Freescale Semiconductor Technical Data

Document Number: MRF5S9101 Rev. 3, 5/2006

MRF5S9101MR1

MRF5S9101MBR1

869-960 MHz, 100 W, 26 V

GSM/GSM EDGE

LATERAL N-CHANNEL

Replaced by MRF5S9101NR1/NBR1. There are no form, fit or function changes with this part replacement. N suffix added to part number to indicate transition to lead-free terminations.

RF Power Field Effect Transistors N-Channel Enhancement-Mode Lateral MOSFETs

Designed for GSM and GSM EDGE base station applications with frequencies from 869 to 960 MHz. Suitable for multicarrier amplifier applications.

GSM Application

JRMAT

ARCHIVE

 Typical GSM Performance: V_{DD} = 26 Volts, I_{DQ} = 700 mA, P_{out} = 100 Watts CW, Full Frequency Band (869-894 MHz and 921-960 MHz) Power Gain - 17.5 dB Drain Efficiency - 60%

GSM EDGE Application

- Typical GSM EDGE Performance: V_{DD} = 28 Volts, I_{DQ} = 650 mA, P_{out} = 50 Watts Avg., Full Frequency Band (869-894 MHz and 921-960 MHz) Power Gain 18 dB
 - Spectral Regrowth @ 400 kHz Offset = -63 dBc Spectral Regrowth @ 600 kHz Offset = -78 dBc EVM — 2.3% rms
- Capable of Handling 10:1 VSWR, @ 26 Vdc, @ 100 W CW Output Power, @ f = 960 MHz
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Internally Matched for Ease of Use
- Qualified Up to a Maximum of 32 V_{DD} Operation
- Integrated ESD Protection
- 200°C Capable Plastic Package
- In Tape and Reel. R1 Suffix = 500 Units per 44 mm, 13 inch Reel.



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CASE 1484-04, STYLE 1
TO-272 WB-4
PLASTIC
MRF5S9101MBR1
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Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V _{DSS}	- 0.5, +68	Vdc
Gate-Source Voltage	V _{GS}	- 0.5, +15	Vdc
Total Device Dissipation @ T _C = 25°C Derate above 25°C	PD	427 2.44	W W/°C
Storage Temperature Range	T _{stg}	- 65 to +150	°C
Operating Junction Temperature	TJ	200	°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value ^(1,2)	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.41	°C/W
Case Temperature 80°C, 50 W CW		0.47	

1. MTTF calculator available at <u>http://www.freescale.com/rf</u>. Select Tools/Software/Application Software/Calculators to access the MTTF calculators by product.

2. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to <u>http://www.freescale.com/rf</u>. Select Documentation/Application Notes - AN1955.

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



Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	1C (Minimum)
Machine Model (per EIA/JESD22-A115)	A (Minimum)
Charge Device Model (per JESD22-C101)	IV (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°C unless otherwise noted)

Characteristic	Symbol	Min	Тур	Max	Unit
Zero Gate Voltage Drain Leakage Current (V _{DS} = 68 Vdc, V _{GS} = 0 Vdc)	I _{DSS}	_	-	10	μAdc
Zero Gate Voltage Drain Leakage Current (V _{DS} = 26 Vdc, V _{GS} = 0 Vdc)	I _{DSS}	—	_	1	μAdc
Gate-Source Leakage Current (V _{GS} = 5 Vdc, V _{DS} = 0 Vdc)	I _{GSS}	_	_	1	μAdc
On Characteristics		-			
Gate Threshold Voltage (V _{DS} = 10 Vdc, I _D = 400 μAdc)	V _{GS(th)}	2	2.8	3.5	Vdc
Gate Quiescent Voltage (V _{DS} = 26 Vdc, I _D = 700 mAdc)	V _{GS(Q)}	_	3.7	_	Vdc
Drain-Source On-Voltage (V _{GS} = 10 Vdc, I _D = 2 Adc)	V _{DS(on)}	_	0.21	0.3	Vdc
Forward Transconductance (V _{DS} = 10 Vdc, I _D = 6 Adc)	9 _{fs}	—	7	—	S
Dynamic Characteristics ⁽¹⁾					
Output Capacitance (V _{DS} = 26 Vdc \pm 30 mV(rms)ac @ 1 MHz, V _{GS} = 0 Vdc)	C _{oss}	_	70	_	pF
Reverse Transfer Capacitance $(V_{DS} = 26 \text{ Vdc} \pm 30 \text{ mV(rms)ac} @ 1 \text{ MHz}, V_{GS} = 0 \text{ Vdc})$	C _{rss}	_	2.2	—	pF
Functional Tests (In Freescale Test Fixture, 50 ohm system) V_{DD} = 20	6 Vdc, P _{out} = 100	W, I _{DQ} = 700	0 mA, f = 960	MHz	
Power Gain	G _{ps}	16	17.5	19	dB
Drain Efficiency	η _D	56	60	_	%
Input Return Loss	IRL	_	-15	-9	dB
Pout @ 1 dB Compression Point, CW	P1dB	100	110		W

