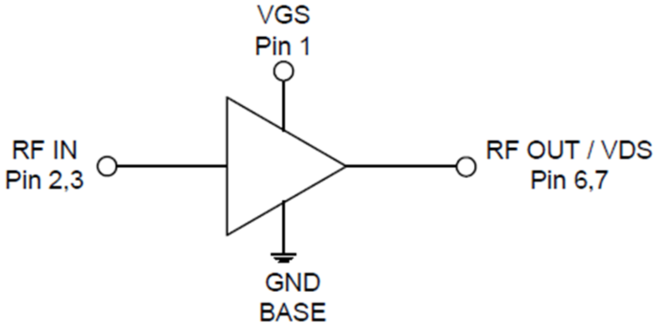
RFHA3832

10W GaN Wide-Band Power Amplifier

The RFHA3832 is a wideband Power Amplifier designed for CW and pulsed applications such as wireless infrastructure, RADAR, two way radios and general purpose amplification. Using an advanced high power density Gallium Nitride (GaN) semiconductor process, these high-performance amplifiers achieve high efficiency, flat gain, and large instantaneous bandwidth in a single amplifier design. The RFHA3832 is an input matched GaN transistor packaged in an air cavity ceramic package which provides excellent thermal stability through the use of advanced heat sink and power dissipation technologies. Ease of integration is accomplished through the incorporation of optimized input matching network within the package that provides wideband gain and power performance in a single amplifier. An external output match offers the flexibility of further optimizing power and efficiency for any sub-band within the overall bandwidth.



Functional Block Diagram

Ordering Information

RFHA3832S2	Sample bag with 2 pieces
RFHA3832SB	Bag with 5 pieces
RFHA3832SQ	Bag with 25 pieces
RFHA3832SR	Short reel with 100 pieces
RFHA3832TR7	7” reel with 500 pieces
RFHA3832TR13	13” reel with 2500 pieces
RFHA3832PCBA-410	Fully assembled evaluation board 30 to 1000 MHz, 48V operation

Package: AIN Leadless Chip Carrier, SO8

Features

- Advanced GaN HEMT Technology
- Output Power of 10W
- Advanced Heat-Sink Technology
- 30MHz to 1000MHz Instantaneous Bandwidth
- Input Internally Matched to 50Ω
- 48V Operation Typical Performance
    - Output Power 40dBm
    - Gain 15.5dB
    - Power Added Efficiency 48%
- -40°C to 85°C Operating Temperature
- Large Signal Models Available

Applications

- Class AB Operation for Public Mobile Radio
- Power Amplifier Stage for Commercial Wireless Infrastructure
- General Purpose Tx Amplification
- Test Instrumentation
- Civilian and Military Radar

RF Micro Devices Inc. 7628 Thorndike Road, Greensboro, NC 27409-9421
For sales or technical support, contact RFMD at +1.336.678.5570 or customerservice@rfmd.com.

Absolute Maximum Ratings

Parameter	Rating	Unit
Drain Voltage (V_D)	150	V
Gate Voltage (V_G)	-8 to +2	V
Gate Current (I_G)	10	mA
Operational Voltage	48	V
RF- Input Power	30	dBm
Ruggedness (VSWR)	12:1	
Storage Temperature Range	-55 to +125	°C
Operating Temperature Range (T_L)	-40 to +85	°C
Operating Junction Temperature (T_J)	250	°C
Human Body Model	Class 1A	
MTTF (T_J < 200°C, 95% Confidence Limits)*	3.2E + 06	Hours
MTTF (T_J < 250°C, 95% Confidence Limits)*	5.3E + 04	
Thermal Resistance, R_{TH} (Junction to Case) measured at T_C = 85°C, DC bias only	TBD	°C/W

Caution! ESD sensitive device.

RFMD Green: RoHS compliant per EU Directive 2011/65/EU, halogen free per IEC 61249-2-21, <1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony solder.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

* MTTF – median time to failure as determined by the process technology wear-out failure mode. Refer to product qualification report for FIT (random) failure rate.

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table above.

