Advanced technology to maximize broadcast transmitter performance

Overview
Freescale has been a trusted supplier of RF power semiconductors to the broadcast industry for over 50 years. Building on this history, Freescale's newest E series portfolio of 50V high-power devices enables broadcast system designers to meet increasingly demanding performance, reliability and ruggedness requirements of the HF, VHF and UHF radio and television transmitter industry.

Enhanced Ruggedness 50V LDMOS Technology
Freescale's latest generation of enhanced ruggedness 50V LDMOS devices brings the broadcast system designer unprecedented ruggedness combined with industry-leading performance. Freescale's enhanced ruggedness line of broadcast devices are designed to handle operating into a voltage standing wave ratio (VSWR) greater than 65:1. These attributes allow broadcast transmitter designers to meet the most challenging performance and reliability demands of today's broadcast industry.

Freescale's innovative low thermal resistance packaging technology enables higher device power densities for even the highest power designs. High device power density, combined with the high-power gain offered by Freescale's portfolio of 50V LDMOS devices simplifies designs by reducing the number of driver and output stages needed, thereby increasing reliability and reducing cost.

The broadband performance of Freescale LDMOS devices maximizes power and efficiency across complete broadcast bands by eliminating the need to tune the power amplifier for an individual channel or band segment. This simplifies production and maintenance, and reduces overhead associated with channel-specific designs.

The breadth of our high power portfolio enables broadcast transmitter designers to choose an optimal solution, capable of meeting or exceeding even the most rigorous performance requirements across any desired power level, modulation type and frequency range. The exceptional efficiency and gain cover virtually every broadcast transmitter application, including analog television, DVB-T, ISDB-T and ATSC digital television as well as AM, single sideband, FM, HD and DAB radio applications.

Freescale's broadcast devices are designed to meet quality and reliability standards demanded by even the most quality-conscious transmitter manufacturers and operators.

Complementing Freescale's line of trusted LDMOS devices, the enhanced ruggedness 50V devices underscore our commitment to deliver industry-leading performance across a comprehensive broadcast system portfolio.

Advantages
- More than 50 years of experience delivering solid state solutions for broadcast applications
- Proven product quality, reliability and consistency
- Comprehensive portfolio, serving both driver and output stages
  - Power levels from 1W to 1250W
  - Frequency coverage from 1.8 to 860 MHz
- Broadest line of enhanced ruggedness devices
  - Field proven enhanced ruggedness process
  - Capable of handling >65:1 VSWR with 3 dB overdrive
  - Devices from 300W to 1250W
  - Frequency coverage from 1.8 to 860 MHz
- Enhanced ESD protection
- Superior thermal performance
- Cost-effective, high performance plastic package options
- RoHS compliant
- Secure, high volume manufacturing capability
- Long term commitment to all broadcast products with minimum 10 years of product availability from introduction
- Regional broadcast applications support teams
Analog and Digital FM and VHF TV: 1.25 kW Output Transistor

The MRFE6VP61K25H power transistor is ideal for FM/VHF broadcast applications. The high level of output power (1.25 kW CW) and high gain (25 dB) allows for very compact lineups, providing over 70 dB gain in three stages. The exceptional efficiency, combined with low thermal resistance, considerably reduces thermal constraints.

1.6 kW Avg. Lineup—VHF TV
- 0.5 dB of combining loss
- >65:1 VSWR
- Compact driver design
- Compact fixture design
- DVB-T OFDM @ 10 PAR dB

71 dB of gain in three stages

<table>
<thead>
<tr>
<th>Devices</th>
<th>MRF6V2010N</th>
<th>MRF6V2150N</th>
<th>MRFE6VP61K25H</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Gain</td>
<td>24 dB</td>
<td>24 dB</td>
<td>25 dB</td>
<td>71 dB</td>
</tr>
<tr>
<td>$P_{out}$ Avg.</td>
<td>0.03W</td>
<td>8W</td>
<td>225W</td>
<td>1.6 kW</td>
</tr>
<tr>
<td>Drain Efficiency</td>
<td>5%</td>
<td>15%</td>
<td>30%</td>
<td>27%</td>
</tr>
<tr>
<td>IMD (Delta Marker 4.2 MHz)</td>
<td>-40 dBc</td>
<td>-40 dBc</td>
<td>-30 dBc</td>
<td>-30 dBc</td>
</tr>
</tbody>
</table>

71 dB of gain in three stages

7.8 kW Lineup—FM
- 0.5 dB of combining loss
- >65:1 VSWR
- Compact driver design
- Compact fixture design

<table>
<thead>
<tr>
<th>Devices</th>
<th>MRF6V2010N</th>
<th>MRF6V2150N</th>
<th>MRFE6VP61K25H</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Gain</td>
<td>22 dB</td>
<td>24 dB</td>
<td>25 dB</td>
<td>71 dB</td>
</tr>
<tr>
<td>$P_{out}$ Avg.</td>
<td>1W</td>
<td>30W</td>
<td>1.1 kW</td>
<td>7.8 kW CW</td>
</tr>
<tr>
<td>Drain Efficiency</td>
<td>20%</td>
<td>33%</td>
<td>80%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Analog and Digital UHF TV: 450 Watt Output Transistor

The MRF6VP3091NB and MRFE6VP8600H power transistors are ideal for UHF broadcast applications. Their high output power capability and high gain enhance system-level efficiency by minimizing device count and combining losses. The exceptional efficiency of these RF power transistors can help reduce operating costs for TV broadcasters.

