NXP Semiconductors
Technical Data

Document Number: MRFE8VP8600H
Rev. 1, 08/2017

RF Power LDMOS Transistors

N-Channel Enhancement-Mode Lateral MOSFETs

These high power transistors are designed for use in UHF TV broadcast applications. The devices have an integrated input matching network for better power distribution and are ideal for use in both analog and digital TV transmitters.

DBV-T Broadband Class AB Performance: V_{DD} = 50 Vdc, I_{DQ} = 1400 mA, Channel Bandwidth = 8 MHz, Input Signal PAR = 9.5 dB @ 0.01% Probability on CCDF.

Signal Type	P_{out} (W)	f (MHz)	G_{ps} (dB)	η_D (%)	Output PAR (dB)
DVB-T (8k OFDM)	140 Avg.	474	20.2	29.7	8.9
		610	20.7	34.5	8.2
		810	20.0	34.0	8.4

Load Mismatch/Ruggedness

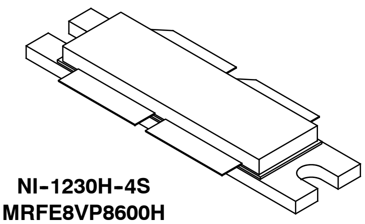
Frequency (MHz)	Signal Type	VSWR	P_{out} (W)	Test Voltage	Result
860	DVB-T (8k OFDM)	20:1 at all Phase Angles	125 (3 dB Overdrive)	50	No Device Degradation

Features

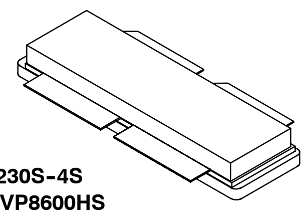
- Excellent thermal characteristics
- High gain for reduced PA size
- High efficiency for Class AB and Doherty operations
- Integrated input matching and unmatched output
- Extended negative gate-source voltage range of –6 Vdc to +10 Vdc

MRFE8VP8600H
MRFE8VP8600HS

470–860 MHz, 140 W AVG., 50 V
RF POWER LDMOS TRANSISTORS



NI-1230H-4S
MRFE8VP8600H



NI-1230S-4S
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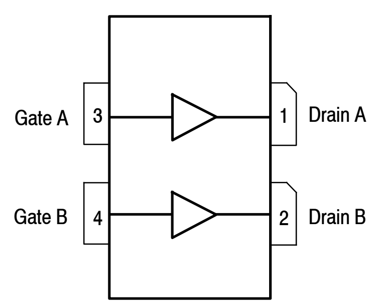


(Top View)

Note: The backside of the package is the source terminal for the transistor.

Figure 1. Pin Connections

Table 1. Maximum Ratings

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	–0.5, +115	Vdc
Gate-Source Voltage	V_{GS}	–6.0, +10	Vdc
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–40 to +150	°C
Operating Junction Temperature Range (1)	T_J	–40 to +225	°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1250 6.25	W W/°C

Table 2. Thermal Characteristics

Characteristic	Symbol	Value (2,3)	Unit
Thermal Resistance, Junction to Case Case Temperature 99°C, 125 W DVB-T (8k OFDM), 50 Vdc, I_{DQ} = 1400 mA, 860 MHz	$R_{\theta JC}$	0.16	°C/W

Table 3. ESD Protection Characteristics

Test Methodology	Class
Human Body Model (per JESD22-A114)	2, passes 2500 V
Machine Model (per EIA/JESD22-A115)	B, passes 250 V
Charge Device Model (per JESD22-C101)	IV, passes 2000 V

Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off Characteristics (4)					
Gate-Source Leakage Current (V_{GS} = 5 Vdc, V_{DS} = 0 Vdc)	I_{GSS}	—	—	1	μAdc
Drain-Source Breakdown Voltage (V_{GS} = 0 Vdc, I_D = 10 μAdc)	$V_{(BR)DSS}$	115	118	—	Vdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	5	μAdc
Zero Gate Voltage Drain Leakage Current (V_{DS} = 115 Vdc, V_{GS} = 0 Vdc)	I_{DSS}	—	—	20	μAdc
On Characteristics					
Gate Threshold Voltage (4) (V_{DS} = 10 Vdc, I_D = 925 μAdc)	$V_{GS(th)}$	1.3	2.1	2.3	Vdc
Gate Quiescent Voltage (5) (V_{DD} = 50 Vdc, I_D = 1400 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	1.8	2.4	2.8	Vdc
Drain-Source On-Voltage (4) (V_{GS} = 10 Vdc, I_D = 2.8 Adc)	$V_{DS(on)}$	0.1	0.3	0.5	Vdc
Forward Transconductance (V_{DS} = 10 Vdc, I_D = 17 Adc)	g_{fs}	—	19.4	—	S
Dynamic Characteristics (4)					
Reverse Transfer Capacitance (6) (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{rss}	—	1.62	—	pF
Output Capacitance (6) (V_{DS} = 50 Vdc ± 30 mV(rms)ac @ 1 MHz, V_{GS} = 0 Vdc)	C_{oss}	—	71.2	—	pF
Input Capacitance (7) (V_{DS} = 50 Vdc, V_{GS} = 0 Vdc ± 30 mV(rms)ac @ 1 MHz)	C_{iss}	—	452	—	pF

1. Continuous use at maximum temperature will affect MTTF.
2. MTTF calculator available at http://www.nxp.com/RF/calculators.
3. Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers.* Go to http://www.nxp.com/RF and search for AN1955.
4. Each side of device measured separately.
5. Measurement made with device in push-pull configuration.
6. Part internally input matched.
7. Die capacitance value without internal matching.

