QPA7489A

DC – 3500 MHz Cascadable SiGe HBT Amplifier

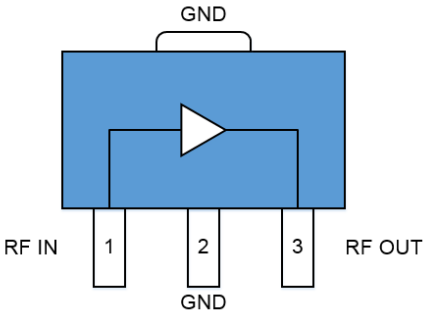
Product Overview

The QPA7489A is a high performance SiGe HBT MMIC amplifier. A Darlington configuration provides high FT and excellent thermal performance. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in higher suppression of intermodulation products.

The QPA7489A may be operated from a variety of supply voltages by using a voltage dropping resistor. Two DC-blocking capacitors, bypass capacitors and an optional RF choke complete the circuit required for operation of this internally matched 50 ohm device.

The QPA7489A is assembled in an industry standard SOT-89 package that is lead-free and RoHS-compliant.

Functional Block Diagram



Top View

3 Lead SOT-89 Package

Key Features

- DC to 3500 MHz Operation
- Single Positive Voltage Supply
- Cascadable 50 Ω
- Gain: 17.7 dB at 1950 MHz
- Output IP3: +37.7 dBm typical at 850 MHz
- Noise Figure: 3.2 dB Typical at 1950 MHz
- Low Thermal Resistance SOT-89 Package
- Lead-free / RoHS-Compliant

Applications

- Cellular, PCS, GSM, UMTS
- Power Amplifier Driver
- IF/RF Buffer Amplifier
- Wireless Data, Satellite

Ordering Information

Part No.	Description
QPA7489ASQ	25 Piece Sample Bag
QPA7489ASR	100 Pieces on 7” Reel
QPA7489ATR13	3000 pieces on a 13” reel
QPA7489APCK401	850 MHz, EVB with 5 Piece Sample Bag

Absolute Maximum Ratings

Parameter	Rating
Storage Temp	−55 to +150 °C
Device Voltage (V_D)	+7 V
Device Current (I_D)	170 mA
RF Input Power (Z_L = 50 Ω)	+16 dBm
RF Input Power (Z_L = 10:1 VSWR)*	+2 dBm

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.

Bias Conditions should also satisfy the following expression:
$I_D \times V_D < (T_{JUNCTION} - T_{LEAD}) / R_{TH}$

* Take into account out of band load VSWR presented by devices such a SAW filters to determine maximum RF input power. Reflected harmonic levels in saturation are significant.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Operating Temperature	−40		+85	°C
Junction Temperature (T_J)			+125	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