Typical Performance—Wideband 470–860 MHz

<table>
<thead>
<tr>
<th>Devices</th>
<th>MRF6VP3091NB</th>
<th>MRFE6VP8600H</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Gain</td>
<td>21 dB</td>
<td>19 dB</td>
<td>39 dB</td>
</tr>
<tr>
<td>$P_{out}$ Avg.</td>
<td>9W</td>
<td>125W</td>
<td>450W</td>
</tr>
<tr>
<td>Drain Efficiency</td>
<td>18%</td>
<td>30%</td>
<td>26%</td>
</tr>
</tbody>
</table>

5 total parts, DVB-T (8k OFDM) signal

39 dB of gain in two stages

MRFE6VP8600H
450W Avg. DVB-T Lineup
- Compact design
- High efficiency
- Extremely rugged
- 50V supply for both driver and output stages
- ~0.5 dB splitting and combining losses
# Performance Table for Freescale 50V Broadcast Devices

## HF/VHF Broadcast

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Voltage (V)</th>
<th>Operating Frequency (MHz)</th>
<th>P1dB (W)</th>
<th>Technology</th>
<th>Package</th>
<th>θjC °C/W</th>
<th>Typical Gain (dB)</th>
<th>Typical Efficiency (%)</th>
<th>Reference Designs and Demo Boards (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRF6V2010N/NB</td>
<td>50</td>
<td>10–450</td>
<td>10</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>3</td>
<td>23.9</td>
<td>62</td>
<td>CW: 27, 87.5–108 FM, 130, 220, 450</td>
</tr>
<tr>
<td>MRF6V2150N/NB</td>
<td>50</td>
<td>10–450</td>
<td>150</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>0.24</td>
<td>25</td>
<td>68.3</td>
<td>CW: 27, 87.5–108 FM, 220, 450 Pulsed: 130</td>
</tr>
<tr>
<td>MRF6VP6300H/HS</td>
<td>50</td>
<td>1.8–600</td>
<td>300</td>
<td>EVHV6</td>
<td>Enhanced Ruggedness</td>
<td>0.19</td>
<td>25</td>
<td>80</td>
<td>CW: 87.5–108 FM, 230, 500 Pulsed: 130, 450</td>
</tr>
<tr>
<td>MRF6V2300N/NB</td>
<td>50</td>
<td>10–600</td>
<td>300</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>0.24</td>
<td>25.5</td>
<td>68</td>
<td>CW: 27, 87.5–108 FM, 130, 425, 450 Pulsed: 170–230 Analog, 220</td>
</tr>
<tr>
<td>MRF6V4300N/NB</td>
<td>50</td>
<td>10–600</td>
<td>300</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>0.24</td>
<td>22</td>
<td>60</td>
<td>CW: 450</td>
</tr>
<tr>
<td>MRF6VP5600H/HS</td>
<td>50</td>
<td>1.8–600</td>
<td>600</td>
<td>EVHV6</td>
<td>Enhanced Ruggedness</td>
<td>0.12</td>
<td>24.6</td>
<td>75.2</td>
<td>CW: 230 Pulsed: 175–225, 230</td>
</tr>
<tr>
<td>MRF6VP2600H</td>
<td>50</td>
<td>2–500</td>
<td>600</td>
<td>VH6</td>
<td>Air Cavity</td>
<td>0.20</td>
<td>25/125W (DVB-T)</td>
<td>28.5/125W (DVB-T)</td>
<td>CW: 87.5–108 FM Pulsed: 175–225 Analog, 225</td>
</tr>
<tr>
<td>MRF6VP11KH</td>
<td>50</td>
<td>10–150</td>
<td>1000</td>
<td>VH6</td>
<td>Air Cavity</td>
<td>0.13</td>
<td>26</td>
<td>71</td>
<td>CW: 81, 87.5–108 FM, 100, 130 Pulsed: 15, 27</td>
</tr>
<tr>
<td>MRF6VP41KH/HS</td>
<td>50</td>
<td>10–500</td>
<td>1000</td>
<td>VH6</td>
<td>Air Cavity</td>
<td>0.15</td>
<td>20</td>
<td>64</td>
<td>CW: 352 Pulsed: 450</td>
</tr>
<tr>
<td>MRF6VP61K25H/HS</td>
<td>50</td>
<td>1.8–600</td>
<td>1250</td>
<td>EVHV6</td>
<td>Enhanced Ruggedness</td>
<td>0.15</td>
<td>22.9</td>
<td>74.6</td>
<td>CW: 87.5–108 FM, 500 Pulsed: 170–230, 230, 352</td>
</tr>
</tbody>
</table>

