

37.0-40.0 GHz GaAs Power Amplifier QFN, 7x7mm

January 2010 - Rev 22-Jan-10

Features

- X Linear Power Amplifier
- X On-Chip Power Detector
- X Output Power Adjust
- X 25.0 dB Small Signal Gain
- X +27.0 dBm P1dB Compression Point
- X +38.0 dBm OIP3



General Description

Mimix Broadband's four stage 37.0-40.0 GHz packaged GaAs MMIC power amplifier has a small signal gain of 25.0 dB with a +38.0 dBm Output Third Order Intercept. The amplifier contains an integrated, temperature compensated, on-chip power detector. This MMIC uses Mimix Broadband's GaAs pHEMT device model technology, and is based upon electron beam lithography to ensure high repeatability and uniformity. The device comes in a RoHS compliant 7x7mm QFN Surface Mount Package offering excellent RF and thermal properties. This device is well suited for Millimeter-wave Point-to-Point Radio, LMDS, SATCOM and VSAT applications.

Absolute Maximum Ratings^{1,2}

Supply Voltage (Vd)	+4.3V
Gate Bias Voltage (Vg)	-1.5V < Vg < 0V
Input Power (Pin)	15 dBm
Abs. Max. Junction/Channel Temp	See MTTF Graph 1
Max. Operating Junction/Channel Temp	175 °C
Continuous Power Dissipation (Pdiss) at 85 °C	7.0 W
Thermal Resistance (Tchannel=150 °C)	12 °C/W
Operating Temperature (Ta)	-40 to +85 °C
Storage Temperature (Tstg)	-65 to +150 °C
Mounting Temperature	See solder reflow profile
ESD Min. - Machine Model (MM)	Class A
ESD Min. - Human Body Model (HBM)	Class 1A
MSL Level	MSL3

(1) Channel temperature directly affects a device's MTTF. Channel temperature should be kept as low as possible to maximize lifetime.

(2) For saturated performance it recommended that the sum of $(2 \cdot V_{dd} + \text{abs}(V_{gg})) < 9V$

Electrical Characteristics for 37 - 40 GHz (Ambient Temperature T = 25 °C)

Parameter	Units	Min.	Typ.	Max.
Frequency Range (f)	GHz	37.0	-	40.0
Input Return Loss (S11)	dB	10.0	14.0	-
Output Return Loss (S22)	dB	4.0	8.0	-
Small Signal Gain (S21)	dB	21.0	25.0	30.0
Gain Flatness ($\Delta S21$)	dB	-	+/-1.0	-
Reverse Isolation (S12)	dB	-	50	-
Output Power for 1dB Compression (P1dB)	dBm	-	27.0	-
Output IMD3 with Pout (scl) = 14 dBm	dBc	43.0	48.0	-
Output IP3	dBm	35.5	+38.0	-
Drain Bias Voltage (Vd)	VDC	-	4.0	4.0
Gate Bias Voltage (Vg)	VDC	-1.0	-0.3	-0.1
Supply Current (Id1) (Vd=4.0V, Vg=-0.3V)	mA	-	1000	1200

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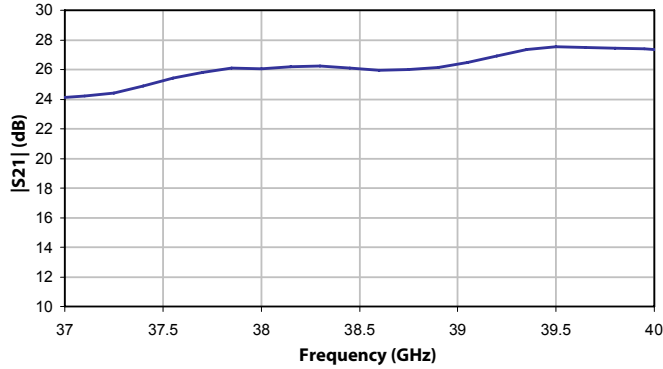


