

# RF Power LDMOS Transistors

## High Ruggedness N-Channel Enhancement-Mode Lateral MOSFETs

Optimized for broadband operation from 470 to 860 MHz. Device has an integrated input matching network for better power distribution. These devices are ideally suited for use in analog or digital television transmitters.

- Typical Narrowband Performance:  $V_{DD} = 50$  Volts,  $I_{DQ} = 1400$  mA, Channel Bandwidth = 8 MHz, Input Signal PAR = 9.5 dB @ 0.01% Probability on CCDF. ACPR measured in 7.61 MHz Signal Bandwidth @  $\pm 4$  MHz Offset with an Integration Bandwidth of 4 kHz.

| Signal Type     | $P_{out}$<br>(W) | f<br>(MHz) | $G_{ps}$<br>(dB) | $\eta_D$<br>(%) | ACPR<br>(dBc) | IRL<br>(dB) |
|-----------------|------------------|------------|------------------|-----------------|---------------|-------------|
| DVB-T (8k OFDM) | 125 Avg.         | 860        | 19.3             | 30.0            | -60.5         | -12         |

- Typical Pulsed Broadband Performance:  $V_{DD} = 50$  Volts,  $I_{DQ} = 1400$  mA, Pulsed Width = 100  $\mu$ sec, Duty Cycle = 10%

| Signal Type | $P_{out}$<br>(W) | f<br>(MHz) | $G_{ps}$<br>(dB) | $\eta_D$<br>(%) |
|-------------|------------------|------------|------------------|-----------------|
| Pulsed      | 600 Peak         | 470        | 19.3             | 47.1            |
|             |                  | 650        | 20.0             | 53.1            |
|             |                  | 860        | 18.8             | 48.9            |

### Features

- Capable of Handling >65:1 VSWR through all Phase Angles @ 50 Vdc, 860 MHz, DVB-T (8k OFDM) 240 Watts Avg. Output Power (3 dB Input Overdrive from Rated  $P_{out}$ )
- Exceptional Efficiency for Class AB Analog or Digital Television Operation
- Full Performance across Complete UHF TV Spectrum, 470-860 MHz
- Capable of 600 Watt CW Output Power with Adequate Thermal Management
- Integrated Input Matching
- Extended Negative Gate-Source Voltage Range of -6.0 V to +10 V
  - Improves Class C Performance, e.g. in a Doherty Peaking Stage
  - Enables Fast, Easy and Complete Shutdown of the Amplifier
- Characterized from 20 V to 50 V for Extended Operating Range for use with Drain Modulation
- Excellent Thermal Characteristics
- RoHS Compliant
- In Tape and Reel. R6 Suffix = 150 Units, 56 mm Tape Width, 13 inch Reel. R5 Suffix = 50 Units, 56 mm Tape Width, 13 inch Reel.

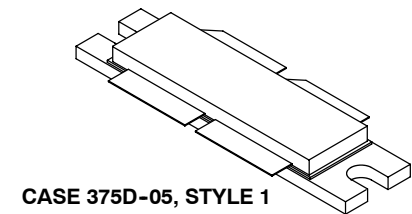
**Table 1. Maximum Ratings**

| Rating                                                                                 | Symbol    | Value        | Unit      |
|----------------------------------------------------------------------------------------|-----------|--------------|-----------|
| Drain-Source Voltage                                                                   | $V_{DSS}$ | -0.5, +130   | Vdc       |
| Gate-Source Voltage                                                                    | $V_{GS}$  | -6.0, +10    | Vdc       |
| Storage Temperature Range                                                              | $T_{stg}$ | -65 to +150  | °C        |
| Case Operating Temperature                                                             | $T_C$     | 150          | °C        |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$     | 1052<br>5.26 | W<br>W/°C |
| Operating Junction Temperature (1,2)                                                   | $T_J$     | 225          | °C        |

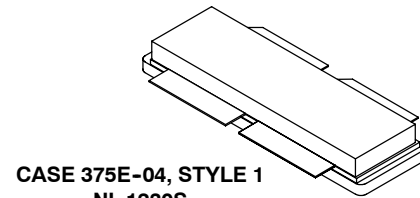
- Continuous use at maximum temperature will affect MTTF.
- MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.

**MRFE6VP8600HR6**  
**MRFE6VP8600HR5**  
**MRFE6VP8600HSR6**  
**MRFE6VP8600HSR5**

**470-860 MHz, 600 W, 50 V**  
**LDMOS BROADBAND**  
**RF POWER TRANSISTORS**

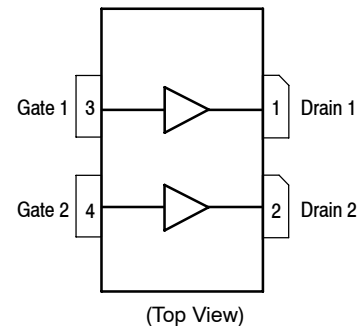


**CASE 375D-05, STYLE 1**  
**NI-1230**  
**MRFE6VP8600HR6**



**CASE 375E-04, STYLE 1**  
**NI-1230S**  
**MRFE6VP8600HSR6**

**PARTS ARE PUSH-PULL**



Note: The backside of the package is the source terminal for the transistor.

**Figure 1. Pin Connections**

**Table 2. Thermal Characteristics**

| Characteristic                                                                                  | Symbol          | Value (1,2) | Unit |
|-------------------------------------------------------------------------------------------------|-----------------|-------------|------|
| Thermal Resistance, Junction to Case<br>Case Temperature 74°C, 125 W CW, 50 V, 1400 mA, 860 MHz | $R_{\theta JC}$ | 0.19 (3)    | °C/W |

**Table 3. ESD Protection Characteristics**

| Test Methodology                      | Class           |
|---------------------------------------|-----------------|
| Human Body Model (per JESD22-A114)    | 2 (2001-4000 V) |
| Machine Model (per EIA/JESD22-A115)   | B (201-400 V)   |
| Charge Device Model (per JESD22-C101) | IV (>1000 V)    |

**Table 4. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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

**Off Characteristics (4)**

|                                                                                                    |               |     |     |    |                 |
|----------------------------------------------------------------------------------------------------|---------------|-----|-----|----|-----------------|
| Gate-Source Leakage Current<br>( $V_{GS} = 5\text{ Vdc}$ , $V_{DS} = 0\text{ Vdc}$ )               | $I_{GSS}$     | —   | —   | 1  | $\mu\text{Adc}$ |
| Drain-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 100\text{ mA}$ )              | $V_{(BR)DSS}$ | 130 | 140 | —  | Vdc             |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 50\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )  | $I_{DSS}$     | —   | —   | 5  | $\mu\text{Adc}$ |
| Zero Gate Voltage Drain Leakage Current<br>( $V_{DS} = 100\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ) | $I_{DSS}$     | —   | —   | 20 | $\mu\text{Adc}$ |

**On Characteristics**

|                                                                                                                    |              |     |      |     |     |
|--------------------------------------------------------------------------------------------------------------------|--------------|-----|------|-----|-----|
| Gate Threshold Voltage (4)<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 980\text{ }\mu\text{Adc}$ )                      | $V_{GS(th)}$ | 1.5 | 2.07 | 2.5 | Vdc |
| Gate Quiescent Voltage (5)<br>( $V_{DD} = 50\text{ Vdc}$ , $I_D = 1400\text{ mAdc}$ , Measured in Functional Test) | $V_{GS(Q)}$  | 2.1 | 2.65 | 3.1 | Vdc |
| Drain-Source On-Voltage (4)<br>( $V_{GS} = 10\text{ Vdc}$ , $I_D = 2\text{ Adc}$ )                                 | $V_{DS(on)}$ | —   | 0.24 | —   | Vdc |
| Forward Transconductance<br>( $V_{DS} = 10\text{ Vdc}$ , $I_D = 20\text{ Adc}$ )                                   | $g_{fs}$     | —   | 15.6 | —   | S   |

**Dynamic Characteristics (4)**

|                                                                                                                           |           |   |      |   |    |
|---------------------------------------------------------------------------------------------------------------------------|-----------|---|------|---|----|
| Reverse Transfer Capacitance (6)<br>( $V_{DS} = 50\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ ) | $C_{rss}$ | — | 1.49 | — | pF |
| Output Capacitance (6)<br>( $V_{DS} = 50\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$ )           | $C_{oss}$ | — | 79.9 | — | pF |
| Input Capacitance (7)<br>( $V_{DS} = 50\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc} \pm 30\text{ mV(rms)ac}$ @ 1 MHz)            | $C_{iss}$ | — | 264  | — | pF |

**Functional Tests (5)** (In Freescale Narrowband Test Fixture, 50 ohm system)  $V_{DD} = 50\text{ Vdc}$ ,  $I_{DQ} = 1400\text{ mA}$ ,  $P_{out} = 125\text{ W Avg.}$ ,  $f = 860\text{ MHz}$ , DVB-T (8k OFDM) Single Channel. ACPR measured in 7.61 MHz Signal Bandwidth @  $\pm 4\text{ MHz}$  Offset with an Integration Bandwidth of 4 kHz.

|                              |          |      |       |       |     |
|------------------------------|----------|------|-------|-------|-----|
| Power Gain                   | $G_{ps}$ | 18.0 | 19.3  | 21.0  | dB  |
| Drain Efficiency             | $\eta_D$ | 29.0 | 30.0  | —     | %   |
| Adjacent Channel Power Ratio | ACPR     | —    | -60.5 | -58.5 | dBc |
| Input Return Loss            | IRL      | —    | -12   | -9    | dB  |

