



Doherty Combiner

Description:

The X3DC07E2S is a low-profile, high-performance Doherty Combiner, with a high-power rating of 200 Watts (AVG) and a peak to average ratio of 12dB, in a new easy to use, Xinger style manufacturing friendly surface mount package. The X3DC07E2S is designed particularly for Doherty Amplifier applications, where tightly controlled phase and amplitude imbalance as well as low insertion loss are required for maximum and low power condition.

Parts have been subjected to rigorous Xinger 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. Produced with 6 of 6 RoHS compliant tin immersion finish.



Features:

- 728 - 768 MHz
- High Power 200 Watts(AVG)
- Peak to Average Power Ratio 12dB
- Low Amp Imbalance (<0.12dB)
- Very Low Loss (>0.15dB)
- Production Friendly
- Tape and Reel
- Lead Free

Electrical Specifications*

Frequency	Return Loss [1]	Insertion Loss [1]	Amplitude Imbalance [1]	Phase Imbalance [1]
<i>MHz</i>	<i>dB Min</i>	<i>dB Max</i>	<i>dB Max</i>	<i>Degrees</i>
728 – 768	20	0.15	±0.12	90 ± 3.0
Return Loss [2]	Insertion Loss [2]	Port Extension [3]	Power	Operating Temp.
<i>dB Min</i>	<i>dB Max</i>	<i>Degrees</i>	<i>Avg. Watts@95°C</i>	<i>°C</i>
20	0.25	0	200	-55 to +150

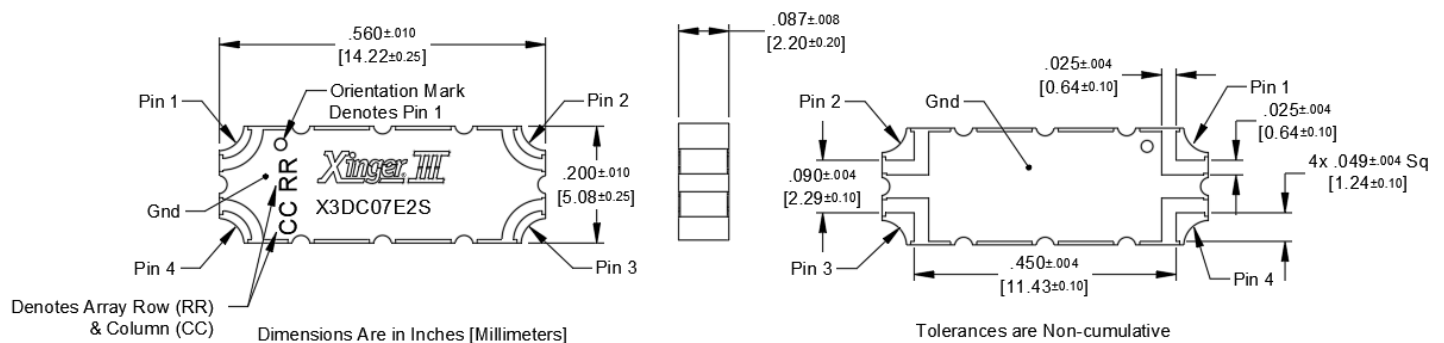
*Specification based on performance of unit properly installed on a TTM test board.

[1] At maximum power condition, Doherty combiner functions as an equal-split power combiner.

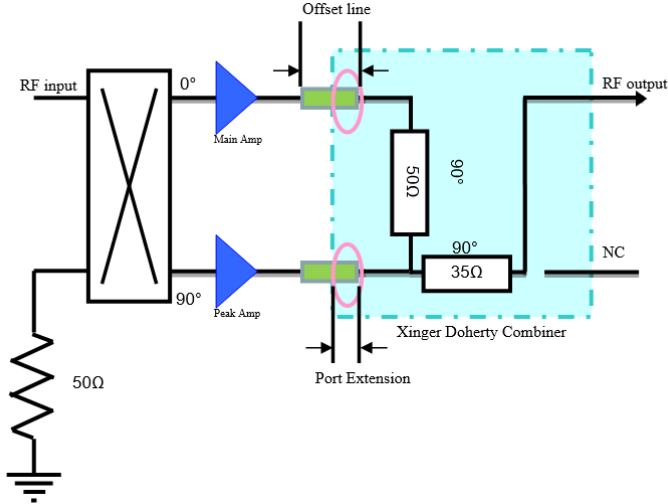
[2] At low power condition, Doherty combiner functions as a 100Ω to 50Ω impedance transformer.

