Freescale's RF Power Transistors

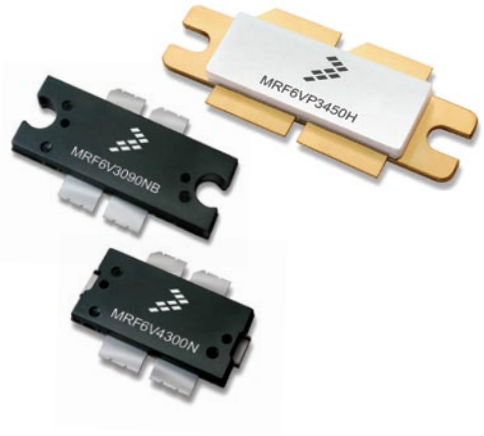
Broadcast Solutions

Higher RF performance and power densities

Building on a legacy of leadership in the RF power transistor market space, Freescale introduced a broad portfolio of high power transistors for broadcast communications systems. Engineered for FM, VHF and UHF transmitter equipment, these power transistors leverage Freescale's heritage of innovation and RF expertise to usher in a new era of high performance in an evolving industry.

VHV6: A Step Up in Performance

Capitalizing on extensive experience with LDMOS semiconductors, the sixth-generation Very High Voltage 50V LDMOS platform (VHV6) is derived directly from Freescale's sixth-generation 32V LDMOS platform.



Commercialized for the first time, this 50V platform is characterized by industry-leading gain and efficiency. When combined with innovations in device packaging and thermal management, VHV6 enables significant increases in rated power per transistor to reduce device count, offering opportunity for significant system-level cost savings.

The initial product offering for VHV6 products ranges in power from 10W to 1 kW and covers frequencies from 10 to 860 MHz. For applications requiring the highest output power, devices are available in Freescale's low thermal resistance (Low Rth) packaging. For applications requiring moderate output power, low-cost over-molded plastic package options are available. In addition, all VHV6 products have been specially designed to meet quality and reliability standards demanded by transmitter manufacturers and operators.

Complementing Freescale's UHF product portfolio based on 32V LDMOS, our expansion into VHV6 underscores our commitment to deliver a comprehensive, industry-leading product portfolio for broadcast communication systems.

Freescale Competitive Advantages

- Highest gain figures in the industry: up to 26 dB
- Highest efficiency in the industry: 71% at P1dB
- Low thermal resistance values reduce system cooling costs
- Wide frequency range enables use in numerous applications
- 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
- World-class, global applications and design support
- RoHS compliant
- Proven high voltage LDMOS process

