MMIC DIE

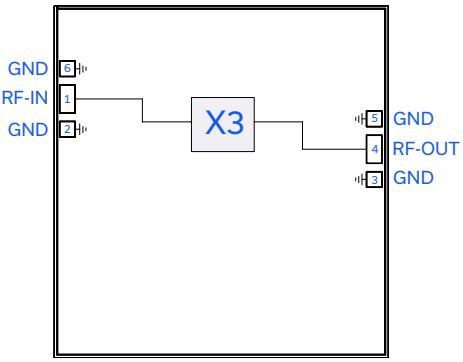
X3 Frequency Multiplier CY3-723-D+

50Ω Output 40 to 72 GHz

THE BIG DEAL

- Wideband Output Frequency: 40 to 72 GHz
- Excellent Fundamental and Harmonic Suppression:
  - F1: 41 dBc Typ.
  - F2: 33 dBc Typ.
  - F4: 33 dBc Typ.
- Input Drive Level: +12 to +19 dBm
- Conversion Loss: 21.1 dB Typ.

FUNCTIONAL DIAGRAM



SEE ORDERING INFORMATION ON THE LAST PAGE

APPLICATIONS

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

PRODUCT OVERVIEW

Mini-Circuits' CY3-723-D+ is a wideband MMIC Frequency Tripler, converting input frequencies from 13.3 to 24 GHz into output frequencies from 40 to 72 GHz. Its wide output range makes this model suitable for broadband systems as well as a wide variety of narrow-band applications. The CY3-723-D+ die utilizes GaAs HBT technology and is suitable for chip and wire assemblies.

KEY FEATURES

Features	Advantages
Broadband, 40 to 72 GHz output	With an output frequency range spanning 40 to 72 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: • F1, 41 dBc Typ. • F2, 33 dBc Typ. • F4, 33 dBc Typ.	Harmonic and fundamental filtering requirements are dramatically simplified due to the high suppression resulting from internal cancellation within the diode configuration.
Wide input power range, +12 to +19 dBm	Wide input power signal range accommodates different input signal levels while still maintain low conversion loss.
Unpackaged Die	Enables integration into hybrid chip and wire assemblies.

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ELECTRICAL SPECIFICATIONS[1,3] AT +25°C AND Zo = 50Ω, UNLESS NOTED OTHERWISE

Parameter		Input Frequency (GHz)	Min	Typ.	Max.	Unit
Multiplication Factor				3		
Frequency Range, Input (F1)			13.33	-	22.33	GHz
Frequency Range, Output (F3)			40	-	72	GHz
Input Power			+12	+18	+19	dBm
Conversion Loss (F3)		13.3 - 15		20.5		dB
		15 - 16.6		19.5		
		16.6 - 18.3		20.1		
		18.3 - 20		21.7		
		20 - 22.3		23.6		
		22.3 - 24		25.0		
Harmonic Output[2]	F1	13.3 - 15		50		dBc
		15 - 16.6		50		
		16.6 - 18.3		42		
		18.3 - 20		36		
		20 - 22.3		30		
		22.3 - 24		28		
	F2	13.3 - 15		49		dBc
		15 - 16.6		41		
		16.6 - 18.3		31		
		18.3 - 20		25		
		20 - 22.3		22		
		22.3 - 24		19		
	F4	13.3 - 15		31		dBc
		15 - 16.6		42		
		16.6 - 18.3		31		
		18.3 - 20		36		
		20 - 22.3		28		
		22.3 - 24		28		

1. Measured on Mini-Circuits Die Evaluation board. See Figure 3 for test conditions.
2. Harmonics of input frequency below the power of desired output F3.
3. All specifications are measured with RF input power = +18 dBm.

X3 Frequency Multiplier CY3-723-D+

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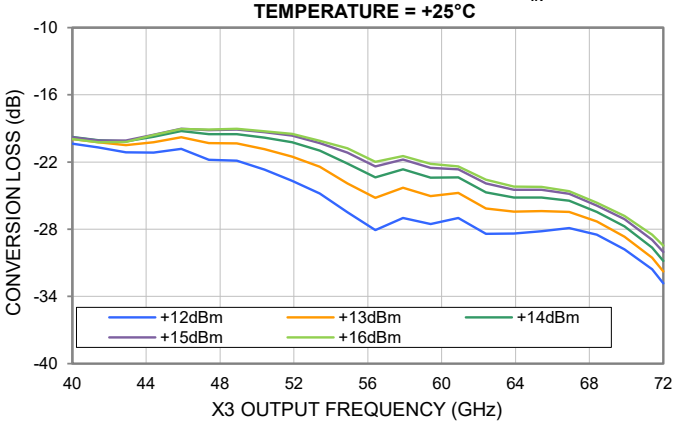
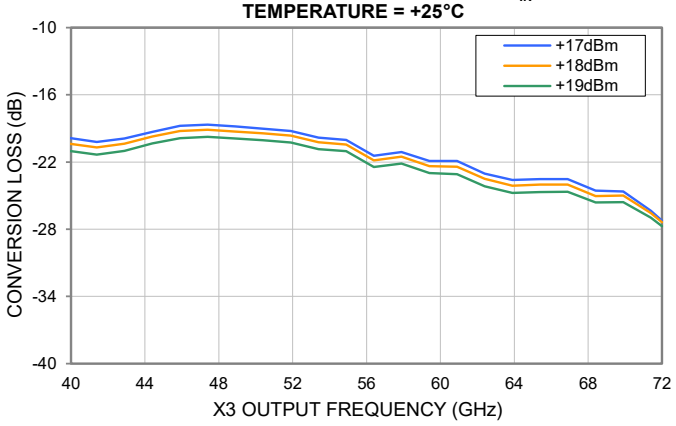
TYPICAL PERFORMANCE GRAPHS

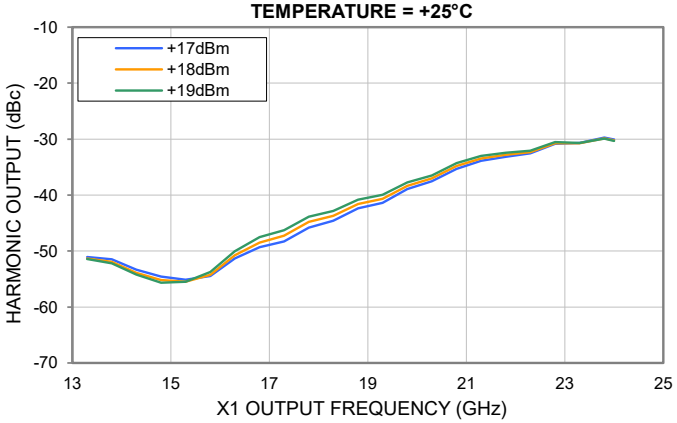
CONVERSION LOSS X3 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



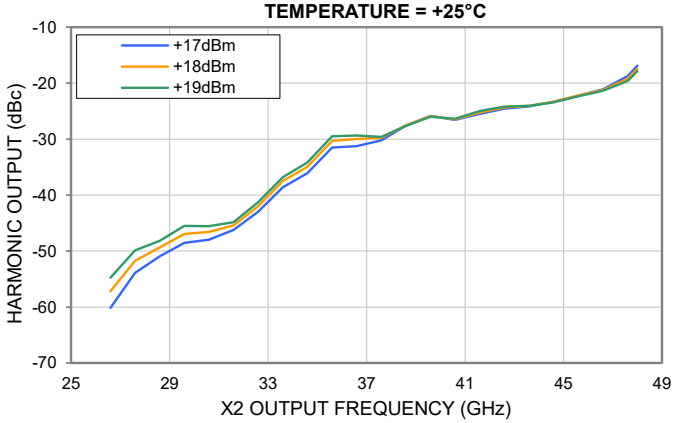
CONVERSION LOSS X3 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



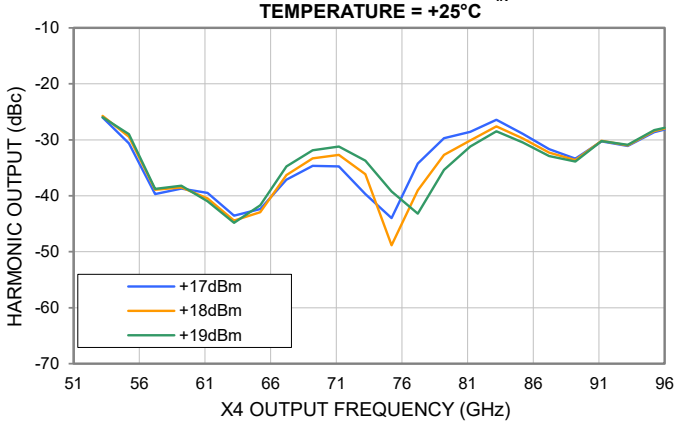
HARMONIC X1 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



