XS1001-BD

2.5-4.0 GHz GaAs MMIC
6-Bit Phase Shifter

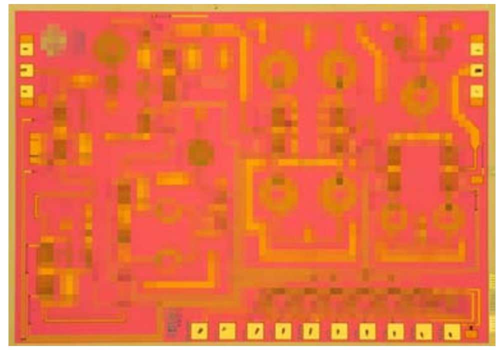
Rev 01-Sep-10

M/A-COM Tech Asia

Features

- 6-Bit Phase Shifter
- LVCMOS/TTL Compatible Digital Control
- LSB = 5.625º
- 26 dBm Input P1dB Compression Point
- 100% On-Wafer RF and DC Testing
- 100% Visual Inspection to MIL-STD-883 Method 2010

Chip Device Layout



General Description

M/A-COM Tech Asia's 2.5-4.0 GHz phase shifter is digitally controlled with 6-Bit operation and a LSB of 5.625º. The device uses a single supply voltage of -10V and digital control voltage of 0 to 5V. This MMIC uses M/A-COM Tech Asia's GaAs PHEMT device model technology, and is based upon optical gate lithography to ensure high repeatability and uniformity. The chip has surface passivation to protect and provide a rugged part with backside via holes and gold metallization to allow either a conductive epoxy or eutectic solder die attach process. This device is well suited for Beamforming, EW Receivers, Military & Weather RADAR and SATCOM applications.

Absolute Maximum Ratings

Supply Voltage (Vss)	-10.0 VDC
Supply Current (Iss)	10.0 mA
Input Power (Pin)	+30.0 dBm
Storage Temperature (Tstg)	-65 to +165 ºC
Operating Temperature (Ta)	-55 to +85 ºC

Electrical Characteristics (Ambient Temperature T = 25 ºC)

Parameter	Units	Min.	Typ.	Max.
Frequency Range (f)	GHz	2.5	-	4.0
Insertion Loss (S21), All States	dB	-	6.0	-
Input Return Loss (S11), All States	dB	-	15	-
Output Return Loss (S22), All States	dB	-	15	-
Input 1dB Compression Point (IP1dB)	dBm	-	26.0	-
RMS Phase Error	deg	-	2.5	-
RMS Attentuation Error	dB	-	0.4	-
Control Voltage (Vc1,2,3,4,5,6 - High)	VDC	2.0	-	5.0
Control Voltage (Vc1,2,3,4,5,6 - Low)	VDC	0.0	-	0.8
Source Supply Voltage (Vss)	VDC	-	-10.0	-
Supply Current (Iss) (Vss = -10.0V Typical)	mA	-	8.5	-