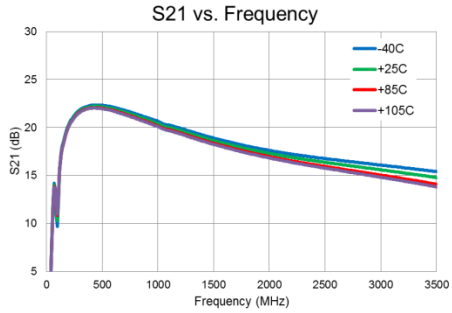
Electrical Specifications

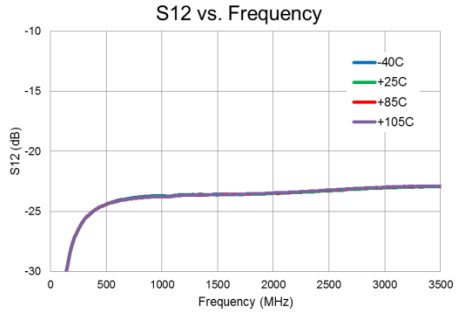
Parameter	Conditions	Min	Typ	Max	Units
Small Signal Gain, S21	850 MHz		21.2		dB
	1950 MHz		17.7		
	2400 MHz		16.9		
Output Power at 1dB Compression	850 MHz		+22.1		dBm
	1950 MHz		+21.1		
	2400 MHz		+20.1		
Output Third Intercept Point	500 MHz		+39.1		dBm
	850 MHz		+37.7		
	1950 MHz		+34.1		
	2400 MHz		+32.5		
Input Return Loss, S11	850 MHz		10.5		dB
	1950 MHz		12.3		
	2400 MHz		14.9		
Output Return Loss, S22	850 MHz		11.8		dB
	1950 MHz		6.2		
	2400 MHz		6.3		
Reverse Isolation, S12	850 MHz		23.8		dB
	1950 MHz		23.5		
	2400 MHz		23.3		
Noise Figure	850 MHz		2.8		dB
	1950 MHz		3.2		
	2400 MHz		3.4		
Device Operating Voltage		+4.7	+5.0	+5.3	V
Device Operating Current			118		mA
Thermal Resistance			45		°C/W

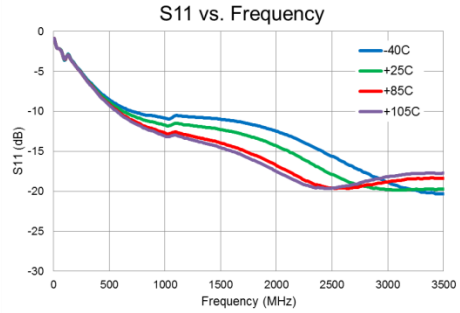
Notes:
1. Test conditions unless otherwise noted: V_S = +8 V, R_{BIAS} =26 Ω, I_D = 118 mA Typ., OIP3 Tone Spacing = 1 MHz, P_{OUT} per tone = 0 dBm, T_{LEAD} = +25°C, Z_S = Z_L =50 Ω

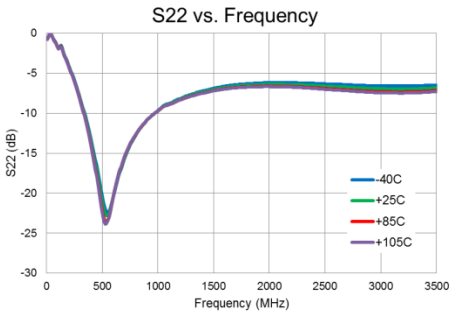
Performance Plots – 850 MHz Application Circuit

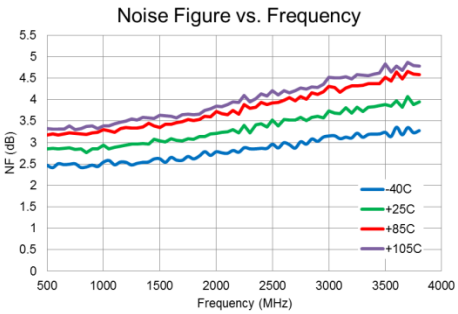
Test conditions unless otherwise noted: V_S = +8 V, R_{BIAS} =26 Ω, I_D = 118 mA Typ.