HARMONIC X2 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



HARMONIC X4 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



X3 Frequency Multiplier CY3-723-D+

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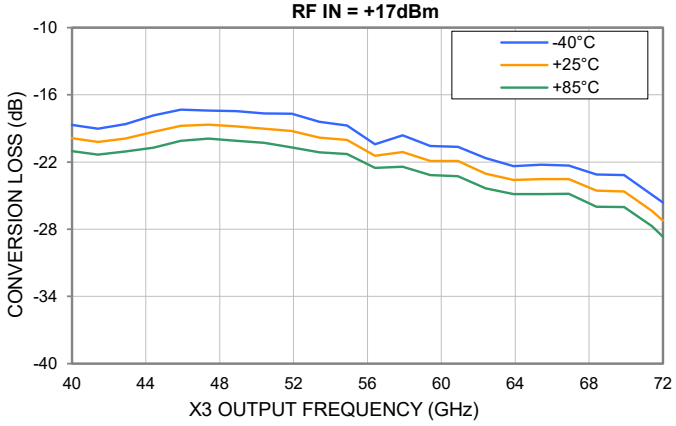
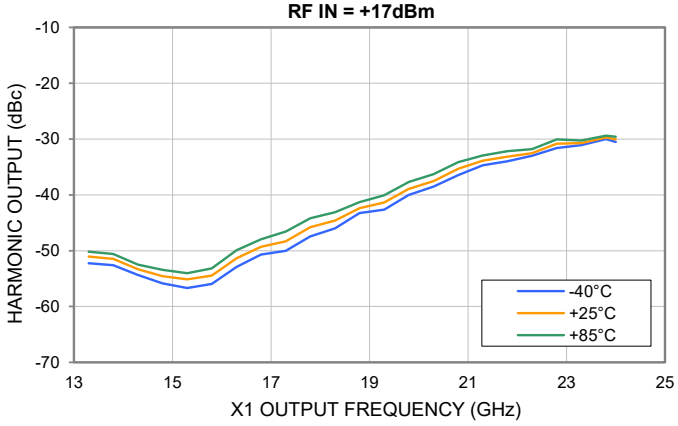
TYPICAL PERFORMANCE GRAPHS

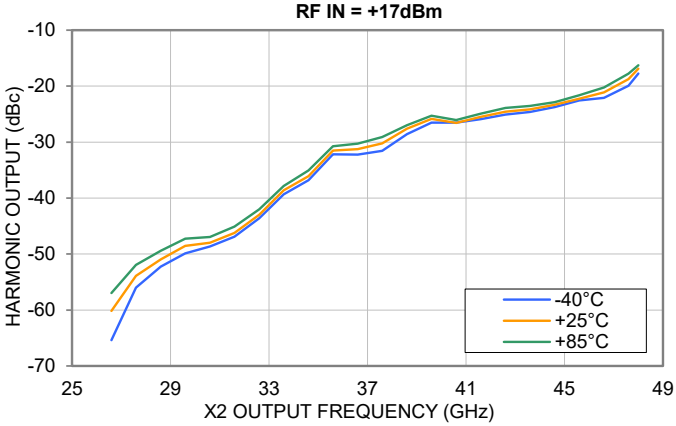
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



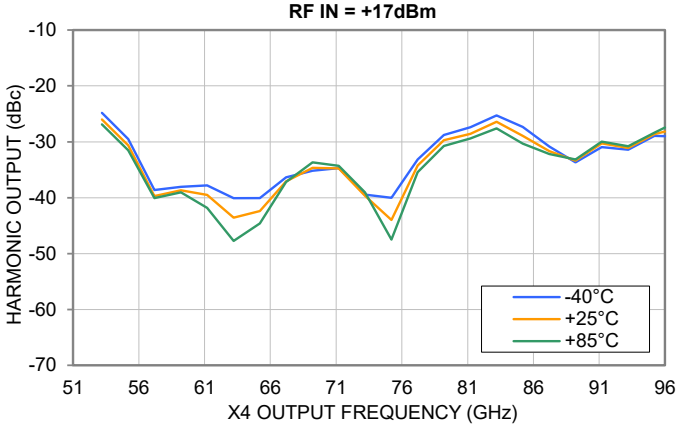
HARMONIC X1 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



HARMONIC X4 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



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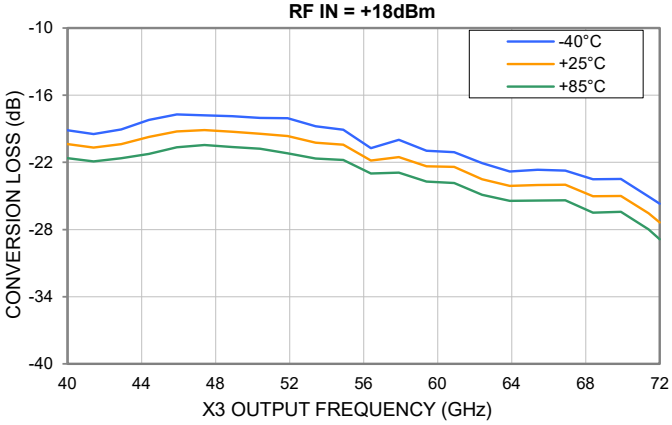
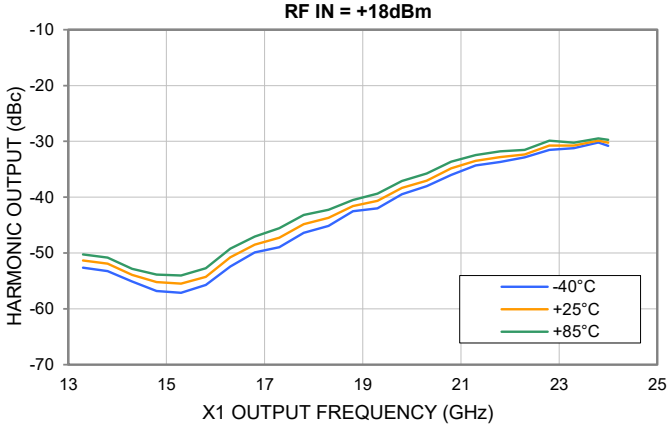
TYPICAL PERFORMANCE GRAPHS

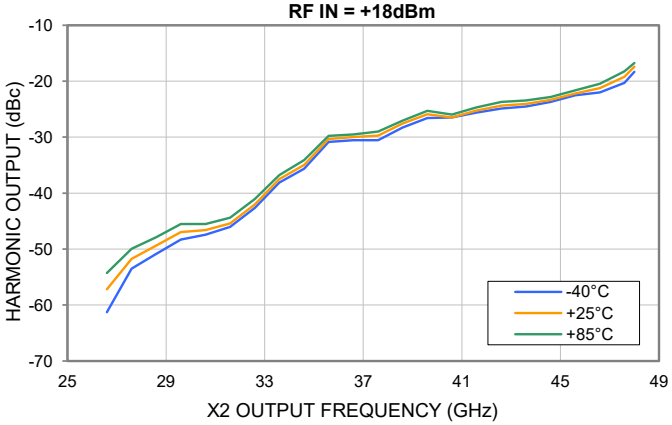
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



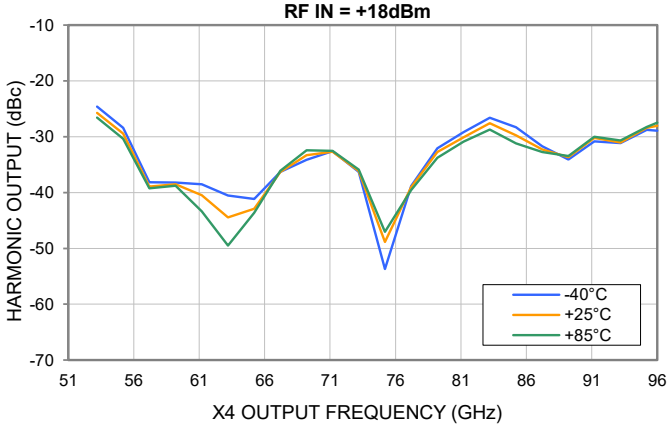
HARMONIC X1 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