freescale™ semiconductor

RF Power HF/VHF/UHF Broadcast

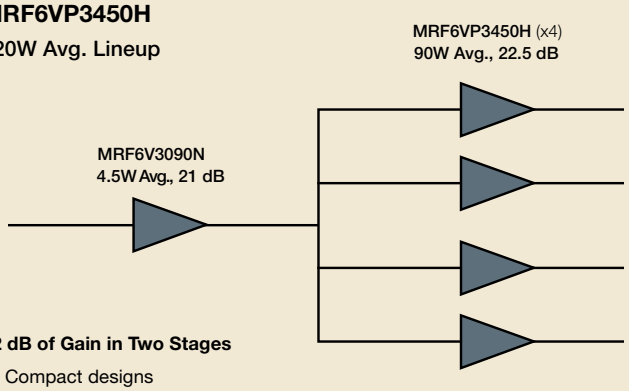
MRF6VP3450H/HS 450W Pulsed, NI-1230/S	MRF6V3090N 90W PEP, TO-270 WB-4	MRF6VP21KH 1 kW Pulsed, NI-1230	MRF6V2300N 300W CW, TO-270 WB
Analog and Digital UHF TV	Analog and Digital UHF TV	Digital VHF TV	Analog and Digital FM VHF TV
Designed primarily for wideband applications with frequencies up to 860 MHz	**Designed primarily for wideband applications with frequencies up to 860 MHz**	**Designed primarily for pulsed wideband applications with frequencies up to 235 MHz**	**Designed primarily for CW large-signal output applications with frequencies up to 600 MHz**
• Typical DVB-T OFDM performance at 860 MHz: V_{DD} = 50 volts, I_{DQ} = 1400 mA, P_{out} = 90 watts – Power gain = 22.5 dB – Drain efficiency = 28% – ACPR @ 4 MHz offset = -62 dBc in 4 kHz bandwidth	• Typical DVB-T OFDM performance at 860 MHz: V_{DD} = 50 volts, I_{DQ} = 350 mA, P_{out} = 4.5 watts – Power gain = 21 dB – Drain efficiency = 12% – ACPR @ 4 MHz offset = -68 dBc in 4 kHz bandwidth	• Typical pulsed performance at 225 MHz: V_{DD} = 50 volts, I_{DQ} =150 mA, P_{out} = 1000 watts peak, pulse width = 100 µsec, duty cycle = 20% – Power gain = 24 dB – Drain efficiency = 67.5% – θ_{JC} = 0.03° C/W	• Typical CW performance at 220 MHz: V_{DD} = 50 volts, I_{DQ} = 900 mA, P_{out} = 300 watts – Power gain = 25.5 dB – Drain efficiency = 68% – θ_{JC} = 0.24° C/W
• Capable of handling 10:1 VSWR, @ 50 Vdc, 470 MHz, 450 watts peak power, pulse width = 50 µsec, duty cycle = 2.5%	• Capable of handling 10:1 VSWR, @ 50 Vdc, 860 MHz, 90 watts CW.	• Capable of handling 10:1 VSWR @ 50 Vdc, 225 MHz, 1000 watts peak power, pulse width = 100 µsec, duty cycle = 20%	• Capable of handling 10:1 VSWR, @ 50 Vdc, 220 MHz, 300 watts CW output power

Analog and Digital UHF TV: 450 Watt Output Transistor

The MRF6VP3450H and MRF6V3090N power transistors are ideal for UHF broadcast applications. The 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.

MRF6VP3450H

320W Avg. Lineup



42 dB of Gain in Two Stages

- Compact designs
- 8 dB higher gain than current standard solution
- 50V supply, compatible with low-cost telecommunication DC supplies

Devices	MRF6V3090N	4xMRF6VP3450H	Totals
Typical Gain	21 dB	22.5 dB	42.5 dB
P_{out}	2.2W	90W	320W Avg.
Drain Efficiency	8%	28%	24%

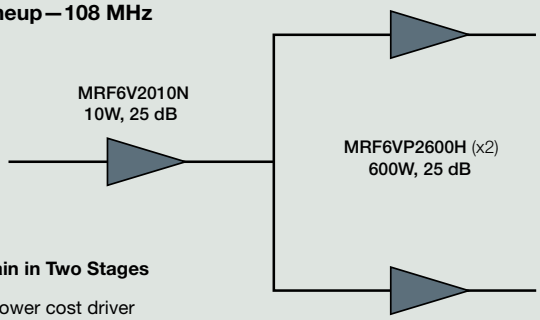
5 total parts, DVB-T OFDM signal, 10 PAR dB, 0.5 dB splitting and combining loss

Analog and Digital FM and VHF TV: 600 Watt Output Transistor

The MRF6VP2600H power transistor is ideal for FM/VHF broadcast applications. The high level of output power (600W CW) and high gain (26 dB*) allows for very compact lineups, providing 50 dB of gain in two stages. The exceptional efficiency, combined with low thermal resistance, considerably reduces thermal constraints.

MRF6VP2600H

1.1 kW Lineup—108 MHz



50 dB of Gain in Two Stages

- Smaller, lower cost driver
- More compact design
- Decreased part count
- Better thermal, smaller heatsinks
- 2:1 combining losses (0.2 dB)

Devices	MRF6V2010N	2xMRF6VP2600H	Totals
Typical Gain	24 dB	26 dB*	50 dB
P_{out}	2.7W	600W	1.14 kW CW
Drain Efficiency	30%	72%*	72%