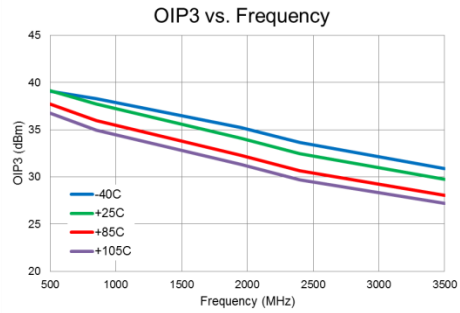


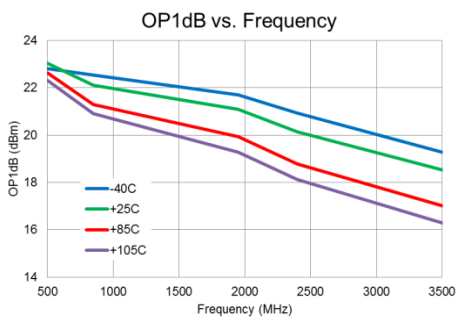


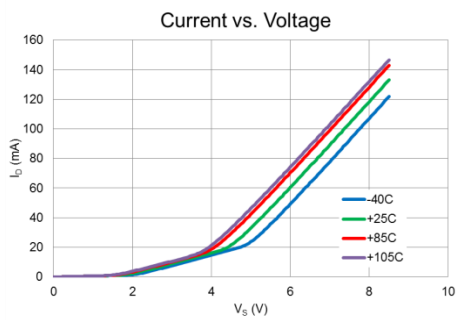




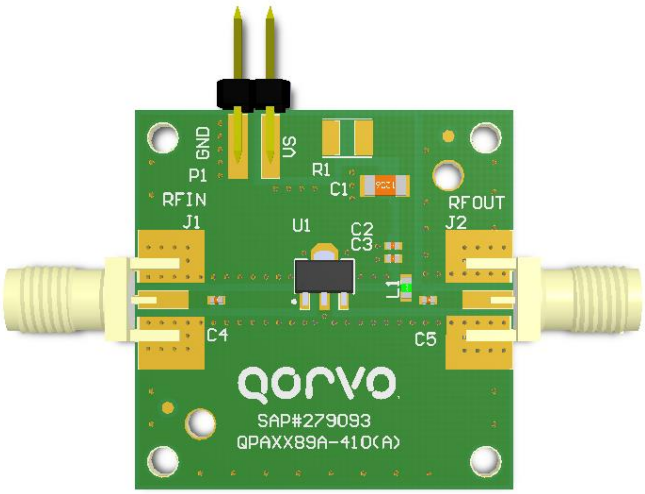


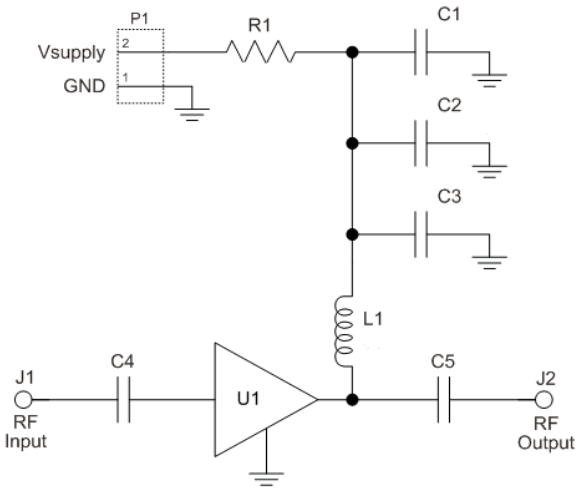






Evaluation Board and Schematic – 850 MHz Application Circuit





Bill of Material – 850 MHz Application Circuit

Reference	Value	Description	Manufacturer	Part Number
n/a	n/a	PCB	Qorvo	QPAXX89X-410(A)
U1	n/a	HBT MMIC Amplifier	Qorvo	QPA7489A
C1	1 uF	CAP, 10%, 25V, X7R, 1206	Murata Electronics	GRM31MR71E105KA01L
C2	1000 pF	CAP, 10%, 50V, X7R, 0402	Murata Electronics	GRM155R71H102KA01D
C3	68 pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H680JA01D
C4, C5	100 pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H101JA01D
R1	26 Ω	RES, 5%, 1/2W, 1210	Panasonic Industrial Devices	ERJ-P14F26R1U
L1	33 nH	IND, 5%, M/L, 0603	Murata Electronics	LL1608-FSL33NJ
J1, J2	n/a	CONN, SMA, EL, FLT, 0.068" SPE-000318	Amphenol RF Asia Corp	901-10426
P1	n/a	CONN, HDR, ST, 1x2, 0.100", Hi-temp, T/H	Samtec Inc	HTSW-102-07-G-S

