Freescale’s Industrial, Scientific and Medical RF Semiconductors

ISM Solutions
Advanced technology for top RF power performance

Industrial systems include hundreds of applications that operate at frequencies from DC up to 6 GHz and beyond. Freescale’s Industrial portfolio of RF power amplifiers are designed for very high power applications in the HF/VHF/UHF frequency range (1.8 to 600 MHz) and for applications at 2.45 GHz. Freescale’s RF industrial solutions range from the very rugged (up to 65:1 VSWR) to the high power output (up to 1.25 kW).

The increase from 28V to a 50V supply voltage in RF Power LDMOS technology allows the designer to achieve higher power levels, greater power densities and attain performance levels exceeding those available in industrial markets today. In addition, availability of some devices in over-molded plastic packaging allows for the most cost-effective industrial solutions available.

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Application Examples
- Plasma generators
- Laser exciters
- RF heating
- Magnetic Resonance Imaging (MRI)
- RF plasma lighting

Typical ISM Applications

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Typical ISM Applications

Magnetic Resonance Imaging

RF Lighting
2.4 kW, 230 MHz CW Lineup

47 dB of Gain in 2 Stages

- MRF6V2010N
  10W, 24 dB

- MRF6VP61K25HS (x2)
  1.25 kW, 23 dB, 65:1 VSWR

- Smaller, lower cost, over-molded plastic driver
- Extremely rugged final stage
- High output power
- 2:1 combining losses (0.2 dB)

2.0 kW, 450 MHz Lineup

46 dB of Gain in 2 Stages

- MRF6V4300N (x8)
  300W, 22 dB

- MRF6V2150N
  150W, 25 dB

- More compact design
- Cost effective
- Smaller, lower cost, over-molded plastic driver
- 8:1 combining losses (0.7 dB)

2.45 GHz Systems

Freescale's line of 2.45 GHz RF power products provide superior gain and efficiency in thermally enhanced low Rth packaging (140 Watt/190 Watt) as well as over-molded plastic packaging (25 Watt RFIC driver) This makes them ideally suited for a broad array of high power applications.

267W Line-up—41 dB of Gain in 2 Stages
2.1 combining losses (0.2 dB)

1.3 kW Line-up—54 dB of Gain in 3 Stages
8:1 combining losses (0.7 dB)

Freescale Competitive Advantages

- Highest ruggedness capability in the industry—up to 65:1 VSWR
- Highest gain figures in the industry—up to 26 dB
- Highest efficiency in the industry—up to 80% at P1dB
- Available in a wide frequency range—1.8 to 600 MHz, 2.45 GHz
- Cost-effective, over-molded plastic packaging options
- Low thermal resistance air cavity packaging options
- Backed by Freescale's secure volume manufacturing capability
- Proven reliability, quality and consistency
- Integrated ESD protection with greater negative gate-source voltage range for improved Class C operation
- World-class, global applications and design support
- RoHS compliant
- Proven high voltage LDMOS process
### Performance Table for ISM LDMOS Devices

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Voltage (V)</th>
<th>Operating Frequency (MHz)</th>
<th>Rated Power (W)</th>
<th>Technology</th>
<th>Package</th>
<th>Δ_Jc °C/W</th>
<th>Typical Gain (dB)</th>
<th>Typical Efficiency (%)</th>
<th>Reference Designs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HF/VHF/UHF ISM — To 600 MHz Devices</strong> — Freescale’s line of VHV ISM devices offer high gain and efficiency and can be used up to 600 MHz at 50V supply voltage. Superior gain in the harmonic frequencies makes them highly suitable for higher classes of amplifier operation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRF6V2010N/NB</td>
<td>50</td>
<td>10-450</td>
<td>10 CW</td>
<td>VHV6</td>
<td>Over-molded</td>
<td>3(2)</td>
<td>23.9</td>
<td>62</td>
<td>CW: 64, 88-108, 130, 220, 450</td>
</tr>
<tr>
<td>MRF6V2150N/NB</td>
<td>50</td>
<td>10-450</td>
<td>150 CW</td>
<td>VHV6</td>
<td>Over-molded</td>
<td>0.24(2)</td>
<td>25</td>
<td>68.3</td>
<td>CW: 27, 64, 220, 450 Pulsed: 130</td>
</tr>
<tr>
<td>MRFE6VP6300H/HS</td>
<td>50</td>
<td>1.8-600</td>
<td>300 CW</td>
<td>VHV6E</td>
<td>Air Cavity</td>
<td>0.19(2)</td>
<td>25</td>
<td>80</td>
<td>CW: 230 Pulsed: 130</td>
</tr>
<tr>
<td>MRF6V2300N/NB</td>
<td>50</td>
<td>10-600</td>
<td>300 CW</td>
<td>VHV6</td>
<td>Over-molded</td>
<td>0.24(2)</td>
<td>25.5</td>
<td>68</td>
<td>CW: 27, 88-108, 130, 450 Pulsed: 64, 175-225 Analog, 220</td>
</tr>
<tr>
<td>MRF6V4300N/NB</td>
<td>50</td>
<td>10-600</td>
<td>300 CW</td>
<td>VHV6</td>
<td>Over-molded</td>
<td>0.24(2)</td>
<td>22</td>
<td>60</td>
<td>CW: 450</td>
</tr>
<tr>
<td>MRF6VP2600H</td>
<td>50</td>
<td>10-250</td>
<td>600 CW</td>
<td>VHV6</td>
<td>Air Cavity</td>
<td>0.20(2)</td>
<td>25.125W (OFDM)</td>
<td>24.5/600W (CW)</td>
<td>CW: 175-225 Analog, 88-108 Pulsed: 225</td>
</tr>
<tr>
<td>MRFE6VP5600H/HS*</td>
<td>50</td>
<td>1.8-600</td>
<td>600 CW</td>
<td>VHV6E</td>
<td>Air Cavity</td>
<td>–</td>
<td>24.6</td>
<td>75.2</td>
<td>Pulsed: 230</td>
</tr>
<tr>
<td>MRF6VP61K25H/HS</td>
<td>50</td>
<td>1.8-600</td>
<td>1250 CW</td>
<td>VHV6E</td>
<td>Air Cavity</td>
<td>0.15(3)</td>
<td>22.9</td>
<td>74.6</td>
<td>Pulsed: 230</td>
</tr>
<tr>
<td>MRF6VP11KH</td>
<td>50</td>
<td>10-150</td>
<td>1000(1)</td>
<td>VHV6</td>
<td>Air Cavity</td>
<td>0.03(3)</td>
<td>26</td>
<td>71</td>
<td>CW: 81, 88-108, 130 Pulsed: 27</td>
</tr>
<tr>
<td>MRF6VP21KH</td>
<td>50</td>
<td>10-235</td>
<td>1000(1)</td>
<td>VHV6</td>
<td>Air Cavity</td>
<td>0.03(3)</td>
<td>24</td>
<td>67.5</td>
<td>Pulsed: 175-225 Analog, 225</td>
</tr>
<tr>
<td>MRF6VP41KH/HS</td>
<td>50</td>
<td>10-450</td>
<td>1000(1)</td>
<td>VHV6</td>
<td>Air Cavity</td>
<td>0.03(3)</td>
<td>20</td>
<td>64</td>
<td>CW: 352 Pulsed: 450</td>
</tr>
</tbody>
</table>

