

RF Power Field Effect Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and GSM EDGE base station applications with frequencies from 921 to 960 MHz, the high gain and broadband performance of these devices make them ideal for large-signal, common-source amplifier applications in 28 volt base station equipment.

- Typical Performance for GSM Frequencies, 921 to 960 MHz, 28 Volts Output Power @ P1dB — 135 Watts
Power Gain — 16.5 dB @ 130 Watts Output Power
Efficiency — 48% @ 130 Watts Output Power
- Capable of Handling 5:1 VSWR, @ 28 Vdc, 945 MHz, 130 Watts CW Output Power

Features

- Internally Matched for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Low Gold Plating Thickness on Leads, 40μ" Nominal.
- RoHS Compliant
- In Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF9130LR3
MRF9130LSR3

GSM/GSM EDGE
921-960 MHz, 130 W, 28 V
LATERAL N-CHANNEL
RF POWER MOSFETs

CASE 465-06, STYLE 1
NI-780
MRF9130LR3

CASE 465A-06, STYLE 1
NI-780S
MRF9130LSR3

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	- 0.5, +65	Vdc
Gate-Source Voltage	V_{GS}	- 0.5, +15	Vdc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	298 1.7	W W/°C
Storage Temperature Range	T_{stg}	- 65 to +200	°C
Case Operating Temperature	T_C	150	°C
Operating Junction Temperature	T_J	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.6	°C/W

Table 3. ESD Protection Characteristics

Test Conditions	Class
Human Body Model	1 (Minimum)
Machine Model	M2 (Minimum)
Charge Device Model	C7 (Minimum)

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

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics					
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 65\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	10	μAdc
Zero Gate Voltage Drain Leakage Current ($V_{DS} = 28\text{ Vdc}$, $V_{GS} = 0\text{ Vdc}$)	I_{DSS}	—	—	1	μAdc
Gate-Source Leakage Current ($V_{GS} = 5\text{ Vdc}$, $V_{DS} = 0\text{ Vdc}$)	I_{GSS}	—	—	1	μAdc
On Characteristics					
Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 450\ \mu\text{Adc}$)	$V_{GS(th)}$	2	3	4	Vdc
Gate Quiescent Voltage ($V_{DS} = 28\text{ Vdc}$, $I_D = 1000\ \text{mAdc}$)	$V_{GS(Q)}$	—	3.6	—	Vdc
Drain-Source On-Voltage ($V_{GS} = 10\text{ Vdc}$, $I_D = 3\ \text{Adc}$)	$V_{DS(on)}$	—	0.2	0.4	Vdc
Forward Transconductance ($V_{DS} = 10\text{ Vdc}$, $I_D = 9\ \text{Adc}$)	g_{fs}	—	12	—	S
Dynamic Characteristics (1)					
Output Capacitance ($V_{DS} = 28\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{oss}	—	110	—	pF
Reverse Transfer Capacitance ($V_{DS} = 28\text{ Vdc} \pm 30\ \text{mV(rms)ac}$ @ 1 MHz, $V_{GS} = 0\text{ Vdc}$)	C_{rss}	—	4.4	—	pF
Functional Tests (In Freescale Test Fixture)					
Power Output, 1 dB Compression Point ($V_{DD} = 28\text{ Vdc}$, $I_{DQ} = 1000\ \text{mA}$, $f = 921$ and $960\ \text{MHz}$)	P_{1dB}	120	135	—	W
Common-Source Amplifier Power Gain ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 130\ \text{W}$, $I_{DQ} = 1000\ \text{mA}$, $f = 921$ and $960\ \text{MHz}$)	G_{ps}	15.5	16.5	—	dB
Drain Efficiency ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 130\ \text{W}$, $I_{DQ} = 1000\ \text{mA}$, $f = 921$ and $960\ \text{MHz}$)	η	43	48	—	%
Input Return Loss ($V_{DD} = 28\text{ Vdc}$, $P_{out} = 130\ \text{W}$, $I_{DQ} = 1000\ \text{mA}$, $f = 921$ and $960\ \text{MHz}$)	IRL	—	-12	-9	dB