(continued)

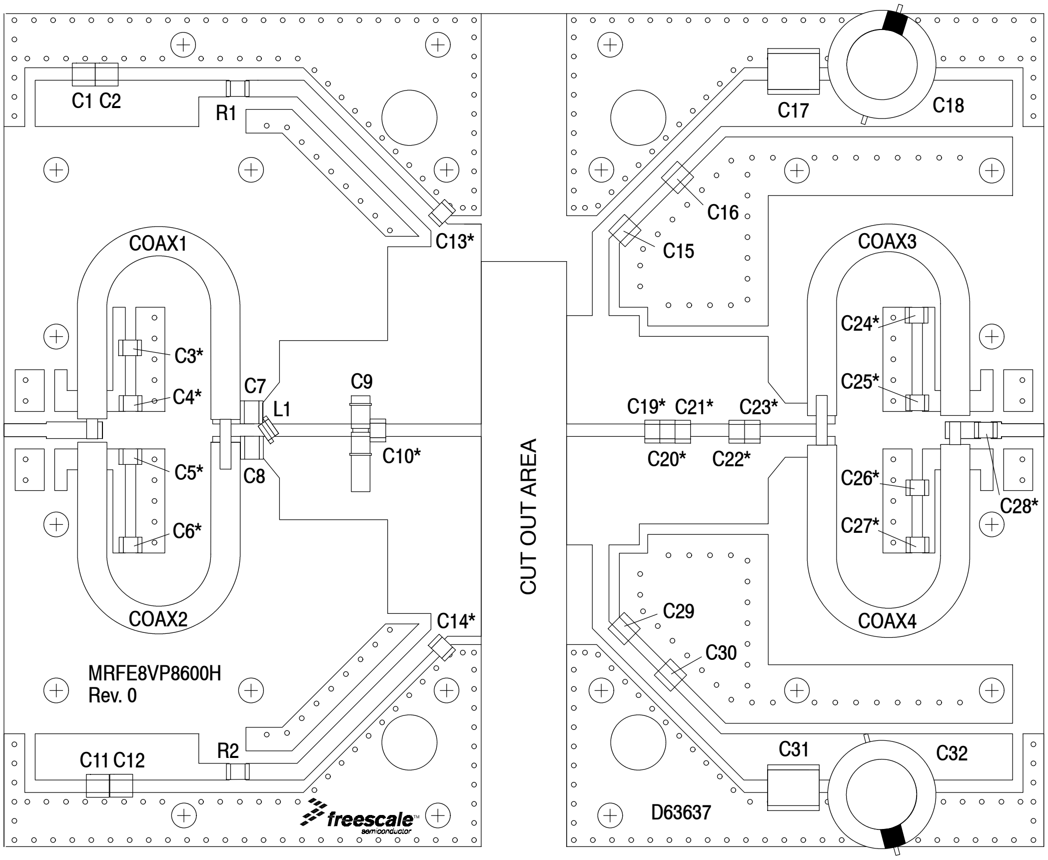
Table 4. Electrical Characteristics (T_A = 25°C unless otherwise noted) **(continued)**

Characteristic	Symbol	Min	Typ	Max	Unit
Functional Tests [1] (In NXP Narrowband Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 1400 mA, P_{out} = 125 W Avg., f = 860 MHz, DVB-T (8k OFDM) Single Channel. ACPR measured in 7.61 MHz Signal Bandwidth @ ±4 MHz Offset with an Integration Bandwidth of 4 kHz.					
Power Gain	G_{ps}	20.6	21.0	23.6	dB
Drain Efficiency	η_D	28.0	30.0	—	%
Adjacent Channel Power Ratio	ACPR	—	–61.0	–59.4	dBc
Input Return Loss	IRL	—	–12	–9	dB
Typical DVB-T (8k OFDM) Performance (In NXP Narrowband Test Fixture, 50 ohm system) V_{DD} = 50 Vdc, I_{DQ} = 1400 mA, f = 860 MHz, DVB-T (8k OFDM) Single Channel.					
Output Peak-to-Average Ratio @ 0.01% Probability on CCDF, P_{out} = 125 W Avg.	PAR	—	7.8	—	dB
Load Mismatch VSWR 20:1 at all Phase Angles, 3 dB Overdrive from Rated P_{out} (125 W Avg.)	Ψ	No Degradation in Output Power			

Table 5. Ordering Information

Device	Tape and Reel Information	Package
MRFE8VP8600HR5	R5 Suffix = 50 Units, 56 mm Tape Width, 13-inch Reel	NI-1230H-4S
MRFE8VP8600HSR5		NI-1230S-4S

1. Measurement made with device in push-pull configuration.



*C3, C4, C5, C6, C10, C13, C14, C19, C20, C21, C22, C23, C24, C25, C26, C27, and C28 are mounted vertically.

