



## MMIC SURFACE MOUNT

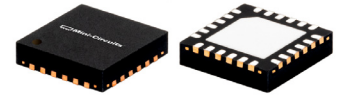
# X3 Frequency Multiplier

## CY3-453+

50Ω Output 20 to 45 GHz

### THE BIG DEAL

- Wideband Output From: 20 to 45 GHz
- Outstanding Fundamental and Close-in Harmonic Suppression:
  - F1: 39 dBc Typ.
  - F2: 46 dBc Typ.
  - F4: 40 dBc Typ.
- Input Drive Level: +12 to +17 dBm
- Conversion Loss: 20 dB Typ.
- Tiny Size, 4x4mm 24-Lead, QFN-Style

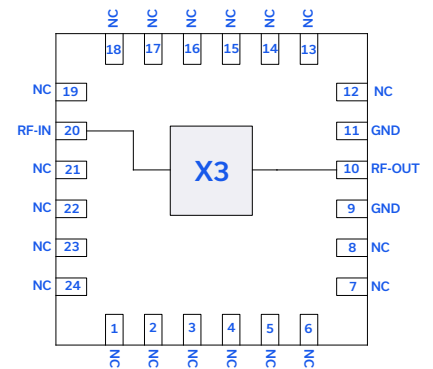


Generic photo used for illustration purposes only

### APPLICATIONS

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

### FUNCTIONAL DIAGRAM



### PRODUCT OVERVIEW

Mini-Circuits' CY3-453+ is a 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. Utilizing GaAs HBT technology, the CY3-453+ comes housed in a 4x4mm 24-Lead QFN-Style package and offers excellent repeatability, low inductance, and good thermal efficiency.

### KEY FEATURES

| Features                                                                                                                                                             | Advantages                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Broadband, 20 to 45 GHz output                                                                                                                                       | With an output frequency range spanning 20 to 45 GHz, this multiplier supports broadband applications.                                                                       |
| Excellent Fundamental and Harmonic Suppression <ul style="list-style-type: none"><li>• F1, 39 dBc Typ.</li><li>• F2, 46 dBc Typ.</li><li>• F4, 40 dBc Typ.</li></ul> | 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<br>+12 to +17 dBm                                                                                                                             | Wide input power signal range accommodates different input signal levels while still maintain a low conversion loss.                                                         |





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**ELECTRICAL SPECIFICATIONS<sup>1,3</sup> AT +25°C AND Z<sub>0</sub> = 50Ω, UNLESS NOTED OTHERWISE**

| Parameter                      |    | Input Frequency (GHz) | Min. | Typ. | Max. | Unit |
|--------------------------------|----|-----------------------|------|------|------|------|
| Multiplication Factor          |    |                       | 3    |      |      |      |
| Frequency Range, Input (F1)    |    |                       | 6.66 |      | 15   | GHz  |
| Frequency Range, Output (F3)   |    |                       | 20   |      | 45   | GHz  |
| Input Power                    |    |                       | +12  | +16  | +17  | dBm  |
| Conversion Loss (F3)           |    | 6.66-8                |      | 20.1 | 22.0 | dB   |
|                                |    | 8-10                  |      | 19.8 | 21.6 |      |
|                                |    | 10-12                 |      | 19.4 | 21.4 |      |
|                                |    | 12-15                 |      | 21.0 | 23.7 |      |
| Harmonic Output <sup>2,3</sup> | F1 | 6.66-8                |      | 40   |      | dBc  |
|                                |    | 8-10                  |      | 43   |      |      |
|                                |    | 10-12                 |      | 45   |      |      |
|                                |    | 12-15                 |      | 27   |      |      |
|                                | F2 | 6.66-8                |      | 58   |      | dBc  |
|                                |    | 8-10                  |      | 42   |      |      |
|                                |    | 10-12                 |      | 49   |      |      |
|                                |    | 12-15                 |      | 38   |      |      |
|                                | F4 | 6.66-8                |      | 30   |      | dBc  |
|                                |    | 8-10                  |      | 47   |      |      |
|                                |    | 10-12                 |      | 41   |      |      |
|                                |    | 12-15                 |      | 43   |      |      |

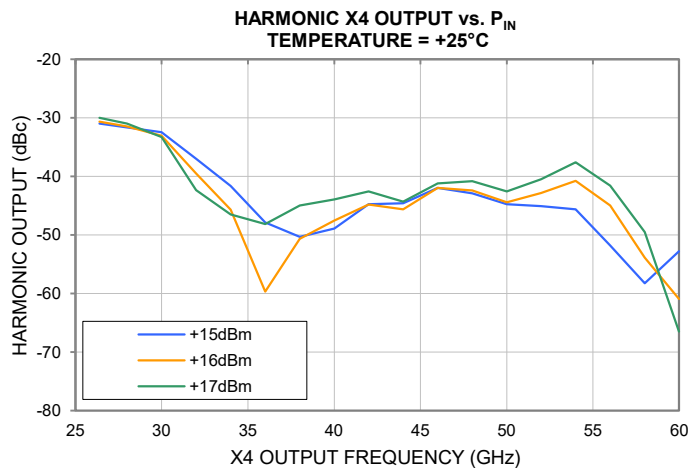
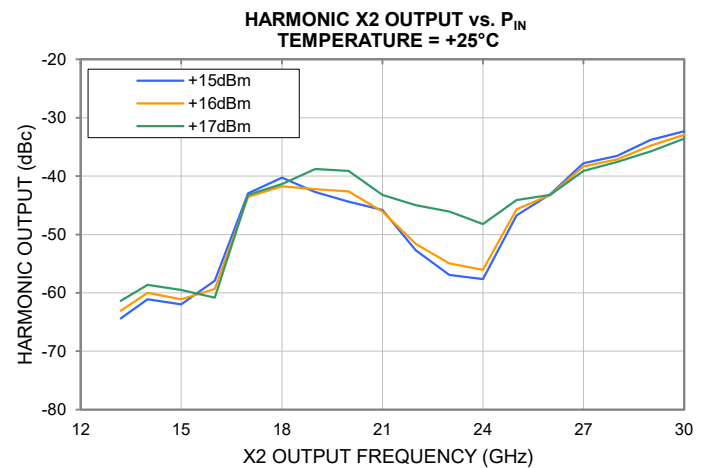
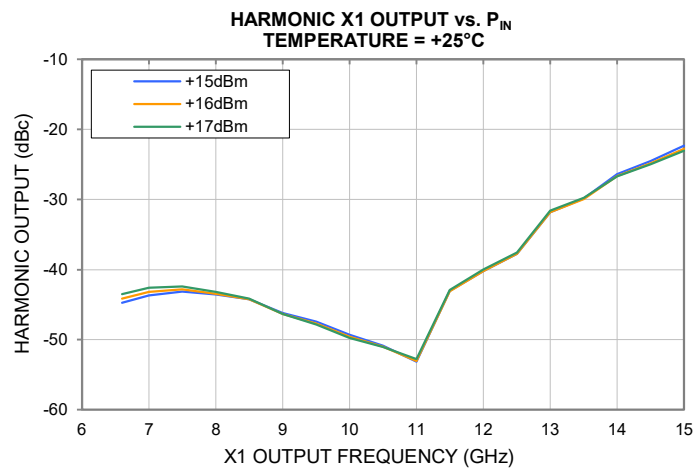
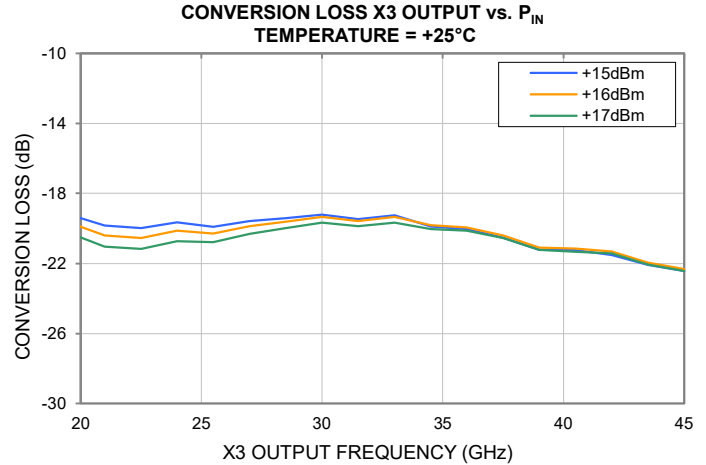
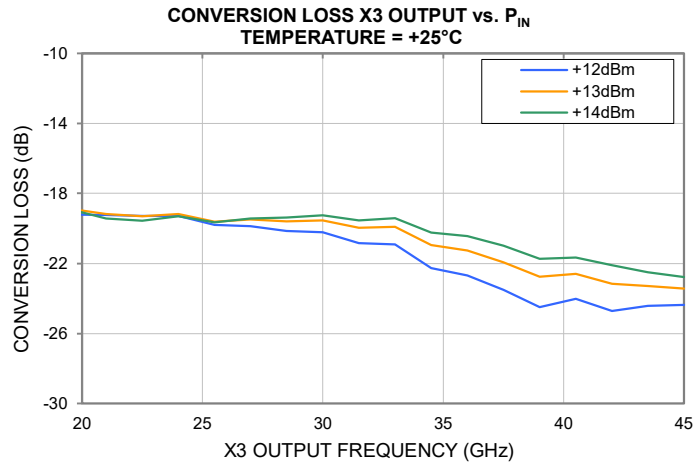
1. Measured on Mini-Circuits Characterization Test Board TB-CY3-453C+.

