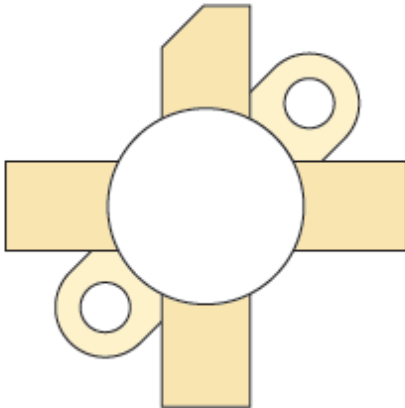

50 V, 300 W, 150 MHz RF Power MOSFET

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 $V_{(BR)DSS} = 170\text{ V}$
- 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

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. $T_C = 25\text{ }^\circ\text{C}$ 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 | $^\circ\text{C}$ |
| T_J | Operating junction temperature | 200 | |

1.2 Electrical Performance

The following table shows the static characteristics of the VRF2933(MP) device. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-2. Static Characteristics

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

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. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-4. Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|-----------|------------------------------|---|-----|-----|-----|------|
| C_{iss} | Input capacitance | $V_{GS} = 0\text{ V}, V_{DS} = 50\text{ V}, f = 1\text{ MHz}$ | | 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. $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified.

Table 1-5. Functional Characteristics

| Parameter | Characteristics | Test Conditions | Min | Typ | Max | Unit |
|-----------|------------------------------------|--|--------------------------------|-----|-----|------|
| G_{PS} | Common source amplifier power gain | $f_1 = 30\text{ MHz}, V_{DD} = 50\text{ V}, I_{DQ} = 250\text{ mA}, P_{out} = 300\text{ W}$ | 20 | 25 | | dB |
| η | Drain efficiency | $f_1 = 30\text{ MHz}, V_{DD} = 50\text{ V}, I_{DQ} = 250\text{ mA}, P_{out} = 300\text{ W CW}$ | | 50 | | % |
| Ψ | Electrical ruggedness VSWR 5:1 | $f_1 = 30\text{ MHz}, V_{DD} = 50\text{ V}, I_{DQ} = 250\text{ mA}, P_{out} = 300\text{ W CW}$ 70:1 VSWR — all phase angles, 0.2 ms \times 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.

