



## MMIC DIE

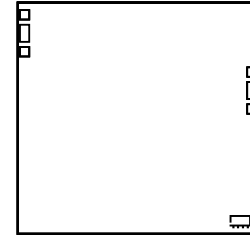
# X3 Frequency Multiplier

## CY3-453-D+

50Ω Output 20 to 45 GHz

### THE BIG DEAL

- Ultra-wideband, output from 20 to 45 GHz
- Wide input power range, +12 to +17 dBm
- Low Conversion Loss, 20 dB Typ.
- Good Fundamental and Harmonic Suppression:  
F1 > +40 dBc; F2 > +25 dBc; F4 > +35 dBc.



### +RoHS Compliant

The +Suffix identifies RoHS Compliance. See our website for methodologies and qualifications

### APPLICATIONS

- 5G MIMO and Back Haul Radio Systems
- Satellite Communications
- Test and Measurement Equipment
- Radar, EW, and ECM Defense Systems

SEE ORDERING INFORMATION ON THE LAST PAGE

### PRODUCT OVERVIEW

Mini-Circuits' CY3-453-D+ is an ultra-wideband MMIC Frequency Tripler, converting input frequencies from 6.66 to 15 GHz into output frequencies from 20 to 45 GHz. Its wide output range makes this model suitable for broadband systems as well as a wide variety of narrow-band applications. The CY3-453-D+ die utilizes GaAs HBT technology and is suitable for chip and wire assemblies.

### KEY FEATURES

Feature	Advantages
Broadband, 20 to 45 GHz output	With an output frequency range spanning 20 to 45 GHz, this multiplier supports broadband applications such as defense and instrumentation as well as a wide range of narrowband system requirements including 5G.
Excellent fundamental and harmonic suppression: <ul style="list-style-type: none"> <li>• F1, +40 dBc</li> <li>• F2, +25 dBc</li> <li>• F4, +35 dBc</li> </ul>	Reduces spurious signals and the need for additional filtering.
Unpackaged Die	Enable user to integrate it directly into hybrid chip and wire assemblies.
Wide input power range, +12 to +17 dBm	Wide input power signal range accommodates different input signal levels while still maintaining a low Conversion Loss.

REV. A  
ECO-018288  
CY3-453-D+  
MCL NY  
230711





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## ELECTRICAL SPECIFICATIONS<sup>1</sup> AT 25°C AND Z<sub>0</sub> = 50Ω, UNLESS NOTED OTHERWISE

Parameter	Condition (GHz)	RF Input = +16 dBm			Unit
		Min.	Typ.	Max.	
Multiplication Factor			3		
Frequency Range, Input (F1)		6.66	-	15	GHz
Frequency Range, Output (F2)		20	-	45	GHz
Input Power		15		17	dBm
Conversion Loss	6.66-8		20.0		dB
	8-10		19.3		
	10-12		19.0		
	12-15		20.3		
Harmonic Output <sup>2</sup>	F1	6.66-8		48	dBc
		8-10		44	
		10-12		42	
		12-15		37	
	F2	6.66-8		72	dBc
		8-10		38	
		10-12		29	
		12-15		25	
	F4	6.66-8		35	dBc
		8-10		33	
		10-12		31	
		12-15		36	

1. Electrical specifications are measured by soldering the die on Mini-Circuits Die Characterization Test Board and de-embedded to the bond wires

2. Harmonics of input frequency below the power of F3

## MAXIMUM RATINGS<sup>3</sup>

Parameter	Ratings
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C
RF Input Power	+22 dBm (5 minute max) +19 dBm (Continuous)

3. Permanent damage may occur if any of these limits are exceeded.





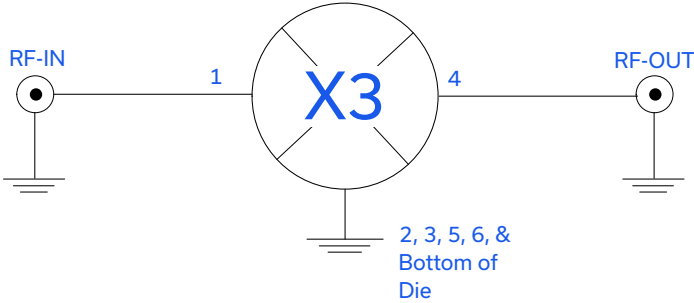
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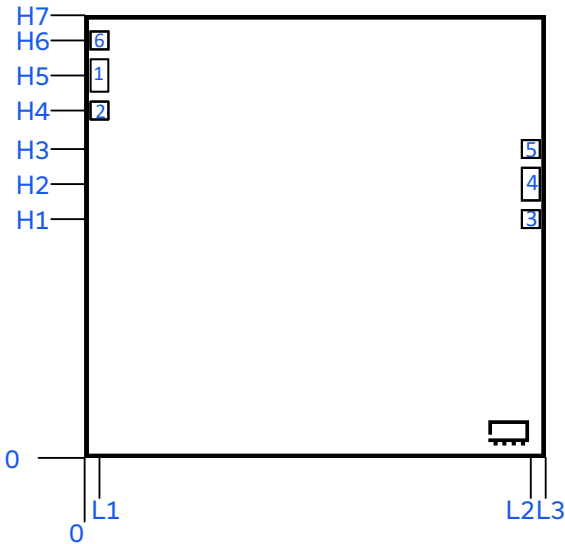
50Ω Output 20 to 45 GHz

## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



Function	Pad Number	Description
RF-IN	1	RF-Input Pad.
RF-OUT	4	RF-Output Pad.
Ground	2, 3, 5, 6 & Bottom of Die	The bond pads are connected to back-side through vias and do not require wire-bond connections to ground.

## BONDING PAD POSITION



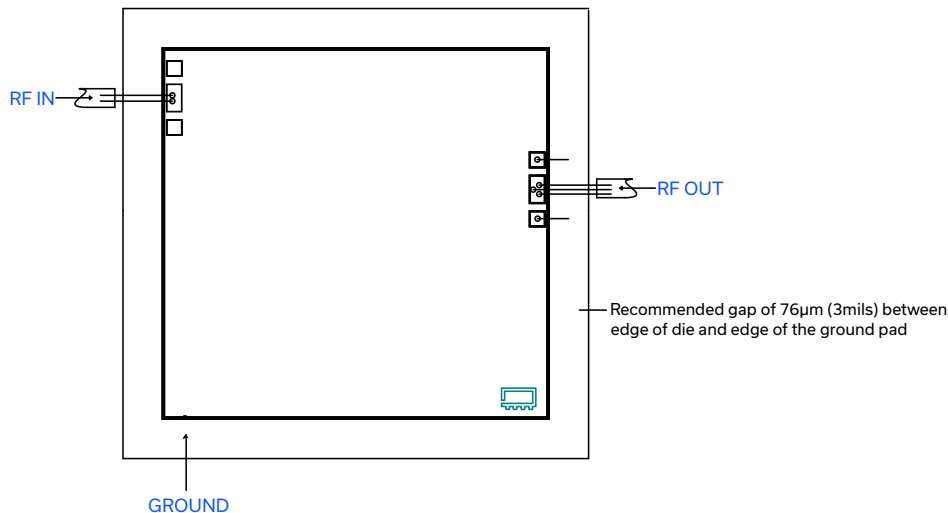
## DIMENSIONS IN $\mu\text{M}$ , TYPICAL