1. Part internally input matched.

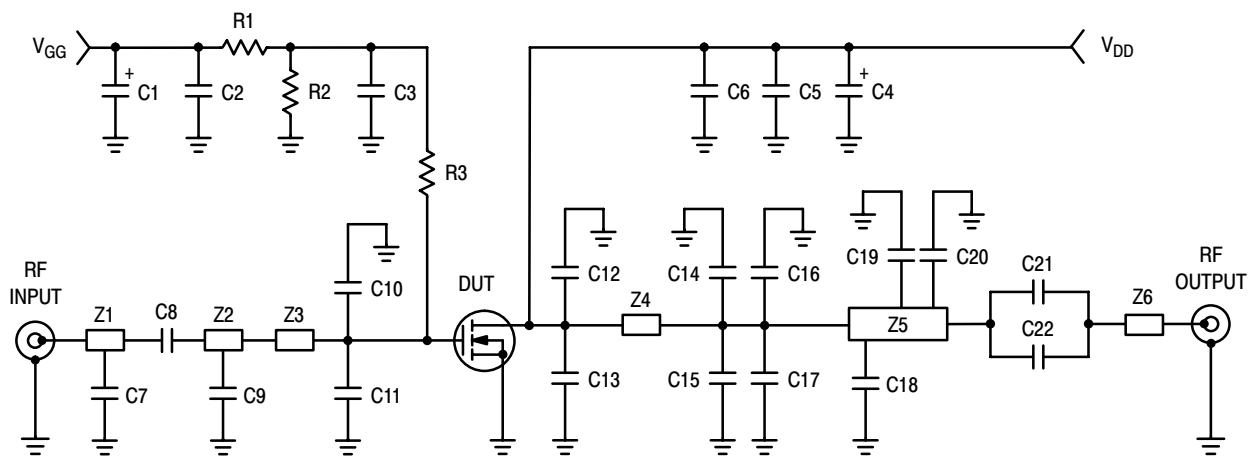
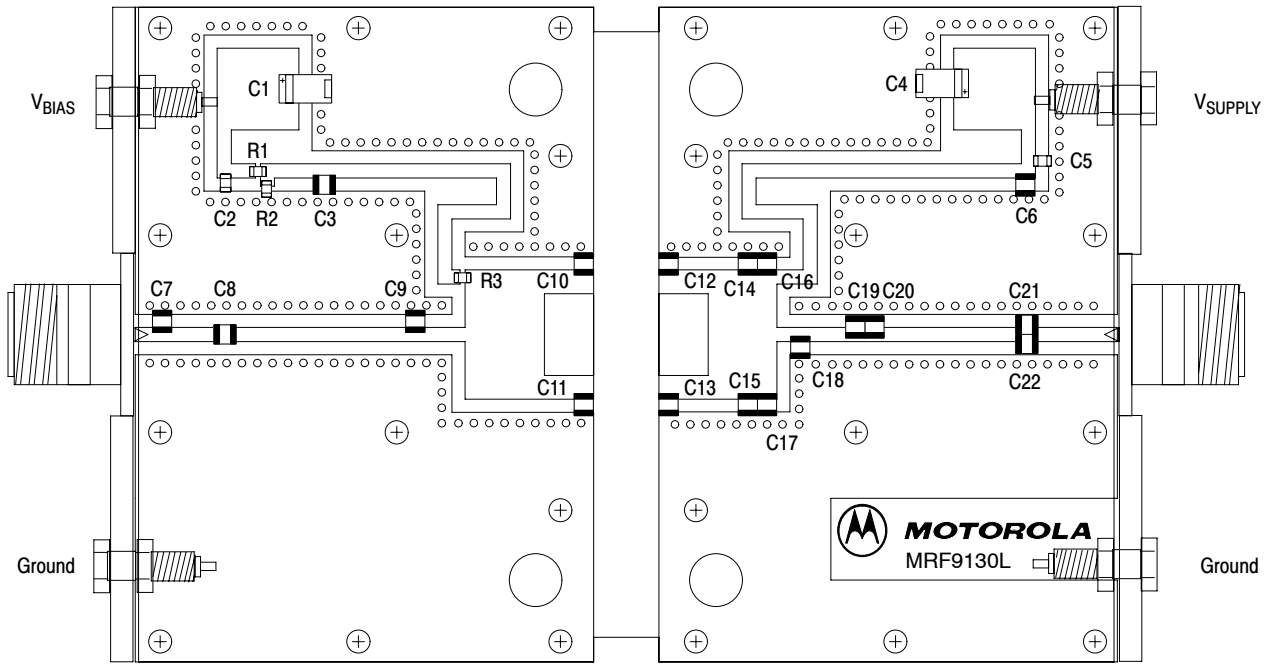


