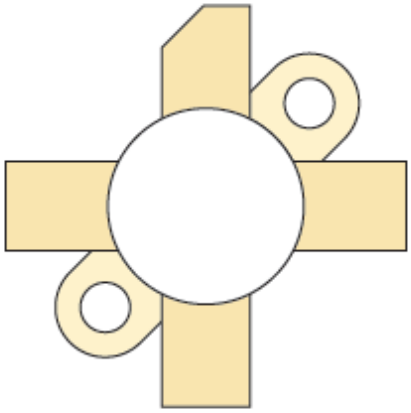
VRF2933, VRF2933MP

50 V, 300 W, 150 MHz RF Power MOSFET

Product Overview

The VRF2933(MP) is a gold-metallized silicon n-channel RF power transistor designed for broadband commercial and military applications requiring high power and gain without compromising reliability, ruggedness, or inter-modulation distortion. Adding MP at the end of part number specifies a matched pair where $V_{GS(TH)}$ is matched between the two parts.



Features

- Improved ruggedness $V_{(BR)DSS}$ = 170 V
- 300 W with 22 dB typical gain at 30 MHz, 50 V
- Excellent stability and low IMD
- Common source configuration
- Available in matched pairs (VRF2933MP)
- 70:1 load VSWR capability at specified operating conditions
- Nitride passivated
- Refractory gold metallization
- High voltage replacement for SD2933
- Thermally enhanced package
- RoHS compliant

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1. Device Specifications

This section shows the specifications of the VRF2933(MP) device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the VRF2933(MP) device. T_C = 25 °C unless otherwise specified.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	170	V
I_D	Continuous drain current	42	A
V_{GS}	Gate-source voltage	±40	V
P_D	Total power dissipation	648	W
T_{STG}	Storage temperature range	–65 to 150	°C
T_J	Operating junction temperature	200	

1.2 Electrical Performance

The following table shows the static characteristics of the VRF2933(MP) device. T_C = 25 °C unless otherwise specified.

Table 1-2. Static Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 100 mA	170	180		V
$V_{DS(ON)}$	On-state drain voltage	$I_{D(ON)}$ = 20 A, V_{GS} = 10 V		2.1	2.4	
I_{DSS}	Zero gate voltage drain current	V_{DS} = 100 V, V_{GS} = 0 V			2.0	mA
I_{GSS}	Gate-source leakage current	V_{DS} = ±20 V, V_{DS} = 0 V			2.0	µA
g_{fs}	Forward transconductance	V_{DS} = 10 V, I_D = 20 A	8			mhos
$V_{GS(th)}$	Gate-source threshold voltage	V_{DS} = 10 V, I_D = 100 mA	2.9	3.6	4.4	V

The following table shows the thermal characteristics of the VRF2933(MP) device.

Table 1-3. Thermal Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance			0.27	°C/W

Note: These devices are sensitive to electrostatic discharge. Proper handling procedures should be followed.

The following table shows the dynamic characteristics of the VRF2933(MP) device. T_C = 25 °C unless otherwise specified.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	V_{GS} = 0 V, V_{DS} = 50 V, f = 1 MHz		740		pF
C_{oss}	Output capacitance			400		
C_{rss}	Reverse transfer capacitance			32		

The following table shows the functional characteristics of the VRF2933(MP) device. T_C = 25 °C unless otherwise specified.

Table 1-5. Functional Characteristics

Parameter	Characteristics	Test Conditions	Min	Typ	Max	Unit
G_{PS}	Common source amplifier power gain	f_1 = 30 MHz, V_{DD} = 50 V, I_{DQ} = 250 mA, P_{out} = 300 W	20	25		dB
η	Drain efficiency	f_1 = 30 MHz, V_{DD} = 50 V, I_{DQ} = 250 mA, P_{out} = 300 W CW		50		%
Ψ	Electrical ruggedness VSWR 5:1	f_1 = 30 MHz, V_{DD} = 50 V, I_{DQ} = 250 mA, P_{out} = 300 W CW 70:1 VSWR — all phase angles, 0.2 ms × 20% duty factor	No degradation in output power			

1.3 Typical Performance Curves

This section shows the typical performance curves of the VRF2933(MP) device.