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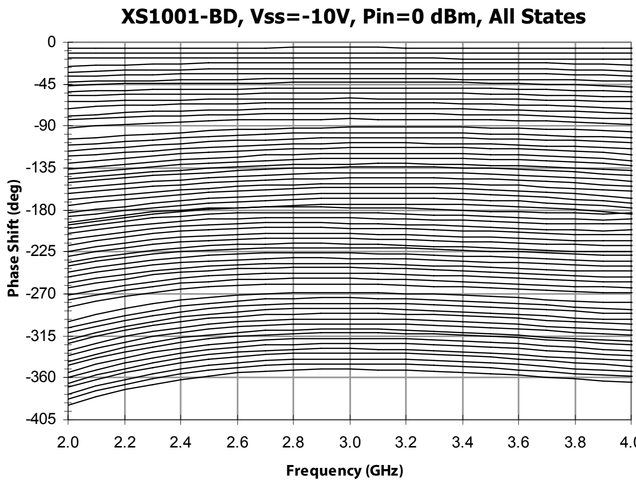
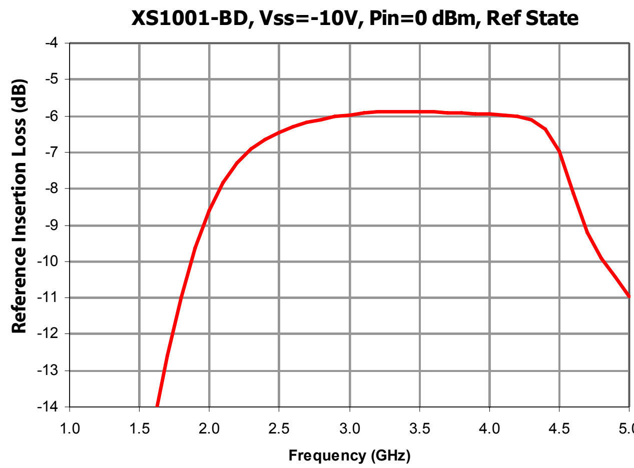
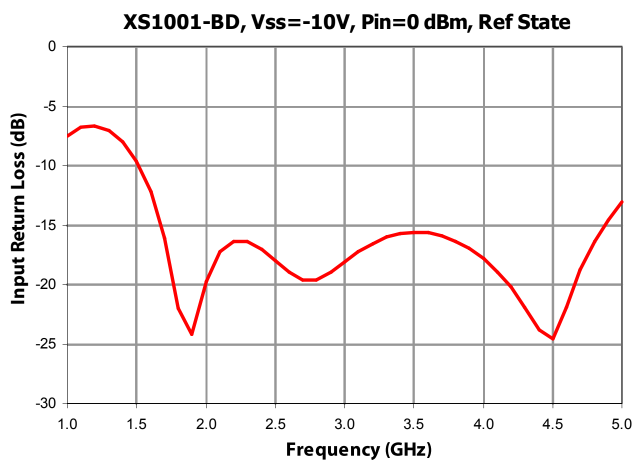
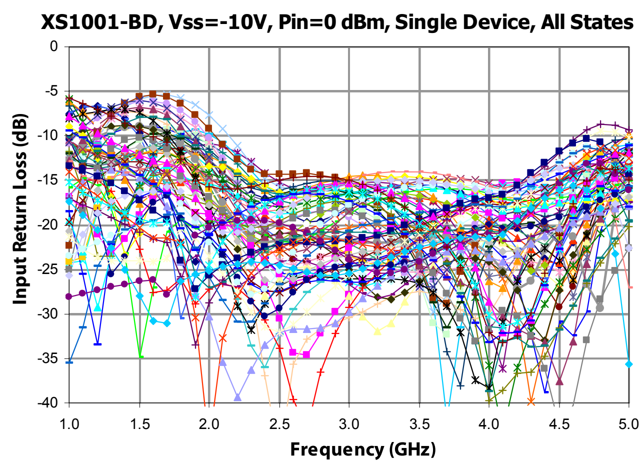
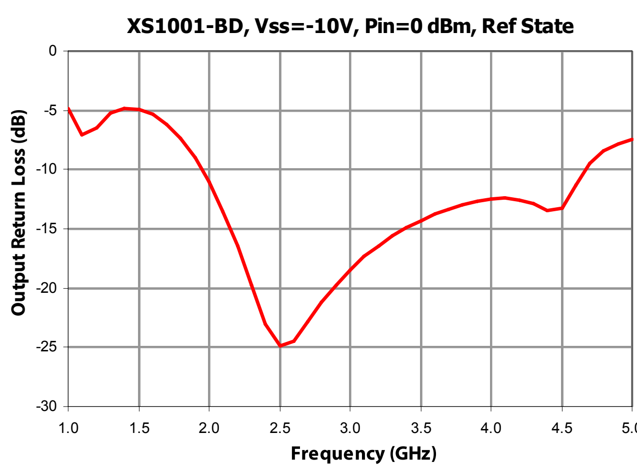
Phase Shifter Measurements

