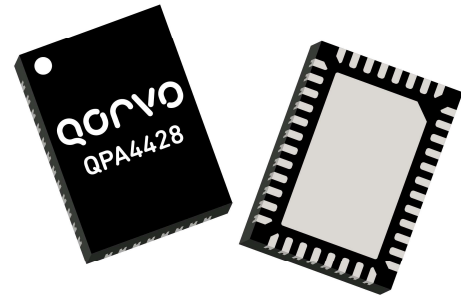


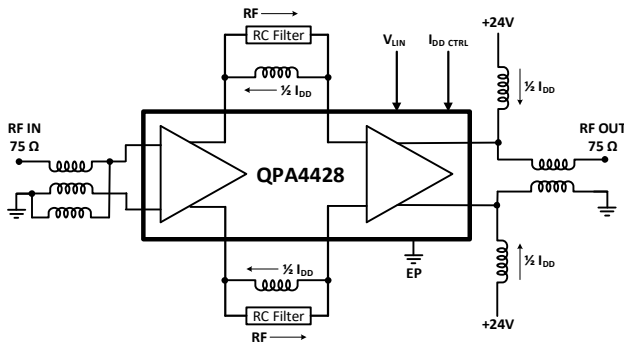
### Product Overview

The QPA4428 is a GaAs pHEMT/MESFET 75-ohm push-pull RF amplifier IC featuring 28dB of flat gain and low noise. This IC is designed to support DOCSIS 3.1 applications up to 1218MHz using a single 24V supply. The QPA4428 offers low noise and low distortion at high efficiency consuming only 7W in a 5x7 QFN package. Its compact size and low  $\Theta_{jc}$  enable integration that is ideally suited for hybrid module applications.



40 pin 5x7 QFN Package

### Functional Block Diagram



### Key Features

- High Gain: 28dB @ 1218MHz
- Adjustable Bias
- 47 - 1218 MHz BW
- 47dBmV/ch flat
- Low Noise: 4.6dB
- Excellent Composite Distortion
- pHEMT / MESFET device technologies
- Compact Size: 40P 5x7 QFN
- Power Consumption (24V, 290mA - 7W)

### Applications

- DOCSIS 3.1
- Broadband CATV hybrid modules
- Head End CMTS Equipment
- 75-ohm amplifiers

### Ordering Information

Part No.	Description
QPA4428SB	Sample bag with 5 pieces
QPA4428SR	7" Reel with 100 pieces
QPA4428TR13	13" Reel with 2500 pieces
QPA4428EVB-01	47 – 1218MHz PCBA

## Absolute Maximum Ratings

Parameter	Rating
Supply Voltage (V <sub>DD</sub> )	+30V (5min)
Supply Current (I <sub>DD</sub> )	350mA
Maximum Input Level (single tone)	+70dBmV
Operating Temperature Range	-40 to +100°C
Storage Temperature Range	-65 to +165°C
Maximum Junction Temperature	+150°C

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.