Figure 1-1. Output Characteristics

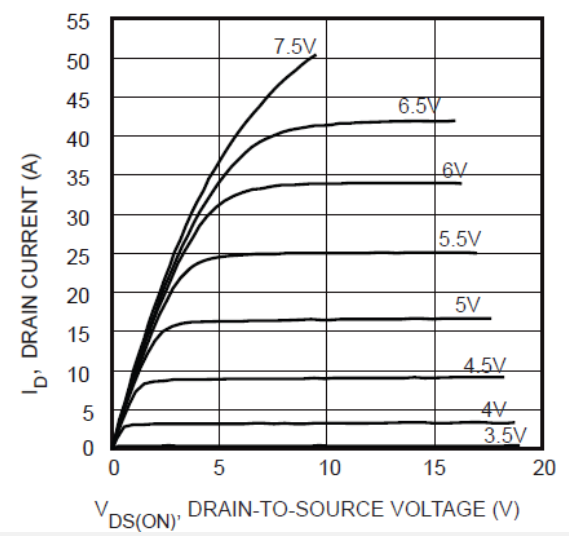


Figure 1-2. Transfer Characteristics

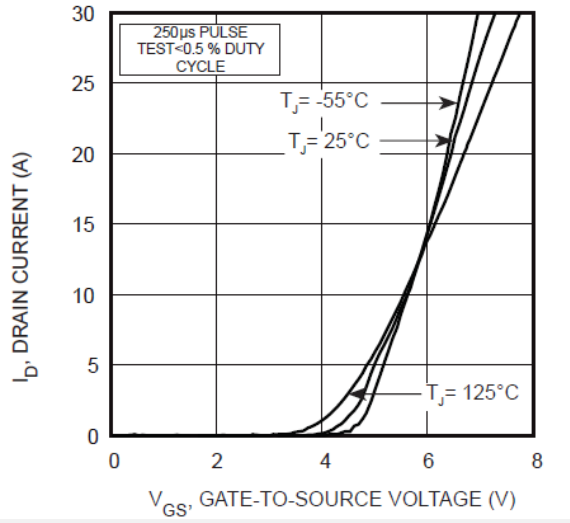


Figure 1-3. Capacitance vs. Drain-to-Source Voltage

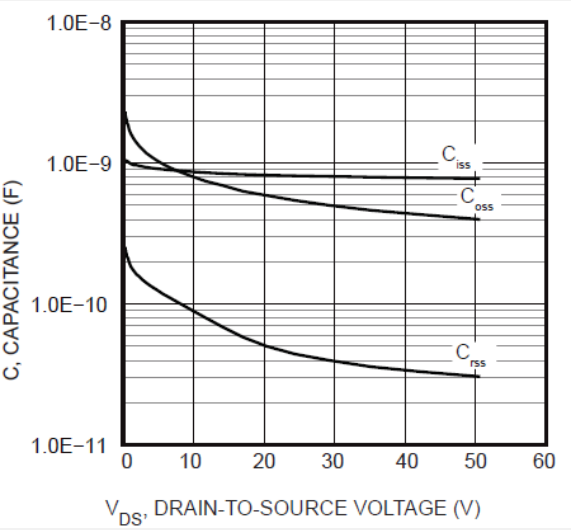


Figure 1-4. Forward Safe Operating Area

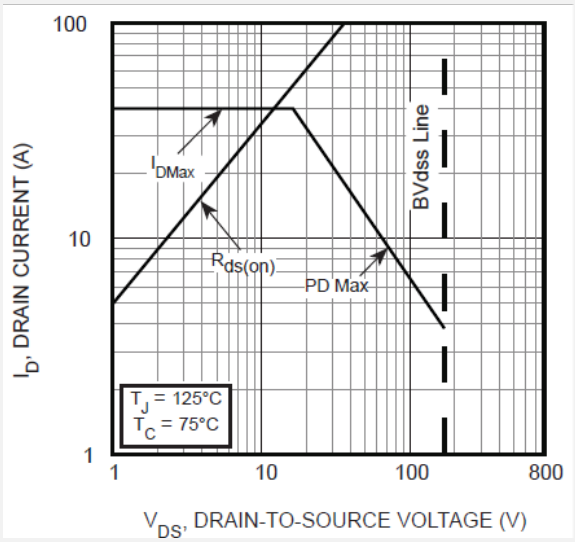


Figure 1-5. Maximum Effective Transient Thermal Impedance Junction-to-Case vs. Pulse Duration