L1	L2	L3
81.0	2419.0	2500.0

H1	H2	H3	H4	H5	H6	H7
1295.0	1485.0	1675.0	1884.0	2074.0	2264.0	2400.0

Thickness	Die Size	Pad Size 1 & 4	Pad Size 2, 3, 5, & 6
100	2500 x 2400	92 x 172	92 x 92

## ASSEMBLY DIAGRAM



Note: bond wires should be as short as possible





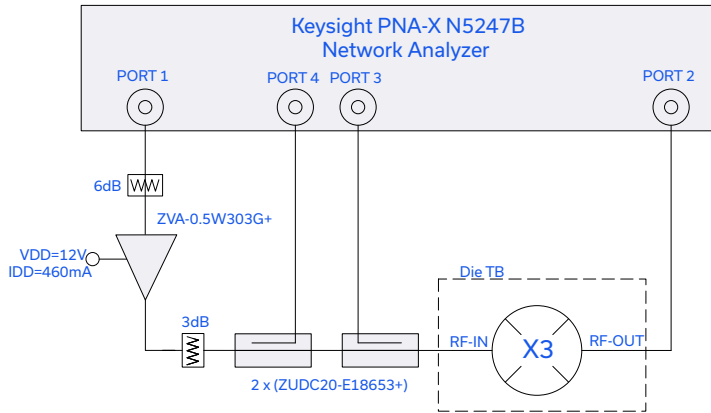
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### APPLICATION AND CHARACTERIZATION CIRCUIT




6 dB attenuator P/N BW-E6-1W653+  
 3 dB attenuator P/N BW-E3-1W653+

Figure 1: Block diagram of test circuit used for characterization

Note: DUT is soldered onto a Mini-Circuits Die Characterization Test Board and de-embedded to the bond wires. Conversion Loss and Harmonic Output are measured using PNA-X N5247B Network Analyzer

### ASSEMBLY PROCEDURE

- Storage**  
Die should be stored in a dry nitrogen purged desiccators or equivalent.
-  **ESD**  
MMIC HBT Multiplier die are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
- Die Handling and Attachment**  
Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition.
- Wire Bonding**  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the die gold bond pads. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged or substrate. All bond wire length and bond wire height should be kept as short as possible unless specified by the Assembly Drawing to minimize performance degradation due to undesirable series inductance





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# X3 Frequency Multiplier

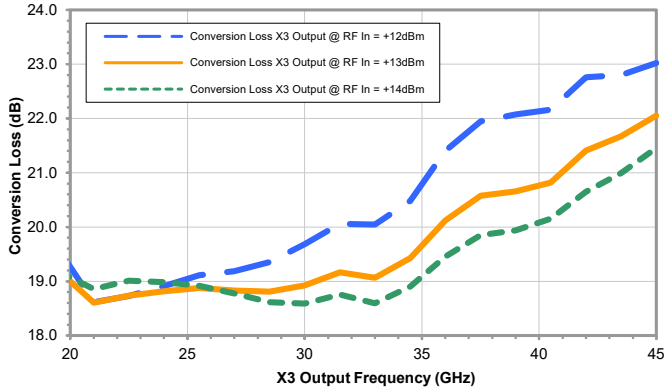
## CY3-453-D+

50Ω Output 20 to 45 GHz

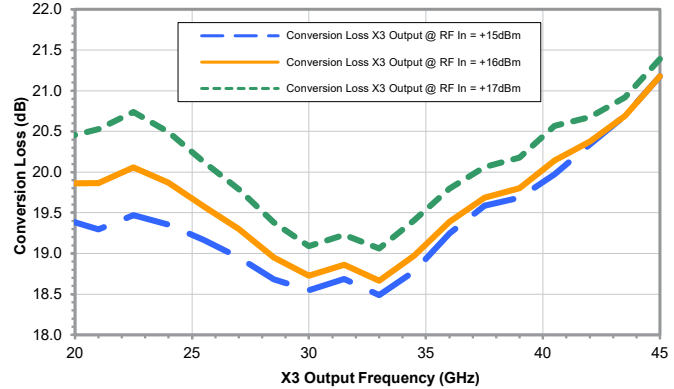
### TYPICAL PERFORMANCE CURVES

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3

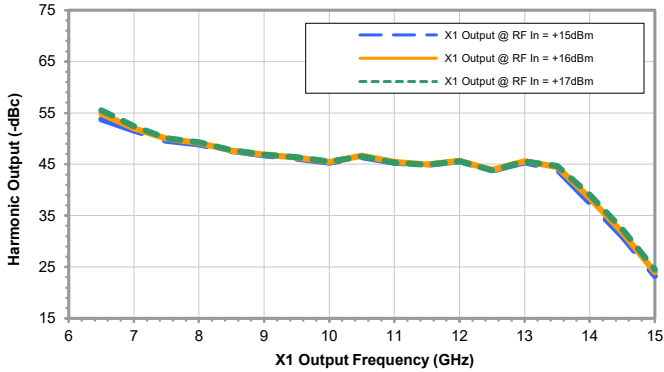
Conversion Loss X3 Output Vs Pin  
Temperature = +25°C



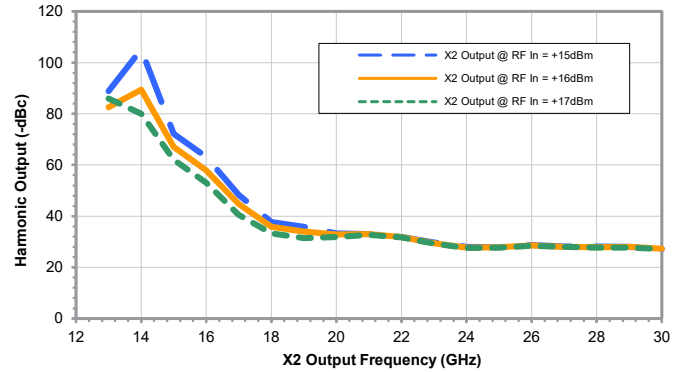
Conversion Loss X3 Output Vs Pin  
Temperature = +25°C



