QPB8896

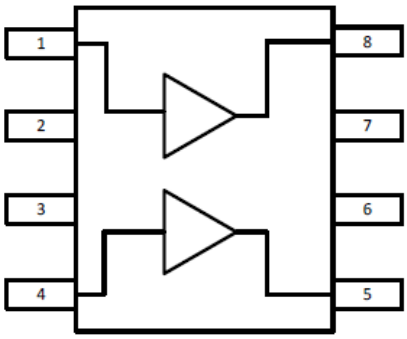
25 dB Balanced Return Path Amplifier (5 – 700 MHz)

Product Overview

The QPB8896 is a GaAs pHEMT RF balanced amplifier IC operating as return path amplifier capable of supporting FDx and DOCSIS 3.1 applications. This IC is designed to provide a low noise, high gain option for 5 – 700 MHz interface using a 5 V power supply to provide lower overall power dissipation. QPB8896 is in a convenient SOIC-8 package.

SOIC-8 with Exposed Pad

Functional Block Diagram



Functional Block Diagram

Top View

Key Features

- 5 MHz to 700 MHz Operation
- 5 V Operation
- High Gain: 25 dB Typical
- Low Noise Figure: 1.8 dB
- SOIC-8 Exposed Pad

Applications

- Head End CMTS Equipment
- Post Amp for Return Path Optical Receivers
- Full Duplex Upstream
- DOCSIS 3.1 Optical Nodes

Ordering Information

Part Number	Description
QPB8896SR	7" Reel with 100 pieces
QPB8896TR13	13" Reel with 2500 pieces
QPB8896PCK	5 – 700 MHz PCBA with 5 pc sample bag
QPB8896PCK-1	5 – 300 MHz PCBA with 5 pc sample bag

Absolute Maximum Ratings

Parameter	Rating
Supply Voltage (V_{DD})	+8 V
Supply Current (I_{DD})	360 mA
Maximum CW Input Power for VDD = 5 V	+1 dBm
Operating Temperature Range	-40 to +85 °C
Storage Temperature Range	−40 to +150 °C
Maximum Junction Temperature	+160 °C

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extende application of Absolute Maximum Rating conditions to the device may reduce device reliability.

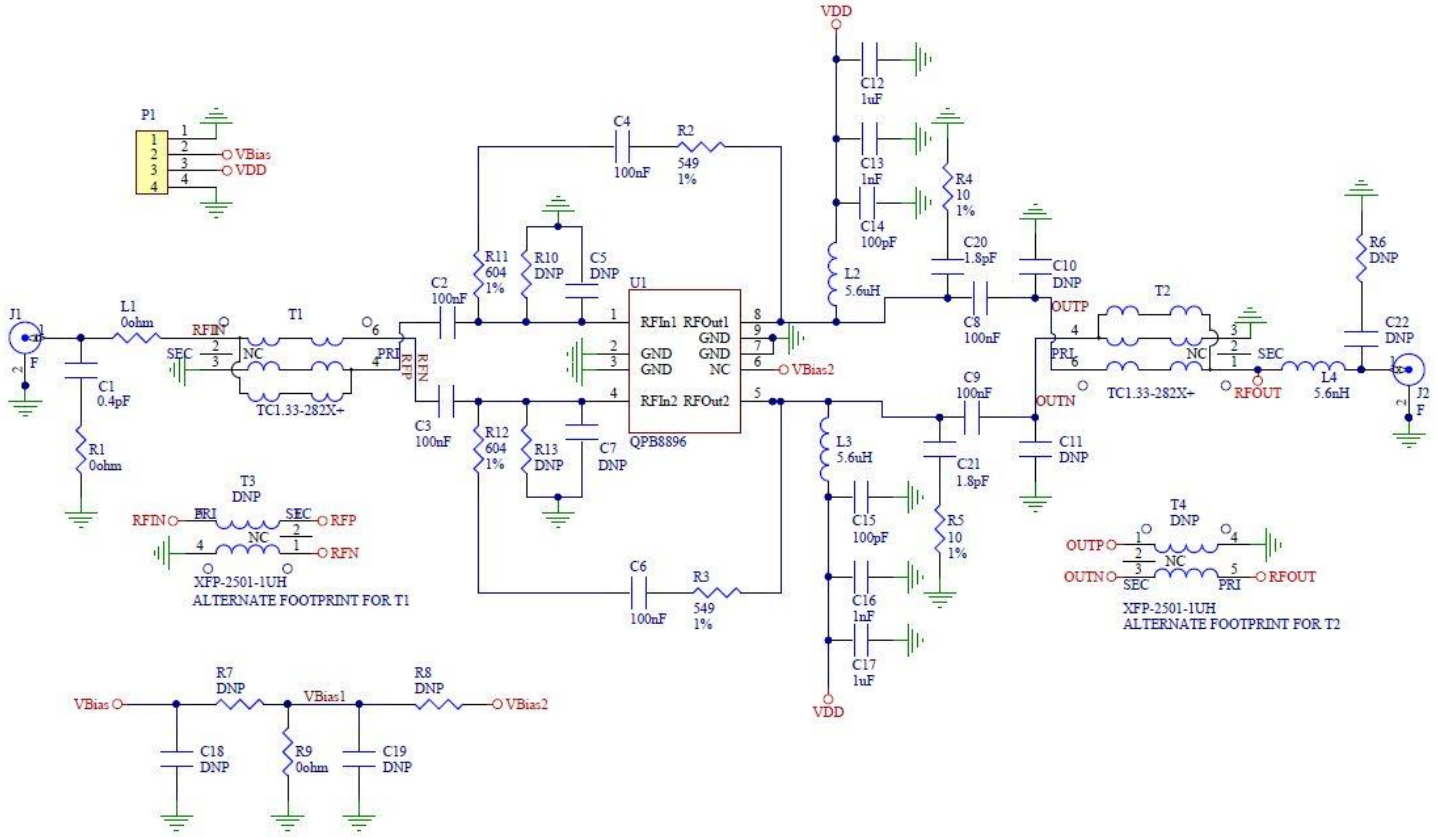
Electrical Specifications

Parameter	Condition [1]	Min	Typ	Max	Unit
Supply Voltage (V_{DD})			5		V
Supply Current (I_{DD})			275		mA
Frequency Range		5		700	MHz
Gain	Full Bandwidth		25.0		dB
Gain Flatness	Max. deviation from line using least squares fit from 5 to 700 MHz		±0.5		dB
Gain Tilt	Gain (700 MHz) – Gain (5 MHz)		-0.1		dB
Input Return Loss	5 MHz		33		dB
	125 MHz		26		dB
	300 MHz		20		dB
	700 MHz		16		dB
Output Return Loss	5 MHz		20		dB
	125 MHz		22		dB
	300 MHz		18		dB
	700 MHz		16.5		dB
Reverse Isolation			30		dB
Noise Figure	(includes balun loss)		1.8		dB
ACLR	Pout = 62 dBmV, 5 – 195 MHz OFDM w/ 9.6 MHz exclusion band.		59.7		dB
DTO/DSO	f1=13 MHz, f2=19 MHz 58.75 dBmV/tone		-60		dBc
OIP2	5 – 700 MHz 2-Tone, 6 MHz spacing 3 dBm/tone		70		dBm
OIP3	5 – 700 MHz 2-Tone, 6 MHz spacing 5 dBm/tone		38		dBm
Output P1dB	Full Band		22.6		dBm
Thermal Resistance	Θ_{JC}		23		˚C/W

Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +5 V, 75 Ω system

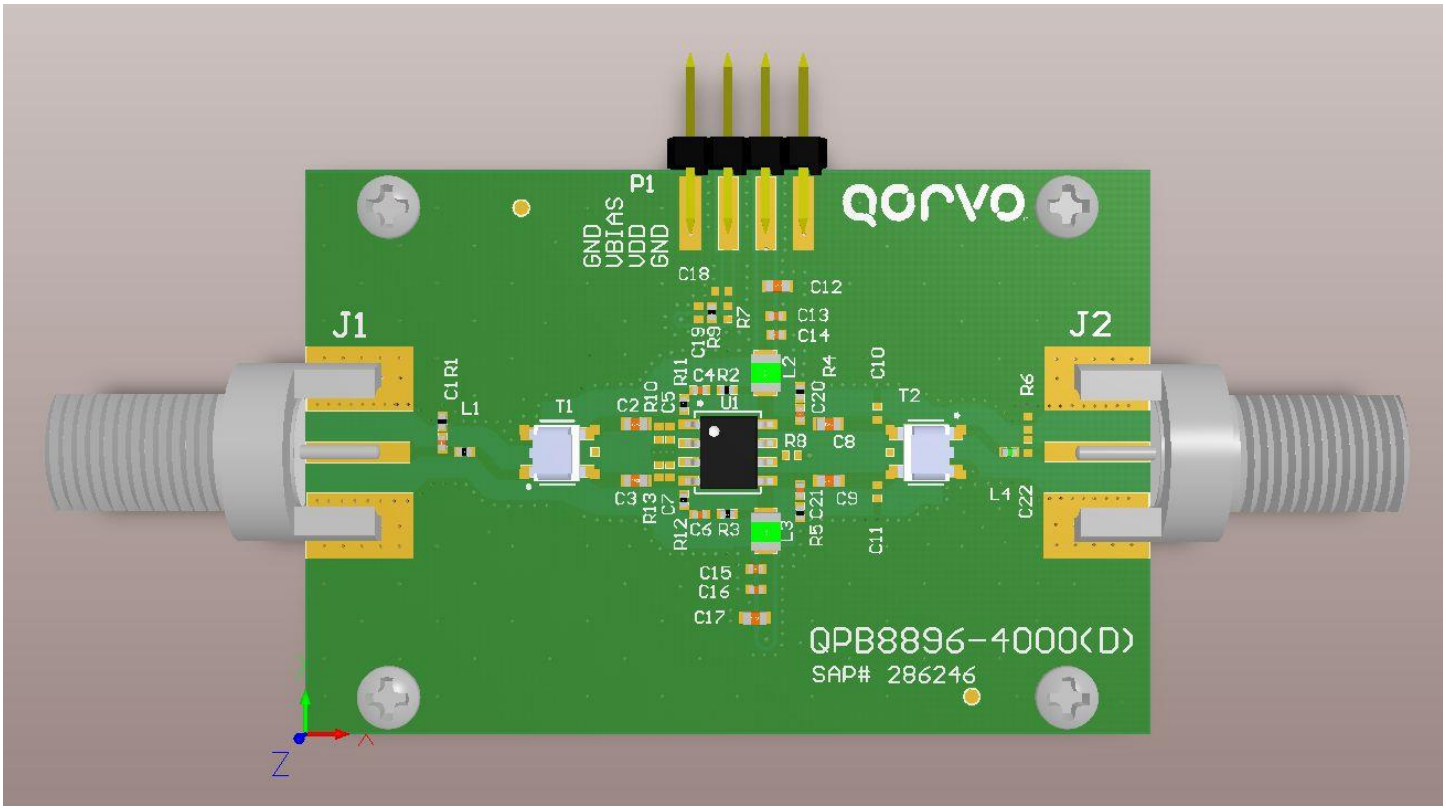
Evaluation Board Schematic for QPB8896-4000 (5 – 700 MHz)



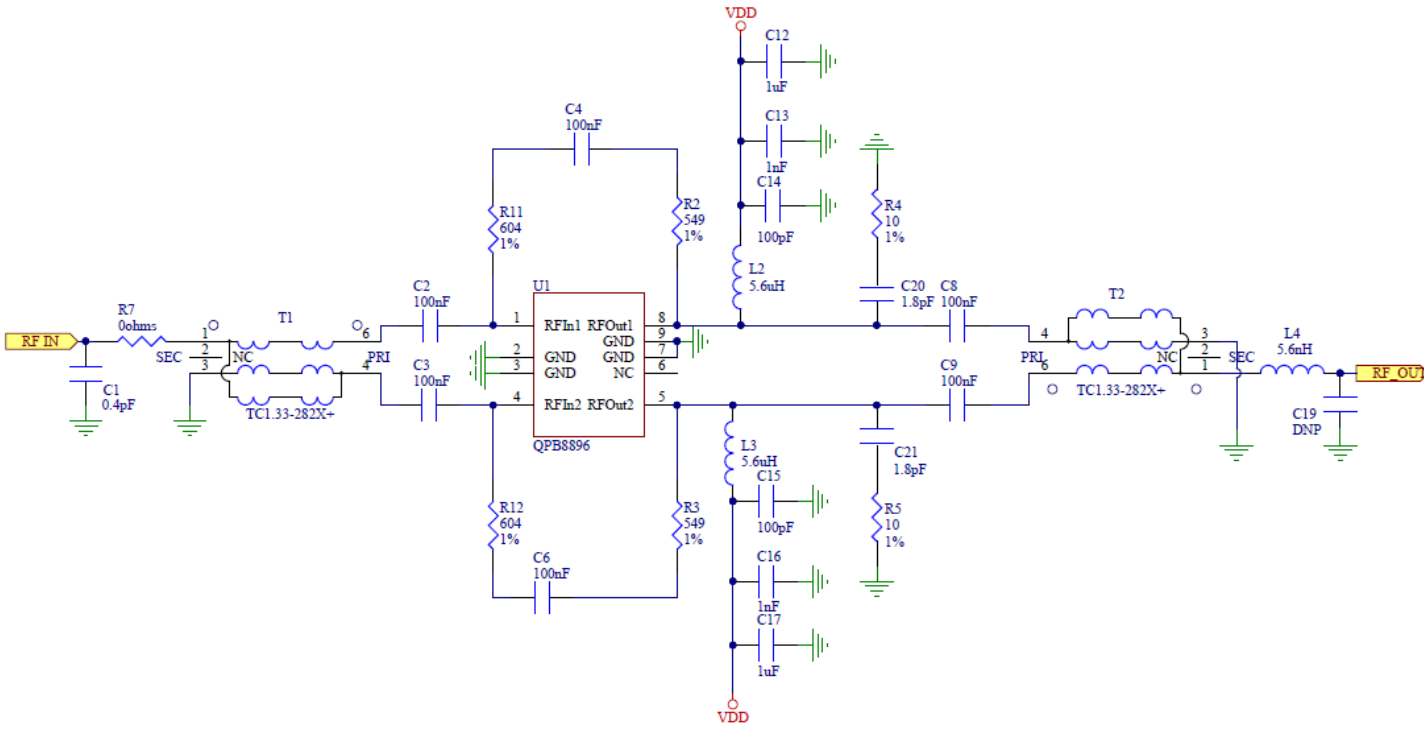
Evaluation Board Bill of Materials for QPB8896-4000 (5 – 700 MHz)