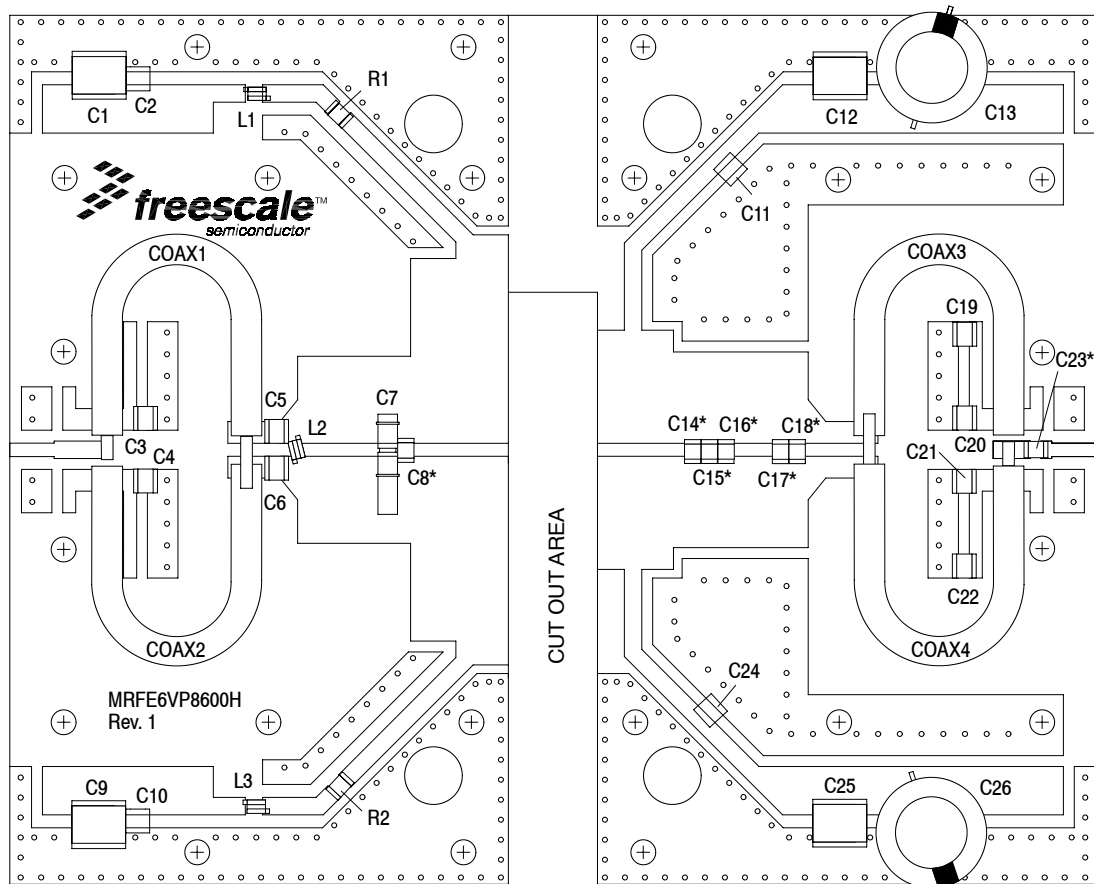
1. MTTF calculator available at <http://www.freescale.com/rf>. Select Software & Tools/Development Tools/Calculators to access MTTF calculators by product.
2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <http://www.freescale.com/rf>. Select Documentation/Application Notes - AN1955.
3. Performance with thermal grease TIM (thermal interface material) will typically degrade by  $0.05^\circ\text{C/W}$  due to the increased thermal contact resistance of this TIM.
4. Each side of device measured separately.
5. Measurement made with device in push-pull configuration.
6. Part internally input matched.
7. Die capacitance value without internal matching.

(continued)

**MRFE6VP8600HR6 MRFE6VP8600HR5 MRFE6VP8600HSR6 MRFE6VP8600HSR5**

**Table 4. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

| Characteristic                                                                                                                                                                                                 | Symbol | Min                            | Typ | Max | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------|-----|-----|------|
| <b>Typical DVB-T (8k OFDM) Performance</b> (In Freescale Narrowband Test Fixture, 50 ohm system) $V_{DD} = 50\text{ Vdc}$ , $I_{DQ} = 1400\text{ mA}$ , $f = 860\text{ MHz}$ , DVB-T (8k OFDM) Single Channel. |        |                                |     |     |      |
| Output Peak-to-Average Ratio @ 0.01% Probability on CCDF,<br>$P_{out} = 125\text{ W Avg.}$                                                                                                                     | PAR    | —                              | 7.8 | —   | dB   |
| Load Mismatch<br>VSWR >65:1 at all Phase Angles, 3 dB Overdrive from<br>Rated $P_{out}$ (240 W Avg.)                                                                                                           | $\Psi$ | No Degradation in Output Power |     |     |      |



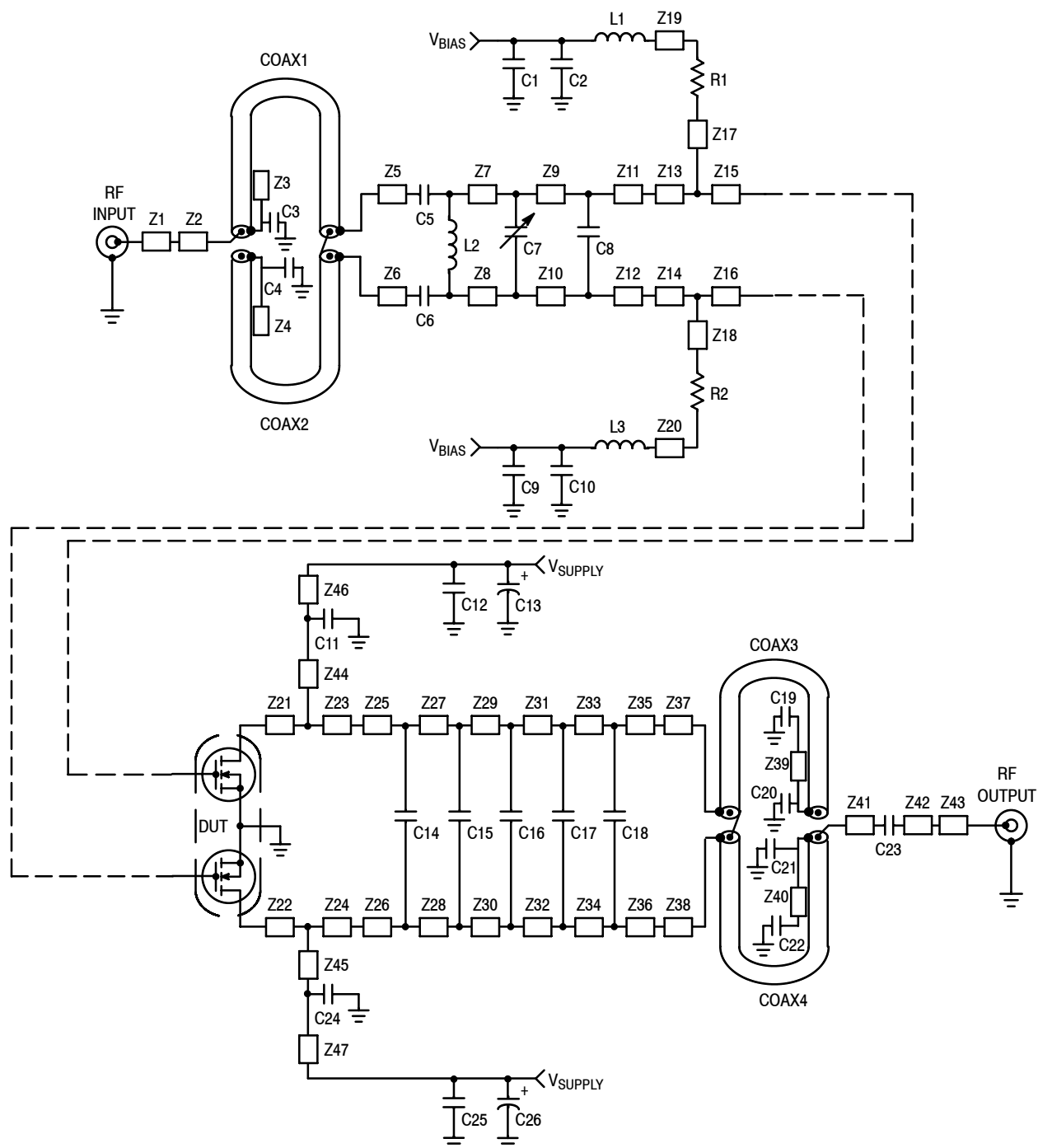
\*C8, C14, C15, C16, C17, C18 and C23 are mounted vertically.