## UHF Broadcast

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Voltage (V)</th>
<th>Operating Frequency (MHz)</th>
<th>P1dB (W)</th>
<th>Technology</th>
<th>Package</th>
<th>θjC °C/W</th>
<th>Typical Gain (dB)</th>
<th>Typical Efficiency (%)</th>
<th>Reference Designs and Demo Boards (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRF6V3090N/NB</td>
<td>50</td>
<td>470–860</td>
<td>90</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>0.79</td>
<td>22/18W</td>
<td>28.5/18W</td>
<td>CW: 470–860</td>
</tr>
<tr>
<td>MRF6VP3091N/NB</td>
<td>50</td>
<td>470–860</td>
<td>450</td>
<td>VH6</td>
<td>Over-Molded</td>
<td>u./m</td>
<td>22/18W</td>
<td>28.5/18W</td>
<td>CW: 470–860</td>
</tr>
<tr>
<td>MRF6VP3450H/HS</td>
<td>50</td>
<td>470–860</td>
<td>450</td>
<td>VH6</td>
<td>Air Cavity</td>
<td>0.23</td>
<td>22.5/90W (DVB-T)</td>
<td>28/90W (DVB-T)</td>
<td>Pulsed: 470–860</td>
</tr>
<tr>
<td>MRF6VP8600H/HS</td>
<td>50</td>
<td>470–860</td>
<td>600</td>
<td>EVHV6</td>
<td>Enhanced Ruggedness</td>
<td>0.19</td>
<td>19.3/125W (DVB-T)</td>
<td>18.8/600W (Pulsed)</td>
<td>30</td>
</tr>
</tbody>
</table>

(1) Refer to the respective part number data sheet for thermal measurement operating conditions.

(2) Reference designs for broadcast parts are available at: www.freescale.com/RFbroadcast > Design Support > Reference Designs.

Note: To order Freescale RF broadcast high power devices use Freescale’s Orderable Part search feature to locate a part. Select the Distributor button under Order on the search results page to locate a listing of Distributors who can facilitate your order.
RF Power Broadcast Portfolio

1 kW

- **MRFE6VP61K25H/HS**
  - 1250W, NI-1230/S, 1.8–600 MHz, >65:1 VSWR

- **MRFE6VP11KH**
  - 1 kW Pulsed, NI-1230
  - 10–150 MHz

- **MRFE6VP41KH/HS**
  - 1 kW Pulsed, NI-1230/S
  - 10–500 MHz

- **MRFE6VP8600H/HS**
  - 600W, NI-1230/S
  - 470–860 MHz, >65:1 VSWR

500W

- **MRFE6V5600H/HS**
  - 600W, NI-1230/S, 1.8–600 MHz, >65:1 VSWR

250W

- **MRFE6VP6300H/HS**
  - 300W, NI-780/S-4, 1.8–600 MHz, >65:1 VSWR

- **MRFE6V4300N/NB**
  - 300W, TO-270/2, 10–600 MHz

- **MRFE6V2300N/NB**
  - 300W, TO-270/2, 10–600 MHz

75W

- **MRFE6V2150N/NB**
  - 150W, TO-270/2 WB, 10–450 MHz

- **MRFE6V2010N/NB**
  - 10W, TO-270/2 WB, 10–450 MHz

- **MRFE6V3090N/NB**
  - 90W, TO-270/2 WB-4
  - 470–860 MHz

- **MRFE6V3091N/NB**
  - 90W, TO-270/2 WB-4
  - 470–860 MHz

RF Power Broadcast Packages

- **NI-780S-4**
- **NI-780-4**
- **NI-1230S**
- **NI-1230**
- **TO-270-2**
- **TO-272-2**
- **TO-270 WB-4**
- **TO-272 WB-4**
Industry-Leading Packaging

- Thermal performance leadership
- Package design
- Freescale’s JEDEC-registered TO series is the only over-molded plastic package series specifically designed for high-power RF applications
  - Bolt down, clamp down and solder reflow mounting options
  - Low thermal resistance flange material
  - 225°C TJ maximum operating temperature
  - Power dissipation capabilities >1 kW
  - In-package impedance matching
  - Low Au solderable finish for improved reliability
  - Plastic package with a larger contact area for optimal thermal performance
- Manufacturing
  - Automated high volume assembly and test
  - Multiple manufacturing locations
- Materials
  - RoHS compliant

Why Choose Freescale?

- Best-in-class RF performance
- Industry-leading package designs
- Consistent and repeatable RF performance
- Consistent high quality
- Proven long-term reliability
- High volume manufacturing capability
- Assured long-term supply
- Comprehensive, in-region design support

Solder Reflow Process for RF High Power Devices

Design Support

For information on design support for broadcast products select Design Support at freescale.com/RFbroadcast.

- Application-specific reference designs
- Test and evaluation fixtures
- Fully validated RF high-power models for Agilent AUS and AWR Microwave Office®
- MTTF calculation programs
- 50V RF LDMOS white paper
- Packaging and mounting application notes
- Thermal management application notes
- Support centers in Asia, Europe and Americas

For more information, visit freescale.com/RFpower