TTM Technologies
Time-To-Market Interconnect Solutions

Xinger®

Hybrid Coupler
3 dB, 90º

Description:

The XEC24A6-03G is a low profile, high performance 3dB hybrid coupler in a new easy to use, manufacturing friendly Xinger® surface mount package. It is designed for RF heating, renewable energy applications in the 2400MHz to 2500MHz IMS band. It can be used in high power applications up to 600 Watts (AVG) and has a Peak to Average power ratio of 12dB.

The XEC24A6-03G has been subjected to rigorous qualification testing and they are manufactured using materials with coefficients of thermal expansion (CTE) compatible with common substrates such as FR4, G-10, RF-35, RO4350 and polyimide. Available in 6 of 6 ENIG (XEC24A6-03G) RoHS compliant finish.
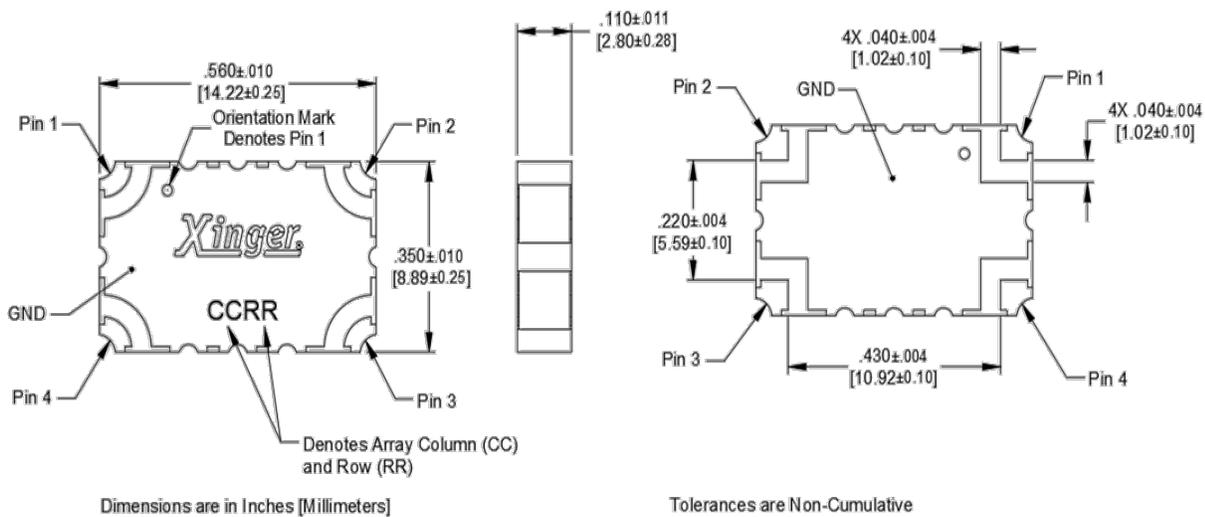
Features:
- **2400 - 2500 MHz**
- **RF Heating and renewable energy**
- **High Power 600 W (AVG)**
- **Very Low Loss (<0.15dB)**
- **Production Friendly**
- **Tape and Reel**
- **ENIG Finish**
- **Made in the USA**

Electrical Specifications*:

Frequency	Isolation	Insertion Loss	VSWR
MHz	*dB Min*	*dB Max*	*Max : 1*
2400 - 2500	20	0.15	1.22

| Amplitude Balance	Phase	Power	Operating Temp.
dB Max	*Degrees*	*Avg. Watts @ 95°C*	*°C*
± 0.30	90 ± 4.0	600	-55 to +150

*Power Handling for commercial, non-life critical applications. See derating chart for other applications. Specification based on performance of unit properly installed on TTM test board with small signal applied. Specifications subject to change without notice. Refer to parameter definitions for details.