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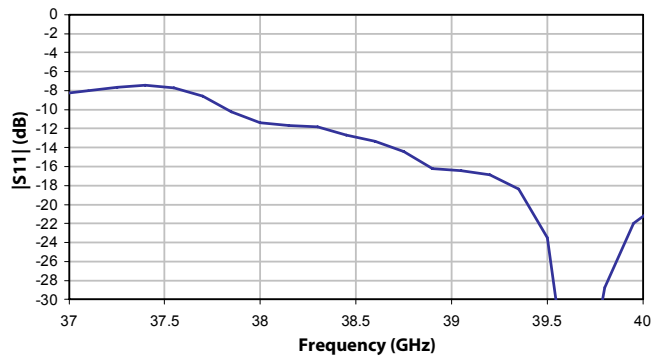
PI080-QU
RoHS

Power Amplifier Measurements

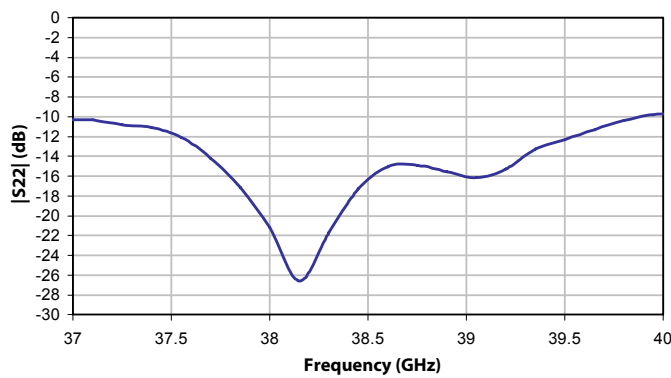
XP1080-QU-0N00: Small signal Gain (S21)
Vd=4.0V, Id=1000mA



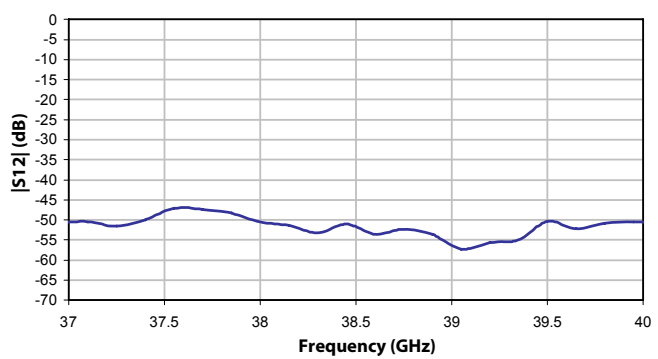
XP1080-QU-0N00: Input Return Loss (S11)
Vd=4.0V, Id=1000mA



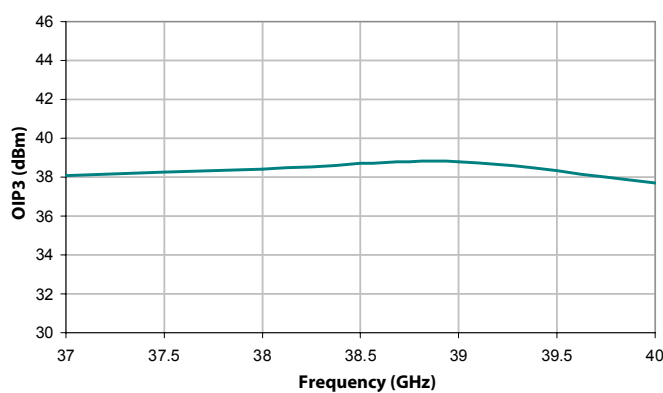
XP1080-QU-0N00: Output Return Loss (S22)
Vd=4.0V, Id=1000mA



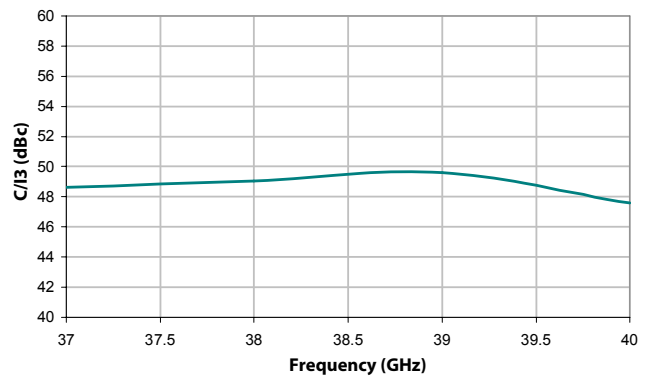
XP1080-QU-0N00: Reverse Isolation (S12)
Vd=4.0V, Id=1000mA



