# X12
# Frequency Multiplier

## 50Ω Output 4500 to 6000 MHz

# ZX90-12-63-S+

*Generic photo used for illustration purposes only*

CASE STYLE: BY1298

| Connectors | Model |
|---|---|
| **SMA** | ZX90-12-63-S+ |

***+RoHS Compliant***

*The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications*

## Maximum Ratings

| | |
|---|---|
| Operating Temperature | -55°C to 100°C |
| Storage Temperature | -55°C to 100°C |
| RF Input Power | 13dBm |
| DC Voltage | 8.5 V |

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

## Coaxial Connections

| | |
|---|---|
| INPUT | 1 |
| OUTPUT | 2 |

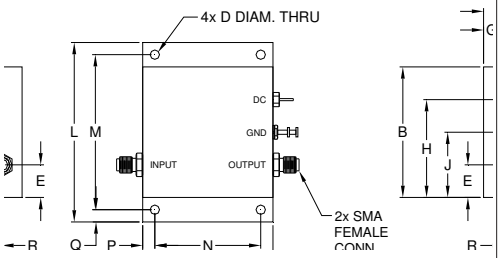
## Features

- broadband
- excellent spurious and harmonics suppression, 40 dBc typ.

## Applications

- military radio
- test equipment
- mobile

## Outline Drawing




## Outline Dimensions (inch / mm)

| A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|
| 2.00 | 2.00 | .62 | .144 | .50 | -- | .26 | 1.50 | 1.00 |
| 50.80 | 50.80 | 15.75 | 3.66 | 12.70 | -- | 6.60 | 38.10 | 25.40 |

| K | L | M | N | P | Q | R | wt |
|---|---|---|---|---|---|---|---|
| .100 | 2.75 | 2.375 | 1.625 | .19 | .19 | .31 | grams |
| 2.54 | 69.85 | 60.33 | 41.28 | 4.83 | 4.83 | 7.87 | 71.80 |

## Electrical Specifications $T_{AMB}$= 25°C

| MULTIPLICATION FACTOR | FREQUENCY (MHz) | | INPUT POWER (dBm) | | CONVERSION LOSS (dB) | | *HARMONIC OUTPUT (dBc) | | | | | | | | DC POWER | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | F12 | | F1 to F3 | | F4 | | F5 to F9 | | F10 to F16 | | | |
| | F1 Input | F12 Output | Min. | Max. | Typ. | Max. | Typ. | Min. | Typ. | Min. | Typ. | Min. | Typ. | Min. | Volts[1] (V) Nom. | Current (mA) Max. |
| 12 | 375-500 | 4500-6000 | -4 | 0 | 6.5 | 12 | 65 | 50 | 34 | 23 | 48 | 33 | 26 | 20 | 8 | 200 |

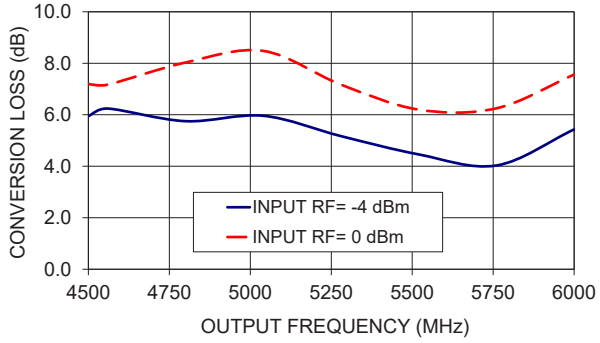
* Harmonics of input frequency below the power level of F12

1. Other volts available upon request.

## Typical Performance Data

| Frequency | | Conversion Loss (dB) at RF Input Power | |
|---|---|---|---|
| Input (MHz) | Output (MHz) | -4 dBm | 0 dBm |
| 375.00 | 4500.00 | 5.95 | 7.19 |
| 380.00 | 4560.00 | 6.24 | 7.17 |
| 400.00 | 4800.00 | 5.75 | 8.03 |
| 420.00 | 5040.00 | 5.96 | 8.48 |
| 440.00 | 5280.00 | 5.17 | 7.17 |
| 460.00 | 5520.00 | 4.46 | 6.20 |
| 480.00 | 5760.00 | 4.03 | 6.25 |
| 500.00 | 6000.00 | 5.43 | 7.56 |

ZX90-12-63-S+
CONVERSION LOSS

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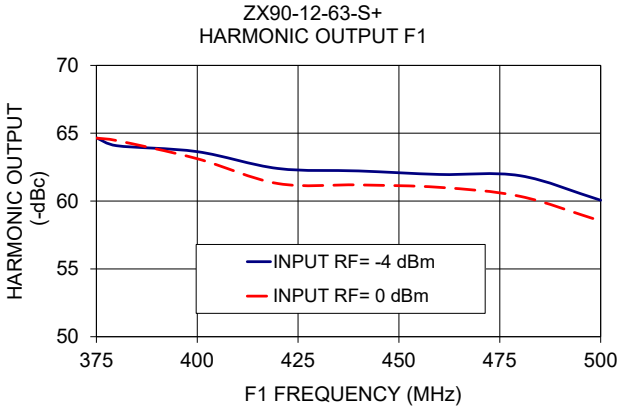
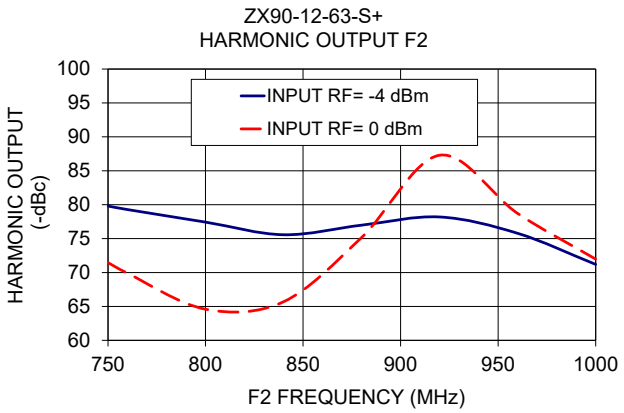
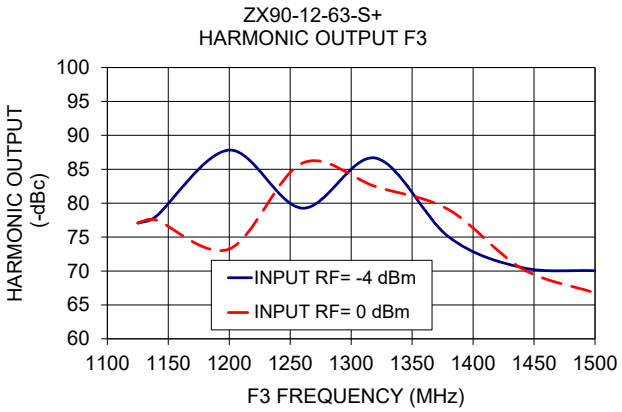
## Typical Performance Data