Mechanical Outline:

.560±.010 [14.22±0.25]
Pin 1   Orientation Mark Denotes Pin 1   Pin 2
GND
CCRR
Pin 4   Pin 3
.350±.010 [8.89±0.25]
Denotes Array Column (CC) and Row (RR)
Dimensions are in Inches [Millimeters]

.110±.011 [2.80±0.28]

4X .040±.004 [1.02±0.10]
Pin 2   GND   Pin 1
4X .040±.004 [1.02±0.10]
.220±.004 [5.59±0.10]
Pin 3   .430±.004 [10.92±0.10]   Pin 4
Tolerances are Non-Cumulative

Hybrid Coupler Pin Configuration

The XEC24A6-03G has an orientation marker to denote Pin 1. Once port one has been identified the other ports are known automatically. Please see the chart below for clarification:
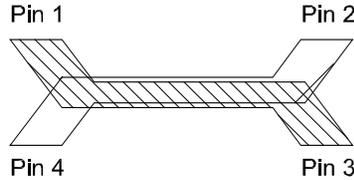

Configuration	Pin 1	Pin 2	Pin 3	Pin 4
Splitter	Input	Isolated	-3dB $\angle\theta - 90$	-3dB $\angle\theta$
Splitter	Isolated	Input	-3dB $\angle\theta$	-3dB $\angle\theta - 90$
Splitter	-3dB $\angle\theta - 90$	-3dB $\angle\theta$	Input	Isolated
Splitter	-3dB $\angle\theta$	-3dB $\angle\theta - 90$	Isolated	Input
***Combiner**	A $\angle\theta - 90$	A $\angle\theta$	Isolated	Output
***Combiner**	A $\angle\theta$	A $\angle\theta - 90$	Output	Isolated
***Combiner**	Isolated	Output	A $\angle\theta - 90$	A $\angle\theta$
***Combiner**	Output	Isolated	A $\angle\theta$	A $\angle\theta - 90$

*Note: "A" is the amplitude of the applied signals. When two quadrature signals with equal amplitudes are applied to the coupler as described in the table, they will combine at the output port. If the amplitudes are not equal, some of the applied energy will be directed to the isolated port.

Peak Power Handling

At Sea-Level

High-Pot testing of these couplers during the qualification procedure resulted in a minimum breakdown voltage of 2.27kV (minimum recorded value). This voltage level corresponds to a breakdown resistance capable of handling at least 12dB peaks over average power levels, for very short durations. The breakdown location consistently occurred across the air interface at the coupler contact pads (see illustration below). The breakdown levels at these points will be affected by any contamination in the gap area around these pads. These areas must be kept clean for optimum performance.


Breakdown Area (4x)

A

Detail A
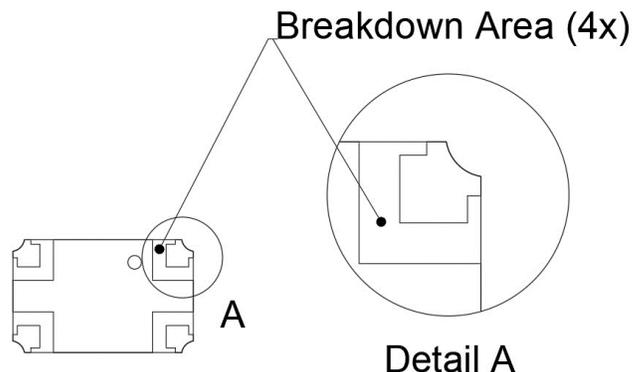
At High Altitudes

Breakdown voltage at high altitude reduces significantly comparing with the one at sea level. As an example, plot below illustrates reduction in breakdown voltage of 1700 V at sea level with increasing altitude. The plot uses Paschen's Law to predict breakdown voltage variation over the air pressure.

