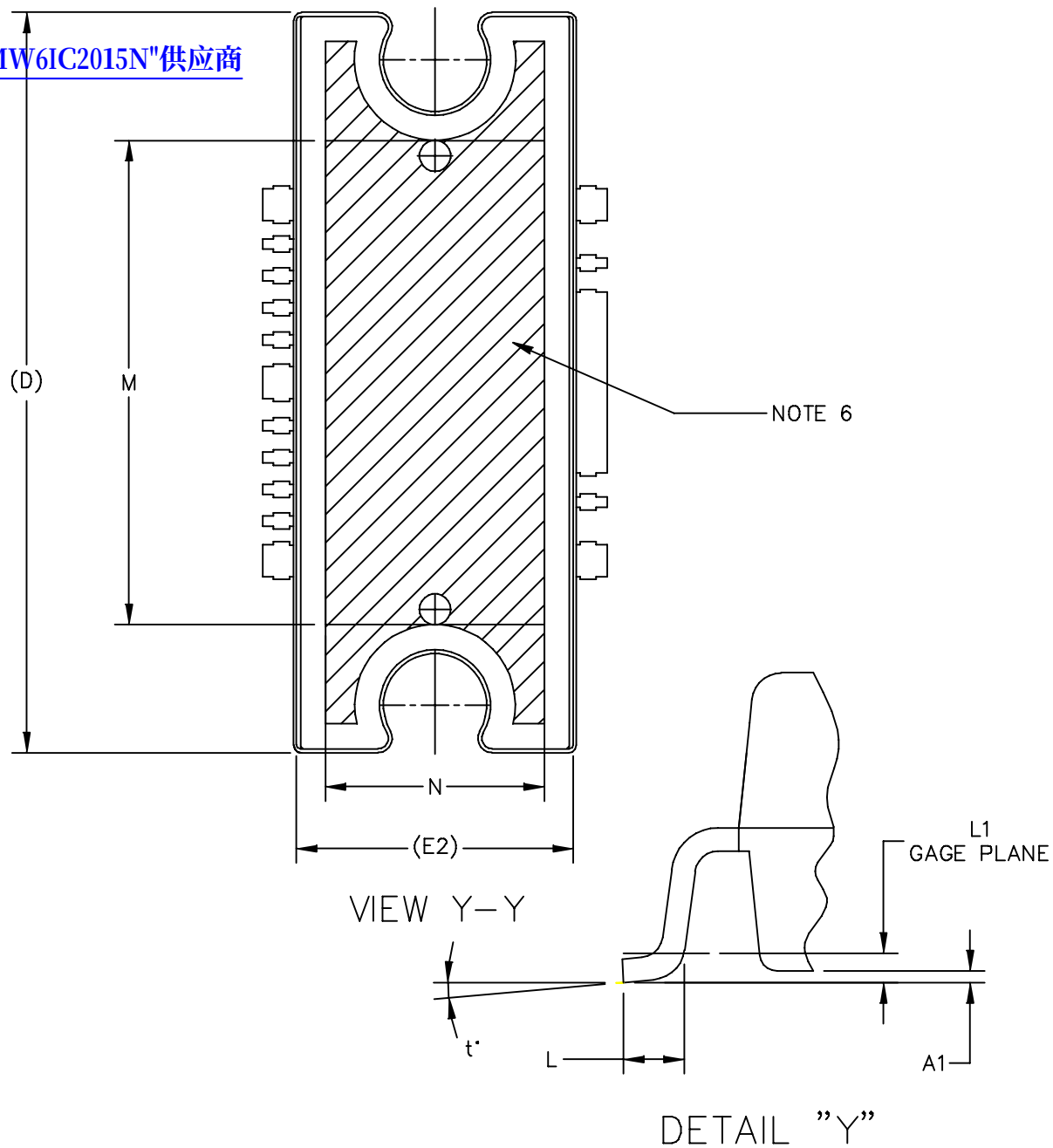
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|                                                         | CASE NUMBER: 1329A-04     |                            | 20 JUN 2007 |
|                                                         | STANDARD: JEDEC MO-253 BA |                            |             |