Figure 1. 921-960 MHz Test Circuit Schematic

Table 5. 921-960 MHz Test Circuit Component Designations and Values

Designators	Description
C1, C4	10 μ F, 35 V Tantalum Capacitors, Vishay-Sprague #293D106X9035D
C2, C5	100 nF Chip Capacitors (1206), AVX #1206C104KATDA
C3, C8, C21, C22	22 pF, 100B Chip Capacitors, ATC #100B220C
C6	33 pF, 100B Chip Capacitor, ATC #100B330JW
C7	1.0 pF, 100B Chip Capacitor, ATC #100B1R0BW
C9	4.7 pF, 100B Chip Capacitor, ATC #100B4R7BW
C10	8.2 pF, 100B Chip Capacitor, ATC #100B8R2CW
C11	10 pF, 100B Chip Capacitor, ATC #100B100GW
C12, C13	12 pF, 100B Chip Capacitors, ATC #100B120GW
C14, C15	2.7 pF, 100B Chip Capacitors, ATC #100B2R7BW
C16, C17, C18	3.9 pF, 100B Chip Capacitors, ATC #100B3R9BW
C19	3.3 pF, 100B Chip Capacitor, ATC #100B3R3BW
C20	1.8 pF, 100B Chip Capacitor, ATC #100B1R8BW
R1	18 k Ω , 1/8 W Chip Resistor (1206)
R2	10 k Ω , 1/8 W Chip Resistor (1206)
R3	1.0 k Ω , 1/8 W Chip Resistor (1206)
Z1	0.117" x 0.600" Microstrip
Z2	0.117" x 1.851" Microstrip
Z3	1.074" x 1.068" Microstrip
Z4	1.074" x 0.980" Microstrip
Z5	0.117" x 1.933" Microstrip
Z6	0.117" x 0.605" Microstrip
PCB	Taconic TLX8, 0.030", $\epsilon_r = 2.55$



Freescale has begun the transition of marking Printed Circuit Boards (PCBs) with the Freescale Semiconductor signature/logo. PCBs may have either Motorola or Freescale markings during the transition period. These changes will have no impact on form, fit or function of the current product.