Component Values for Specific Frequencies

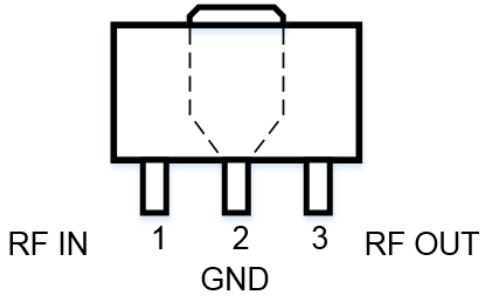
Reference Designator	500 MHz	850 MHz	1950 MHz	2400 MHz	3500 MHz
C4, C5	220 pF	100 pF	68 pF	56 pF	39 pF
C3	100 pF	68 pF	22 pF	22 pF	15 pF
L1	68 nH	33 nH	22 nH	18 nH	15 nH

Bias Resistor Values for Specific Supply Voltages

Reference Designator	V_S=+7 V	V_S=+8 V	V_S=+9 V	V_S=+12 V
R1 (Rbias) (1,2)	17 Ω	26 Ω	35 Ω	61 Ω

Notes:
1. Bias resistor improves current stability over temperature
2. Bias Resistance = $R_{BIAS} + R_{LDC} = (V_S - V_D) / I_D$

Pin Configuration and Description

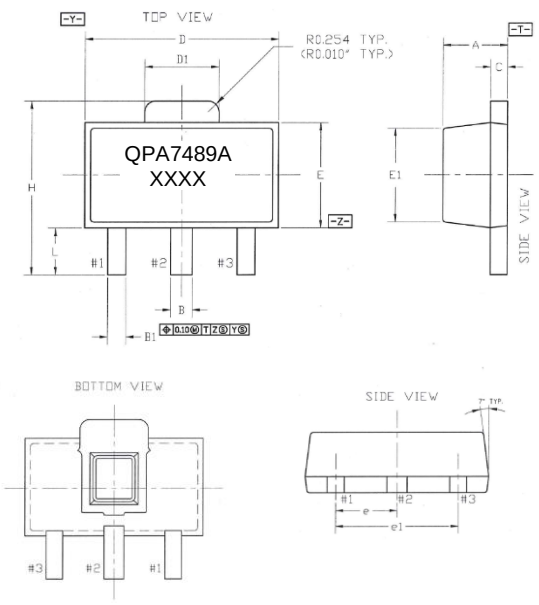


Top View

Pad No.	Label	Description
1	RF_{IN}	RF Input Pin. DC voltage is present on this pin therefore this pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
2	GND	Connection to ground. Use via holes in PCB for best performance to reduce lead inductance as close to ground leads as possible
3	RF_{OUT}/Bias	RF Output and Bias Pin. DC voltage is present on this pin therefore this pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.
Backside Paddle	GND	Exposed area on the bottom side of the package needs to be soldered to the ground plane of the board for optimum thermal and RF performance.

