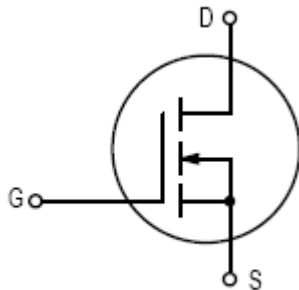


## Linear RF Power FET 30W, to 175MHz, 50V

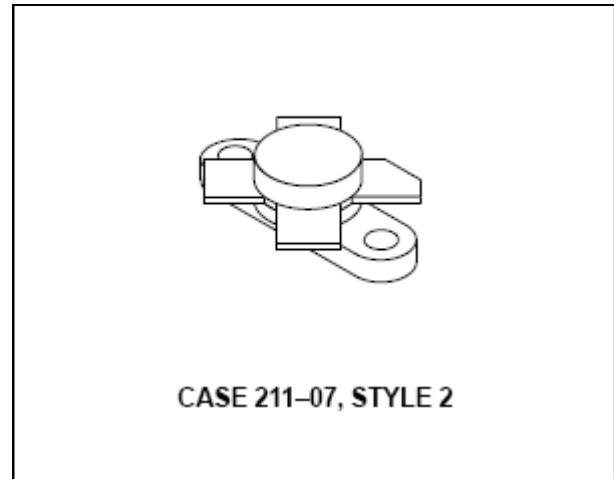
Rev. V1

Designed for power amplifier applications in industrial, commercial and amateur radio equipment to 175MHz.

- Superior high order IMD  
IMD(d3) (30W PEP): -35 dB (Typ.)  
IMD(d11) (30W PEP): -60 dB (Typ.)
- Specified 50V, 30MHz characteristics:  
Output power: 30W  
Gain: 18dB (Typ.)  
Efficiency: 40% (Typ.)
- 100% tested for load mismatch at all phase angles with 30:1 VSWR
- Lower reverse transfer capacitance (3.0 pF typ.)



### Product Image



### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	120	Vdc
Drain-Gate Voltage	$V_{DGO}$	120	Vdc
Gate-Source Voltage	$V_{GS}$	$\pm 40$	Vdc
Drain Current — Continuous	$I_D$	6.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	115 0.66	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.52	$^\circ\text{C}/\text{W}$

NOTE – **CAUTION** – MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.

## Linear RF Power FET 30W, to 175MHz, 50V

Rev. V1

### ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted.)

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

#### OFF CHARACTERISTICS

Drain–Source Breakdown Voltage (V <sub>GS</sub> = 0, I <sub>D</sub> = 10 mA)	V <sub>(BR)DSS</sub>	125	—	—	Vdc
Zero Gate Voltage Drain Current (V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0)	I <sub>DSS</sub>	—	—	1.0	mAdc
Gate–Body Leakage Current (V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0)	I <sub>GSS</sub>	—	—	100	nAdc

#### ON CHARACTERISTICS

Gate Threshold Voltage (V <sub>DS</sub> = 10 V, I <sub>D</sub> = 10 mA)	V <sub>GS(th)</sub>	1.0	2.5	5.0	Vdc
Drain–Source On–Voltage (V <sub>GS</sub> = 10 V, I <sub>D</sub> = 2.5 A)	V <sub>DS(on)</sub>	1.0	3.0	5.0	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 V, I <sub>D</sub> = 2.5 A)	g <sub>fs</sub>	0.8	1.2	—	mhos

#### DYNAMIC CHARACTERISTICS

Input Capacitance (V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0, f = 1.0 MHz)	C <sub>iSS</sub>	—	62	—	pF
Output Capacitance (V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0, f = 1.0 MHz)	C <sub>oSS</sub>	—	35	—	pF
Reverse Transfer Capacitance (V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0, f = 1.0 MHz)	C <sub>rSS</sub>	—	3.0	—	pF