Figure 2. 921-960 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS

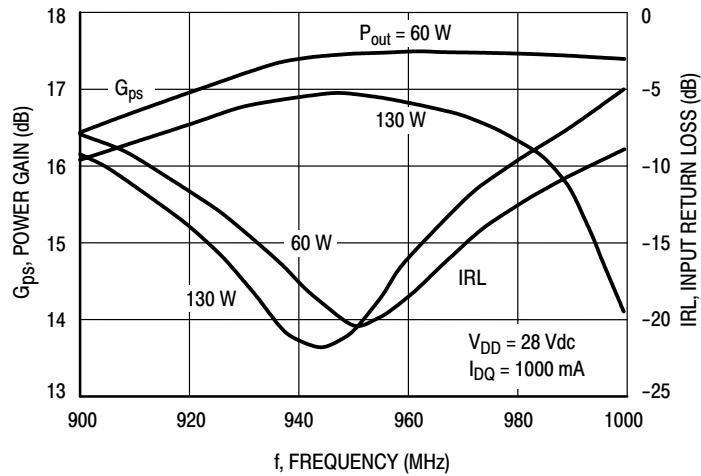


Figure 3. Power Gain and Input Return Loss versus Frequency

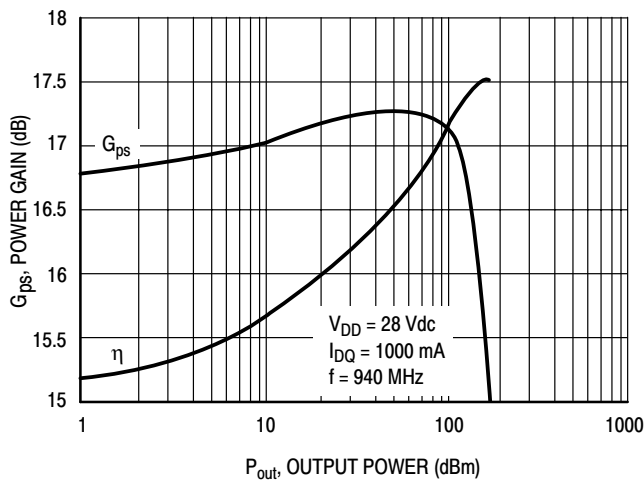