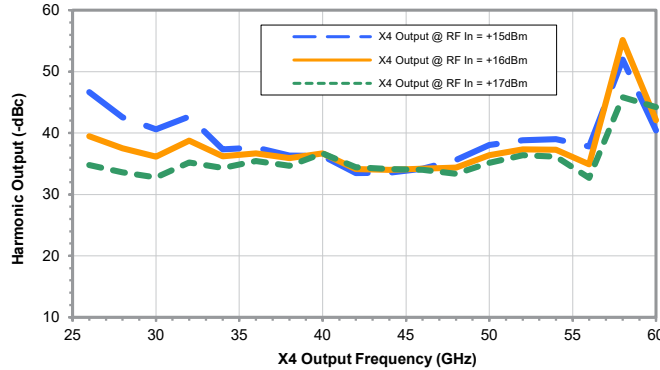
Harmonic X1 Output Vs Pin  
Temperature = +25°C



Harmonic X2 Output Vs Pin  
Temperature = +25°C



Harmonic X4 Output Vs Pin  
Temperature = +25°C





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# X3 Frequency Multiplier

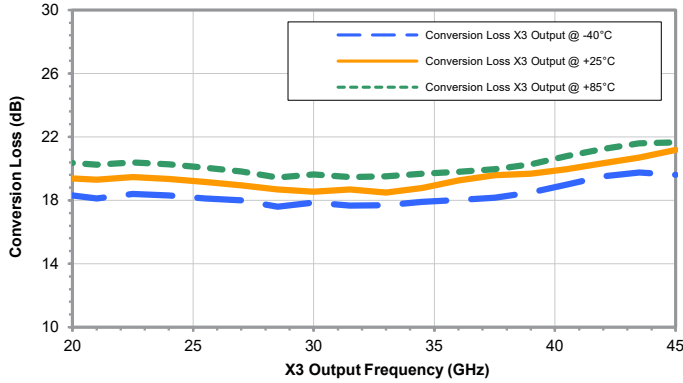
CY3-453-D+

50Ω Output 20 to 45 GHz

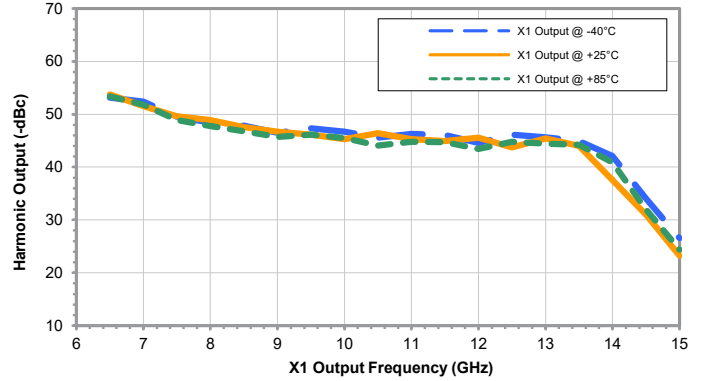
## TYPICAL PERFORMANCE CURVES

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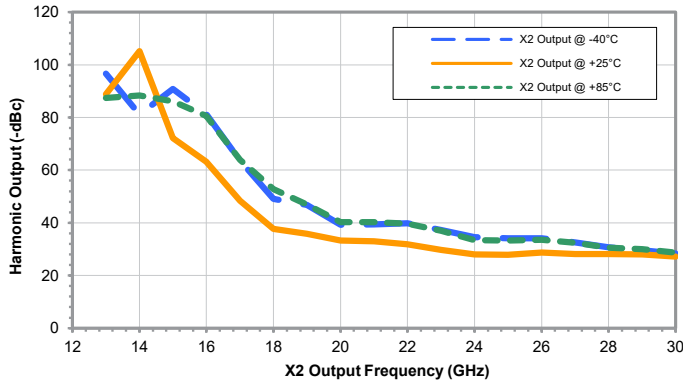
### Conversion Loss X3 Output Vs Temperature RF In = +15dBm



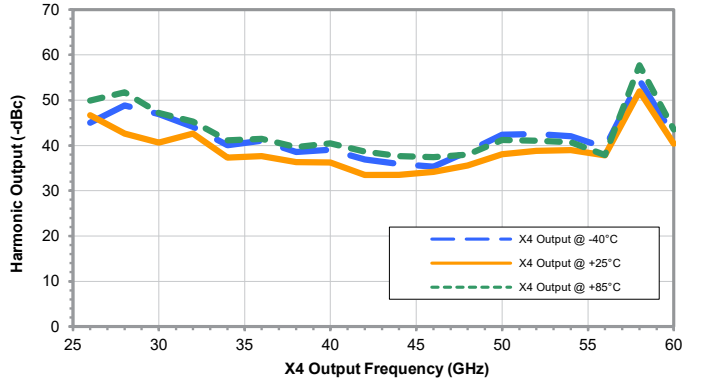
### Harmonic X1 Output Vs Temperature RF In = +15dBm



### Harmonic X2 Output Vs Temperature RF In = +15dBm



### Harmonic X4 Output Vs Temperature RF In = +15dBm





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# X3 Frequency Multiplier

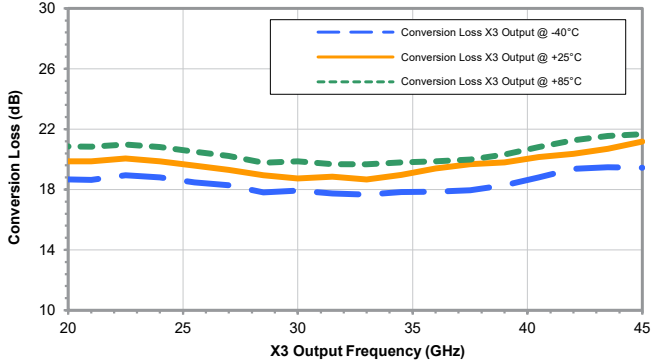
## CY3-453-D+

50Ω Output 20 to 45 GHz

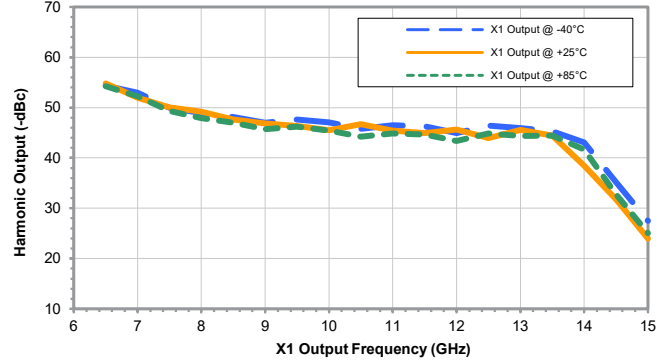
### TYPICAL PERFORMANCE CURVES

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3

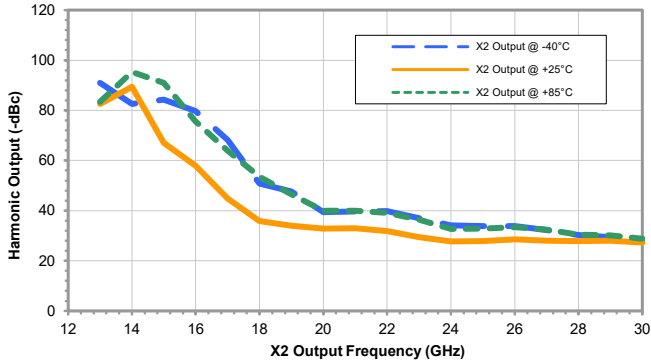
Conversion Loss X3 Output Vs Temperature  
RF In = +16dBm