HARMONIC X4 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



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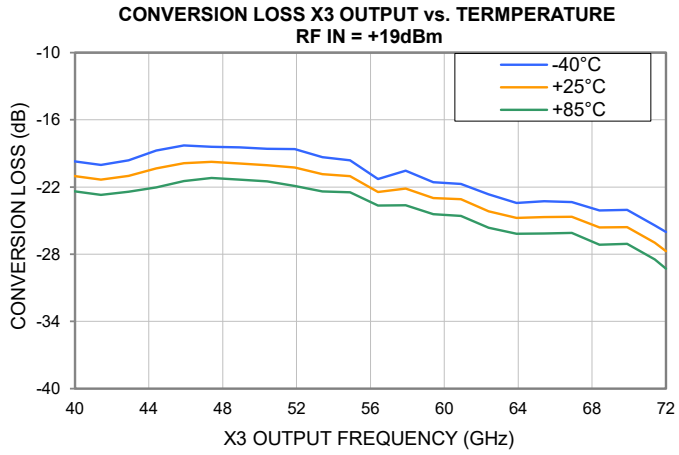
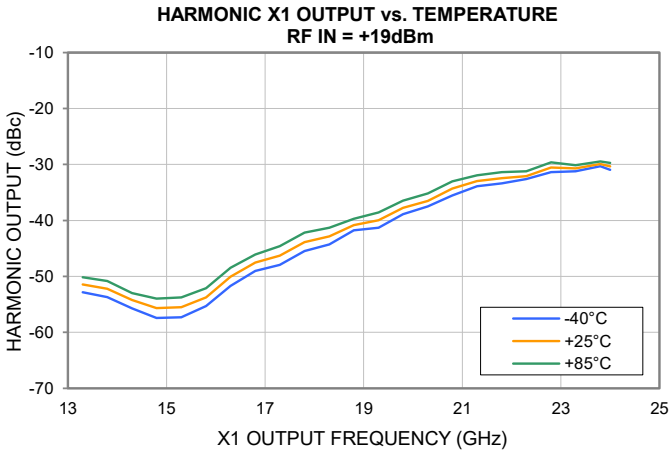
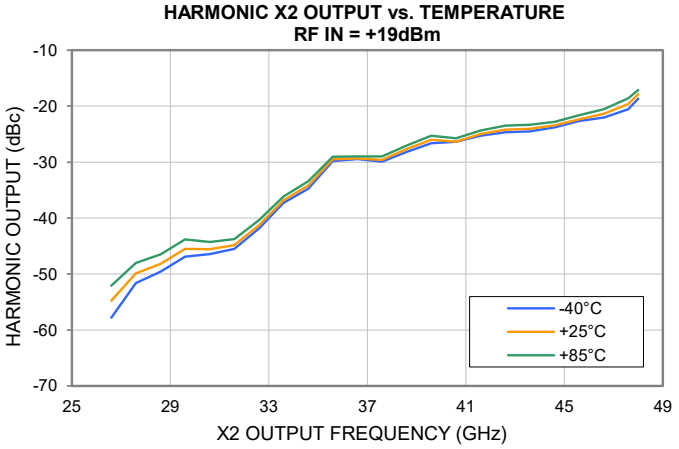
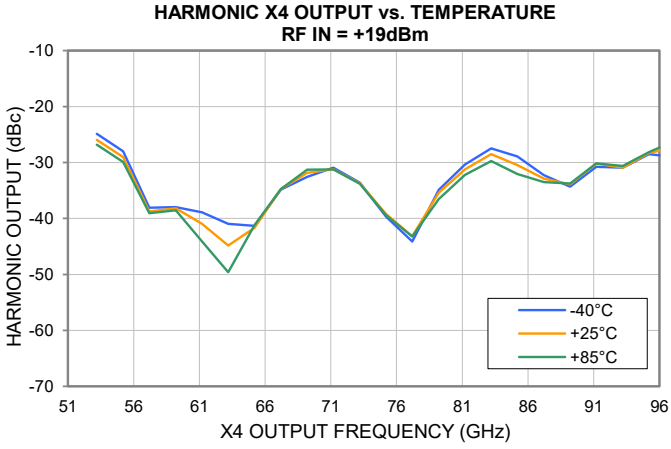
TYPICAL PERFORMANCE GRAPHS









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ABSOLUTE MAXIMUM RATINGS[4]

Parameter	Ratings
Operating Temperature[5]	-40°C to +85°C
Storage Temperature (for Die)[6]	-65°C to +150°C
RF Input Power	+22 dBm
Junction Temperature[7]	+150°C

4. Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.
5. Bottom of Die.
6. For die shipped in Gel-Pak see ENV-80 (limited by packaging).
7. Hot spot temperature on die.

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FUNCTIONAL DIAGRAM

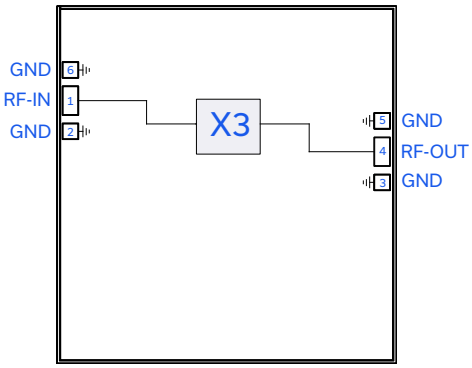

Figure 1. CY3-723-D+ Functional Diagram

PAD DESCRIPTION

Function	Pad #	Description (Refer to Figure 1)
RF-IN	1	Connect to RF Input.
RF-OUT	4	Connect to RF Output.
GND	2, 3, 5 & 6	Connected to die backside through vias. Bond wires to ground are optional.

DIE OUTLINE: inches [mm], Typical

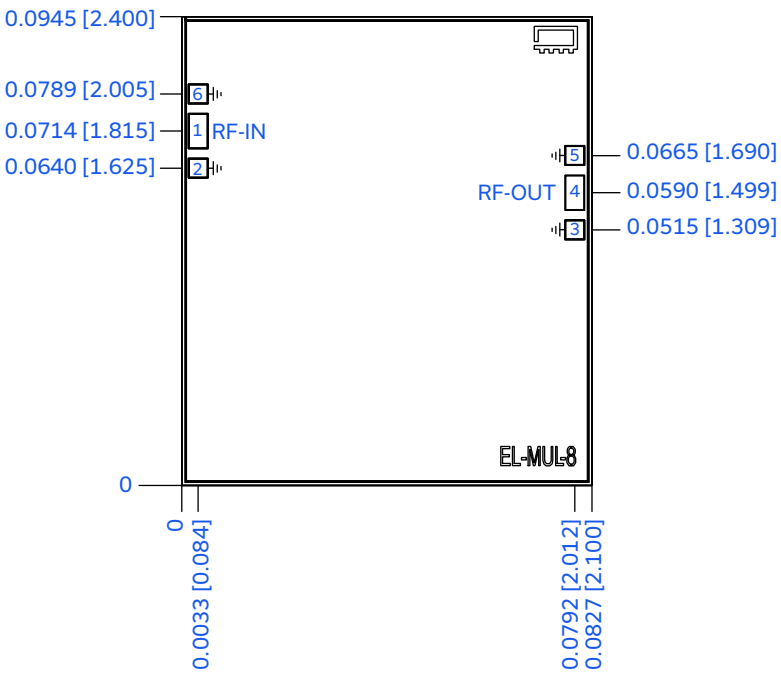

Figure 2. CY3-723-D+ Die Outline

DIMENSIONS: inches [mm], Typical

Die Size	0.0827 x 0.0945 [2.100 x 2.400]
Die Thickness	0.0040 [0.100]
Bond Pad Sizes:	
Pads 1 & 4	0.0036 x 0.0068 [0.092 x 0.172]
Pad 2, 3, 5 & 6	0.0036 x 0.0036 [0.092 x 0.092]
Plating (Pads & Bottom of Die)	Gold

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APPLICATION AND CHARACTERIZATION SETUP

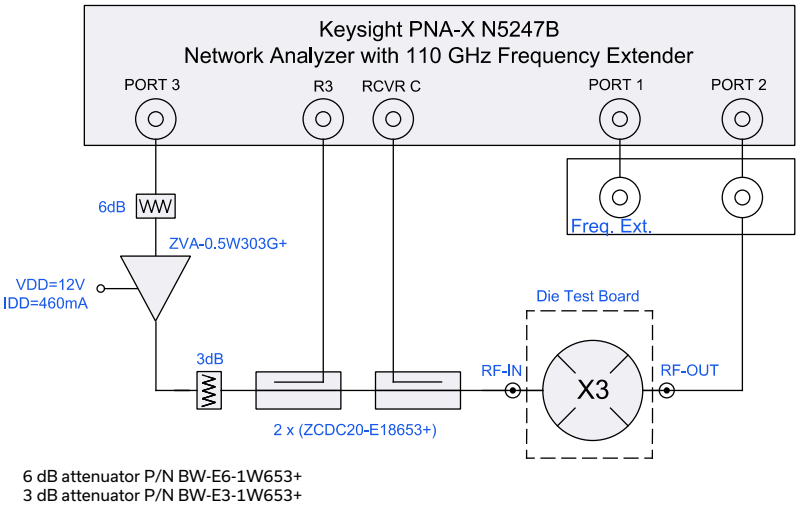

Figure 3. Application and Characterization Setup for CY3-723-D+

TEST PARAMETERS AND CONDITIONS

DUT attached on a Mini-Circuits Die Characterization Test Board. Conversion Loss and Harmonic Output are measured using PNA-X Network Analyzer.