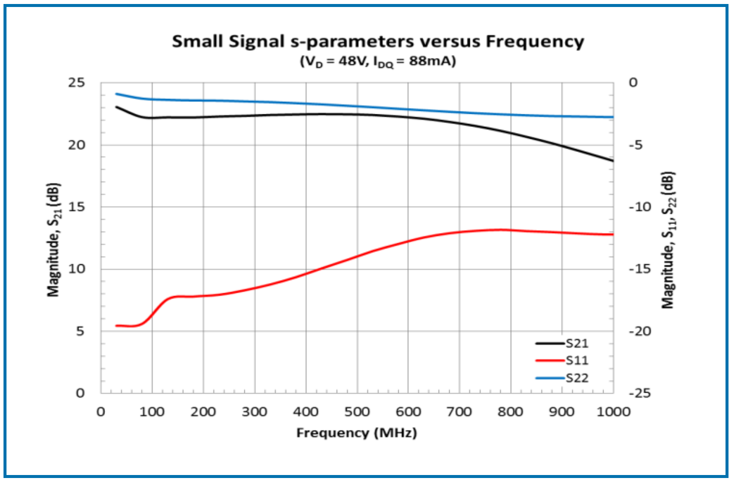
Bias Conditions should also satisfy the following expression: $P_{DISS} < (T_J – T_C) / R_{TH\ J-C}$ and $T_C = T_{CASE}$

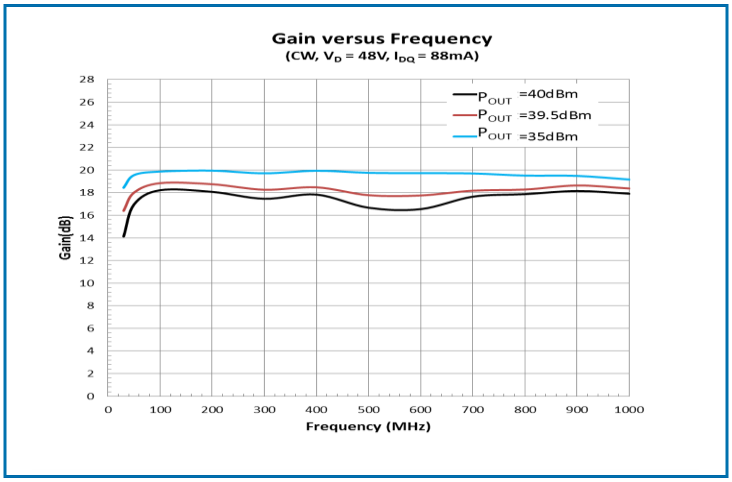
Nominal Operating Parameters

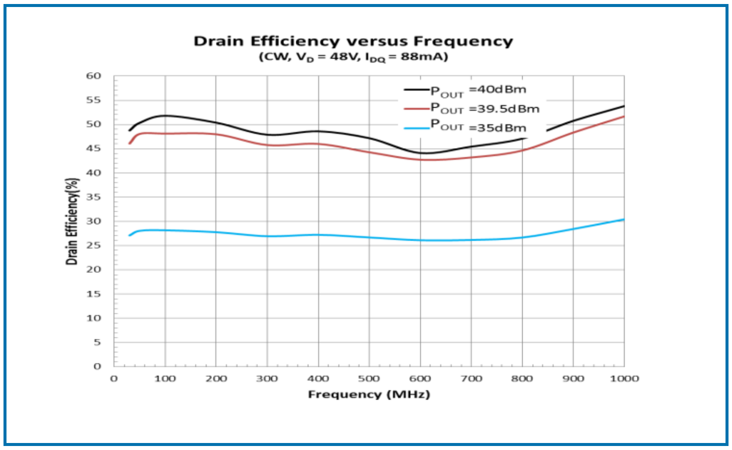
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Recommended Operating Conditions					
Drain Voltage (V_{DSQ})		48		V	
Gate Voltage (V_{GSQ})	-5	-0.9		V	
Drain Bias Current		88		mA	
RF Input Power (P_{IN})			30	dbm	
Input Source VSWR			10:1		
RF Performance Characteristics					
Frequency Range	30		1000	MHz	Small signal 3dB bandwidth
Linear Gain		19.5		dB	P_{IN} = 10dBm, 30MHz to 1000MHz
Power Gain		15.5		dB	P_{IN} = 24.5dBm, 30MHz to 1000MHz
Gain Variation with Temperature		TBD		dB/°C	
Input Return Loss (S_{11})		-14		dB	
Output Power (P_{3dB})		40		dBm	30MHz to 1000MHz
Power Added Efficiency (PAE)		48		%	30MHz to 1000MHz