2. Harmonics of input frequency below power of F3.

3. All specifications are measured with RF input power = +16 dBm.



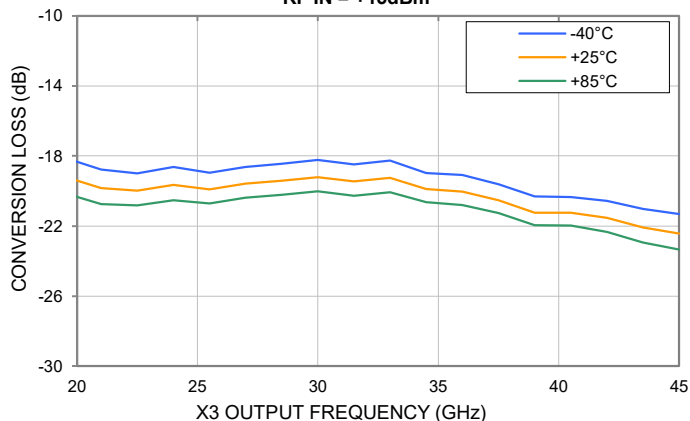
## TYPICAL PERFORMANCE GRAPHS



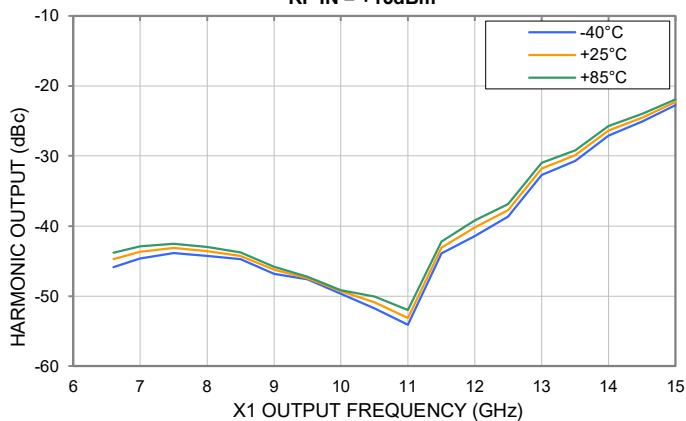


### TYPICAL PERFORMANCE GRAPHS

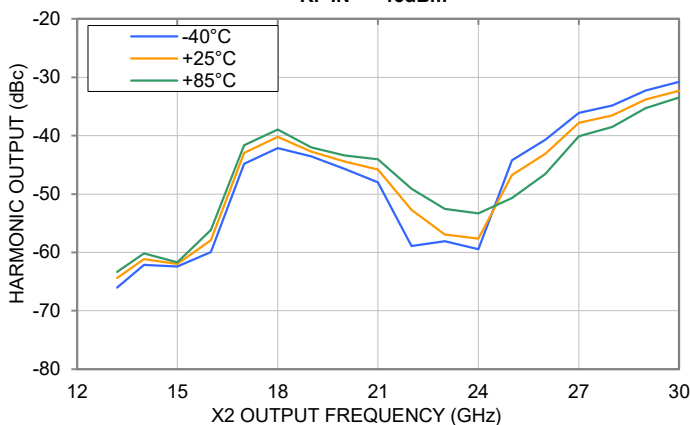
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE  
RF IN = +15dBm



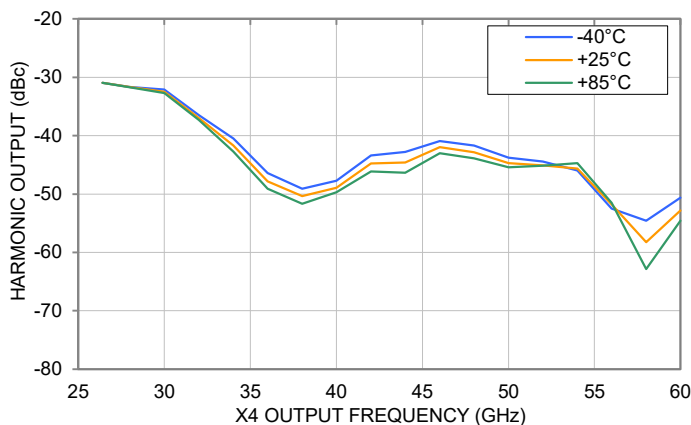
HARMONIC X1 OUTPUT vs. TEMPERATURE  
RF IN = +15dBm



HARMONIC X2 OUTPUT vs. TEMPERATURE  
RF IN = +15dBm

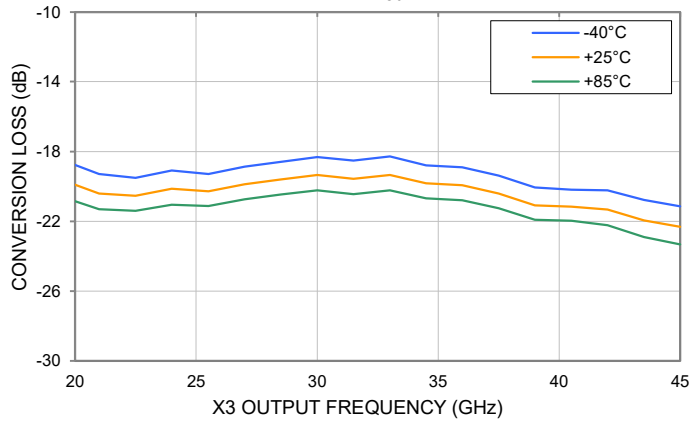
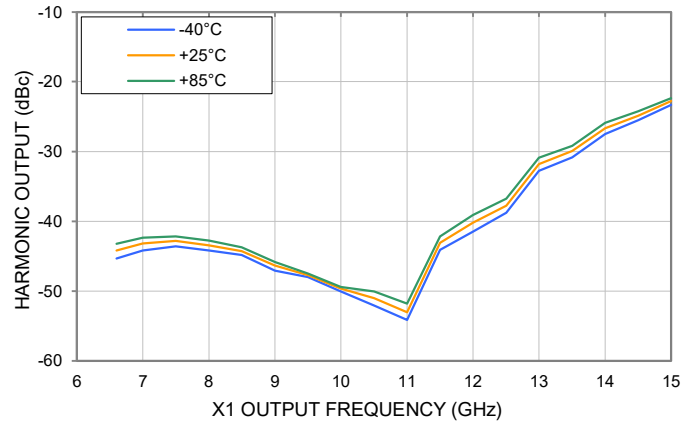
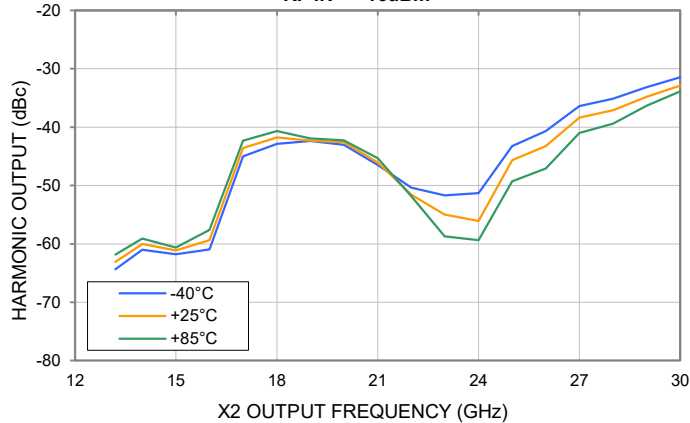
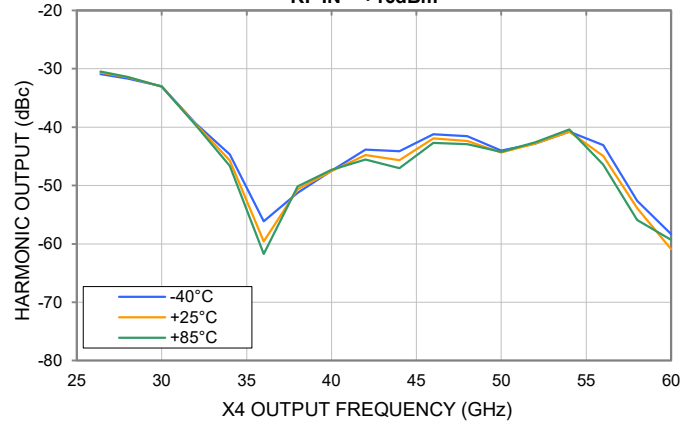


HARMONIC X4 OUTPUT vs. TEMPERATURE  
RF IN = +15dBm





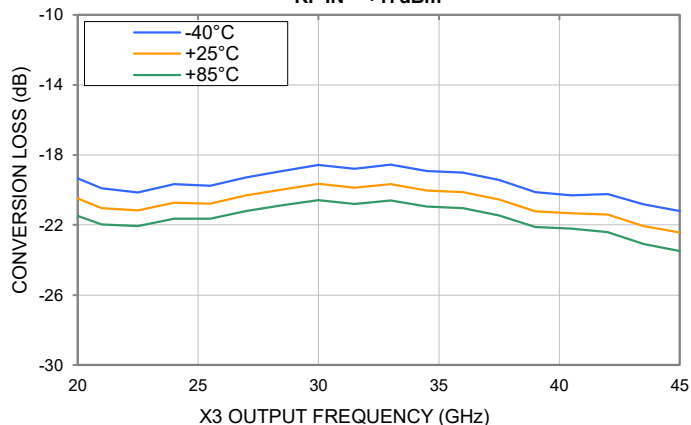
## TYPICAL PERFORMANCE GRAPHS

CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE  
RF IN = +16dBmHARMONIC X1 OUTPUT vs. TEMPERATURE  
RF IN = +16dBmHARMONIC X2 OUTPUT vs. TEMPERATURE  
RF IN = +16dBmHARMONIC X4 OUTPUT vs. TEMPERATURE  
RF IN = +16dBm

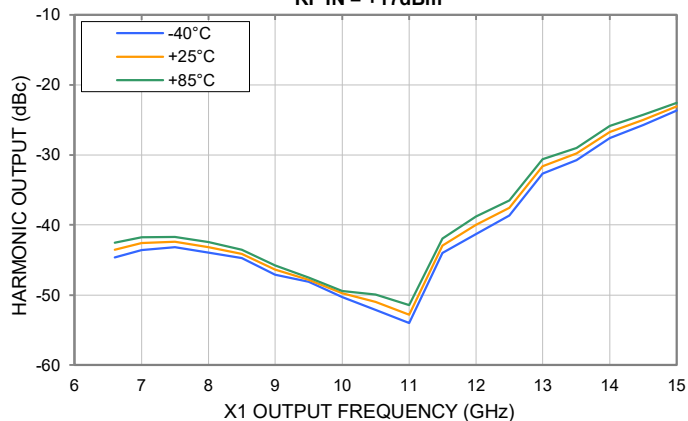


### TYPICAL PERFORMANCE GRAPHS

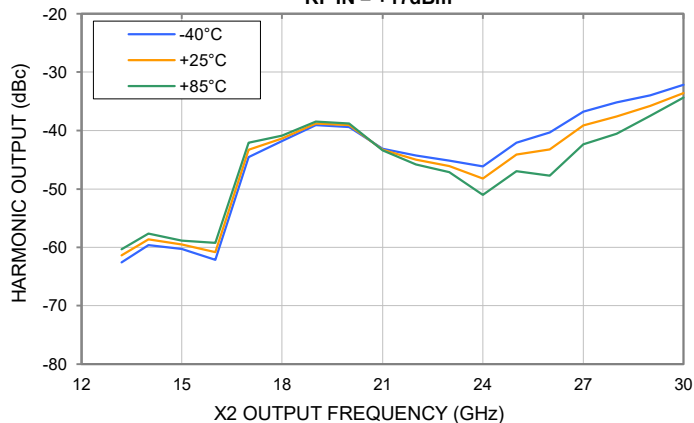
CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE  
RF IN = +17dBm



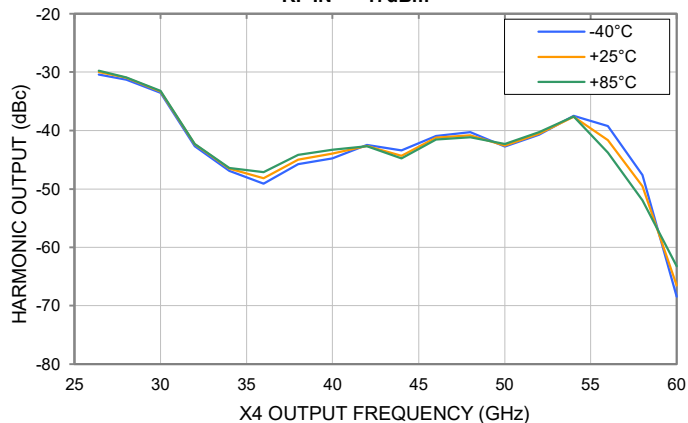
HARMONIC X1 OUTPUT vs. TEMPERATURE  
RF IN = +17dBm



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



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





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CY3-453+

50Ω Output 20 to 45 GHz

## ABSOLUTE MAXIMUM RATINGS<sup>5</sup>

| Parameter                           | Ratings                                        |
|-------------------------------------|------------------------------------------------|
| Operating Temperature (ground lead) | -40°C to +85°C                                 |
| Storage Temperature                 | -65°C to +150°C                                |
| RF Input Power                      | +26 dBm (5 minute max)<br>+23 dBm (Continuous) |

5. Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.