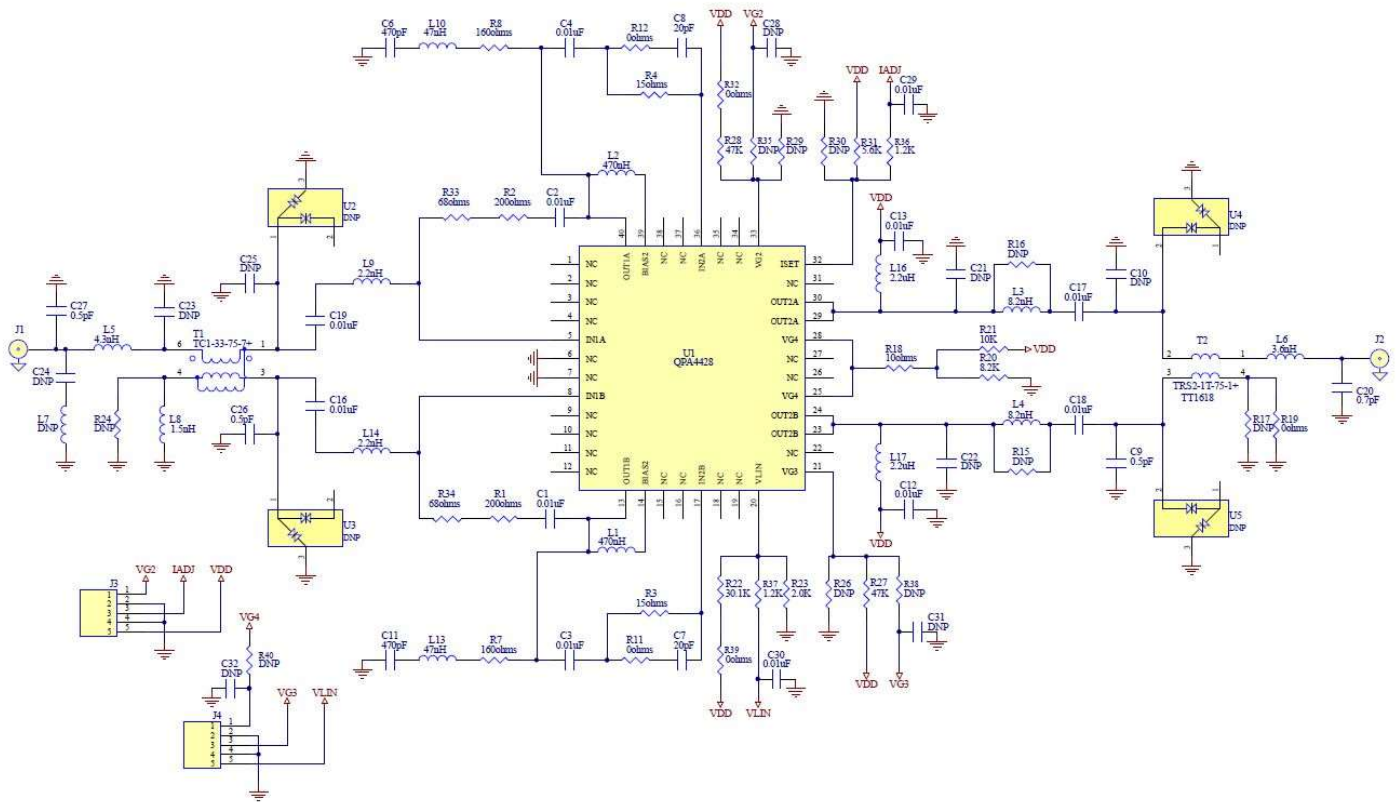
## Electrical Specifications – 24V

Parameter	Condition <sup>(1)</sup>	Min	Typ	Max	Unit
Supply Voltage (V <sub>DD</sub> )			24		V
Supply Current (I <sub>DD</sub> )	V <sub>DD</sub> total current		290		mA
Frequency Range		47		1218	MHz
Gain <sup>2</sup>	1218MHz		29.7		dB
Gain Flatness	Max. deviation from line using least squares fit from 47 to 1218 MHz		±0.5		dB
Gain Slope	Gain(1218MHz) - Gain(50MHz)		1.1		dB
Reverse Isolation			-44		dB
Input Return Loss			18.9		dB
Output Return Loss			19.5		dB
Noise Figure			4.6		dB
CSO	80 NTSC + 111 QAM (-6dB offset), 47dBmV/ch out, 0dB tilt		-78.2		dBc
CTB			-75.0		dBc
CCN			64.0		dB
OIP2	Low band: 225MHz, 275.5MHz, 15dBm/tone		87.9		dBm
	High band: 1100MHz, 1150.5MHz, 15dBm/tone		65.5		dBm
OIP3	Low band: 225MHz, 275.5MHz, 15dBm/tone		55.8		dBm
	High band: 1100MHz, 1150.5MHz, 15dBm/tone		49.3		dBm
Output P1dB	1218 MHz		28.0		dBm
Thermal Resistance	Θ <sub>JB</sub> (Junction to backside of QFN)		6.0		°C/W

### Notes:

1. Typical performance at these conditions: Temp = +25°C, V<sub>DD</sub> = +24V, 75Ω system, Full band unless otherwise noted
2. Gain (or Tilt) can be modified between stages by approximately -4dB (S21 = 21dB).