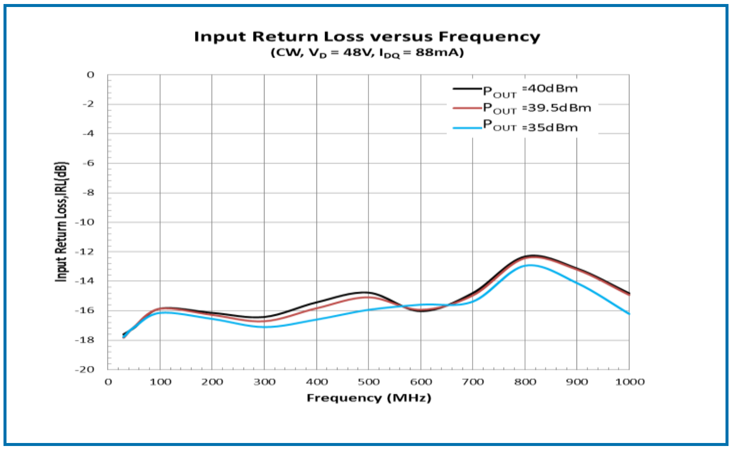
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
RF Functional Test					**Test Conditions: V_{DSQ} = 48V, I_{DQ} = 88mA, CW, f = 500MHz, T = 25ºC, Performance in a standard tuned test fixture**
$V_{GS(Q)}$		-0.9		V	
Power Gain		15.5		dB	P_{IN} = 24.5dBm
Input Return Loss		-15		dB	
Output Power		39.8		dBm	
Power Added Efficiency (PAE)		46		%	

Typical Performance in Standard Fixed Tuned Test Fixture Matched for 30MHz to 1000MHz: (T = 25°C unless noted)