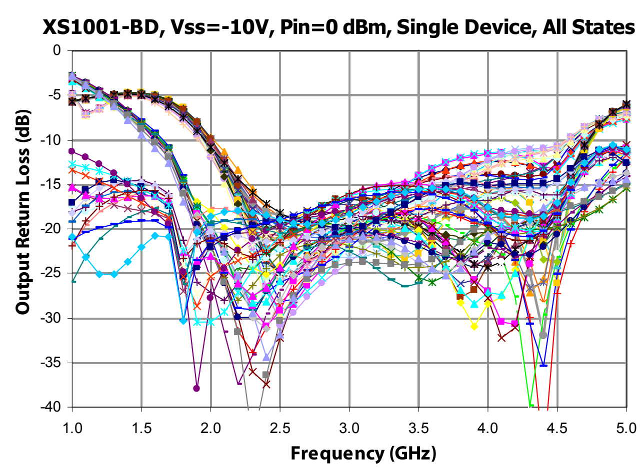












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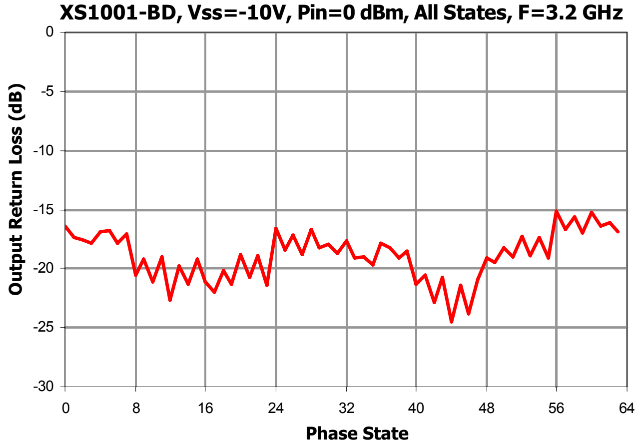
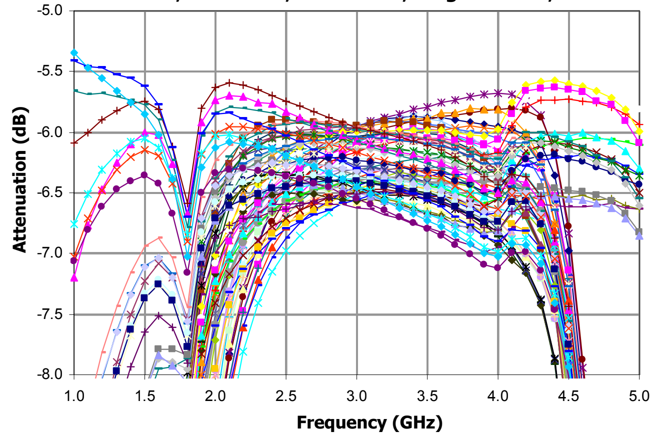
Phase Shifter Measurements (cont.)

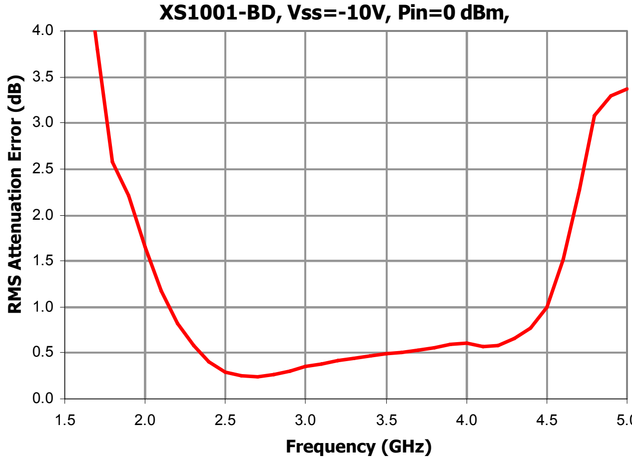
XS1001-BD, Vss=-10V, Pin=0 dBm, All States, F=3.2 GHz



