

Replaced by MRF5P20180HR6. "H" suffix indicates lower thermal resistance package.

# The RF MOSFET Line RF Power Field Effect Transistor N-Channel Enhancement-Mode Lateral MOSFET

Designed for W-CDMA base station applications with frequencies from 1930 to 1990 MHz. Suitable for TDMA, CDMA and multicarrier amplifier applications. To be used in Class AB for PCN-PCS/cellular radio and WLL applications.

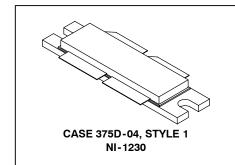
Typical 2-carrier W-CDMA Performance for V<sub>DD</sub> = 28 Volts, I<sub>DQ</sub> = 2 x 800 mA, f1 = 1955 MHz, f2 = 1965 MHz, Channel Bandwidth = 3.84 MHz, Adjacent Channels Measured over 3.84 MHz BW @ f1 - 5 MHz and f2 + 5 MHz. Distortion Products Measured over a 3.84 MHz BW @ f1 - 10 MHz and f2 + 10 MHz, Each Carrier Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF. Output Power — 38 Watts Avg. Power Gain — 14 dB

Power Gain — 14 dl Efficiency — 26% IM3 — -37.5 dBc ACPR — -41 dBc

- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 10:1 VSWR, @ 28 Vdc, 1960 MHz, 120 Watts CW Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Qualified Up to a Maximum of 32 V<sub>DD</sub> Operation
- In Tape and Reel. R6 Suffix = 150 Units per 56 mm, 13 inch Reel.

### MRF5P20180R6

1990 MHz, 38 W AVG., 2 x W-CDMA, 28 V LATERAL N-CHANNEL RF POWER MOSFET



#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>	65	Vdc
Gate-Source Voltage	V <sub>GS</sub>	-0.5, +15	Vdc
Total Device Dissipation @ T <sub>C</sub> = 25°C Derate above 25°C	P <sub>D</sub>	407 2.3	Watts W/°C
Storage Temperature Range	T <sub>stg</sub>	- 65 to +150	°C
Operating Junction Temperature	T <sub>J</sub>	200	°C
CW Operation	CW	120	Watts

### THERMAL CHARACTERISTICS

Characteristic		Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$		°C/W
Case Temperature 80°C, 120 W CW		0.43	
Case Temperature 80°C, 38 W CW		0.43	

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







#### **ESD PROTECTION CHARACTERISTICS**

Test Conditions	Class
Human Body Model	2 (Minimum)
Machine Model	M3 (Minimum)
Charge Device Model	C7 (Minimum)

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

Characteristic	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS (1)	<u>.</u>				
Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 65 Vdc, V <sub>GS</sub> = 0 Vdc)	I <sub>DSS</sub>	_	_	10	μAdc
Zero Gate Voltage Drain Leakage Current (V <sub>DS</sub> = 28 Vdc, V <sub>GS</sub> = 0)	I <sub>DSS</sub>	=	_	1	μAdc
Gate-Source Leakage Current (V <sub>GS</sub> = 5 Vdc, V <sub>DS</sub> = 0 Vdc)	I <sub>GSS</sub>	_	_	1	μAdc
ON CHARACTERISTICS (1)	•	•	•	•	•

Gate Threshold Voltage (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 200 μAdc)	V <sub>GS(th)</sub>	2.5	2.7	3.5	Vdc
Gate Quiescent Voltage (V <sub>DS</sub> = 28 Vdc, I <sub>D</sub> = 850 mAdc)	V <sub>GS(Q)</sub>	_	3.6	_	Vdc
Drain-Source On-Voltage (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 2 Adc)	V <sub>DS(on)</sub>	_	0.26	0.3	Vdc
Forward Transconductance (V <sub>DS</sub> = 10 Vdc, I <sub>D</sub> = 2 Adc)	9 <sub>fs</sub>	_	5		S

#### **DYNAMIC CHARACTERISTICS (1)**

Reverse Transfer Capacitance	C <sub>rss</sub>	_	1.7	_	pF
$(V_{DS} = 28 \text{ Vdc} \pm 30 \text{ mV(rms)ac} @ 1 \text{ MHz}, V_{GS} = 0 \text{ Vdc})$					

FUNCTIONAL TESTS (In Motorola Test Fixture, 50 ohm system) (2) 2-carrier W-CDMA, 3.84 MHz Channel Bandwidth Carriers, ACPR and IM3 measured in 3.84 MHz Bandwidth. Peak/Avg. = 8.5 dB @ 0.01% Probability on CCDF.