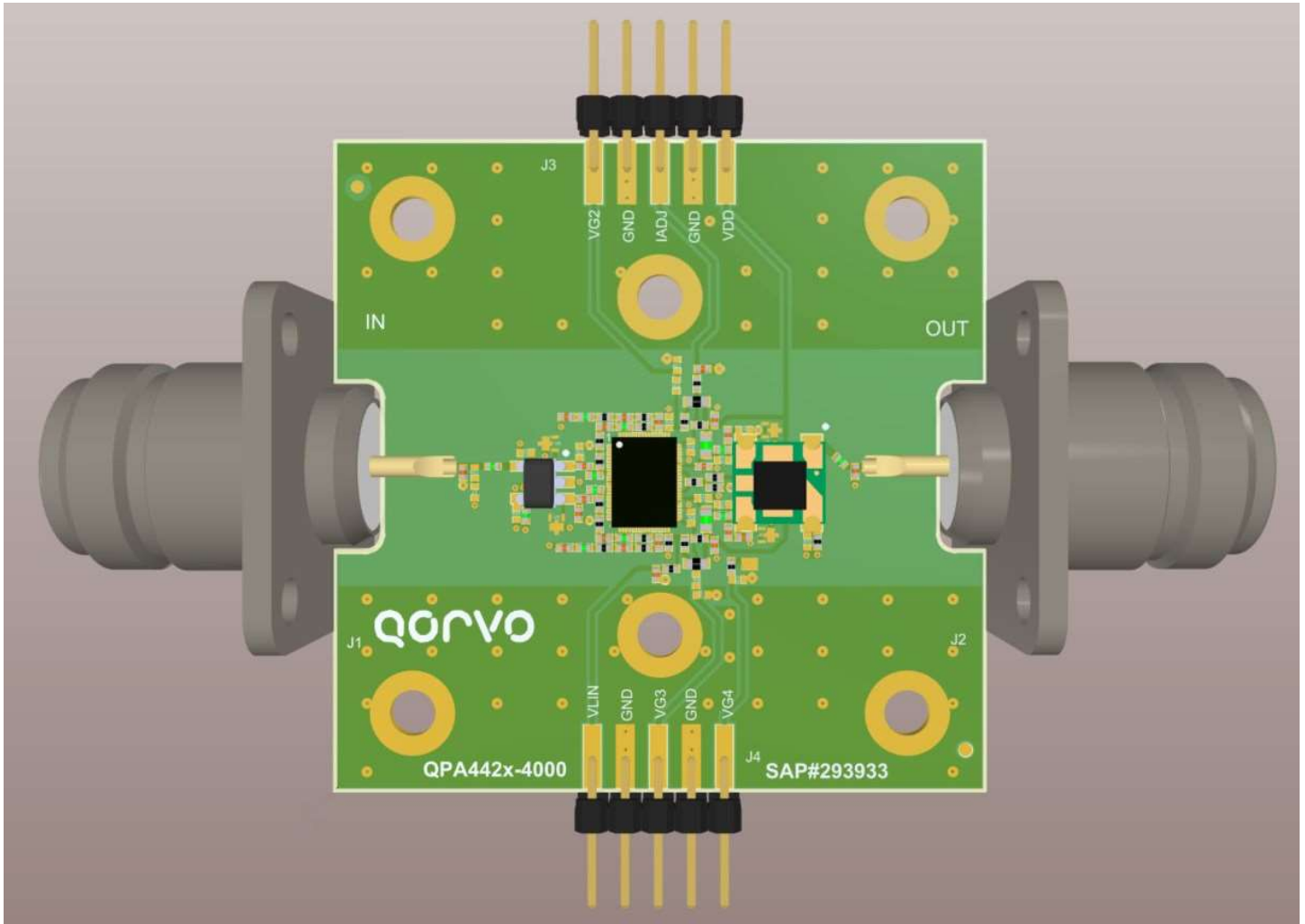
### Evaluation Board Schematic



**Evaluation Board Bill of Materials**

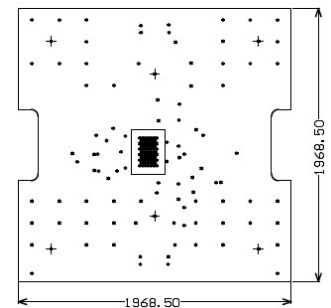
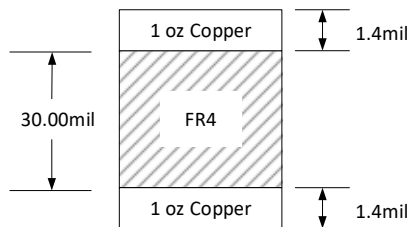
Reference Designator	Description	Manufacturer	PART #
U1	1.2GHz, 28dB Push-Pull MMIC	Qorvo	QPA4428
C1,C2,C3,C4,C12,C13, C16,C17,C18,C19,C29, C30	CAP, 0.01uF, ±10%, 50V, X7R, 0402	Murata	GCM155R71H103KA55D
C9, C26, C27	CAP, 0.5pF, ±0.1pF, 50V, COG, HIQ, 0402	Murata	GJM1555C1HR50BB01D
C20	CAP, 0.7pF, ±0.05pF, 50V, HI-Q, 0402	Murata	GJM1555C1HR70BB01D
C7, C8	CAP, 20pF, 2%, 50V, HI-Q, 0402	Murata	GJM1555C1H200GB01D
C6, C11	CAP, 470pF, 5%, 50V, COG, 0402	Murata	GRM1555C1H471JA01D
R18	RES, 10 OHM, 1%, 1/16W, 0402	Panasonic	ERJ-2RKF10R0X
R31	RES, 5.60K ohm, 1%, 1/16W, 0402	Vishay	CRCW04025K60FKED
R19, R11, R12	RES, 0 OHM, 5%, 1/10W, 0402	Kamaya	RMC1/16SJPTH
R3, R4	RES, 15 OHM, 5%, 1/16W, 0402	Kamaya	RMC1/16S-150JTH
R33, R34	RES, 68 OHM, 5%, 1/16W, 0402	Kamaya	RMC1/16S-680JTH
R21	RES, 10K, 1%, 1/16W, 0402	Panasonic	ERJ-2RKF1002X
R20	RES, 8.2K, +/-1%, 1/10W, 0402	Panasonic	ERJ-2RKF1801X
R22	RES, 30.1K, 1/16W, 1%, 04 02	KOA Speer	RK73H1ETTP3012F
R27, R28	RES, 47K, 1%, 1/16W, 0402	Yageo	RC0402FR-0747KL
R1, R2	RES, 200 OHM, 5%, 1/16W, 0402	Kamaya	RMC1/16SK2000FTH
R36, R37	RES, 1.2K, 5%, 1/16W, 0402	Panasonic	ERJ-2GEJ122
R32, R39	RES, 0 OHM, 0603	Kamaya	RMC1/16JPTP
R23	RES, 2K, 5%, 1/16W, 0402	Panasonic	ERJ-2GEJ202
R7, R8	160 OHM,5%,1/16W,0402, LEAD FREE	KOA Speer	RK73B1ETTP161J
L1, L2	IND, 470nH, ±5%, 310mA, 650mHZ, 0402	Coilcraft	0402AF-471XJLW
L9, L14	IND, 2.2nH, +/-0.3nH, M/L, 0402	Murata	LQG15HN2N2S02D
L8	IND, 1.5nH, +/-0.3nH, M/L, 0402	Murata	LQG15HN1N5S02D
L3, L4	IND, 8.2nH, 5%, M/L, 0402	Murata	LQG15HN8N2J02D
L10, L13	IND, 47nH, 5%, M/L, 0402	Murata	LQG15HN47NJ02D
L5	IND, 4.3nH, +/-0.1nH, M/L, 0402	Murata	LQG15HS4N3B02D
L6	IND, 3.6nH, +/-0.1nH, M/L, 0402	Murata	LQG15HS3N6B02D
L16, L17	IND, 2.2uH, 20%, 0.36A, 0.7mm, W/W, 0603	Taiyo Uden	BRL1608T2R2M
T1	XFMR, SMT, 75 OHM, CD542, 1:1 BALUN, TC1	Mini Circuits	TC1-33-75-7+
T2	TRANS, 75ohm, 30mA, 4.5-3000MHz	Mini Circuits	TRS2-1T-75-1+
U2,U3, U4,U5,C10,C21, C22, C23,C24,C25,C28,C31, C32,L7,R15,R16,R17,R24 R26,R29,R30,R35,R38,R40	Not Populated		

