MRF177

The RF MOSFET Line
100W, 400MHz, 28V

Designed for broadband commercial and military applications up to 400 MHz frequency range. Primarily used as a driver or output amplifier in push–pull configurations. Can be used in manual gain control, ALC and modulation circuits.

N-Channel enhancement mode MOSFET

- Typical performance at 400 MHz, 28 V:
  - Output power — 100 W
  - Gain — 12 dB
  - Efficiency — 60%
- Low thermal resistance
- Low Crss — 10 pF typ. @ VDS = 28 V
- Ruggedness tested at rated output power
- Nitride passivated die for enhanced reliability
- Excellent thermal stability; suited for Class A operation

MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain–Source Voltage</td>
<td>VDSS</td>
<td>65</td>
<td>Vdc</td>
</tr>
<tr>
<td>Drain–Gate Voltage (RGS = 1.0 MΩ)</td>
<td>VDGR</td>
<td>65</td>
<td>Vdc</td>
</tr>
<tr>
<td>Gate–Source Voltage</td>
<td>VGs</td>
<td>440</td>
<td>Vdc</td>
</tr>
<tr>
<td>Drain Current — Continuous</td>
<td>ID</td>
<td>16</td>
<td>Adc</td>
</tr>
<tr>
<td>Total Device Dissipation @ TΩ = 25°C (1)</td>
<td>PD</td>
<td>270</td>
<td>Watts</td>
</tr>
<tr>
<td>Derate above 25°C</td>
<td></td>
<td>1.54</td>
<td>W/°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>Tstg</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>TJ</td>
<td>200</td>
<td>°C</td>
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</table>

THERMAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Resistance, Junction–to–Case</td>
<td>RsJc</td>
<td>0.55</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

(1) Total device dissipation rating applies only when the device is operated as an RF push–pull amplifier.

NOTE — CAUTION — MOS devices are susceptible to damage from electrostatic charge. Reasonable precautions in handling and packaging MOS devices should be observed.
# The RF MOSFET Line

## 100W, 400MHz, 28V

**ELECTRICAL CHARACTERISTICS** \( T_C = 25°C \) unless otherwise noted

<table>
<thead>
<tr>
<th>Characteristic (1)</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td><strong>OFF CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain–Source Breakdown Voltage ( (V_GS = 0, I_D = 50,mA) )</td>
<td>( V_{(BR)DSS} )</td>
<td>65</td>
<td>—</td>
<td>—</td>
<td>Vdc</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current ( (V_DS = 26,V, V_GS = 0) )</td>
<td>( I_{DSS} )</td>
<td>—</td>
<td>—</td>
<td>2.0</td>
<td>mA dc</td>
</tr>
<tr>
<td>Gate–Source Leakage Current ( (V_GS = 20,V, V_DS = 0) )</td>
<td>( I_{GSS} )</td>
<td>—</td>
<td>—</td>
<td>1.0</td>
<td>µA dc</td>
</tr>
<tr>
<td><strong>ON CHARACTERISTICS</strong> (1)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage ( (V_DS = 10,V, I_D = 50,mA) )</td>
<td>( V_{GS(th)} )</td>
<td>1.0</td>
<td>3.0</td>
<td>6.0</td>
<td>Vdc</td>
</tr>
<tr>
<td>Drain–Source On–Voltage ( (V_GS = 10,V, I_D = 3.0,A) )</td>
<td>( V_{DS(on)} )</td>
<td>—</td>
<td>—</td>
<td>1.4</td>
<td>Vdc</td>
</tr>
<tr>
<td>Forward Transconductance ( (V_DS = 10,V, I_D = 2.0,A) )</td>
<td>( G_{fs} )</td>
<td>1.8</td>
<td>2.2</td>
<td>—</td>
<td>mhos</td>
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<td><strong>DYNAMIC CHARACTERISTICS</strong> (1)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Capacitance ( (V_DS = 28,V, V_GS = 0, f = 1.0,MHz) )</td>
<td>( C_{ISS} )</td>
<td>—</td>
<td>100</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance ( (V_DS = 28,V, V_GS = 0, f = 1.0,MHz) )</td>
<td>( C_{OSS} )</td>
<td>—</td>
<td>105</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance ( (V_DS = 28,V, V_GS = 0, f = 1.0,MHz) )</td>
<td>( C_{RSS} )</td>
<td>—</td>
<td>10</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td><strong>FUNCTIONAL CHARACTERISTICS</strong> (Figure 9) (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Source Power Gain ( (V_DD = 28,Vdc, P_{out} = 100,W, f = 400,MHz, I_{DQ} = 200,mA) )</td>
<td>( G_{PS} )</td>
<td>10</td>
<td>12</td>
<td>—</td>
<td>dB</td>
</tr>
<tr>
<td>Drain Efficiency ( (V_DD = 28,Vdc, P_{out} = 100,W, f = 400,MHz, I_{DQ} = 200,mA) )</td>
<td>( \eta )</td>
<td>55</td>
<td>60</td>
<td>—</td>
<td>%</td>
</tr>
<tr>
<td>Electrical Ruggedness ( (V_DD = 28,Vdc, P_{out} = 100,W, f = 400,MHz, I_{DQ} = 200,mA, Load VSWR = 30:1, All Phase Angles At Frequency of Test) )</td>
<td>( \psi )</td>
<td>—</td>
<td>No Degradation in Output Power Before &amp; After Test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Note each transistor chip measured separately  
(2) Both transistor chips operating in push–pull amplifier
TYPICAL CHARACTERISTICS