XP1080-QU-0N00; Output IP3 vs Freq
Vd=4V, Id=1000mA



XP1080-QU-0N00: C/I3 vs Freq
Psc1=14dBm, Vd=4V, Id=1000mA



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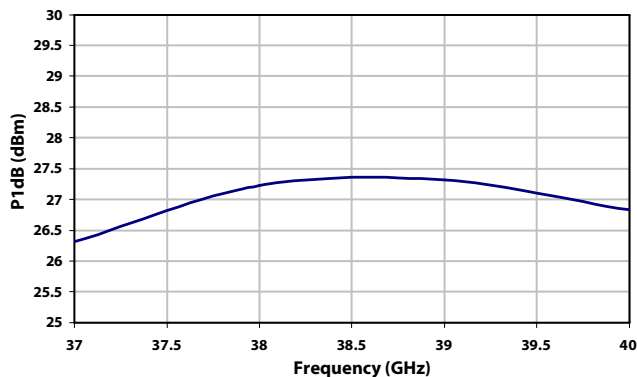


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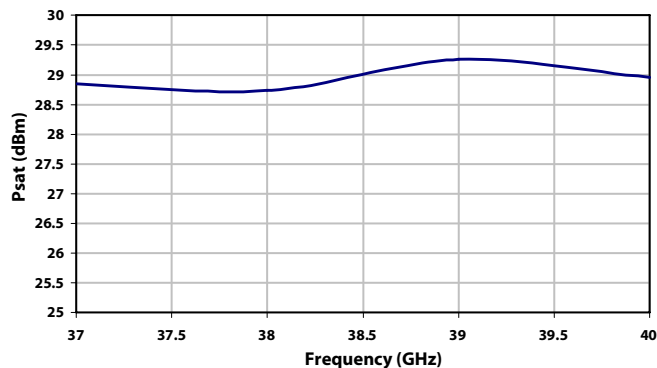
XP1080-QU
RoHS

Power Amplifier Measurements (cont.)

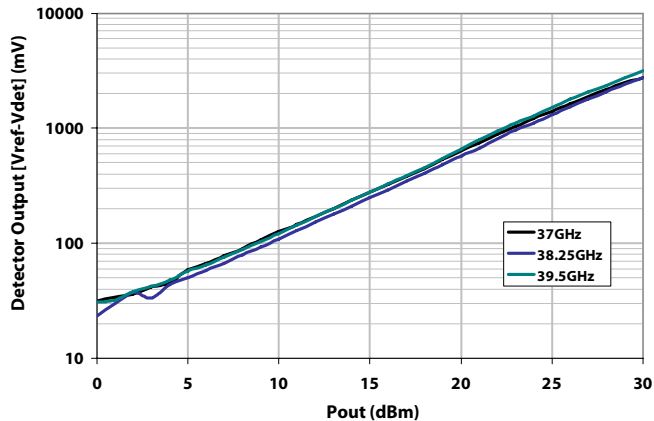
XP1080-QU: P1dB vs Freq
Vd=4V, Id=1000mA



XP1080-QU: Psat vs Freq
Vd=4V, Id=1000mA



XP1080-QU: Detector Output (Diff) vs Freq
Vd=4V, Id=1000mA, Vdet/ref Bias = +5V/100k