[3] There are short 50-ohm lines associated with input ports of 0° at 748MHz. Details on page 2.

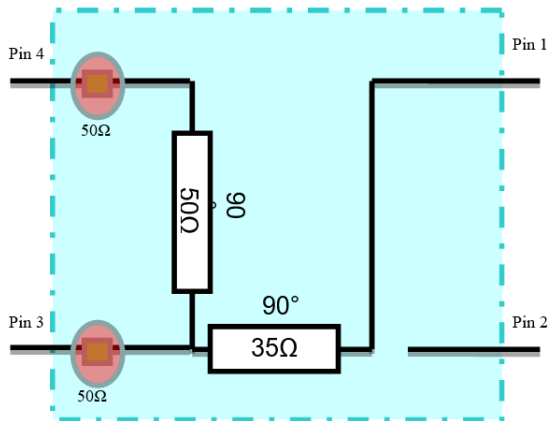
Mechanical Outline:



Doherty Amplifier Configuration:



Doherty Combiner Pin Configuration:

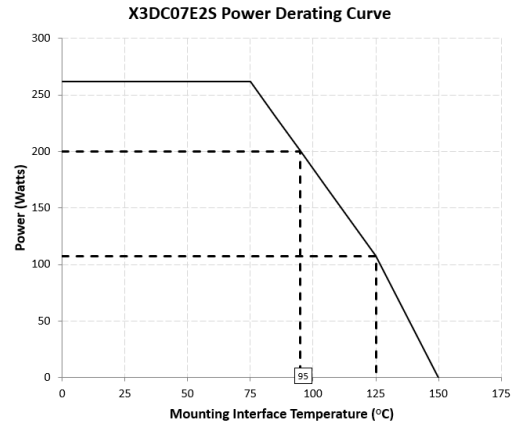
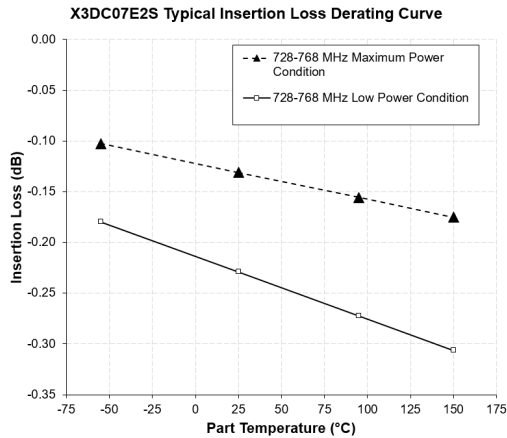


The X3DC07E2S has an orientation marker to denote Pin 1. Once port one has been identified the other ports are known automatically. Please see the chart below for clarification:

Pin 1	Pin 2	Pin 3	Pin 4
Combining Port	Not Used	Peak Amp Port	Main Amp Port

There are inevitably short lines associated with input ports in some high frequency band parts. The length of the short line is specified as electrical length at center frequency and noted as port extension in this datasheet. The designer should take this length into consideration to optimize the offset line length.

Insertion Loss and Power Derating Curves:



Insertion Loss Derating

The insertion loss, at a given frequency, of the Doherty Combiner 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.