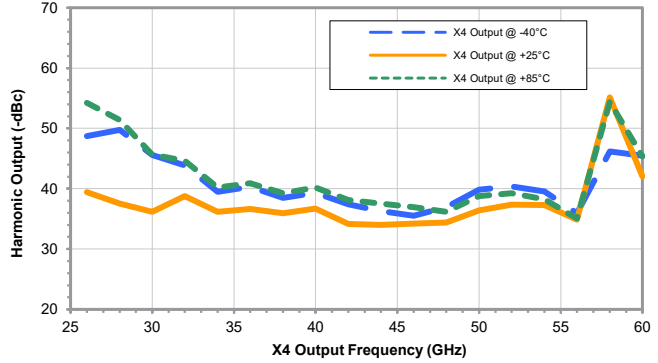
Harmonic X1 Output Vs Temperature  
RF In = +16dBm



Harmonic X2 Output Vs Temperature  
RF In = +16dBm



Harmonic X4 Output Vs Temperature  
RF In = +16dBm





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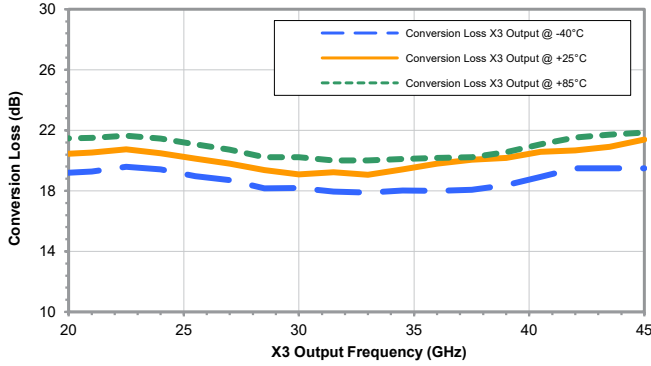
## CY3-453-D+

50Ω Output 20 to 45 GHz

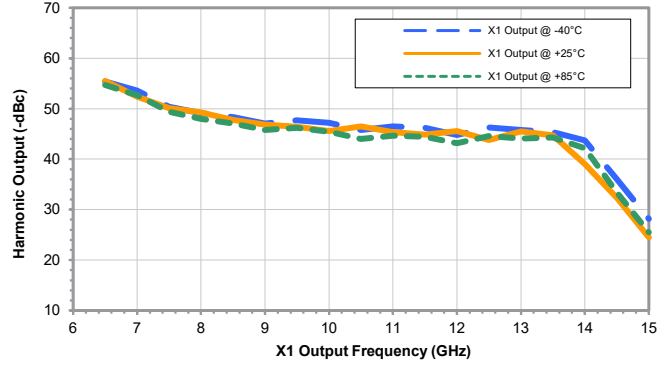
### TYPICAL PERFORMANCE CURVES

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3

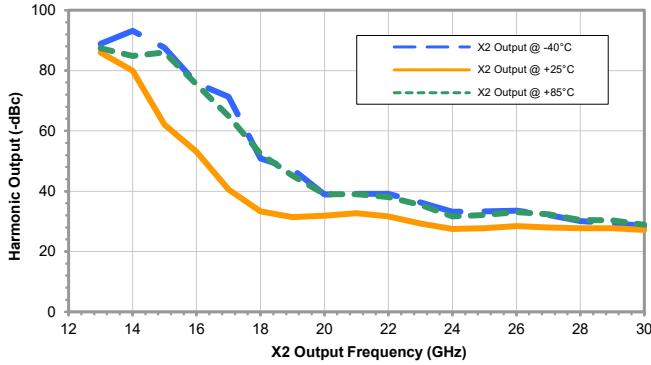
#### Conversion Loss X3 Output Vs Temperature RF In = +17dBm



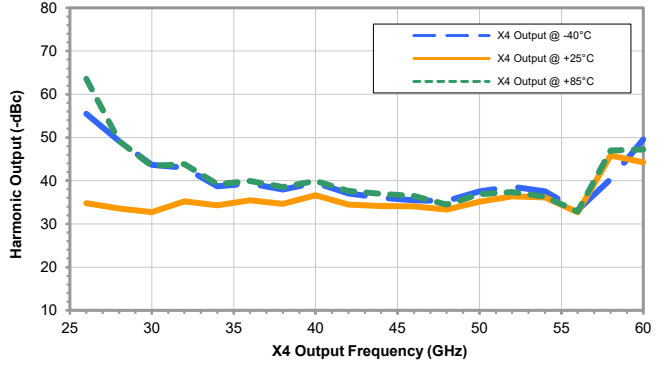
#### Harmonic X1 Output Vs Temperature RF In = +17dBm



#### Harmonic X2 Output Vs Temperature RF In = +17dBm



#### Harmonic X4 Output Vs Temperature RF In = +17dBm







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**CY3-453-D+**

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**ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD.**

<b>Performance Data</b>	Data Table
	Swept Graphs
<b>Case Style</b>	Die
<b>Die Ordering and packaging information</b>	Quantity, Package
	Model No. Gel - Pak: 5, 10, 50 Medium†, Partial wafer: <400 Full Wafer
<b>Die Marking</b>	EL-MUL-3
<b>Environmental Ratings</b>	ENV80

### NOTES

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
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## Typical Performance Data