**Figure 2. MRFE6VP8600HR6(HSR6) Test Circuit Component Layout — 860 MHz, DVB-T (8k OFDM)**

**Table 5. MRFE6VP8600HR6(HSR6) Test Circuit Component Designations and Values — 860 MHz, DVB-T (8k OFDM)**

| Part                  | Description                               | Part Number          | Manufacturer        |
|-----------------------|-------------------------------------------|----------------------|---------------------|
| C1, C9                | 10 $\mu$ F, 50 V, Chip Capacitors         | GRM55DR61H106KA88L   | Murata              |
| C2, C10               | 2.2 $\mu$ F, 50 V, Chip Capacitors        | C3225X7R1H225K       | TDK                 |
| C3, C4, C20, C21, C23 | 100 pF Chip Capacitors                    | ATC100B101JT500XT    | ATC                 |
| C5, C6                | 24 pF Chip Capacitors                     | ATC100B240JT500XT    | ATC                 |
| C7                    | 0.8–8.0 pF Variable Capacitor             | 27291SL              | Johanson Components |
| C8                    | 12 pF Chip Capacitor                      | ATC100B120JT500XT    | ATC                 |
| C11, C24              | 2.2 $\mu$ F, 100 V, Chip Capacitors       | C3225X7R2A225KT      | TDK                 |
| C12, C25              | 4.7 $\mu$ F, 100 V, Chip Capacitors       | GRM55ER72A475KA01B   | Murata              |
| C13, C26              | 470 $\mu$ F, 63 V Electrolytic Capacitors | MCGPR63V477M13X26-RH | Multicomp           |
| C14                   | 6.8 pF Chip Capacitor                     | ATC100B6R8CT500XT    | ATC                 |
| C15                   | 3.0 pF Chip Capacitor                     | ATC100B3R0CT500XT    | ATC                 |
| C16                   | 2.7 pF Chip Capacitor                     | ATC100B2R7BT500XT    | ATC                 |
| C17                   | 3.9 pF Chip Capacitor                     | ATC100B3R9CT500XT    | ATC                 |
| C18                   | 5.1 pF Chip Capacitor                     | ATC100B5R1CT500XT    | ATC                 |
| C19, C22              | 1000 pF Chip Capacitors                   | ATC100B102JT50XT     | ATC                 |
| Coax1, 2, 3, 4        | 25 $\Omega$ SemiRigid Coax, Length 2.0"   | UT-141C-25           | Micro-Coax          |
| L1, L3                | 5.0 nH, 2 Turn Inductors                  | A02TKLC              | Coilcraft           |
| L2                    | 2.5 nH, 1 Turn Inductor                   | A01TKLC              | Coilcraft           |
| R1, R2                | 10 $\Omega$ , 1/4 W Chip Resistors        | CRCW120610R0JNEA     | Vishay              |
| PCB                   | 0.030", $\epsilon_r = 3.5$                | RO4350B              | Rogers              |

**MRFE6VP8600HR6 MRFE6VP8600HR5 MRFE6VP8600HSR6 MRFE6VP8600HSR5**

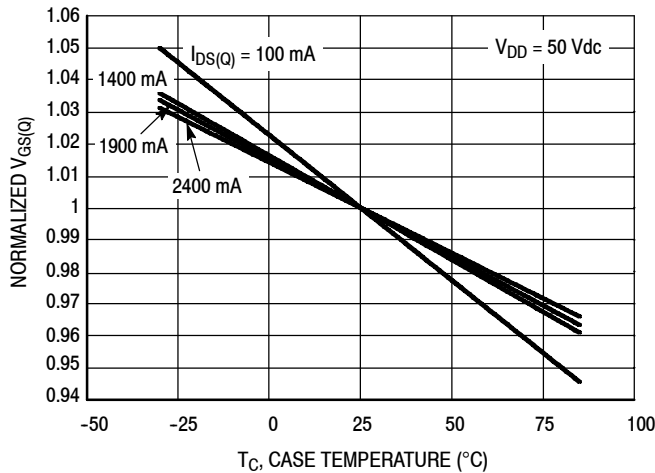


|          |                            |            |                            |            |                            |
|----------|----------------------------|------------|----------------------------|------------|----------------------------|
| Z1       | 0.204" x 0.062" Microstrip | Z17, Z18   | 0.780" x 0.080" Microstrip | Z35, Z36   | 0.052" x 0.420" Microstrip |
| Z2       | 0.245" x 0.080" Microstrip | Z19*, Z20* | 0.354" x 0.080" Microstrip | Z37, Z38   | 0.211" x 0.100" Microstrip |
| Z3, Z4   | 0.445" x 0.060" Microstrip | Z21, Z22   | 0.164" x 0.520" Microstrip | Z39, Z40   | 0.389" x 0.060" Microstrip |
| Z5, Z6   | 0.019" x 0.100" Microstrip | Z23, Z24   | 0.186" x 0.520" Microstrip | Z41        | 0.070" x 0.080" Microstrip |
| Z7, Z8   | 0.415" x 0.400" Microstrip | Z25, Z26   | 0.088" x 0.420" Microstrip | Z42        | 0.018" x 0.080" Microstrip |
| Z9, Z10  | 0.083" x 0.400" Microstrip | Z27, Z28   | 0.072" x 0.420" Microstrip | Z43        | 0.204" x 0.062" Microstrip |
| Z11, Z12 | 0.022" x 0.400" Microstrip | Z29, Z30   | 0.072" x 0.420" Microstrip | Z44*, Z45* | 0.850" x 0.080" Microstrip |
| Z13, Z14 | 0.208" x 0.850" Microstrip | Z31, Z32   | 0.259" x 0.420" Microstrip | Z46, Z47   | 0.250" x 0.080" Microstrip |
| Z15, Z16 | 0.242" x 0.960" Microstrip | Z33, Z34   | 0.075" x 0.420" Microstrip |            |                            |

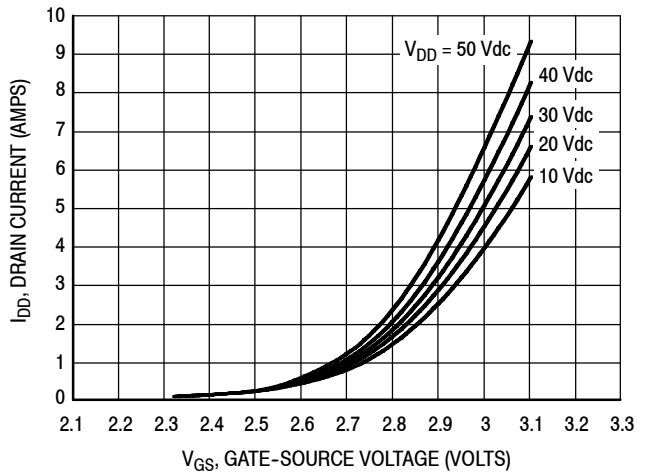
\* Line length includes microstrip bends

Figure 3. MRFE6VP8600HR6(HSR6) Test Circuit Schematic — 860 MHz, DVB-T (8k OFDM)

## TYPICAL CHARACTERISTICS — 860 MHz

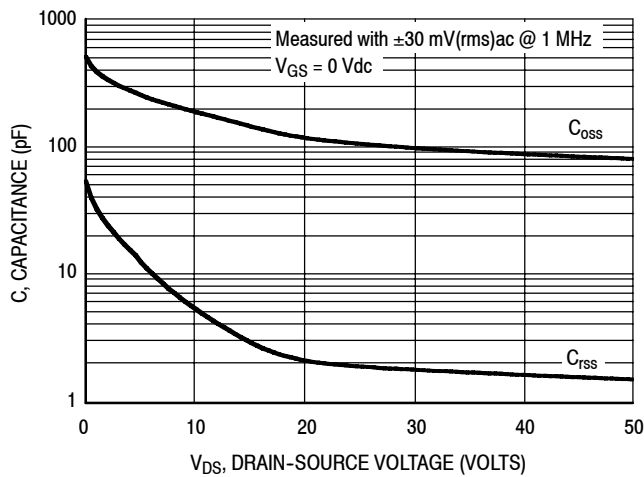


**Figure 4. Normalized  $V_{GS}$  Quiescent versus Case Temperature**



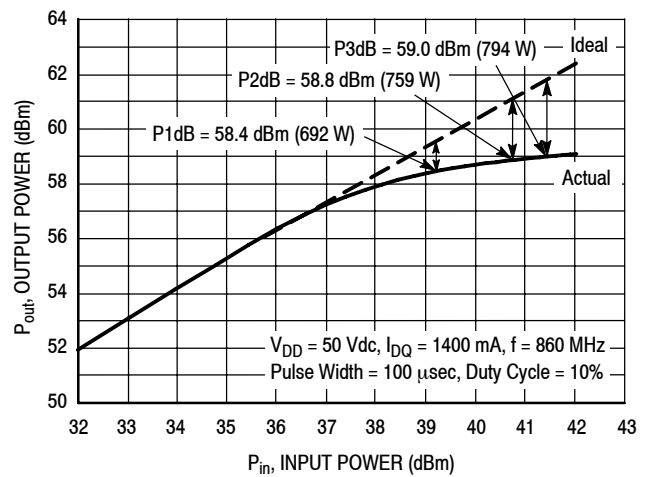
**Note:** Measured with both sides of the transistor tied together.