## ESD RATING

|     | Class | Voltage Range   | Reference Standard          |
|-----|-------|-----------------|-----------------------------|
| HBM | 1B    | 500V to < 1000V | ANSI/ESDA/JEDEC JS-001-2017 |
| CDM | C2    | 500V to < 1000V | JESD22-C101F                |



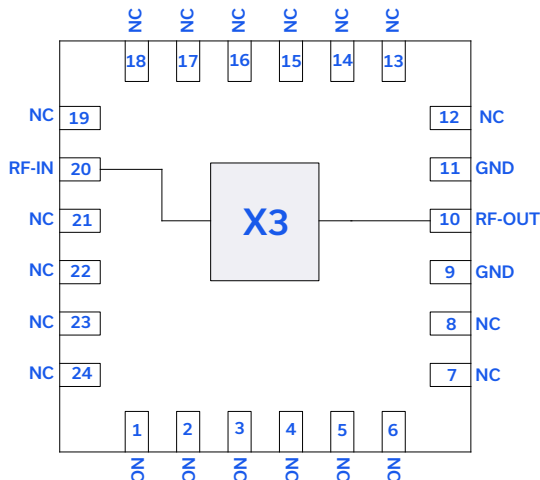
ESD HANDLING PRECAUTION: This device is designed to be Class 1B for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E/JEDEC J-STD-033C

50Ω    Output 20 to 45 GHz

## FUNCTIONAL DIAGRAM

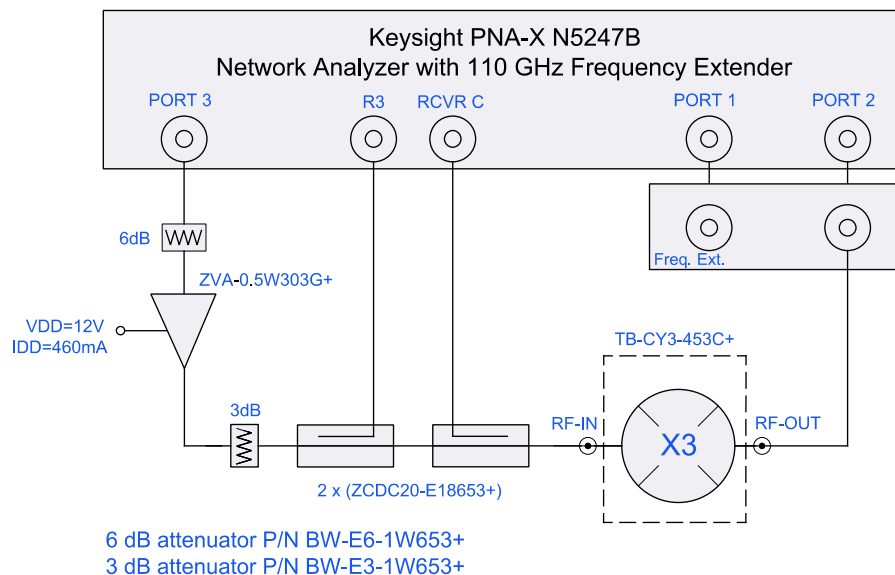


## PAD DESCRIPTION

| Function | Pad Number        | Description (Refer to Fig 1)                           |
|----------|-------------------|--------------------------------------------------------|
| RF-IN    | 20                | RF-IN Pad connects to RF Input Port                    |
| RF-OUT   | 10                | RF-OUT Pad connects to RF Output Port                  |
| GND      | 9, 11, & Paddle   | Connects to ground                                     |
| NC       | 1-8, 12-19, 21-24 | Not used internally. Connected to ground on test board |

**Figure 1. CY3-453+ Functional Diagram**

## APPLICATION AND CHARACTERIZATION SETUP



**Figure 2. Application and Characterization Setup for CY3-453+**

Conversion Loss and F1, F2, F4 Harmonic Rejection are measured using N5245A PNA-X microwave network analyzer.

Condition:

1. Conversion Loss and Harmonic Rejection:  $P_{IN} = +16$  dBm



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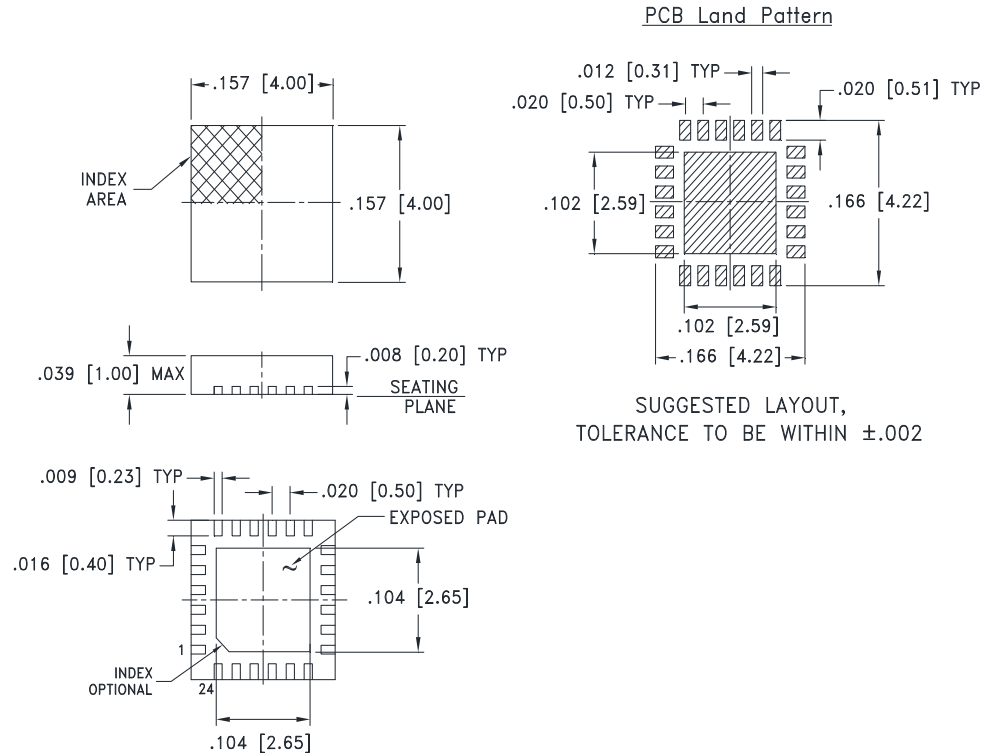
# X3 Frequency Multiplier

CY3-453+

Mini-Circuits

50Ω Output 20 to 45 GHz

## CASE STYLE DRAWING



Weight: .04 Grams

Dimensions are in inches [mm]. Tolerances: 2 Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control





ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD

[CLICK HERE](#)

|                                                      |                                                                 |
|------------------------------------------------------|-----------------------------------------------------------------|
| Performance Data                                     | Data Table                                                      |
|                                                      | Swept Graphs                                                    |
| Case Style                                           | DG1847. Plastic package, exposed paddle, Lead Finish: Matte-Tin |
| RoHs Status                                          | Compliant                                                       |
| Tape & Reel<br>Standard quantities available on reel | F68<br>7" reels with 20, 50, 100, 200, 500, 1K or 2K devices    |
| Suggested Layout for PCB Design                      | PL-732                                                          |
| Evaluation Board                                     | TB-CY3-453C+                                                    |
| Environmental Ratings                                | ENV08T1                                                         |