#### Evaluation Board Assembly Drawing

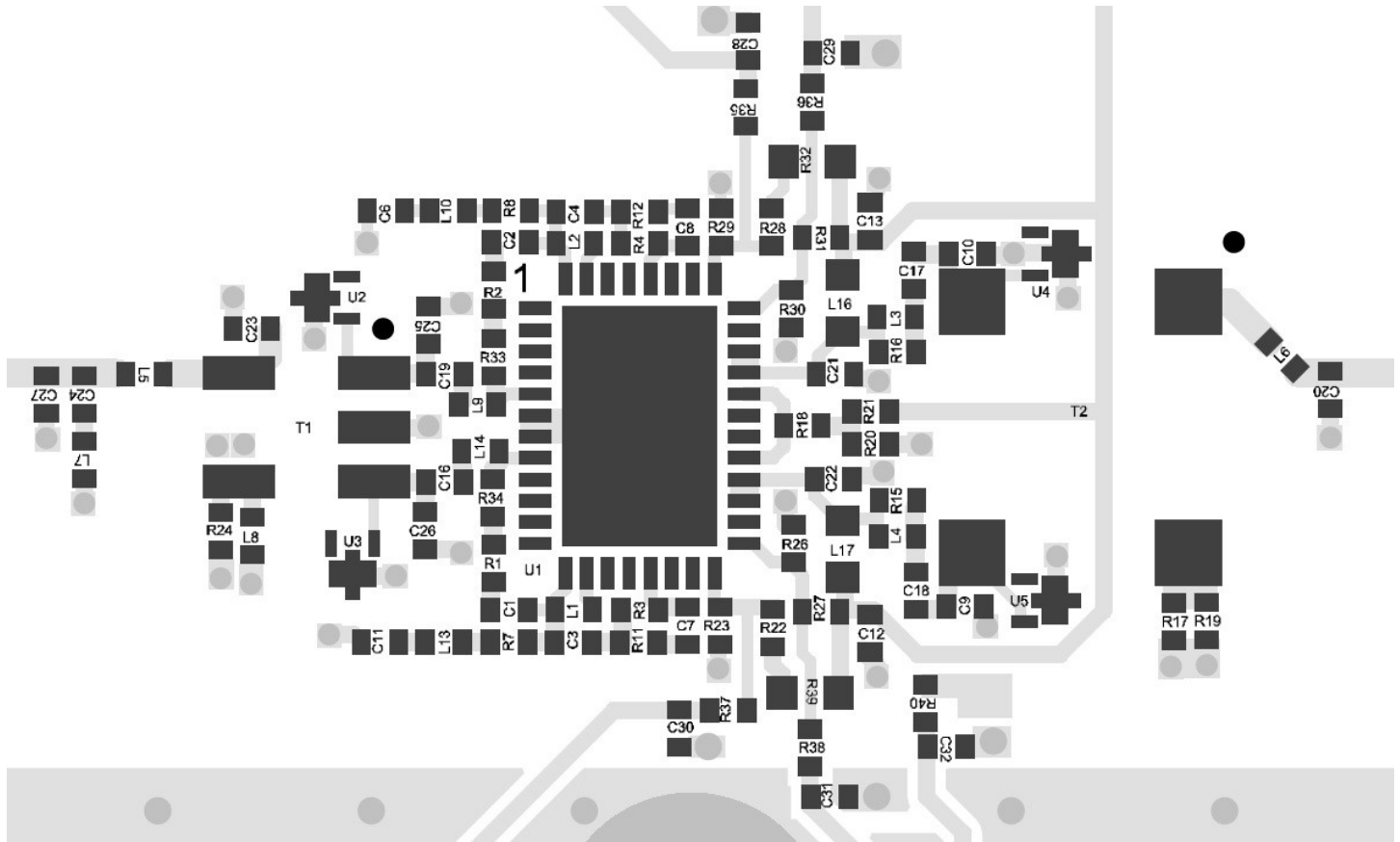


#### EVB PCB Material and Stack-up

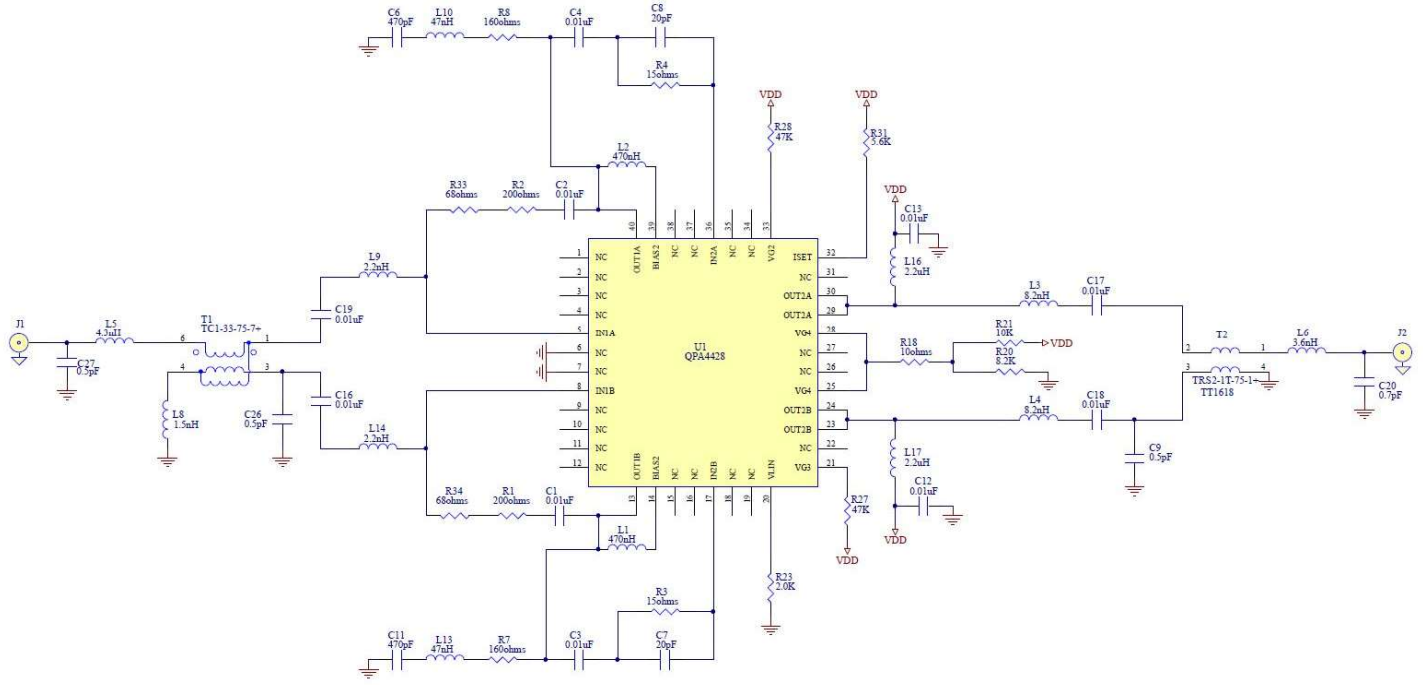
Board Material: 0.030" FR4,  $\epsilon_r=4.2$   
 Plating: 1oz Copper  
 Board Dimension: 1.9685" x 1.9685"