37.0-40.0 GHz GaAs Power Amplifier

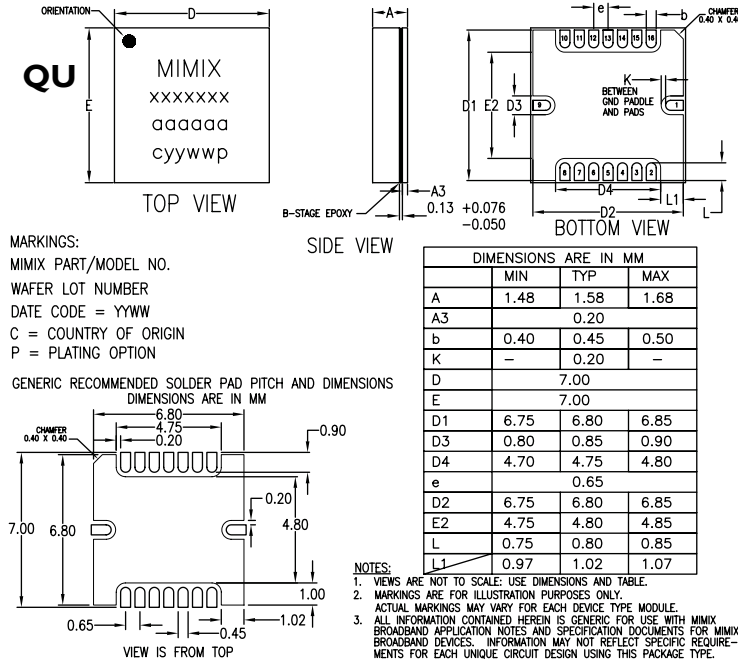
QFN, 7x7mm



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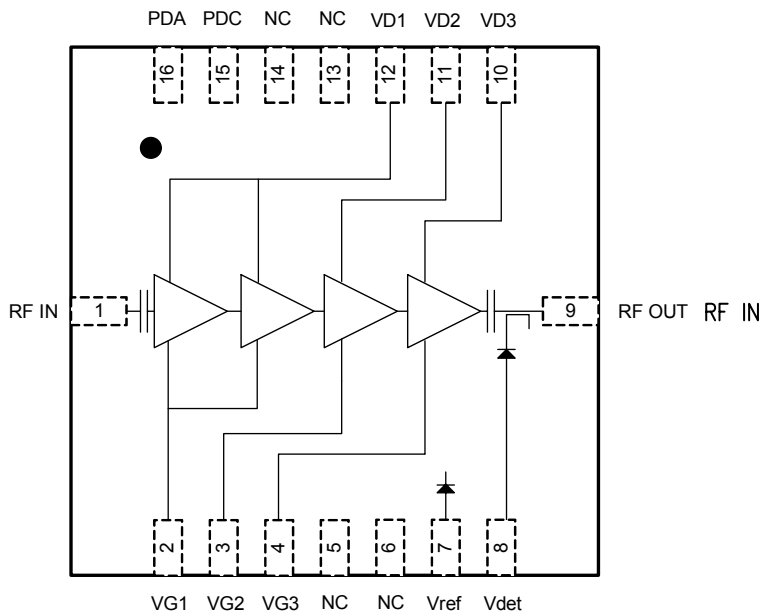
PI080-QU
RoHS