#### FUNCTIONAL TESTS (SSB)

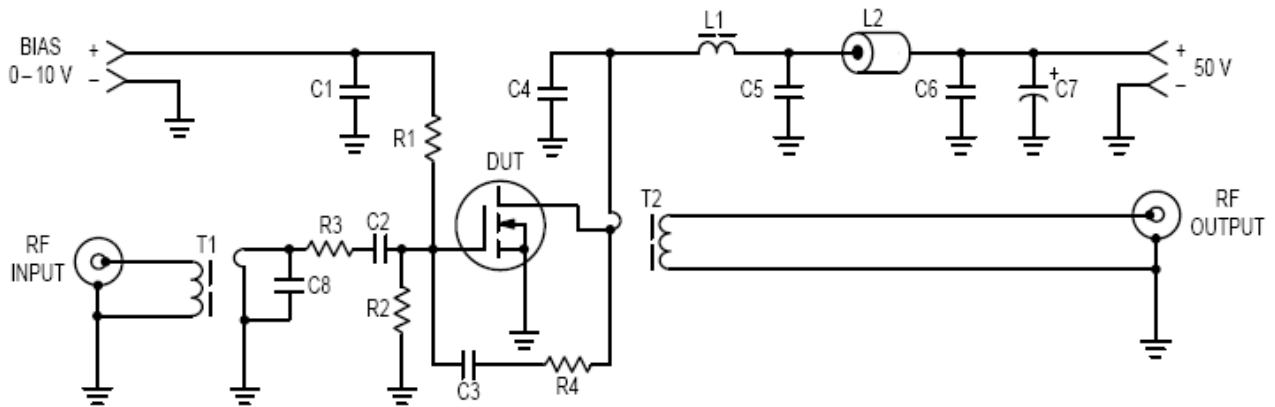
Common Source Amplifier Power Gain (V <sub>DD</sub> = 50 V, P <sub>out</sub> = 30 W (PEP), I <sub>DQ</sub> = 100 mA)	(30 MHz) (175 MHz)	G <sub>ps</sub>	— —	18 15	— —	dB
Drain Efficiency (V <sub>DD</sub> = 50 V, f = 30 MHz, I <sub>DQ</sub> = 100 mA)	(30 W PEP) (30 W CW)	η	— —	40 50	— —	%
Intermodulation Distortion (V <sub>DD</sub> = 50 V, P <sub>out</sub> = 30 W (PEP), f = 30; 30.001 MHz, I <sub>DQ</sub> = 100 mA)		IMD <sub>(d3)</sub> IMD <sub>(d11)</sub>	— —	–35 –60	— —	dB
Load Mismatch (V <sub>DD</sub> = 50 V, P <sub>out</sub> = 30 W (PEP), f = 30; 30.001 MHz, I <sub>DQ</sub> = 100 mA, VSWR 30:1 at all Phase Angles)		ψ	No Degradation in Output Power			

#### CLASS A PERFORMANCE

Intermodulation Distortion (1) and Power Gain (V <sub>DD</sub> = 50 V, P <sub>out</sub> = 10 W (PEP), f <sub>1</sub> = 30 MHz, f <sub>2</sub> = 30.001 MHz, I <sub>DQ</sub> = 1.0 A)		G <sub>ps</sub> IMD <sub>(d3)</sub> IMD <sub>(d9–13)</sub>	— — —	20 –50 –70	— — —	dB
--	--	--	-------------	------------------	-------------	----

#### NOTE:

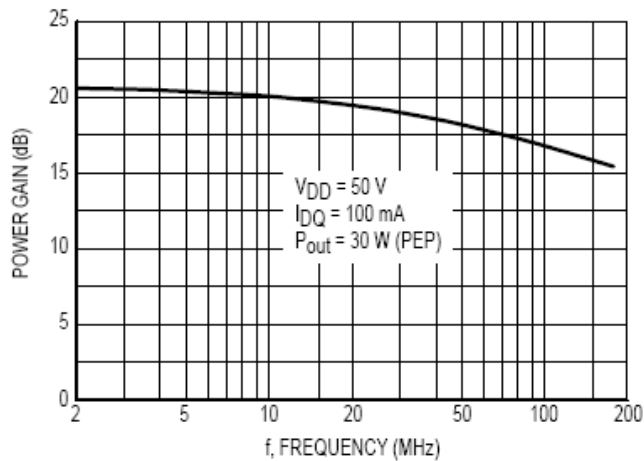
1. To MIL–STD–1311 Version A, Test Method 2204B, Two Tone, Reference Each Tone.