**Figure 5. Drain Current versus Gate-Source Voltage**

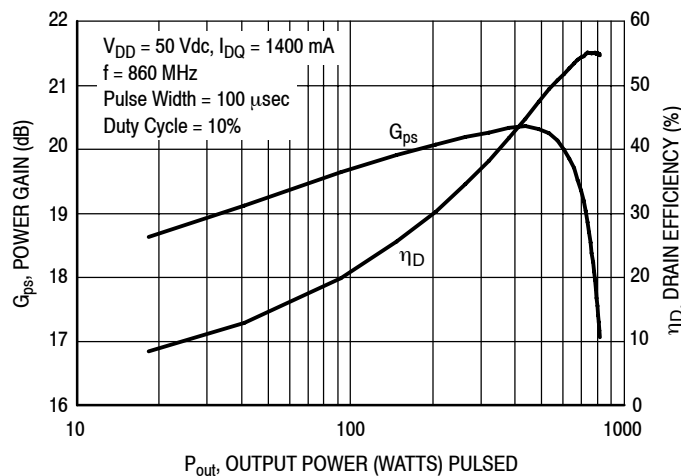


**Note:** Each side of device measured separately.

**Figure 6. Capacitance versus Drain-Source Voltage**



**Figure 7. Pulsed CW Output Power versus Input Power**



**Figure 8. Pulsed Power Gain and Drain Efficiency versus Output Power**

## TYPICAL CHARACTERISTICS — DVB-T (8k OFDM)

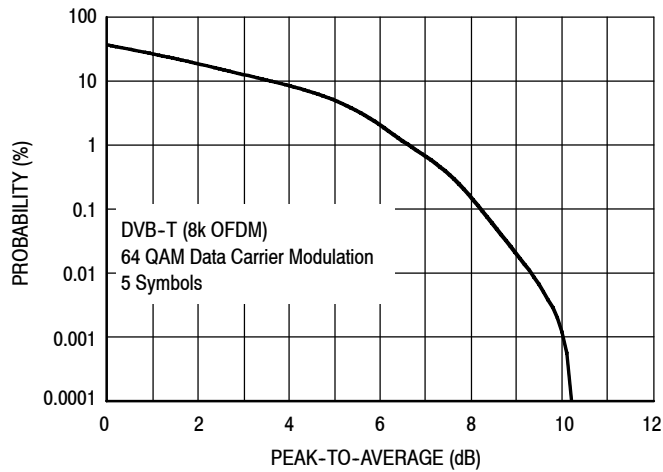


Figure 9. Source Peak-to-Average DVB-T (8k OFDM)

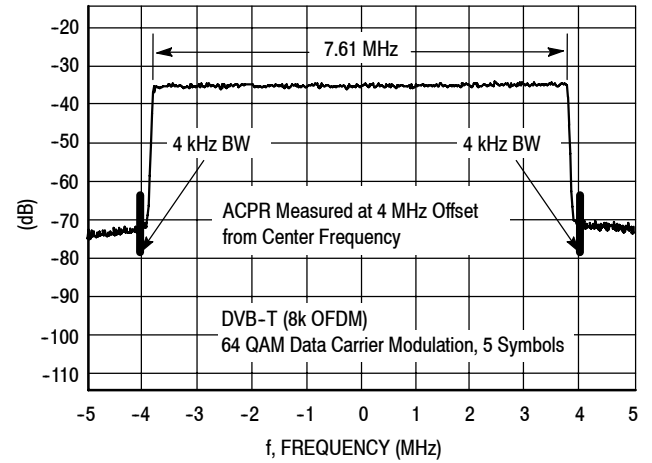


Figure 10. DVB-T (8k OFDM) Spectrum

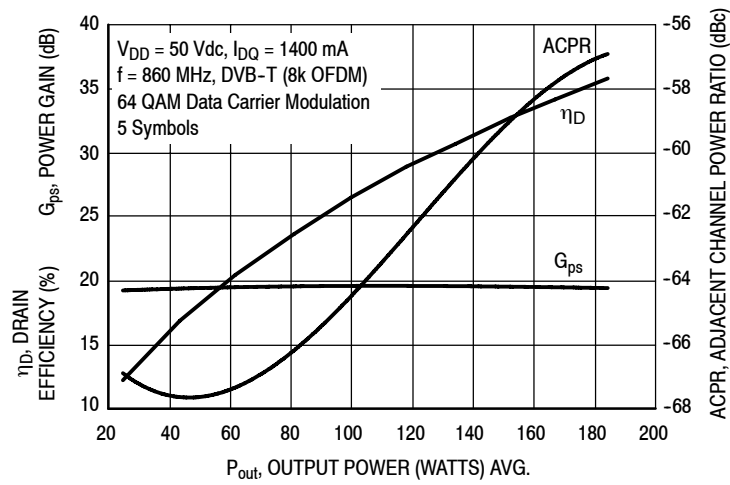
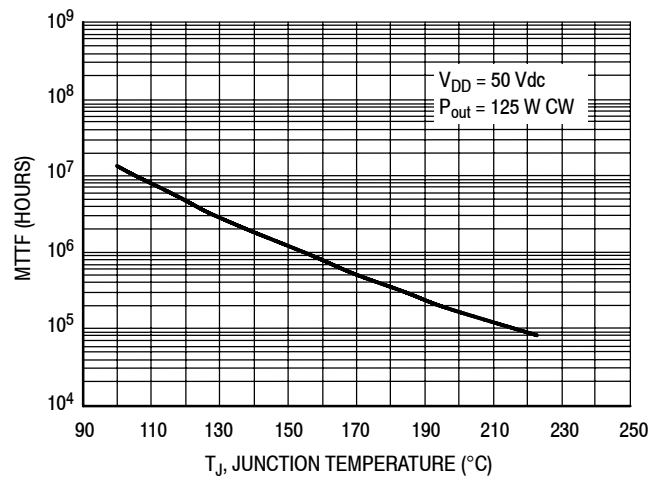


Figure 11. Single-Carrier DVB-T (8k OFDM) Drain Efficiency, Power Gain and ACPR versus Output Power

## TYPICAL CHARACTERISTICS



**Note:** The MTTF calculation for this graph is based on the thermal resistance of the part using thermal grease TIM mounting.

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

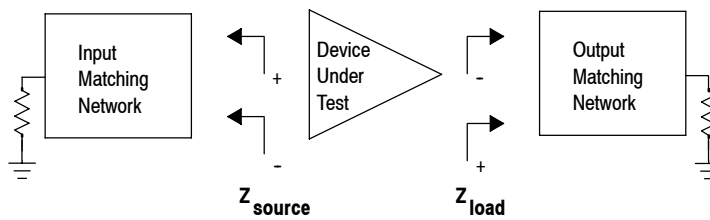
**Figure 12. MTTF versus Junction Temperature - CW**

$V_{DD} = 50 \text{ Vdc}$ ,  $I_{DQ} = 1400 \text{ mA}$ ,  $P_{out} = 125 \text{ W Avg.}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 860      | $1.14 + j0.88$           | $2.61 + j1.84$         |

$Z_{source}$  = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$  = Test circuit impedance as measured from drain to drain, balanced configuration.

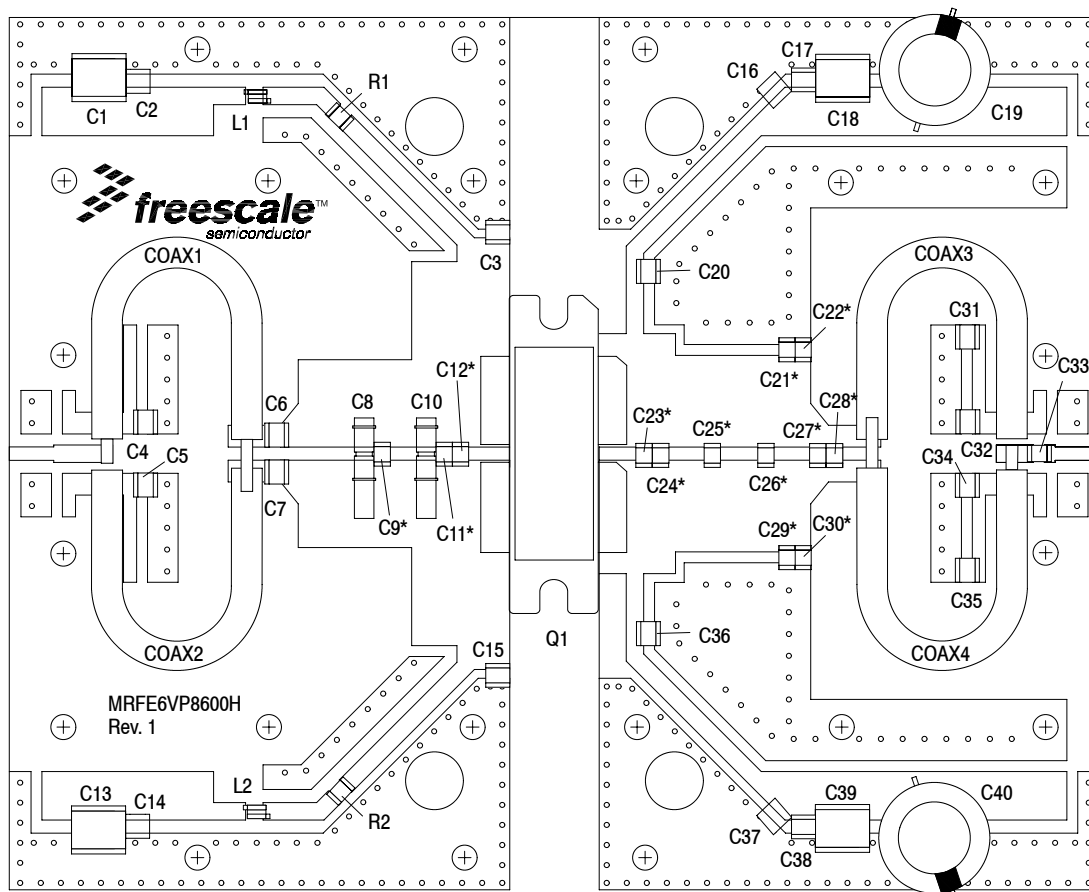


**Figure 13. Series Equivalent Source and Load Impedance**

## 470-860 MHz REFERENCE CIRCUIT

$V_{DD} = 50$  Volts,  $I_{DQ} = 1400$  mA, Channel Bandwidth = 8 MHz, Input Signal PAR = 9.5 dB @ 0.01% Probability on CCDF,  $T_C = 50^\circ\text{C}$ .

| Signal Type     | $P_{out}$<br>(W) | f<br>(MHz) | $G_{ps}$<br>(dB) | $\eta_D$<br>(%) | Output<br>PAR<br>(dB) | IMD<br>Shoulder<br>(dBc) |
|-----------------|------------------|------------|------------------|-----------------|-----------------------|--------------------------|
| DVB-T (8k OFDM) | 125 Avg.         | 470        | 19.0             | 27.2            | 8.2                   | -31.1                    |
|                 |                  | 650        | 20.3             | 30.6            | 7.6                   | -30.3                    |
|                 |                  | 860        | 19.0             | 27.9            | 7.7                   | -30.4                    |



\*C9, C11, C12, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30 and C33 are mounted vertically.