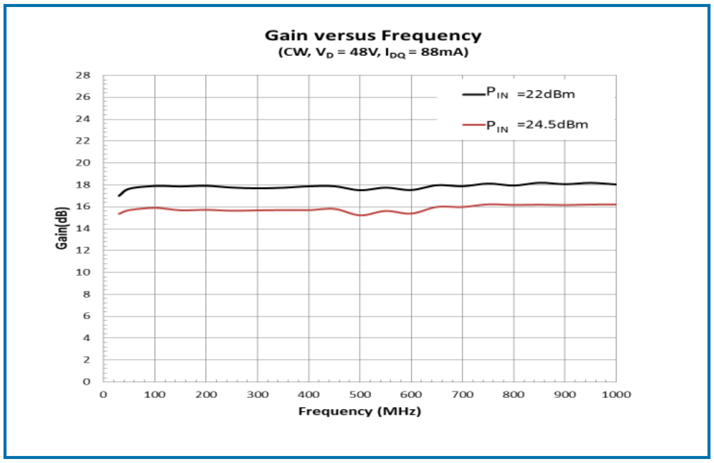


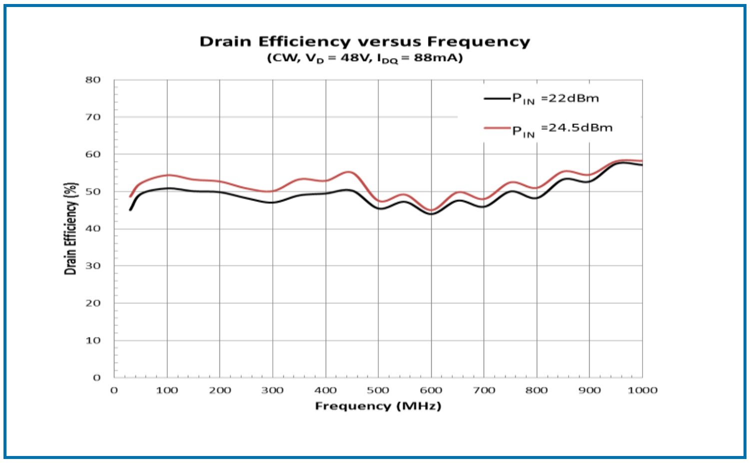


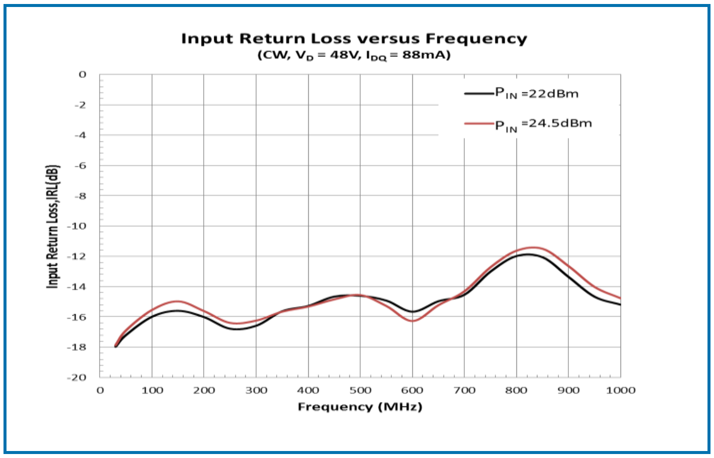


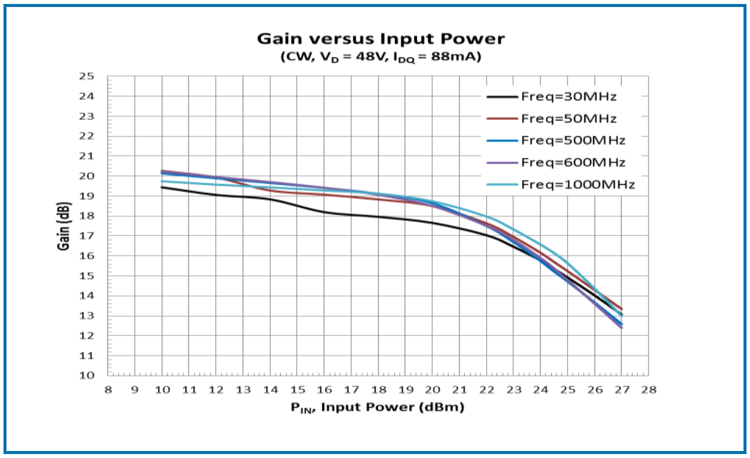


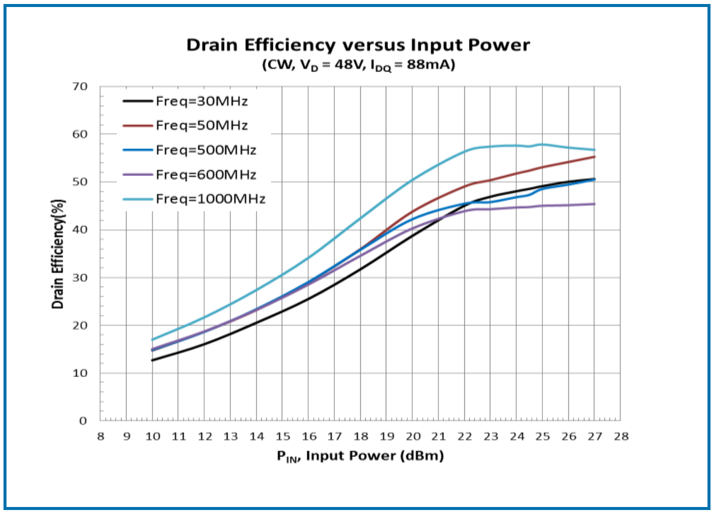
Typical Performance in Standard Fixed Tuned Test Fixture Matched for 30MHz to 1000MHz: (T = 25°C unless noted) (continued)