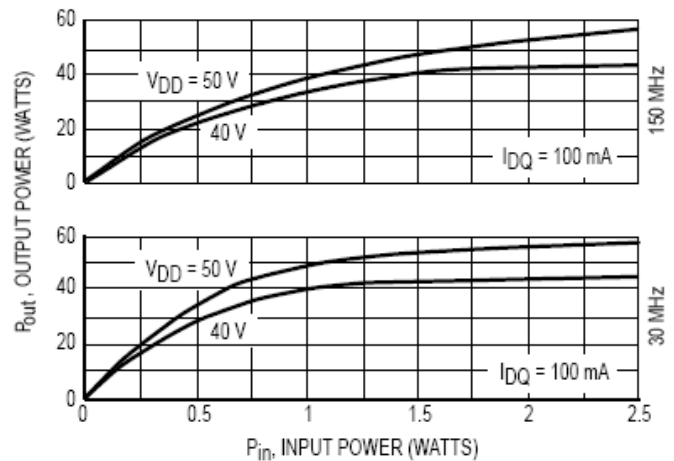
C1, C2, C3, C4, C5, C6 — 0.1  $\mu$ F Ceramic Chip or Equivalent  
 C7 — 10  $\mu$ F, 100 V Electrolytic  
 C8 — 100 pF Dipped Mica  
 L1 — VK200 20/4B Ferrite Choke or Equivalent (3.0  $\mu$ H)  
 L2 — Ferrite Bead(s), 2.0  $\mu$ H

R1, R2 — 200  $\Omega$ , 1/2 W Carbon  
 R3 — 4.7  $\Omega$ , 1/2 W Carbon  
 R4 — 470  $\Omega$ , 1.0 W Carbon  
 T1 — 4:1 Impedance Transformer  
 T2 — 1:2 Impedance Transformer

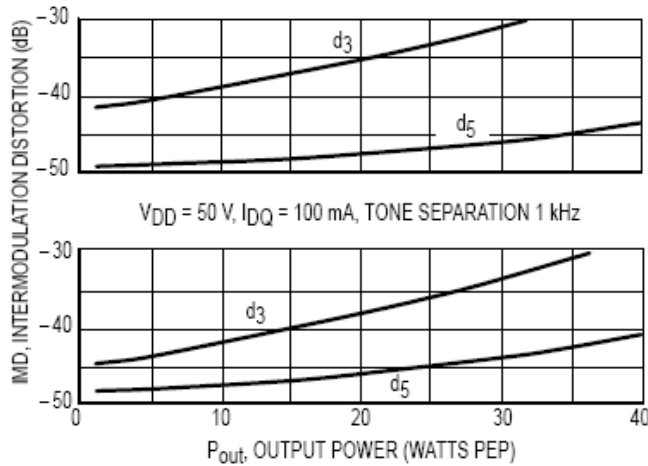
**Figure 1. 2.0 to 50 MHz Broadband Test Circuit**



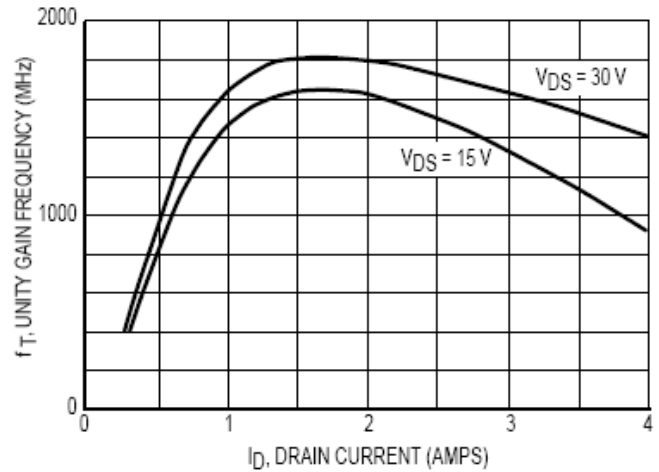
**Figure 2. Power Gain versus Frequency**