* Preliminary

Performance Table for HF/VHF/UHF Broadcast: 50 Volt Devices

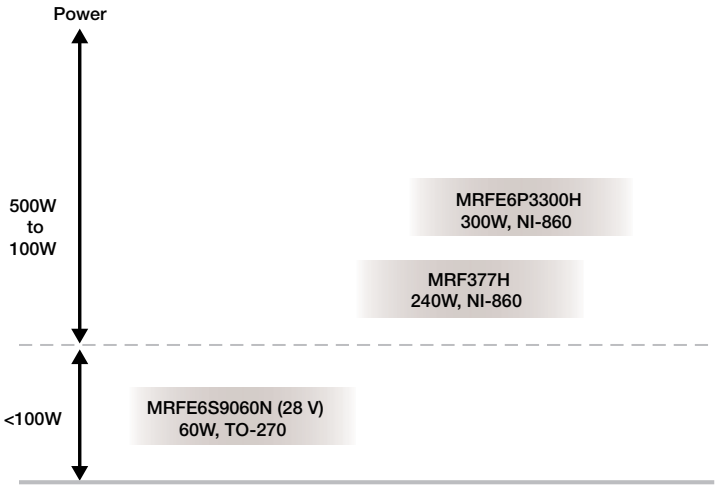
Part Number	Voltage (V)	Operating Frequency (MHz)	Rated Power (W)	Technology	Package	θ_{JC} °C/W	Typical Gain (dB)	Typical Efficiency (%)	Demo Board Options
MRF6V2010N/B	50	10–450	10 CW	VHV6	Over-Molded	3 (2)	23.9	62	27, 130, 220, 450 MHz
MRF6V3090N/B*	50	470–860	90 PEP	VHV6	Over-Molded	—	21/4.5W (OFDM)	12/4.5W (OFDM)	470–860 MHz
MRF6V2150N/B	50	10–450	150 CW	VHV6	Over-Molded	0.24 (2)	25	68.3	27, 130, 220, 450 MHz
MRF6V2300N/B	50	10–600	300 CW	VHV6	Over-Molded	0.24 (2)	25.5	68	27, 88–108 FM, 130, 170–230 Analog, 220, 450 MHz
MRF6V4300N/NB	50	10–600	300 CW	VHV6	Over-Molded	0.24 (2)	22	60	450 MHz
MRF6VP3450H/HS	50	470–860	450 (1)	VHV6	Air Cavity	0.23 (3)	22.5/90W (OFDM)	28/90W (OFDM)	470–860 MHz
MRF6VP2600H	50	10–250 88–108	600 CW	VHV6	Air Cavity	0.20 (4) —	25/125W (OFDM) 26*/600W (CW)	28.5/125W (OFDM) 72*/600W (CW)	88–108 FM, 170–230 Analog, 225, 352 MHz
MRF6VP11KH	50	10–150	1000 (1)	VHV6	Air Cavity	0.03 (5)	26	71	15, 27, 82, 82 CW, 88-108 FM, 100 CW, 130 MHz
MRF6VP21KH	50	10–235	1000 (1)	VHV6	Air Cavity	0.03 (6)	24	67.5	175–225 Analog, 225 MHz

*Preliminary

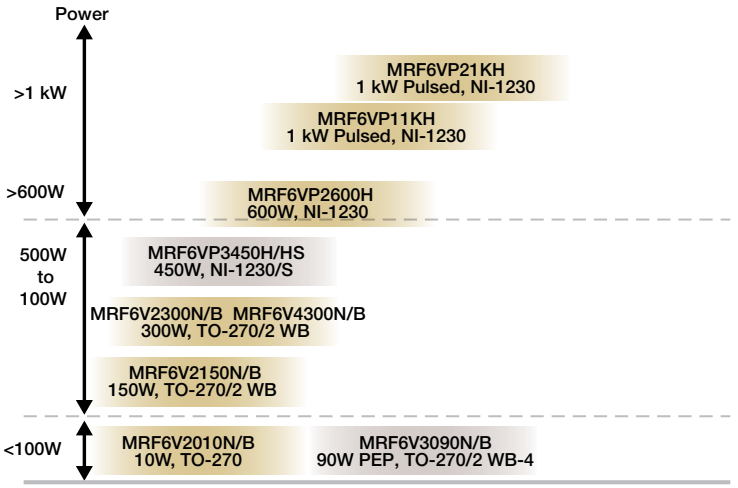
Performance Table for UHF Broadcast: 32 Volt Devices