TEST CONDITION: RF In = +15dBm

Frequency (GHz)				Temperature = -40°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	18.4	53.1	96.6	45.0
7.0	14.0	21.0	28.0	18.1	52.4	81.1	48.9
7.5	15.0	22.5	30.0	18.4	49.5	90.9	46.9
8.0	16.0	24.0	32.0	18.3	48.4	81.3	44.1
8.5	17.0	25.5	34.0	18.1	47.8	63.6	40.1
9.0	18.0	27.0	36.0	18.0	46.5	49.2	41.0
9.5	19.0	28.5	38.0	17.6	47.3	46.7	38.6
10.0	20.0	30.0	40.0	17.9	46.7	39.3	39.1
10.5	21.0	31.5	42.0	17.7	45.5	39.5	36.9
11.0	22.0	33.0	44.0	17.7	46.3	39.9	35.9
11.5	23.0	34.5	46.0	17.9	46.0	37.2	35.3
12.0	24.0	36.0	48.0	18.0	44.6	34.5	38.6
12.5	25.0	37.5	50.0	18.2	46.2	34.1	42.4
13.0	26.0	39.0	52.0	18.5	45.6	34.1	42.6
13.5	27.0	40.5	54.0	19.0	44.9	32.5	42.0
14.0	28.0	42.0	56.0	19.5	42.1	30.7	39.6
14.5	29.0	43.5	58.0	19.8	34.0	29.6	54.4
15.0	30.0	45.0	60.0	19.6	26.6	28.3	42.0

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	19.4	53.7	88.9	46.7
7.0	14.0	21.0	28.0	19.3	51.6	105.2	42.6
7.5	15.0	22.5	30.0	19.5	49.6	72.2	40.6
8.0	16.0	24.0	32.0	19.4	48.9	63.2	42.6
8.5	17.0	25.5	34.0	19.2	47.6	48.3	37.3
9.0	18.0	27.0	36.0	18.9	46.7	37.7	37.6
9.5	19.0	28.5	38.0	18.7	46.1	35.9	36.3
10.0	20.0	30.0	40.0	18.5	45.3	33.3	36.3
10.5	21.0	31.5	42.0	18.7	46.4	33.0	33.5
11.0	22.0	33.0	44.0	18.5	45.3	31.9	33.5
11.5	23.0	34.5	46.0	18.8	44.9	29.7	34.2
12.0	24.0	36.0	48.0	19.2	45.6	28.0	35.6
12.5	25.0	37.5	50.0	19.6	43.8	27.9	38.1
13.0	26.0	39.0	52.0	19.7	45.4	28.7	38.8
13.5	27.0	40.5	54.0	20.0	44.0	28.1	39.0
14.0	28.0	42.0	56.0	20.3	37.5	28.2	37.8
14.5	29.0	43.5	58.0	20.7	30.9	28.1	52.0
15.0	30.0	45.0	60.0	21.2	23.2	27.2	40.4

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	20.4	53.4	87.4	49.9
7.0	14.0	21.0	28.0	20.3	51.8	88.3	51.7
7.5	15.0	22.5	30.0	20.4	48.9	86.1	47.2
8.0	16.0	24.0	32.0	20.3	47.8	80.6	45.3
8.5	17.0	25.5	34.0	20.1	46.8	63.9	41.1
9.0	18.0	27.0	36.0	19.8	45.7	52.8	41.5
9.5	19.0	28.5	38.0	19.4	46.2	46.9	39.6
10.0	20.0	30.0	40.0	19.6	45.5	40.3	40.5
10.5	21.0	31.5	42.0	19.5	44.1	40.3	38.7
11.0	22.0	33.0	44.0	19.5	44.8	39.6	37.6
11.5	23.0	34.5	46.0	19.7	44.7	37.0	37.4
12.0	24.0	36.0	48.0	19.8	43.4	33.4	38.0
12.5	25.0	37.5	50.0	20.0	44.8	33.3	41.2
13.0	26.0	39.0	52.0	20.3	44.4	33.6	41.0
13.5	27.0	40.5	54.0	20.8	44.2	32.4	40.7
14.0	28.0	42.0	56.0	21.2	40.9	30.6	37.9
14.5	29.0	43.5	58.0	21.6	31.9	29.9	57.7
15.0	30.0	45.0	60.0	21.7	24.4	28.7	43.5

\* Harmonic Output below power level of X3 Output

## Typical Performance Data

TEST CONDITION: RF In = +16dBm

Frequency (GHz)				Temperature = -40°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	18.7	54.4	91.0	48.8
7.0	14.0	21.0	28.0	18.6	52.9	82.6	49.7
7.5	15.0	22.5	30.0	18.9	50.0	84.3	45.6
8.0	16.0	24.0	32.0	18.8	48.9	79.7	43.9
8.5	17.0	25.5	34.0	18.5	48.1	68.1	39.5
9.0	18.0	27.0	36.0	18.3	47.0	50.8	40.3
9.5	19.0	28.5	38.0	17.8	47.6	47.7	38.5
10.0	20.0	30.0	40.0	17.9	47.0	39.4	39.3
10.5	21.0	31.5	42.0	17.7	45.7	39.6	37.4
11.0	22.0	33.0	44.0	17.7	46.5	39.8	36.3
11.5	23.0	34.5	46.0	17.8	46.3	37.0	35.5
12.0	24.0	36.0	48.0	17.9	44.9	34.1	36.9
12.5	25.0	37.5	50.0	18.0	46.4	33.9	39.9
13.0	26.0	39.0	52.0	18.3	45.9	33.9	40.4
13.5	27.0	40.5	54.0	18.8	45.3	32.3	39.6
14.0	28.0	42.0	56.0	19.4	43.1	30.3	35.9
14.5	29.0	43.5	58.0	19.5	35.1	29.5	46.2
15.0	30.0	45.0	60.0	19.4	27.5	28.5	45.5

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	19.9	54.8	82.5	39.5
7.0	14.0	21.0	28.0	19.9	52.0	89.4	37.5
7.5	15.0	22.5	30.0	20.1	50.0	67.1	36.2
8.0	16.0	24.0	32.0	19.9	49.2	57.9	38.8
8.5	17.0	25.5	34.0	19.6	47.6	44.8	36.2
9.0	18.0	27.0	36.0	19.3	46.9	35.9	36.7
9.5	19.0	28.5	38.0	19.0	46.3	33.9	35.9
10.0	20.0	30.0	40.0	18.7	45.5	32.8	36.7
10.5	21.0	31.5	42.0	18.9	46.7	33.1	34.1
11.0	22.0	33.0	44.0	18.7	45.4	31.9	34.0
11.5	23.0	34.5	46.0	19.0	45.0	29.4	34.2
12.0	24.0	36.0	48.0	19.4	45.6	27.7	34.4
12.5	25.0	37.5	50.0	19.7	43.9	27.8	36.4
13.0	26.0	39.0	52.0	19.8	45.6	28.5	37.4
13.5	27.0	40.5	54.0	20.1	44.5	28.0	37.3
14.0	28.0	42.0	56.0	20.4	38.5	27.9	34.9
14.5	29.0	43.5	58.0	20.7	31.7	28.0	55.1
15.0	30.0	45.0	60.0	21.2	24.0	27.3	42.1

