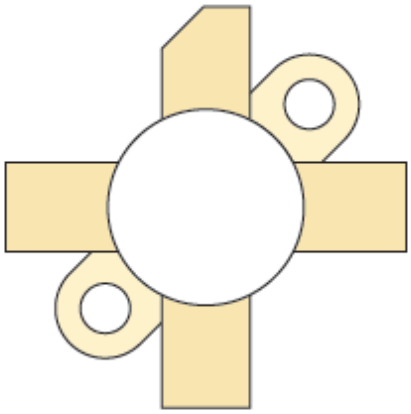
# VRF141, VRF141MP

## 28 V, 150 W, 175 MHz RF Power MOSFET

## Product Overview

The VRF141(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.



**Features**

- Improved ruggedness $V_{(BR)DSS}$ = 80 V
- 150 W with 22 dB typical gain at 30 MHz, 28 V
- 150 W with 13 dB typical gain at 175 MHz, 28 V
- Excellent stability and low IMD
- Common source configuration
- Available in matched pairs (VRF141MP)
- 30:1 load VSWR capability at specified operating conditions
- Nitride passivated
- Refractory gold metallization
- High voltage replacement for MRF141
- RoHS compliant

# 1. Device Specifications

This section shows the specifications of the VRF141(MP) device.

## 1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the VRF141(MP) device. $T_C$ = 25 °C unless otherwise specified.

**Table 1-1. Absolute Maximum Ratings**

| Symbol | Parameter | Ratings | Unit |
|---|---|---|---|
| $V_{DSS}$ | Drain source voltage | 80 | V |
| $I_D$ | Continuous drain current at $T_C$ = 25 °C | 20 | A |
| $V_{GS}$ | Gate-source voltage | ±40 | V |
| $P_D$ | Total power dissipation at $T_C$ = 25 °C | 300 | 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 VRF141(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 | 80 | | | V |
| $V_{DS(ON)}$ | On-state drain voltage | $I_{D(ON)}$ = 10 A, $V_{GS}$ = 10 V | | 1.0 | 1.4 | |
| $I_{DSS}$ | Zero gate voltage drain current | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | | | 1.0 | mA |
| $I_{GSS}$ | Gate-source leakage current | $V_{DS}$ = ±20 V, $V_{GS}$ = 0 V | | | 1.0 | µA |
| $g_{fs}$ | Forward transconductance | $V_{DS}$ = 10 V, $I_D$ = 5 A | 5.0 | | | 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 VRF141(MP) device.

**Table 1-3. Thermal Characteristics**

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-case thermal resistance | | | 0.60 | °C/W |

The following table shows the dynamic characteristics of the VRF141(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, $V_{DS}$ = 28 V, f = 1 MHz | | 400 | | pF |
| $C_{oss}$ | Output capacitance | | | 375 | | |
| $C_{rss}$ | Reverse transfer capacitance | | | 50 | | |

The following table shows the functional characteristics of the VRF141(MP) device. $T_C$ = 25 °C unless otherwise specified.

**Table 1-5. Functional Characteristics**

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $G_{PS}$ | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 $W_{PEP}$ | 16 | 20 | | dB |
| $G_{PS}$ | $f_1$ = 175 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 W | | 13 | | |
| η | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 $W_{PEP}$ | 40 | 45 | | % |
| $IMD_{(d3)}$ | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 $W_{PEP}$[1] | | –30 | –28 | dB |
| $IMD_{(d11)}$ | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 $W_{PEP}$ | | –60 | | |
| Ψ | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 250 mA, $P_{out}$ = 150 $W_{PEP}$<br>30:1 VSWR — all phase angles | No degradation in output power | | | |

**Note:**

1. To MIL-STD-1311 Version A, test method 2204B, Two Tone, Reference Each Tone

The following table shows the class A characteristics of the VRF141(MP) device. $T_C$ = 25 °C unless otherwise specified.

**Table 1-6. Class A Characteristics**

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $G_{PS}$ | $f_1$ = 30 MHz, $f_2$ = 30.001 MHz, $V_{DD}$ = 28 V, $I_{DQ}$ = 4.0 A, $P_{out}$ = 50 $W_{PEP}$ | | 23 | | dB |
| $IMD_{(d3)}$ | | | –50 | | |
| $IMD_{(d11)}$ | | | –75 | | |

## 1.3 Typical Performance Curves

This section shows the typical performance curves of the VRF141(MP) device.