**Figure 14. MRFE6VP8600HR6(HSR6) Broadband Test Circuit Component Layout — 470-860 MHz**

## 470–860 MHz REFERENCE CIRCUIT

**Table 6. MRFE6VP8600HR6(HSR6) Broadband Test Circuit Component Designations and Values — 470–860 MHz**

| Part           | Description                                | Part Number        | Manufacturer        |
|----------------|--------------------------------------------|--------------------|---------------------|
| C1, C13        | 10 $\mu$ F, 50 V Chip Capacitors           | GRM55DR61H106KA88L | Murata              |
| C2, C14        | 2.2 $\mu$ F, 50 V Chip Capacitors          | C3225X7R1H225K     | TDK                 |
| C3, C15        | 10 pF Chip Capacitors                      | ATC100B100JT500XT  | ATC                 |
| C4, C5         | 47 pF Chip Capacitors                      | ATC100B470JT500XT  | ATC                 |
| C6, C7         | 27 pF Chip Capacitors                      | ATC100B270JT500XT  | ATC                 |
| C8, C10        | 0.8–8.0 pF Variable Capacitors             | 27291SL            | Johanson Components |
| C9, C28        | 8.2 pF Chip Capacitors                     | ATC100B8R2CT500XT  | ATC                 |
| C11, C12       | 6.8 pF Chip Capacitors                     | ATC800B6R8BT500XT  | ATC                 |
| C16, C37       | 39,000 pF Chip Capacitors                  | ATC200B393KT500XT  | ATC                 |
| C17, C38       | 2.2 $\mu$ F, 100 V Chip Capacitors         | C3225X7R2A225KT    | TDK                 |
| C18, C39       | 4.7 $\mu$ F, 100 V Chip Capacitors         | GRM55ER72A475KA01B | Murata              |
| C19, C40       | 220 $\mu$ F, 100 V Electrolytic Capacitors | EEV-FK2A221M       | Panasonic-ECG       |
| C20, C36       | 56 pF Chip Capacitors                      | ATC100B560CT500XT  | ATC                 |
| C21, C25, C29  | 7.5 pF Chip Capacitors                     | ATC800B7R5CT500XT  | ATC                 |
| C22, C30       | 8.2 pF Chip Capacitors                     | ATC800B8R2CT500XT  | ATC                 |
| C23            | 13 pF Chip Capacitor                       | ATC800B130JT500XT  | ATC                 |
| C24            | 9.1 pF Chip Capacitor                      | ATC800B9R1CT500XT  | ATC                 |
| C26            | 3.3 pF Chip Capacitor                      | ATC800B3R3CT500XT  | ATC                 |
| C27            | 3.9 pF Chip Capacitor                      | ATC100B3R9CT500XT  | ATC                 |
| C31, C35       | 1,000 pF Chip Capacitors                   | ATC100B102JT50XT   | ATC                 |
| C32, C33, C34  | 120 pF Chip Capacitors                     | ATC100B121JT500XT  | ATC                 |
| L1, L2         | 5.0 nH, 2 Turn Inductors                   | A02TKLC            | Coilcraft           |
| R1, R2         | 10 $\Omega$ , 1/4 W Chip Resistors         | CRCW120610R0JNEA   | Vishay              |
| Coax1, 2, 3, 4 | 25 $\Omega$ SemiRigid Coax, Length 2.0"    | UT-141C-25         | Micro-Coax          |
| Q1             | RF Power LDMOS Transistor                  | MRFE6VP8600HR6     | Freescale           |
| PCB            | 0.030", $\epsilon_r = 3.5$                 | RO4350B            | Rogers              |

**Table 7. MRFE6VP8600HR6(HSR6) Broadband Test Circuit Microstrips — 470–860 MHz**

| Microstrip | Description                | Microstrip | Description                |
|------------|----------------------------|------------|----------------------------|
| Z1         | 0.204" x 0.062" Microstrip | Z33, Z34   | 0.038" x 0.520" Microstrip |
| Z2         | 0.245" x 0.080" Microstrip | Z35, Z36   | 0.170" x 0.420" Microstrip |
| Z3, Z4     | 0.445" x 0.060" Microstrip | Z37, Z38   | 0.269" x 0.420" Microstrip |
| Z5, Z6     | 0.019" x 0.100" Microstrip | Z39, Z40   | 0.069" x 0.420" Microstrip |
| Z7, Z8     | 0.305" x 0.400" Microstrip | Z41, Z42   | 0.075" x 0.420" Microstrip |
| Z9, Z10    | 0.083" x 0.400" Microstrip | Z43, Z44   | 0.038" x 0.420" Microstrip |
| Z11, Z12   | 0.095" x 0.400" Microstrip | Z45, Z46   | 0.038" x 0.100" Microstrip |
| Z13, Z14   | 0.055" x 0.850" Microstrip | Z47, Z48   | 0.075" x 0.100" Microstrip |
| Z15, Z16   | 0.083" x 0.850" Microstrip | Z49, Z50   | 0.169" x 0.100" Microstrip |
| Z17, Z18   | 0.071" x 0.850" Microstrip | Z51, Z52   | 0.389" x 0.060" Microstrip |
| Z19, Z20   | 0.187" x 0.960" Microstrip | Z53        | 0.070" x 0.080" Microstrip |
| Z21, Z22   | 0.055" x 0.960" Microstrip | Z54        | 0.018" x 0.080" Microstrip |
| Z23, Z24   | 0.780" x 0.080" Microstrip | Z55        | 0.204" x 0.062" Microstrip |
| Z25*, Z26* | 0.354" x 0.080" Microstrip | Z56, Z57   | 0.278" x 0.080" Microstrip |
| Z27, Z28   | 0.164" x 0.520" Microstrip | Z58*, Z59* | 0.886" x 0.080" Microstrip |
| Z29, Z30   | 0.074" x 0.520" Microstrip |            |                            |
| Z31, Z32   | 0.075" x 0.520" Microstrip |            |                            |