Package Marking and Dimensions

Package Marking:
Part number – QPA7489A
Lot code – XXXX

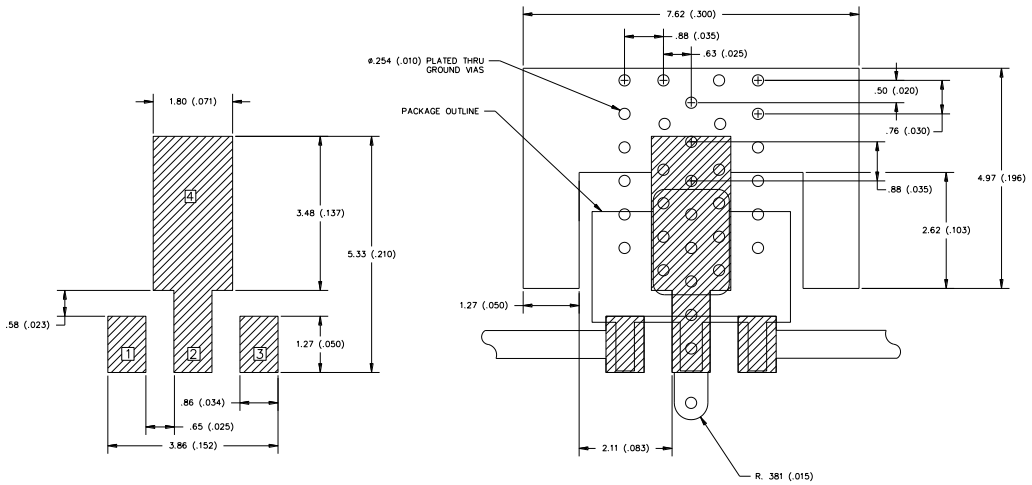


SYMBOL	Common					
	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.40	1.50	1.60	0.055	0.059	0.063
B	0.44	0.50	0.56	0.017	0.020	0.022
B1	0.36	0.42	0.48	0.014	0.017	0.019
C	0.35	0.40	0.44	0.014	0.016	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.62	1.73	1.83	0.064	0.068	0.072
E	2.30	2.50	2.60	0.091	0.098	0.102
E1	2.13	2.20	2.29	0.084	0.087	0.090
e	1.50 BSC.			0.059 BSC.		
e1	3.00 BSC.			0.118 BSC.		
H	3.95	4.10	4.25	0.156	0.161	0.167
L	0.90	1.10	1.20	0.035	0.043	0.047

NOTES :
1. DIMENSIONING & TOLERANCING PER ANSI.Y14.5M–1982
2. CONTROLLING DIMENSION : MILLIMETER CONVERTED INCH ARE NOT NECESSARILY EXACT.
3. DIMENSION B1, 2 PLACES.

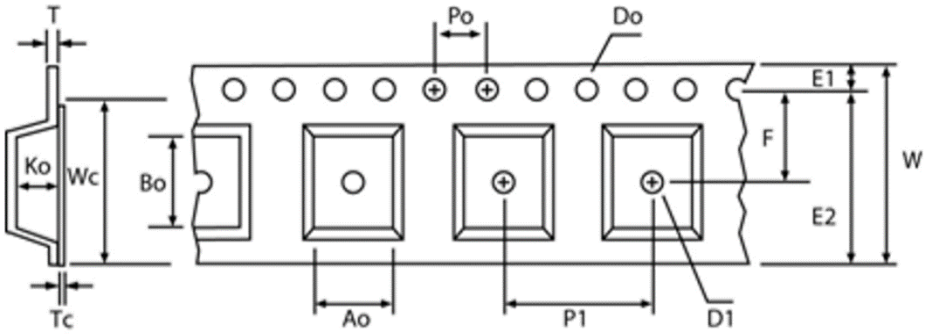
Notes:
1. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
2. Trace code up to 4 characters to be assigned by sub-contractor.

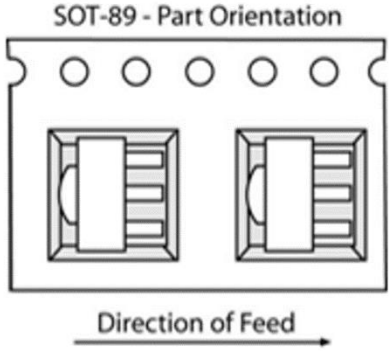
PCB Mounting Pattern



Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.01”).
4. Ensure good package backside paddle solder attach for best electrical and thermal performance.