Figure 2. MRFE8VP8600H Test Circuit Component Layout — 860 MHz, DVB-T (8k OFDM)

Table 6. MRFE8VP8600H Test Circuit Component Designations and Values — 860 MHz, DVB-T (8k OFDM)

Part	Description	Part Number	Manufacturer
C1, C11	10 μF Chip Capacitors	GRM32ER61H106KA12L	Murata
C2, C12	2.2 μF Chip Capacitors	C3225X7R1H225K250AB	TDK
C3, C4, C5, C6	30 pF Chip Capacitors	ATC100B300JT500XT	ATC
C7, C8	24 pF Chip Capacitors	ATC100B240JT500XT	ATC
C9	0.8–8.0 pF Variable Capacitor	27291SL	Johanson Components
C10	12 pF Chip Capacitor	ATC100B120JT500XT	ATC
C13, C14	8.2 pF Chip Capacitors	ATC100B8R2CT500XT	ATC
C15, C29	2.2 μF Chip Capacitors	C3225X7R2A225K230AB	TDK
C16, C25, C26, C28, C30	100 pF Chip Capacitors	ATC100B101JT500XT	ATC
C17, C31	4.7 μF Chip Capacitors	C575X7R2A475K230KA	TDK
C18, C32	470 μF, 63 V Electrolytic Capacitors	MCGPR63V477M13X26-RH	Multicomp
C19	7.5 pF Chip Capacitor	ATC100B7R5CT500XT	ATC
C20	3.3 pF Chip Capacitor	ATC100B3R3CT500XT	ATC
C21	3.0 pF Chip Capacitor	ATC100B3R0BT500XT	ATC
C22	3.9 pF Chip Capacitor	ATC100B3R9CT500XT	ATC
C23	5.1 pF Chip Capacitor	ATC100B5R1CT500XT	ATC
C24, C27	1000 pF Chip Capacitors	ATC100B102JT50XT	ATC
Coax1, 2	25 Ω Semi Rigid Coax, 2.0″ Shield Length	UT-141C-25	Micro-Coax
Coax3, 4	25 Ω Semi Rigid Coax, 2.2″ Shield Length	UT-141C-25	Micro-Coax
L1	2.5 nH, 1 Turn Inductor	A01TKLC	Coilcraft
R1, R2	10 Ω, 1/4 W Chip Resistors	CRCW120610R0JNEA	Vishay
PCB	Rogers RO4350B, 0.030″, ε_r = 3.66	D63637	MTL