#### 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.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)

## Typical Performance Data

TEST CONDITION: RF IN = +15dBm

| Frequency (GHz) |           |           |           | Temperature = -40°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 18.24                        | 45.85     | 66.03                         | 30.95     |
| 7.0             | 14.0      | 21.0      | 28.0      | 18.76                        | 44.62     | 62.13                         | 31.63     |
| 7.5             | 15.0      | 22.5      | 30.0      | 18.99                        | 43.85     | 62.41                         | 32.10     |
| 8.0             | 16.0      | 24.0      | 32.0      | 18.63                        | 44.27     | 59.94                         | 36.47     |
| 8.5             | 17.0      | 25.5      | 34.0      | 18.94                        | 44.74     | 44.79                         | 40.48     |
| 9.0             | 18.0      | 27.0      | 36.0      | 18.62                        | 46.83     | 42.10                         | 46.42     |
| 9.5             | 19.0      | 28.5      | 38.0      | 18.43                        | 47.61     | 43.52                         | 49.08     |
| 10.0            | 20.0      | 30.0      | 40.0      | 18.23                        | 49.63     | 45.71                         | 47.72     |
| 10.5            | 21.0      | 31.5      | 42.0      | 18.48                        | 51.75     | 47.99                         | 43.37     |
| 11.0            | 22.0      | 33.0      | 44.0      | 18.26                        | 54.08     | 58.86                         | 42.78     |
| 11.5            | 23.0      | 34.5      | 46.0      | 18.97                        | 43.90     | 58.09                         | 40.94     |
| 12.0            | 24.0      | 36.0      | 48.0      | 19.08                        | 41.41     | 59.44                         | 41.67     |
| 12.5            | 25.0      | 37.5      | 50.0      | 19.62                        | 38.65     | 44.25                         | 43.77     |
| 13.0            | 26.0      | 39.0      | 52.0      | 20.31                        | 32.70     | 40.70                         | 44.43     |
| 13.5            | 27.0      | 40.5      | 54.0      | 20.35                        | 30.69     | 36.09                         | 45.93     |
| 14.0            | 28.0      | 42.0      | 56.0      | 20.55                        | 27.09     | 34.85                         | 52.46     |
| 14.5            | 29.0      | 43.5      | 58.0      | 21.01                        | 25.07     | 32.26                         | 54.59     |
| 15.0            | 30.0      | 45.0      | 60.0      | 21.31                        | 22.77     | 30.77                         | 50.65     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +25°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 19.33                        | 44.74     | 64.38                         | 30.96     |
| 7.0             | 14.0      | 21.0      | 28.0      | 19.84                        | 43.67     | 61.13                         | 31.65     |
| 7.5             | 15.0      | 22.5      | 30.0      | 19.99                        | 43.13     | 61.99                         | 32.46     |
| 8.0             | 16.0      | 24.0      | 32.0      | 19.66                        | 43.57     | 57.89                         | 36.98     |
| 8.5             | 17.0      | 25.5      | 34.0      | 19.90                        | 44.24     | 42.97                         | 41.66     |
| 9.0             | 18.0      | 27.0      | 36.0      | 19.58                        | 46.22     | 40.25                         | 47.85     |
| 9.5             | 19.0      | 28.5      | 38.0      | 19.40                        | 47.45     | 42.75                         | 50.34     |
| 10.0            | 20.0      | 30.0      | 40.0      | 19.21                        | 49.29     | 44.40                         | 48.91     |
| 10.5            | 21.0      | 31.5      | 42.0      | 19.45                        | 50.89     | 45.81                         | 44.76     |
| 11.0            | 22.0      | 33.0      | 44.0      | 19.24                        | 53.13     | 52.73                         | 44.59     |
| 11.5            | 23.0      | 34.5      | 46.0      | 19.89                        | 43.07     | 56.93                         | 41.96     |
| 12.0            | 24.0      | 36.0      | 48.0      | 20.03                        | 40.22     | 57.63                         | 42.85     |
| 12.5            | 25.0      | 37.5      | 50.0      | 20.52                        | 37.76     | 46.75                         | 44.74     |
| 13.0            | 26.0      | 39.0      | 52.0      | 21.23                        | 31.78     | 43.09                         | 45.08     |
| 13.5            | 27.0      | 40.5      | 54.0      | 21.24                        | 29.88     | 37.84                         | 45.65     |
| 14.0            | 28.0      | 42.0      | 56.0      | 21.52                        | 26.38     | 36.55                         | 51.77     |
| 14.5            | 29.0      | 43.5      | 58.0      | 22.08                        | 24.50     | 33.78                         | 58.27     |
| 15.0            | 30.0      | 45.0      | 60.0      | 22.42                        | 22.30     | 32.29                         | 52.79     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +85°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 20.25                        | 43.79     | 63.35                         | 30.94     |
| 7.0             | 14.0      | 21.0      | 28.0      | 20.73                        | 42.88     | 60.18                         | 31.68     |
| 7.5             | 15.0      | 22.5      | 30.0      | 20.83                        | 42.51     | 61.71                         | 32.69     |
| 8.0             | 16.0      | 24.0      | 32.0      | 20.53                        | 42.97     | 56.18                         | 37.32     |
| 8.5             | 17.0      | 25.5      | 34.0      | 20.71                        | 43.74     | 41.59                         | 42.73     |
| 9.0             | 18.0      | 27.0      | 36.0      | 20.38                        | 45.79     | 38.95                         | 49.13     |
| 9.5             | 19.0      | 28.5      | 38.0      | 20.21                        | 47.27     | 41.99                         | 51.67     |
| 10.0            | 20.0      | 30.0      | 40.0      | 20.01                        | 49.13     | 43.40                         | 49.68     |
| 10.5            | 21.0      | 31.5      | 42.0      | 20.26                        | 50.03     | 44.03                         | 46.16     |
| 11.0            | 22.0      | 33.0      | 44.0      | 20.06                        | 51.97     | 49.11                         | 46.33     |
| 11.5            | 23.0      | 34.5      | 46.0      | 20.64                        | 42.20     | 52.52                         | 43.01     |
| 12.0            | 24.0      | 36.0      | 48.0      | 20.80                        | 39.21     | 53.31                         | 43.89     |
| 12.5            | 25.0      | 37.5      | 50.0      | 21.27                        | 36.83     | 50.69                         | 45.39     |
| 13.0            | 26.0      | 39.0      | 52.0      | 21.95                        | 30.96     | 46.54                         | 45.13     |
| 13.5            | 27.0      | 40.5      | 54.0      | 21.97                        | 29.21     | 40.08                         | 44.71     |
| 14.0            | 28.0      | 42.0      | 56.0      | 22.33                        | 25.71     | 38.48                         | 51.48     |
| 14.5            | 29.0      | 43.5      | 58.0      | 22.95                        | 24.00     | 35.29                         | 62.86     |
| 15.0            | 30.0      | 45.0      | 60.0      | 23.35                        | 21.95     | 33.44                         | 54.59     |

\* 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<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 18.67                        | 45.33     | 64.34                         | 30.90     |
| 7.0             | 14.0      | 21.0      | 28.0      | 19.29                        | 44.16     | 61.00                         | 31.68     |
| 7.5             | 15.0      | 22.5      | 30.0      | 19.51                        | 43.59     | 61.80                         | 33.02     |
| 8.0             | 16.0      | 24.0      | 32.0      | 19.10                        | 44.19     | 60.92                         | 39.32     |
| 8.5             | 17.0      | 25.5      | 34.0      | 19.29                        | 44.82     | 44.98                         | 44.64     |
| 9.0             | 18.0      | 27.0      | 36.0      | 18.86                        | 47.06     | 42.88                         | 56.11     |
| 9.5             | 19.0      | 28.5      | 38.0      | 18.58                        | 47.97     | 42.40                         | 51.26     |
| 10.0            | 20.0      | 30.0      | 40.0      | 18.31                        | 50.08     | 43.01                         | 47.46     |
| 10.5            | 21.0      | 31.5      | 42.0      | 18.52                        | 52.05     | 46.48                         | 43.89     |
| 11.0            | 22.0      | 33.0      | 44.0      | 18.28                        | 54.13     | 50.37                         | 44.10     |
| 11.5            | 23.0      | 34.5      | 46.0      | 18.79                        | 44.10     | 51.65                         | 41.21     |
| 12.0            | 24.0      | 36.0      | 48.0      | 18.89                        | 41.49     | 51.32                         | 41.55     |
| 12.5            | 25.0      | 37.5      | 50.0      | 19.37                        | 38.78     | 43.25                         | 44.03     |
| 13.0            | 26.0      | 39.0      | 52.0      | 20.06                        | 32.81     | 40.64                         | 42.85     |
| 13.5            | 27.0      | 40.5      | 54.0      | 20.18                        | 30.83     | 36.35                         | 40.75     |
| 14.0            | 28.0      | 42.0      | 56.0      | 20.22                        | 27.50     | 35.13                         | 43.08     |
| 14.5            | 29.0      | 43.5      | 58.0      | 20.79                        | 25.54     | 33.16                         | 52.60     |
| 15.0            | 30.0      | 45.0      | 60.0      | 21.14                        | 23.34     | 31.43                         | 58.33     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +25°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 19.81                        | 44.18     | 63.09                         | 30.64     |
| 7.0             | 14.0      | 21.0      | 28.0      | 20.40                        | 43.18     | 60.01                         | 31.48     |
| 7.5             | 15.0      | 22.5      | 30.0      | 20.54                        | 42.83     | 61.13                         | 33.05     |
| 8.0             | 16.0      | 24.0      | 32.0      | 20.14                        | 43.45     | 59.34                         | 39.47     |
| 8.5             | 17.0      | 25.5      | 34.0      | 20.28                        | 44.25     | 43.56                         | 45.67     |
| 9.0             | 18.0      | 27.0      | 36.0      | 19.87                        | 46.36     | 41.74                         | 59.62     |
| 9.5             | 19.0      | 28.5      | 38.0      | 19.60                        | 47.73     | 42.27                         | 50.64     |
| 10.0            | 20.0      | 30.0      | 40.0      | 19.35                        | 49.61     | 42.60                         | 47.54     |
| 10.5            | 21.0      | 31.5      | 42.0      | 19.57                        | 51.01     | 46.05                         | 44.79     |
| 11.0            | 22.0      | 33.0      | 44.0      | 19.34                        | 53.04     | 51.59                         | 45.64     |
| 11.5            | 23.0      | 34.5      | 46.0      | 19.83                        | 43.12     | 54.95                         | 41.92     |
| 12.0            | 24.0      | 36.0      | 48.0      | 19.94                        | 40.21     | 56.06                         | 42.38     |
| 12.5            | 25.0      | 37.5      | 50.0      | 20.40                        | 37.77     | 45.64                         | 44.39     |
| 13.0            | 26.0      | 39.0      | 52.0      | 21.09                        | 31.79     | 43.21                         | 42.81     |
| 13.5            | 27.0      | 40.5      | 54.0      | 21.16                        | 29.94     | 38.35                         | 40.74     |
| 14.0            | 28.0      | 42.0      | 56.0      | 21.32                        | 26.67     | 37.11                         | 44.97     |
| 14.5            | 29.0      | 43.5      | 58.0      | 21.95                        | 24.85     | 34.77                         | 53.87     |
| 15.0            | 30.0      | 45.0      | 60.0      | 22.32                        | 22.79     | 32.91                         | 60.92     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +85°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 20.77                        | 43.22     | 61.86                         | 30.48     |
| 7.0             | 14.0      | 21.0      | 28.0      | 21.32                        | 42.37     | 59.05                         | 31.38     |
| 7.5             | 15.0      | 22.5      | 30.0      | 21.40                        | 42.17     | 60.63                         | 33.09     |
| 8.0             | 16.0      | 24.0      | 32.0      | 21.04                        | 42.79     | 57.62                         | 39.62     |
| 8.5             | 17.0      | 25.5      | 34.0      | 21.13                        | 43.71     | 42.31                         | 46.65     |
| 9.0             | 18.0      | 27.0      | 36.0      | 20.72                        | 45.85     | 40.68                         | 61.74     |
| 9.5             | 19.0      | 28.5      | 38.0      | 20.47                        | 47.49     | 41.95                         | 50.13     |
| 10.0            | 20.0      | 30.0      | 40.0      | 20.22                        | 49.40     | 42.22                         | 47.30     |
| 10.5            | 21.0      | 31.5      | 42.0      | 20.44                        | 50.09     | 45.35                         | 45.55     |
| 11.0            | 22.0      | 33.0      | 44.0      | 20.23                        | 51.78     | 51.87                         | 47.05     |
| 11.5            | 23.0      | 34.5      | 46.0      | 20.68                        | 42.15     | 58.70                         | 42.69     |
| 12.0            | 24.0      | 36.0      | 48.0      | 20.80                        | 39.10     | 59.35                         | 42.95     |
| 12.5            | 25.0      | 37.5      | 50.0      | 21.25                        | 36.75     | 49.29                         | 44.21     |
| 13.0            | 26.0      | 39.0      | 52.0      | 21.92                        | 30.88     | 47.09                         | 42.57     |
| 13.5            | 27.0      | 40.5      | 54.0      | 21.97                        | 29.20     | 40.99                         | 40.42     |
| 14.0            | 28.0      | 42.0      | 56.0      | 22.24                        | 25.89     | 39.42                         | 46.41     |
| 14.5            | 29.0      | 43.5      | 58.0      | 22.91                        | 24.24     | 36.31                         | 55.90     |
| 15.0            | 30.0      | 45.0      | 60.0      | 23.32                        | 22.35     | 33.89                         | 59.32     |