Test Conditions:
For Conversion Loss and Harmonic Rejection: RF input power: +12 to +19 dBm.

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ASSEMBLY DIAGRAM

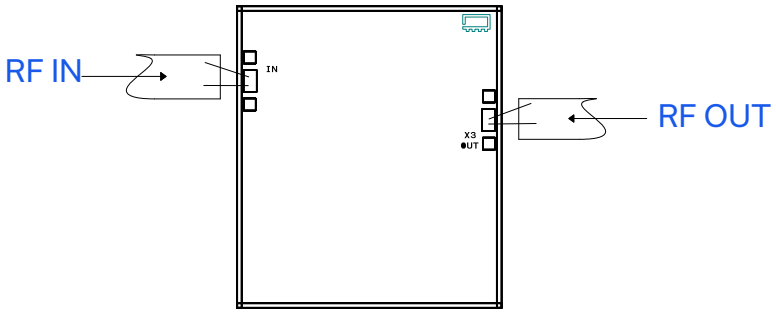

Figure 4. CY3-723-D+ Assembly Diagram

- Bond wire diameter: 1 mil
- Bond wire lengths from Die Pad to PCB at RF-IN & RF-OUT ports: 11 ± 1 mils
- Typical Gap from Die edge to PCB edge: 3 mils
- PCB thickness and material: 3.5 mils (Thickness: 0.5 oz copper on each side).

ASSEMBLY AND HANDLING PROCEDURE

1. Storage
   Die should be stored in a dry nitrogen purged desiccator or equivalent.
2. ESD Precautions
   MMIC Multiplier Die are susceptible to electrostatic and mechanical damage. Die are supplied in anti-static protected material, which should be opened only in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices require careful handling using tools appropriate for manipulating semiconductor chips. It is recommended to handle the chips along the edges with a custom designed collet. The surface of the chips have exposed air bridges and should not be touched with a vacuum collet, tweezers or fingers.
   The die mounting surface must be clean and flat. Using conductive silver-filled epoxy, apply sufficient adhesive to meet the required bond line thickness, fillet height and coverage around the total periphery of the device. The recommended epoxy is Ablestik 84-1 LMISR4 or equivalent. Parts should be cured in a nitrogen-filled atmosphere per manufacturer's recommended cure profile.
4. Wire Bonding
   Openings in the surface passivation above the gold bond pads are provided to allow wire bonding to the die. Thermosonic bonding is recommended with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. The suggested interconnect is pure gold, 1 mil diameter wire . Bonds are recommended to be made from the bond pads on the die to the package or substrate. All bond wire length and bond wire height should be kept as short as possible, unless specified by design, to minimize performance degradation due to undesirable series inductance.

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD CLICK HERE

Performance Data	Table Graphs	
Case Style	Die	
RoHs Status	Compliant	
Die Ordering and Packaging Information	Quantity, Package	Model No.
	Gel - Pak: 5, 10, 50, KGD*	CY3-723-DG+
	Medium†, Partial wafer: <460	CY3-723-DP+
	Full wafer†	CY3-723-DF+
	†Available upon request contact sales representative. Refer to AN-60-067	
Die Marking	EL-MUL-8	
Environmental Ratings	ENV-80	

*Known Good Die ("KGD") means that the die in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such die fall within a predefined range. While DC testing is not definitive, it does provide a higher degree of confidence that die are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

Frequency Multiplier CY3-723-D+

Typical Performance Data

TEST CONDITION: RF IN = +17dBm

Frequency (GHz)				Temperature = -40°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	18.65	52.24	65.39	24.83
13.8	27.6	41.4	55.2	19.03	52.58	56.01	29.50
14.3	28.6	42.9	57.2	18.62	54.37	52.23	38.63
14.8	29.6	44.4	59.2	17.85	55.83	49.87	38.08
15.3	30.6	45.9	61.2	17.32	56.68	48.67	37.81
15.8	31.6	47.4	63.2	17.39	55.96	46.91	40.09
16.3	32.6	48.9	65.2	17.46	52.92	43.60	40.06
16.8	33.6	50.4	67.2	17.65	50.70	39.33	36.35
17.3	34.6	51.9	69.2	17.69	50.01	36.82	35.18
17.8	35.6	53.4	71.2	18.40	47.42	32.20	34.71
18.3	36.6	54.9	73.2	18.74	46.01	32.25	39.45
18.8	37.6	56.4	75.2	20.41	43.28	31.57	40.05
19.3	38.6	57.9	77.2	19.62	42.65	28.58	33.18
19.8	39.6	59.4	79.2	20.58	40.01	26.54	28.80
20.3	40.6	60.9	81.2	20.65	38.49	26.53	27.40
20.8	41.6	62.4	83.2	21.65	36.47	25.90	25.28
21.3	42.6	63.9	85.2	22.37	34.72	25.11	27.33
21.8	43.6	65.4	87.2	22.23	33.97	24.61	30.86
22.3	44.6	66.9	89.2	22.32	32.97	23.75	33.70
22.8	45.6	68.4	91.2	23.11	31.59	22.56	30.93
23.3	46.6	69.9	93.2	23.16	31.10	22.10	31.40
23.8	47.6	71.4	95.2	24.90	30.01	19.94	28.96
24.0	48.0	72.0	96.0	25.62	30.53	17.75	29.02

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	19.86	51.07	60.17	26.01
13.8	27.6	41.4	55.2	20.21	51.48	53.89	30.64
14.3	28.6	42.9	57.2	19.89	53.34	50.95	39.70
14.8	29.6	44.4	59.2	19.30	54.57	48.57	38.69
15.3	30.6	45.9	61.2	18.78	55.13	47.96	39.49
15.8	31.6	47.4	63.2	18.66	54.48	46.25	43.57
16.3	32.6	48.9	65.2	18.82	51.35	42.99	42.38
16.8	33.6	50.4	67.2	19.01	49.31	38.63	37.10
17.3	34.6	51.9	69.2	19.24	48.31	36.11	34.65
17.8	35.6	53.4	71.2	19.81	45.80	31.53	34.76
18.3	36.6	54.9	73.2	20.03	44.58	31.23	39.68
18.8	37.6	56.4	75.2	21.45	42.38	30.22	43.99
19.3	38.6	57.9	77.2	21.10	41.37	27.62	34.27
19.8	39.6	59.4	79.2	21.90	38.91	25.87	29.71
20.3	40.6	60.9	81.2	21.90	37.52	26.57	28.57
20.8	41.6	62.4	83.2	23.03	35.30	25.49	26.44
21.3	42.6	63.9	85.2	23.61	33.90	24.55	28.93
21.8	43.6	65.4	87.2	23.53	33.14	24.17	31.68
22.3	44.6	66.9	89.2	23.53	32.53	23.33	33.36
22.8	45.6	68.4	91.2	24.56	30.84	22.24	30.27
23.3	46.6	69.9	93.2	24.64	30.71	21.10	31.12
23.8	47.6	71.4	95.2	26.35	29.73	18.75	28.62
24.0	48.0	72.0	96.0	27.23	30.05	16.89	28.15