Reference Designator	Description	Manufacturer	Part Number
PCB	QPB8896−4000	Viasystems	QPB8896-4000
U1	Balanced Return Path Amplifier, 5-700 MHz	Qorvo	QPB8896SB
C1	CAP, 0.4 pF, +/-0.05 pF, 50 V, C0G, 0402	Murata Electronics	GRM1555C1HR40WA01D
C13, C16	CAP, 1000 pF, 10 %, 50 V, X7R, 0402	Taiyo Yuden	RM UMK105BJ102KV-F
C4, C6	CAP, 0.1 uF, 10 %, 16 V, X7R, 0402	Murata Electronics	GRM155R71C104KA88D
C2, C3, C8, C9	CAP, 0.1 uF, 10 %, 16 V, X7R, 0603	Murata Electronics	GRM188R71C104KA01D
C20, C21	CAP, 1.8 pF, +/-0.1 pF, 50 V, C0G, 0402	Murata Electronics	GRM1555C1H1R8BA01E
C12, C17	CAP, 1 uF, 10 %, 16 V, X7R, 0603	Murata Electronics	GRM188R71C105KA12D
C14, C15	CAP, 100 pF, 5 %, 50 V, C0G, 0402	Taiyo Yuden	RM UMK105CG101JV-F
L2, L3	IND, 5.6 uH, 5 %, W/W, 1008	Coilcraft, Inc.	1008LS-562XJLC
R2, R3	RES, 549 Ω, 1 %, 1/10 W, 0402	Kamaya, Inc	RMC1/16SK5490FTH
R11, R12	RES, 604 Ω, 1 %, 1/10 W, 0402	Kamaya, Inc	RMC1/16SK6040FTH
R4. R5	RES, 10 Ω, 1 %, 1/16 W, 0402	Panasonic Industrial Devices	ERJ-2RKF10R0X
R1, R9, L1	RES, 0 Ω, 0402	Kamaya, Inc	RMC1/16SJPTH
L4	IND, 5.6 nH, +/-0.1 nH, T/F, 0402	Murata Electronics	LQP15MN5N6B02D
T1, T2	XFMR, 5-2800 MHz, 100-75 Ω	MiniCircuits	TC1.33-282X+
P1	CONN, HDR, ST, FRCTN LOCK, 4-PIN	Molex	22-23-2041
J1, J2	CONN, F FEM EDGE MOUNT, 75 Ω, 0.068"	Millimeter Wave, LLC	MW-846-C-DD-75
M1	HEATSINK BLOCK, 1.5 X 2.0 IN	Shenzhen Minxingda Automation	EEF-105441
S1-S4	SCREW, 2-56X3/16", SOCKET HEAD	McMaster-Carr Supply Co.	92196A076

Evaluation Board Assembly Drawing for QPB8896-4000 (5 – 700 MHz)



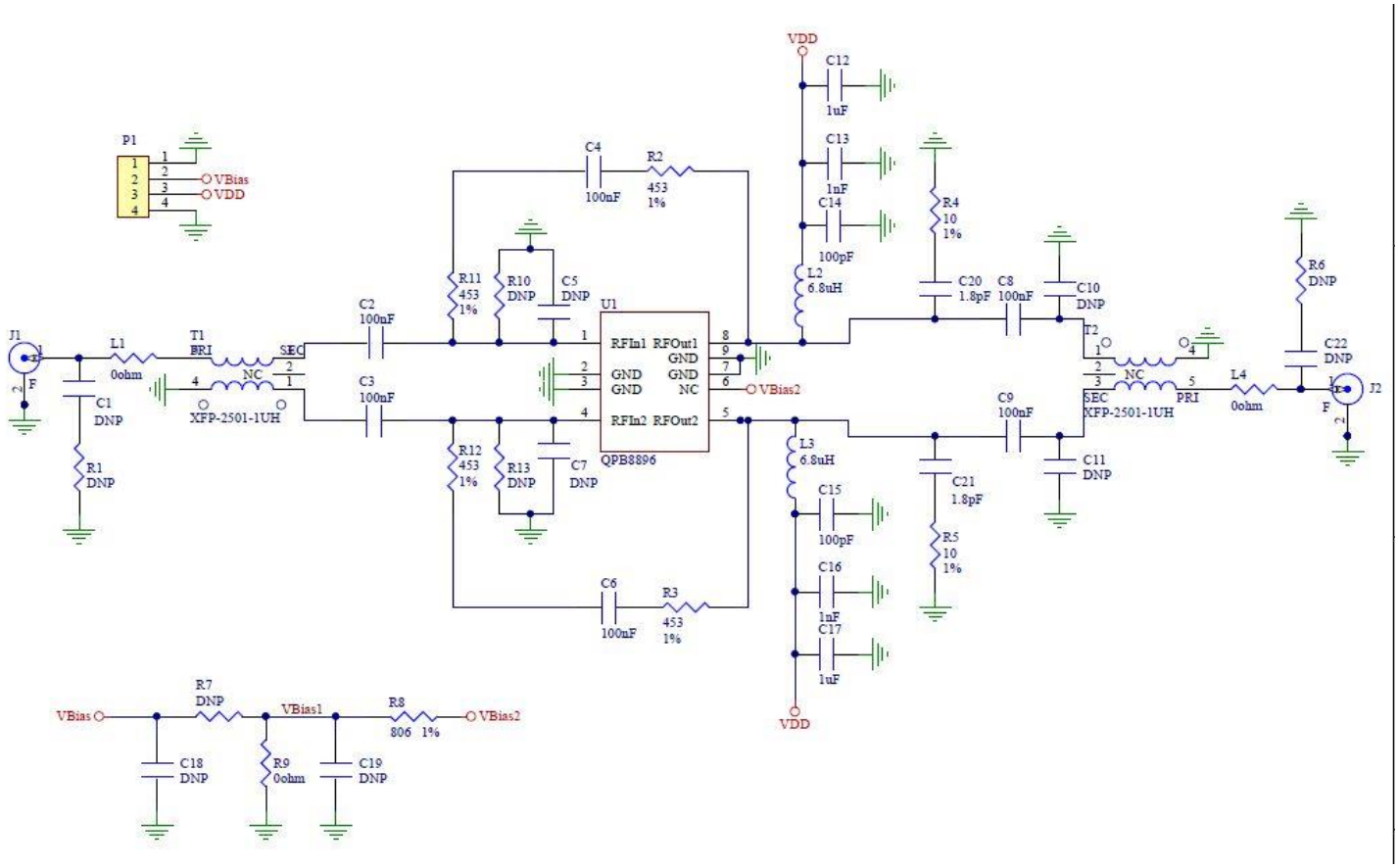
Typical Applications Schematic (5 – 700 MHz)



Notes:

1. C1-R7 tune to optimize input return loss.
2. L4-C19 tune to optimize output return loss.
3. Feedback R11/R2/C4 and R12/R3/C6 can be adjusted to balance gain flatness versus return loss and IMD performance.