\* 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<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 19.22                        | 44.64     | 62.56                         | 30.38     |
| 7.0             | 14.0      | 21.0      | 28.0      | 19.91                        | 43.56     | 59.62                         | 31.29     |
| 7.5             | 15.0      | 22.5      | 30.0      | 20.14                        | 43.17     | 60.29                         | 33.52     |
| 8.0             | 16.0      | 24.0      | 32.0      | 19.67                        | 43.95     | 62.12                         | 42.67     |
| 8.5             | 17.0      | 25.5      | 34.0      | 19.76                        | 44.73     | 44.56                         | 46.90     |
| 9.0             | 18.0      | 27.0      | 36.0      | 19.27                        | 47.09     | 41.77                         | 49.08     |
| 9.5             | 19.0      | 28.5      | 38.0      | 18.92                        | 48.12     | 39.06                         | 45.78     |
| 10.0            | 20.0      | 30.0      | 40.0      | 18.58                        | 50.32     | 39.42                         | 44.72     |
| 10.5            | 21.0      | 31.5      | 42.0      | 18.78                        | 52.12     | 43.12                         | 42.47     |
| 11.0            | 22.0      | 33.0      | 44.0      | 18.56                        | 53.98     | 44.27                         | 43.40     |
| 11.5            | 23.0      | 34.5      | 46.0      | 18.92                        | 44.00     | 45.14                         | 40.92     |
| 12.0            | 24.0      | 36.0      | 48.0      | 19.01                        | 41.32     | 46.11                         | 40.26     |
| 12.5            | 25.0      | 37.5      | 50.0      | 19.43                        | 38.65     | 42.04                         | 42.70     |
| 13.0            | 26.0      | 39.0      | 52.0      | 20.12                        | 32.65     | 40.30                         | 40.69     |
| 13.5            | 27.0      | 40.5      | 54.0      | 20.30                        | 30.72     | 36.73                         | 37.47     |
| 14.0            | 28.0      | 42.0      | 56.0      | 20.23                        | 27.61     | 35.14                         | 39.18     |
| 14.5            | 29.0      | 43.5      | 58.0      | 20.83                        | 25.74     | 33.98                         | 47.60     |
| 15.0            | 30.0      | 45.0      | 60.0      | 21.20                        | 23.66     | 32.14                         | 68.46     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +25°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 20.39                        | 43.51     | 61.36                         | 29.98     |
| 7.0             | 14.0      | 21.0      | 28.0      | 21.04                        | 42.59     | 58.66                         | 30.98     |
| 7.5             | 15.0      | 22.5      | 30.0      | 21.17                        | 42.40     | 59.51                         | 33.29     |
| 8.0             | 16.0      | 24.0      | 32.0      | 20.72                        | 43.17     | 60.80                         | 42.34     |
| 8.5             | 17.0      | 25.5      | 34.0      | 20.78                        | 44.12     | 43.25                         | 46.51     |
| 9.0             | 18.0      | 27.0      | 36.0      | 20.31                        | 46.35     | 41.37                         | 48.15     |
| 9.5             | 19.0      | 28.5      | 38.0      | 19.98                        | 47.82     | 38.78                         | 44.99     |
| 10.0            | 20.0      | 30.0      | 40.0      | 19.67                        | 49.78     | 39.08                         | 43.95     |
| 10.5            | 21.0      | 31.5      | 42.0      | 19.87                        | 51.02     | 43.27                         | 42.59     |
| 11.0            | 22.0      | 33.0      | 44.0      | 19.66                        | 52.79     | 44.99                         | 44.32     |
| 11.5            | 23.0      | 34.5      | 46.0      | 20.03                        | 42.93     | 46.05                         | 41.20     |
| 12.0            | 24.0      | 36.0      | 48.0      | 20.11                        | 39.97     | 48.21                         | 40.79     |
| 12.5            | 25.0      | 37.5      | 50.0      | 20.54                        | 37.56     | 44.09                         | 42.55     |
| 13.0            | 26.0      | 39.0      | 52.0      | 21.22                        | 31.58     | 43.19                         | 40.52     |
| 13.5            | 27.0      | 40.5      | 54.0      | 21.33                        | 29.79     | 39.08                         | 37.61     |
| 14.0            | 28.0      | 42.0      | 56.0      | 21.41                        | 26.70     | 37.57                         | 41.61     |
| 14.5            | 29.0      | 43.5      | 58.0      | 22.06                        | 24.97     | 35.75                         | 49.53     |
| 15.0            | 30.0      | 45.0      | 60.0      | 22.43                        | 23.05     | 33.57                         | 66.51     |

\* Harmonic Output below power level of X3 Output

| Frequency (GHz) |           |           |           | Temperature = +85°C          |           |                               |           |
|-----------------|-----------|-----------|-----------|------------------------------|-----------|-------------------------------|-----------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss<br>X3 Output | X1 Output | Harmonic Output*<br>X2 Output | X4 Output |
| 6.6             | 13.2      | 19.8      | 26.4      | 21.38                        | 42.53     | 60.32                         | 29.76     |
| 7.0             | 14.0      | 21.0      | 28.0      | 21.98                        | 41.73     | 57.68                         | 30.87     |
| 7.5             | 15.0      | 22.5      | 30.0      | 22.05                        | 41.71     | 58.85                         | 33.20     |
| 8.0             | 16.0      | 24.0      | 32.0      | 21.64                        | 42.46     | 59.22                         | 42.28     |
| 8.5             | 17.0      | 25.5      | 34.0      | 21.65                        | 43.50     | 42.09                         | 46.42     |
| 9.0             | 18.0      | 27.0      | 36.0      | 21.20                        | 45.76     | 40.88                         | 47.10     |
| 9.5             | 19.0      | 28.5      | 38.0      | 20.88                        | 47.52     | 38.46                         | 44.15     |
| 10.0            | 20.0      | 30.0      | 40.0      | 20.59                        | 49.46     | 38.78                         | 43.28     |
| 10.5            | 21.0      | 31.5      | 42.0      | 20.80                        | 49.95     | 43.42                         | 42.65     |
| 11.0            | 22.0      | 33.0      | 44.0      | 20.59                        | 51.43     | 45.81                         | 44.77     |
| 11.5            | 23.0      | 34.5      | 46.0      | 20.95                        | 41.90     | 47.11                         | 41.52     |
| 12.0            | 24.0      | 36.0      | 48.0      | 21.04                        | 38.80     | 50.99                         | 41.15     |
| 12.5            | 25.0      | 37.5      | 50.0      | 21.46                        | 36.48     | 46.94                         | 42.32     |
| 13.0            | 26.0      | 39.0      | 52.0      | 22.12                        | 30.62     | 47.69                         | 40.22     |
| 13.5            | 27.0      | 40.5      | 54.0      | 22.21                        | 29.00     | 42.36                         | 37.60     |
| 14.0            | 28.0      | 42.0      | 56.0      | 22.40                        | 25.84     | 40.54                         | 43.75     |
| 14.5            | 29.0      | 43.5      | 58.0      | 23.08                        | 24.29     | 37.50                         | 51.93     |
| 15.0            | 30.0      | 45.0      | 60.0      | 23.48                        | 22.55     | 34.32                         | 63.24     |

\* Harmonic Output below power level of X3 Output

## Typical Performance Data

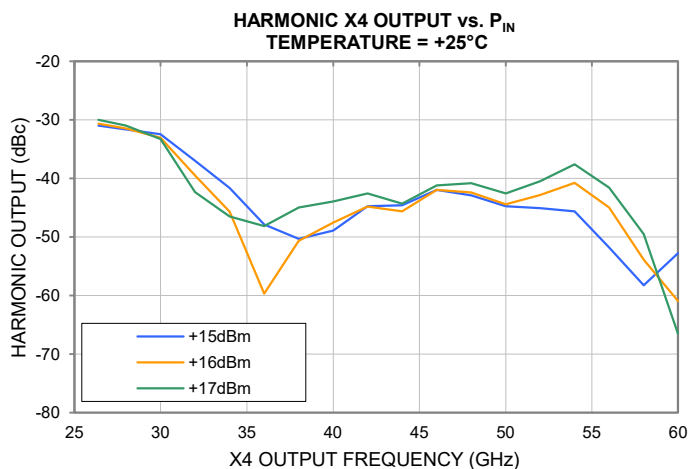
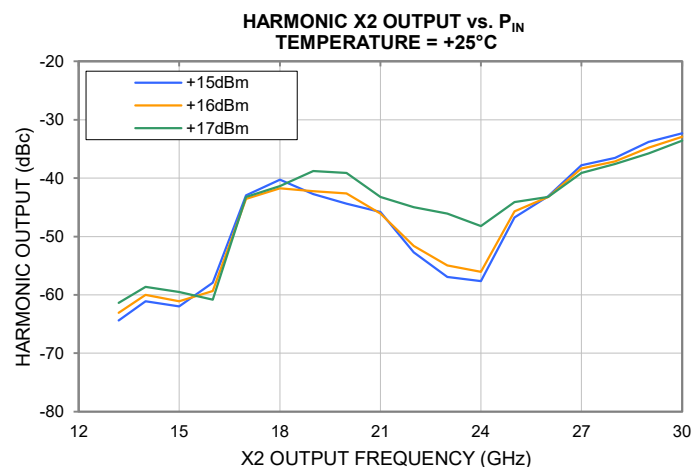
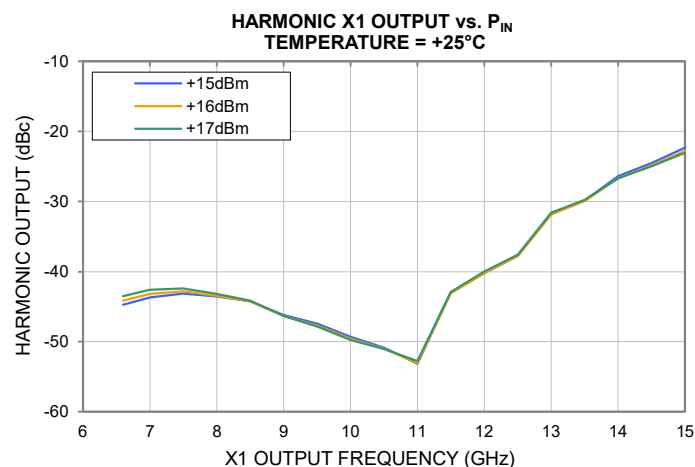
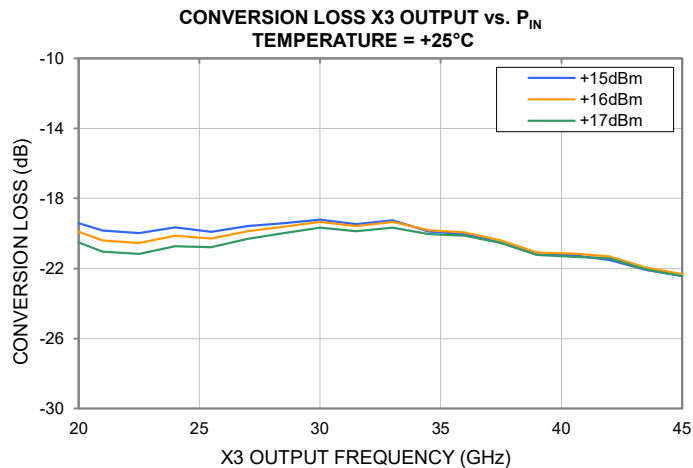
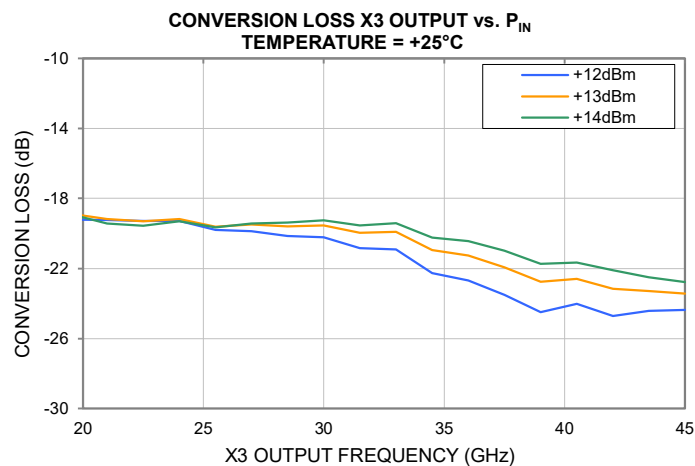
TEST CONDITION: RF IN = +12 to 14dBm