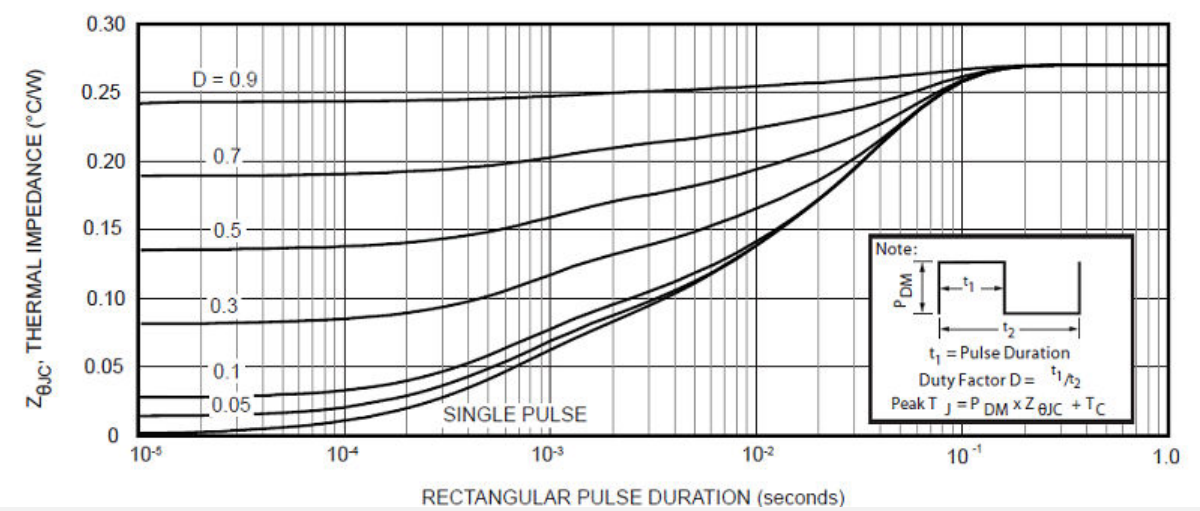


Figure 1-6. Transient Thermal Impedance Model

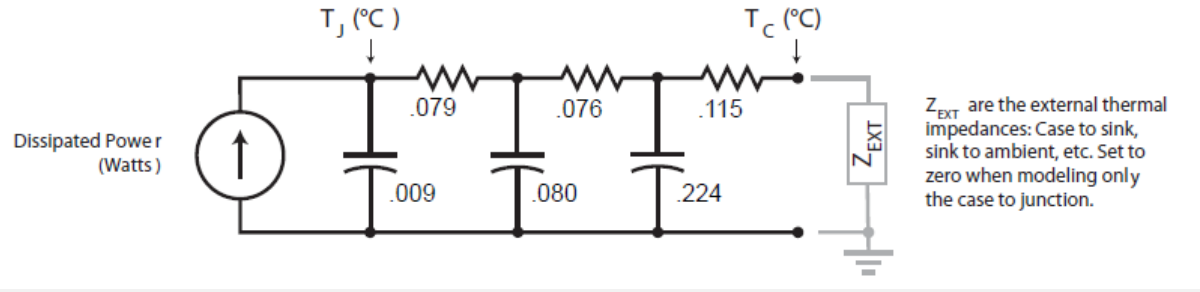


Figure 1-7. P_{IN} vs. P_{OUT}

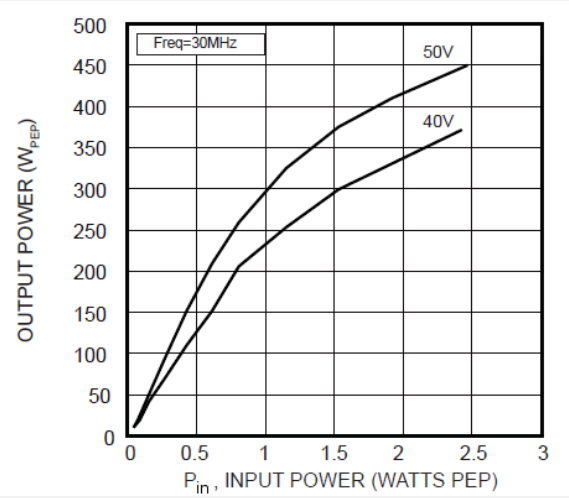
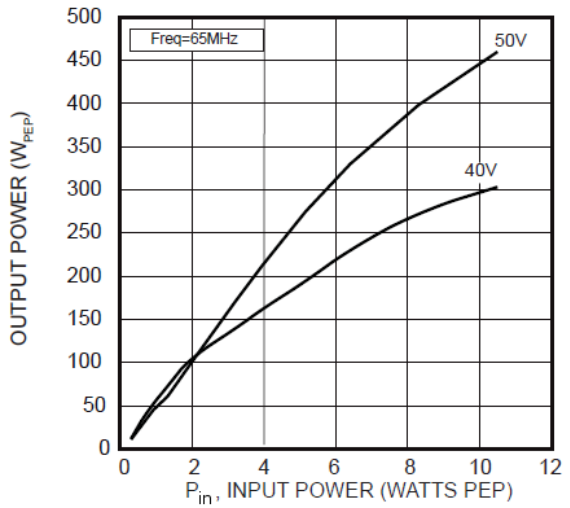


Figure 1-8. P_{IN} vs. P_{OUT}



The following table shows the typical Class AB large signal input-output impedance for the VRF2933(MP) device.