Figure 1. Output Power versus Input Power

Figure 2. Output Power versus Input Power

Figure 3. Output Power versus Supply Voltage

Figure 4. Output Power versus Gate Voltage
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Figure 5. Capacitance versus Drain Voltage

Figure 6. DC Safe Operating Area
NOTE: Input and Output Impedance values given are measured gate-to-gate and drain-to-drain respectively.

\[
\begin{array}{cccc}
V_{DD} &=& 28 \text{ V} & \text{I}_{DQ} = 200 \text{ mA} & P_{out} = 100 \text{ W} \\
\text{f (MHz)} & Z_{in} \text{ Ohms} & Z_{OL*} \text{ Ohms} \\
100 & 2.0 - j11.5 & 3.5 - j6 \\
150 & 2.05 - j9.45 & 3.35 - j6.34 \\
200 & 2.1 - j7.5 & 3.3 - j4.4 \\
400 & 2.35 + j0.4 & 3.2 - j1.38 \\
\end{array}
\]

\(Z_{OL*}\): Conjugate of optimum load impedance into which the device operates at a given output power, voltage, current and frequency.

Figure 7. Impedance or Admittance Coordinates
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Rev. V1

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Figure 8. Test Circuit Electrical Schematic

C1, C12 1-10 pF JOHANSON OR EQUIVALENT
C2, C3, C5, C6, C10, C11 270 pF ATC 100 MIL CHIP CAP
C4, C9 1-20 pF
C7 36 pF CHIP CAP
C8 10 pF CHIP CAP
C13, C14 0.1 µF @ 50 V dc
C15, C18 10 µF @ 50 V dc
C16 500 pF BUTTON
C17 1000 pF UNCASED MICA

D1 1N5347B, 20 Vdc
L1 1-TURN NO. 18, 0.25", 2-HOLE FERRITE BEAD
L2 8-1/2 TURNS NO. 18, CLOSE WOUND .375" DIA.
R1, R4, R5 10 kΩ @ 1/2 W RESISTOR
R2 10 kΩ, 10 TURN RESISTOR
R3 2.0 kΩ @ 1/2 W RESISTOR
T1 1-1/2" T. 50 Ω COAX, .034" DIA. ON DUAL 0.5" FERRITE CORE
T2 2.0" 25 Ω COAX, .075" DIA.
T3 2.1" 10 Ω COAX, .075" DIA.
T4 4.0" 50 Ω COAX, .065" DIA.