| Frequency (GHz) |           |           |           | Temperature = +25°C |       |       |
|-----------------|-----------|-----------|-----------|---------------------|-------|-------|
| X1 Output       | X2 Output | X3 Output | X4 Output | Conversion Loss     |       |       |
|                 |           |           |           | 12dBm               | 13dBm | 14dBm |
| 6.6             | 13.2      | 19.8      | 26.4      | 19.21               | 18.93 | 19.01 |
| 7.0             | 14.0      | 21.0      | 28.0      | 19.22               | 19.18 | 19.42 |
| 7.5             | 15.0      | 22.5      | 30.0      | 19.27               | 19.29 | 19.55 |
| 8.0             | 16.0      | 24.0      | 32.0      | 19.27               | 19.17 | 19.32 |
| 8.5             | 17.0      | 25.5      | 34.0      | 19.80               | 19.60 | 19.65 |
| 9.0             | 18.0      | 27.0      | 36.0      | 19.86               | 19.50 | 19.43 |
| 9.5             | 19.0      | 28.5      | 38.0      | 20.15               | 19.59 | 19.37 |
| 10.0            | 20.0      | 30.0      | 40.0      | 20.22               | 19.53 | 19.24 |
| 10.5            | 21.0      | 31.5      | 42.0      | 20.84               | 19.96 | 19.54 |
| 11.0            | 22.0      | 33.0      | 44.0      | 20.90               | 19.90 | 19.41 |
| 11.5            | 23.0      | 34.5      | 46.0      | 22.28               | 20.96 | 20.23 |
| 12.0            | 24.0      | 36.0      | 48.0      | 22.68               | 21.24 | 20.44 |
| 12.5            | 25.0      | 37.5      | 50.0      | 23.51               | 21.94 | 20.98 |
| 13.0            | 26.0      | 39.0      | 52.0      | 24.49               | 22.77 | 21.73 |
| 13.5            | 27.0      | 40.5      | 54.0      | 24.02               | 22.59 | 21.67 |
| 14.0            | 28.0      | 42.0      | 56.0      | 24.72               | 23.16 | 22.10 |
| 14.5            | 29.0      | 43.5      | 58.0      | 24.43               | 23.29 | 22.50 |
| 15.0            | 30.0      | 45.0      | 60.0      | 24.36               | 23.43 | 22.78 |

\* Harmonic Output below power level of X3 Output

## Typical Performance Curves

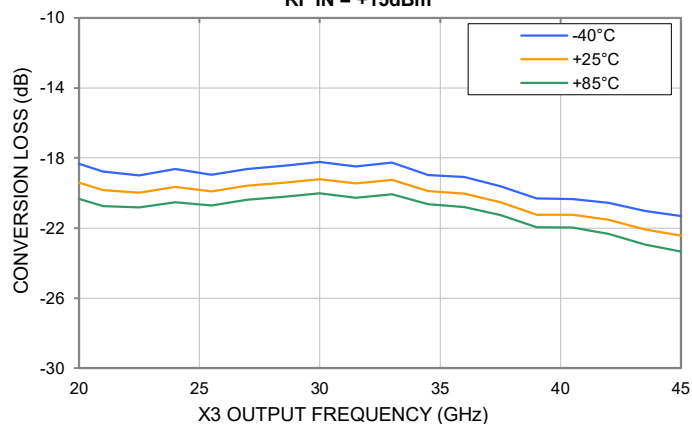
Note: Harmonics data is presented as the harmonic of input frequency below the power of F3



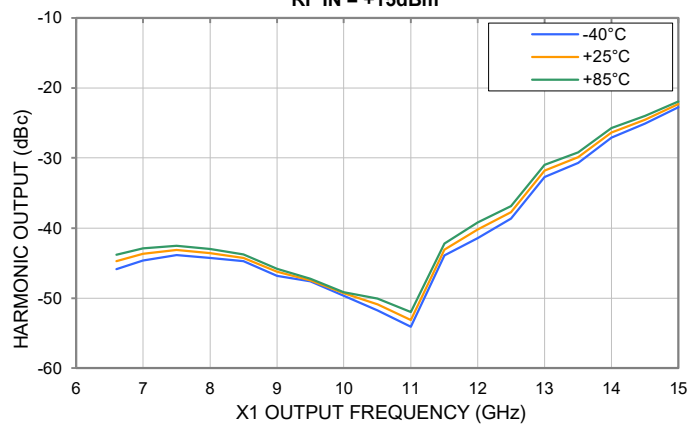
## Typical Performance Curves

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

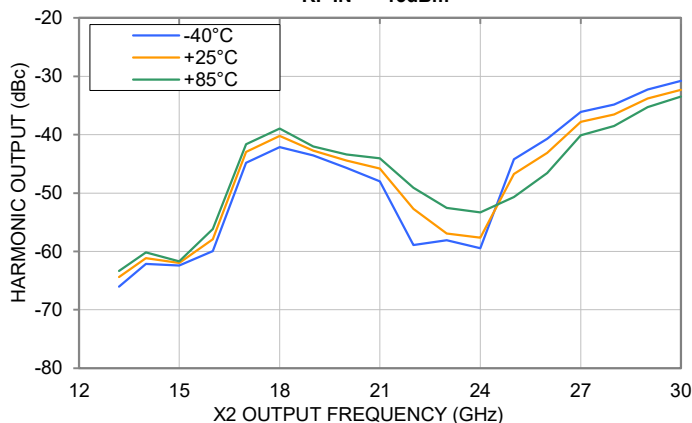
**CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE**  
RF IN = +15dBm



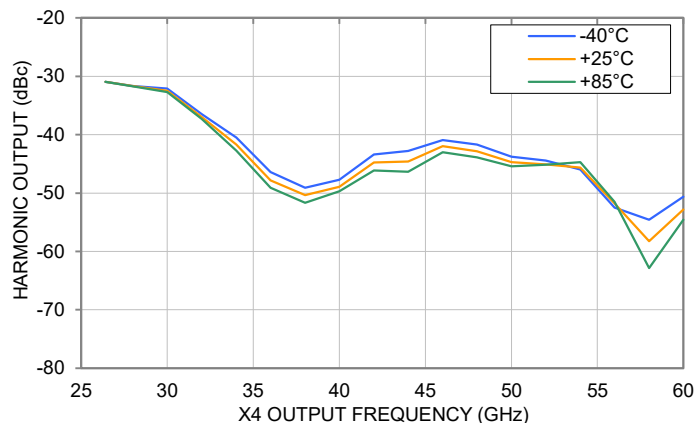
**HARMONIC X1 OUTPUT vs. TEMPERATURE**  
RF IN = +15dBm



**HARMONIC X2 OUTPUT vs. TEMPERATURE**  
RF IN = +15dBm



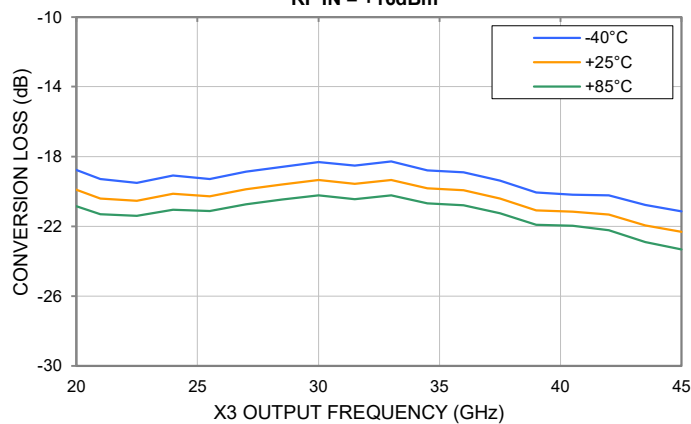
**HARMONIC X4 OUTPUT vs. TEMPERATURE**  
RF IN = +15dBm



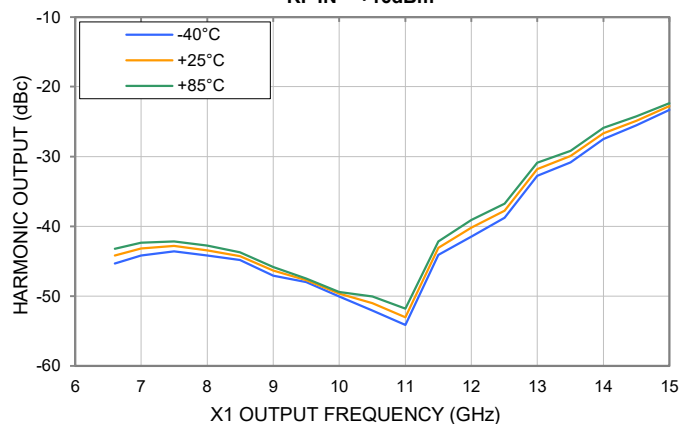
## Typical Performance Curves

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

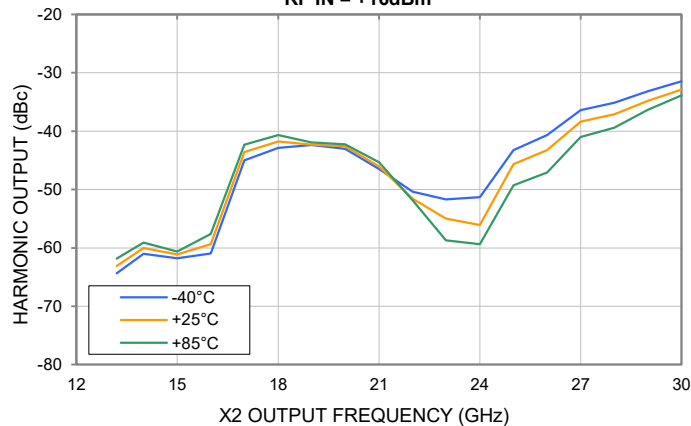
**CONVERSION LOSS X3 OUTPUT vs. TEMPERATURE**  
RF IN = +16dBm