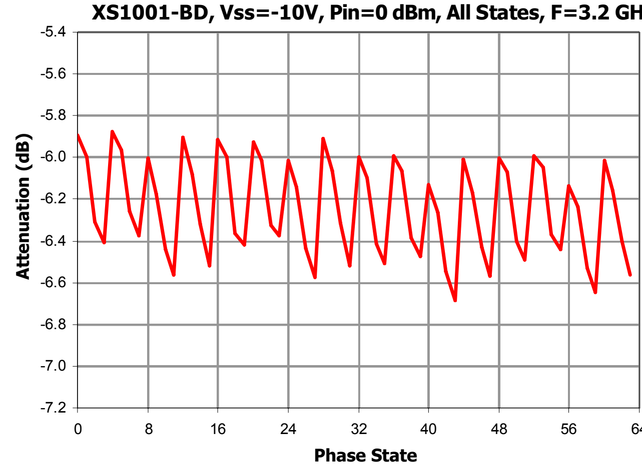
XS1001-BD, Vss=-10V, Pin=0 dBm, Single Device, All States



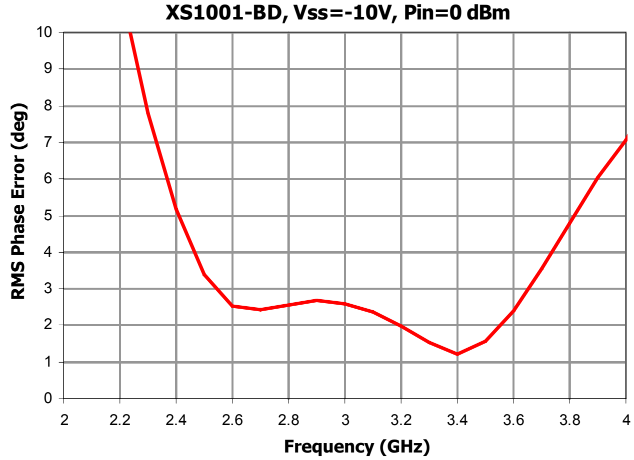
XS1001-BD, Vss=-10V, Pin=0 dBm,



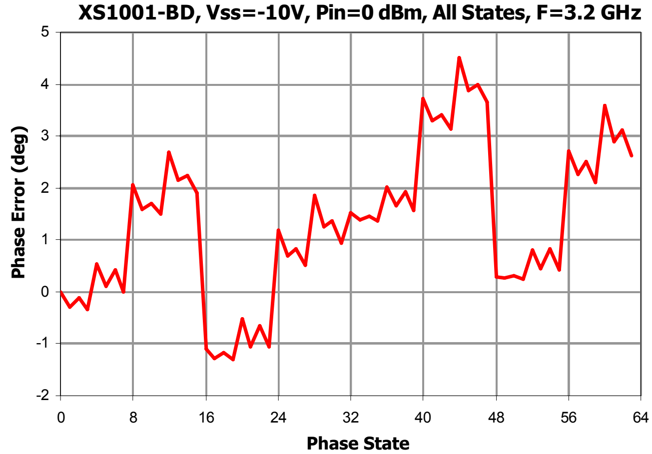
XS1001-BD, Vss=-10V, Pin=0 dBm, All States, F=3.2 GHz