Board: Dielectric Thickness = 0.060" 2oz Copper, Cu-Clad, Teflon Fiberglass, εr = 2.55
## Table 1. Common Source S-Parameters (V_{DS} = 24 V, I_{D} = 0.4 A)

<table>
<thead>
<tr>
<th>f MHz</th>
<th>$S_{11}$</th>
<th>$S_{21}$</th>
<th>$S_{12}$</th>
<th>$S_{22}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.797</td>
<td>-154</td>
<td>12.40</td>
<td>88.029</td>
</tr>
<tr>
<td>40</td>
<td>0.796</td>
<td>-151</td>
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<td>89.027</td>
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<td>50</td>
<td>0.749</td>
<td>-164</td>
<td>6.84</td>
<td>85.026</td>
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<tr>
<td>60</td>
<td>0.770</td>
<td>-163</td>
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<td>-168</td>
<td>3.47</td>
<td>64.024</td>
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<tr>
<td>110</td>
<td>0.816</td>
<td>-169</td>
<td>3.14</td>
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<td>-173</td>
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<tr>
<td>180</td>
<td>0.869</td>
<td>-173</td>
<td>1.63</td>
<td>46.018</td>
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<td>190</td>
<td>0.872</td>
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<td>1.52</td>
<td>44.017</td>
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<td>200</td>
<td>0.873</td>
<td>-175</td>
<td>1.41</td>
<td>43.017</td>
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<tr>
<td>210</td>
<td>0.877</td>
<td>-176</td>
<td>1.28</td>
<td>42.018</td>
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<tr>
<td>220</td>
<td>0.880</td>
<td>-176</td>
<td>1.18</td>
<td>41.019</td>
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<td>230</td>
<td>0.881</td>
<td>-177</td>
<td>1.15</td>
<td>38.024</td>
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<tr>
<td>240</td>
<td>0.877</td>
<td>-178</td>
<td>1.09</td>
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<td>-180</td>
<td>1.04</td>
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<td>0.513</td>
<td>-176</td>
<td>0.77</td>
<td>30.017</td>
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<td>300</td>
<td>0.519</td>
<td>-177</td>
<td>0.72</td>
<td>30.012</td>
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<tr>
<td>310</td>
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<td>-176</td>
<td>0.71</td>
<td>28.012</td>
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<td>320</td>
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<td>-178</td>
<td>0.67</td>
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<td>-179</td>
<td>0.64</td>
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<td>0.55</td>
<td>24.017</td>
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<td>0.537</td>
<td>-179</td>
<td>0.52</td>
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<td>380</td>
<td>0.540</td>
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<td>0.49</td>
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<td>390</td>
<td>0.541</td>
<td>-178</td>
<td>0.46</td>
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<td>400</td>
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<td>0.46</td>
<td>18.021</td>
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<td>410</td>
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<td>420</td>
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<td>430</td>
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<td>-176</td>
<td>0.41</td>
<td>16.029</td>
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### Table 1. Common Source S–Parameters (VDS = 24 V, ID = 0.4 A) (continued)