### Evaluation Board Component Placement

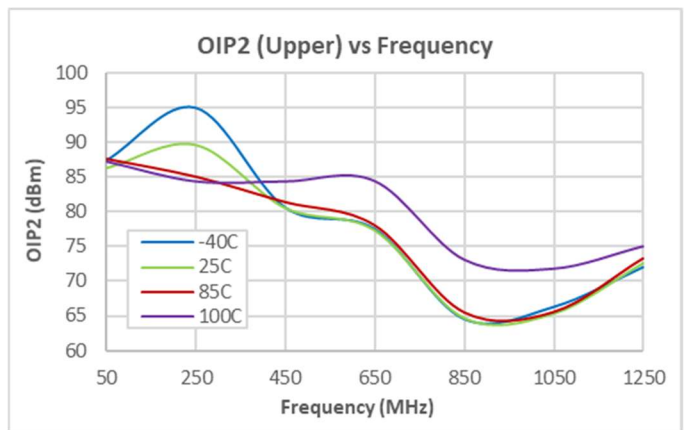
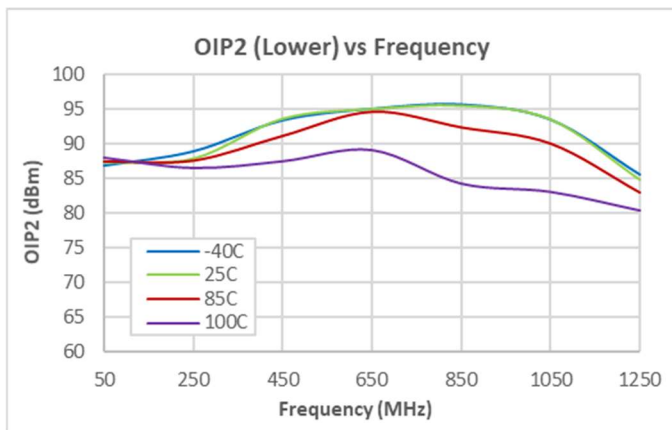
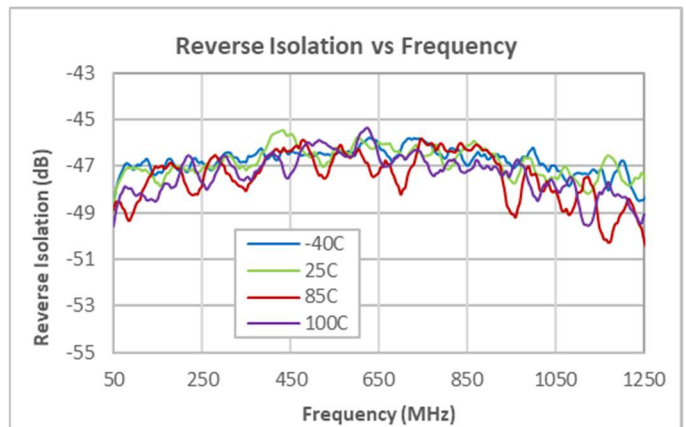
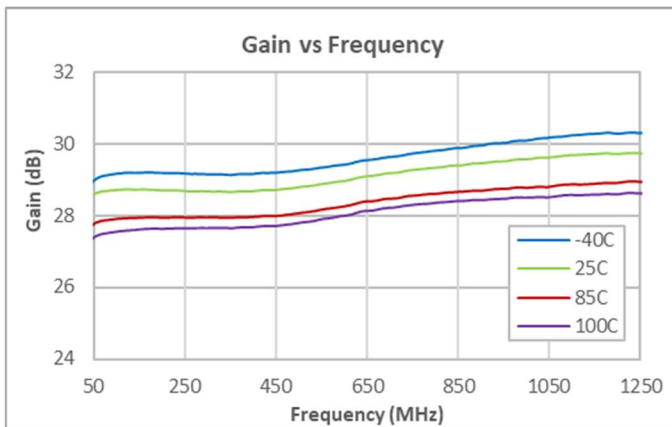
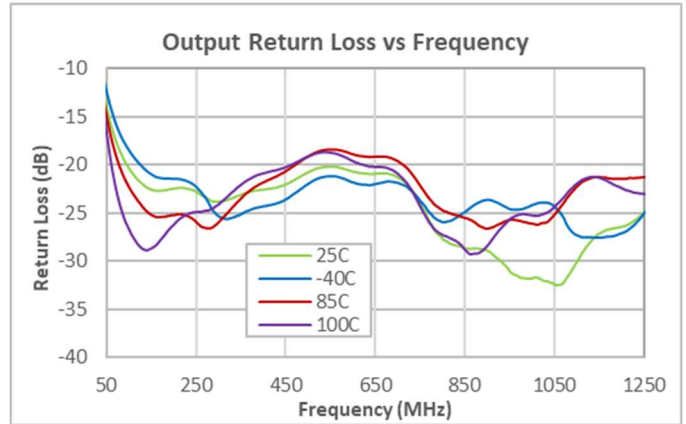
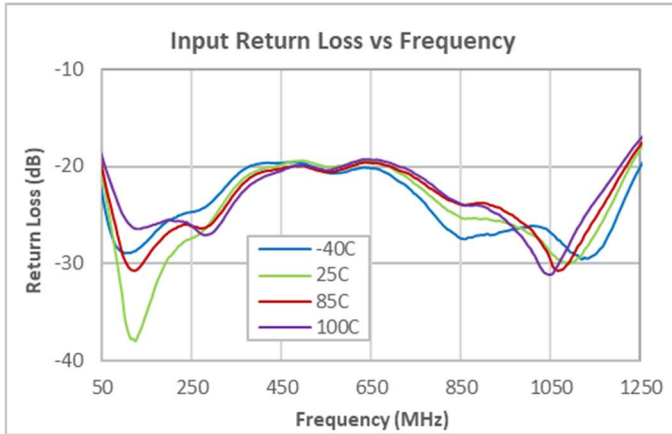