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	21.01	50.18	56.97	26.89
13.8	27.6	41.4	55.2	21.34	50.61	51.95	31.52
14.3	28.6	42.9	57.2	21.06	52.51	49.40	40.06
14.8	29.6	44.4	59.2	20.71	53.44	47.26	39.05
15.3	30.6	45.9	61.2	20.10	54.03	46.96	41.85
15.8	31.6	47.4	63.2	19.91	53.17	45.11	47.74
16.3	32.6	48.9	65.2	20.09	49.92	42.01	44.64
16.8	33.6	50.4	67.2	20.28	47.95	37.83	37.19
17.3	34.6	51.9	69.2	20.69	46.57	35.09	33.71
17.8	35.6	53.4	71.2	21.14	44.18	30.77	34.30
18.3	36.6	54.9	73.2	21.29	43.13	30.28	39.03
18.8	37.6	56.4	75.2	22.51	41.28	29.08	47.49
19.3	38.6	57.9	77.2	22.41	40.06	27.00	35.46
19.8	39.6	59.4	79.2	23.17	37.68	25.28	30.75
20.3	40.6	60.9	81.2	23.25	36.29	26.07	29.40
20.8	41.6	62.4	83.2	24.34	34.12	24.92	27.60
21.3	42.6	63.9	85.2	24.86	32.93	23.89	30.33
21.8	43.6	65.4	87.2	24.86	32.15	23.53	32.17
22.3	44.6	66.9	89.2	24.83	31.79	22.85	33.18
22.8	45.6	68.4	91.2	25.99	30.04	21.61	29.97
23.3	46.6	69.9	93.2	26.01	30.28	20.26	30.78
23.8	47.6	71.4	95.2	27.72	29.39	17.80	28.39
24.0	48.0	72.0	96.0	28.67	29.60	16.27	27.47

* Harmonic Output below power level of X3 Output

Typical Performance Data

TEST CONDITION: RF IN = +18dBm

Frequency (GHz)				Temperature = -40°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	19.11	52.60	61.27	24.60
13.8	27.6	41.4	55.2	19.47	53.22	53.49	28.38
14.3	28.6	42.9	57.2	19.05	55.09	50.89	38.14
14.8	29.6	44.4	59.2	18.22	56.78	48.32	38.20
15.3	30.6	45.9	61.2	17.72	57.13	47.40	38.52
15.8	31.6	47.4	63.2	17.81	55.74	46.05	40.54
16.3	32.6	48.9	65.2	17.87	52.41	42.61	41.15
16.8	33.6	50.4	67.2	18.03	49.89	38.10	36.31
17.3	34.6	51.9	69.2	18.05	48.95	35.63	34.13
17.8	35.6	53.4	71.2	18.77	46.40	30.84	32.56
18.3	36.6	54.9	73.2	19.08	45.14	30.55	36.28
18.8	37.6	56.4	75.2	20.74	42.49	30.53	53.69
19.3	38.6	57.9	77.2	19.98	41.98	28.30	38.81
19.8	39.6	59.4	79.2	20.97	39.45	26.58	32.09
20.3	40.6	60.9	81.2	21.10	38.03	26.48	29.16
20.8	41.6	62.4	83.2	22.06	36.02	25.58	26.61
21.3	42.6	63.9	85.2	22.81	34.34	24.87	28.30
21.8	43.6	65.4	87.2	22.65	33.71	24.54	31.72
22.3	44.6	66.9	89.2	22.74	32.85	23.70	34.08
22.8	45.6	68.4	91.2	23.52	31.52	22.51	30.82
23.3	46.6	69.9	93.2	23.48	31.20	22.00	31.13
23.8	47.6	71.4	95.2	25.05	30.20	20.29	28.76
24.0	48.0	72.0	96.0	25.70	30.79	18.32	28.93

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	20.35	51.34	57.18	25.73
13.8	27.6	41.4	55.2	20.69	51.93	51.74	29.46
14.3	28.6	42.9	57.2	20.37	53.89	49.38	38.94
14.8	29.6	44.4	59.2	19.72	55.21	46.98	38.51
15.3	30.6	45.9	61.2	19.23	55.48	46.59	40.49
15.8	31.6	47.4	63.2	19.12	54.25	45.40	44.43
16.3	32.6	48.9	65.2	19.27	50.78	42.03	42.92
16.8	33.6	50.4	67.2	19.44	48.47	37.50	36.29
17.3	34.6	51.9	69.2	19.65	47.28	34.97	33.30
17.8	35.6	53.4	71.2	20.23	44.81	30.33	32.71
18.3	36.6	54.9	73.2	20.43	43.71	29.99	36.15
18.8	37.6	56.4	75.2	21.85	41.60	29.74	48.84
19.3	38.6	57.9	77.2	21.53	40.67	27.57	39.01
19.8	39.6	59.4	79.2	22.36	38.33	25.92	32.72
20.3	40.6	60.9	81.2	22.41	37.04	26.46	30.13
20.8	41.6	62.4	83.2	23.51	34.82	25.24	27.59
21.3	42.6	63.9	85.2	24.10	33.47	24.35	29.77
21.8	43.6	65.4	87.2	24.01	32.82	24.07	32.28
22.3	44.6	66.9	89.2	24.01	32.35	23.32	33.65
22.8	45.6	68.4	91.2	25.03	30.73	22.20	30.20
23.3	46.6	69.9	93.2	25.00	30.74	21.22	31.02
23.8	47.6	71.4	95.2	26.55	29.87	19.22	28.43
24.0	48.0	72.0	96.0	27.37	30.23	17.41	28.03

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	21.60	50.27	54.27	26.57
13.8	27.6	41.4	55.2	21.93	50.84	49.93	30.35
14.3	28.6	42.9	57.2	21.64	52.83	47.90	39.26
14.8	29.6	44.4	59.2	21.26	53.85	45.50	38.78
15.3	30.6	45.9	61.2	20.66	54.03	45.53	43.37
15.8	31.6	47.4	63.2	20.45	52.74	44.39	49.49
16.3	32.6	48.9	65.2	20.63	49.20	41.04	43.61
16.8	33.6	50.4	67.2	20.79	47.03	36.78	36.08
17.3	34.6	51.9	69.2	21.19	45.58	34.08	32.45
17.8	35.6	53.4	71.2	21.66	43.18	29.78	32.51
18.3	36.6	54.9	73.2	21.78	42.25	29.49	35.89
18.8	37.6	56.4	75.2	22.98	40.49	29.00	47.01
19.3	38.6	57.9	77.2	22.92	39.35	27.02	39.55
19.8	39.6	59.4	79.2	23.70	37.08	25.30	33.75
20.3	40.6	60.9	81.2	23.84	35.76	25.93	30.89
20.8	41.6	62.4	83.2	24.89	33.62	24.68	28.73
21.3	42.6	63.9	85.2	25.43	32.45	23.71	31.17
21.8	43.6	65.4	87.2	25.41	31.78	23.42	32.75
22.3	44.6	66.9	89.2	25.39	31.53	22.83	33.46
22.8	45.6	68.4	91.2	26.50	29.87	21.62	30.03
23.3	46.6	69.9	93.2	26.43	30.25	20.45	30.70
23.8	47.6	71.4	95.2	27.98	29.47	18.26	28.23
24.0	48.0	72.0	96.0	28.87	29.72	16.75	27.47

* Harmonic Output below power level of X3 Output

Typical Performance Data

TEST CONDITION: RF IN = +19dBm

Frequency (GHz)				Temperature = -40°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	19.69	52.83	57.81	24.88
13.8	27.6	41.4	55.2	20.04	53.68	51.65	27.99
14.3	28.6	42.9	57.2	19.62	55.72	49.57	38.09
14.8	29.6	44.4	59.2	18.75	57.43	46.88	37.99
15.3	30.6	45.9	61.2	18.29	57.29	46.44	38.89
15.8	31.6	47.4	63.2	18.40	55.31	45.50	40.98
16.3	32.6	48.9	65.2	18.46	51.71	41.88	41.31
16.8	33.6	50.4	67.2	18.59	49.03	37.29	34.84
17.3	34.6	51.9	69.2	18.62	47.96	34.75	32.55
17.8	35.6	53.4	71.2	19.34	45.47	29.80	30.93
18.3	36.6	54.9	73.2	19.62	44.28	29.47	33.58
18.8	37.6	56.4	75.2	21.27	41.75	29.90	39.66
19.3	38.6	57.9	77.2	20.54	41.30	28.19	44.13
19.8	39.6	59.4	79.2	21.56	38.88	26.64	34.91
20.3	40.6	60.9	81.2	21.73	37.50	26.35	30.34
20.8	41.6	62.4	83.2	22.66	35.51	25.26	27.49
21.3	42.6	63.9	85.2	23.43	33.86	24.66	28.90
21.8	43.6	65.4	87.2	23.27	33.36	24.53	32.28
22.3	44.6	66.9	89.2	23.34	32.62	23.81	34.32
22.8	45.6	68.4	91.2	24.08	31.39	22.67	30.76
23.3	46.6	69.9	93.2	24.03	31.20	22.04	30.95
23.8	47.6	71.4	95.2	25.44	30.31	20.56	28.50
24.0	48.0	72.0	96.0	26.01	30.94	18.67	28.72