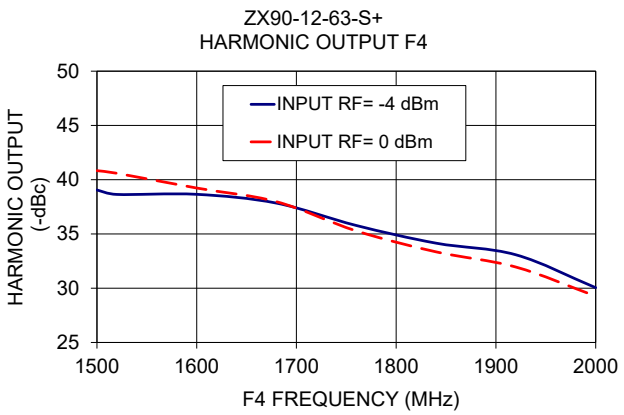
| Frequency | | Harmonic Rejection Below F12 (-dBc) at RF Input Power -4 dBm | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Input (MHz) | Output (MHz) | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F13 | F14 | F15 | F16 |
| 375.00 | 4500.00 | 64.66 | 79.80 | 77.05 | 39.05 | 62.08 | 55.81 | 64.27 | 71.85 | 71.12 | 42.22 | 32.97 | 24.73 | 28.12 | 48.25 | 31.03 |
| 380.00 | 4560.00 | 64.08 | 79.28 | 78.05 | 38.64 | 62.22 | 56.04 | 63.03 | 63.68 | 73.49 | 38.30 | 33.03 | 25.13 | 28.42 | 47.76 | 31.68 |
| 400.00 | 4800.00 | 63.64 | 77.43 | 87.83 | 38.65 | 61.23 | 59.64 | 62.54 | 63.22 | 58.33 | 38.54 | 38.24 | 30.38 | 30.61 | 53.46 | 30.96 |
| 420.00 | 5040.00 | 62.40 | 75.57 | 79.26 | 37.84 | 61.73 | 57.78 | 66.74 | 54.32 | 50.14 | 38.04 | 38.07 | 34.73 | 30.83 | 50.99 | 32.06 |
| 440.00 | 5280.00 | 62.22 | 76.98 | 86.65 | 35.78 | 64.41 | 67.28 | 77.48 | 61.62 | 49.55 | 43.77 | 31.07 | 32.03 | 53.14 | 51.43 | 34.49 |
| 460.00 | 5520.00 | 61.96 | 78.19 | 75.03 | 34.15 | 62.06 | 70.03 | 71.28 | 47.47 | 46.70 | 38.28 | 30.83 | 32.41 | 56.21 | 49.98 | 46.38 |
| 480.00 | 5760.00 | 61.87 | 75.78 | 70.51 | 33.08 | 58.06 | 64.02 | 68.63 | 42.16 | 48.94 | 34.41 | 27.95 | 31.70 | 42.42 | 57.20 | 49.95 |
| 500.00 | 6000.00 | 60.06 | 71.20 | 70.04 | 30.05 | 54.70 | 63.89 | 58.01 | 43.20 | 49.53 | 30.60 | 24.01 | 28.91 | 38.06 | 62.56 | 57.80 |

| Frequency | | Harmonic Rejection Below F12 (-dBc) at RF Input Power 0 dBm | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Input (MHz) | Output (MHz) | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | F11 | F13 | F14 | F15 | F16 |
| 375.00 | 4500.00 | 64.64 | 71.46 | 77.11 | 40.83 | 57.63 | 54.72 | 63.03 | 49.41 | 56.29 | 41.40 | 32.78 | 25.37 | 28.28 | 45.86 | 29.60 |
| 380.00 | 4560.00 | 64.46 | 69.90 | 77.51 | 40.59 | 57.54 | 54.96 | 60.50 | 47.64 | 58.19 | 37.48 | 33.89 | 26.28 | 28.11 | 46.11 | 30.60 |
| 400.00 | 4800.00 | 63.12 | 64.59 | 73.24 | 39.23 | 58.38 | 62.79 | 52.58 | 53.99 | 57.95 | 35.91 | 44.77 | 29.96 | 30.64 | 53.53 | 31.81 |
| 420.00 | 5040.00 | 61.29 | 65.69 | 85.91 | 37.97 | 57.50 | 54.15 | 41.63 | 46.14 | 49.55 | 39.42 | 26.32 | 26.03 | 32.55 | 49.93 | 34.58 |
| 440.00 | 5280.00 | 61.19 | 75.16 | 82.45 | 35.28 | 59.51 | 62.90 | 54.34 | 61.47 | 46.75 | 41.37 | 25.32 | 26.12 | 53.65 | 46.65 | 38.53 |
| 460.00 | 5520.00 | 61.01 | 87.29 | 79.04 | 33.35 | 62.18 | 61.94 | 65.60 | 47.47 | 43.06 | 42.98 | 26.59 | 28.42 | 44.73 | 49.11 | 50.63 |
| 480.00 | 5760.00 | 60.35 | 78.71 | 70.37 | 31.95 | 62.17 | 61.17 | 60.69 | 43.05 | 38.82 | 36.28 | 26.22 | 30.12 | 39.82 | 52.65 | 53.32 |
| 500.00 | 6000.00 | 58.53 | 71.98 | 66.76 | 29.27 | 68.41 | 52.10 | 58.78 | 43.19 | 41.26 | 32.15 | 24.96 | 28.59 | 39.01 | 59.79 | 60.16 |