Tape and Reel Information – Carrier and Cover Tape Dimensions

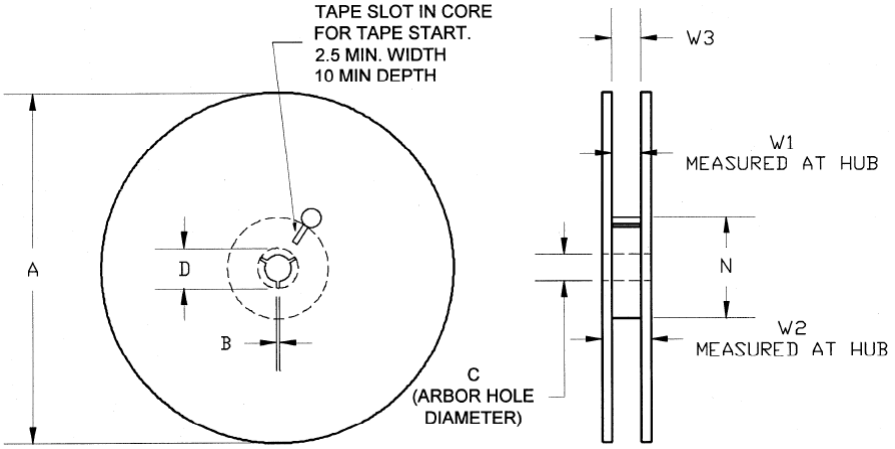




Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.181	4.60
	Width	B0	0.193	4.90
	Depth	K0	0.075	1.90
	Pitch	P1	0.315	8.00
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.00
	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width	C	0.362	9.20
Carrier Tape	Width	W	0.472	12.0

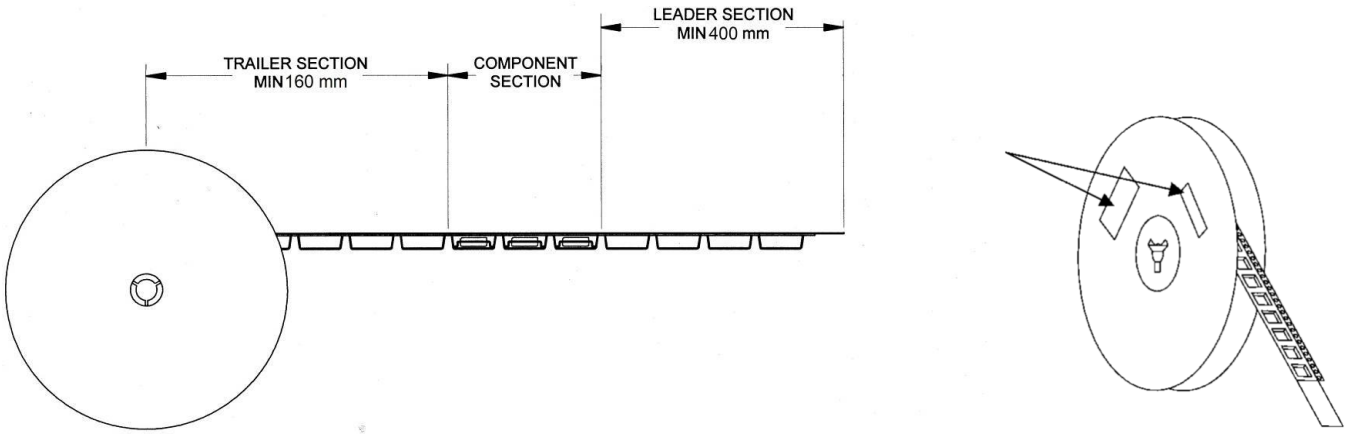
Tape and Reel Information – Reel Dimensions

Standard T/R size = 1,000 pieces on a 7” reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	6.969	170.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	2.283	58.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.787	20.0

Tape and Reel Information – Tape Length and Label Placement



Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 2	ESDA / JEDEC JS-001-2014
ESD – Charged Device Model (CDM)	Class C3	ESDA / JEDEC JS-002-2014
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering process.
Solder profiles available upon request.

Contact plating: NiPdAu

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:

Web: www.qorvo.com
Tel: 1-844-890-8163
Email: customer.support@qorvo.com

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