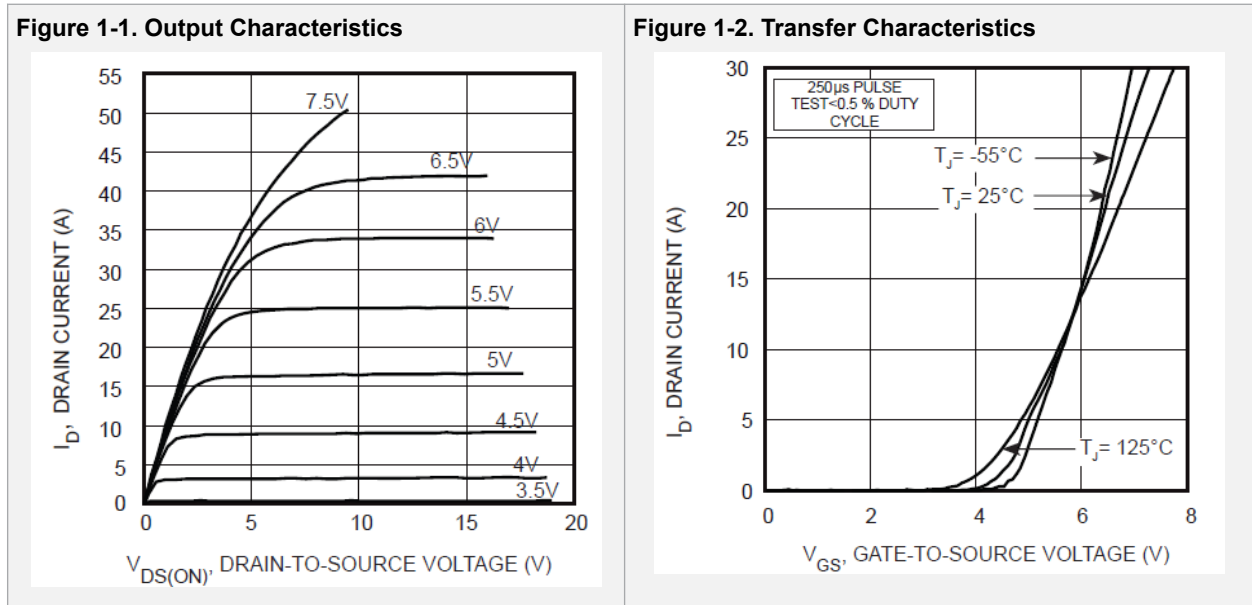


Figure 1-3. Capacitance vs. Drain-to-Source Voltage

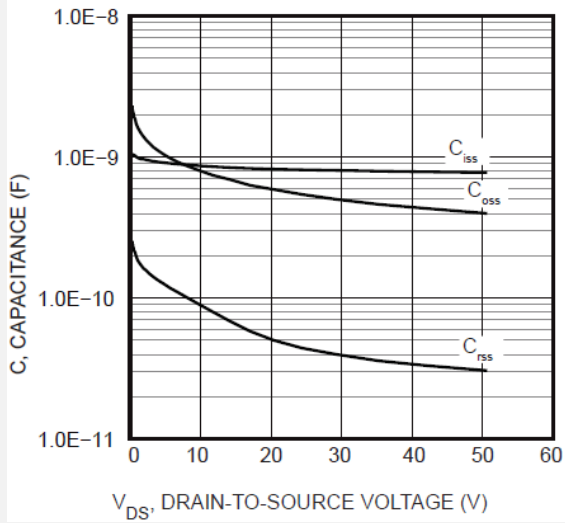


Figure 1-4. Forward Safe Operating Area

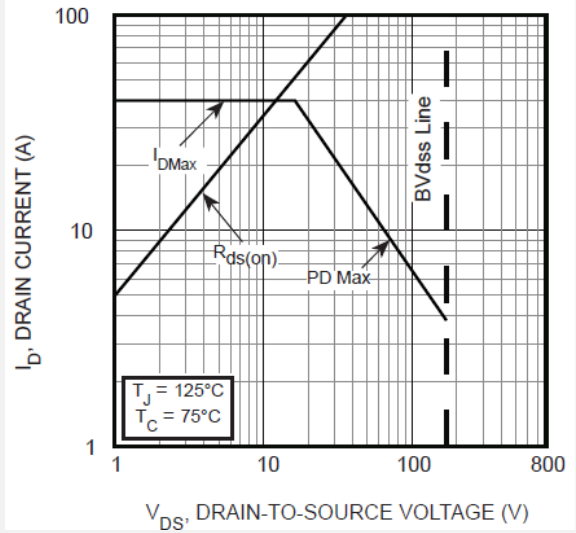


Figure 1-5. Maximum Effective Transient Thermal Impedance Junction-to-Case vs. Pulse Duration