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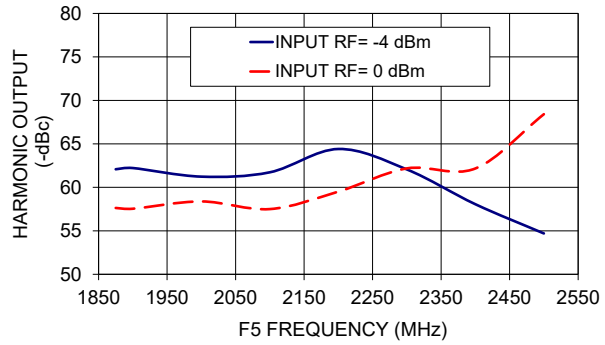
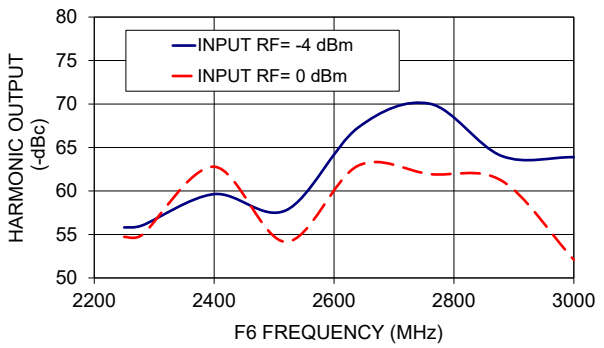
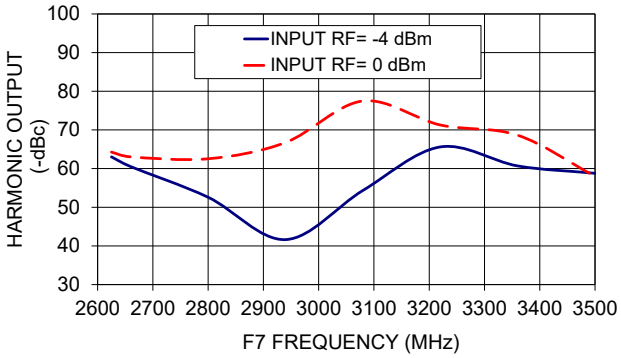
ZX90-12-63-S+
HARMONIC OUTPUT F5