Physical Dimensions/Layout

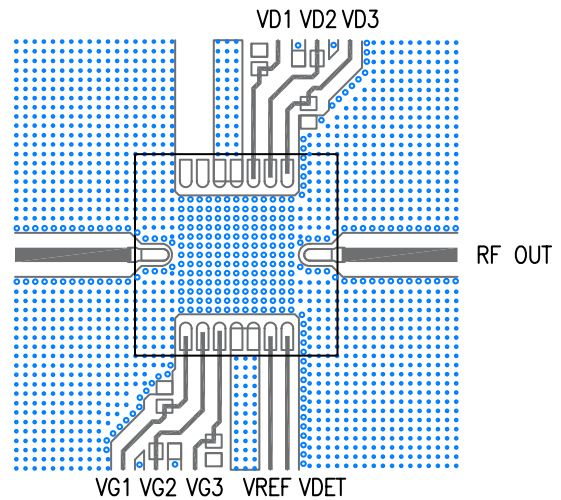


Pin Number	Pin Name	Pin Function	Nominal Value
1	RF IN	RF Input	0Ω
2	VG1	Gate bias, Stage 1	-0.3 V, 700kΩ.
3	VG2	Gate bias, Stage 2	-0.3 V, 700kΩ.
4	VG3	Gate bias, Stage 3	-0.3 V, 600kΩ.
5,6	NC		Not Connected
7	Vref	Detector reference output	+5.0 V thru 100kΩ (2.5MΩ)
8	Vdet	Detector output	+5.0 V thru 100kΩ (2.5MΩ)
9	RF OUT	RF Output	>1MΩ
10	VD3	Drain bias for stage 3	+4.0 V, 533mA, 0.9Ω
11	VD2	Drain bias for stage 2	+4.0 V, 267mA, 1.1Ω
12	VD1	Drain bias for stage 1	+4.0 V, 200mA, 1.6Ω
13,14	NC		Not Connected
15	PDC		Not Connected
16	PDA		Not Connected

Functional Block Diagram/Board Layout



Bypass Capacitors - See App Note [2]



Recommended Decoupling Capacitors: 100pF 0402
10uF 0805

Recommend to externally ground all NC pins

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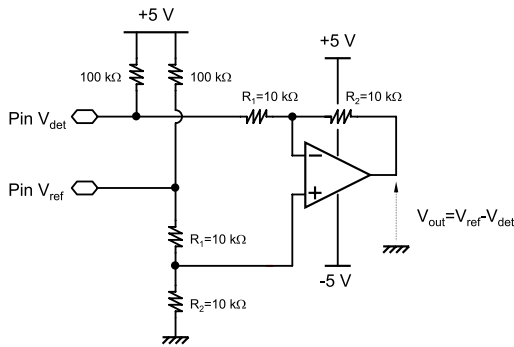
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App Note [1] Biasing - It is recommended to bias the amplifier with $V_d=4.0V$ and $I_d=1000mA$. It is also recommended to use active biasing to keep the currents constant as the RF power and temperature vary; this gives the most reproducible results. Depending on the supply voltage available and the power dissipation constraints, the bias circuit may be a single transistor or a low power operational amplifier, with a low value resistor in series with the drain supply used to sense the current. The gate of the pHEMT is controlled to maintain correct drain current and thus drain voltage. The typical gate voltage needed to do this is $-0.3V$. Typically the gate is protected with Silicon diodes to limit the applied voltage. Also, make sure to sequence the applied voltage to ensure negative gate bias is available before applying the positive drain supply.

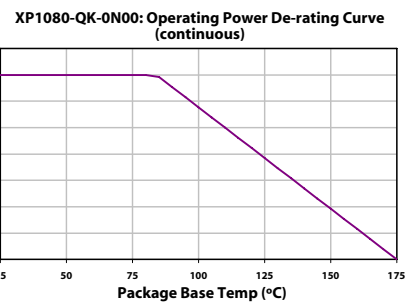
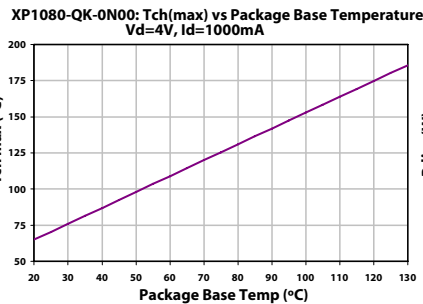
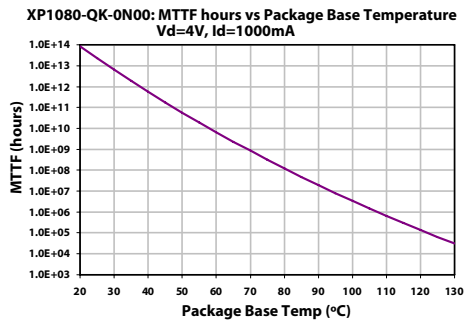
App Note [2] Bias Arrangement -

Each DC pin ($V_{d1,2,3}$ and $V_{g1,2,3}$) needs to have DC bypass capacitance (10 nF/1 uF) as close to the package as possible.