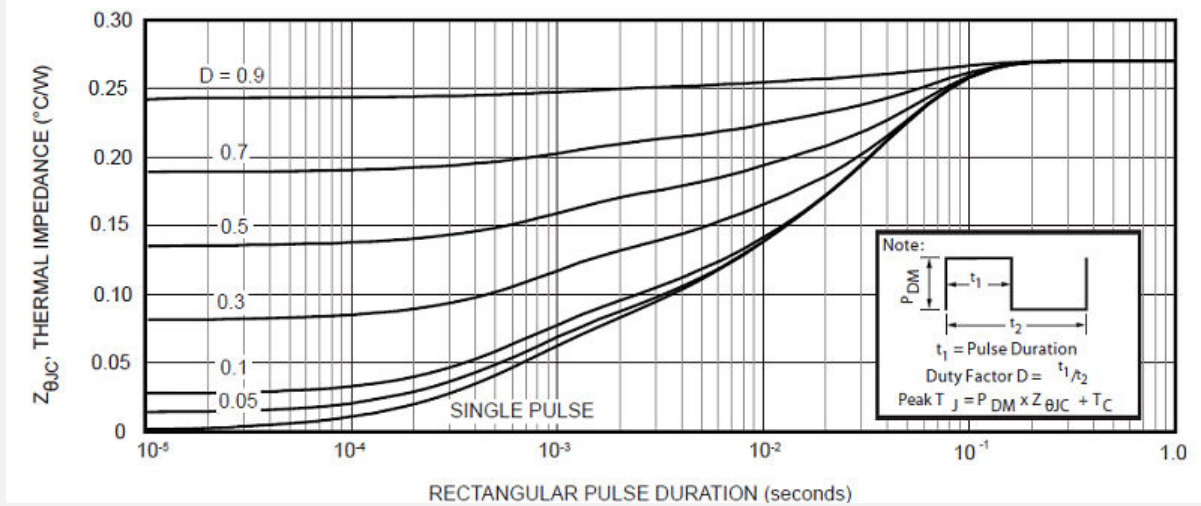


Figure 1-6. Transient Thermal Impedance Model

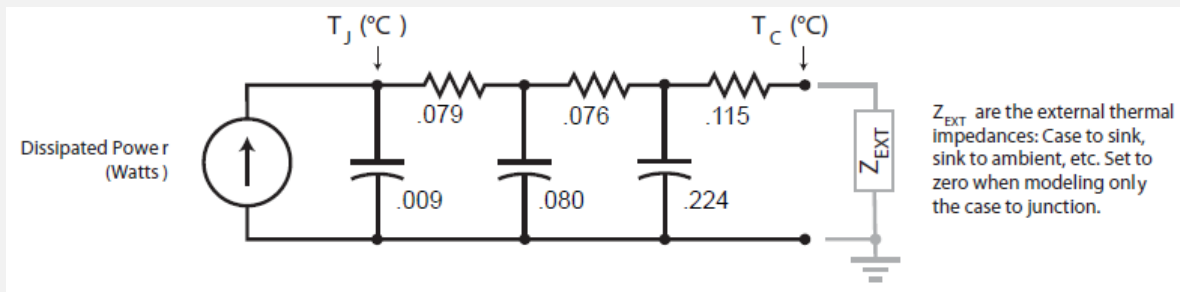


Figure 1-7. P_{IN} vs. P_{OUT}

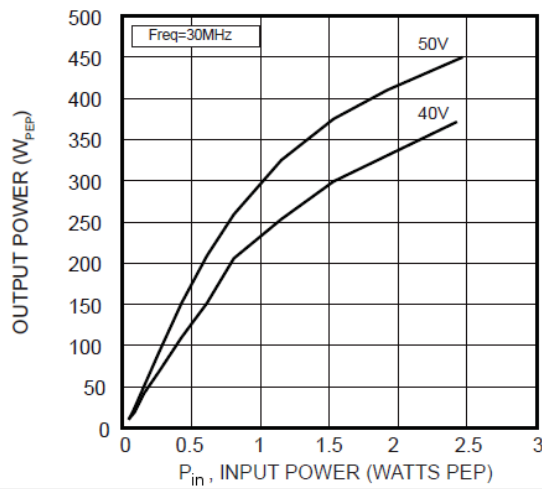
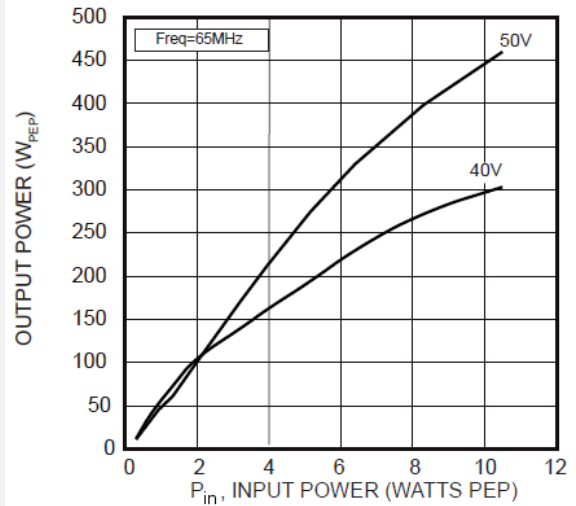


Figure 1-8. P_{IN} vs. P_{OUT}



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 |

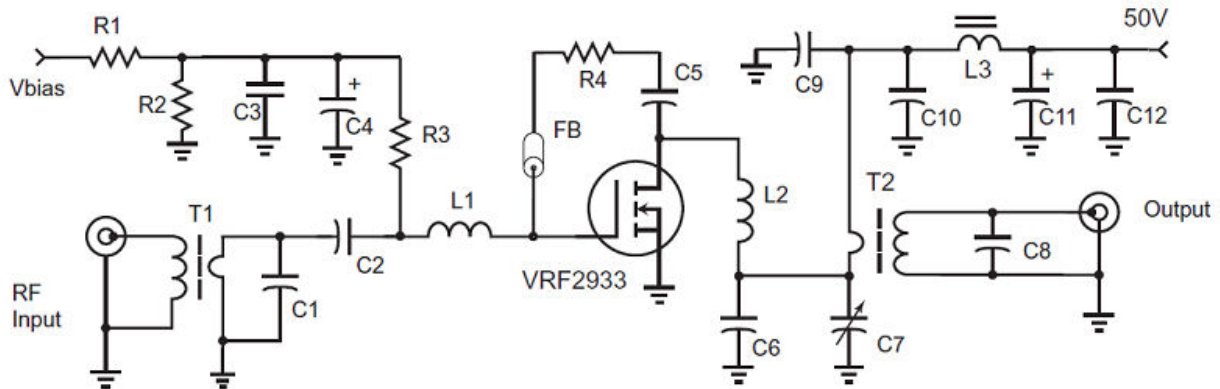
Notes:

- 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
- $j = \sqrt{-1}$

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 $\mu_i = 125$
 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 transformer 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

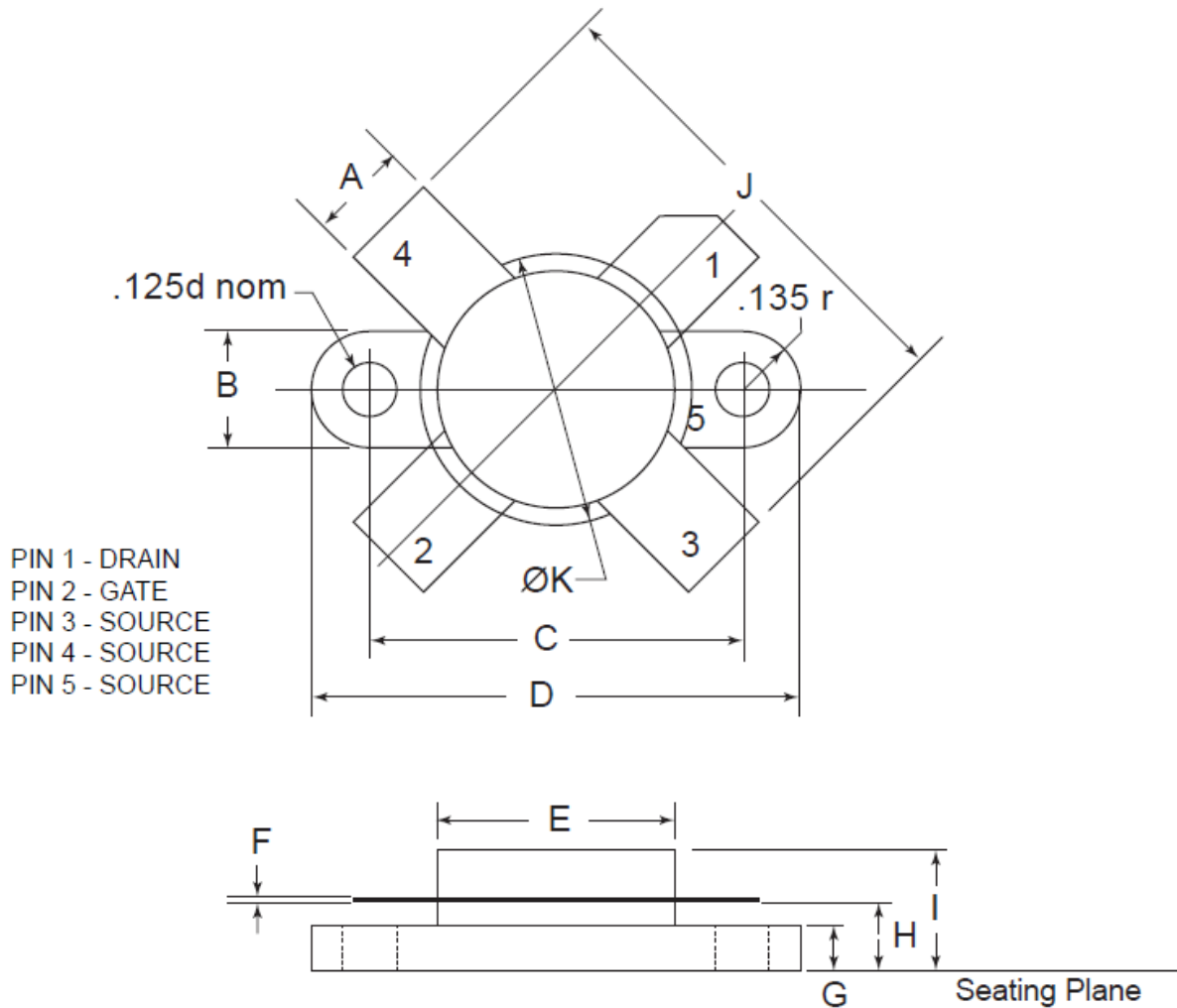
3. Package Specification

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 taken 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 |

VRF2933, VRF2933MP

Package Specification

.....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 |

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%.

5. Revision History

Table 5-1. Revision History

| Revision | Date | Description |
|--|-------------------|---|
| A | 02/2022 | <ul style="list-style-type: none">• 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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