Table 1-6. Typical Class AB Large Signal Input–Output Impedance

Frequency (MHz)	Z_{in}	Z_{out}
2	23.6 - j 5.5	4.0 - j 0.1
13.5	7.6 - j 10.1	3.9 - j 0.6
27.1	3.5 - j 6.0	3.7 - j 1.1
40.7	2.5 - j 4.0	3.3 - j 1.5
65	1.95 - j 2.07	2.6 - j 1.9
100	1.8 - j 0.66	1.76 - j 0.2
150	1.78 + j 0.5	1.03 + j 1.7

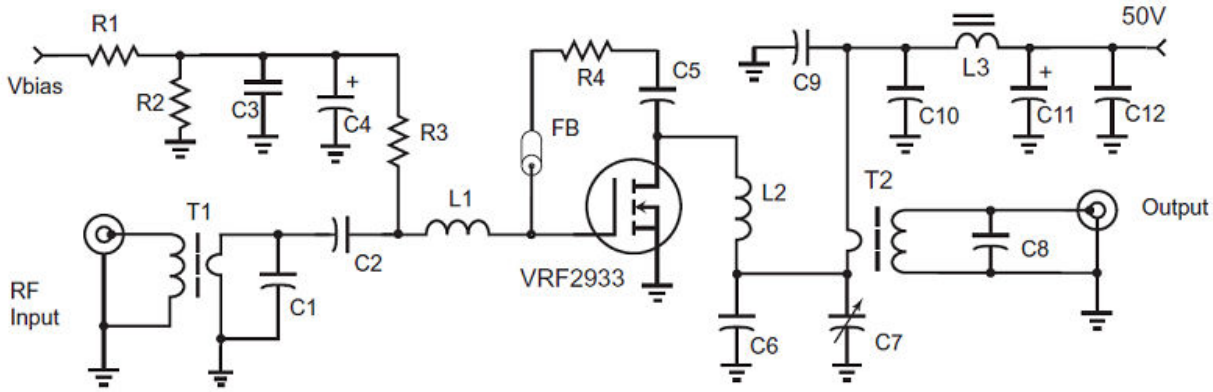
Notes:

- Z_{in} — Gate shunted with 25 Ω
- I_{dq} = 250 mA
- Z_{OL} — Conjugate of optimum load for 300 W output at V_{dd} = 50 V
- j = √ – 1

2. Test Circuits

The following figure shows the test circuit of the VRF2933 device.

Figure 2-1. 30 MHz Test Circuit



C1 1800pF ATC100B ceramic
C2, C3, C5, C9, C10, C12 0.1uF 100V
C6 680 pF metal clad 500V mica
C7 ARCO 467 mica trimmer
C8 100 pF ATC 100E ceramic
C4, C11 10uF 100V Electrolytic
FB small ferrite bead u_i =125
L1 20 nH 2t #18 0.188"d .2"l
L2 38 nH - 2.5t #14 enam. .25" dia.

L3 2t #16 on 2x 267300081 .5" bead
R1-R2 1k Ohm 1/4W
R3 100 Ohm 1W
R4 470 Ohm "low inductance" 3W
T1 16:1 transforner 4t #20 teflon on
RF Parts Co. T1/2 transformer core
T2 9:1 transformer 3t #16 teflon on
RF Parts Co. T1 transformer core

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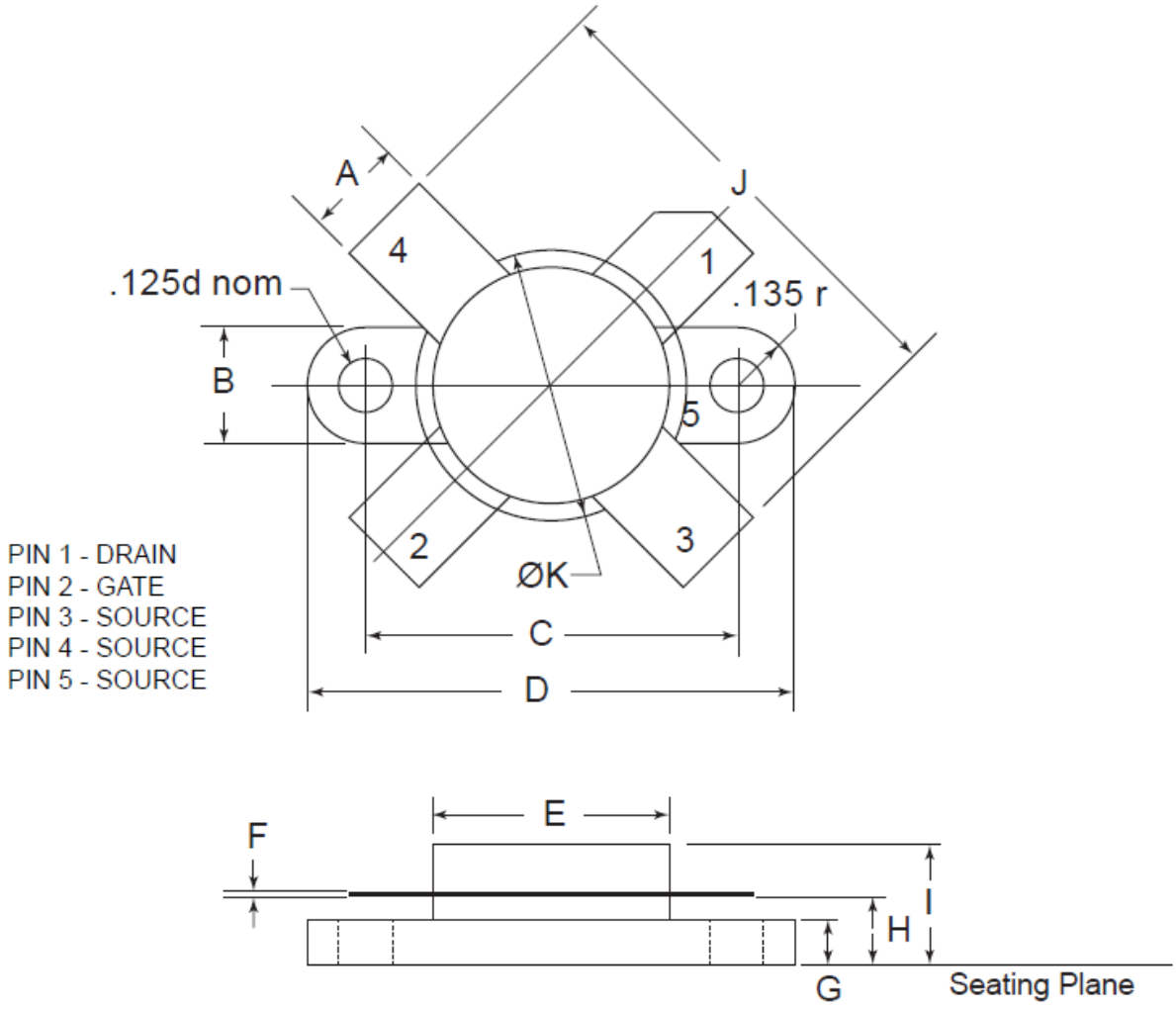
3. Package Specification