| f MHz | | \( |S_{11}| \) | \( \phi \) | \( |S_{21}| \) | \( \phi \) | \( |S_{12}| \) | \( \phi \) | \( |S_{22}| \) | \( \phi \) |
|-------|-----|----------------|-----|----------------|-----|----------------|-----|----------------|-----|
| 440   |     | 0.947          | 176 | 0.38           | 16  | 0.029          | 75  | 0.962          | –179|
| 450   |     | 0.949          | 176 | 0.38           | 19  | 0.030          | 78  | 0.984          | –178|
| 460   |     | 0.952          | 175 | 0.36           | 17  | 0.029          | 72  | 0.987          | 178 |
| 470   |     | 0.953          | 175 | 0.34           | 18  | 0.030          | 70  | 0.976          | 179 |
| 480   |     | 0.952          | 174 | 0.34           | 14  | 0.035          | 69  | 0.968          | 179 |
| 490   |     | 0.952          | 174 | 0.34           | 14  | 0.039          | 72  | 0.987          | 178 |
| 500   |     | 0.952          | 174 | 0.32           | 13  | 0.040          | 76  | 1.002          | 179 |
| 600   |     | 0.938          | 170 | 0.22           | 9   | 0.047          | 117 | 1.013          | 172 |
| 700   |     | 0.962          | 166 | 0.19           | 13  | 0.060          | 73  | 0.993          | 171 |
| 800   |     | 0.963          | 162 | 0.17           | 18  | 0.097          | 68  | 0.981          | 171 |
| 900   |     | 0.953          | 159 | 0.14           | 21  | 0.097          | 65  | 0.949          | 166 |
| 1000  |     | 0.952          | 156 | 0.14           | 27  | 0.110          | 68  | 0.982          | 163 |
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### Table 2. Common Source S–Parameters (VDS = 28 V, ID = 0.435 A)

| f MHz | $|S_{11}|$ | $\phi$ | $|S_{21}|$ | $\phi$ | $|S_{12}|$ | $\phi$ | $|S_{22}|$ | $\phi$ |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 30    | 0.803  | −153   | 13.50  | 89     | 0.028  | 3      | 0.746  | −157   |
| 40    | 0.742  | −160   | 9.90   | 90     | 0.026  | 9      | 0.696  | −164   |
| 50    | 0.752  | −163   | 7.48   | 85     | 0.025  | 8      | 0.692  | −168   |
| 60    | 0.773  | −163   | 6.62   | 80     | 0.026  | 4      | 0.739  | −167   |
| 70    | 0.794  | −164   | 5.91   | 74     | 0.026  | 1      | 0.761  | −167   |
| 80    | 0.803  | −166   | 5.04   | 70     | 0.025  | 1      | 0.763  | −167   |
| 90    | 0.812  | −167   | 4.32   | 68     | 0.024  | 1      | 0.783  | −167   |
| 100   | 0.819  | −168   | 3.81   | 64     | 0.022  | 1      | 0.798  | −168   |
| 110   | 0.818  | −169   | 3.44   | 62     | 0.022  | 1      | 0.797  | −168   |
| 120   | 0.817  | −170   | 3.03   | 61     | 0.021  | 9      | 0.779  | −168   |
| 130   | 0.823  | −171   | 2.68   | 59     | 0.020  | 15     | 0.784  | −170   |
| 140   | 0.830  | −171   | 2.49   | 57     | 0.021  | 21     | 0.793  | −169   |
| 150   | 0.838  | −171   | 2.30   | 53     | 0.027  | 27     | 0.792  | −169   |
| 160   | 0.864  | −172   | 2.16   | 52     | 0.030  | −5     | 0.816  | −167   |
| 170   | 0.865  | −173   | 1.95   | 49     | 0.019  | −2     | 0.827  | −166   |
| 180   | 0.870  | −173   | 1.79   | 46     | 0.017  | 8      | 0.869  | −168   |
| 190   | 0.873  | −174   | 1.67   | 44     | 0.016  | 18     | 0.882  | −168   |
| 200   | 0.874  | −175   | 1.55   | 43     | 0.017  | 27     | 0.878  | −171   |
| 210   | 0.878  | −176   | 1.40   | 42     | 0.017  | 37     | 0.866  | −171   |
| 220   | 0.881  | −176   | 1.29   | 41     | 0.019  | 47     | 0.858  | −171   |
| 230   | 0.881  | −177   | 1.25   | 38     | 0.025  | 53     | 0.916  | −172   |
| 240   | 0.877  | −178   | 1.20   | 35     | 0.031  | 59     | 0.882  | −173   |
| 250   | 0.856  | −180   | 1.13   | 33     | 0.048  | 57     | 0.893  | −173   |
| 260   | 0.760  | −178   | 1.03   | 31     | 0.088  | 24     | 0.899  | −172   |
| 270   | 0.864  | −171   | 0.96   | 31     | 0.066  | −33    | 0.931  | −172   |
| 280   | 0.903  | −174   | 0.93   | 32     | 0.027  | −38    | 0.946  | −173   |
| 290   | 0.914  | −176   | 0.85   | 30     | 0.016  | −25    | 0.885  | −174   |