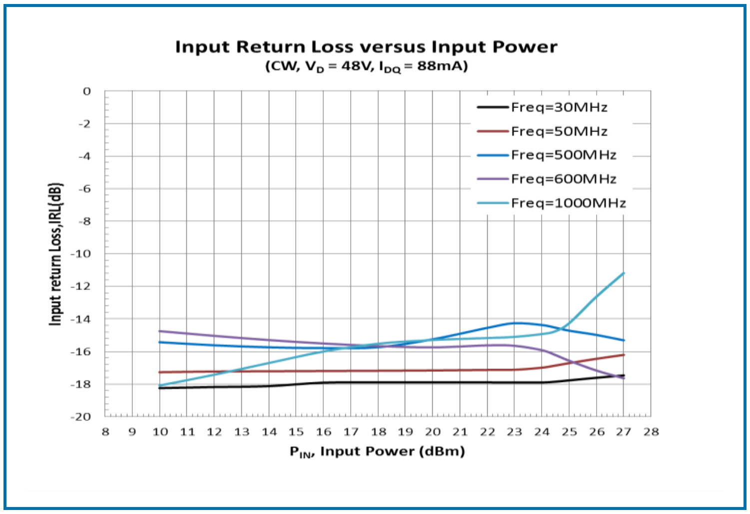




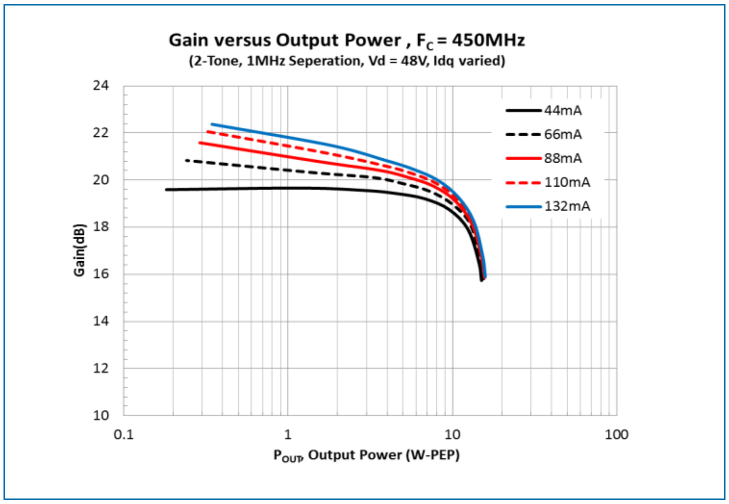


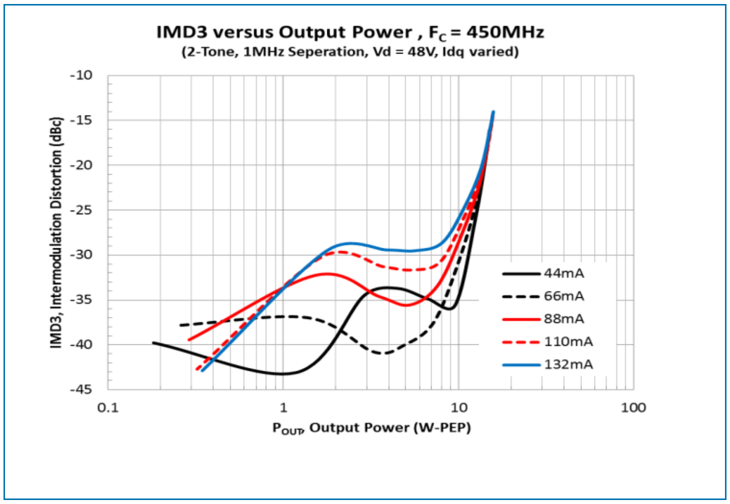


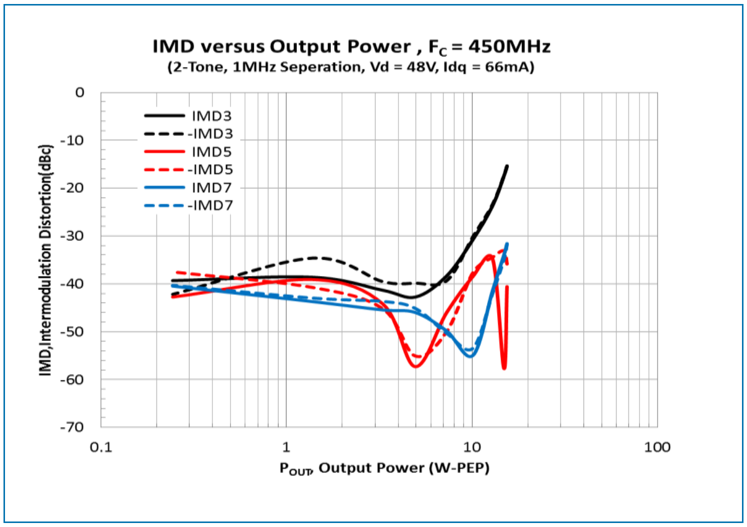




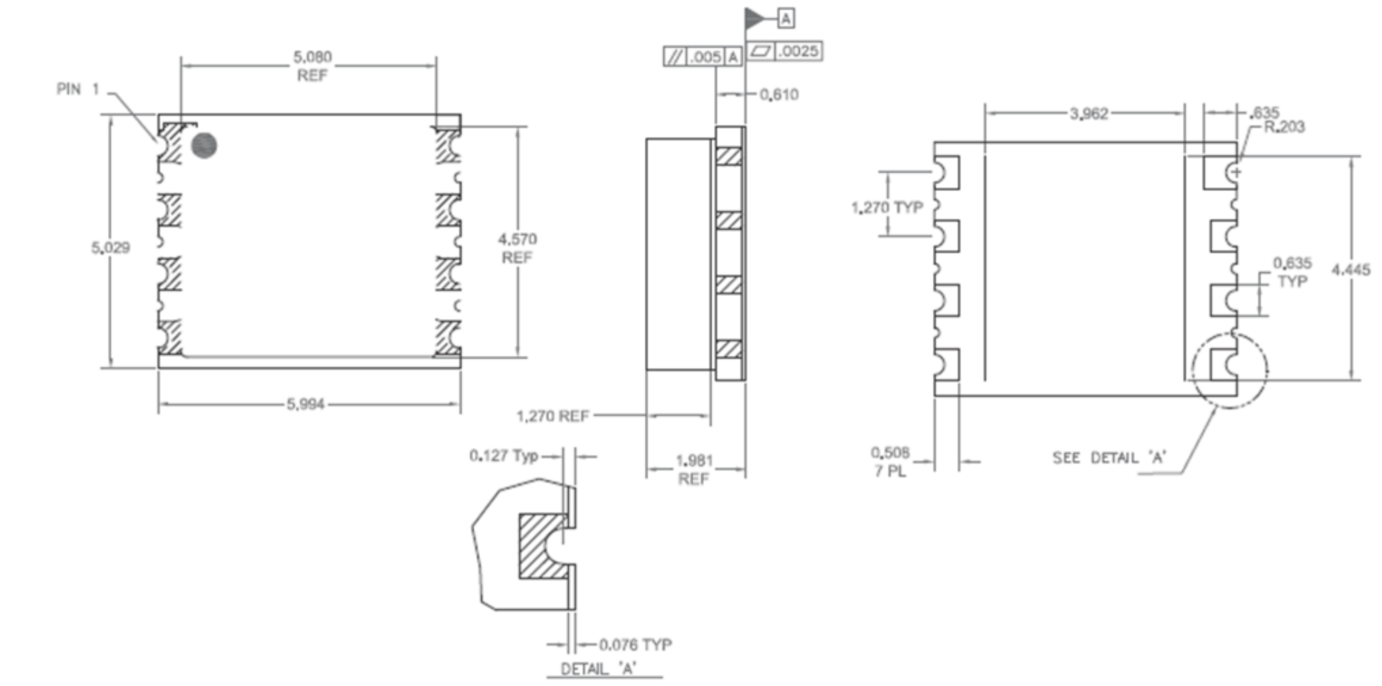
Typical Performance in Standard Fixed Tuned Test Fixture Matched for 30MHz to 1000MHz: (T = 25°C unless noted) (continued)