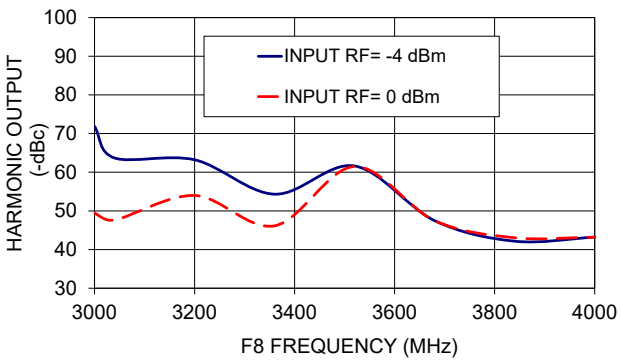

ZX90-12-63-S+
HARMONIC OUTPUT F6



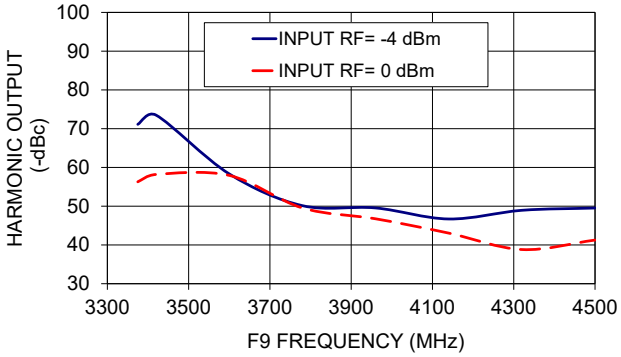

ZX90-12-63-S+
HARMONIC OUTPUT F7



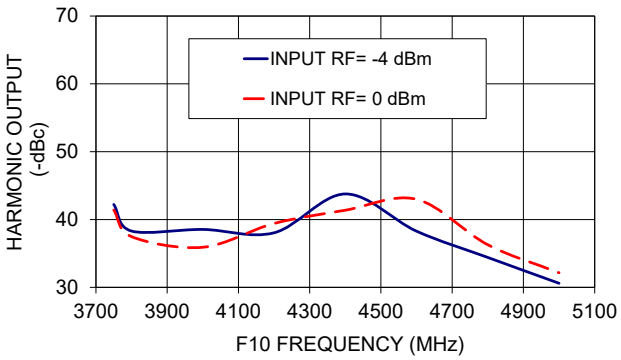

ZX90-12-63-S+
HARMONIC OUTPUT F8



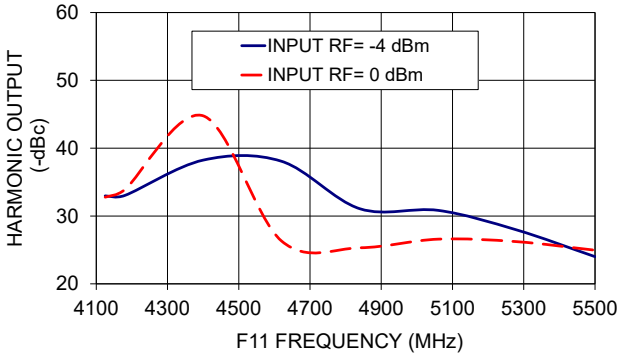

ZX90-12-63-S+
HARMONIC OUTPUT F9



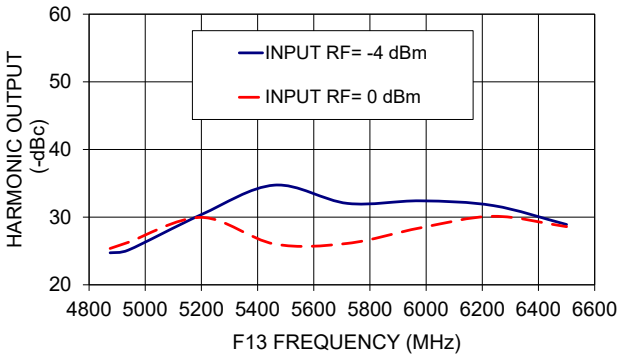

ZX90-12-63-S+
HARMONIC OUTPUT F10




ZX90-12-63-S+
HARMONIC OUTPUT F11




ZX90-12-63-S+
HARMONIC OUTPUT F13

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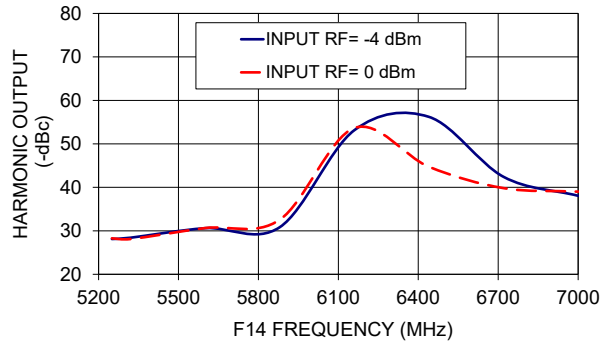
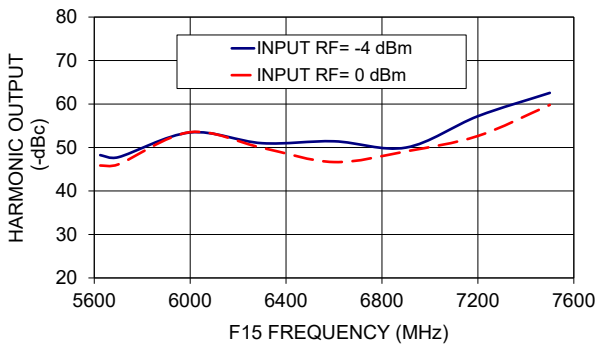
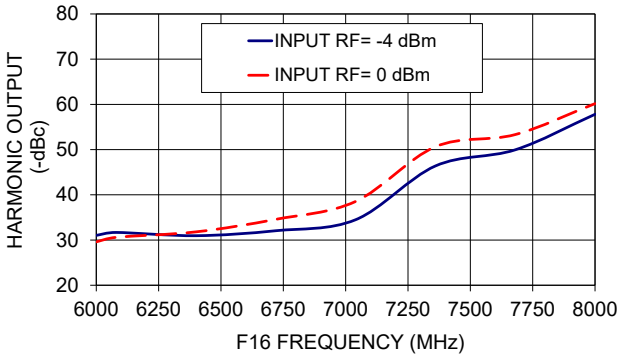
ZX90-12-63-S+
HARMONIC OUTPUT F14




ZX90-12-63-S+
HARMONIC OUTPUT F15




ZX90-12-63-S+
HARMONIC OUTPUT F16

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*Typical Performance Data*

| Frequency (MHz) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **X12 Output** | **X1 Output** | **X2 Output** | **X3 Output** | **X4 Output** | **X5 Output** | **X6 Output** | **X7 Output** | **X8 Output** | **X9 Output** | **X10 Output** | **X11 Output** | **X13 Output** | **X14 Output** | **X15 Output** | **X16 Output** |
| 4500 | 375 | 750 | 1125 | 1500 | 1875 | 2250 | 2625 | 3000 | 3375 | 3750 | 4125 | 4875 | 5250 | 5625 | 6000 |
| 4560 | 380 | 760 | 1140 | 1520 | 1900 | 2280 | 2660 | 3040 | 3420 | 3800 | 4180 | 4940 | 5320 | 5700 | 6080 |
| 4800 | 400 | 800 | 1200 | 1600 | 2000 | 2400 | 2800 | 3200 | 3600 | 4000 | 4400 | 5200 | 5600 | 6000 | 6400 |
| 5040 | 420 | 840 | 1260 | 1680 | 2100 | 2520 | 2940 | 3360 | 3780 | 4200 | 4620 | 5460 | 5880 | 6300 | 6720 |
| 5280 | 440 | 880 | 1320 | 1760 | 2200 | 2640 | 3080 | 3520 | 3960 | 4400 | 4840 | 5720 | 6160 | 6600 | 7040 |
| 5520 | 460 | 920 | 1380 | 1840 | 2300 | 2760 | 3220 | 3680 | 4140 | 4600 | 5060 | 5980 | 6440 | 6900 | 7360 |
| 5760 | 480 | 960 | 1440 | 1920 | 2400 | 2880 | 3360 | 3840 | 4320 | 4800 | 5280 | 6240 | 6720 | 7200 | 7680 |
| 6000 | 500 | 1000 | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | 5000 | 5500 | 6500 | 7000 | 7500 | 8000 |