Typical Application Schematic; 24V





Performance Data 24V

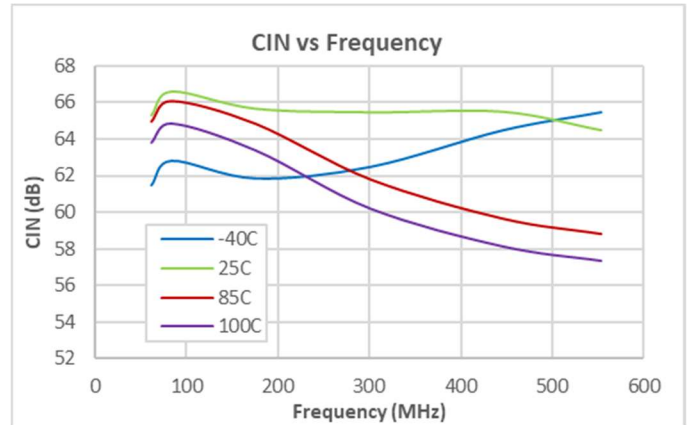
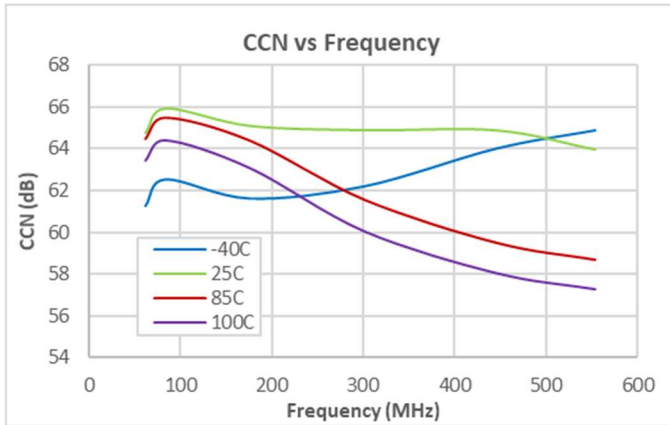
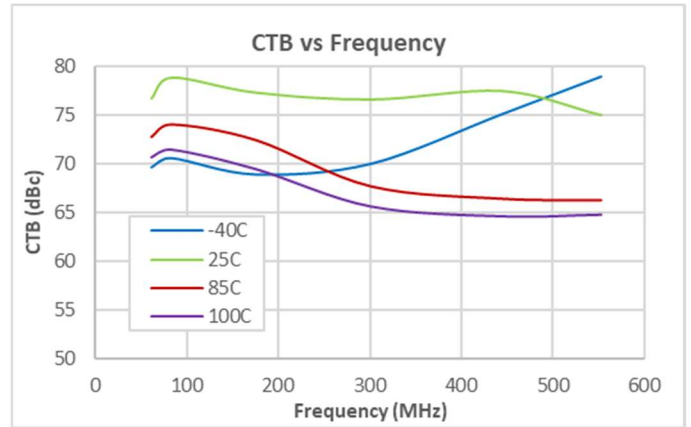
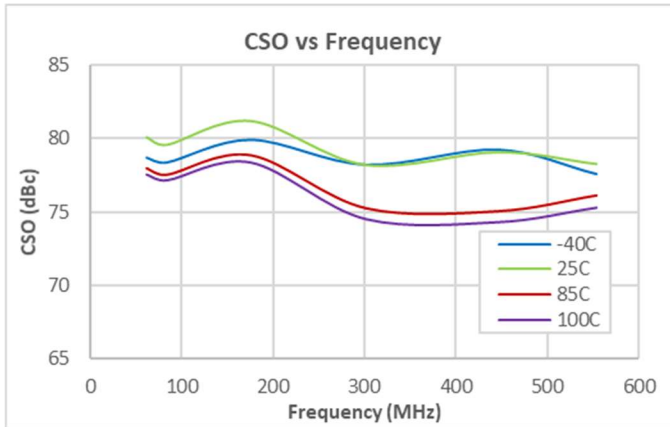
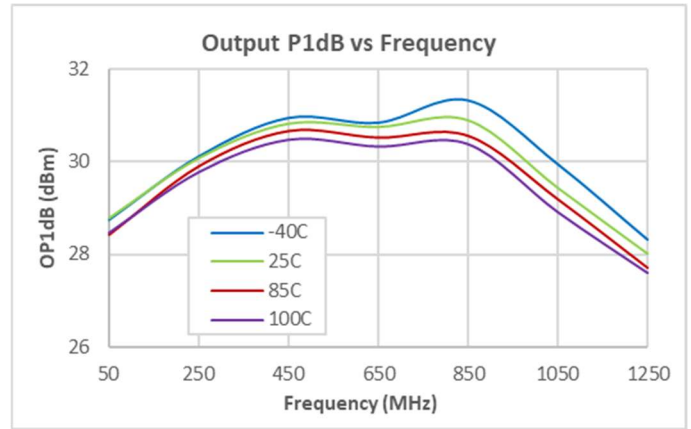
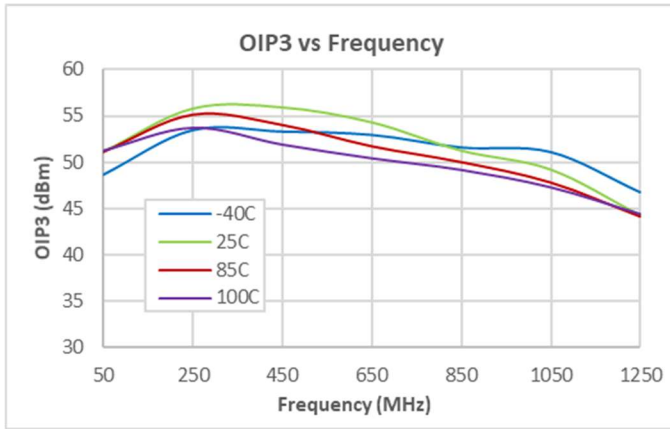


Test Conditions:

1. Test conditions unless otherwise noted:  $V_{DD} = +24V$ ,  $Z_o = 75\Omega$
2. OIP2: +15dBm per Tone.



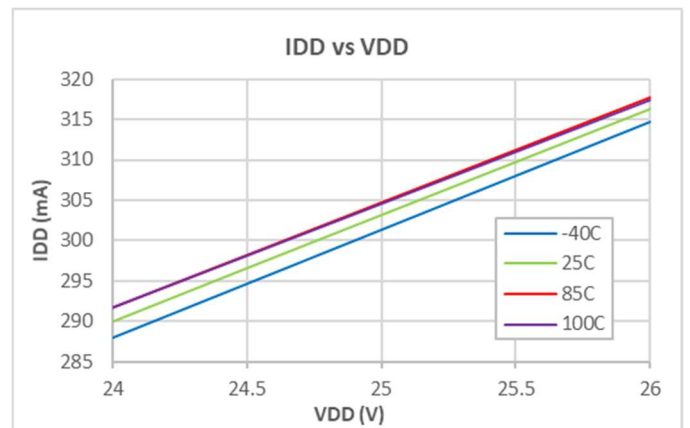
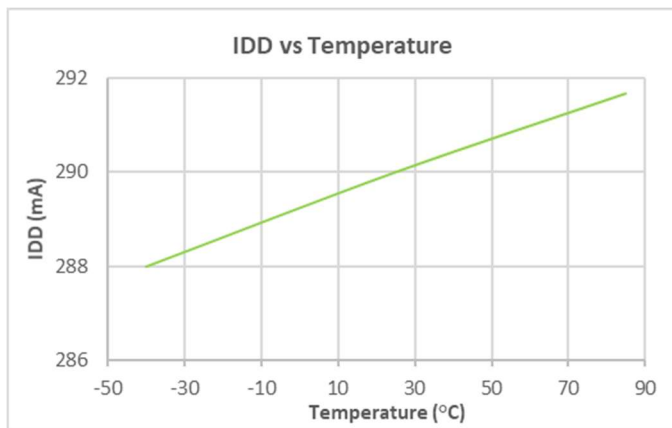
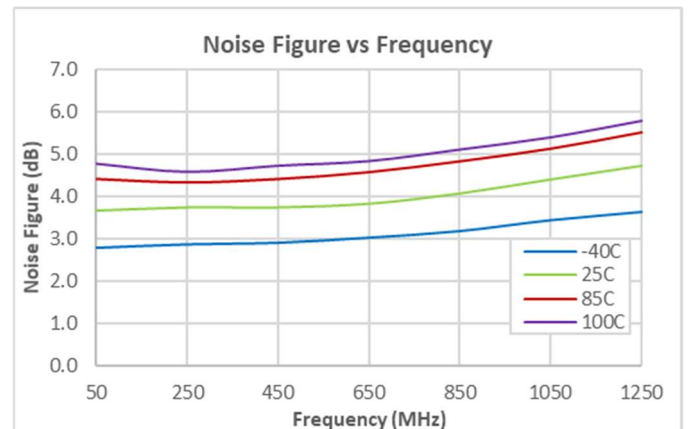
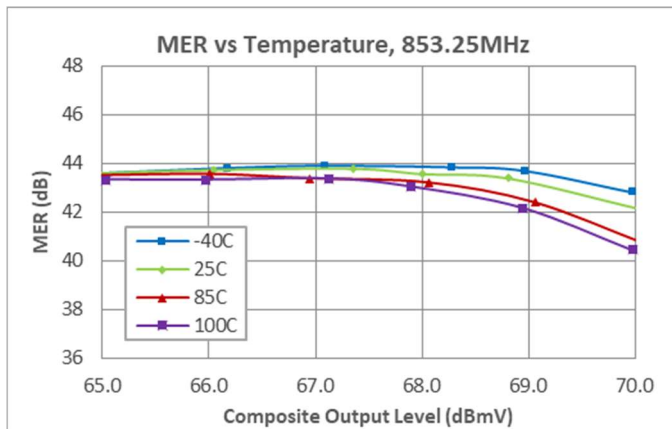
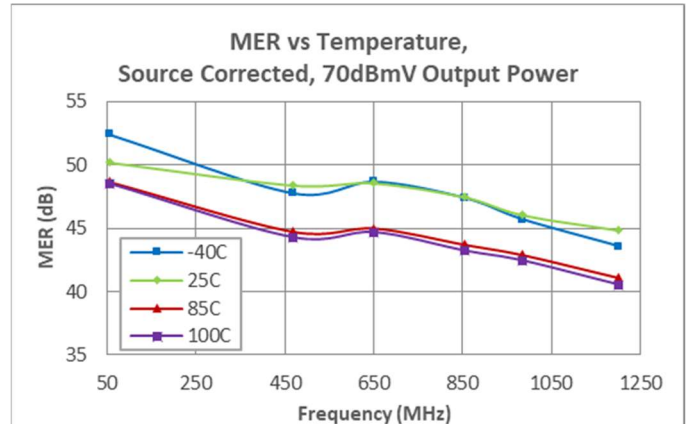
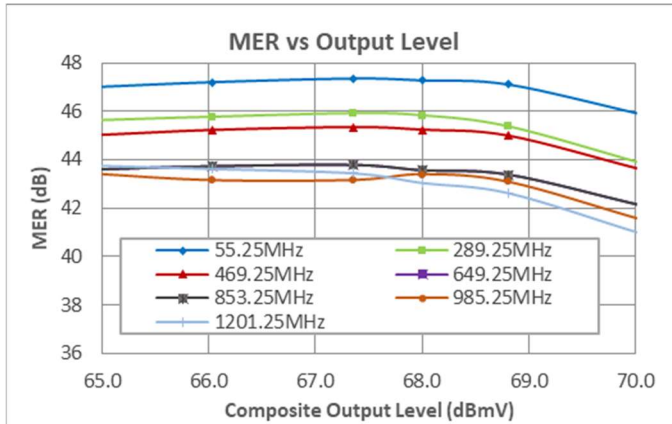
### Performance Data 24V



**Test Conditions:**

1. Test conditions unless otherwise noted:  $V_{DD} = +24V$ ,  $Z_o = 75\Omega$
2. OIP3: +15dBm per Tone.
3. CSO, CTB, CCN: 80 NTSC + 111 QAM (-6dB offset), 47dBmV/ch out, 0dB tilt