Package Drawing (Dimensions in millimeters)



Pin Names and Descriptions

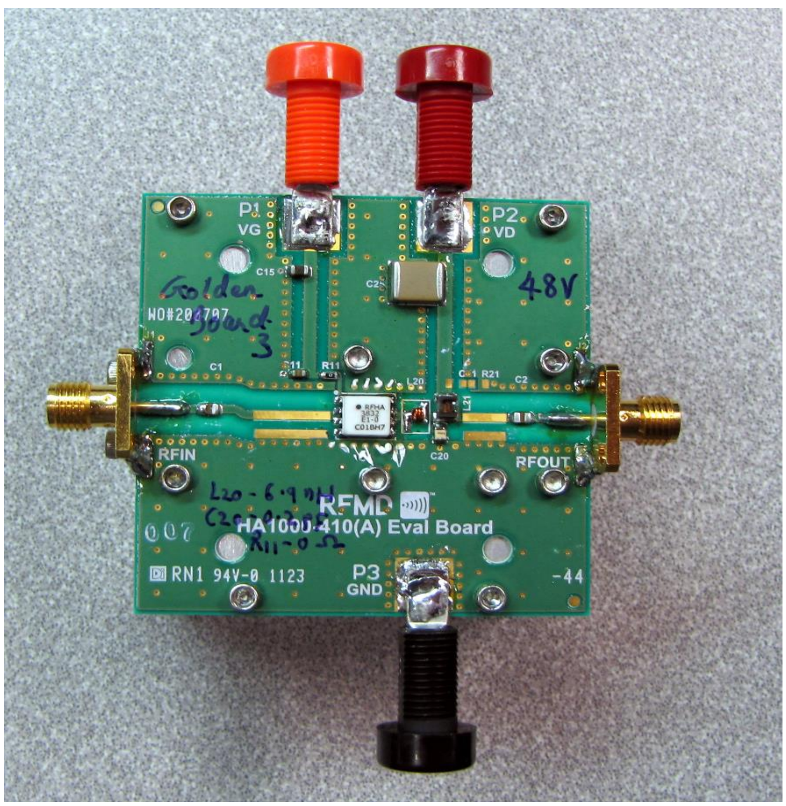
Pin	Name	Description
1	VGS	Gate DC Bias Pin
2-3	RFIN	RF Input
4-5	N/C	No Connect
6-7	RFOUT/VDS	RF Output/Drain DC Bias Pin
8	N/C	No Connect
Pkg Base	GND	Ground