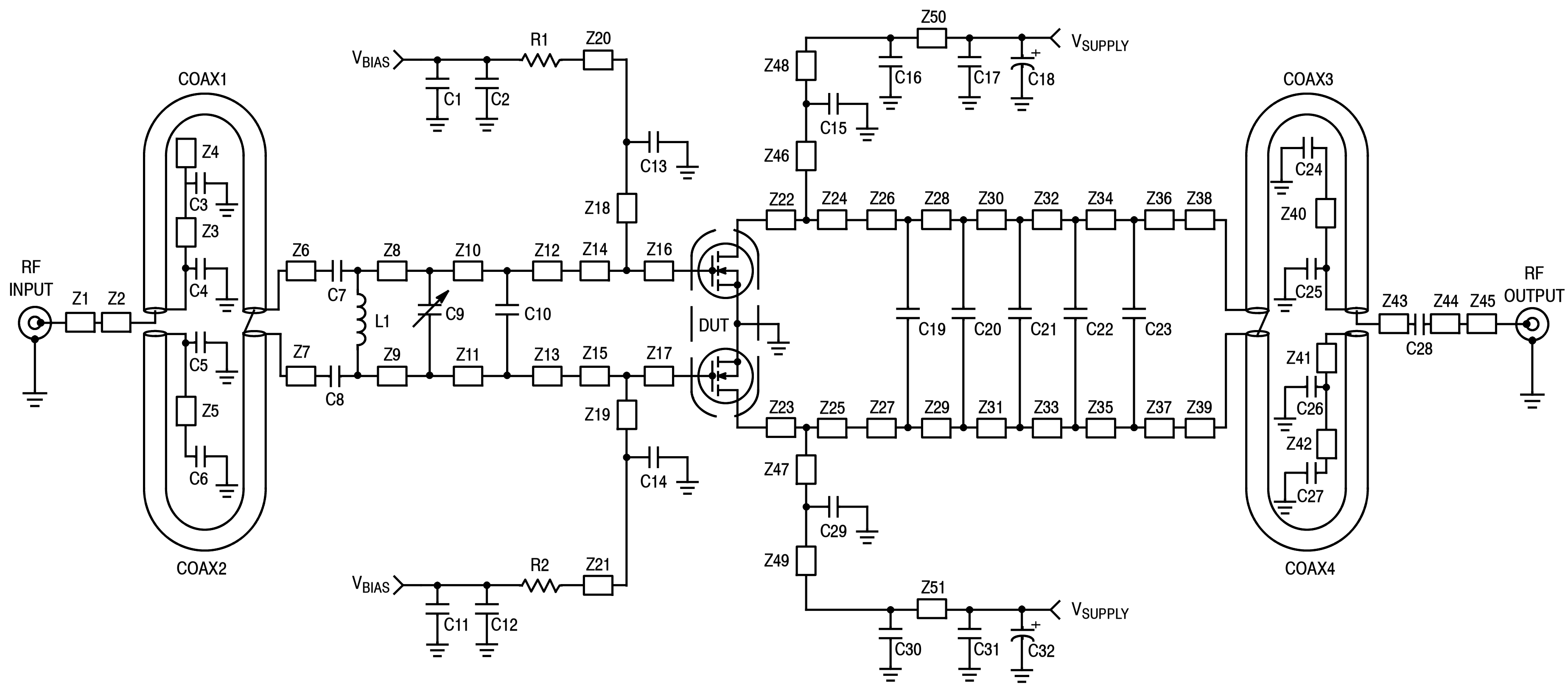


Figure 3. MRFE8VP8600H Test Circuit Schematic — 860 MHz DVB-T (8k OFDM)

Table 7. MRFE8VP8600H Test Circuit Schematic — 860 MHz DVB-T (8k OFDM)

Microstrip	Description	Microstrip	Description	Microstrip	Description
Z1	0.204″ × 0.062″ Microstrip	Z18, Z19	0.115″ × 0.080″ Microstrip	Z38, Z39	0.211″ × 0.100″ Microstrip
Z2	0.245″ × 0.080″ Microstrip	Z20*, Z21*	1.026″ × 0.080″ Microstrip	Z40	0.389″ × 0.060″ Microstrip
Z3, Z4	0.220″ × 0.060″ Microstrip	Z22, Z23	0.164″ × 0.520″ Microstrip	Z41	0.155″ × 0.060″ Microstrip
Z5	0.410″ × 0.062″ Microstrip	Z24, Z25	0.186″ × 0.520″ Microstrip	Z42	0.280″ × 0.060″ Microstrip
Z6, Z7	0.019″ × 0.100″ Microstrip	Z26, Z27	0.015″ × 0.420″ Microstrip	Z43	0.070″ × 0.080″ Microstrip
Z8, Z9	0.341″ × 0.400″ Microstrip	Z28, Z29	0.072″ × 0.420″ Microstrip	Z44	0.018″ × 0.080″ Microstrip
Z10, Z11	0.083″ × 0.400″ Microstrip	Z30, Z31	0.072″ × 0.420″ Microstrip	Z45	0.204″ × 0.062″ Microstrip
Z12, Z13	0.065″ × 0.400″ Microstrip	Z32, Z33	0.275″ × 0.420″ Microstrip	Z46, Z47	0.358″ × 0.080″ Microstrip
Z14, Z15	0.208″ × 0.850″ Microstrip	Z34, Z35	0.072″ × 0.420″ Microstrip	Z48*, Z49*	0.297″ × 0.080″ Microstrip
Z16, Z17	0.242″ × 0.960″ Microstrip	Z36, Z37	0.074″ × 0.420″ Microstrip	Z50, Z51	0.371″ × 0.080″ Microstrip