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +25°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	21.00	51.42	54.78	25.97
13.8	27.6	41.4	55.2	21.33	52.19	49.88	29.00
14.3	28.6	42.9	57.2	21.01	54.22	48.16	38.76
14.8	29.6	44.4	59.2	20.34	55.66	45.51	38.19
15.3	30.6	45.9	61.2	19.87	55.50	45.57	40.99
15.8	31.6	47.4	63.2	19.75	53.76	44.82	44.83
16.3	32.6	48.9	65.2	19.89	50.03	41.28	41.69
16.8	33.6	50.4	67.2	20.05	47.52	36.80	34.74
17.3	34.6	51.9	69.2	20.27	46.28	34.20	31.86
17.8	35.6	53.4	71.2	20.86	43.85	29.49	31.19
18.3	36.6	54.9	73.2	21.03	42.83	29.33	33.70
18.8	37.6	56.4	75.2	22.43	40.82	29.63	39.23
19.3	38.6	57.9	77.2	22.14	39.96	27.63	43.19
19.8	39.6	59.4	79.2	22.98	37.76	26.02	35.39
20.3	40.6	60.9	81.2	23.08	36.50	26.35	31.22
20.8	41.6	62.4	83.2	24.15	34.28	24.96	28.50
21.3	42.6	63.9	85.2	24.77	32.98	24.19	30.46
21.8	43.6	65.4	87.2	24.67	32.45	24.08	32.89
22.3	44.6	66.9	89.2	24.65	32.09	23.43	33.89
22.8	45.6	68.4	91.2	25.61	30.55	22.35	30.23
23.3	46.6	69.9	93.2	25.59	30.71	21.38	30.91
23.8	47.6	71.4	95.2	26.97	29.91	19.63	28.28
24.0	48.0	72.0	96.0	27.73	30.32	17.86	27.87

* Harmonic Output below power level of X3 Output

Frequency (GHz)				Temperature = +85°C			
				Conversion Loss	Harmonic Output*		
X1 Output	X2 Output	X3 Output	X4 Output	X3 Output	X1 Output	X2 Output	X4 Output
13.3	26.6	39.9	53.2	22.37	50.14	52.08	26.82
13.8	27.6	41.4	55.2	22.70	50.84	48.02	29.89
14.3	28.6	42.9	57.2	22.41	52.98	46.51	39.04
14.8	29.6	44.4	59.2	22.03	53.96	43.81	38.52
15.3	30.6	45.9	61.2	21.45	53.74	44.30	44.09
15.8	31.6	47.4	63.2	21.19	52.10	43.75	49.61
16.3	32.6	48.9	65.2	21.35	48.45	40.34	41.22
16.8	33.6	50.4	67.2	21.50	46.08	36.16	34.74
17.3	34.6	51.9	69.2	21.90	44.58	33.44	31.27
17.8	35.6	53.4	71.2	22.38	42.19	29.04	31.21
18.3	36.6	54.9	73.2	22.48	41.32	28.99	33.80
18.8	37.6	56.4	75.2	23.65	39.69	28.99	39.44
19.3	38.6	57.9	77.2	23.61	38.57	27.02	43.23
19.8	39.6	59.4	79.2	24.41	36.45	25.30	36.56
20.3	40.6	60.9	81.2	24.58	35.17	25.75	32.21
20.8	41.6	62.4	83.2	25.63	33.01	24.34	29.75
21.3	42.6	63.9	85.2	26.18	31.91	23.48	32.07
21.8	43.6	65.4	87.2	26.14	31.35	23.33	33.51
22.3	44.6	66.9	89.2	26.09	31.21	22.82	33.75
22.8	45.6	68.4	91.2	27.15	29.62	21.63	30.15
23.3	46.6	69.9	93.2	27.07	30.15	20.56	30.60
23.8	47.6	71.4	95.2	28.45	29.45	18.62	28.15
24.0	48.0	72.0	96.0	29.29	29.74	17.11	27.34

* Harmonic Output below power level of X3 Output

Typical Performance Data

TEST CONDITION: RF IN = +12 to 16dBm

Frequency (GHz)				Temperature = +25°C		
				Conversion Loss		
X1 Output	X2 Output	X3 Output	X4 Output	12dBm	13dBm	14dBm
13.3	26.6	39.9	53.2	20.34	19.92	19.74
13.8	27.6	41.4	55.2	20.69	20.24	20.06
14.3	28.6	42.9	57.2	21.13	20.48	20.15
14.8	29.6	44.4	59.2	21.16	20.24	19.75
15.3	30.6	45.9	61.2	20.81	19.78	19.23
15.8	31.6	47.4	63.2	21.80	20.31	19.51
16.3	32.6	48.9	65.2	21.89	20.32	19.50
16.8	33.6	50.4	67.2	22.68	20.84	19.82
17.3	34.6	51.9	69.2	23.67	21.52	20.23
17.8	35.6	53.4	71.2	24.80	22.43	20.98
18.3	36.6	54.9	73.2	26.49	23.91	22.13
18.8	37.6	56.4	75.2	28.08	25.20	23.37
19.3	38.6	57.9	77.2	26.99	24.30	22.65
19.8	39.6	59.4	79.2	27.53	25.05	23.40
20.3	40.6	60.9	81.2	26.99	24.75	23.38
20.8	41.6	62.4	83.2	28.41	26.14	24.72
21.3	42.6	63.9	85.2	28.40	26.43	25.18
21.8	43.6	65.4	87.2	28.18	26.37	25.18
22.3	44.6	66.9	89.2	27.90	26.45	25.45
22.8	45.6	68.4	91.2	28.48	27.31	26.45
23.3	46.6	69.9	93.2	29.79	28.67	27.75
23.8	47.6	71.4	95.2	31.58	30.54	29.63
24.0	48.0	72.0	96.0	32.83	31.77	30.83

* Harmonic Output below power level of X3 Output

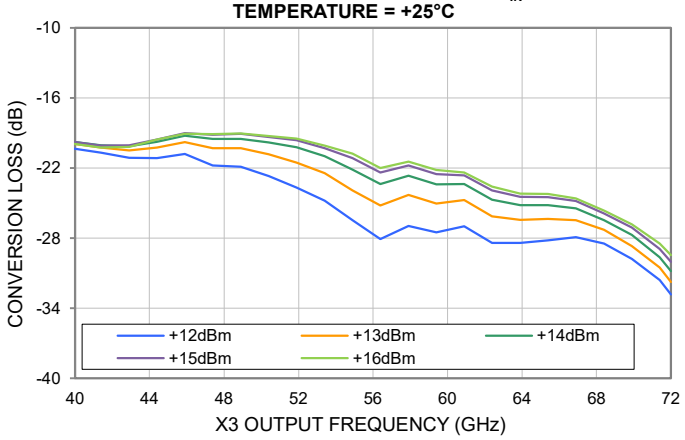
Frequency (GHz)				Temperature = +25°C	
				Conversion Loss	
X1 Output	X2 Output	X3 Output	X4 Output	15dBm	16dBm
13.3	26.6	39.9	53.2	19.76	19.92
13.8	27.6	41.4	55.2	20.08	20.24
14.3	28.6	42.9	57.2	20.08	20.20
14.8	29.6	44.4	59.2	19.55	19.58
15.3	30.6	45.9	61.2	19.02	19.05
15.8	31.6	47.4	63.2	19.16	19.10
16.3	32.6	48.9	65.2	19.09	19.03
16.8	33.6	50.4	67.2	19.34	19.25
17.3	34.6	51.9	69.2	19.63	19.48
17.8	35.6	53.4	71.2	20.30	20.10
18.3	36.6	54.9	73.2	21.16	20.76
18.8	37.6	56.4	75.2	22.40	21.99
19.3	38.6	57.9	77.2	21.79	21.45
19.8	39.6	59.4	79.2	22.51	22.17
20.3	40.6	60.9	81.2	22.64	22.39
20.8	41.6	62.4	83.2	23.91	23.59
21.3	42.6	63.9	85.2	24.46	24.18
21.8	43.6	65.4	87.2	24.47	24.21
22.3	44.6	66.9	89.2	24.84	24.61
22.8	45.6	68.4	91.2	25.88	25.64
23.3	46.6	69.9	93.2	27.11	26.82
23.8	47.6	71.4	95.2	28.94	28.49
24.0	48.0	72.0	96.0	30.03	29.46