**ISM Band — 2.45 GHz Devices** — Derived from Freescale’s industry-leading cellular infrastructure portfolios, the MW7IC2425N, MRF6S24140H and MRF6P24190H devices operate at 28V and achieve high levels of performance for 2.45 GHz applications.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>MW7IC2425N/GN/NB</td>
<td>28</td>
<td>2450</td>
<td>20</td>
<td>28 Volt</td>
<td>Over-molded</td>
<td>1.2</td>
<td>27.7</td>
<td>43.8</td>
<td>CW: 2450</td>
</tr>
<tr>
<td>MRF6S24140H/HS</td>
<td>28</td>
<td>2450</td>
<td>140</td>
<td>28 Volt</td>
<td>Flanged Air Cavity</td>
<td>0.29</td>
<td>13.2</td>
<td>45</td>
<td>CW: 2450</td>
</tr>
<tr>
<td>MRF6P24190HR6</td>
<td>28</td>
<td>2450</td>
<td>190</td>
<td>28 Volt</td>
<td>Flanged Air Cavity</td>
<td>0.22</td>
<td>13.2</td>
<td>46.2</td>
<td>CW: 2450</td>
</tr>
</tbody>
</table>

**RF Power ISM Portfolio**

![RF Power ISM Portfolio Diagram](image-url)

* Preliminary Data
(1) Peak power
(2) Refer to the respective part number data sheet for thermal measurement operating conditions.
Industry Leading Packaging
With over 80 million RF power devices delivered in over-molded plastic packaging, Freescale has established a proven track record for reliability. Thermally optimized, these packages demonstrate an industry-leading junction thermal resistance with 0.24°C/W for a single-ended part rated at 300 Watts. These RoHS-compliant packages are also available in both solder reflow and bolt down versions.

Why Freescale?
• RF performance leadership
• Package design
  ○ Freescale JEDEC-registered TO series is the only over-molded plastic package series specifically designed for high power RF applications
  ○ The OMNI series of over-molded packages are designed to be mechanical drop-ins for their air cavity equivalents
  ○ Bolt down, clamp down and solder reflow mounting options
  ○ Multiple mounting configurations
  ○ 225°C TJ
• Manufacturing
  ○ Internal dedicated RF power plastic manufacturing line
  ○ Over 80 million RF power plastic packages shipped with no known package related failures
  ○ Automated high volume assembly and test
  ○ Multiple manufacturing locations
• Materials
  ○ RoHS compliant
  ○ Over-molded plastic
    ○ Highly conductive die attach for better thermal performance
    ○ Package with a larger heatsink contact area for optimum thermal performance
• Conventional ceramic packaging
  ○ Lower thermal resistance flange material
  ○ Higher on-package impedance matching
  ○ Higher power > 1 kW
  ○ Low Au solderable finish

Design Support
For information on design support for industrial products select Design Support at www.freescale.com/rfindustrial.
• MTTF Calculation Programs
• Application-specific Reference Designs
• RF High Power Models—ADS and AWR Microwave Office®
• RF 50V LDMOS White Paper
• Video introducing Freescale’s new 65:1 VSWR 50V LDMOS device designed for high mismatch applications

Learn More: For current information about Freescale RF Solutions, please visit: www.freescale.com/rfpower.