\* Line length includes microstrip bends

# 470-860 MHz REFERENCE CIRCUIT

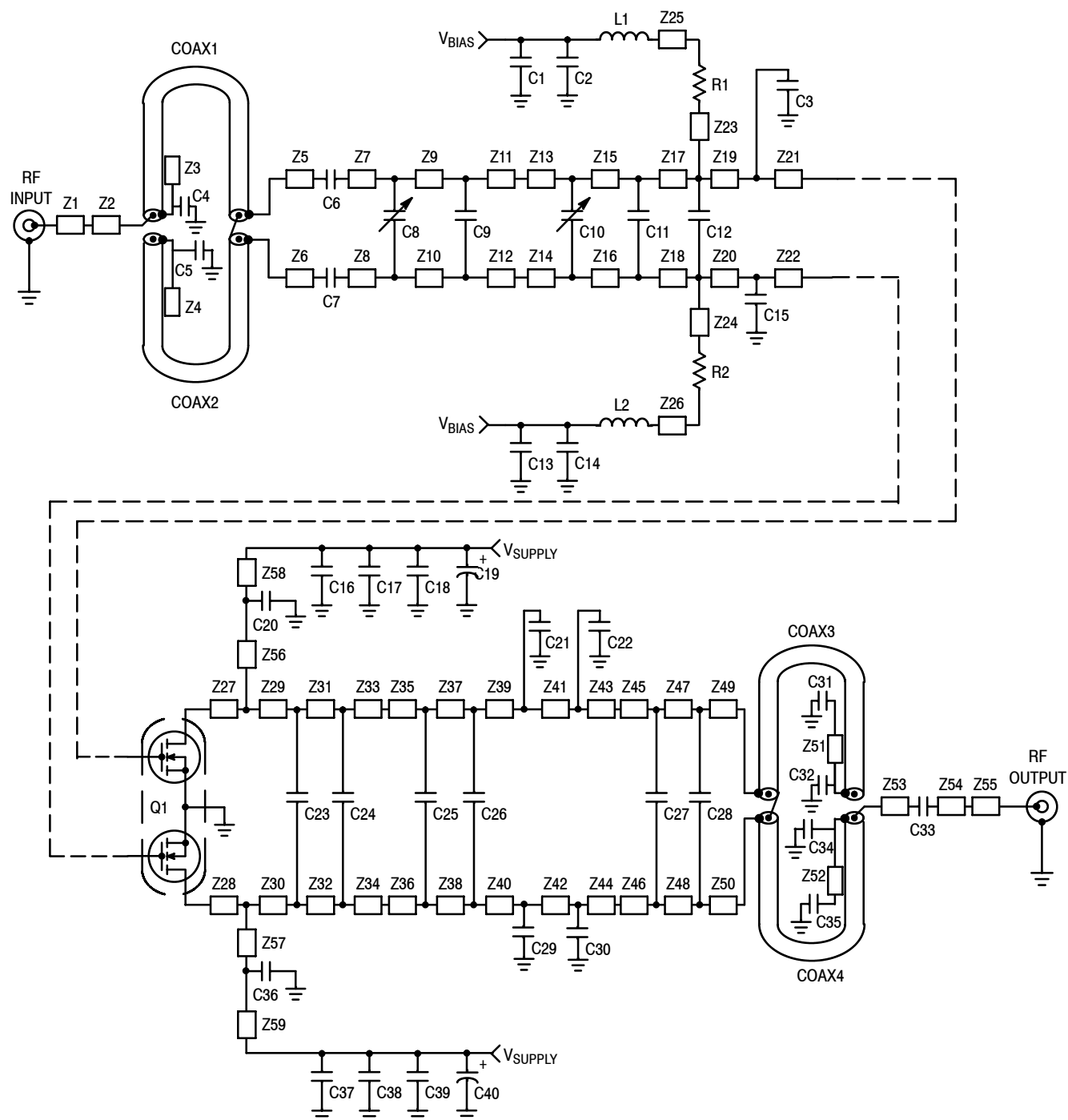
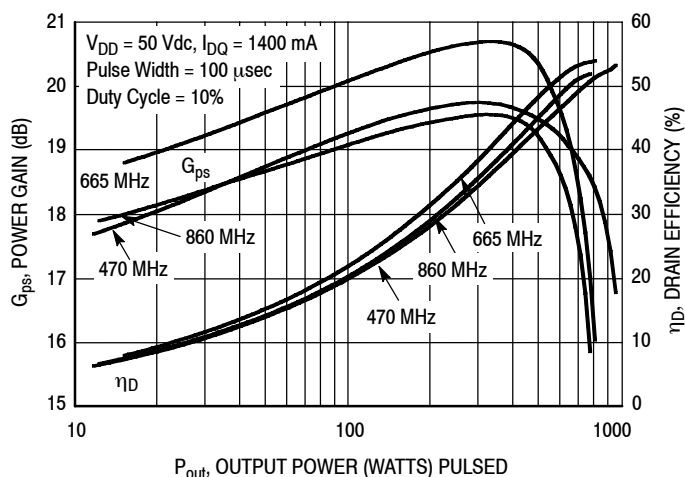
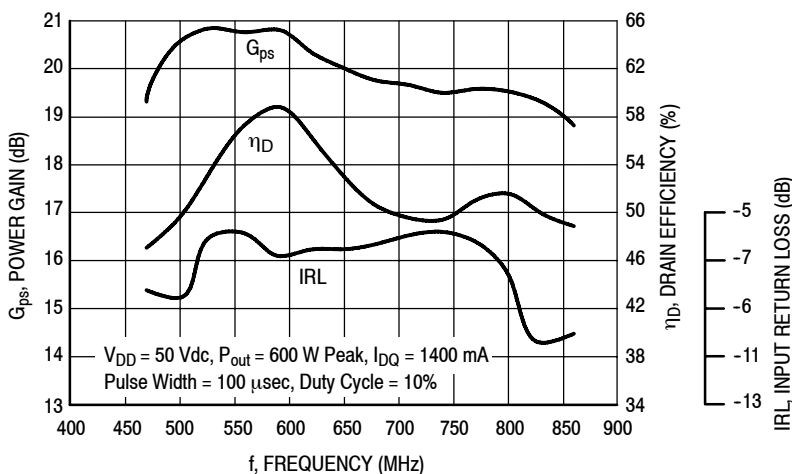


Figure 15. MRFE6VP8600HR6(HSR6) Broadband Test Circuit Schematic — 470-860 MHz

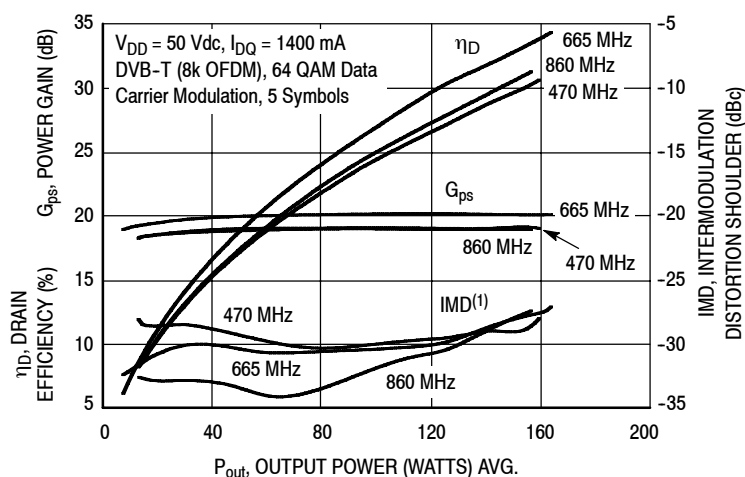
## TYPICAL CHARACTERISTICS — 470-860 MHz REFERENCE CIRCUIT



**Figure 16. Broadband Pulsed Power Gain and Drain Efficiency versus Output Power — 470-860 MHz**



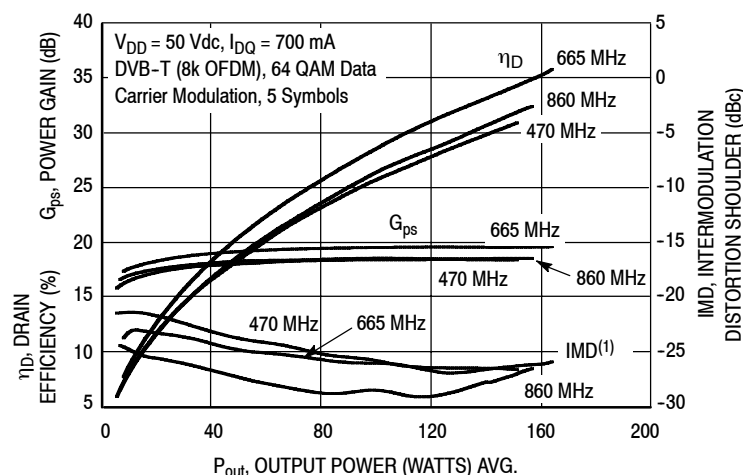
**Figure 17. Broadband Pulsed Power Gain, Drain Efficiency and IRL versus Frequency**



(1) Intermodulation distortion shoulder measurement made using delta marker at 4.2 MHz offset from center frequency.

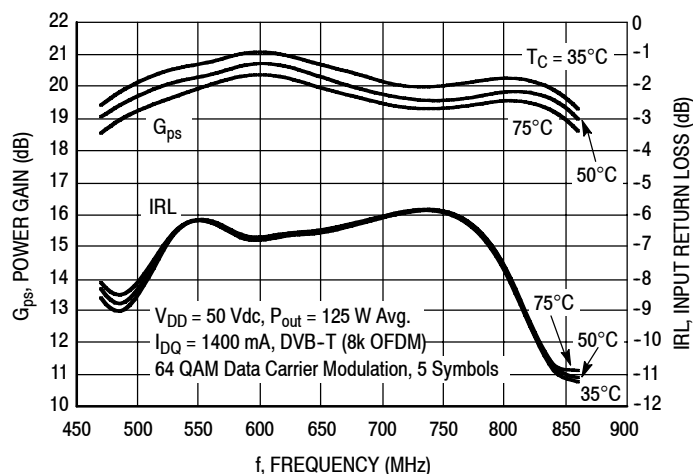
**Figure 18. DVB-T (8k OFDM) Drain Efficiency, Power Gain and IMD Shoulder versus Output Power — 470-860 MHz**

## TYPICAL CHARACTERISTICS — 470-860 MHz REFERENCE CIRCUIT

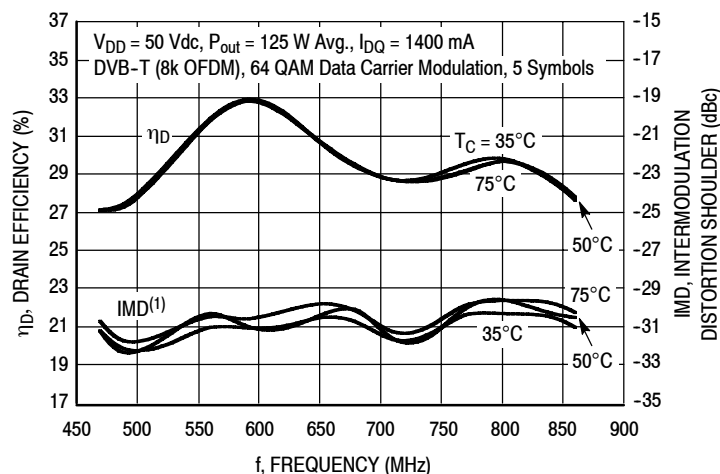


(1) Intermodulation distortion shoulder measurement made using delta marker at 4.2 MHz offset from center frequency.