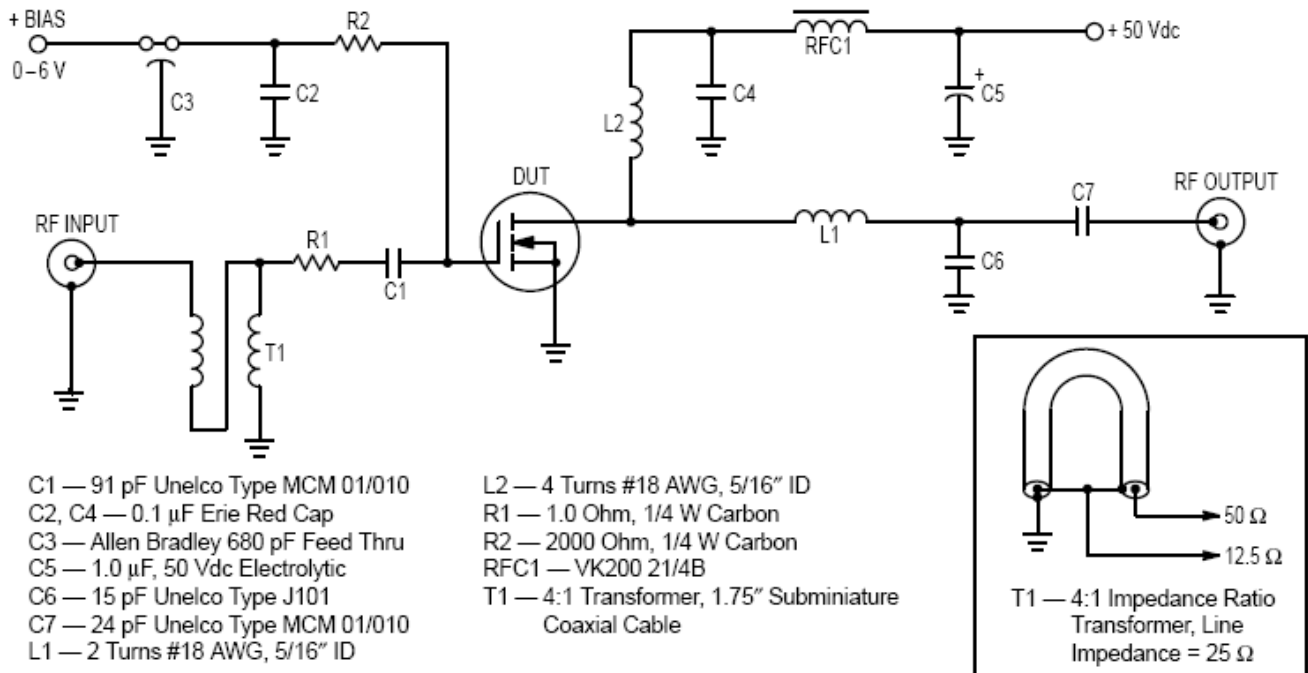
**Figure 3. Output Power versus Input Power**