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|                                                         |  | CASE NUMBER: 1329A-04     | 20 JUN 2007                |
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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     |      | MILLIMETER         |       | DIM                       | INCH                       |      | MILLIMETER  |      |
|---------------------------------------------------------|----------|------|--------------------|-------|---------------------------|----------------------------|------|-------------|------|
|                                                         | MIN      | MAX  | MIN                | MAX   |                           | MIN                        | MAX  | MIN         | 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 | 0.46               | 0.61  | e3                        | .150 BSC                   |      | 3.81 BSC    |      |
| L1                                                      | .01 BSC  |      | 0.25 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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## PRODUCT DOCUMENTATION

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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

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2        | Feb. 2007 | <ul style="list-style-type: none"><li>• Added "and TD-SCDMA" to data sheet description paragraph, p. 1.</li><li>• Updated verbiage on Typical Performances table, p. 2</li><li>• Corrected <math>V_{BIAS}</math> and <math>V_{SUPPLY}</math> callouts, Figs. 3 and 21, Test Circuit Schematic, p. 4, 11, Figs. 4 and 22, Test Circuit Component Layout, p. 5, 12</li><li>• Updated Part Numbers in Tables 6 and 7, Component Designations and Values, to RoHS compliant part numbers, p. 4, 11</li><li>• Adjusted scale for Figs. 7 and 25, Two-Tone Power Gain versus Output Power, Figs. 8 and 26, Intermodulation Distortion Products versus Output Power, Figs. 11 and 29, 2-Carrier W-CDMA ACPR, IM3, Power Gain and Power Added Efficiency versus Output Power, Figs. 12 and 30, Power Gain and Power Added Efficiency versus CW Output Power, Figs. 16 and 34, EVM and Power Added Efficiency versus Output Power, Figs. 17 and 35, Spectral Regrowth at 400 and 600 kHz versus Output Power, to better match the device's capabilities, p. 6-8, 13-15</li><li>• Replaced Figure 18, MTTF versus Junction Temperature with updated graph. Removed Amps<sup>2</sup> and listed operating characteristics and location of MTTF calculator for device, p. 9</li><li>• Corrected Series Impedance data table test conditions, Figs. 20 and 36, p. 10, 16</li><li>• Added TD-SCDMA test circuit schematic, component designations and values, component layout, typical characteristic curves, test signal and series impedance, p. 17-20.</li><li>• Added Product Documentation and Revision History, p. 27</li></ul>                                                                                   |
| 3        | Dec. 2008 | <ul style="list-style-type: none"><li>• Modified data sheet to reflect RF Test Reduction described in Product and Process Change Notification number, PCN13232, p. 1, 2</li><li>• Changed 220°C to 225°C in Capable Plastic Package bullet, p. 1</li><li>• Added Footnote 1 to Quiescent Current Temperature bullet under Features section and to callout in Fig. 1, Functional Block Diagram, p. 1</li><li>• Changed Storage Temperature Range in Max Ratings table from -65 to +200 to -65 to +150 for standardization across products, p. 2</li><li>• Added Case Operating Temperature limit to the Maximum Ratings table and set limit to 150°C, p. 2</li><li>• Operating Junction Temperature increased from 200°C to 225°C in Maximum Ratings table and related "Continuous use at maximum temperature will affect MTTF" footnote added, p. 2</li><li>• Updated Part Numbers in Tables 6, 7, and 8 Component Designations and Values, to latest RoHS compliant part numbers, p. 4, 11, 17</li><li>• Removed lower voltage tests from Figs. 13 and 31, Power Gain versus Output Power, due to fixed tuned fixture limitations, p. 7, 14</li><li>• Adjust scale for Fig. 27, Intermodulation Distortion Products versus Tone Spacing, to show wider dynamic range, p. 14</li><li>• Replaced Case Outline 1329A-03 with 1329A-04, Issue F, p. 1, 24-26. Added pin numbers 1 through 17. Corrected mm dimension L for gull-wing foot from 4.90-5.06 Min-Max to 0.46-0.61 Min-Max. Corrected L1 mm dimension from .025 BSC to 0.25 BSC. Added JEDEC Standard Package Number.</li><li>• Replaced Case Outline 1329-09, Issue L, with 1329-09, Issue M, p. 21-23. Added pin numbers 1 through 17.</li></ul> |

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