**Figure 1-1. Output Characteristics**

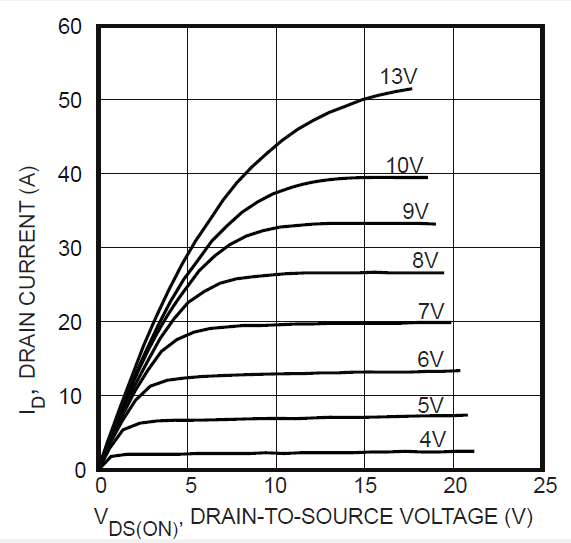



**Figure 1-2. Transfer Characteristics**

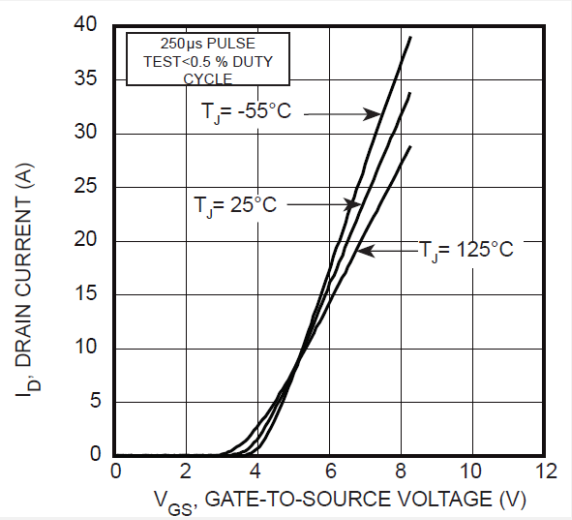



**Figure 1-3. Capacitance vs. Drain-to-Source Voltage**

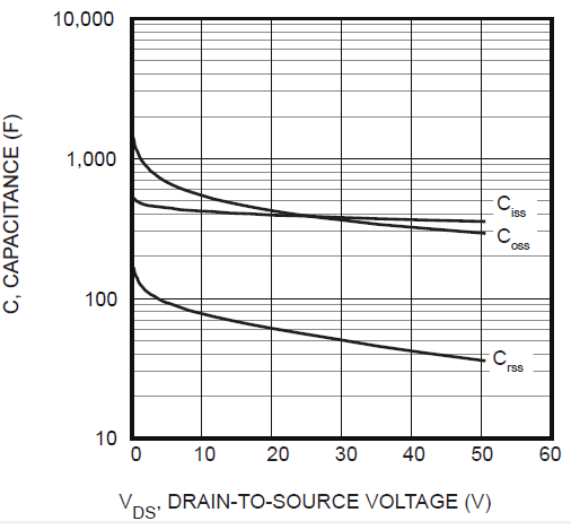