**Figure 19. DVB-T (8k OFDM) Drain Efficiency, Power Gain and IMD Shoulder versus Output Power — 470-860 MHz**



**Figure 20. Broadband Power Gain and IRL versus Frequency**

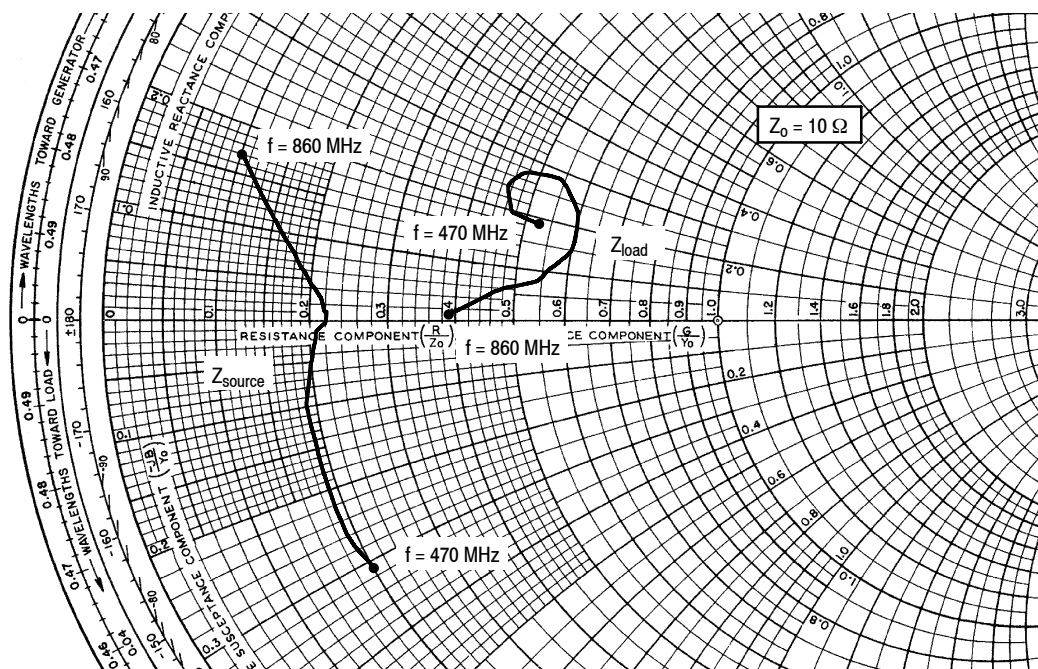


(1) Intermodulation distortion shoulder measurement made using delta marker at 4.2 MHz offset from center frequency.

**Figure 21. Broadband Drain Efficiency and IMD Shoulder versus Frequency**

MRFE6VP8600HR6 MRFE6VP8600HR5 MRFE6VP8600HSR6 MRFE6VP8600HSR5

## 470-860 MHz REFERENCE CIRCUIT



$V_{DD} = 50 \text{ Vdc}$ ,  $I_{DQ} = 1400 \text{ mA}$ ,  $P_{out} = 125 \text{ W Avg.}$

| f<br>MHz | $Z_{source}$<br>$\Omega$ | $Z_{load}$<br>$\Omega$ |
|----------|--------------------------|------------------------|
| 470      | $1.96 - j3.13$           | $5.30 + j1.92$         |
| 500      | $1.91 - j2.46$           | $4.65 + j1.95$         |
| 530      | $1.88 - j1.86$           | $4.50 + j2.35$         |
| 560      | $1.91 - j1.37$           | $4.71 + j2.66$         |
| 590      | $1.93 - j0.94$           | $5.40 + j2.75$         |
| 620      | $1.99 - j0.49$           | $5.93 + j2.29$         |
| 650      | $2.11 - j0.14$           | $6.03 + j1.81$         |
| 680      | $2.17 + j0.02$           | $6.04 + j1.45$         |
| 710      | $2.14 + j0.26$           | $5.58 + j0.95$         |
| 740      | $2.11 + j0.32$           | $5.37 + j0.80$         |
| 770      | $1.92 + j0.56$           | $4.80 + j0.56$         |
| 800      | $1.65 + j0.91$           | $4.78 + j0.55$         |
| 830      | $1.50 + j1.07$           | $4.59 + j0.45$         |
| 860      | $0.95 + j1.72$           | $3.93 + j0.11$         |

$Z_{source}$  = Test circuit impedance as measured from gate to gate, balanced configuration.

$Z_{load}$  = Test circuit impedance as measured from drain to drain, balanced configuration.

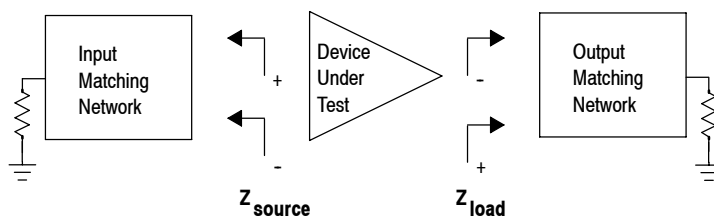
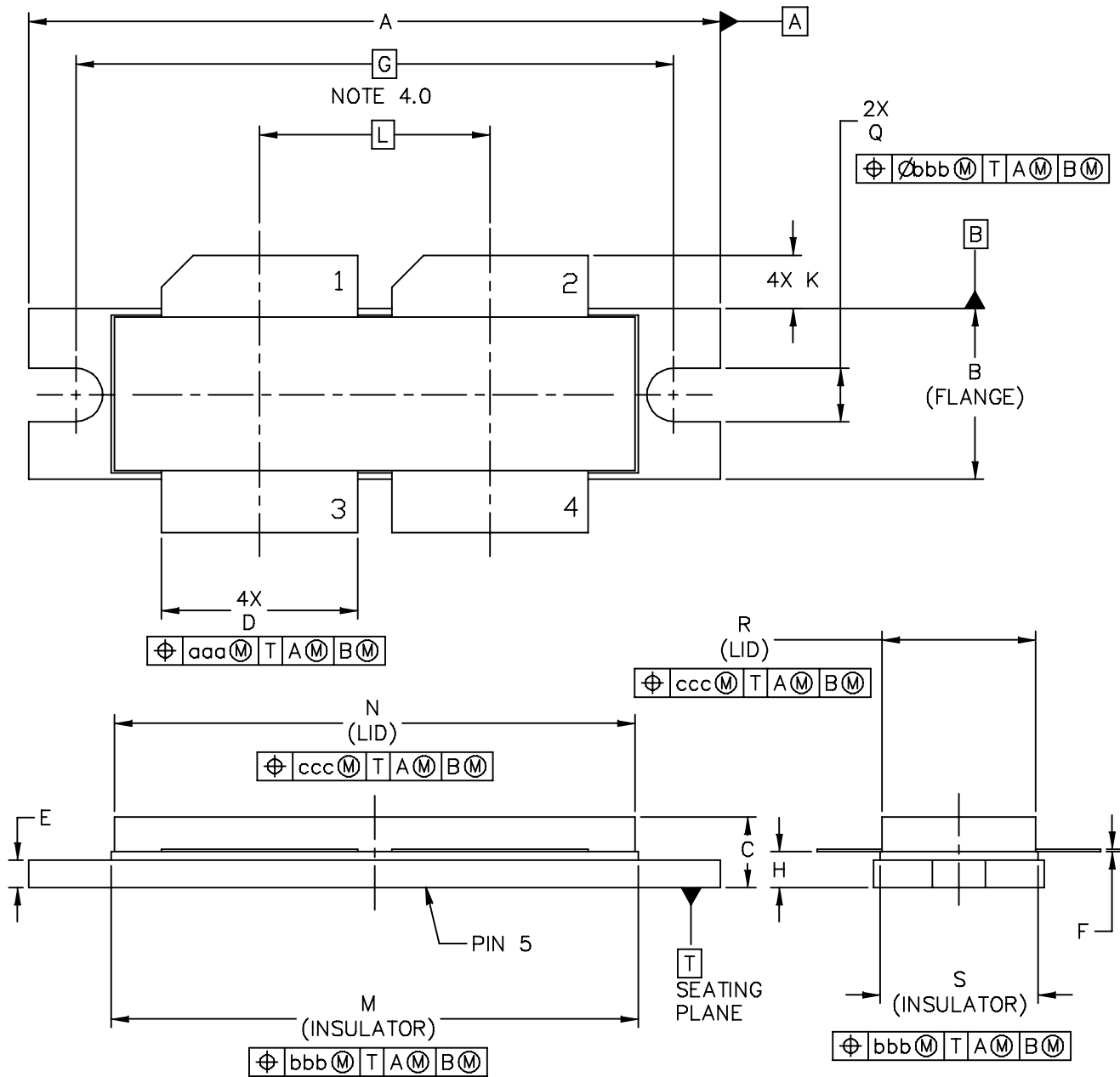


Figure 22. Broadband Series Equivalent Source and Load Impedance — 470-860 MHz

# PACKAGE DIMENSIONS



|                                                         |  |                          |  |                            |  |
|---------------------------------------------------------|--|--------------------------|--|----------------------------|--|
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| TITLE:<br><br>NI-1230                                   |  | DOCUMENT NO: 98ASB16977C |  | REV: E                     |  |
|                                                         |  | CASE NUMBER: 375D-05     |  | 31 MAR 2005                |  |
|                                                         |  | STANDARD: NON-JEDEC      |  |                            |  |