XS1001-BD, Vss=-10V, Pin=0 dBm



XS1001-BD, Vss=-10V, Pin=0 dBm, All States, F=3.2 GHz



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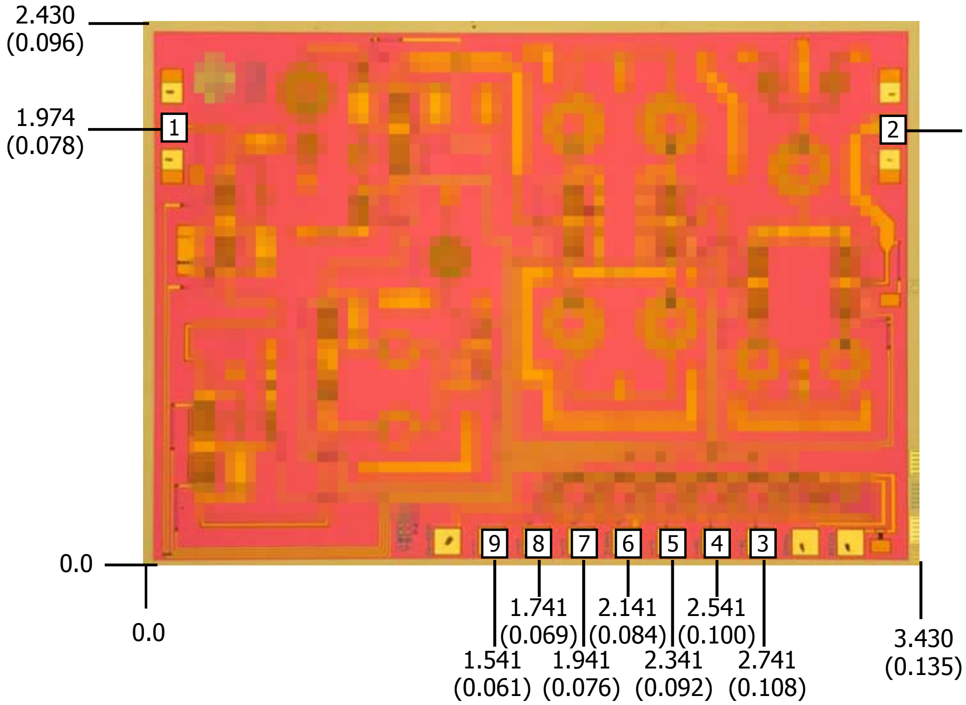
Mechanical Drawing

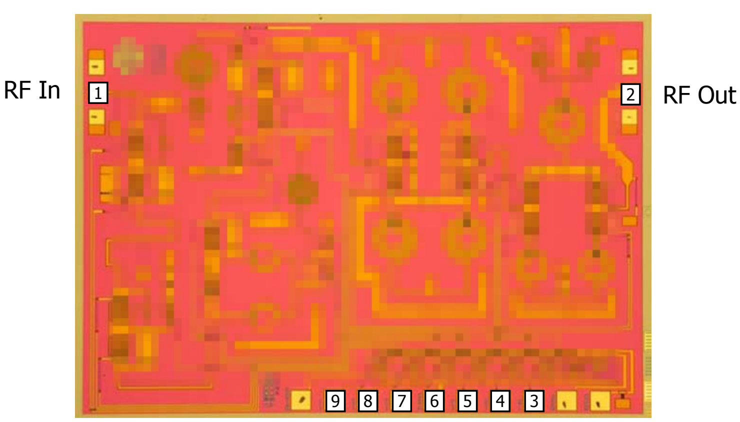


(Note: Engineering designator is 3PSH1011)

Units: millimeters (inches) Bond pad dimensions are shown to center of bond pad.
Thickness: 0.110 +/- 0.010 (0.0043 +/- 0.0004), Backside is ground, Bond Pad/Backside Metallization: Gold
All Bond Pads are 0.100 x 0.100 (0.004 x 0.004).
Bond pad centers are approximately 0.109 (0.004) from the edge of the chip.
Dicing tolerance: +/- 0.005 (+/- 0.0002). Approximate weight: 5.17 mg.

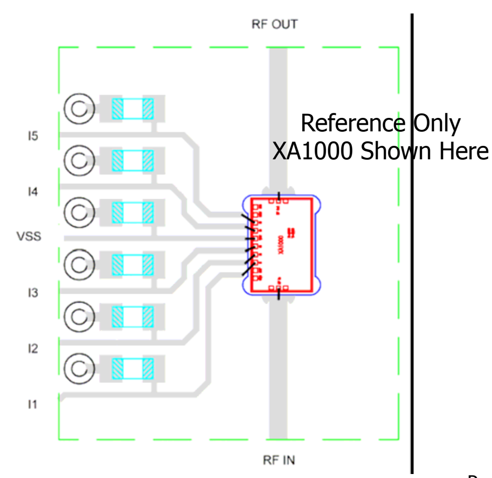
Bond Pad #1 (RF In)	Bond Pad #4 (Vc5)	Bond Pad #6 (Vss)	Bond Pad #8 (Vc2)
Bond Pad #2 (RF Out)	Bond Pad #5 (Vc4)	Bond Pad #7 (Vc3)	Bond Pad #9 (Vc1)
Bond Pad #3 (Vc6)			

Bias Arrangement



Vss & Input Control

Bypass Capacitors - See App Note [2]



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App Note [1] Biasing - Logic buffering is integrated in the device to supply the necessary internal switching voltages. The reference state is enabled with logic "low" on all inputs, and the binary weighted phase(amplitude) states are switched by a logic "high" on the respective control input. Amplitude(phase) variation between phase(amplitude) states is minimised by optimisation of internal matching and isolation between bits. Each bit is controlled using a '0' for the reference state and a '1' for the enabled state.