**Figure 1-4. Forward Safe Operating Area**

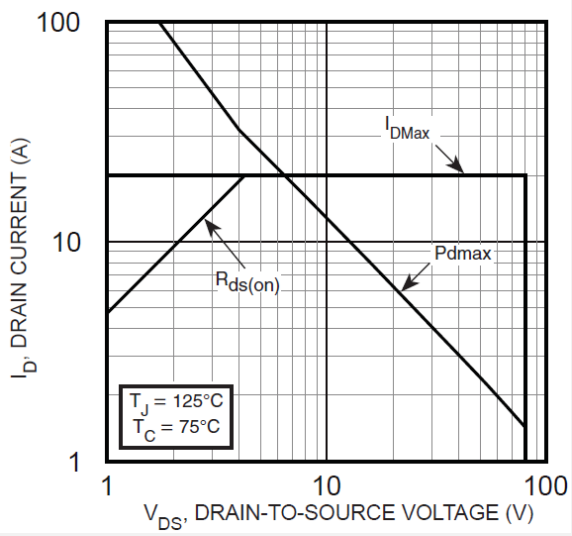


**Figure 1-5. Maximum Effective Transient Thermal Impedance Junction-to-Case vs Pulse Duration**

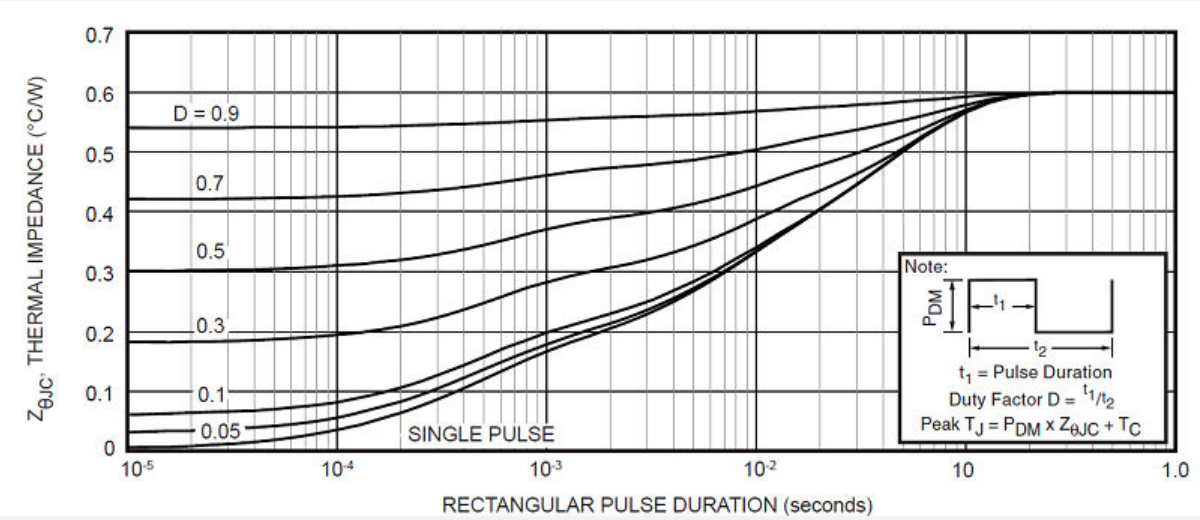



**Figure 1-6. IMD vs. $P_{OUT}$**

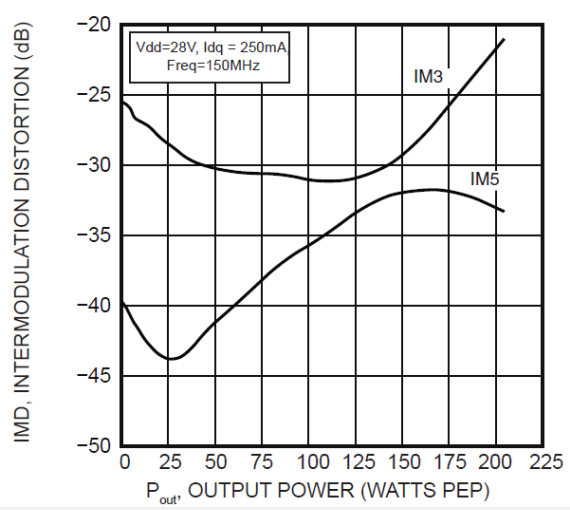