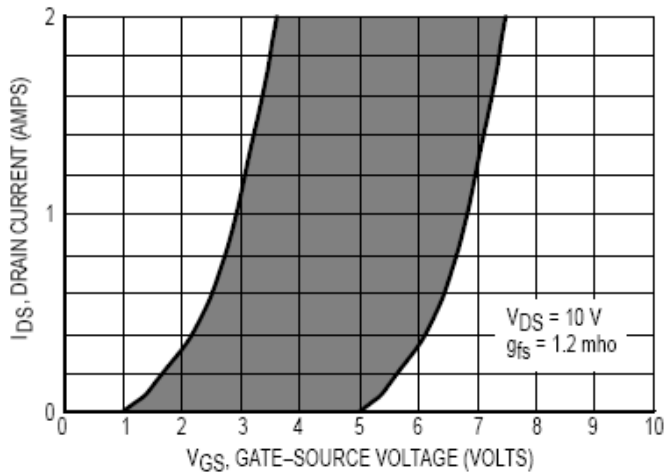
**Figure 4. IMD versus Pout**



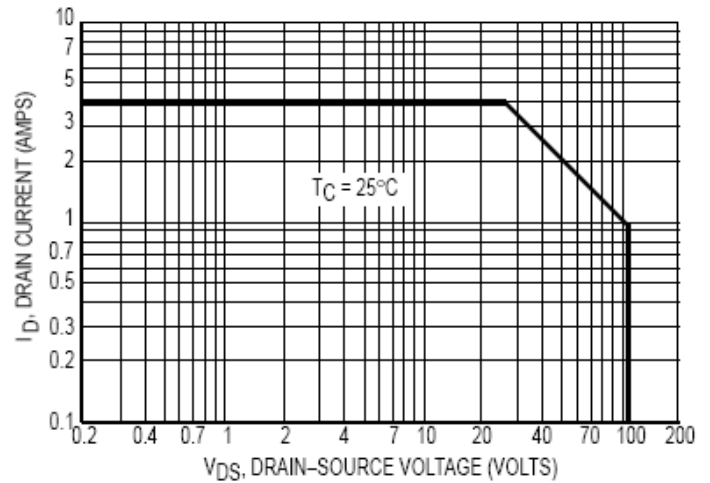
**Figure 5. Common Source Unity Gain Frequency versus Drain Current**



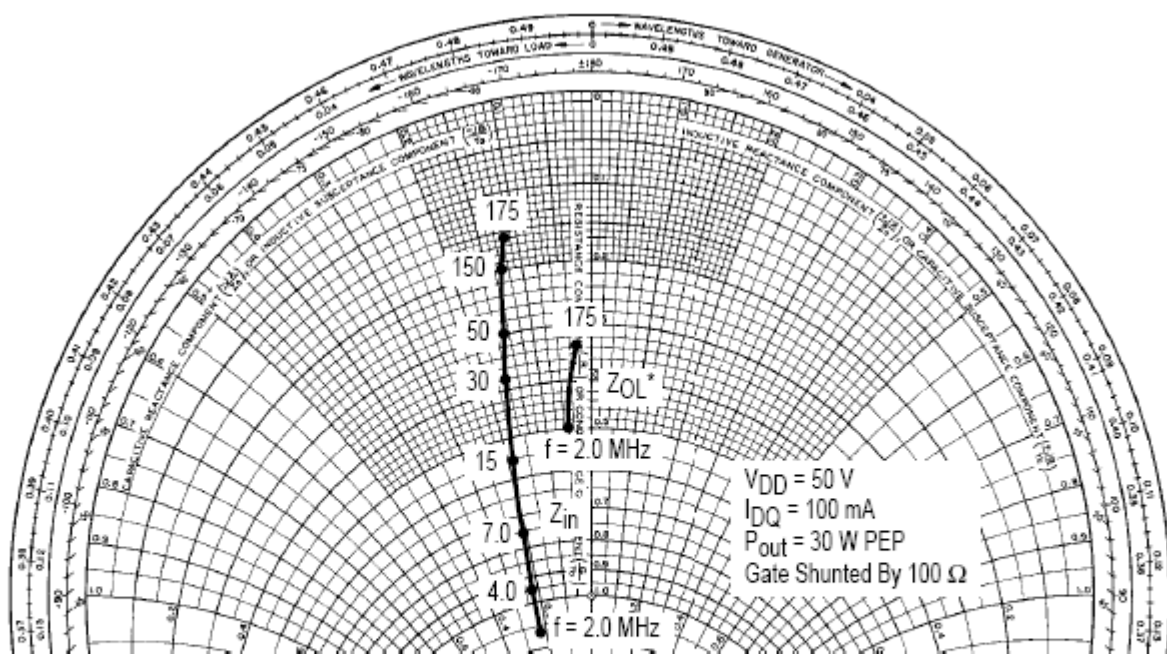
**Figure 6. 150 MHz Test Circuit**



**Figure 7. Gate Voltage versus Drain Current**



**Figure 8. DC Safe Operating Area (SOA)**



$Z_{OL}^*$  = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage and frequency.

**Figure 9. Impedance Coordinates — 50 Ohm Characteristic Impedance**

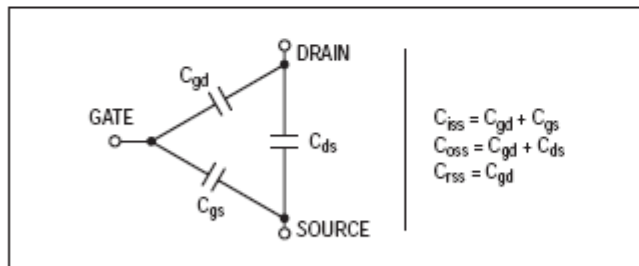
## RF POWER MOSFET CONSIDERATIONS

### MOSFET CAPACITANCES

The physical structure of a MOSFET results in capacitors between the terminals. The metal oxide gate structure determines the capacitors from gate-to-drain ( $C_{gd}$ ), and gate-to-source ( $C_{gs}$ ). The PN junction formed during the fabrication of the RF MOSFET results in a junction capacitance from drain-to-source ( $C_{ds}$ ).