Common-Source Amplifier Power Gain (V <sub>DD</sub> = 28 Vdc, P <sub>out</sub> = 38 W Avg., I <sub>DQ</sub> = 2 x 800 mA, f1 = 1932.5 MHz, f2 = 1942.5 MHz and f1 = 1977.5 MHz, f2 = 1987.5 MHz)	G <sub>ps</sub>	12.5	14	_	dB
Drain Efficiency $(V_{DD}=28~Vdc,~P_{out}=38~W~Avg.,~I_{DQ}=2~x~800~mA, f1=1932.5~MHz,~f2=1942.5~MHz~and~f1=1977.5~MHz, f2=1987.5~MHz)$	η	23	26	_	%
Third Order Intermodulation Distortion $(V_{DD}=28~Vdc,~P_{out}=38~W~Avg.,~I_{DQ}=2~x~800~mA,\\f1=1932.5~MHz,~f2=1942.5~MHz~and~f1=1977.5~MHz,\\f2=1987.5~MHz;~IM3~measured~over~3.84~MHz~BW~@~f1~-10~MHz~and~f2~+10~MHz~referenced~to~carrier~channel~power.)$	IM3	_	-37.5	-35	dBc
Adjacent Channel Power Ratio $(V_{DD}=28~Vdc,~P_{out}=38~W~Avg.,~I_{DQ}=2~x~800~mA,\\f1=1932.5~MHz,~f2=1942.5~MHz~and~f1=1977.5~MHz,\\f2=1987.5~MHz;~ACPR~measured~over~3.84~MHz~BW~@~f1~5~MHz~and~f2~+5~MHz.)$	ACPR	_	-41	-38	dBc
Input Return Loss $(V_{DD}=28\ Vdc,\ P_{out}=38\ W\ Avg.,\ I_{DQ}=2\ x\ 800\ mA, f1=1932.5\ MHz, f2=1942.5\ MHz\ and f1=1977.5\ MHz, f2=1987.5\ MHz)$	IRL	_	-16	-9	dB

<sup>(1)</sup> Each side of device measured separately. Part is internally matched both on input and output.

<sup>(2)</sup> Measurements made with device in push-pull configuration.



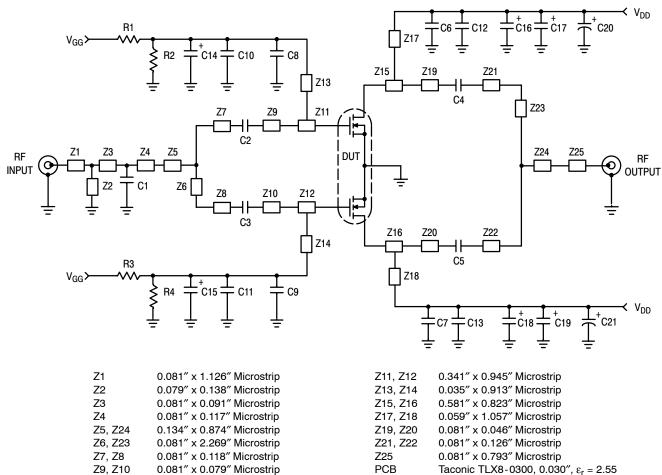


Figure 1. MRF5P20180 Test Circuit Schematic

Table 1. MRF5P20180 Test Circuit Component Designations and Values

Part	Description	Value, P/N or DWG	Manufacturer
C1	1.8 pF 100B Chip Capacitor	100B1R8BW	ATC
C2, C3, C4, C5, C6, C7	10 pF 100B Chip Capacitors	100B100GW	ATC
C8, C9	6.8 pF 100B Chip Capacitors	100B6R8CW	ATC
C10, C11, C12, C13	10 nF 200B Chip Capacitors	200B103MW	ATC
C14, C15, C16, C17, C18, C19	22 μF, 35 V Tantalum Capacitors	TAJE226M035	AVX
C20, C21	220 μF, 63 V Electrolytic Capacitors	13668221	Philips
R1, R2, R3, R4	10 kΩ Chip Resistors (1206)		