*Line length includes microstrip bends

TYPICAL CHARACTERISTICS — 860 MHz

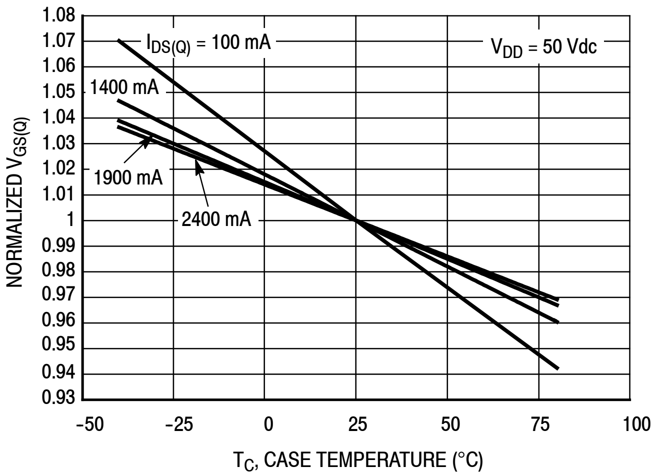


Figure 4. Normalized V_{GS} versus Quiescent Current and Case Temperature

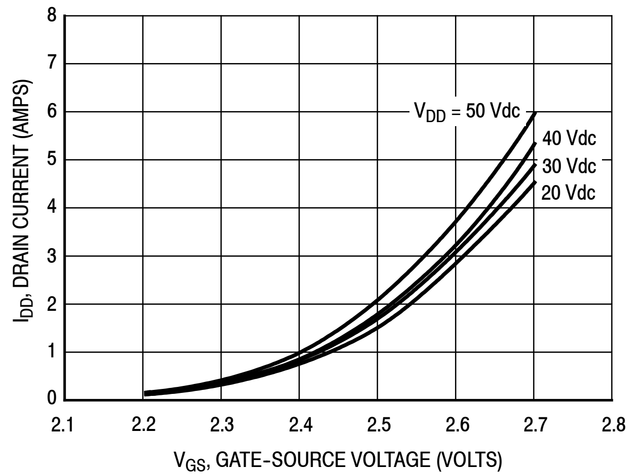
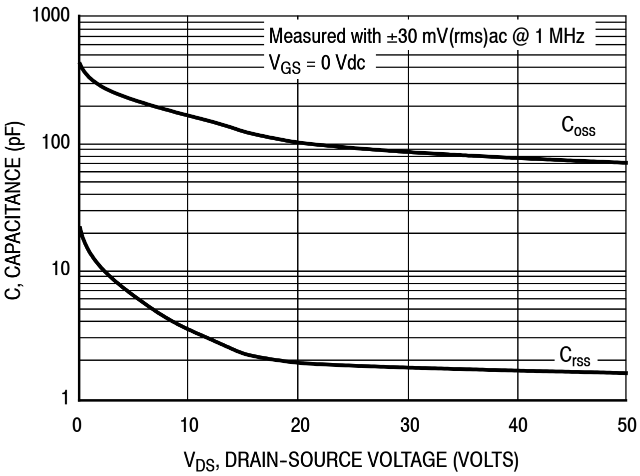


Figure 5. Drain Current versus Gate-Source Voltage



Note: Each side of device measured separately.

Figure 6. Capacitance versus Drain-Source Voltage

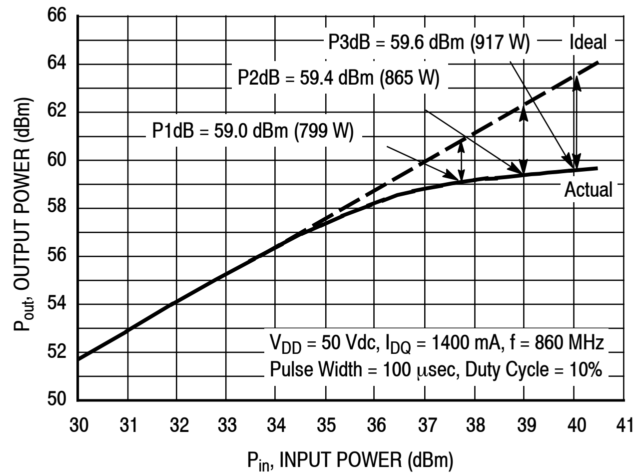


Figure 7. Pulse CW Output Power versus Input Power

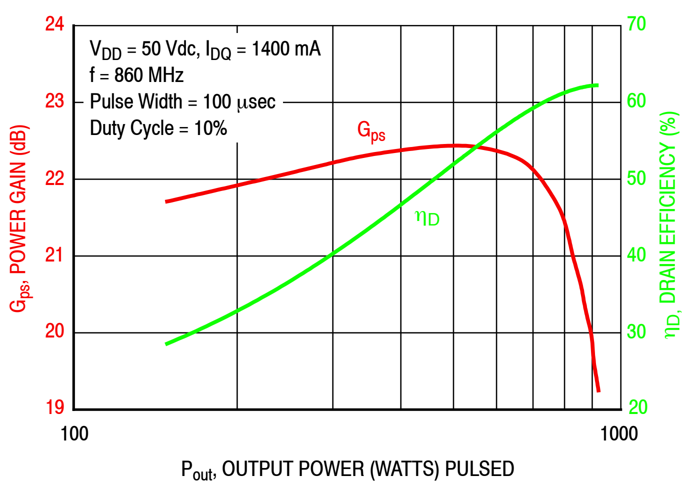


Figure 8. Pulse Power Gain and Drain Efficiency versus Output Power

TYPICAL CHARACTERISTICS — DVB-T (8k OFDM)