**Figure 1-7. $P_{IN}$ vs. $P_{OUT}$**

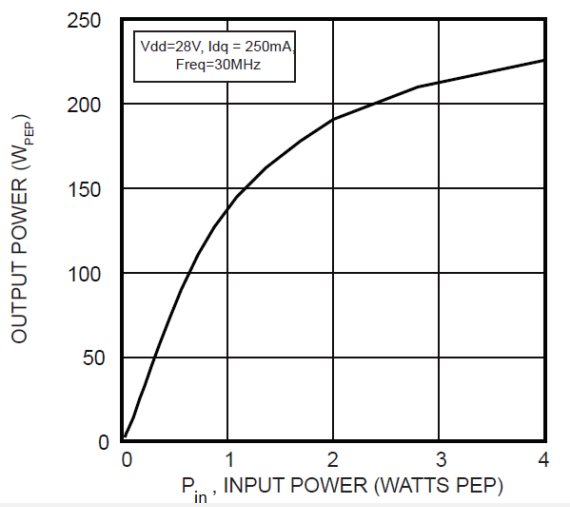
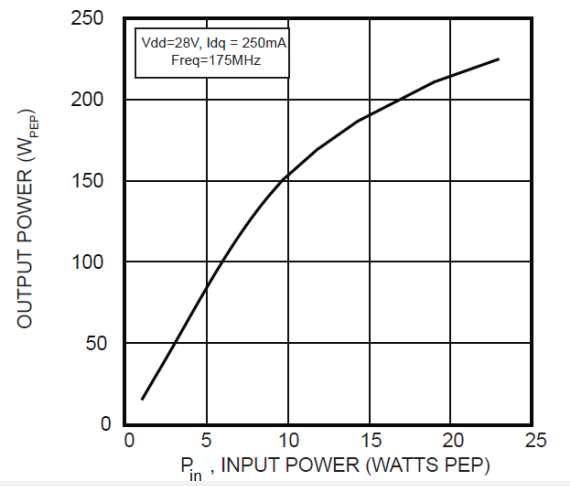


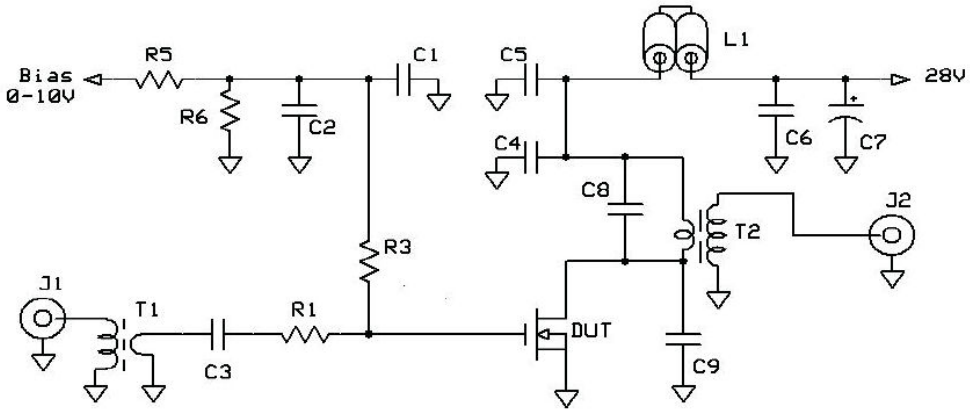

**Figure 1-8. $P_{IN}$ vs. $P_{OUT}$**



# 2. Test Circuits

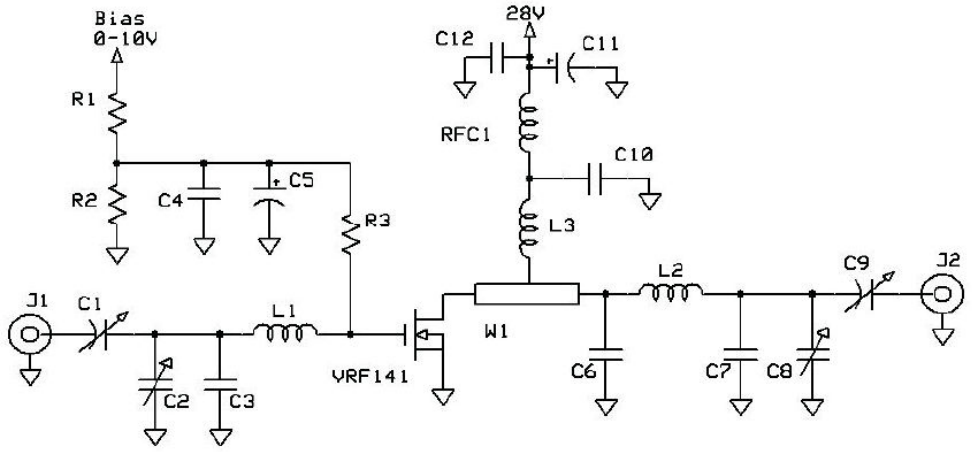
The following figures show the test circuits of the VRF141(MP) device.