Logic Truth Table - Major States

Phase Shift (degrees)	Vc1	Vc2	Vc3	Vc4	Vc5	Vc6
0º	0	0	0	0	0	0
5.625º	1	0	0	0	0	0
11.25º	0	1	0	0	0	0
22.5º	0	0	1	0	0	0
45º	0	0	0	1	0	0
90º	0	0	0	0	1	0
180º	0	0	0	0	0	1
354.375º	1	1	1	1	1	1

App Note [2] Bias Arrangement - Each DC/Control pad (Vss, Vc1-6) needs to have DC bypass capacitance (~100 pF) as close to the device as possible. Alternatively, place 100pF multi-layer ceramic capacitors close to the MMIC as shown on previous page. Choose decoupling capacitance and source resistance (if used) to provide adequate decoupling but not to impede dynamic switching performance of the application.

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Handling and Assembly Information

CAUTION! - M/A-COM Tech Asia 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 - M/A-COM Tech Asia'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 M/A-COM Tech Asia. 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.

ESD - Gallium Arsenide (GaAs) devices are susceptible to electrostatic and mechanical damage. Die are supplied in anti-static containers, which should be opened in cleanroom conditions at an appropriately grounded antistatic workstation. Devices need careful handling using correctly designed collets, vacuum pickups or, with care, sharp tweezers.

Die Attachment - GaAs Products from M/A-COM Tech Asia are 0.100 mm (0.004") thick and have vias through to the backside to enable grounding to the circuit. Microstrip substrates should be brought as close to the die as possible. The mounting surface should be clean and flat. If using conductive epoxy, recommended epoxies are Tanaka TS3332LD, Die Mat DM6030HK or DM6030HK-Pt cured in a nitrogen atmosphere per manufacturer's cure schedule. Apply epoxy sparingly to avoid getting any on to the top surface of the die. An epoxy fillet should be visible around the total die periphery. For additional information please see the M/A-COM Tech Asia "Epoxy Specifications for Bare Die" application note. If eutectic mounting is preferred, then a fluxless gold-tin (AuSn) preform, approximately 0.001^{2} thick, placed between the die and the attachment surface should be used. A die bonder that utilizes a heated collet and provides scrubbing action to ensure total wetting to prevent void formation in a nitrogen atmosphere is recommended. The gold-tin eutectic (80% Au 20% Sn) has a melting point of approximately 280º C (Note: Gold Germanium should be avoided). The work station temperature should be 310ºC +/- 10º C. Exposure to these extreme temperatures should be kept to minimum. The collet should be heated, and the die pre-heated to avoid excessive thermal shock. Avoidance of air bridges and force impact are critical during placement.

Wire Bonding - Windows in the surface passivation above the bond pads are provided to allow wire bonding to the die's gold bond pads. The recommended wire bonding procedure uses 0.076 mm x 0.013 mm (0.003" x 0.0005") 99.99% pure gold ribbon with 0.5-2% elongation to minimize RF port bond inductance. Gold 0.025 mm (0.001") diameter wedge or ball bonds are acceptable for DC Bias connections. Aluminum wire should be avoided. Thermo-compression bonding is recommended though thermosonic bonding may be used providing the ultrasonic content of the bond is minimized. Bond force, time and ultrasonics are all critical parameters. Bonds should be made from the bond pads on the die to the package or substrate. All bonds should be as short as possible.

Ordering Information

Part Number for Ordering	Description
XS1001-BD-000V	RoHS compliant die packed in vacuum release gel paks

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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