Figure 4. Power Gain and Efficiency versus Output Power

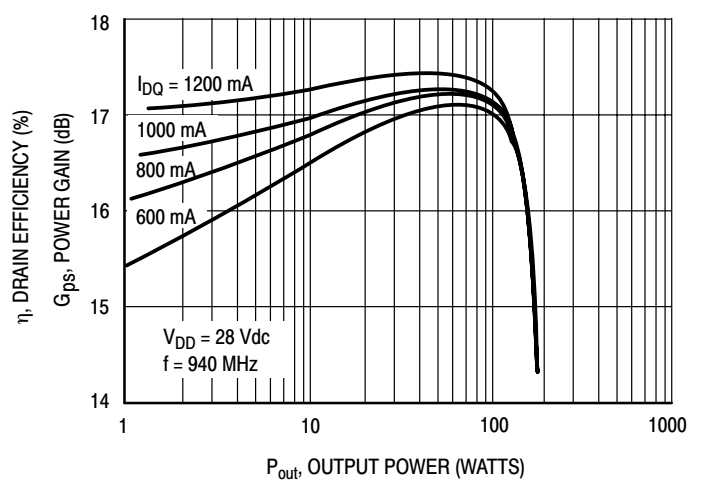


Figure 5. Power Gain versus Output Power

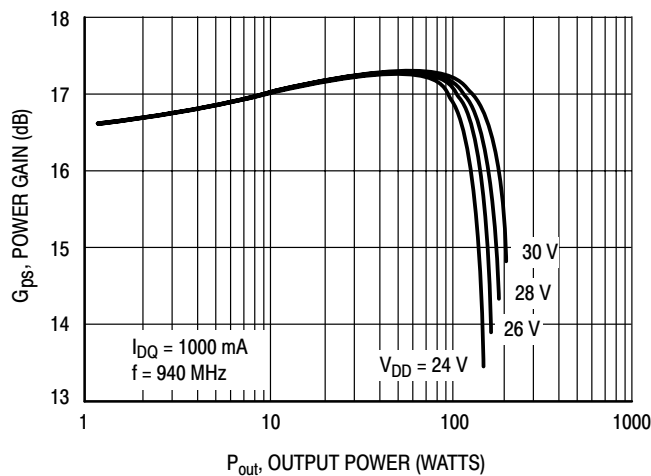


Figure 6. Power Gain versus Output Power

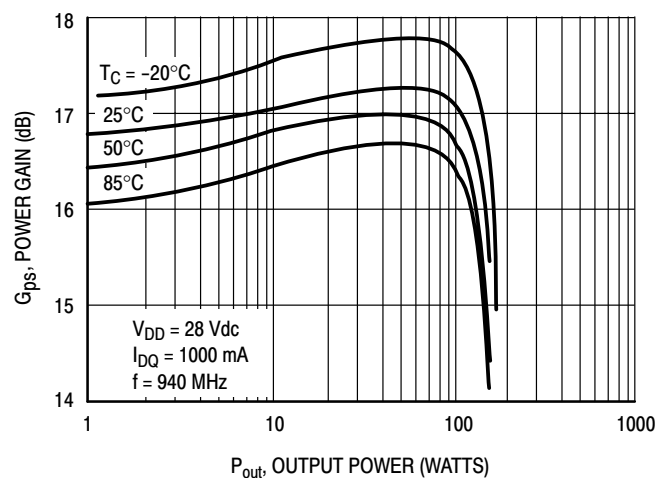