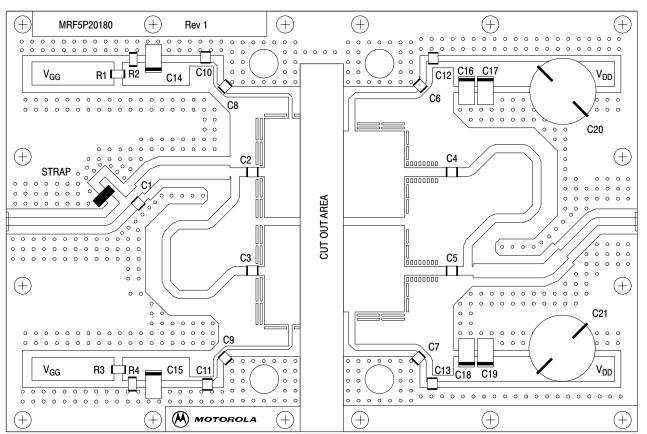


Figure 2. MRF5P20180 Test Circuit Component Layout



#### **TYPICAL CHARACTERISTICS**

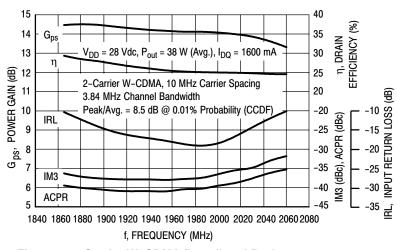


Figure 3. 2-Carrier W-CDMA Broadband Performance

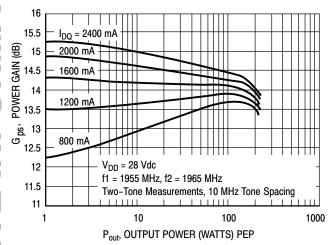


Figure 4. Two-Tone Power Gain versus
Output Power

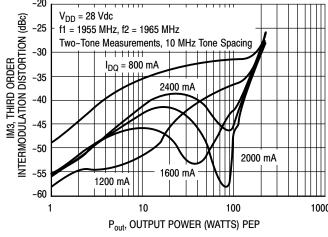


Figure 5. Third Order Intermodulation Distortion versus Output Power

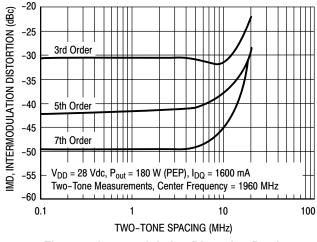


Figure 6. Intermodulation Distortion Products versus Tone Spacing

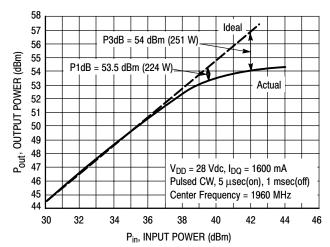


Figure 7. Pulse CW Output Power versus Input Power



#### **TYPICAL CHARACTERISTICS**

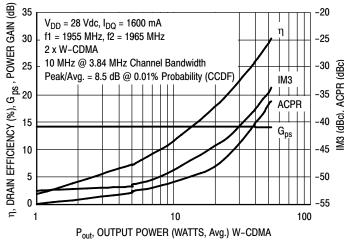


Figure 8. 2-Carrier W-CDMA ACPR, IM3, Power Gain and Drain Efficiency versus Output Power

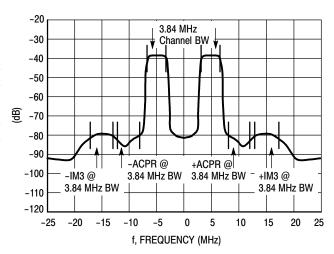


Figure 9. 2-Carrier W-CDMA Spectrum

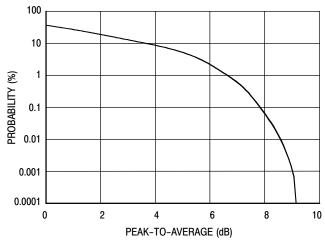
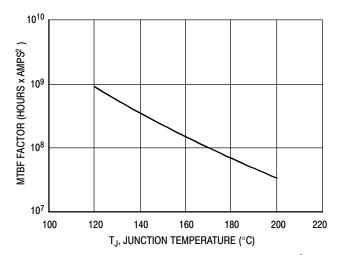