Part Number	Voltage (V)	Operating Frequency (MHz)	Rated Power (W)	Technology	Package	θ_{JC} °C/W	Typical Gain (dB)	Typical Efficiency (%)	Demo Board Options
MRFE6P3300H	32	470–860	300 CW	HV6E LDMOS	Air Cavity	0.23	20.4	44.8	470–860, 820–900 MHz
MRF377H	32	470–860	240 CW	HV6 LDMOS	Air Cavity	0.27	18.2	23	860, 470–860 MHz
MRFE6S9060N	28	470–960	60 CW	HV6E LDMOS	Over-Molded	0.77	21.1	33	865–895, 920–960 MHz

RF Power 32 Volt UHF Broadcast Portfolio



RF Power 50 Volt FM/VHF/UHF Broadcast Portfolio



UHF VHF/FM

(1) Peak power
(2) Thermal resistance is determined under specified RF operating conditions: 220 MHz @ CW rated power. MRF6V4300N/NB: 450 MHz @ CW rated power
(3) Thermal resistance is determined under RF operating conditions: 860 MHz @ 90W Avg.
(4) Thermal resistance is determined under specified RF operating conditions: 225 MHz @ 125W Avg.
(5) Thermal resistance is determined under specified RF operating conditions: 130 MHz @ 1000W peak, 100 µsec pulse width, 20% duty cycle
(6) Thermal resistance is determined under specified RF operating conditions: 225 MHz @ 1000W peak, 100 µsec pulse width, 20% duty cycle

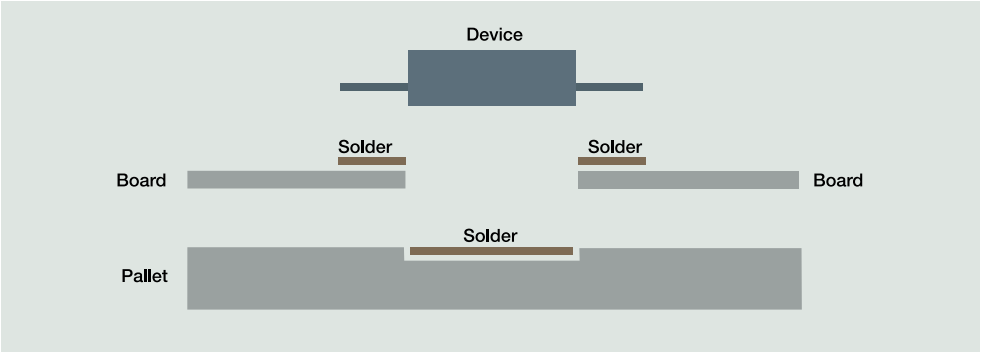
Industry-Leading Packaging

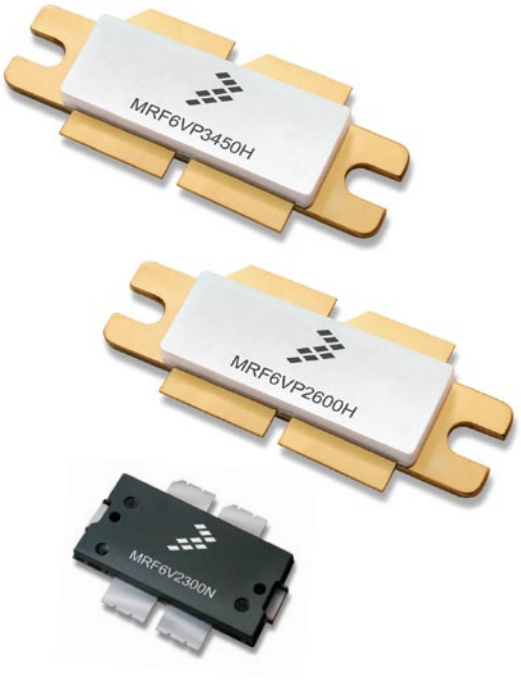
With over 80 million RF power devices delivered in over-molded plastic packaging, Freescale has established a proven reliability track record. Thermally optimized, these packages demonstrate an industry-leading junction thermal resistance with 0.24°C/W for a single-ended part rated at 300 Watts. These 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
  - Bolt down and solder reflow options
  - Multiple mounting configurations
  - 200°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
  - Solderable backmetal die attach = 20% better thermal results over epoxy
  - 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

RF Over-Molded Plastic Solder Reflow Process





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

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