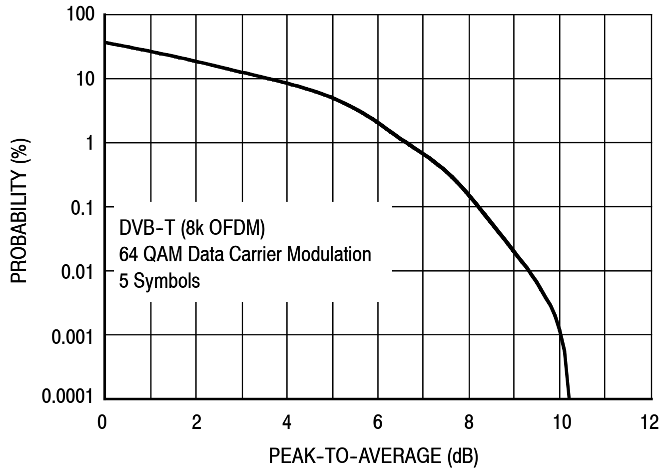


Figure 9. Source Peak-to-Average DVB-T (8k OFDM)

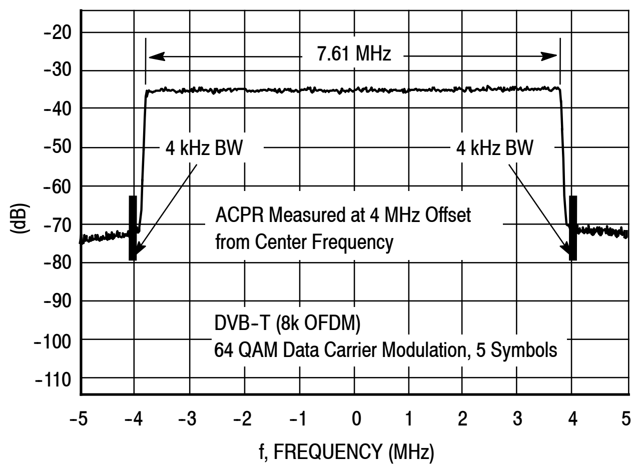
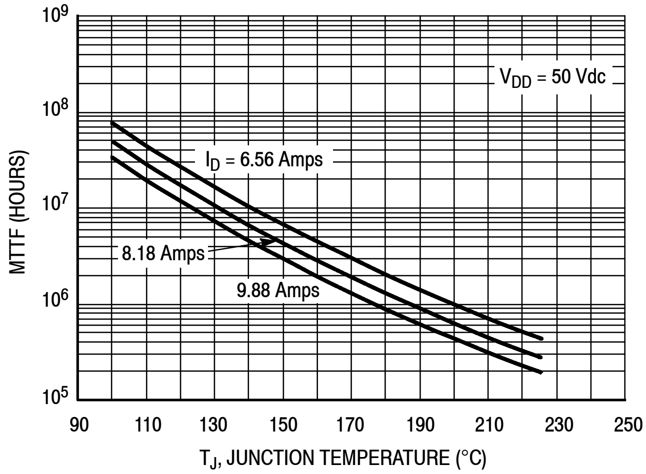


Figure 10. DVB-T (8k OFDM) Spectrum



Note: MTTF value represents the total cumulative operating time under indicated test conditions.

MTTF calculator available at http:/www.nxp.com/RF/calculators.

Figure 11. MTTF versus Junction Temperature - CW

f MHz	Z_{source} Ω	Z_{load} Ω
860	0.85 – j0.90	4.0 + j1.1

Z_{source} = Test circuit impedance as measured from gate to gate, balanced configuration.

Z_{load} = Test circuit impedance as measured from drain to drain, balanced configuration.