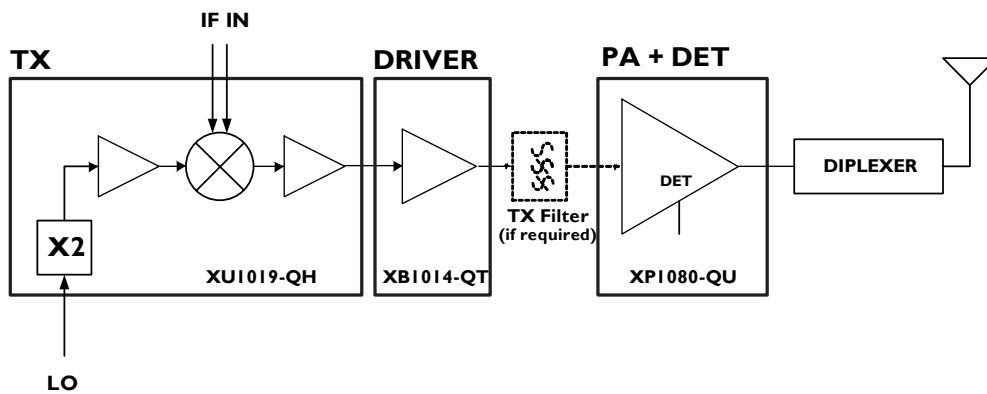
App Note [3] Power Detector - As shown in the schematic below, the power detector is implemented by providing +5V bias and measuring the difference in output voltage with standard op-amp in a differential mode configuration.



MTTF



Typical Application



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Handling and Assembly Information

CAUTION! - Mimix Broadband MMIC Products contain gallium arsenide (GaAs) which can be hazardous to the human body and the environment. For safety, observe the following procedures:

- Do not ingest.
- Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.
- Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.

Life Support Policy - Mimix Broadband's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of Mimix Broadband. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user. (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Package Attachment - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Vacuum tools or other suitable pick and place equipment may be used to pick and place this part. Care should be taken to ensure that there are no voids or gaps in the solder connection so that good RF, DC and ground connections are maintained. Voids or gaps can eventually lead not only to RF performance degradation, but reduced reliability and life of the product due to thermal stress.

Typical Reflow Profiles

Reflow Profile	SnPb	Pb Free
Ramp Up Rate	3-4 °C/sec	3-4 °C/sec
Activation Time and Temperature	60-120 sec @ 140-160 °C	60-180 sec @ 170-200 °C
Time Above Melting Point	60-150 sec	60-150 sec
Max Peak Temperature	240 °C	265 °C
Time Within 5 °C of Peak	10-20 sec	10-20 sec
Ramp Down Rate	4-6 °C/sec	4-6 °C/sec

Factory Automation and Identification

Mimix Designator	Package Type	Number of leads offered	W Tape Width	P ₁ Component Pitch	P ₀ Hole Pitch	Reel Diameter	Units per Reel
-QU	QFN (7x7mm)	28	16mm	12mm	4mm	329mm (13in)	1000

Component Orientation: Parts are to be oriented with the PIN 1 closest to the tape's round sprocket holes on the tape's trailing edge.

Note: Tape and Reel packaging is ordered with a -0NOT suffix. Package is available in 500 unit reels through designated sales channels. Minimum order quantities should be discussed with your local sales representative.

Mimix Lead-Free RoHS Compliant Program - Mimix has an active program in place to meet customer and governmental requirements for eliminating lead (Pb) and other environmentally hazardous materials from our products. All Mimix RoHS compliant components are form, fit and functional replacements for their non-RoHS equivalents. Lead plating of our RoHS compliant parts is 100% matte tin (Sn) over copper alloy and is backwards compatible with current standard SnPb low-temperature reflow processes as well as higher temperature (260°C reflow) "Pb Free" processes.

Ordering Information

Part Number for Ordering

XP1080-QU-0N00
XP1080-QU-0N0T
XP1080-QU-EV1

Description

Ni/Au plated RoHS compliant 7x7 28L surface mount package in bulk quantity
Ni/Au plated RoHS compliant 7x7 28L surface mount package in tape and reel
XP1080-QU evaluation board



Caution: ESD Sensitive
Appropriate precautions in handling, packaging
and testing devices must be observed.

Proper ESD procedures should be followed when handling this device.

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