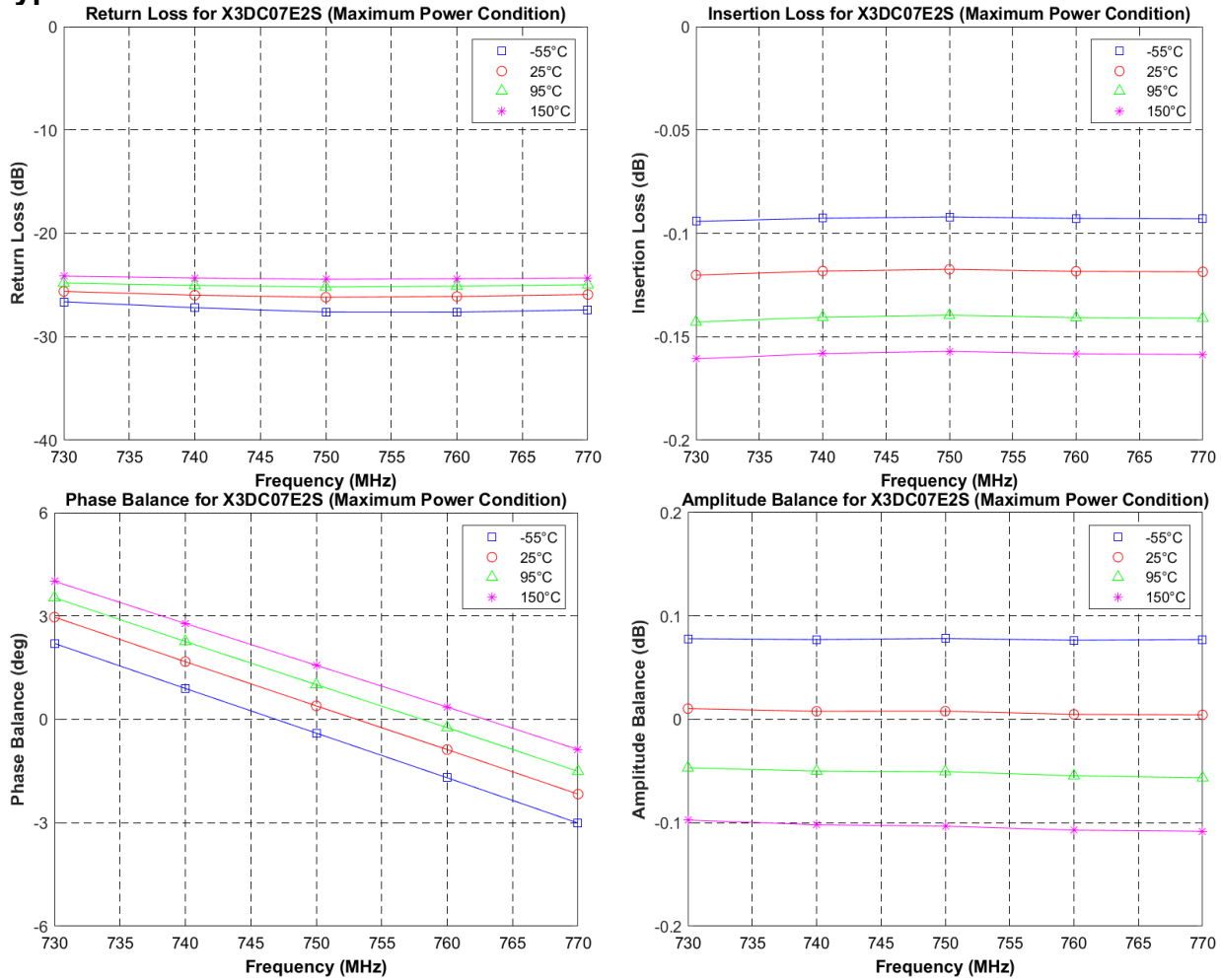
Power Derating

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 Doherty Combiner, and the thermal insertion loss. The thermal insertion loss is defined in the Power Handling section of the data sheet.