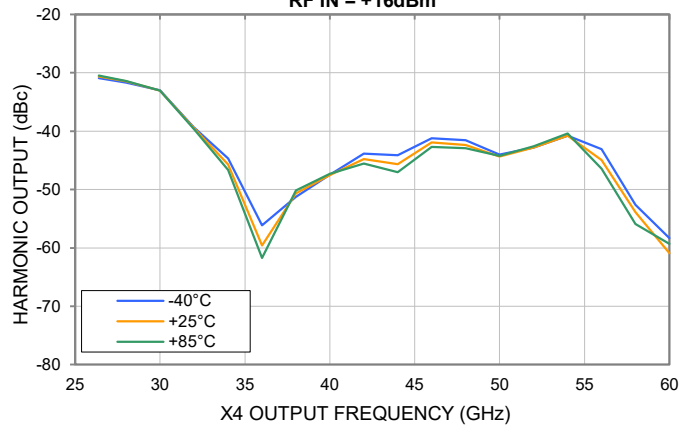
**HARMONIC X1 OUTPUT vs. TEMPERATURE**  
RF IN = +16dBm



**HARMONIC X2 OUTPUT vs. TEMPERATURE**  
RF IN = +16dBm

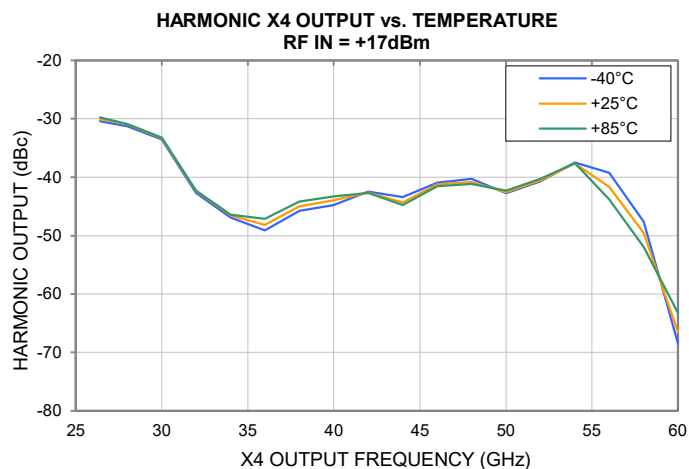
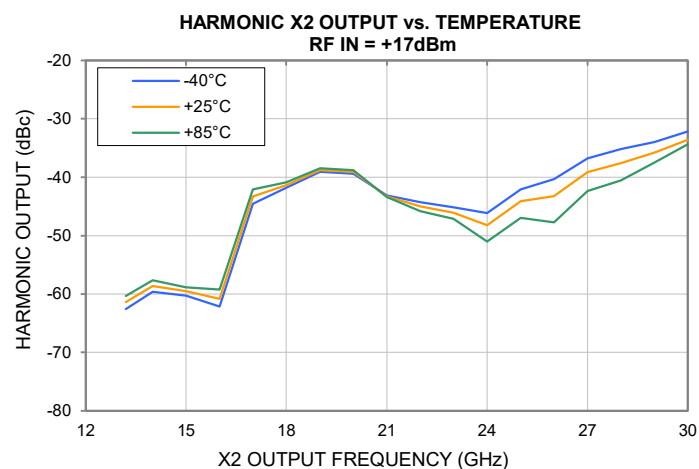
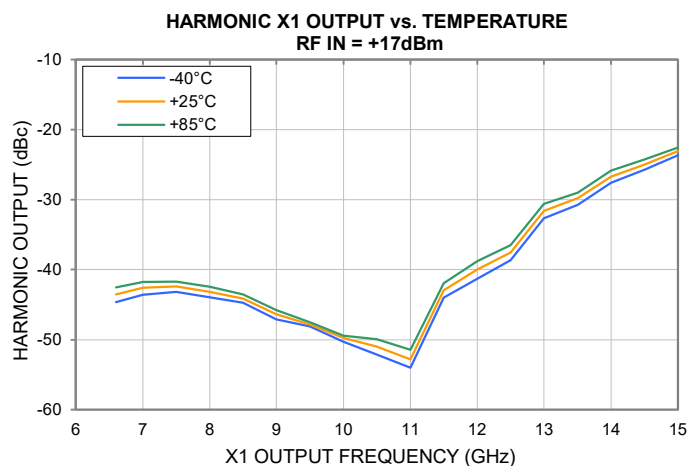
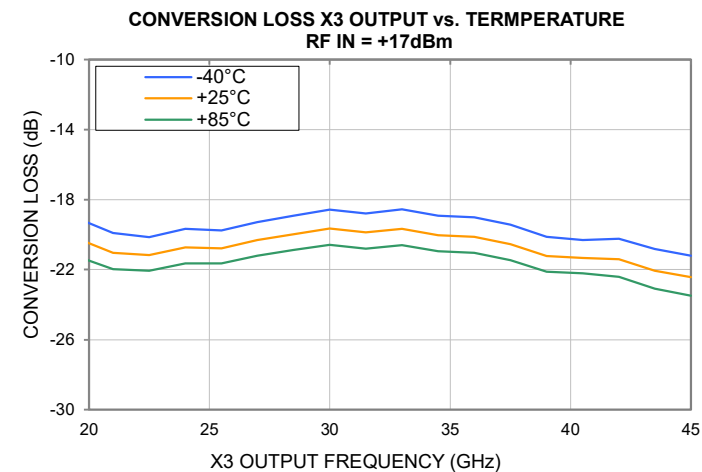


**HARMONIC X4 OUTPUT vs. TEMPERATURE**  
RF IN = +16dBm

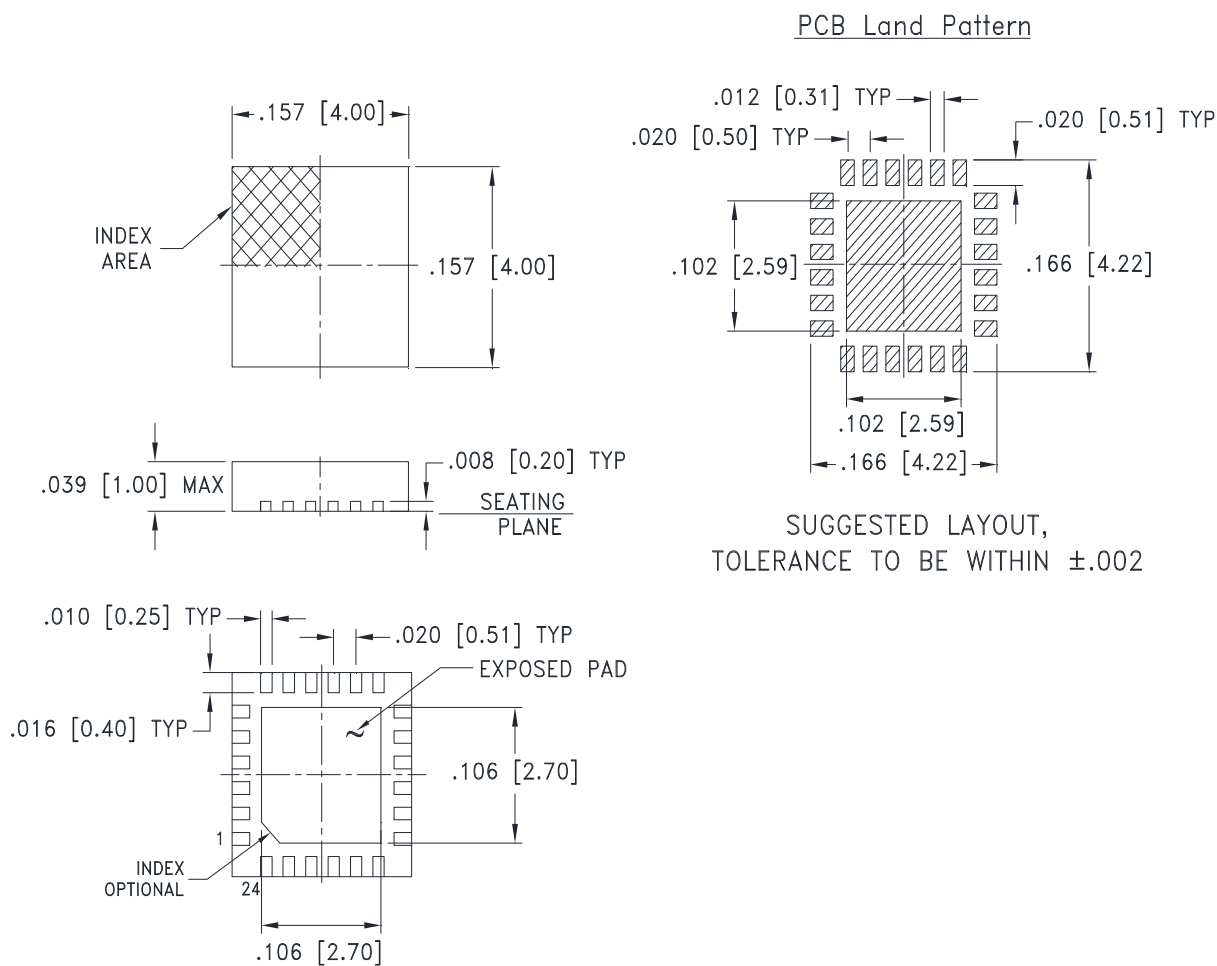


## Typical Performance Curves

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



## Outline Dimensions



**Weight: .04 Grams**

**Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$**

### Notes:

1. Case material: Plastic.
2. Termination finish:
  - For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier or Matte-Tin. All models, (+) suffix. See model Data sheet.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

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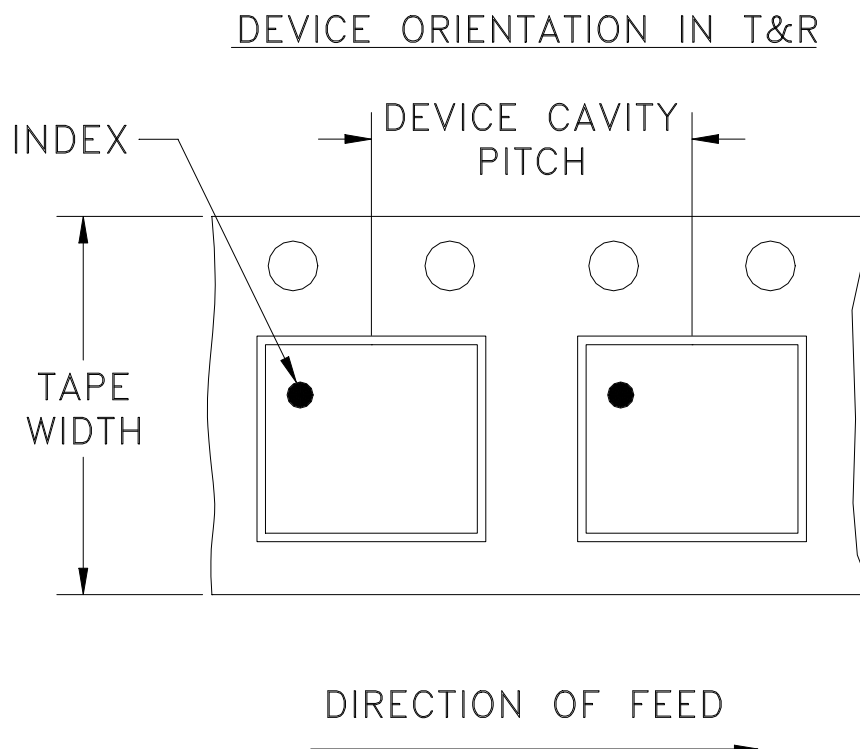
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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F68