Breakdown voltage variation over the air pressure (Altitude)
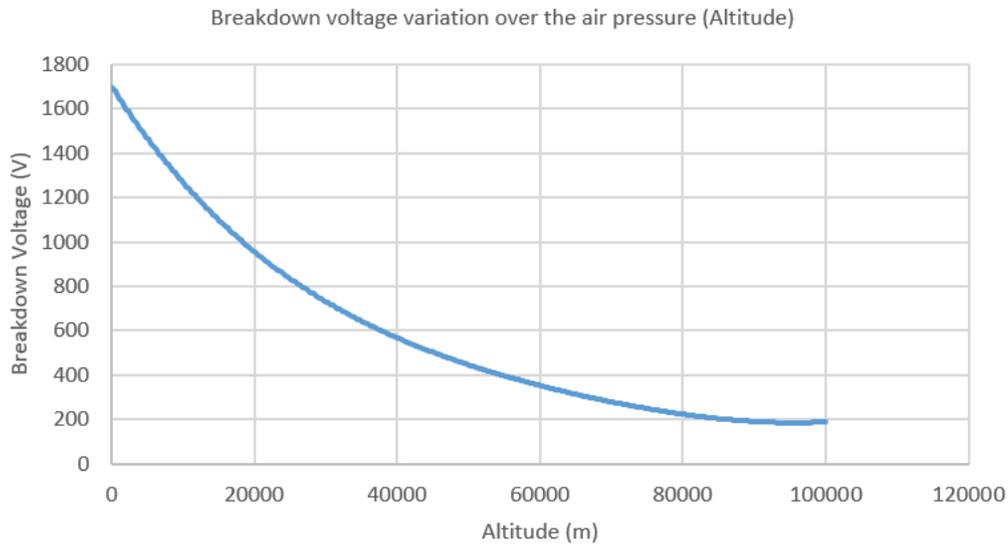
It is recommended that the user test for voltage breakdown under the maximum operating conditions and over worst case modulation induced power peaking. This evaluation should also include extreme environmental conditions (such as high humidity) and physical conditions such as alignment of part to carrier board, cleanliness of carrier board etc.

Insertion Loss and Power Derating Curves:

XEC24A6-03G Typical Insertion Loss Derating Curve

XEC24A6-03G Power Derating Curve
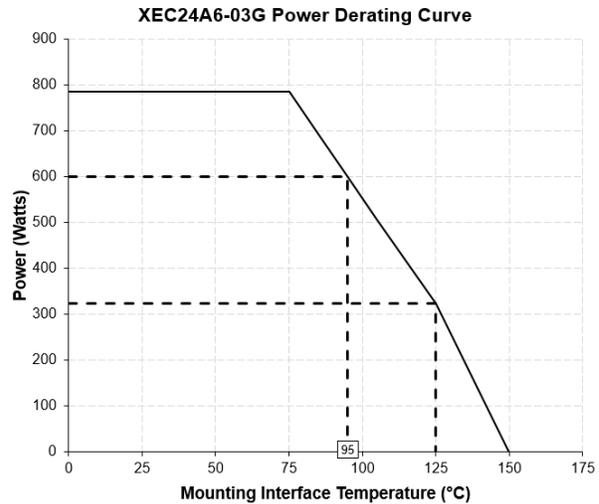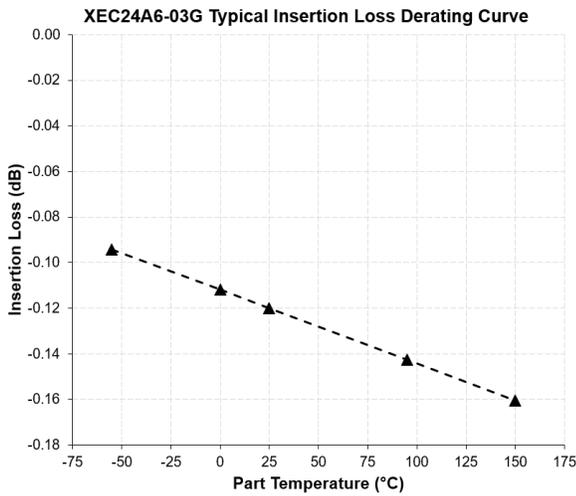
Insertion Loss Derating:

The insertion loss, at a given frequency, of a group of couplers is measured at 25°C and then averaged. The measurements are performed under small signal conditions (i.e. using a Vector Network Analyzer). The process is repeated at 95°C and 150°C. A best-fit line for the measured data is computed and then plotted from -55°C to 150°C.
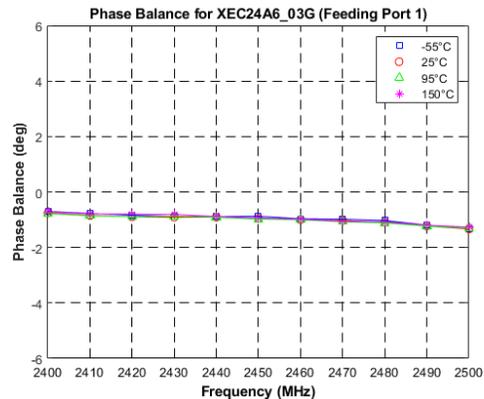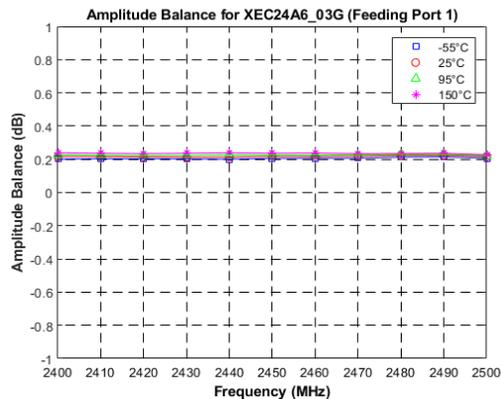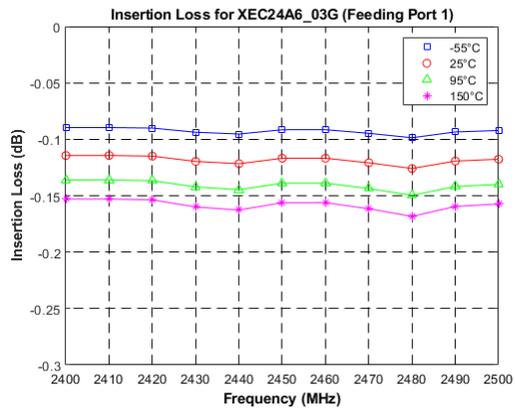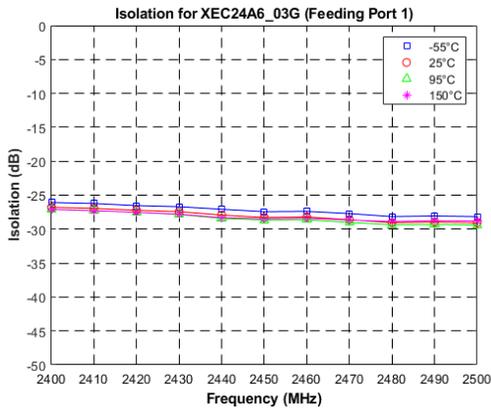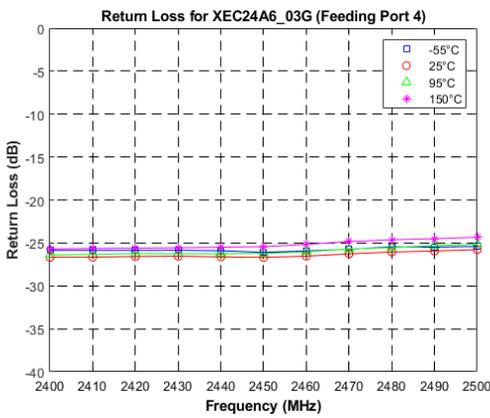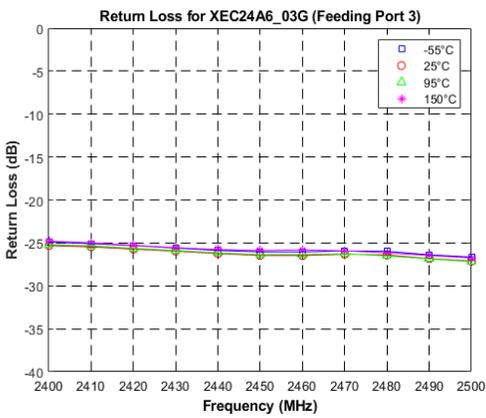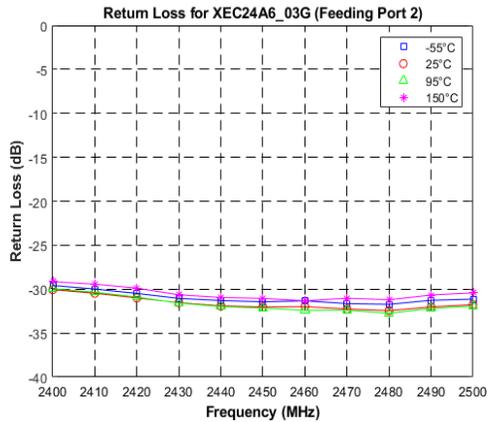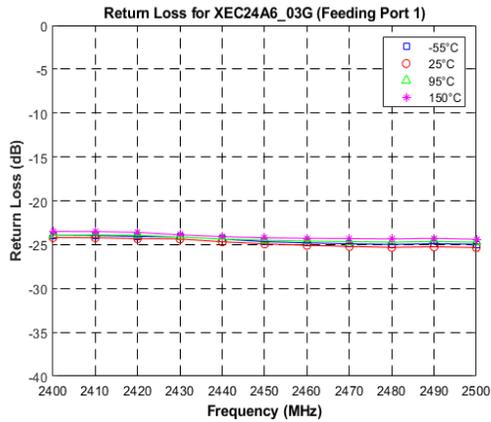
Power Derating:

The power handling and corresponding power derating plots are a function of the thermal resistance, mounting surface temperature (base plate temperature), maximum continuous operating temperature of the coupler, and the thermal insertion loss. The thermal insertion loss is defined in the Power Handling section of the data sheet.

As the mounting interface temperature approaches the maximum continuous operating temperature, the power handling decreases to zero.

If mounting temperature is greater than 95°C, the Xinger® coupler will perform reliably as long as the input power is derated to the curve above.

Typical Performance: 2400-2500 MHz

Return Loss for XEC24A6_03G (Feeding Port 1)

Return Loss for XEC24A6_03G (Feeding Port 2)

Return Loss for XEC24A6_03G (Feeding Port 3)

Return Loss for XEC24A6_03G (Feeding Port 4)

Isolation for XEC24A6_03G (Feeding Port 1)

Insertion Loss for XEC24A6_03G (Feeding Port 1)

Amplitude Balance for XEC24A6_03G (Feeding Port 1)

Phase Balance for XEC24A6_03G (Feeding Port 1)

Definition of Measured specifications

Parameter	Definition	Mathematical Representation
VSWR (Voltage Standing Wave Ratio)	The impedance match of the coupler to a 50Ω system. A VSWR of 1:1 is optimal.	$$\text{VSWR} = \frac{V_{max}}{V_{min}}$$ Vmax = voltage maxima of a standing wave Vmin = voltage minima of a standing wave
Return Loss	The impedance match of the coupler to a 50Ω system. Return Loss is an alternate means to express VSWR.	$$\text{Return Loss(dB)} = 20\log\frac{\text{VSWR} + 1}{\text{VSWR} - 1}$$
Insertion Loss	The input power divided by the sum of the power at the two output ports.	$$\text{Insertion Loss(dB)} = 10\log\frac{P_{in}}{P_{cpl} + P_{direct}}$$
Isolation	The input power divided by the power at the isolated port.	$$\text{Isolation(dB)} = 10\log\frac{P_{in}}{P_{iso}}$$
Phase Balance	The difference in phase angle between the two output ports.	Phase at coupled port – Phase at direct port
Amplitude Balance	The power at each output divided by the average power of the two outputs.	$$10\log\frac{P_{cpl}}{(P_{cpl} + P_{direct})/2} \text{ and } 10\log\frac{P_{direct}}{(P_{cpl} + P_{direct})/2}$$

Packaging and Ordering Information:

Parts are available in reels. Packaging follows EIA 481 for reels. Parts are oriented in tape and reel as shown below. Tape and reel is available in 250 pcs or 1000 pcs per reel.
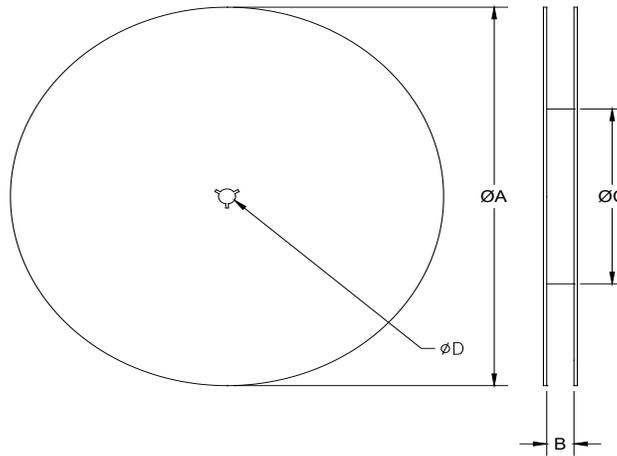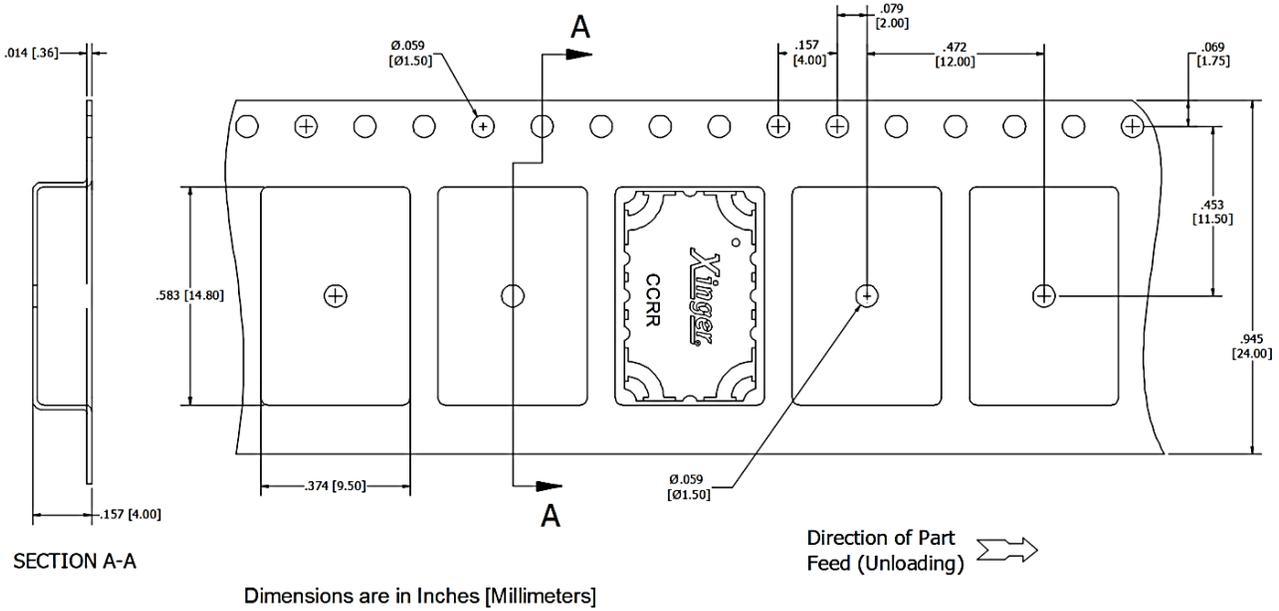

SECTION A-A

Dimensions are in Inches [Millimeters]

Direction of Part
Feed (Unloading)

TABLE 1 (for 250 pcs)	
REEL DIMENSIONS (inches [mm])	
ØA	13.0 [330.0]
B	.945 [24.0]
ØC	4.017 [102.03]
ØD	0.512 [13.0]

TABLE 2 (for 1000 pcs)	
REEL DIMENSIONS (inches [mm])	
ØA	13.0 [330.0]
B	.945 [24.0]
ØC	4.017 [102.03]
ØD	0.512 [13.0]

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