Figure 7. Power Gain versus Output Power

TYPICAL CHARACTERISTICS

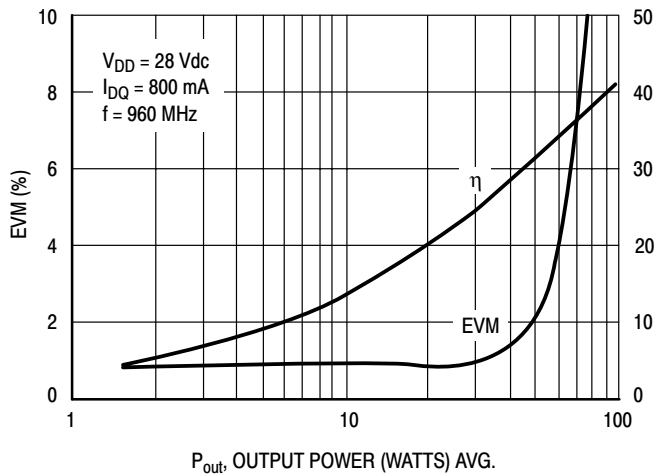


Figure 8. EVM and Efficiency versus Output Power

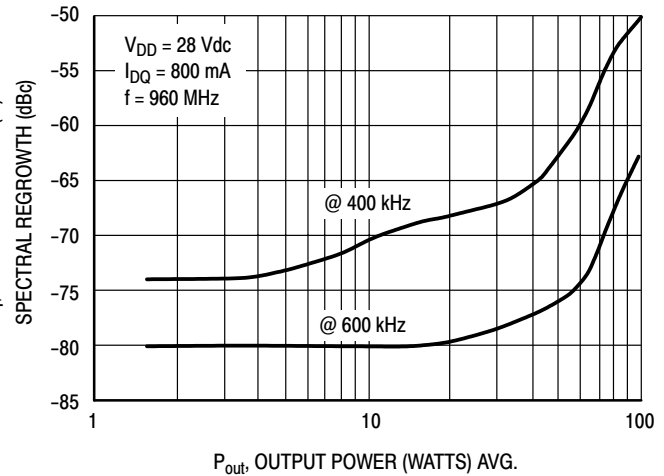
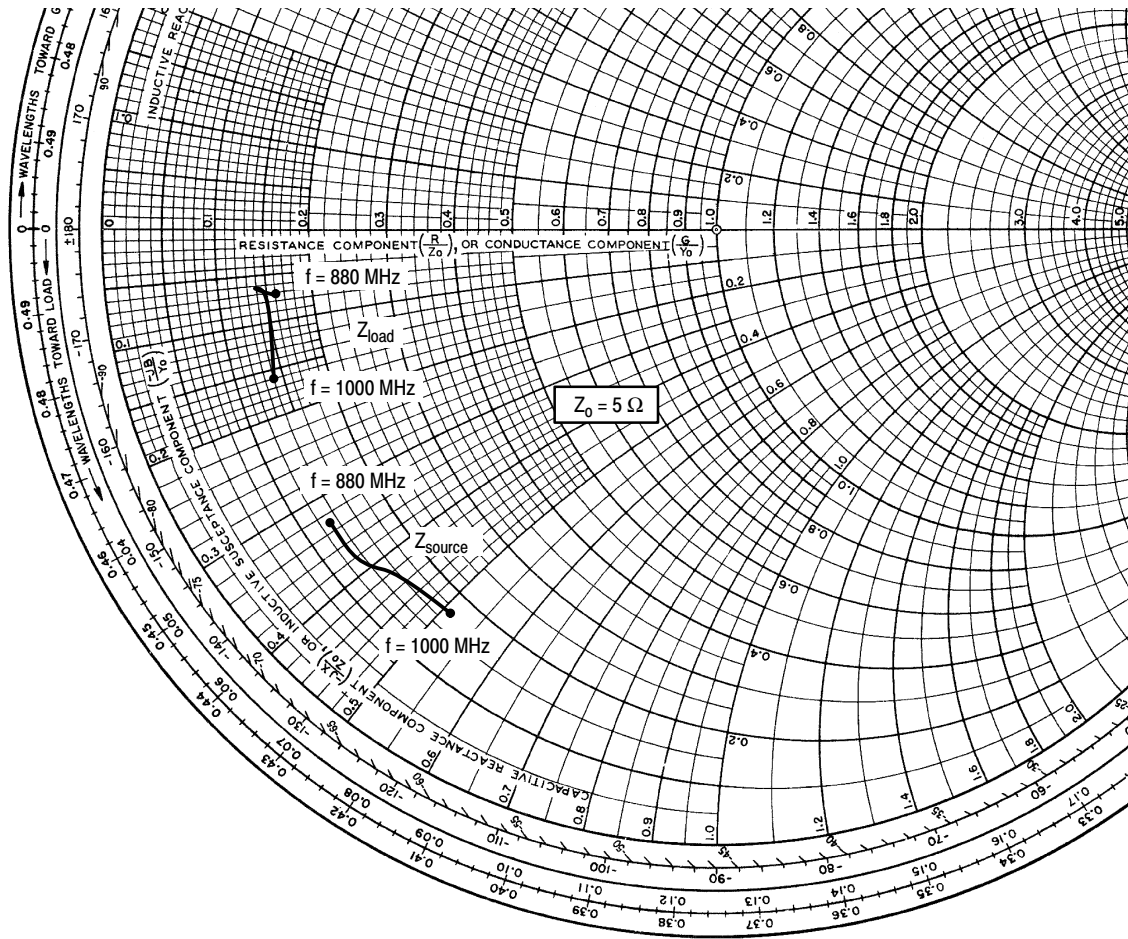