Figure 10. CCDF W-CDMA 3GPP, Test Model 1, 64 DPCH, 67% Clipping, Single Carrier Test Signal



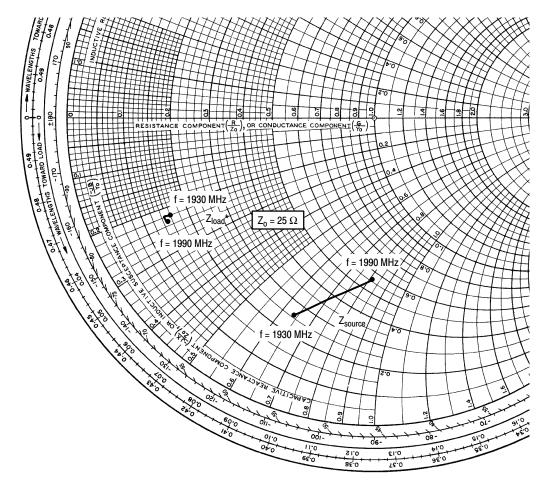
This above graph displays calculated MTBF in hours x ampere<sup>2</sup> drain current. Life tests at elevated temperatures have correlated to better than  $\pm 10\%$  of the theoretical prediction for metal failure. Divide MTBF factor by  $I_D^2$  for MTBF in a particular application.

Figure 11. MTBF Factor versus Junction Temperature



ARCHIVE INFORMATION

### Freescale Semiconductor, Inc.



 $V_{DD}$  = 28 V,  $I_{DQ}$  = 2 x 800 mA,  $P_{out}$  = 38 W Avg.

f MHz	$\mathbf{Z_{source}}_{\Omega}$	$\mathbf{Z_{load}}_{\Omega}$
1930	6.54 - j16.04	4.06 - j5.56
1960	9.70 - j17.92	3.70 - j5.48
1990	13.88 - j20.46	3.64 - j5.76

Z<sub>source</sub> = Test circuit impedance as measured from gate to gate, balanced configuration.

Z<sub>load</sub> = Test circuit impedance as measured from drain to drain, balanced configuration.

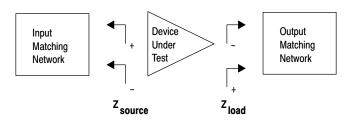
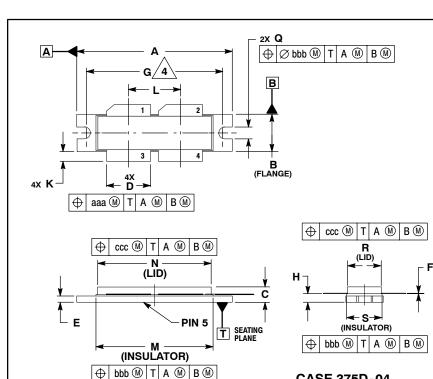


Figure 12. Series Equivalent Input and Output Impedance



### PACKAGE DIMENSIONS



#### NOTES:

- INTERPRET DIMENSIONS AND TOLERANCES
  PER ASME Y14.5M-1994.
- CONTROLLING DIMENSION: INCH
- DIMENSION H IS MEASURED 0.030 (0.762) AWAY FROM PACKAGE BODY.

  RECOMMENDED BOLT CENTER DIMENSION OF
- 1.52 (38.61) BASED ON M3 SCREW.

	INC	HES	MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	1.615	1.625	41.02	41.28
В	0.395	0.405	10.03	10.29
С	0.150	0.200	3.81	5.08
D	0.455	0.465	11.56	11.81
Е	0.062	0.066	1.57	1.68
F	0.004	0.007	0.10	0.18
G	1.400	BSC	35.56	BSC
Н	0.079	0.089	2.01	2.26
K	0.117	0.137	2.97	3.48
٦	0.540 BSC		13.72	BSC
M	1.219	1.241	30.96	31.52
N	1.218	1.242	30.94	31.55
œ	0.120	0.130	3.05	3.30
R	0.355	0.365	9.01	9.27
S	0.365	0.375	9.27	9.53
aaa	0.013	REF	0.33 REF	
bbb	0.010	REF	0.25 REF	
ccc	0.020	RFF	0.51 RFF	

STYLE 1:

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

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**CASE 375D-04** 

**ISSUE C** NI-1230

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