**Figure 2-1. 30 MHz Test Circuit**




C1 - 1uF 50V tantalum
C2-C6 - 0.1uF 100V SMT
C7 - 15uF 100V Elect
C8 - 820 pF ATC 100B
T1 - 16:1 bead/tube transformer
T2 = 1:25 bradband bead/tube transformer u=125
C9 - 100 pF ATC 100B
L1 - two ferrite beads on #18
R1 - 1 ohm 1 W SMT
R3 - 200 ohm 1/2 Carbn
R4 - 470 ohm 1W
R5 R6 - 2200 ohm 1/4W

**Figure 2-2. 175 MHz Test Circuit**




C1, 2, 8, 9 - ARCO 463
C3 C7 - 25 pF ATC 100B
C4 C10 C12 - 0.1uF 100V SMT
C5 - 1 uF 15WV tant
C6 - 270 pF ATC 100B
C10 - .05 100V 1206 SMT
C11 - 15uF 100V Elect
L1 - 3/4" #18 ga into Hairpin
W1 - printed line 0.23"W x 0.7" L
L2 - 2t #16 ga .25" dia x .25" ~ 35nH
L3 -2 turns #16 ga 5/16" ID tight. ~ 50nH
R1 R2 - 2.2k ohm 1/4W
R3 - 150 ohm 1/4W
RFC1 Fair-Rite 2961666631 (WK200-4B)

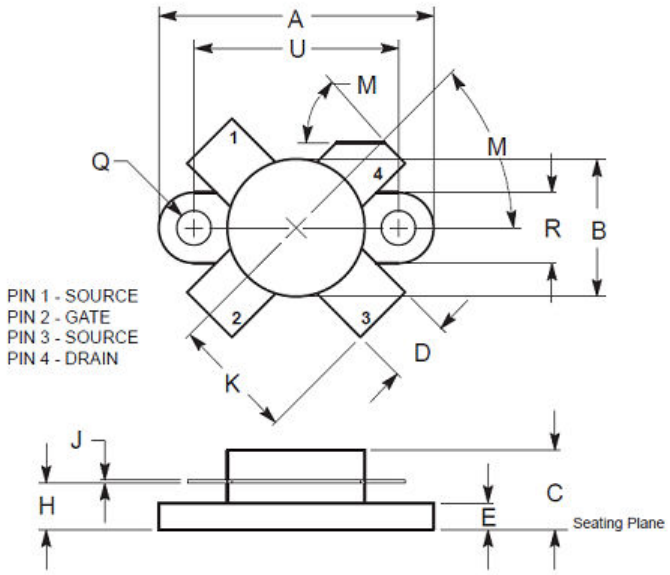
# 3. Package Specification

This section shows the package specification of the VRF141(MP) device.

## 3.1 Package Outline Drawing

The following figure illustrates the package outline of the VRF141(MP) device.

**Figure 3-1. M174 Package Outline 0.5” SOE**




| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.096 | 0.990 | 24.39 | 25.14 |
| B | 0.465 | 0.510 | 11.82 | 12.95 |
| C | 0.229 | 0.275 | 5.82 | 6.98 |
| D | 0.216 | 0.235 | 5.49 | 5.96 |
| E | 0.084 | 0.110 | 2.14 | 2.79 |
| H | 0.144 | 0.178 | 3.66 | 4.52 |
| J | 0.003 | 0.007 | 0.08 | 0.17 |
| K | 0.435 | | 11.0 | |
| M | 45° NOM | | 45° NOM | |
| Q | 0.115 | 0.130 | 2.93 | 3.30 |
| R | 0.246 | 0.255 | 6.25 | 6.47 |
| U | 0.720 | 0.730 | 18.29 | 18.54 |

# 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. $V_{TH}$ values 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%.

# 5. Revision History

**Table 5-1. Revision History**

| Revision | Date | Description |
|---|---|---|
| A | 12/2021 | • Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00004329A,which replaces the previous Microsemi literature number 050-4942.<br>• Increased $V_{DS(on)}$ limit from 1.3V max. to 1.4V max. |
| Initial releases (Microsemi Revisions A through E) | 09/2007 – 12/2020 | Previous releases. |

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