| RF IN = -4dBm | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conversion Loss (dB)** | **Harmonic Output*(-dBc)** | | | | | | | | | | | | | | |
| **X12 Output** | **X1 Output** | **X2 Output** | **X3 Output** | **X4 Output** | **X5 Output** | **X6 Output** | **X7 Output** | **X8 Output** | **X9 Output** | **X10 Output** | **X11 Output** | **X13 Output** | **X14 Output** | **X15 Output** | **X16 Output** |
| 5.95 | 64.66 | 79.80 | 77.05 | 39.05 | 62.08 | 55.81 | 64.27 | 71.85 | 71.12 | 42.22 | 32.97 | 24.73 | 28.12 | 48.25 | 31.03 |
| 6.24 | 64.08 | 79.28 | 78.05 | 38.64 | 62.22 | 56.04 | 63.03 | 63.68 | 73.49 | 38.30 | 33.03 | 25.13 | 28.42 | 47.76 | 31.68 |
| 5.75 | 63.64 | 77.43 | 87.83 | 38.65 | 61.23 | 59.64 | 62.54 | 63.22 | 58.33 | 38.54 | 38.24 | 30.38 | 30.61 | 53.46 | 30.96 |
| 5.96 | 62.40 | 75.57 | 79.26 | 37.84 | 61.73 | 57.78 | 66.74 | 54.32 | 50.14 | 38.04 | 38.07 | 34.73 | 30.83 | 50.99 | 32.06 |
| 5.17 | 62.22 | 76.98 | 86.65 | 35.78 | 64.41 | 67.28 | 77.48 | 61.62 | 49.55 | 43.77 | 31.07 | 32.03 | 53.14 | 51.43 | 34.49 |
| 4.46 | 61.96 | 78.19 | 75.03 | 34.15 | 62.06 | 70.03 | 71.28 | 47.47 | 46.70 | 38.28 | 30.83 | 32.41 | 56.21 | 49.98 | 46.38 |
| 4.03 | 61.87 | 75.78 | 70.51 | 33.08 | 58.06 | 64.02 | 68.63 | 42.16 | 48.94 | 34.41 | 27.95 | 31.70 | 42.42 | 57.20 | 49.95 |
| 5.43 | 60.06 | 71.20 | 70.04 | 30.05 | 54.70 | 63.89 | 58.01 | 43.20 | 49.53 | 30.60 | 24.01 | 28.91 | 38.06 | 62.56 | 57.80 |

*Harmonic Output below power level of X12 Output .

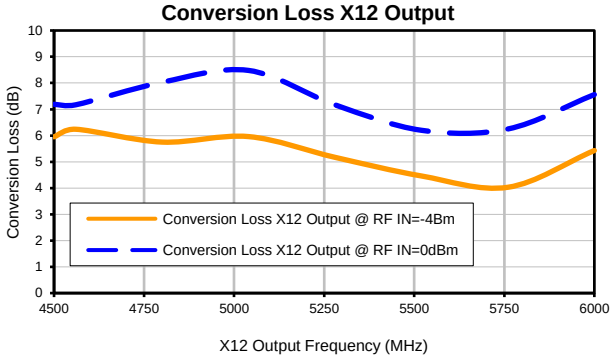
| RF IN = 0dBm | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conversion Loss (dB)** | **Harmonic Output*(-dBc)** | | | | | | | | | | | | | | |
| **X12 Output** | **X1 Output** | **X2 Output** | **X3 Output** | **X4 Output** | **X5 Output** | **X6 Output** | **X7 Output** | **X8 Output** | **X9 Output** | **X10 Output** | **X11 Output** | **X13 Output** | **X14 Output** | **X15 Output** | **X16 Output** |
| 7.19 | 64.64 | 71.46 | 77.11 | 40.83 | 57.63 | 54.72 | 63.03 | 49.41 | 56.29 | 41.40 | 32.78 | 25.37 | 28.28 | 45.86 | 29.60 |
| 7.17 | 64.46 | 69.90 | 77.51 | 40.59 | 57.54 | 54.96 | 60.50 | 47.64 | 58.19 | 37.48 | 33.89 | 26.28 | 28.11 | 46.11 | 30.60 |
| 8.03 | 63.12 | 64.59 | 73.24 | 39.23 | 58.38 | 62.79 | 52.58 | 53.99 | 57.95 | 35.91 | 44.77 | 29.96 | 30.64 | 53.53 | 31.81 |
| 8.48 | 61.29 | 65.69 | 85.91 | 37.97 | 57.50 | 54.15 | 41.63 | 46.14 | 49.55 | 39.42 | 26.32 | 26.03 | 32.55 | 49.93 | 34.58 |
| 7.17 | 61.19 | 75.16 | 82.45 | 35.28 | 59.51 | 62.90 | 54.34 | 61.47 | 46.75 | 41.37 | 25.32 | 26.12 | 53.65 | 46.65 | 38.53 |
| 6.20 | 61.01 | 87.29 | 79.04 | 33.35 | 62.18 | 61.94 | 65.60 | 47.47 | 43.06 | 42.98 | 26.59 | 28.42 | 44.73 | 49.11 | 50.63 |
| 6.25 | 60.35 | 78.71 | 70.37 | 31.95 | 62.17 | 61.17 | 60.69 | 43.05 | 38.82 | 36.28 | 26.22 | 30.12 | 39.82 | 52.65 | 53.32 |
| 7.56 | 58.53 | 71.98 | 66.76 | 29.27 | 68.41 | 52.10 | 58.78 | 43.19 | 41.26 | 32.15 | 24.96 | 28.59 | 39.01 | 59.79 | 60.16 |

*Harmonic Output below power level of X12 Output .