(continued)

Characteristic	Symbol	Min	Тур	Max	Unit		
fypical GSM EDGE Performances (In Freescale GSM EDGE Test Fixture, 50 ohm system) V _{DD} = 28 Vdc, P _{out} = 50 W Avg., _{DQ} = 650 mA, 869 MHz <frequency<894 920="" mhz,="" mhz<="" mhz<frequency<960="" td=""></frequency<894>							
Power Gain	G _{ps}	—	18	_	dB		
Drain Efficiency	η _D	—	42	—	%		
Error Vector Magnitude	EVM	—	2.3	—	% rms		
Spectral Regrowth at 400 kHz Offset	SR1	—	-63	—	dBc		
Spectral Regrowth at 600 kHz Offset	SR2	—	-78	_	dBc		

Table 5. Electrical Characteristics (T_C = 25°C unless otherwise noted) (continued)

ARCHIVE INFORMATION

MRF5S9101MR1 MRF5S9101MBR1

RF Device Data Freescale Semiconductor



Figure 1. MRF5S9101MR1(MBR1) 900 MHz Test Circuit Schematic

ble 6. MRF5S9101MR1	(MBR1)) 900 MHz Test Circuit C	component Desig	gnations and Values

Part	Description	Part Number	Manufacturer	
C1, C2, C3	4.7 μF Chip Capacitors (2220)	GRM55ER7H475KA01	Murata	
C4, C5, C6	10 nF 200B Chip Capacitors	200B103MW	ATC	
C7, C8, C9	33 pF 100B Chip Capacitors	100B330JW	ATC	
C10, C11	22 pF 100B Chip Capacitors	100B220GW	ATC	
C12, C13	2, C13 10 pF 100B Chip Capacitors		ATC	
C14, C15, C16, C17	8.2 pF 100B Chip Capacitors	100B8R2CW	ATC	
C18	5.6 pF 100B Chip Capacitor	100B5R6CW	ATC	
C19	4.7 pF 100B Chip Capacitor		ATC	
C20	3.9 pF 100B Chip Capacitor	100B3R9BW	ATC	
C21	220 μF, 50 V Electrolytic Capacitor, Axial	516D227M050NP7B	Sprague	
R1, R2	10 kΩ, 1/4 W Chip Resistors (1206)			
R3	10 Ω, 1/4 W Chip Resistor (1206)			



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Figure 2. MRF5S9101MR1(MBR1) 900 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS - 900 MHz











Figure 5. Power Gain versus Output Power



MRF5S9101MR1 MRF5S9101MBR1



TYPICAL CHARACTERISTICS - 900 MHz

TYPICAL CHARACTERISTICS - 900 MHz



This above graph displays calculated MTTF in hours x ampere² drain current. Life tests at elevated temperatures have correlated to better than $\pm 10\%$ of the theoretical prediction for metal failure. Divide MTTF factor by I_D^2 for MTTF in a particular application.





Figure 14. MRF5S9101MR1(MBR1) 800 MHz Test Circuit Schematic

Table 7	MRE5S9101MR1	(MBR1) 800) MHz Test	Circuit Com	nonent Desid	nations an	d Values
Iable 1.			/ WILLZ LESL		poment Desid	gilations an	u vaiues