MRFE6VP8600HR6 MRFE6VP8600HR5 MRFE6VP8600HSR6 MRFE6VP8600HSR5

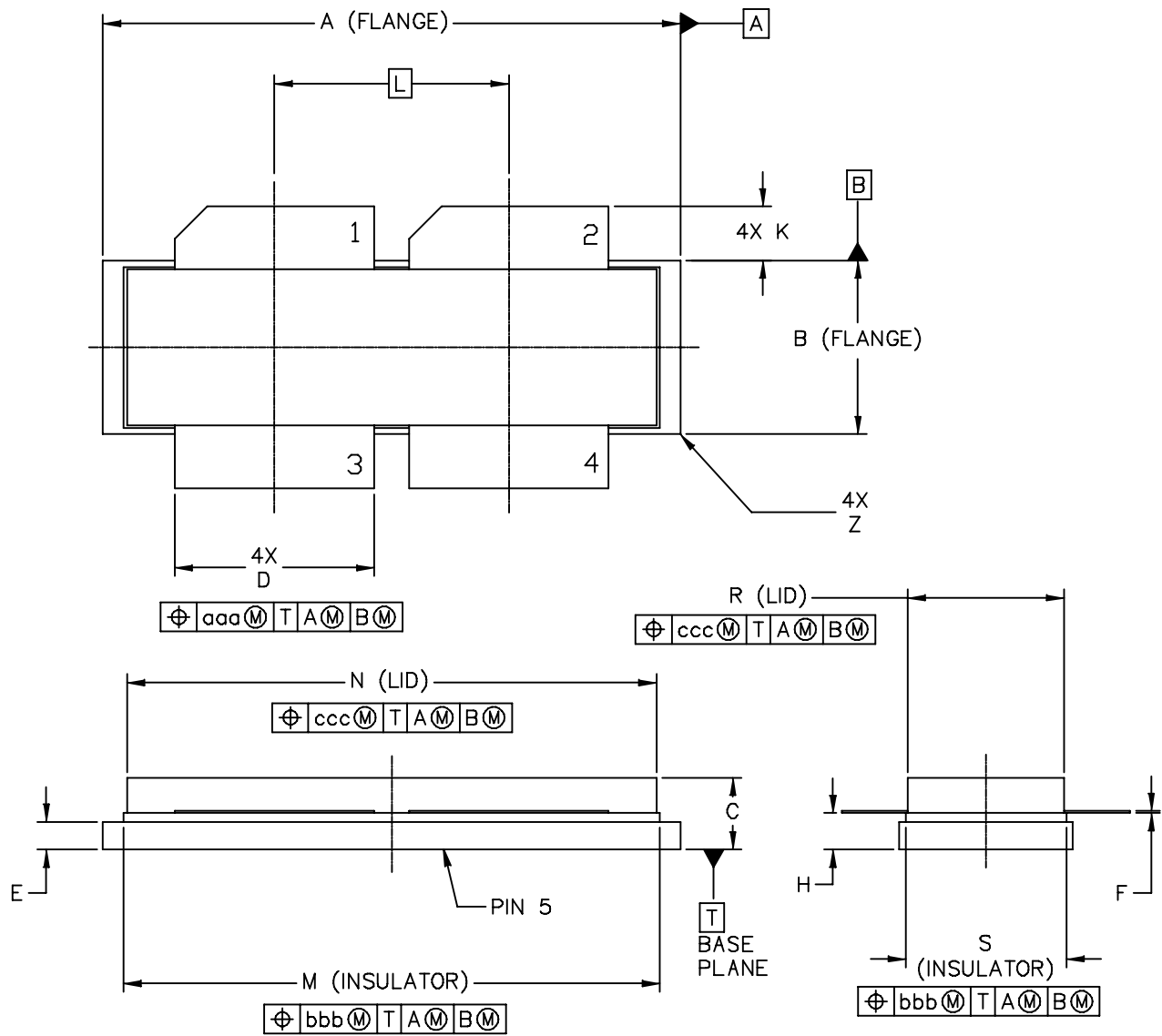
NOTES:

- 1.0 INTERPRET DIMENSIONS AND TOLERANCES  
PER ASME Y14.5M-1994.
- 2.0 CONTROLLING DIMENSION: INCH
- 3.0 DIMENSION H IS MEASURED .030 (0.762)  
AWAY FROM PACKAGE BODY.
- 4.0 RECOMMENDED BOLT CENTER DIMENSION OF  
1.52 (38.61) BASED ON M3 SCREW.

STYLE 1:

- PIN 1 - DRAIN  
2 - DRAIN  
3 - GATE  
4 - GATE  
5 - SOURCE

| INCH                                                    |           |       | MILLIMETER         |       | INCH                     |                            |       | MILLIMETER  |       |
|---------------------------------------------------------|-----------|-------|--------------------|-------|--------------------------|----------------------------|-------|-------------|-------|
| DIM                                                     | MIN       | MAX   | MIN                | MAX   | DIM                      | MIN                        | MAX   | MIN         | MAX   |
| A                                                       | 1.615     | 1.625 | 41.02              | 41.28 | N                        | 1.218                      | 1.242 | 30.94       | 31.55 |
| B                                                       | .395      | .405  | 10.03              | 10.29 | Q                        | .120                       | .130  | 3.05        | 3.3   |
| C                                                       | .150      | .200  | 3.81               | 5.08  | R                        | .355                       | .365  | 9.01        | 9.27  |
| D                                                       | .455      | .465  | 11.56              | 11.81 | S                        | .365                       | .375  | 9.27        | 9.53  |
| E                                                       | .062      | .066  | 1.57               | 1.68  |                          |                            |       |             |       |
| F                                                       | .004      | .007  | 0.1                | 0.18  |                          |                            |       |             |       |
| G                                                       | 1.400 BSC |       | 35.56 BSC          |       | aaa                      | .013                       |       | 0.33        |       |
| H                                                       | .082      | .090  | 2.08               | 2.29  | bbb                      | .010                       |       | 0.25        |       |
| K                                                       | .117      | .137  | 2.97               | 3.48  | ccc                      | .020                       |       | 0.51        |       |
| L                                                       | .540 BSC  |       | 13.72 BSC          |       |                          |                            |       |             |       |
| M                                                       | 1.219     | 1.241 | 30.96              | 31.52 |                          |                            |       |             |       |
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|                                                         |           |       |                    |       | CASE NUMBER: 375D-05     |                            |       | 31 MAR 2005 |       |
|                                                         |           |       |                    |       | STANDARD: NON-JEDEC      |                            |       |             |       |



|                                                         |  |                    |                          |                            |             |
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|                                                         |  |                    | CASE NUMBER: 375E-04     |                            | 05 AUG 2005 |
|                                                         |  |                    | STANDARD: NON-JEDEC      |                            |             |

NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES  
PER ASME Y14.5M-1994.
2. CONTROLLING DIMENSION: INCH
3. DIMENSION H IS MEASURED .030  
AWAY FROM PACKAGE BODY

STYLE 1:

- PIN 1 - DRAIN  
2 - DRAIN  
3 - GATE  
4 - GATE  
5 - SOURCE

| DIM                                                     | INCHES   |       | MILLIMETERS        |       | DIM                      | INCHES                     |      | MILLIMETERS |      |
|---------------------------------------------------------|----------|-------|--------------------|-------|--------------------------|----------------------------|------|-------------|------|
|                                                         | MIN      | MAX   | MIN                | MAX   |                          | MIN                        | MAX  | MIN         | MAX  |
| A                                                       | 1.265    | 1.275 | 32.13              | 32.38 | R                        | .355                       | .365 | 9.01        | 9.27 |
| B                                                       | .395     | .405  | 10.03              | 10.29 | S                        | .365                       | .375 | 9.27        | 9.53 |
| C                                                       | .150     | .200  | 3.81               | 5.08  | Z                        | ---                        | .040 | ---         | 1.02 |
| D                                                       | .455     | .465  | 11.56              | 11.81 |                          |                            |      |             |      |
| E                                                       | .062     | .066  | 1.57               | 1.68  | aaa                      | .013                       |      | 0.33        |      |
| F                                                       | .004     | .007  | 0.1                | 0.18  | bbb                      | .010                       |      | 0.25        |      |
| H                                                       | .082     | .090  | 2.08               | 2.29  | ccc                      | .020                       |      | 0.51        |      |
| K                                                       | .117     | .137  | 2.97               | 3.48  |                          |                            |      |             |      |
| L                                                       | .540 BSC |       | 13.72 BSC          |       |                          |                            |      |             |      |
| M                                                       | 1.219    | 1.241 | 30.96              | 31.52 |                          |                            |      |             |      |
| N                                                       | 1.218    | 1.242 | 30.94              | 31.55 |                          |                            |      |             |      |
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| TITLE:<br><br>NI-1230S                                  |          |       |                    |       | DOCUMENT NO: 98ARB18247C |                            |      | REV: F      |      |
|                                                         |          |       |                    |       | CASE NUMBER: 375E-04     |                            |      | 05 AUG 2005 |      |
|                                                         |          |       |                    |       | STANDARD: NON-JEDEC      |                            |      |             |      |

## PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following documents to aid your design process.

### Application Notes

- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

### Engineering Bulletins

- EB212: Using Data Sheet Impedances for RF LDMOS Devices

### Software

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

### Development Tools

- Printed Circuit Boards

For Software and Tools, do a Part Number search at <http://www.freescale.com>, and select the "Part Number" link. Go to the Software & Tools tab on the part's Product Summary page to download the respective tool.

## REVISION HISTORY

The following table summarizes revisions to this document.

| Revision | Date       | Description                                                                                                                                                                                          |
|----------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0        | Sept. 2011 | • Initial Release of Data Sheet                                                                                                                                                                      |
| 1        | Sept. 2011 | • Added Fig. 19, DVB-T (8k OFDM) Drain Efficiency, Power Gain and IMD Shoulder versus Output Power - 470-860 MHz @ 700 mA to indicate efficiency gains with appropriate precorrection systems, p. 13 |

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