* Harmonic Output below power level of X3 Output

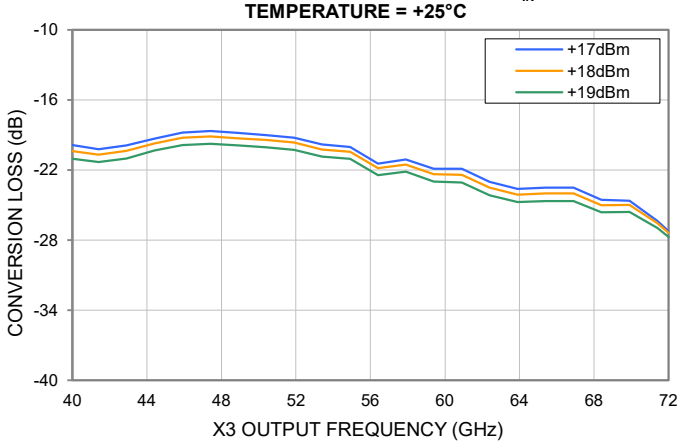
Typical Performance Curves

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

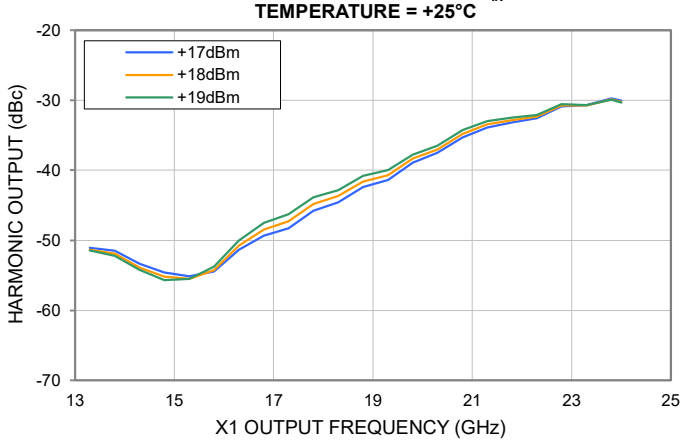
CONVERSION LOSS X3 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



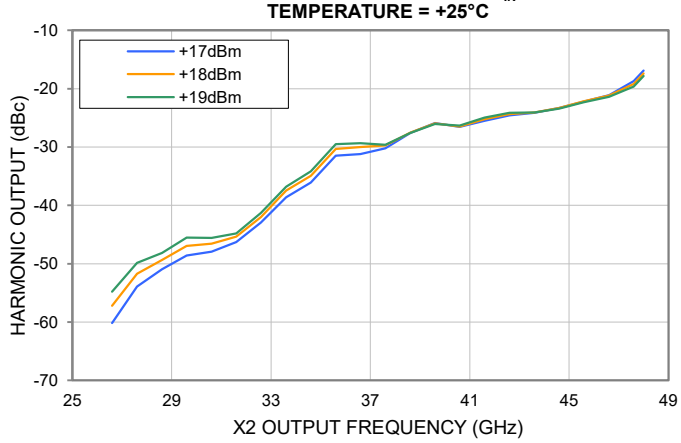
CONVERSION LOSS X3 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



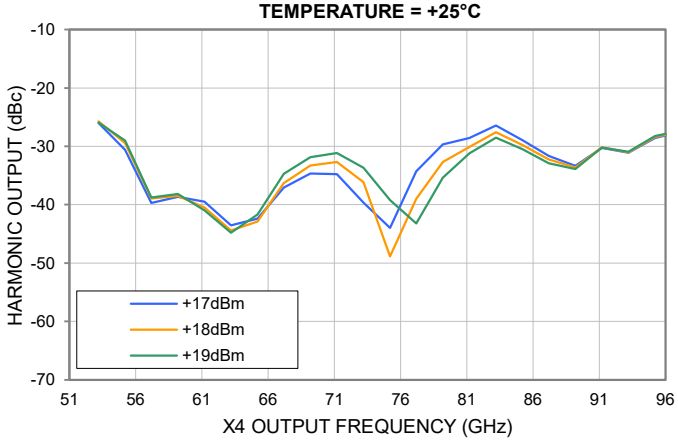
HARMONIC X1 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



HARMONIC X2 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



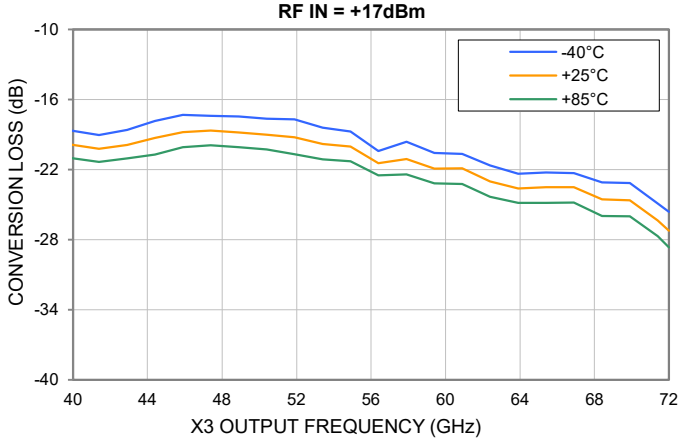
HARMONIC X4 OUTPUT vs. P_{IN}
TEMPERATURE = +25°C



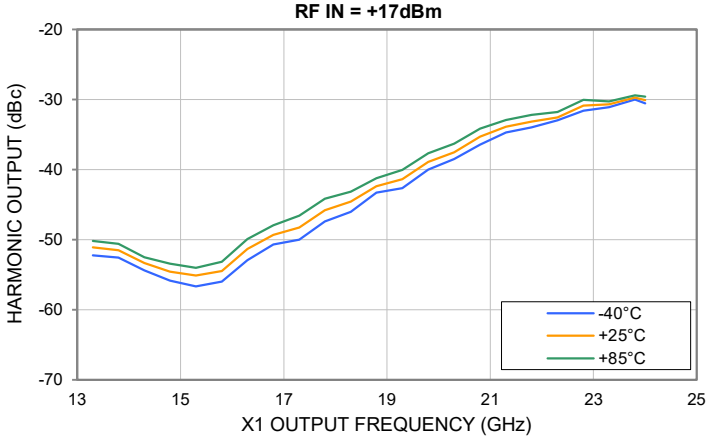
Typical Performance Curves

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

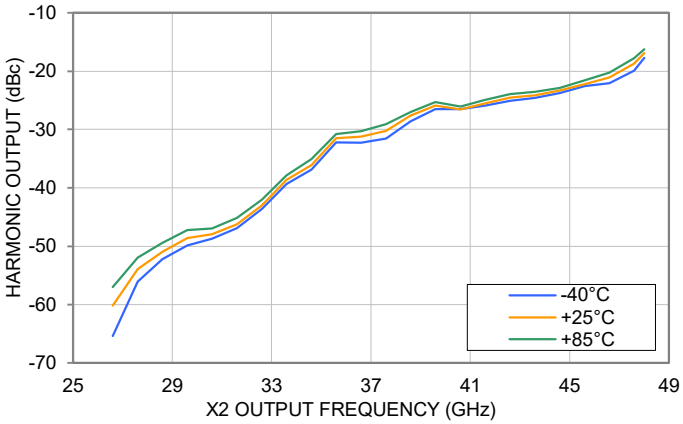
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



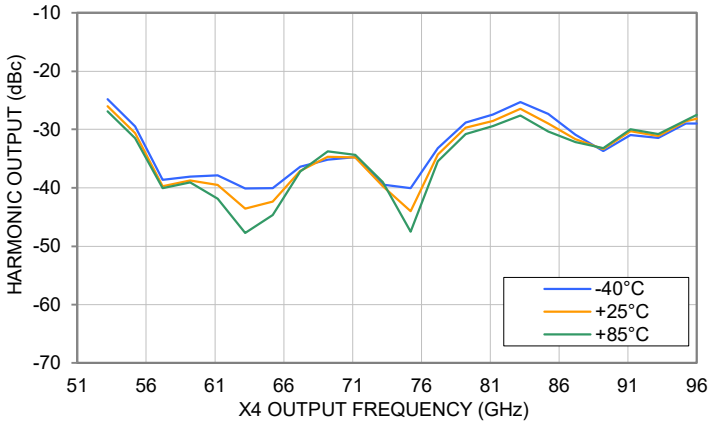
HARMONIC X1 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