These capacitances are characterized as input ( $C_{iss}$ ), output ( $C_{oss}$ ) and reverse transfer ( $C_{rss}$ ) capacitances on data sheets. The relationships between the inter-terminal capacitances and those given on data sheets are shown below. The  $C_{iss}$  can be specified in two ways:

1. Drain shorted to source and positive voltage at the gate.
2. Positive voltage of the drain in respect to source and zero volts at the gate. In the latter case the numbers are lower. However, neither method represents the actual operating conditions in RF applications.



### LINEARITY AND GAIN CHARACTERISTICS

In addition to the typical IMD and power gain data presented, Figure 5 may give the designer additional information on the capabilities of this device. The graph represents the small signal unity current gain frequency at a given drain current level. This is equivalent to  $f_T$  for bipolar transistors.

Since this test is performed at a fast sweep speed, heating of the device does not occur. Thus, in normal use, the higher temperatures may degrade these characteristics to some extent.

### DRAIN CHARACTERISTICS

One figure of merit for a FET is its static resistance in the full-on condition. This on-resistance,  $V_{DS(on)}$ , occurs in the linear region of the output characteristic and is specified under specific test conditions for gate-source voltage and drain current. For MOSFETs,  $V_{DS(on)}$  has a positive temperature coefficient and constitutes an important design consideration at high temperatures, because it contributes to the power dissipation within the device.

### GATE CHARACTERISTICS

The gate of the RF MOSFET is a polysilicon material, and is electrically isolated from the source by a layer of oxide. The input resistance is very high — on the order of  $10^9$  ohms — resulting in a leakage current of a few nanoamperes.

Gate control is achieved by applying a positive voltage slightly in excess of the gate-to-source threshold voltage,  $V_{GS(th)}$ .

**Gate Voltage Rating** — Never exceed the gate voltage rating. Exceeding the rated  $V_{GS}$  can result in permanent damage to the oxide layer in the gate region.

**Gate Termination** — The gates of these devices are essentially capacitors. Circuits that leave the gate open-circuited or floating should be avoided. These conditions can result in turn-on of the devices due to voltage build-up on the input capacitor due to leakage currents or pickup.

**Gate Protection** — These devices do not have an internal monolithic zener diode from gate-to-source. If gate protection is required, an external zener diode is recommended.

## EQUIVALENT TRANSISTOR PARAMETER TERMINOLOGY

Collector .....	Drain
Emitter .....	Source
Base .....	Gate
$V_{(BR)CES}$ .....	$V_{(BR)DSS}$
$V_{CB0}$ .....	$V_{D00}$
$I_C$ .....	$I_D$
$I_{CES}$ .....	$I_{DSS}$
$I_{EBO}$ .....	$I_{GSS}$
$V_{BE(on)}$ .....	$V_{GS(th)}$
$V_{CE(sat)}$ .....	$V_{DS(on)}$
$C_{ib}$ .....	$C_{iss}$
$C_{ob}$ .....	$C_{oss}$
$h_{fe}$ .....	$g_{fs}$

$R_{CE(sat)} = \frac{V_{CE(sat)}}{I_C}$ .....	$r_{DS(on)} = \frac{V_{DS(on)}}{I_D}$
---	---------------------------------------

## PACKAGE DIMENSIONS

NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1992.  
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.990	0.990	24.39	25.14
B	0.370	0.390	9.40	9.90
C	0.229	0.281	5.82	7.13
D	0.215	0.235	5.47	5.96
E	0.085	0.105	2.18	2.66
H	0.150	0.108	3.81	4.67
J	0.004	0.008	0.11	0.15
K	0.395	0.405	10.04	10.28
M	40°	50°	40°	50°
Q	0.113	0.130	2.88	3.30
R	0.245	0.255	6.23	6.47
S	0.790	0.810	20.07	20.57
U	0.720	0.730	18.29	18.54

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

**CASE 211-07  
ISSUE N**

M/A-COM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with M/A-COM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.