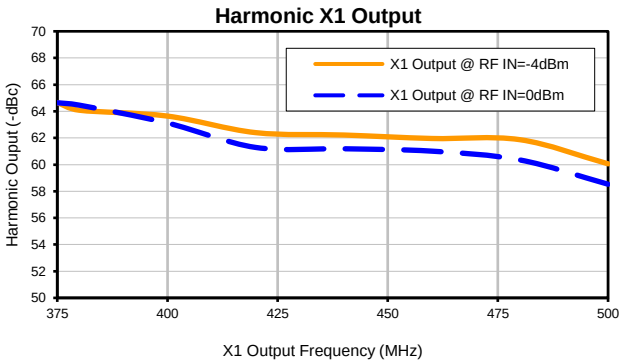
# Frequency Multiplier (X12) ZX90-12-63-S+

## *Typical Performance Curves*

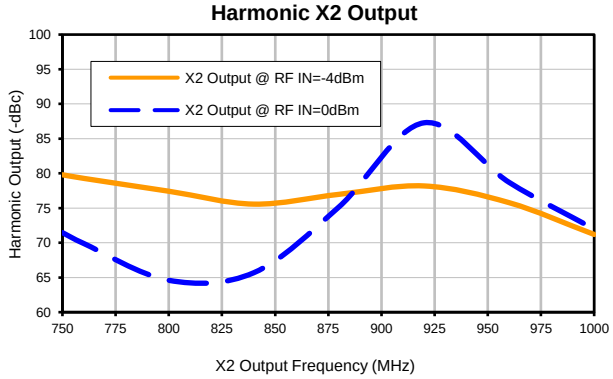
**Conversion Loss X12 Output**



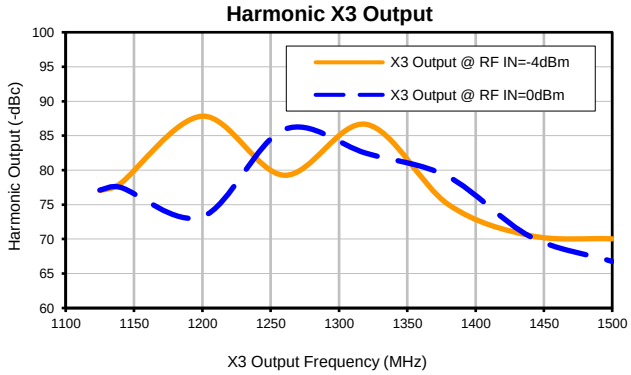

**Harmonic X1 Output**



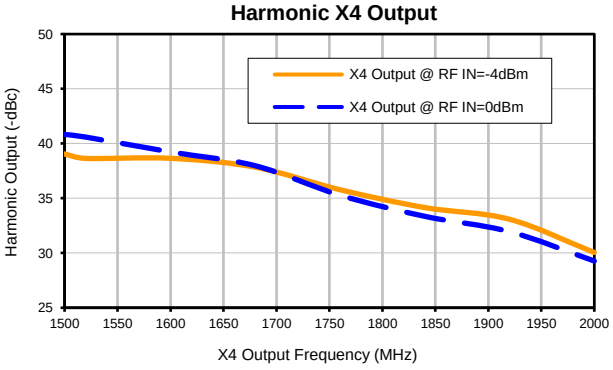

**Harmonic X2 Output**



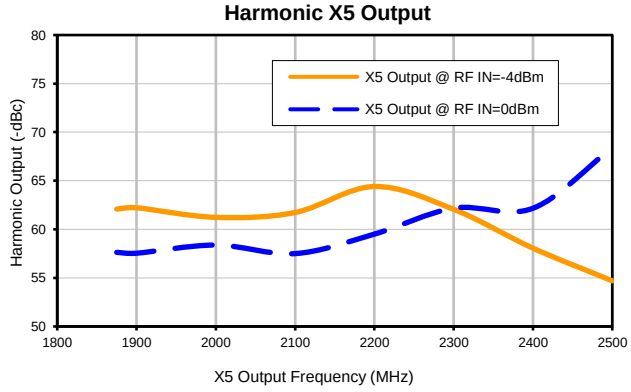

**Harmonic X3 Output**



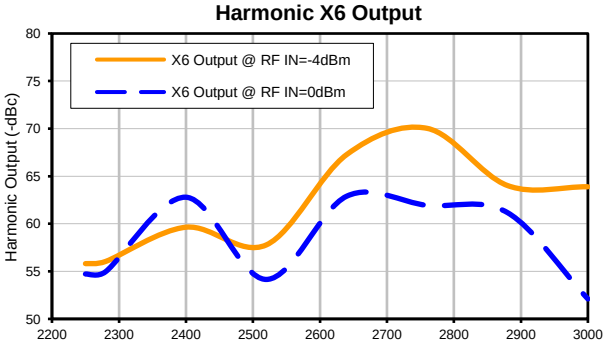

**Harmonic X4 Output**



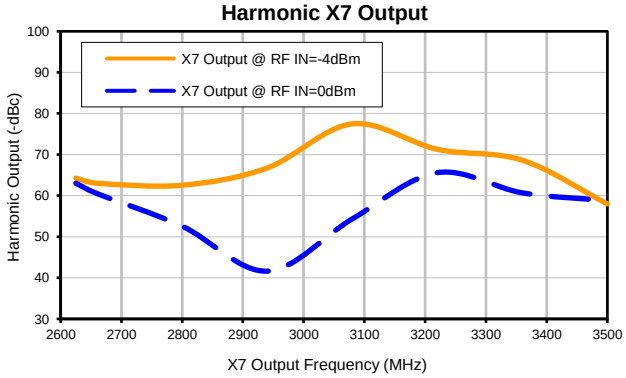

**Harmonic X5 Output**




**Harmonic X6 Output**

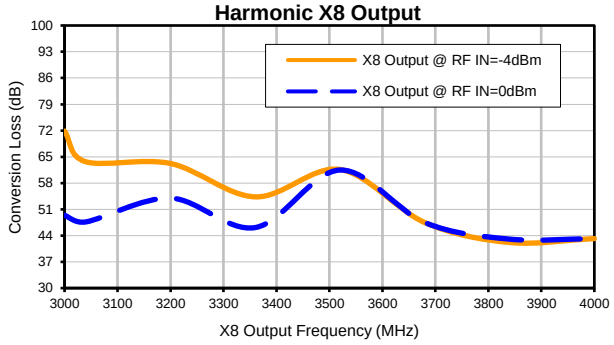



**Harmonic X7 Output**

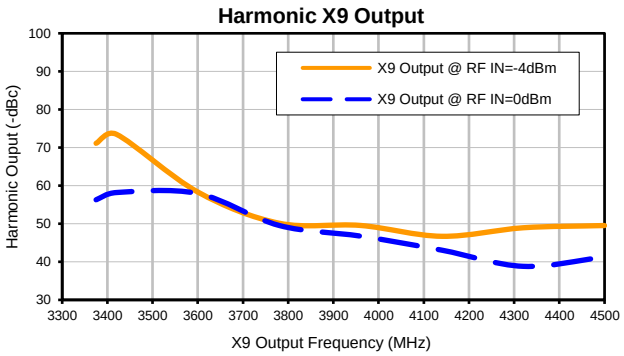


## *Typical Performance Curves*

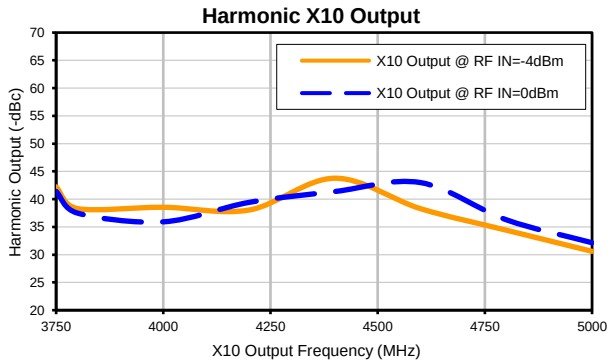
**Harmonic X8 Output**



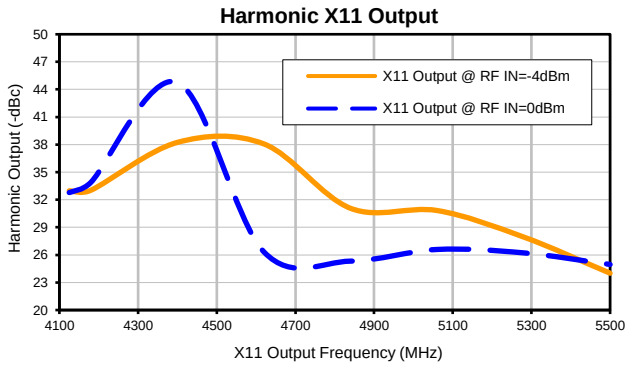

**Harmonic X9 Output**



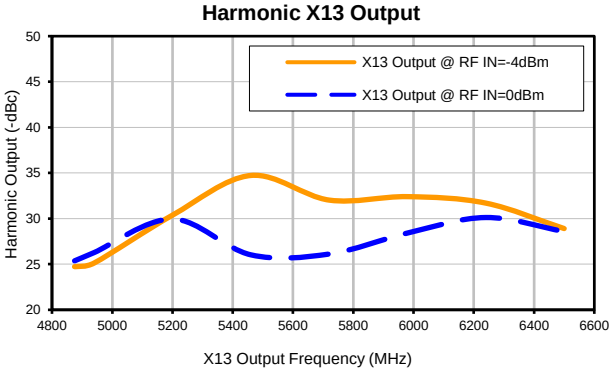