Bias Instruction for RFHA3832 Evaluation Board

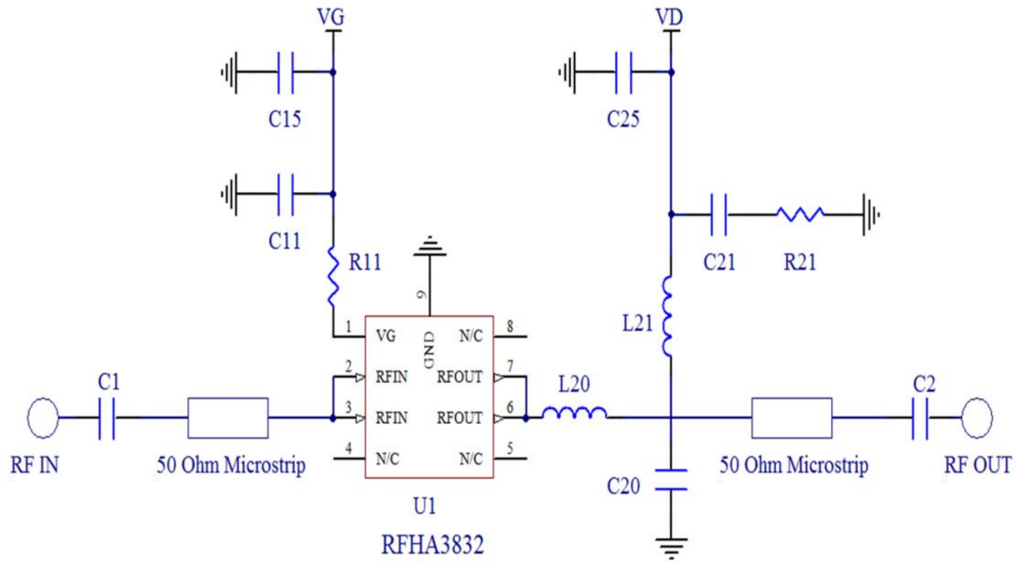
ESD Sensitive Material. Please use proper ESD precautions when handling devices of evaluation board.
Evaluation board requires additional external fan cooling.
Connect all supplies before powering evaluation board.

1. Connect RF cables at RFIN and RFOUT.
2. Connect ground to the ground supply terminal, and ensure that both the VG and VD grounds are also connected to this ground terminal.
3. Apply -5V to VG.
4. Apply 48V to VD.
5. Increase V_G until drain current reaches 88mA or desired bias point.
6. Turn on the RF input.

Typical test data provided is measured to SMA connector reference plane, and include evaluation board/broadband bias network mismatch and losses.