This section shows the package specification of the VRF2933(MP) device.

3.1 Package Outline Drawing

The following figure illustrates the package outline of the VRF2933(MP) device.

Figure 3-1. M177 Package Outline



Note: Hazardous Material Warning!
The ceramic portion of the device between leads and mounting flange is beryllium oxide. Beryllium oxide dust is highly toxic when inhaled. Care must be take during handling and mounting to avoid damage to this area. These devices must never be thrown away with general industrial or domestic waste.

The following table shows the package dimensions for the VRF2933(MP) device.

Table 3-1. Package Dimensions

Dimension	Min.	Typ.	Max.
A	0.225	0.230	0.235

.....continued

Dimension	Min.	Typ.	Max.
B	0.265	0.270	0.275
C	0.860	0.865	0.870
D	1.130	1.135	1.140
E	0.545	0.550	0.555
F	0.003	0.005	0.007
G	0.098	0.103	0.108
H	0.150	0.160	0.170
I			0.280
J	1.080	1.100	1.120
K	0.625	0.630	0.635

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4. Matched Pair Part Marking

Adding MP at the end of part number specifies a matched pair where $V_{GS(TH)}$ is matched between the two parts. V_{TH} range codes are marked on the devices per the following table.

Table 4-1. V_{TH} Range Codes

Code	V_{TH} Range	Code	V_{TH} Range
A	2.900–2.975	M	3.650–3.725
B	2.975–3.050	N	3.725–3.800
C	3.050–3.125	P	3.800–3.875
D	3.125–3.200	R	3.875–3.950
E	3.200–3.275	S	3.950–4.025
F	3.275–3.350	T	4.025–4.100
G	3.350–3.425	W	4.100–4.175
H	3.425–3.500	X	4.175–4.250
J	3.500–3.575	Y	4.250–4.325
K	3.575–3.650	Z	4.325–4.400

Note: V_{TH} values are based on Microchip measurements at datasheet conditions with an accuracy of 1.0%.

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5. Revision History

Table 5-1. Revision History

Revision	Date	Description
A	02/2022	• Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00004434A,which replaces the previous Microsemi literature number 050-4941. • Reduced $V_{DS(on)}$ limit from 2.7 V max. to 2.4 V max.
Initial releases (Microsemi Revisions A through K)	12/2006 – 10/2020	Previous releases.

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