Ζ				3 J	
Ο					C3
	71	0.432" x 0.827" Microstrip 710)	0 897″ x 0 087″ Micro	strip
	Z2	0.720" x 0.788" Microstrip Z11		1.161" x 0.087" Micro	strip
	Z3	0.195" x 0.087" Microstrip Z12	2, Z13*	1.6" x 0.089" Microstr	ip '
\geq	Z4	0.584" x 0.087" Microstrip		(quarter wave length f	or supply purpose)
	Z5	0.173" x 0.087" Microstrip Z14	1 *	1.2" x 0.059" Microstr	ip
	Z6	0.560" x 0.087" Microstrip	_	(quarter wave length f	or bias purpose)
	Z7	0.378" x 0.827" Microstrip PC	В	Taconic TLX8-0300, 0	$0.030'', \epsilon_r = 2.55$
\mathbf{O}	28 70	0.2/9" X 0.087" Microstrip	richle for t	uning	
II	29			uning	
	Table 7. MRF5S9101MR1(N	/IBR1) 800 MHz Test Circuit Component	Designa	tions and Values	
Ц Ш	Table 7. MRF5S9101MR1(M Part	IBR1) 800 MHz Test Circuit Component Description	Designa	tions and Values Part Number	Manufacturer
VE IN	Table 7. MRF5S9101MR1(N Part C1, C2, C3	MBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220)	Designa GRM5	tions and Values Part Number 5ER7H475KA01	Manufacturer Murata
	Pable 7. MRF5S9101MR1(N Part C1, C2, C3 C4, C5, C6	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors	Designa GRM5 200B1	tions and Values Part Number 5ER7H475KA01 03MW	Manufacturer Murata ATC
HIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3	tions and Values Part Number 5ER7H475KA01 03MW 30JW	Manufacturer Murata ATC ATC
HIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3 100B2	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW	Manufacturer Murata ATC ATC ATC
CHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3 100B2 100B1	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 00GW	Manufacturer Murata ATC ATC ATC ATC ATC
SCHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15	MBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3 100B2 100B1 100B8	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 20GW R2CW	ManufacturerMurataATCATCATCATCATCATCATCATCATC
RCHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15 C16, C22	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors 6.8 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3 100B2 100B1 100B8 100B6	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 20GW 00GW R2CW R8CW	ManufacturerMurataATCATCATCATCATCATCATCATCATCATCATC
ARCHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15 C16, C22 C18	ABR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors 6.8 pF 100B Chip Capacitors 5.6 pF 100B Chip Capacitor	Designa GRM5 200B1 100B3 100B3 100B1 100B8 100B6 100B5	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 00GW R2CW R8CW R6CW	ManufacturerMurataATCATCATCATCATCATCATCATCATCATCATCATCATCATC
ARCHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15 C16, C22 C18 C19, C20	MBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors 6.8 pF 100B Chip Capacitors 5.6 pF 100B Chip Capacitor 2.7 pF 100B Chip Capacitors	Designa GRM5 200B1 100B3 100B3 100B1 100B6 100B5 100B2	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 20GW 00GW R2CW R8CW R8CW R8CW R8CW	ManufacturerMurataATC
ARCHIVE IN	Part C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15 C16, C22 C18 C19, C20 C21	MBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors 6.8 pF 100B Chip Capacitors 5.6 pF 100B Chip Capacitors 5.7 pF 100B Chip Capacitors 2.7 pF 100B Chip Capacitors 220 μF, 50 V Electrolytic Capacitor, Axial	Designa GRM5 200B1 100B3 100B2 100B1 100B6 100B5 100B2 516D2	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 20GW 00GW R2CW R8CW R6CW R7BW 27M050NP7B	ManufacturerMurataATCATCATCATCATCATCATCATCATCATCSprague
ARCHIVE IN	C1, C2, C3 C4, C5, C6 C7, C8, C9 C10, C11 C12, C13, C17 C14, C15 C16, C22 C18 C19, C20 C21 R1, R2	IBR1) 800 MHz Test Circuit Component Description 4.7 μF Chip Capacitors (2220) 10 nF 200B Chip Capacitors 33 pF 100B Chip Capacitors 22 pF 100B Chip Capacitors 10 pF 100B Chip Capacitors 8.2 pF 100B Chip Capacitors 6.8 pF 100B Chip Capacitors 5.6 pF 100B Chip Capacitor 2.7 pF 100B Chip Capacitors 220 μF, 50 V Electrolytic Capacitor, Axial 10 kΩ, 1/4 W Chip Resistors (1206)	Designa GRM5 200B1 100B3 100B3 100B4 100B8 100B6 100B5 100B2 516D2	tions and Values Part Number 5ER7H475KA01 03MW 30JW 20GW 00GW R2CW R8CW R6CW R7BW 27M050NP7B	ManufacturerMurataATCATCATCATCATCATCATCATCATCATCSprague



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Figure 15. MRF5S9101MR1(MBR1) 800 MHz Test Circuit Component Layout