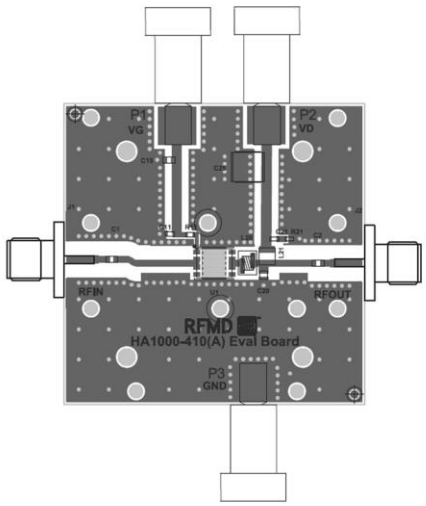
Evaluation Board Schematic



Evaluation Board Bill of Materials (BOM)

Component	Value	Manufacturer	Part Number
C1, C2	2400pF	Dielectric Labs Inc	C08BL242X-5UN-X0
C11	10000pF	Murata Electronics	GRM188R71H103KA01D
C15	10µF	Murata Electronics	GRM21BF51C106ZE15L
C20	0.2pF	ATC	100A0R2BW150XC
C25	4.7µF	Murata Electronics	GRM55ER72A475KA01L
R11	0Ω	Panasonic	ERJ-8GEYJ0R00
L20	6.9nH	Coilcraft	0906-5_LB
L21	0.9µH	Coilcraft	1008AF-901XJLC
C21, R21	NOT USED	-	-

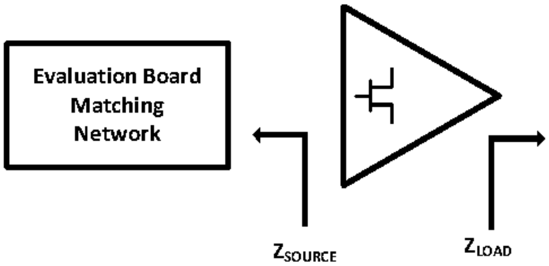
Evaluation Board Layout



Device Impedances

Frequency (MHz)	RFHA1000PCBA-410 (50MHz to 1000MHz)	
	Z Source (Ω)	Z Load (Ω)
30	41.63 - j1.26	38.96 + j11.14
50	42.22 - j0.39	40.71 + j8.95
100	42.35 + j0.64	42.26 + j7.84
200	42.87 + j1.91	43.81 + j10.6
300	43.62 + j2.68	46.00 + j14.27
400	44.54 + j3.17	48.99 + j17.91
500	45.50 + j3.33	52.67 + j21.14
600	46.41 + j3.05	57.04 + j23.82
700	47.10 + j2.60	61.92 + j26.0
800	47.61 + j1.89	67.89 + j27.5
900	47.84 + j1.02	74.02 + j28.2
1000	47.65 + j0.07	80.76 + j28.0

NOTE: Device impedances reported are the measured evaluation board impedances chosen for a tradeoff of efficiency and peak power performance across the entire frequency bandwidth.



Device Handling/Environmental Conditions

RFMD does not recommend operating this device with typical drain voltage applied and the gate pinched off in a high humidity, high temperature environment.

GaN HEMT devices are ESD sensitive materials. Please use proper ESD precautions when handling devices or evaluation boards.

DC Bias

The GaN HEMT device is a depletion mode high electron mobility transistor (HEMT). At zero volts V_{GS} the drain of the device is saturated and uncontrolled drain current will destroy the transistor. The gate voltage must be taken to a potential lower than the source voltage to pinch off the device prior to applying the drain voltage, taking care not to exceed the gate voltage maximum limits. RFMD recommends applying V_{GS} = -5V before applying any V_{DS}.

RF Power transistor performance capabilities are determined by the applied quiescent drain current. This drain current can be adjusted to trade off power, linearity, and efficiency characteristics of the device. The recommended quiescent drain current (I_{DQ}) shown in the RF typical performance table is chosen to best represent the operational characteristics for this device, considering manufacturing variations and expected performance. The user may choose alternate conditions for biasing this device based on performance tradeoffs.

Mounting and Thermal Considerations

The thermal resistance provided as R_{TH} (junction to case) represents only the packaged device thermal characteristics. This is measured using IR microscopy capturing the device under test temperature at the hottest spot of the die. At the same time, the package temperature is measured using a thermocouple touching the backside of the die embedded in the device heatsink but sized to prevent the measurement system from impacting the results. Knowing the dissipated power at the time of the measurement, the thermal resistance is calculated.

In order to achieve the advertised MTTF, proper heat removal must be considered to maintain the junction at or below the maximum of 200°C. Proper thermal design includes consideration of ambient temperature and the thermal resistance from ambient to the back of the package including heat sinking systems and air flow mechanisms. Incorporating the dissipated DC power, it is possible to calculate the junction temperature of the device.