**Harmonic X10 Output**



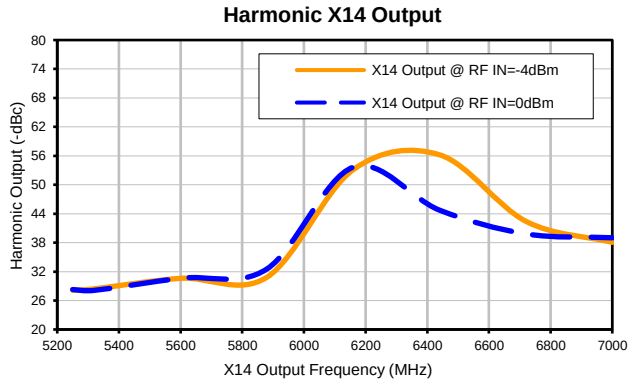

**Harmonic X11 Output**



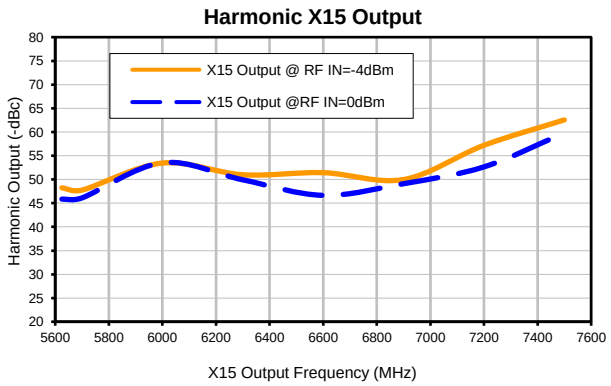

**Harmonic X13 Output**



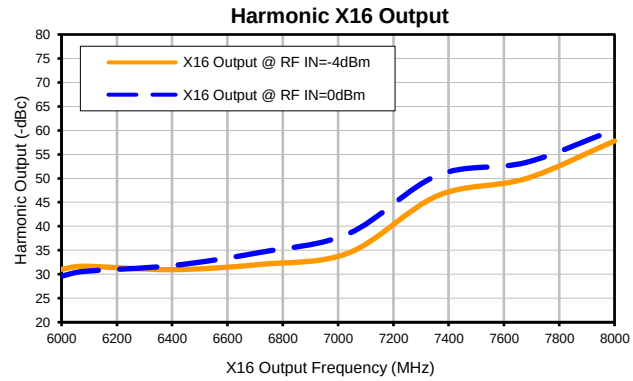

**Harmonic X14 Output**




**Harmonic X15 Output**



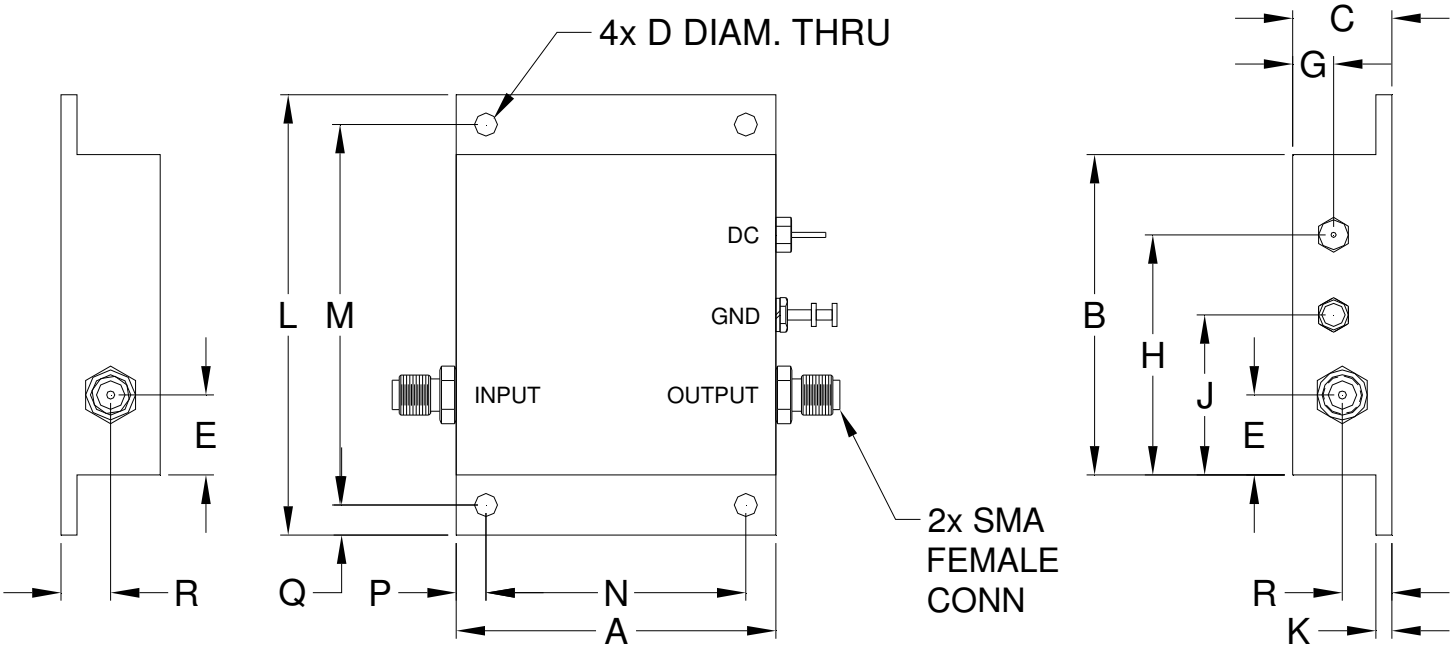

**Harmonic X16 Output**



# Case Style BY

## Outline Dimensions

**BY1298**




| CASE# | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BY1298 | 2.00 (50.80) | 2.00 (50.80) | .62 (15.75) | .144 (3.66) | .50 (12.70) | - - | .26 (6.60) | 1.50 (38.10) | 1.00 (25.40) | .100 (2.54) | 2.75 (69.85) | 2.375 (60.33) | 1.625 (41.28) |

| CASE# | P | Q | R | WT. GRAMS |
|---|---|---|---|---|
| BY1298 | .19 (4.83) | .19 (4.83) | .31 (7.87) | 71.80 |

**Dimensions are in inches (mm). Tolerances: 2 Pl. ± .03; 3 Pl. ± .015**

### Notes:

1. Case material: Aluminum alloy.
2. Case finish: Clear chemical conversion coating, non-chrome or trivalent chrome based.


Mini-Circuits®
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# Environmental Specifications ENV28

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 | -55° to 100°C<br>Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C<br>Ambient Environment | Individual Model Data Sheet |
| Barometric Pressure | 100,000 Feet | MIL-STD-202, Method 105, Condition D |
| Humidity | 90% RH, 65°C<br>Units may require bake-out after humidity to restore full performance. | MIL-STD-202, Method 103 |
| Thermal Shock | -65° to 125°C, 5 cycles | MIL-STD-202, Method 107, Condition B |
| Vibration (High Frequency) | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36) | MIL-STD-202, Method 204, Condition D |
| Mechanical Shock | 100g, 6ms sawtooth, 3 shocks each direction 3 axes (total 18) | MIL-STD-202, Method 213, Condition I |