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	20.9	54.2	83.4	54.3
7.0	14.0	21.0	28.0	20.8	52.3	95.3	51.4
7.5	15.0	22.5	30.0	21.0	49.3	90.9	45.6
8.0	16.0	24.0	32.0	20.8	47.9	75.6	44.7
8.5	17.0	25.5	34.0	20.5	47.0	63.8	40.2
9.0	18.0	27.0	36.0	20.2	45.7	53.6	40.9
9.5	19.0	28.5	38.0	19.8	46.2	46.5	39.2
10.0	20.0	30.0	40.0	19.9	45.4	39.9	40.2
10.5	21.0	31.5	42.0	19.7	44.2	39.9	38.1
11.0	22.0	33.0	44.0	19.7	44.8	39.1	37.5
11.5	23.0	34.5	46.0	19.8	44.7	36.4	36.9
12.0	24.0	36.0	48.0	19.9	43.4	32.7	36.2
12.5	25.0	37.5	50.0	20.0	44.9	32.9	38.8
13.0	26.0	39.0	52.0	20.3	44.4	33.4	39.3
13.5	27.0	40.5	54.0	20.8	44.4	32.3	38.2
14.0	28.0	42.0	56.0	21.3	41.7	30.5	35.1
14.5	29.0	43.5	58.0	21.5	32.7	30.2	54.4
15.0	30.0	45.0	60.0	21.7	25.0	28.8	45.4

\* Harmonic Output below power level of X3 Output

## Typical Performance Data

TEST CONDITION: RF In = +17dBm

Frequency (GHz)				Temperature = -40°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	19.2	55.4	88.9	55.5
7.0	14.0	21.0	28.0	19.3	53.6	93.2	49.2
7.5	15.0	22.5	30.0	19.6	50.4	87.6	43.6
8.0	16.0	24.0	32.0	19.4	49.1	75.8	43.0
8.5	17.0	25.5	34.0	19.0	48.3	71.3	38.7
9.0	18.0	27.0	36.0	18.7	47.1	50.9	39.4
9.5	19.0	28.5	38.0	18.2	47.7	47.4	38.0
10.0	20.0	30.0	40.0	18.2	47.2	38.9	39.6
10.5	21.0	31.5	42.0	17.9	45.8	39.1	37.1
11.0	22.0	33.0	44.0	17.9	46.5	39.1	36.0
11.5	23.0	34.5	46.0	18.0	46.2	36.3	35.4
12.0	24.0	36.0	48.0	18.0	44.8	33.2	35.3
12.5	25.0	37.5	50.0	18.1	46.3	33.3	37.5
13.0	26.0	39.0	52.0	18.4	45.8	33.6	38.6
13.5	27.0	40.5	54.0	18.9	45.4	32.1	37.5
14.0	28.0	42.0	56.0	19.5	43.7	30.1	33.2
14.5	29.0	43.5	58.0	19.5	36.0	29.4	40.3
15.0	30.0	45.0	60.0	19.5	28.2	28.5	49.6

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	20.4	55.5	86.0	34.8
7.0	14.0	21.0	28.0	20.5	52.4	80.0	33.6
7.5	15.0	22.5	30.0	20.7	50.1	62.0	32.8
8.0	16.0	24.0	32.0	20.5	49.3	53.1	35.2
8.5	17.0	25.5	34.0	20.1	47.7	40.5	34.3
9.0	18.0	27.0	36.0	19.8	46.9	33.3	35.4
9.5	19.0	28.5	38.0	19.4	46.4	31.4	34.7
10.0	20.0	30.0	40.0	19.1	45.5	31.9	36.7
10.5	21.0	31.5	42.0	19.2	46.5	32.8	34.4
11.0	22.0	33.0	44.0	19.1	45.3	31.7	34.2
11.5	23.0	34.5	46.0	19.4	44.9	29.2	34.0
12.0	24.0	36.0	48.0	19.8	45.6	27.5	33.3
12.5	25.0	37.5	50.0	20.1	43.8	27.8	35.2
13.0	26.0	39.0	52.0	20.2	45.5	28.5	36.4
13.5	27.0	40.5	54.0	20.6	44.7	28.0	36.1
14.0	28.0	42.0	56.0	20.7	39.0	27.7	32.7
14.5	29.0	43.5	58.0	20.9	32.3	27.7	45.8
15.0	30.0	45.0	60.0	21.4	24.5	27.2	44.2

\* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss X3 Output	X1 Output	X2 Output	X4 Output
6.5	13.0	19.5	26.0	21.5	54.7	87.4	63.6
7.0	14.0	21.0	28.0	21.5	52.7	84.8	49.2
7.5	15.0	22.5	30.0	21.7	49.4	86.0	43.4
8.0	16.0	24.0	32.0	21.5	47.9	75.5	43.8
8.5	17.0	25.5	34.0	21.1	47.0	64.9	39.2
9.0	18.0	27.0	36.0	20.7	45.8	52.4	40.0
9.5	19.0	28.5	38.0	20.2	46.2	45.2	38.6
10.0	20.0	30.0	40.0	20.2	45.5	39.0	40.0
10.5	21.0	31.5	42.0	20.0	44.0	39.0	37.6
11.0	22.0	33.0	44.0	20.0	44.7	38.0	37.0
11.5	23.0	34.5	46.0	20.1	44.4	35.4	36.5
12.0	24.0	36.0	48.0	20.2	43.2	31.6	34.4
12.5	25.0	37.5	50.0	20.2	44.6	32.1	36.8
13.0	26.0	39.0	52.0	20.6	44.1	33.1	37.4
13.5	27.0	40.5	54.0	21.1	44.3	32.4	36.3
14.0	28.0	42.0	56.0	21.5	42.2	30.5	32.8
14.5	29.0	43.5	58.0	21.7	33.3	30.3	47.0
15.0	30.0	45.0	60.0	21.9	25.5	28.9	47.2