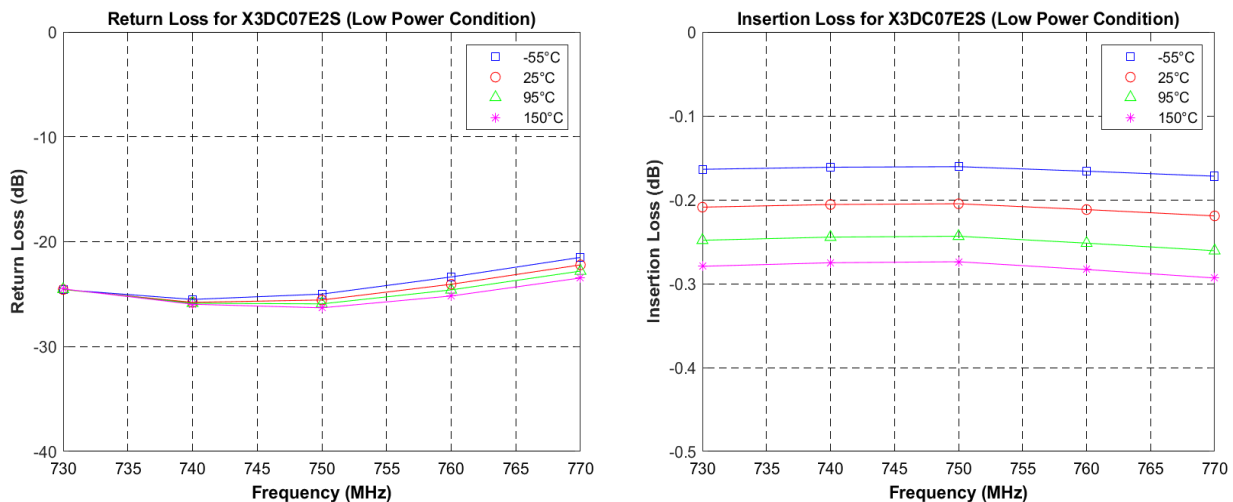
As the mounting interface temperature approaches the maximum continuous operating temperature, the power handling decreases to zero.

If the mounting temperature is greater than 95°C, the Xinger Doherty Combiner will perform reliably if the input power is derated to the curve above.

Typical Performance under Maximum Power Conditions:



Typical Performance Under Low Power Conditions:



Definition of the Specifications:

To guarantee the part performance in Doherty architecture, the part is specified in Doherty operation for maximum power condition and low power condition. The following specification definition assumes the extra port extension is already applied to the raw S parameter and the parts are measured with Pin n connected to Port n (where n=1, 2, 3, 4).

- Maximum power condition:**

Under the maximum power condition, the symmetrical Doherty architecture requires main amplifier and peak amplifier to work at full capacity with the optimum termination (50 Ω). The two amplifiers should deliver RF power of equal magnitude and 90-degree phase difference. Doherty combiner functions as a coherent power combiner and supplies the 90-degree phase compensation. The following specification is defined with 50 Ω port impedance at three ports for this condition. The return loss and the insertion loss in max power mode are not affected by the 50-ohm lossless port rotation mentioned in the electrical spec table on page 1. The phase imbalance and the amplitude imbalance are not affected either since port rotation is taken off equally from the main and the peak amp port.

Parameter	Definition	Mathematical Representation
Return Loss	The impedance matches at the combining port to a 50 Ω system.	$20 \log S_{11} $
Insertion Loss	The combined power divided by the sum of input power under the perfect combining condition	$10 \log (S_{13} ^2 + S_{14} ^2)$
Phase Imbalance	The phase difference between Peak-Combined path and Main-Combined path at $\omega_c = 748\text{MHz}$	$\text{Phase}(S_{14}(\omega_c)) - \text{Phase}(S_{13}(\omega_c))$
Amplitude Imbalance	The magnitude difference between Peak-Combined path and Main-Combined path	$\frac{20 \log S_{14} + 20 \log S_{13} }{2}$

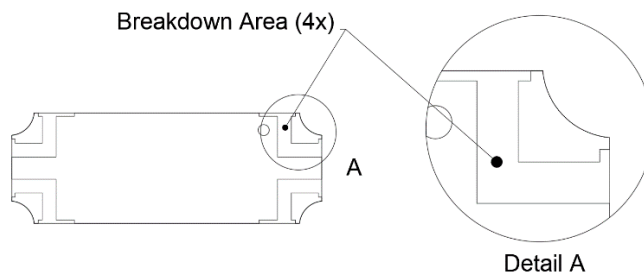
- Low power condition:**

Under low power conditions, the Doherty operation turns off peak amplifier and requires main amplifier to be terminated with double of the optimum impedance (100 Ω). In this configuration, Doherty combiner serves as an impedance transformer transforming 50 Ω at combining port to 100 Ω at main amplifier port. The following specification is defined under the port impedance condition of Port 1 (Combining Port) 50 Ω , Port 4 (Main Amp Port) 100 Ω and Port 3 (Peak Amp Port) open. With the peak amp left off, the extra line length in that port (see figure in page 2) acts as an open stub which shifts the low power mode return loss null and insertion loss. The offset line length needs to be adjusted taking the port rotation number into consideration so that the junction of 50 Ω and 35 Ω transmission line sees high impedance instead of the part edge. The return loss and the insertion loss defined below are after the offset line adjustments specified in the spec table.