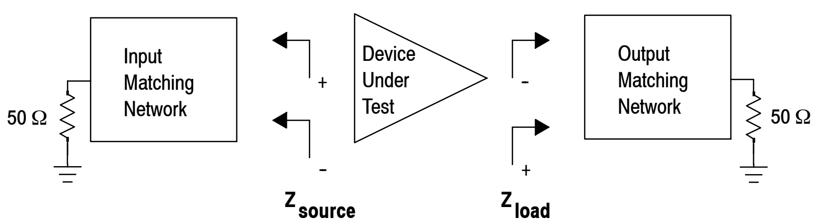
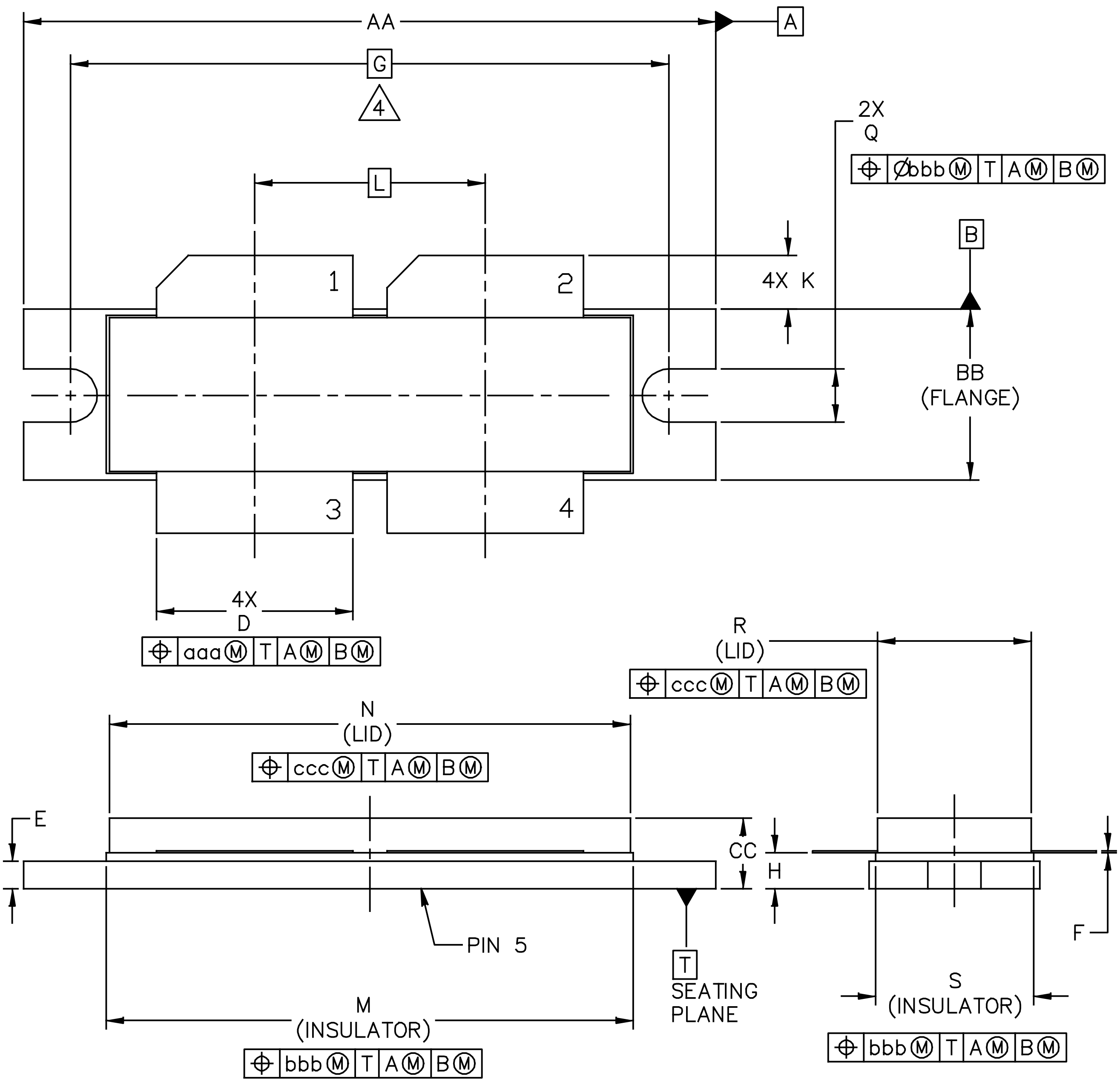


Figure 12. Series Equivalent Source and Load Impedance

PACKAGE DIMENSIONS



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NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

2. CONTROLLING DIMENSION: INCH

3. DIMENSION H IS MEASURED .030 INCH (0.762 MM) AWAY FROM PACKAGE BODY.

4. RECOMMENDED BOLT CENTER DIMENSION OF 1.52 INCH (38.61 MM) BASED ON M3 SCREW.

DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX	DIM	INCH MIN	INCH MAX	MILLIMETER MIN	MILLIMETER MAX
AA	1.615	1.625	41.02	41.28	N	1.218	1.242	30.94	31.55
BB	.395	.405	10.03	10.29	Q	.120	.130	3.05	3.30
CC	.170	.190	4.32	4.83	R	.355	.365	9.02	9.27
D	.455	.465	11.56	11.81	S	.365	.375	9.27	9.53
E	.062	.066	1.57	1.68					
F	.004	.007	0.10	0.18					
G	1.400 BSC		35.56 BSC		aaa	.013		0.33	
H	.082	.090	2.08	2.29	bbb	.010		0.25	
K	.117	.137	2.97	3.48	ccc	.020		0.51	
L	.540 BSC		13.72 BSC						
M	1.219	1.241	30.96	31.52					