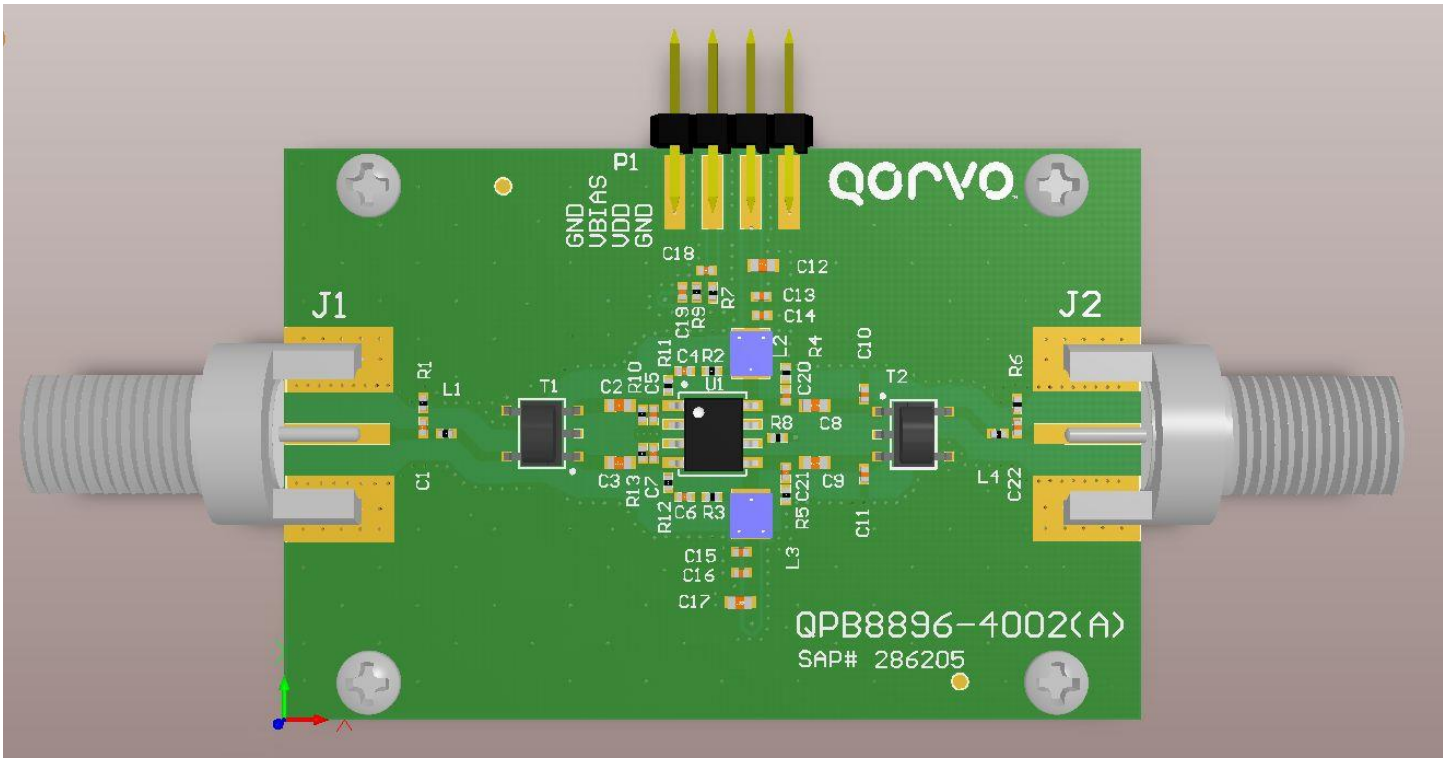
Evaluation Board Schematic for QPB8896-4002 (5 – 300 MHz)



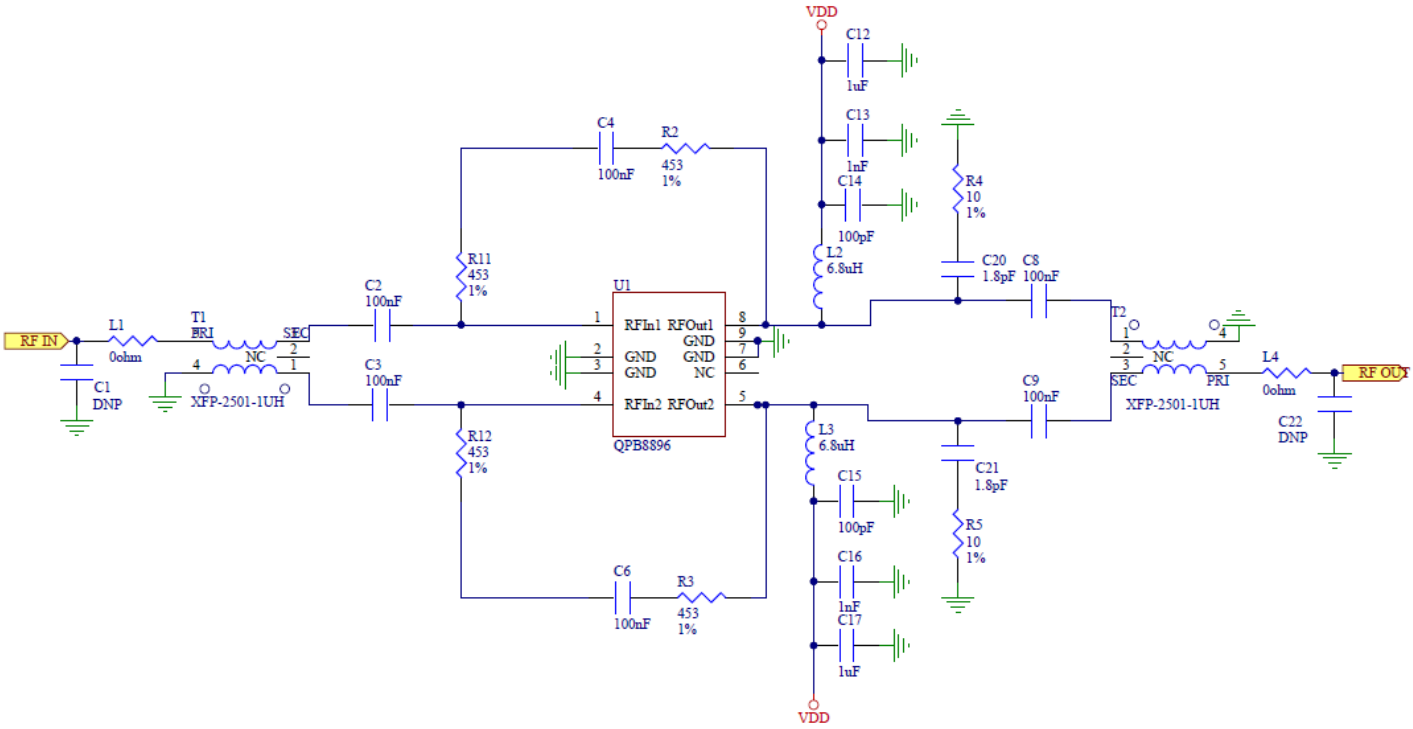
Evaluation Board Bill of Materials for QPB8896-4002 (5 – 300 MHz)