\* Harmonic Output below power level of X3 Output

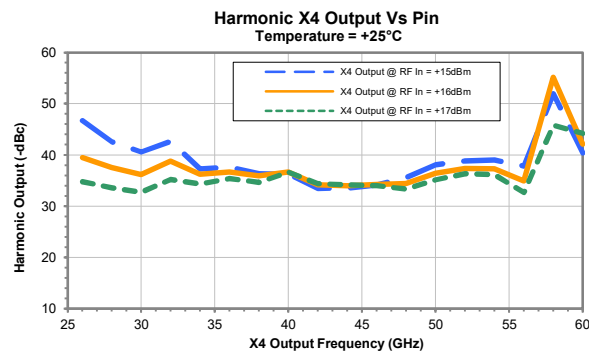
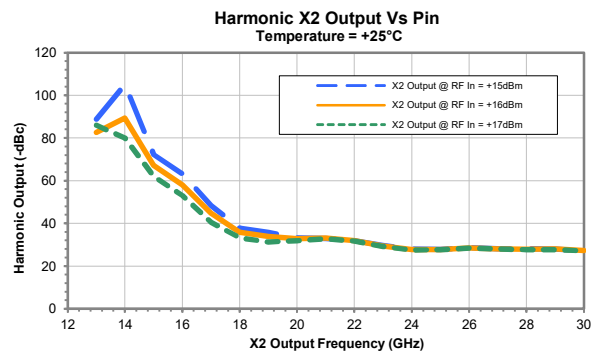
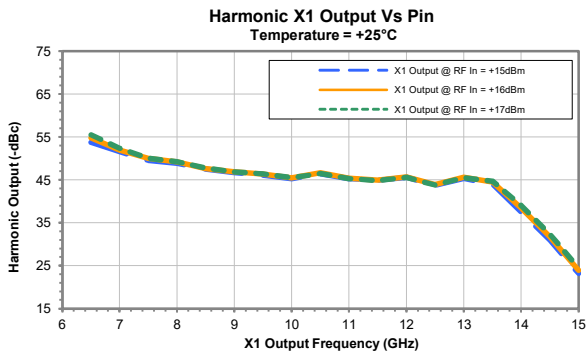
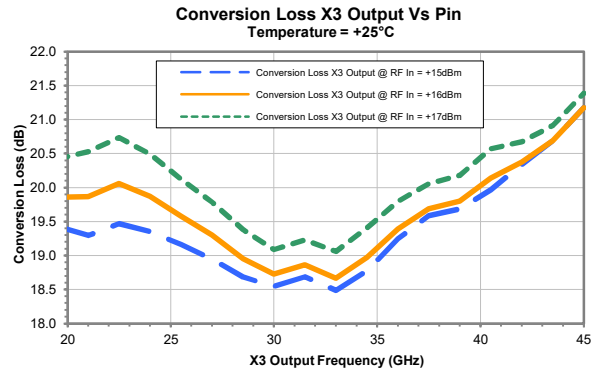
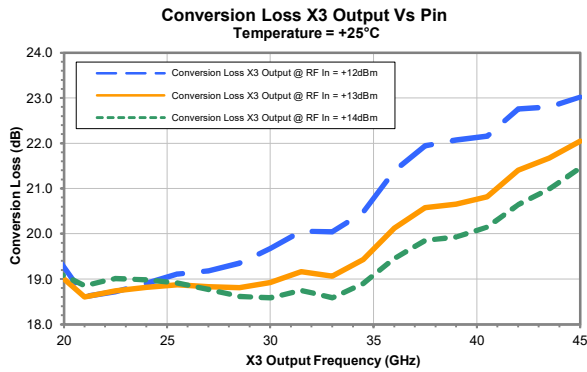
## Typical Performance Data

TEST CONDITION: RF In = +12dBm to 14dBm

Frequency (GHz)				Temperature = +25°C		
X1 Output	X2 Output	X3 Output	X4 Output	Conversion Loss		
				12dBm	13dBm	14dBm
6.5	13.0	19.5	26.0	19.6	19.2	19.2
7.0	14.0	21.0	28.0	18.6	18.6	18.9
7.5	15.0	22.5	30.0	18.7	18.7	19.0
8.0	16.0	24.0	32.0	18.9	18.8	19.0
8.5	17.0	25.5	34.0	19.1	18.9	18.9
9.0	18.0	27.0	36.0	19.2	18.8	18.8
9.5	19.0	28.5	38.0	19.4	18.8	18.6
10.0	20.0	30.0	40.0	19.7	18.9	18.6
10.5	21.0	31.5	42.0	20.1	19.2	18.8
11.0	22.0	33.0	44.0	20.0	19.1	18.6
11.5	23.0	34.5	46.0	20.5	19.4	18.9
12.0	24.0	36.0	48.0	21.4	20.1	19.5
12.5	25.0	37.5	50.0	21.9	20.6	19.9
13.0	26.0	39.0	52.0	22.1	20.7	19.9
13.5	27.0	40.5	54.0	22.2	20.8	20.2
14.0	28.0	42.0	56.0	22.8	21.4	20.6
14.5	29.0	43.5	58.0	22.8	21.7	21.0
15.0	30.0	45.0	60.0	23.0	22.1	21.5

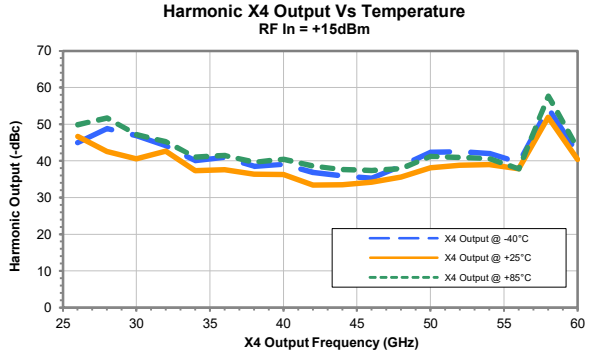
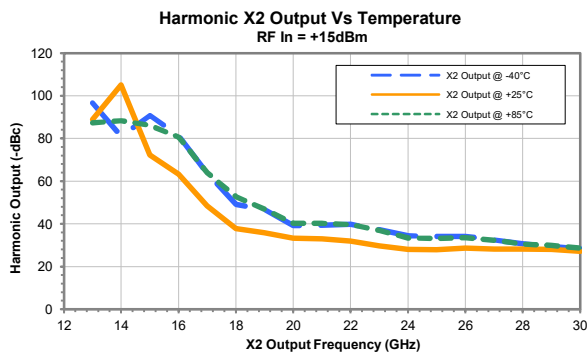
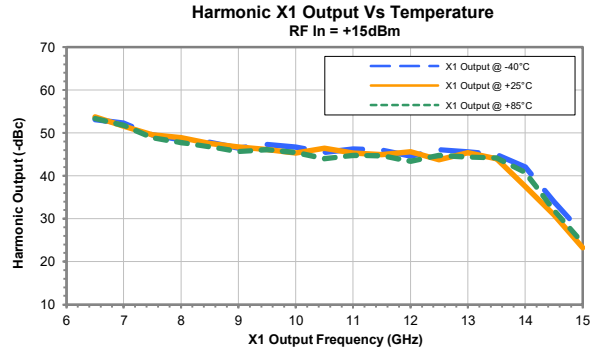
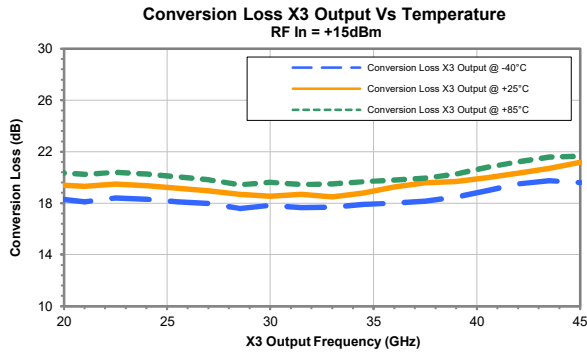
## Typical Performance Curves