Figure 9. Spectral Regrowth versus Output Power

Note: Curves on Figure 8 and 9 gathered on a GSM EDGE optimized text fixture.



$V_{DD} = 28 \text{ Vdc}$, $I_{DQ} = 1000 \text{ mA}$, $P_{out} = 130 \text{ W CW}$

f MHz	Z_{source} Ω	Z_{load} Ω
880	$0.63 - j1.66$	$0.82 - j0.36$
920	$0.67 - j1.88$	$0.72 - j0.30$
960	$0.82 - j2.18$	$0.74 - j0.37$
1000	$0.86 - j2.56$	$0.69 - j0.79$

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

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

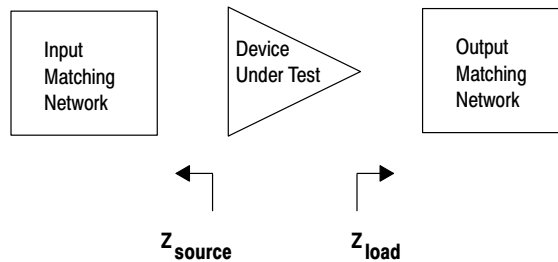


Figure 10. Series Equivalent Source and Load Impedance

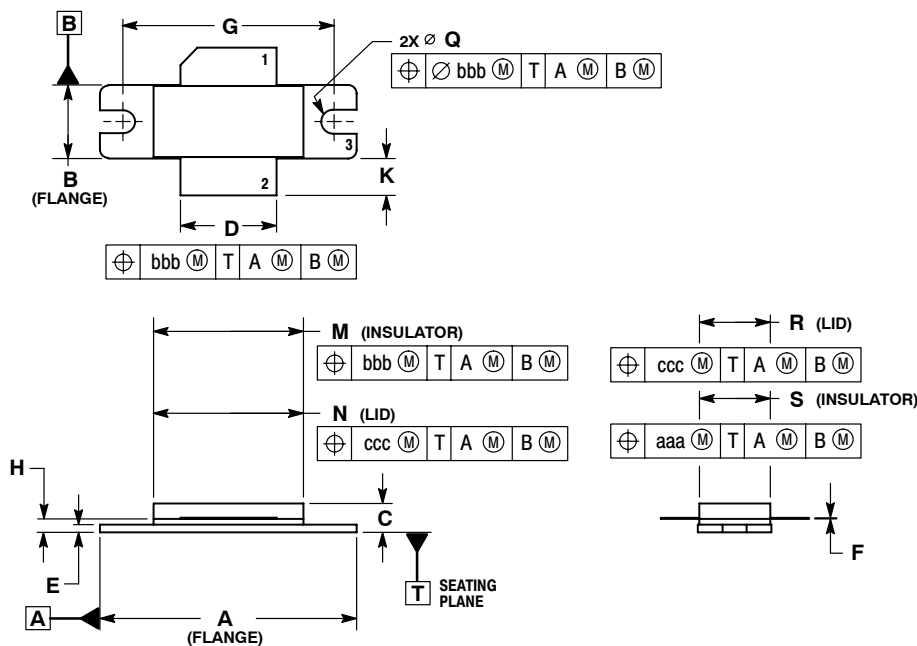
MRF9130LR3 MRF9130LSR3

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PACKAGE DIMENSIONS

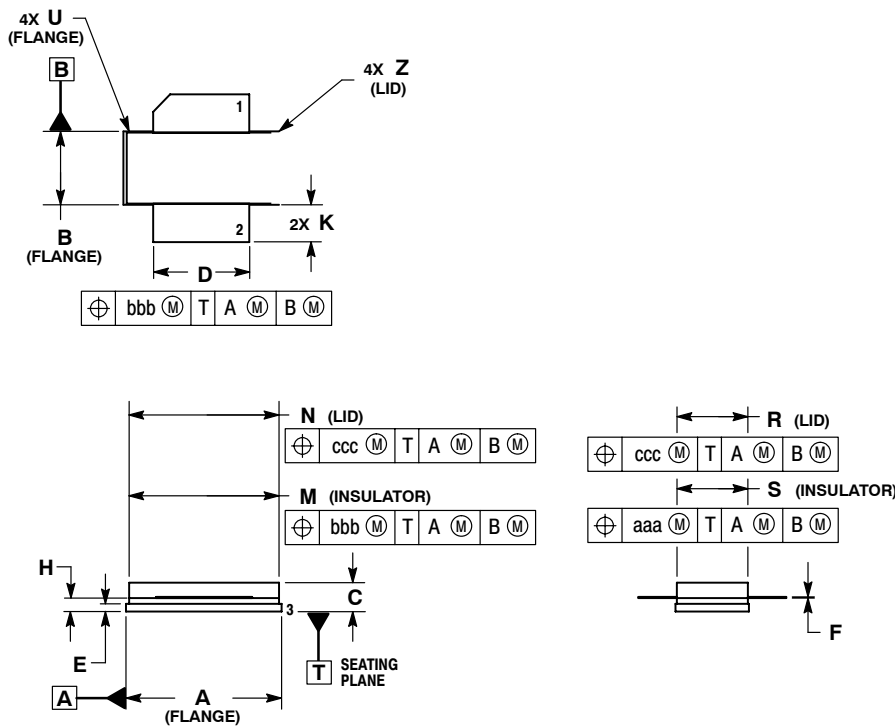


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DELETED
 4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.335	1.345	33.91	34.16
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
G	1.100 BSC		27.94 BSC	
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.66	19.96
N	0.772	0.788	19.60	20.00
Q	$\varnothing 0.118$	$\varnothing 0.138$	$\varnothing 3.00$	$\varnothing 3.51$
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

- STYLE 1:
- PIN 1. DRAIN
 - GATE
 - SOURCE

CASE 465-06 ISSUE G NI-780 MRF9130LR3



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 3. DELETED
 4. DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.805	0.815	20.45	20.70
B	0.380	0.390	9.65	9.91
C	0.125	0.170	3.18	4.32
D	0.495	0.505	12.57	12.83
E	0.035	0.045	0.89	1.14
F	0.003	0.006	0.08	0.15
H	0.057	0.067	1.45	1.70
K	0.170	0.210	4.32	5.33
M	0.774	0.786	19.61	20.02
N	0.772	0.788	19.61	20.02
R	0.365	0.375	9.27	9.53
S	0.365	0.375	9.27	9.52
U	---	0.040	---	1.02
Z	---	0.030	---	0.76
aaa	0.005 REF		0.127 REF	
bbb	0.010 REF		0.254 REF	
ccc	0.015 REF		0.381 REF	

- STYLE 1:
- PIN 1. DRAIN
 - GATE
 - SOURCE

CASE 465A-06 ISSUE H NI-780S MRF9130LSR3

MRF9130LR3 MRF9130LSR3

How to Reach Us:

Home Page:

www.freescale.com

E-mail:

support@freescale.com

USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

Europe, Middle East, and Africa:

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

Japan:

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

Asia/Pacific:

Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

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