Reference Designator	Description	Manufacturer	Part Number
PCB	QPB8896−4002	Viasystems	QPB8896-4002
U1	Balanced Return Path Amplifier, 5-700 MHz	Qorvo	QPB8896SB
C13, C16	CAP, 1000 pF, 10 %, 50 V, X7R, 0402	Taiyo Yuden	RM UMK105BJ102KV-F
C4, C6	CAP, 0.1 uF, 10 %, 16 V, X7R, 0402	Murata Electronics	GRM155R71C104KA88D
C2, C3, C8, C9	CAP, 0.1 uF, 10 %, 16 V, X7R, 0603	Murata Electronics	GRM188R71C104KA01D
C20, C21	CAP, 1.8 pF, +/-0.1 pF, 50 V, C0G, 0402	Murata Electronics	GRM1555C1H1R8BA01E
C12, C17	CAP, 1 uF, 10 %, 16 V, X7R, 0603	Murata Electronics	GRM188R71C105KA12D
C14, C15	CAP, 100 pF, 5 %, 50 V, C0G, 0402	Taiyo Yuden	RM UMK105CG101JV-F
L2, L3	IND, 6.8 uH, 5 %, W/W, 1008	Coilcraft, Inc.	1008LS-682XJLC
R2, R3, R11, R12	RES, 453 Ω, 1 %, 1/10 W, 0402	Panasonic	ERJ-2RKF4530X
R4. R5	RES, 10 Ω, 1 %, 1/16 W, 0402	Panasonic Industrial Devices	ERJ-2RKF10R0X
R9, L1, L4	RES, 0 Ω, 0402	Kamaya, Inc	RMC1/16SJPTH
R8	RES, 806 Ω, 1 %, 1/10 W, 0402	Panasonic Industrial Devices	ERJ-2RKF8060X
T1, T2	BALUN, 1:1, 1-2500 MHz, 75 Ω, SMD	MiniRF	XFP-2501-1UH
P1	CONN, HDR, ST, FRCTN LOCK, 4-PIN	Molex	22-23-2041
J1, J2	CONN, F FEM EDGE MOUNT, 75 Ω, 0.068"	Millimeter Wave , LLC	MW-846-C-DD-75
M1	HEATSINK BLOCK, 1.5 X 2.0 IN	Shenzhen Minxingda Automation	EEF-105441
S1-S4	SCREW, 2-56 X 3/16", SOCKET HEAD	McMaster-Carr Supply Co.	92196A076
C1, C5, C7, C10, C11, C18, C19, C22, R1, R6, R7, R10, R13	DNP		

Evaluation Board Assembly Drawing for QPB8896-4002 (5 – 300 MHz)



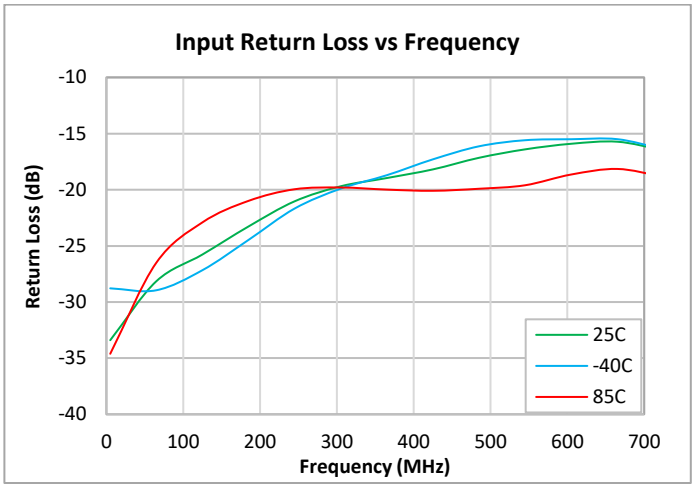
Typical Applications Schematic (5 – 300 MHz)

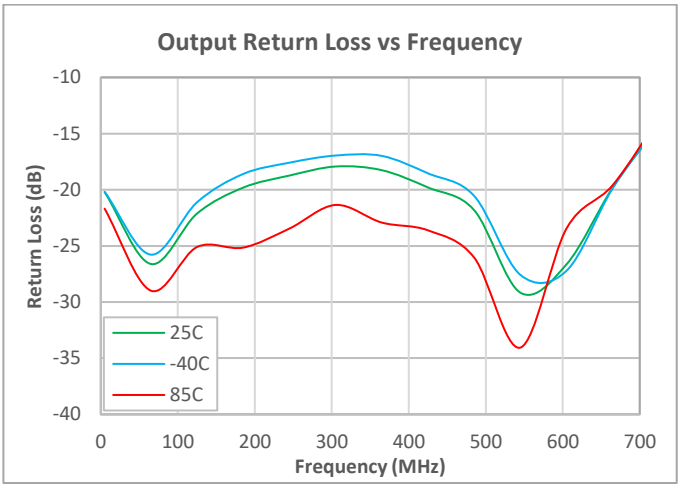


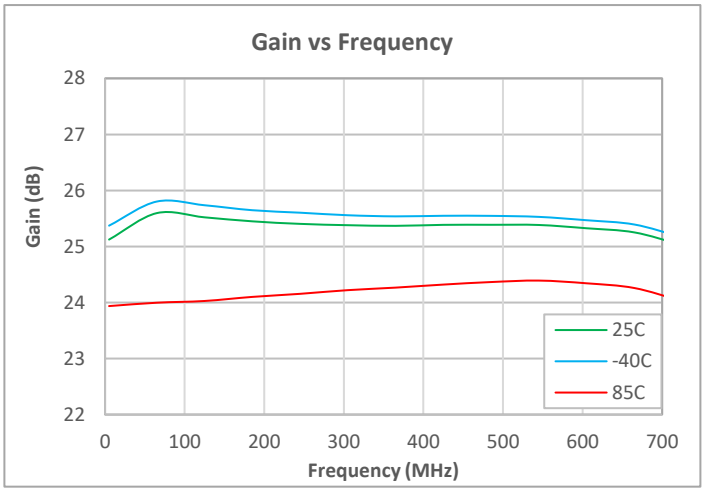
Notes:

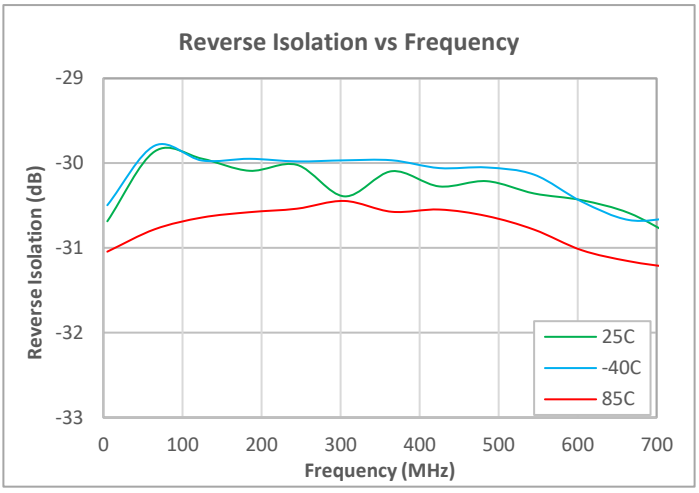
1. C1-L1 tune to optimize input return loss.
2. L4-C22 tune to optimize output return loss.
3. Feedback R11/R2/C4 and R12/R3/C6 can be adjusted to balance gain flatness versus return loss and IMD performance.
4. Lower insertion loss transformers help reduce noise figure ≤ 1.1 dB.

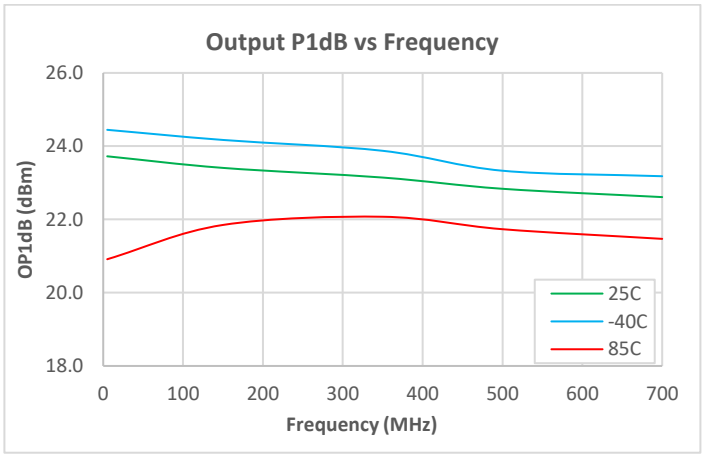
Performance Data (5 – 700 MHz)

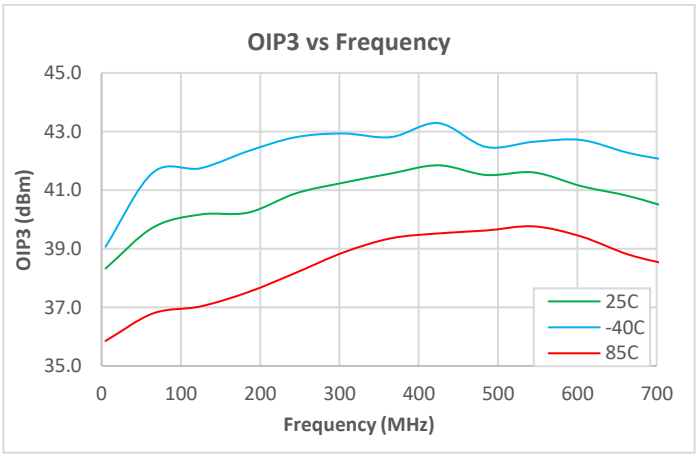








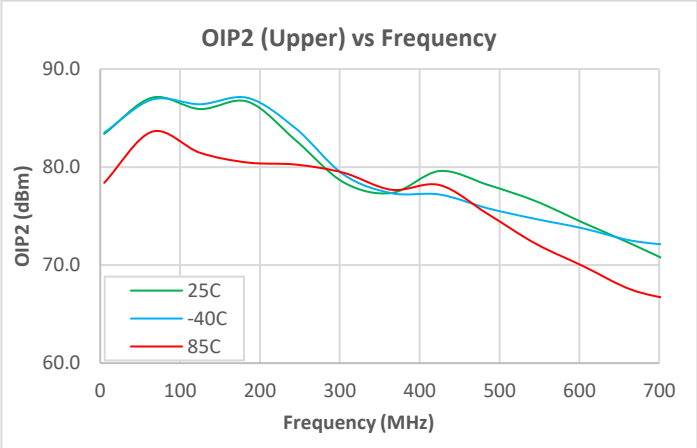


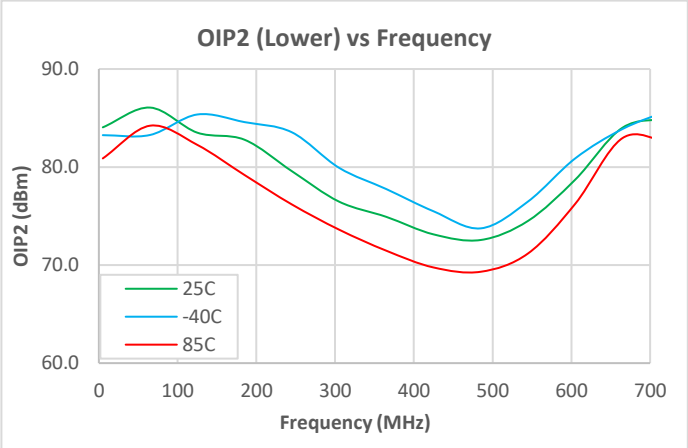


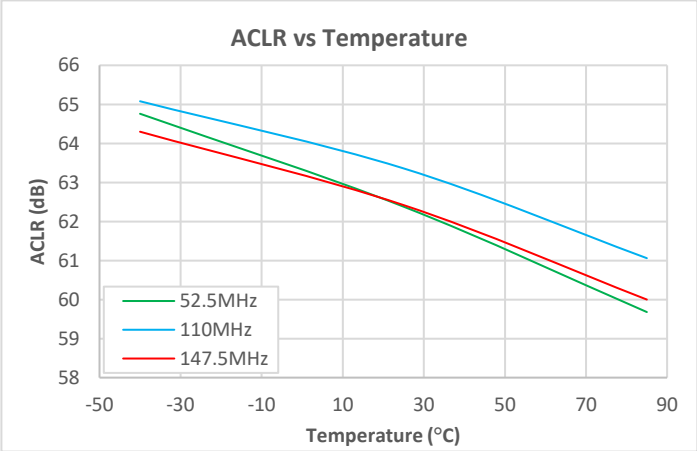
Notes:

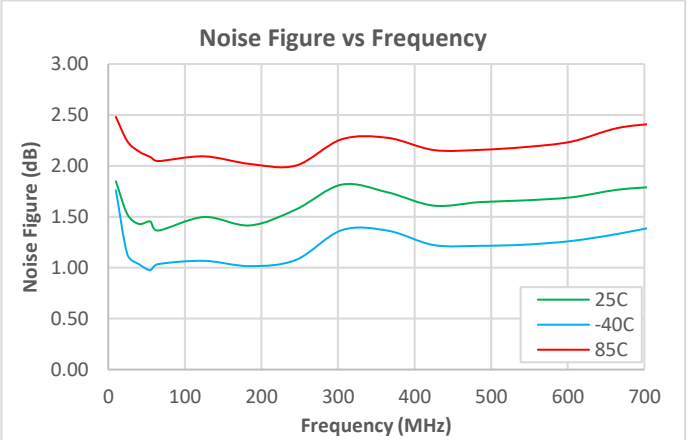
(1) OIP3: +5 dBm/tone, 6 MHz spacing

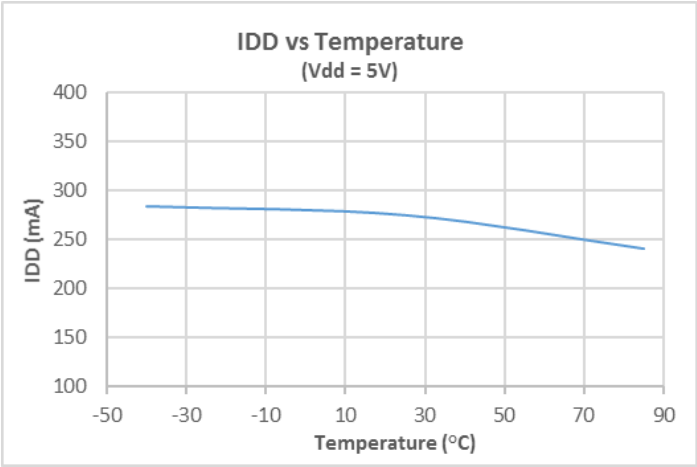
Performance Data (5 – 700 MHz)

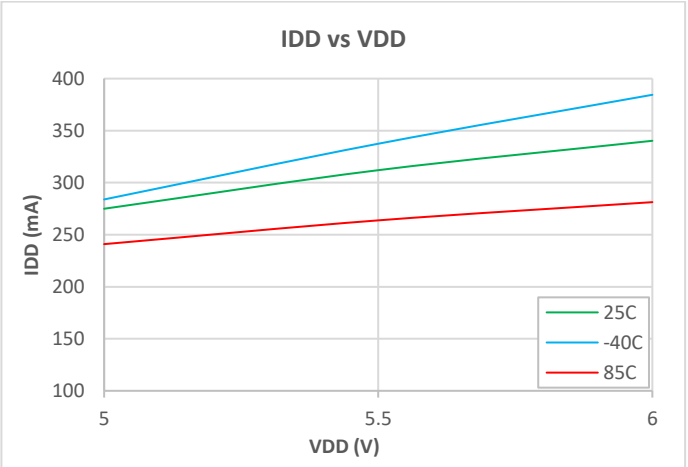








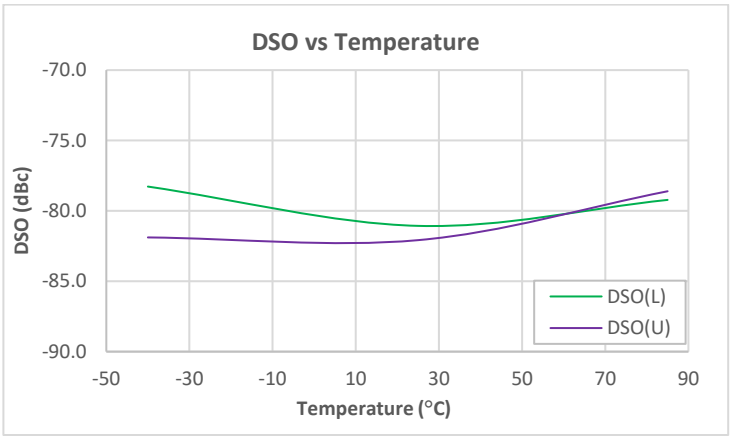


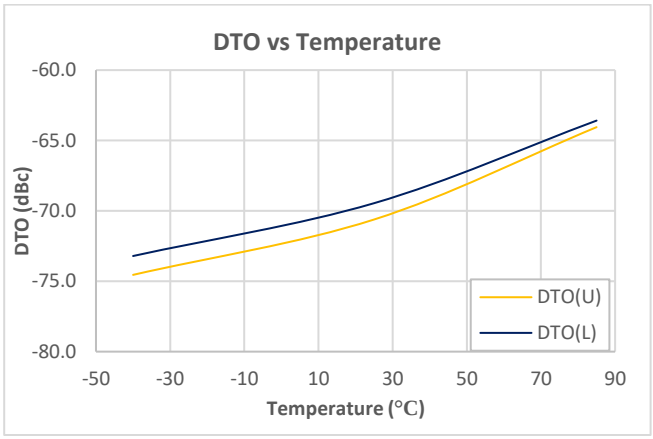


Notes:

(1) OIP2: 3 dBm/tone, 6 MHz spacing
(2) ACLR: Pout = 62 dBmV, 5-195 MHz OFDM w/ 9.6 MHz exclusion band.
(3) IDD vs VDD, -10 dBm input power at 125 MHz
(4) IDD vs Temperature, -10 dBm input power at 125 MHz, VDD = 5 V.

Performance Data (5 – 700 MHz)





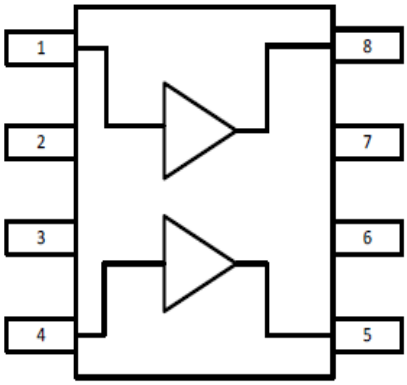
Notes:

Notes:

(1) DSO/DTO: f1=13 MHz, f2=19 MHz 62 dBmV per tone

(1)