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| f MHz | $|S_{11}|$ | $\phi$ | $|S_{21}|$ | $\phi$ | $|S_{12}|$ | $\phi$ | $|S_{22}|$ | $\phi$ |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| 300   | 0.919  | −177   | 0.79   | 30     | 0.010  | −7     | 0.881  | −175   |
| 310   | 0.922  | −178   | 0.78   | 28     | 0.009  | 6      | 0.903  | −175   |
| 320   | 0.925  | −178   | 0.75   | 26     | 0.010  | 18     | 0.900  | −175   |
| 330   | 0.927  | −179   | 0.70   | 24     | 0.012  | 31     | 0.925  | −176   |
| 340   | 0.929  | −180   | 0.68   | 24     | 0.014  | 45     | 0.920  | −178   |
| 350   | 0.931  | 180    | 0.63   | 25     | 0.015  | 63     | 0.932  | −173   |
| 360   | 0.934  | 179    | 0.61   | 23     | 0.014  | 70     | 0.931  | −176   |
| 370   | 0.936  | 179    | 0.57   | 23     | 0.013  | 68     | 0.929  | −176   |
| 380   | 0.939  | 178    | 0.53   | 21     | 0.015  | 61     | 0.909  | −176   |
| 390   | 0.941  | 178    | 0.50   | 22     | 0.018  | 61     | 0.940  | −178   |
| 400   | 0.941  | 178    | 0.50   | 18     | 0.022  | 74     | 0.917  | −173   |
| 410   | 0.940  | 177    | 0.49   | 19     | 0.024  | 80     | 0.955  | −178   |
| 420   | 0.941  | 177    | 0.48   | 18     | 0.022  | 83     | 0.942  | −178   |
| 430   | 0.943  | 176    | 0.46   | 16     | 0.020  | 77     | 0.957  | −179   |
| 440   | 0.946  | 176    | 0.42   | 16     | 0.022  | 69     | 0.960  | −178   |
| 450   | 0.948  | 175    | 0.41   | 18     | 0.029  | 71     | 0.982  | −177   |
| 460   | 0.951  | 175    | 0.39   | 17     | 0.032  | 76     | 0.983  | 178    |
| 470   | 0.951  | 175    | 0.37   | 17     | 0.031  | 88     | 0.968  | 179    |
| 480   | 0.950  | 174    | 0.37   | 13     | 0.027  | 93     | 0.966  | 179    |
| 490   | 0.950  | 174    | 0.37   | 13     | 0.025  | 81     | 0.994  | 179    |
| 500   | 0.950  | 173    | 0.36   | 12     | 0.031  | 69     | 1.012  | 180    |
| 600   | 0.936  | 170    | 0.24   | 7      | 0.063  | 127    | 1.006  | 171    |
| 700   | 0.960  | 166    | 0.20   | 11     | 0.064  | 72     | 0.999  | 171    |
| 800   | 0.953  | 162    | 0.17   | 15     | 0.092  | 66     | 1.017  | 169    |
| 900   | 0.954  | 159    | 0.15   | 19     | 0.092  | 65     | 0.952  | 167    |
| 1000  | 0.952  | 156    | 0.15   | 24     | 0.082  | 56     | 0.988  | 162    |
The RF MOSFET Line
100W, 400MHz, 28V

PACKAGE DIMENSIONS

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CASE 744A-01
ISSUE C

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The RF MOSFET Line
100W, 400MHz, 28V

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