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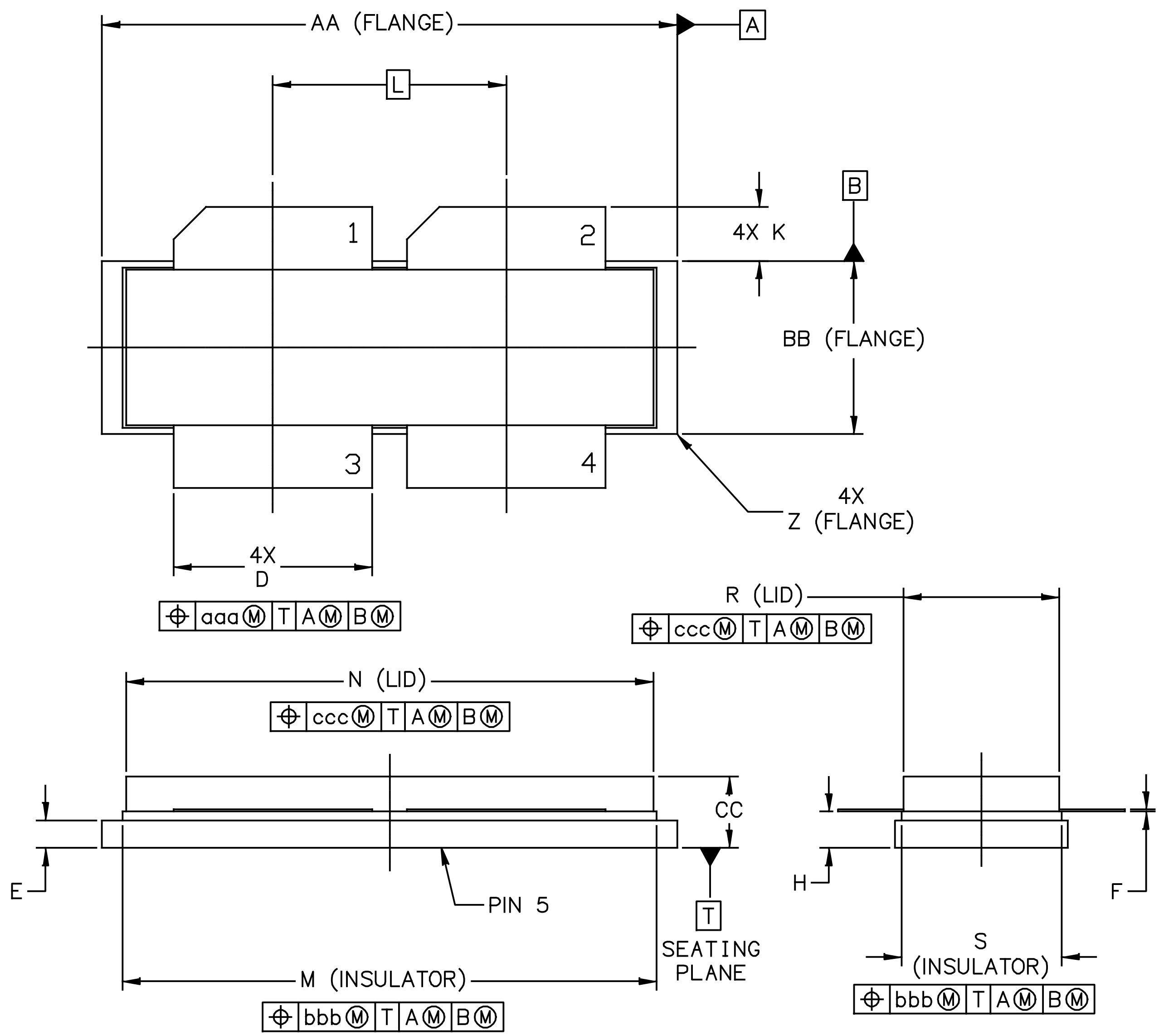

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NOTES:

1. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

2. CONTROLLING DIMENSION: INCH

3. DIMENSION H IS MEASURED .030 INCH (0.762 MM) AWAY FROM PACKAGE BODY

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
AA	1.265	1.275	32.13	32.39	R	.355	.365	9.02	9.27
BB	.395	.405	10.03	10.29	S	.365	.375	9.27	9.53
CC	.170	.190	4.32	4.83	Z	R.000	R.040	R0.00	R1.02
D	.455	.465	11.56	11.81					
E	.062	.066	1.57	1.68	aaa	.013		0.33	
F	.004	.007	0.10	0.18	bbb	.010		0.25	
H	.082	.090	2.08	2.29	ccc	.020		0.51	
K	.117	.137	2.97	3.48					
L	.540 BSC		13.72 BSC						
M	1.219	1.241	30.96	31.52					
N	1.218	1.242	30.94	31.55					

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	STANDARD: NON–JEDEC	
	SOT1829–1	19 FEB 2016

PRODUCT DOCUMENTATION, SOFTWARE AND TOOLS

Refer to the following resources to aid your design process.

Application Notes
- AN1908: Solder Reflow Attach Method for High Power RF Devices in Air Cavity Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Engineering Bulletins
- EB212: Using Data Sheet Impedances for RF LDMOS Devices

Software
- Electromigration MTTF Calculator
- RF High Power Model
- .s2p File

Development Tools
- Printed Circuit Boards

To Download Resources Specific to a Given Part Number:
1. Go to http://www.nxp.com/RF
2. Search by part number
3. Click part number link
4. Choose the desired resource from the drop down menu

REVISION HISTORY

The following table summarizes revisions to this document.

Revision	Date	Description
0	July 2015	• Initial release of data sheet
1	Aug. 2017	• Added part number MRFE8VP8600HS, pp. 1, 3 • Added NI-1230S-4S package isometric, p. 1, and Mechanical Outline, pp. 11-12