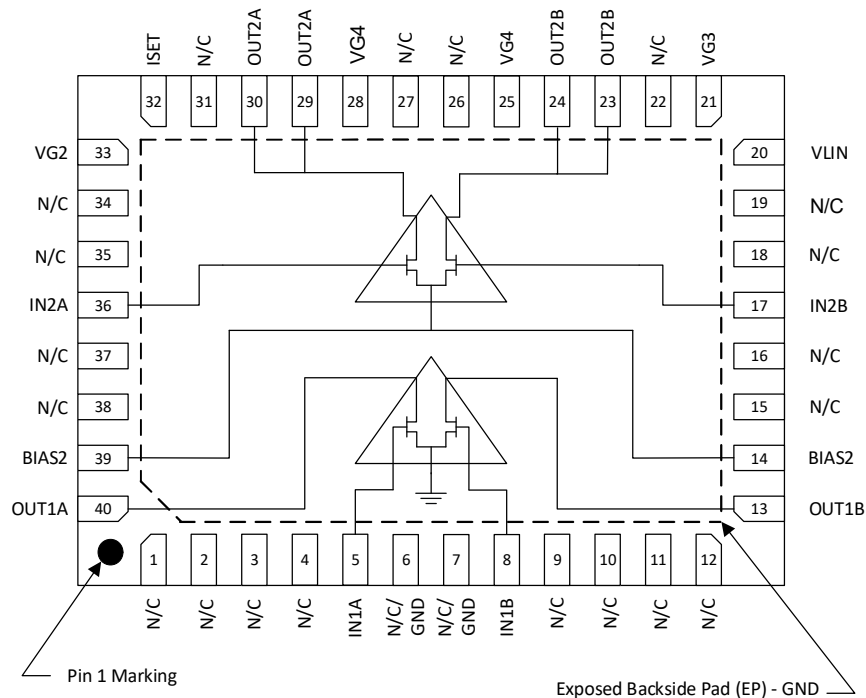
## Performance Data 24V



**Test Conditions:**

1. Test conditions unless otherwise noted:  $V_{DD} = +24V$ ,  $Z_o = 75\Omega$
2. MER: 190 QAM256 Channels Flat Tilt, 57-1215MHz, ITU-T J.83, Annex B

### Pin Configuration and Description



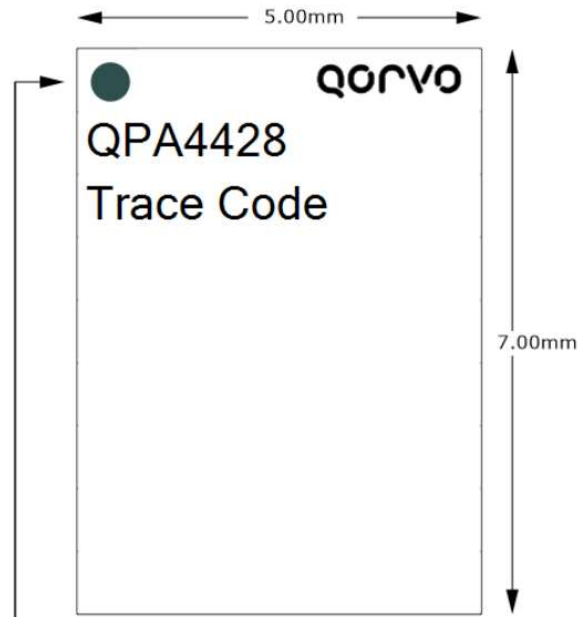
Top View

Pad No.	Label	Description
5	IN1A	RF input 1A
8	IN1B	RF input 1B
13	OUT1B	RF output 1B
14, 39	BIAS2	2nd Stage virtual ground
17	IN2B	RF input 2B
20	VLIN	Linearizer current set
21	VG3	VG3 adjust
23, 24	OUT2B	RF output 2B
25, 28	VG4	VG4 set
29, 30	OUT2A	RF output 2A
32	ISET	IDD set
33	VG2	VG2 adjust
36	IN2A	RF input 2A
40	OUT1A	RF output 1A
1, 2, 3, 4, 9, 10, 11, 12, 15, 16, 18, 19, 22, 26, 27, 31, 34, 35, 37, 38	N/C	No connect
6,7	N/C/GND	No connect or ground
Backside Paddle	GND	Ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.



## Package Marking

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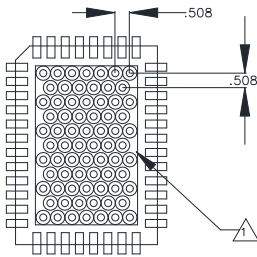
Pin 1 Indicator

Qorvo Logo - Use Qo5D

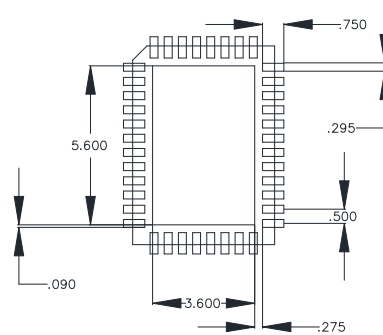
Trace Code to be assigned by SubCon

1. Dimension and tolerance formats conform to ASME Y14.4M-1994.
2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
3. Co-planarity applies to the exposed ground/thermal pad as well as the contact pins.
4. Package body length/width does not include plastic flash protrusion across mold parting line.

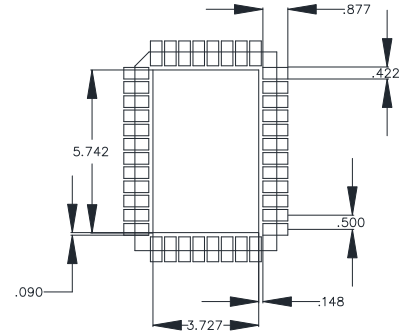
## Recommended Mounting Pattern



VIA PATTERN



LAND PATTERN



SOLDER MASK

NOTES:



GROUND/THERMAL VIAS AND MOUNTING HOLES ARE ESSENTIAL FOR THE PROPER DEVICE PERFORMANCE. DO NOT OMIT. VIAS SHOULD USE A .35mm (#80/.0135") DIAMETER DRILL AND HAVE A FINAL, PLATED THRU DIAMETER OF .25mm (.010").

2. TO ENSURE RELIABLE OPERATION, DEVICE GROUND PADDLE-TO-GROUND PAD SOLDER JOINT IS CRITICAL. NO SOLDER MASK ON BACKSIDE OF PCB IN HEAT SINK CONTACT AREA.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

- Ensure good package backside paddle solder attach for reliable operation and best electrical performance.
- Place mounting screws near the part to fasten a back-side heat sink.
- Do not apply solder mask to the back side of the PC board in the heat sink contact region.
- Ensure that the backside via region makes good physical contact with the heat sink.