Pin Configuration and Description

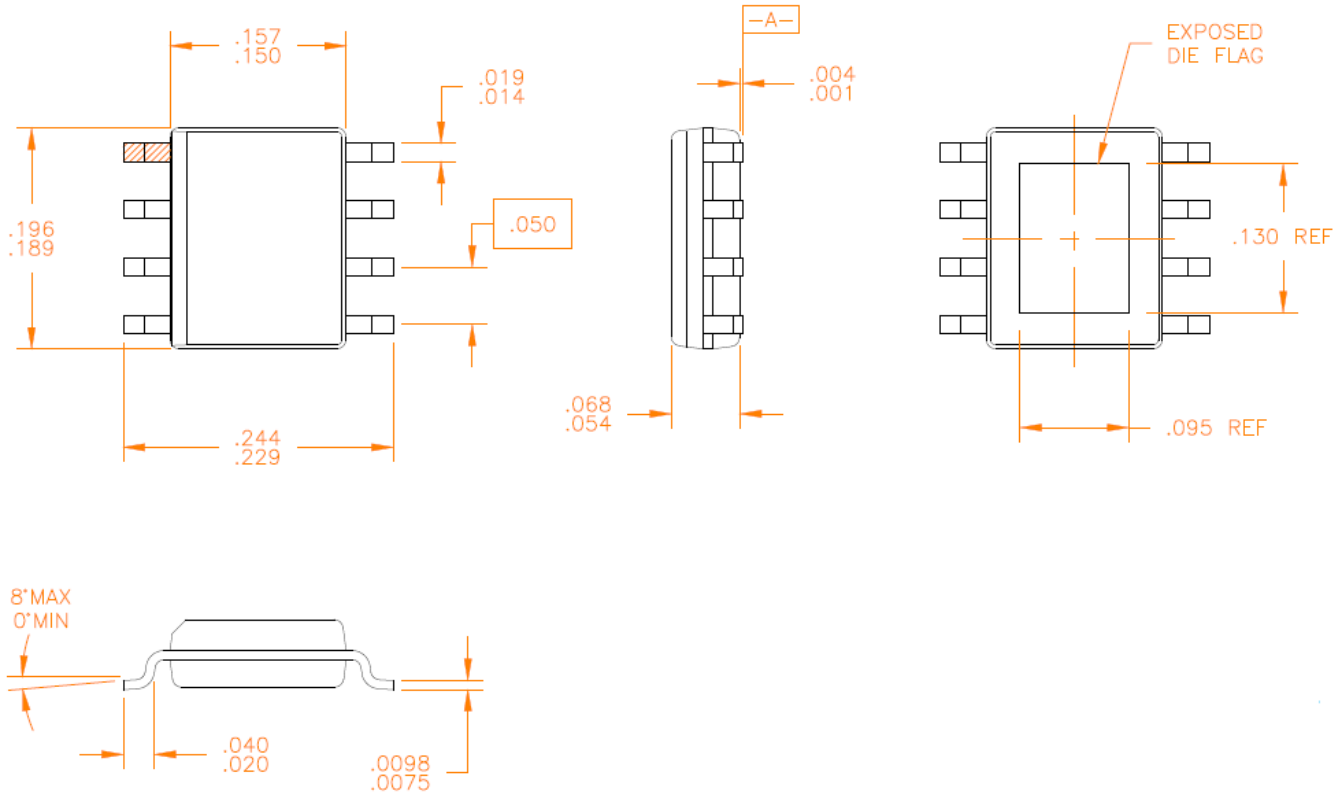


Functional Block Diagram

Top View

Pin Number	Label	Description
1	RFIN1	RF Input for plus side of amplifier
2	GND	Internally Not Connected
3	GND	Internally Not Connected
4	RFIN2	RF Input for minus side of amplifier
5	RFOUT2	RF Output for minus side of amplifier
6	NC	Not Connected
7	GND	Internally Not Connected
8	RFOUT1	RF Output for plus side of amplifier
Backside Paddle	GND	Ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

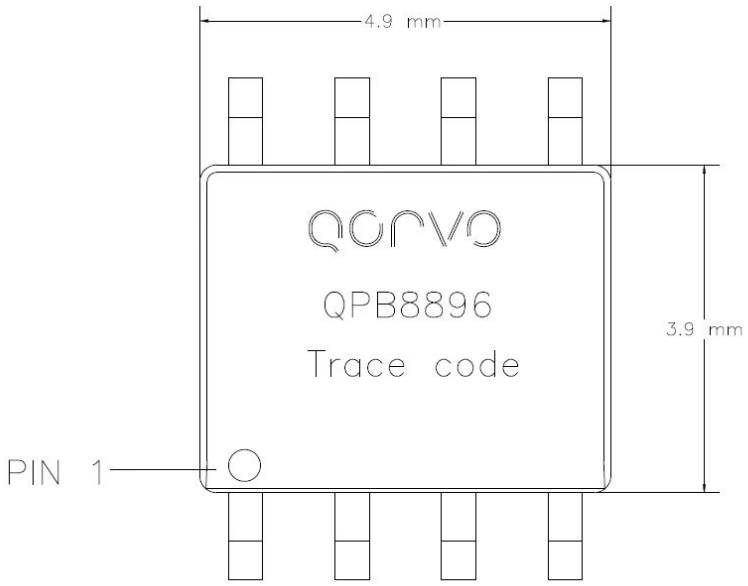
Package Outline



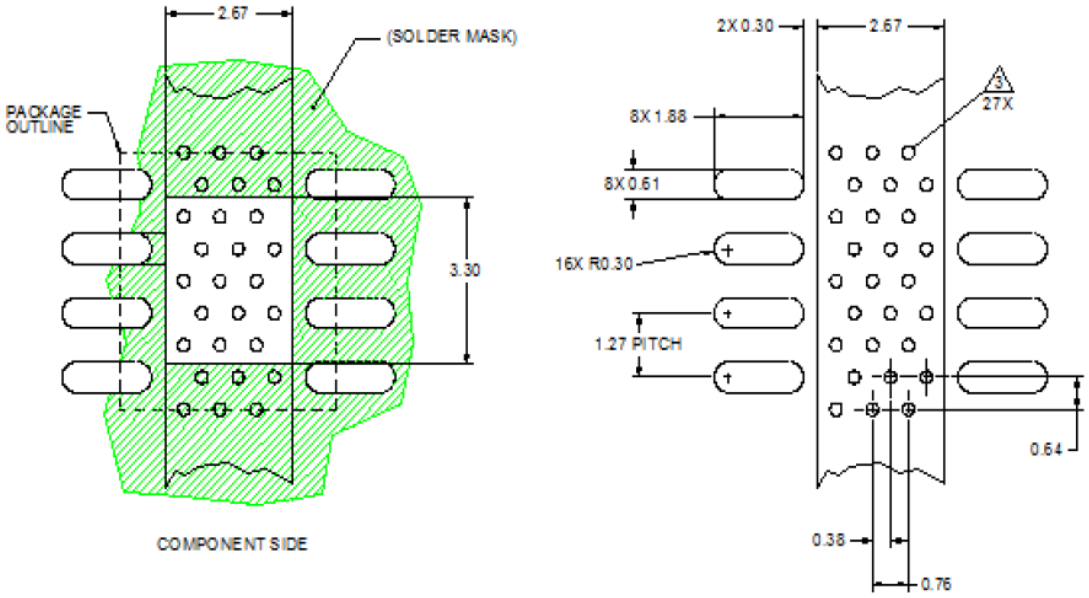
Notes:

1. Dimensions in millimeters

Package Marking



Recommended Mounting Pattern



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layers
3. Vias are required under the backside paddle for proper RF/DC grounding and thermal dissipation. We recommend a 0.35 mm (#80/0.135") diameter bit for drilling via holes and a final plated through diameter of 0.25 mm (0.010").
4. Ensure good backside paddle solder attach for reliable operation and best electrical performance.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	1A (250V)	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	C3 (1000V)	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	MSL2	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin/lead (245 °C max. reflow temp.) soldering processes.
Solder profiles available upon request.

Contact plating: Matte Sn

RoHS Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Tel: **1-844-890-8163**

Web: www.qorvo.com

Email: customer.support@qorvo.com

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