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel see note |      |
|----------------|-------------------------|-------------------|---------------------------|------|
| 12             | 8                       | 7                 | Small quantity standard   | 20   |
|                |                         |                   |                           | 50   |
|                |                         |                   |                           | 100  |
|                |                         |                   |                           | 200  |
|                |                         |                   |                           | 500  |
|                |                         | 7                 | Standard                  | 1000 |
|                |                         | 13                | Standard                  | 2000 |
|                |                         |                   |                           | 3000 |
|                |                         |                   |                           | 4000 |

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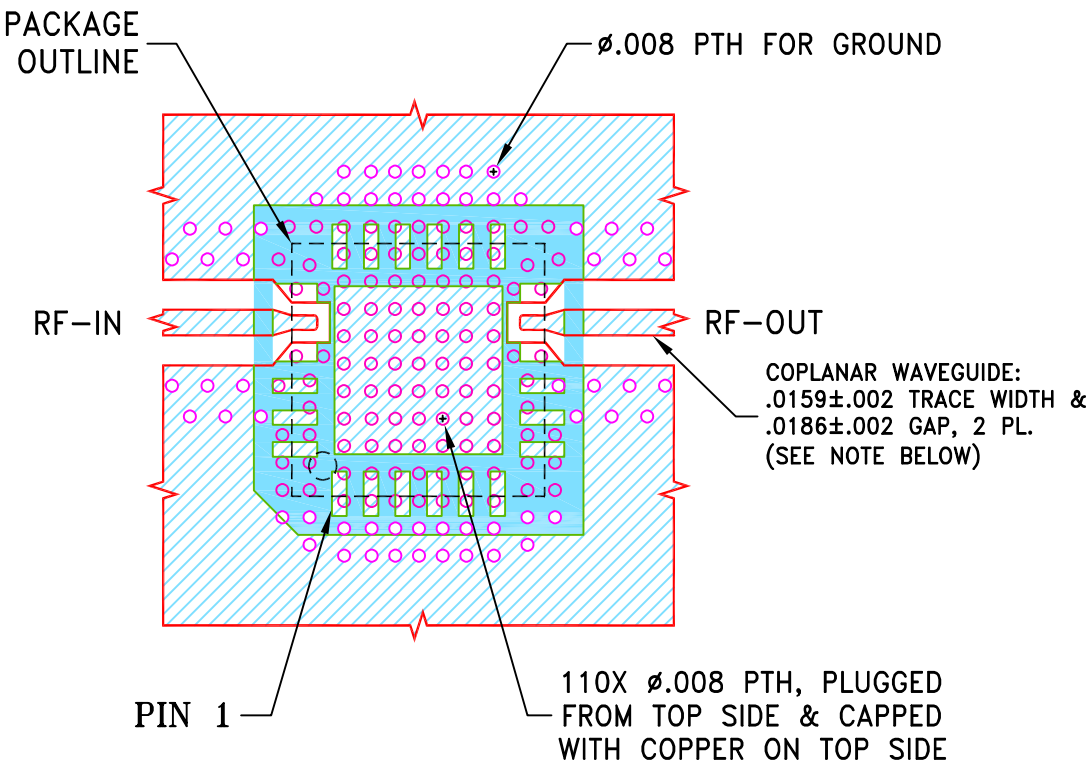
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THIRD ANGLE PROJECTION

| REVISIONS |            |             |          |     |      |
|-----------|------------|-------------|----------|-----|------|
| REV       | ECN No.    | DESCRIPTION | DATE     | DR  | AUTH |
| OR        | ECO-013714 | NEW RELEASE | 06/13/22 | ITG | IL   |
|           |            |             |          |     |      |
|           |            |             |          |     |      |
|           |            |             |          |     |      |

SUGGESTED MOUNTING CONFIGURATION FOR

DG1847 CASE STYLE



NOTES:

1. TRACE WIDTH AND GAP PARAMETERS ARE SHOWN FOR ROGERS RO4003 WITH DIELECTRIC THICKNESS .008±.0007"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.

2. UNIT FOOT PRINT IS OPTIMIZED FOR PERFORMANCE AND IS DIFFERENT FROM CASE STYLE DG1847 RECOMMENDATIONS.

3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

|                            |          |     |          |                                                                                           |
|----------------------------|----------|-----|----------|-------------------------------------------------------------------------------------------|
| UNLESS OTHERWISE SPECIFIED | INITIALS |     | DATE     | <div> <div>Mini-Circuits®</div> <div>13 Neptune Avenue<br/>Brooklyn NY 11235</div> </div> |
| DIMENSIONS ARE IN INCHES   | DRAWN    | ITG | 06/13/22 |                                                                                           |
| TOLERANCES ON:             | CHECKED  | GF  | 06/13/22 |                                                                                           |
| 2 PL DECIMALS ±            | APPROVED | IL  | 06/13/22 |                                                                                           |
| 3 PL DECIMALS ± .005       |          |     |          |                                                                                           |
| ANGLES ±                   |          |     |          |                                                                                           |
| FRACTIONS ±                |          |     |          |                                                                                           |

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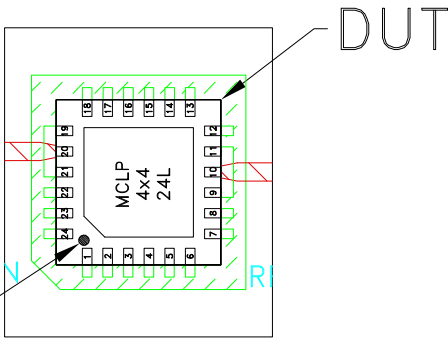
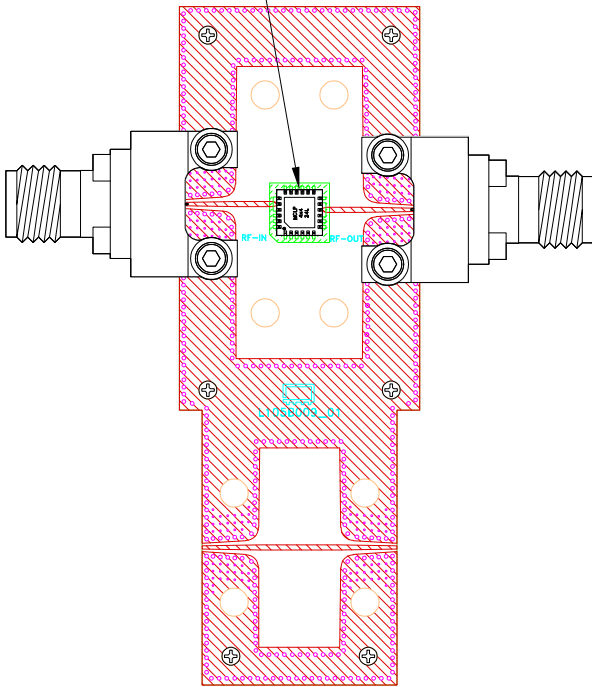
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PL, DG1847, TB-CY3-223(C)+

|                  |                     |                          |            |
|------------------|---------------------|--------------------------|------------|
| SIZE<br>A        | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-732 | REV:<br>OR |
| FILE:<br>98PL732 | SCALE:<br>8:1       | SHEET:<br>1 OF 1         |            |

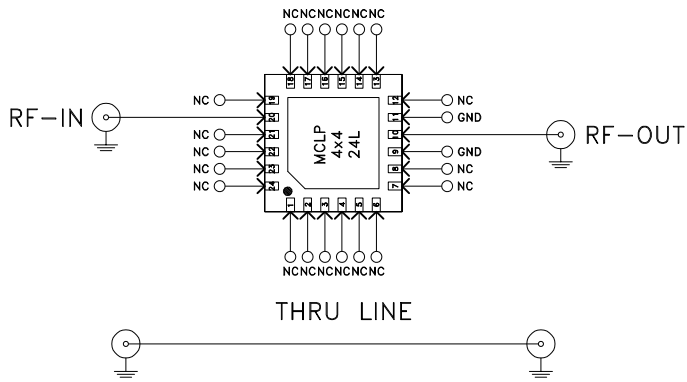
# Evaluation Board and Circuit

SEE DETAIL "A"



INDEX

DETAIL "A"  
(SCALE 3:1)



SCHEMATIC DIAGRAM  
(SCALE 3:1)

| Function               | Pad             |
|------------------------|-----------------|
| RF-IN                  | 20              |
| RF-OUT                 | 10              |
| GND                    | 9,11            |
| NC (Ground Externally) | 1-8,12-19,21-24 |

## NOTES:

1. 1.85mm Female Connectors.
2. PCB Material: Roger R04003C or equivalent,  
Dielectric constant=3.5, Thickness=0.008 inch





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 -45° to 85° C or -55° to 105° C or -40° to 105° C or -40° to 95° C<br>Ambient Environment | Individual Model Data Sheet                                     |
| Storage Temperature            | -55° to 100° C or -65° to 150°<br>Ambient Environment                                                      | Individual Model Data Sheet                                     |
| HTOL                           | 1000 hours at 125°C                                                                                        | MIL-STD-883, Method 1005, Condition B                           |
| Thermal Shock                  | -55° to 100°C, 100 cycles                                                                                  | MIL-STD-202, Method 107, Condition A-3, except +100°C           |
| Mechanical Shock               | 1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only                                                           | MIL-STD-883, Method 2002, Condition B, except Y1 direction only |
| Vibration (Variable Frequency) | 50g peak                                                                                                   | MIL-STD-883, Method 2007, Condition B                           |
| Autoclave                      | 15 psig, 100% RH, 121°C, 96 hours                                                                          | JESD22-A102, Condition C                                        |
| HAST                           | 130°C, 85% RH, 96 hours                                                                                    | JESD22-A110                                                     |
| Solderability                  | 10X Magnification                                                                                          | J-STD-002, Para 4.2.5, Test S, 95% Coverage                     |
| Solder Reflow Heat             | Sn-Pb Eutetic Process: 240°C peak<br>Pb-Free Process: 260°C peak                                           | J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1                   |
| Moisture Sensitivity: Level 1  | Bake at 125°C for 24 hours<br>Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak             | J-STD-020                                                       |



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          |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215 |