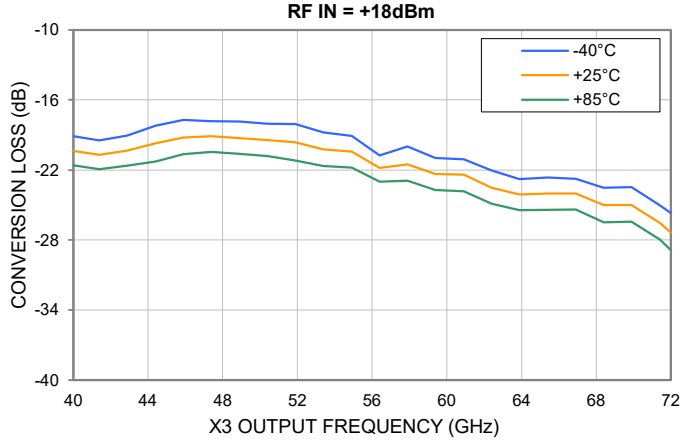
HARMONIC X4 OUTPUT vs. TEMPERATURE
RF IN = +17dBm



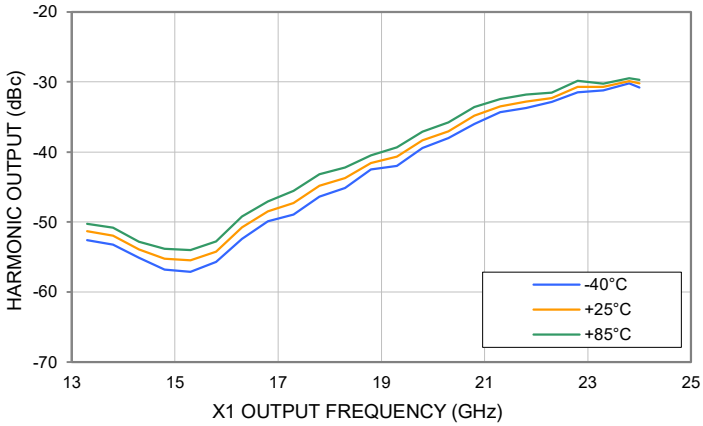
Typical Performance Curves

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

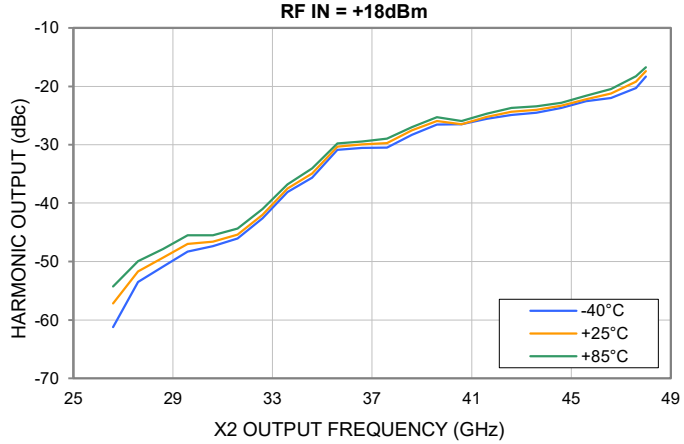
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



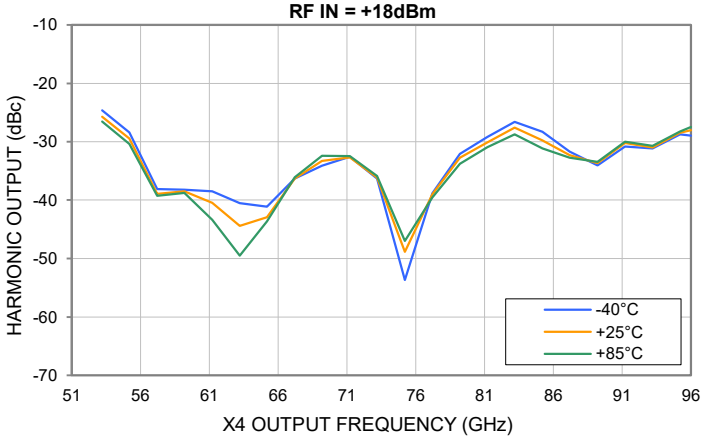
HARMONIC X1 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



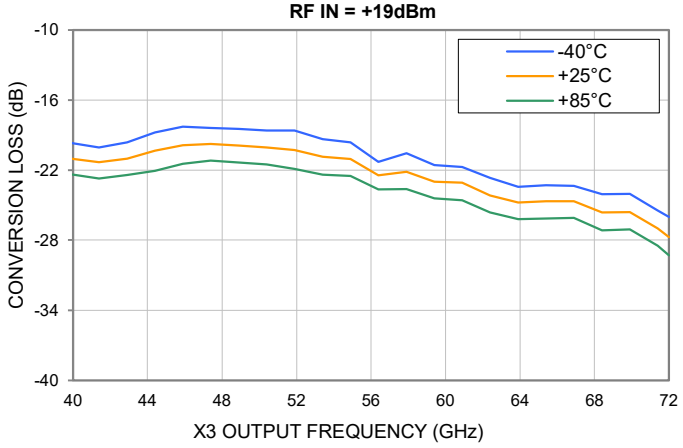
HARMONIC X4 OUTPUT vs. TEMPERATURE
RF IN = +18dBm



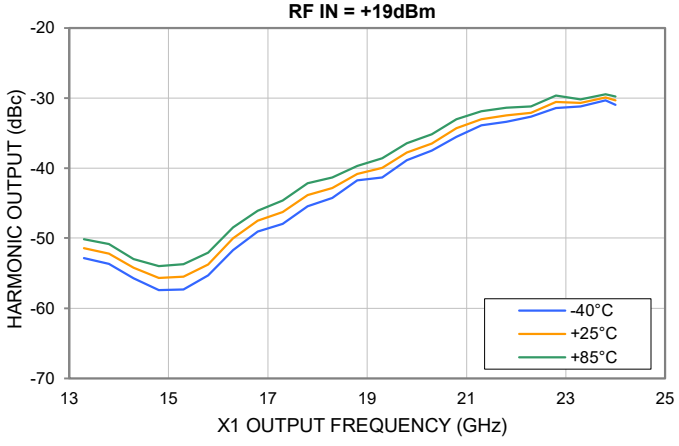
Typical Performance Curves

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

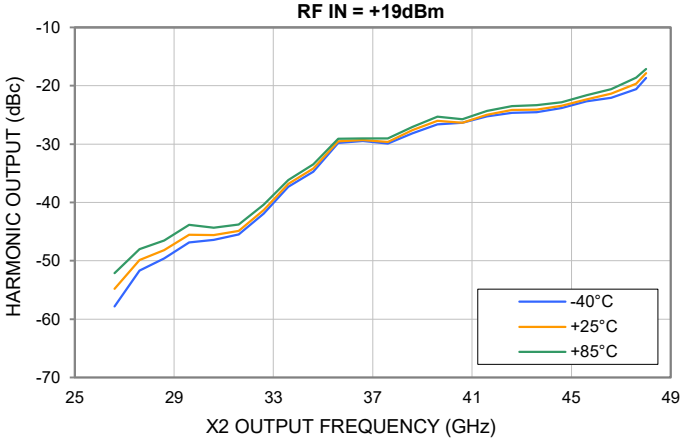
CONVERSION LOSS X3 OUTPUT vs. TERMPERATURE
RF IN = +19dBm



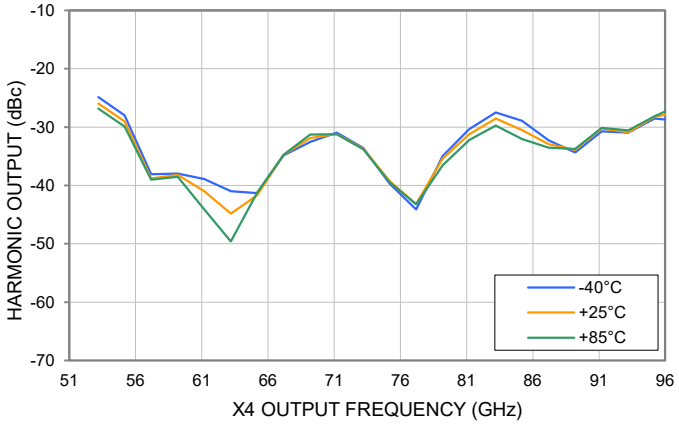
HARMONIC X1 OUTPUT vs. TEMPERATURE
RF IN = +19dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE
RF IN = +19dBm



HARMONIC X4 OUTPUT vs. TEMPERATURE
RF IN = +19dBm



Mini-Circuits

Environmental Specifications ENV80

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)	