Parameter	Definition	Mathematical Representation
Return Loss	The impedance match of the 50 to 100 Ω transformer	$20 \log S_{11} $
Insertion Loss	The output power divided by input power	$20 \log S_{41} $

Peak Power Handling:

High-Pot testing of these couplers during the qualification procedure resulted in a minimum breakdown voltage of 1.71Kv (minimum recorded value). This voltage level corresponds to a breakdown resistance capable of handling at least 12dB peak 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. 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).



Packaging and Ordering Information:

Parts are available in reel. Packaging follows EIA 481. Parts are oriented in tape and reel as shown below. Minimum order quantities are 2000 per reel.

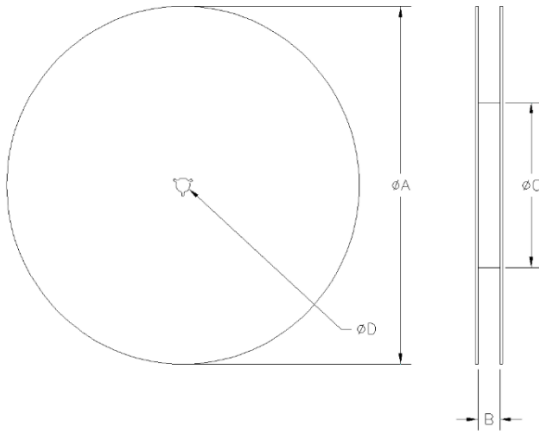
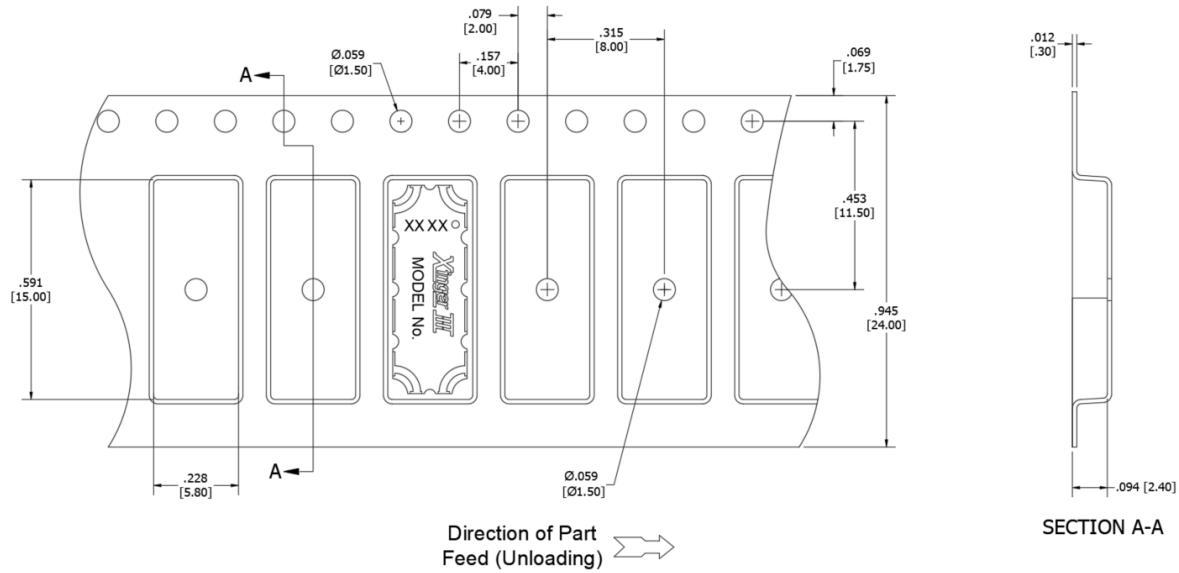


TABLE 1	
REEL DIMENSIONS (inches [mm])	
ØA	13.0 [330.0]
B	.945 [24.0]
ØC	4.017 [102.03]
ØD	0.512 [13.0]

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