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3



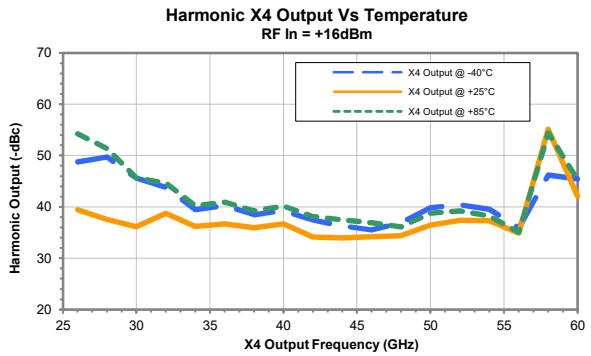
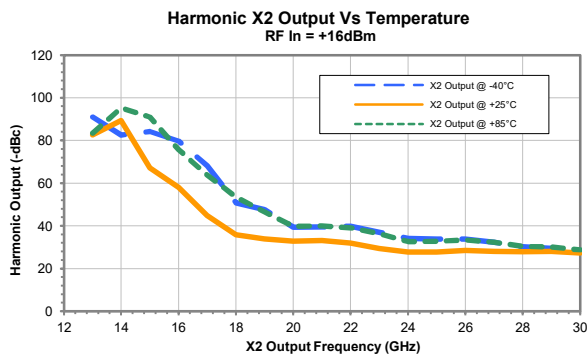
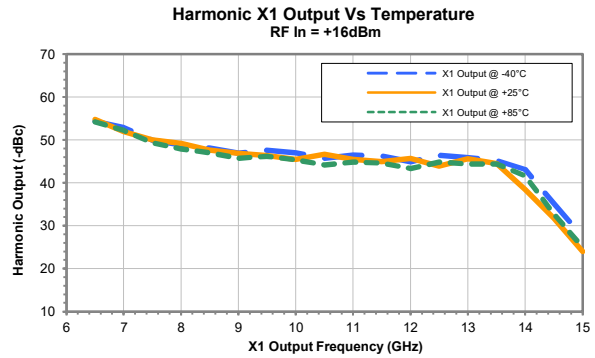
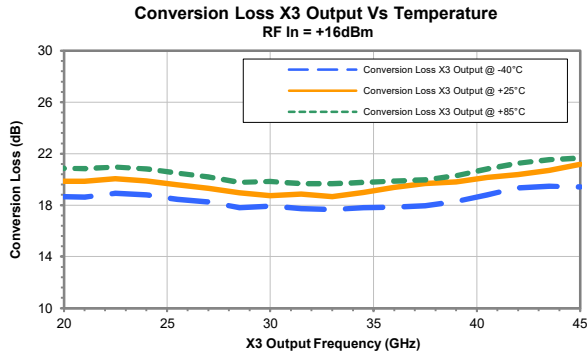
## Typical Performance Curves

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3



## Typical Performance Curves

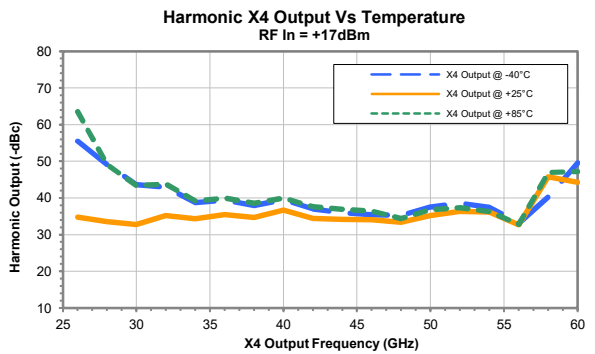
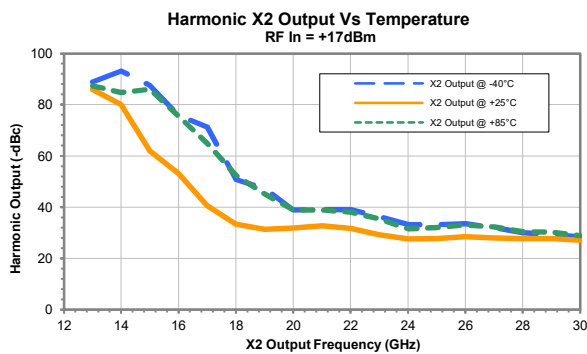
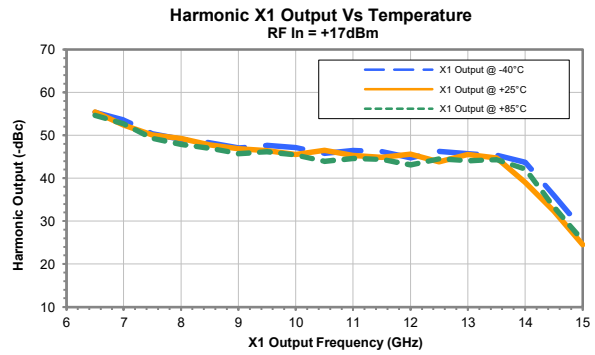
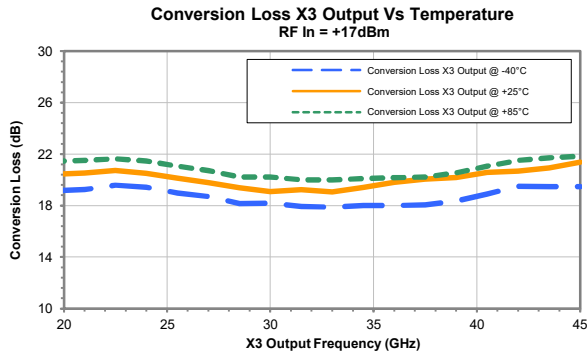
Note: Harmonics data is presented as the harmonic of input frequency below the power of F3





## Typical Performance Curves

Note: Harmonics data is presented as the harmonic of input frequency below the power of F3





All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

Specification	Test/Inspection Condition	Reference/Spec
Operating Temperature	-40° to 85° C or -40° to 105° C or -55° to 105° C or -45° to 105° C Ambient Environment	Refer to Individual Model Data Sheet
Storage Environment (Die)	-65° to 150°C	Individual Model Data Sheet
Storage Environment(Packaging)	-40° to 70°C and 40 to 60% humidity (In Factory Shipped Package)	