TYPICAL CHARACTERISTICS - 800 MHz



60

50

40

30

20

10

0

100

 η , DRAIN EFFICIENCY (%)



TYPICAL CHARACTERISTICS - 800 MHz



 V_{DD} = 26 Vdc, I_{DQ} = 700 mA, P_{out} = 100 W CW

f MHz	Z_{source}	Z _{load} Ω
845	4.29 - j2.23	1.15 - j0.04
865	3.94 - j1.24	1.05 - j0.10
890	890 2.72 - j0.96 1.02 - j0.	
920	1.96 - j1.02	1.03 - j0.15
960	1.58 - j1.43	1.03 - j0.05
990	1.27 - j1.54	0.73 - j0.07

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







NOTES

NOTES

PACKAGE DIMENSIONS



NOTES:

- NOTES:
 CONTROLLING DIMENSION: INCH.
 INTERPRET DIMENSIONS AND TOLERANCES PER ASME '14.5M. 1994.
 DATUM PLANE. -H. IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
 DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETER-MINED AT DATUM PLANE -H.
 DIMENSION "D" DOES NOT INCLUDE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
 DATUMS -A. AND -B- TO BE DETERMINED AT

- CONDITION. 6. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-. 7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY. 8. HATCHING REPRESENTS THE EXPOSED AREA OF STUE DETEXTOR OF STUE DETEXTOR OF THE HEAT SLUG.

	INC	HES	MILLIN	IETERS	
DIM	MIN MAX		MIN	MAX	
Α	.100	.104	2.54	2.64	
A1	.039	.043	0.99	1.09	
A2	.040	.042	1.02	1.07	
D	.712	.720	18.08	18.29	
D1	.688	.692	17.48	17.58	
D2	.011	.019	0.28	0.48	
D3	.600		15.24		
E	.551	.559	14	14.2	
E1	.353	.357	8.97	9.07	
E2	.132	.140	3.35	3.56	
E3	.124	.132	3.15	3.35	
E4	.270		6.86		
E5	.346	.350	8.79	8.89	
F	.025	BSC	0.64	BSC	
b1	.164	.170	4.17	4.32	
c1	.007	.011	0.18	0.28	
е	.106	BSC	2.69 BSC		
aaa	.0	04	0.	10	

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

4. GATE 5. SOURCE





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TITLE:	DOCUMENT N	0: 98ASA10575D	REV: D	
	CASE NUMBE	CASE NUMBER: 1484-04		
	STANDARD: N	ON-JEDEC		

NOTES:

- 1. CONTROLLING DIMENSION: INCH
- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- 3. DATUM PLANE H IS LOCATED AT THE TOP OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE TOP OF THE PARTING LINE.
- 4. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS .006 PER SIDE. DIMENSIONS "D" AND "E1" DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE H.
- 5. DIMENSIONS "b1" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .005 TOTAL IN EXCESS OF THE "b1" DIMENSION AT MAXIMUM MATERIAL CONDITION.
- 6. DATUM A AND B TO BE DETERMINED AT DATUM PLANE H.
- 7. DIMENSION A2 APPLIES WITHIN ZONE "J" ONLY.
- 8. HATCHING REPRESENTS EXPOSED AREA OF THE HEAT SLUG. HATCHED AREA SHOWN IS ON THE SAME PLANE.

STYLE 1: PIN 1 – DRAIN PIN 2 – DRAIN PIN 3 – GATE PIN 4 – GATE PIN 5 – SOURCE

	INCH		MILLIMETER			INCH		MILLIMETER		
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX	
A	.100	.104	2.54	2.64	b1	.164	.170	4.17	4.32	
A1	.039	.043	0.99	1.09	c1	.007	.011	.18	.28	
A2	.040	.042	1.02	1.07	r1	.063	.068	1.60) 1.73	
D	.928	.932	23.57	23.67	е	.1	06 BSC	2	2.69 BSC	
D1	D1 .810 BSC		20.57 BSC		e1	.239	.239 INFO ONLY		6.07 INFO ONLY	
D2	.600		15.24		aaa	.004		.10		
E	.551	.559	14	14.2						
E1	.353	.357	8.97	9.07						
E2	.270		6.86							
E3	.346	.350	8.79	8.89						
F	F .025 BSC		0.64 BSC							
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TITLE: TO-272 4 LEAD WIDE BODY				DOCUMENT NO: 98ASA10575D REV:			REV: D			
				CASE NUMBER: 1484-04			05 APR 2006			
				STANDARD: NON-JEDEC						

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