

# High IP3 Frequency Mixer

Level 17 (LO Power +17 dBm) 100 to 1370 MHz

SYM-14H+



Generic photo used for illustration purposes only

CASE STYLE: TTT167

**+RoHS Compliant**

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

| Reel Size | Available Tape and Reel at no extra cost |
|-----------|------------------------------------------|
| 7"        | 10, 20, 50, 100, 200                     |
| 13"       | 500                                      |

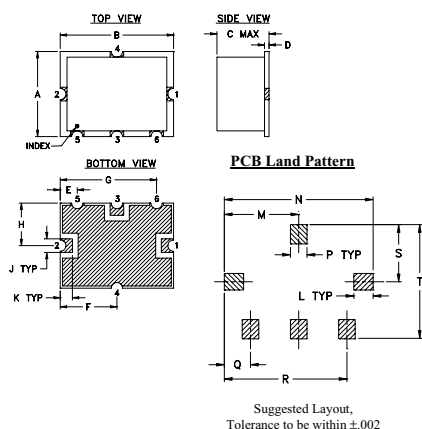
## Maximum Ratings

|                                                                 |                |
|-----------------------------------------------------------------|----------------|
| Operating Temperature                                           | -40°C to 85°C  |
| Storage Temperature                                             | -55°C to 100°C |
| RF Power                                                        | 200mW          |
| IF Current                                                      | 40mA           |
| Permanent damage may occur if any of these limits are exceeded. |                |

## Pin Connections

|        |       |
|--------|-------|
| LO     | 2     |
| RF     | 1     |
| IF     | 3     |
| GROUND | 4,5,6 |

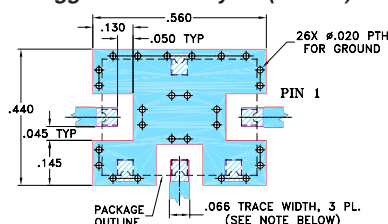
## Outline Drawing



## Outline Dimensions (inch mm)

| A    | B     | C     | D    | E    | F     | G     | H     | J     | K    |
|------|-------|-------|------|------|-------|-------|-------|-------|------|
| .38  | .50   | .23   | .020 | .075 | .250  | .425  | .187  | .050  | .050 |
| 9.65 | 12.70 | 5.84  | 0.51 | 1.91 | 6.35  | 10.80 | 4.75  | 1.27  | 1.27 |
| L    | M     | N     | P    | Q    | R     | S     | T     | wt.   |      |
| .070 | .270  | .540  | .060 | .095 | .445  | .208  | .415  | grams |      |
| 1.78 | 6.86  | 13.72 | 1.52 | 2.41 | 11.30 | 5.28  | 10.54 | 0.8   |      |

## Demo Board MCL P/N: TB-12 Suggested PCB Layout (PL-079)



### NOTE:

- TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
- BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE. DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER). SEE NOTE 2. DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

### 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.
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## Features

- wide bandwidth, 100 to 1370 MHz
- low conversion loss, 6.5 dB typ.
- high IP3, 30 dBm typ.
- excellent match LO VSWR, 1.25:1 typ.; RF VSWR, 1.6:1 typ.
- good L-R isolation, 36 dB typ.

## Applications

- cellular
- UHF TV
- ISM

## Electrical Specifications

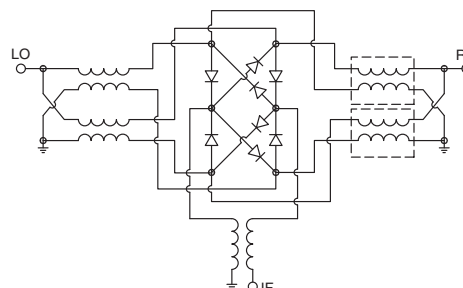
| FREQUENCY<br>(MHz)     |         | CONVERSION LOSS<br>(dB) |          |                        |      | LO-RF ISOLATION<br>(dB) |      | LO-IF ISOLATION<br>(dB) |      | IP3<br>at center<br>band<br>(dBm) |
|------------------------|---------|-------------------------|----------|------------------------|------|-------------------------|------|-------------------------|------|-----------------------------------|
| LO/RF<br>$f_L$ - $f_U$ | IF      | Mid-Band<br>m           |          | Total<br>Range<br>Max. |      | Typ.                    | Min. | Typ.                    | Min. |                                   |
|                        |         | $\overline{X}$          | $\sigma$ | Max.                   | Max. |                         |      |                         |      |                                   |
| 100-1370               | 10-1000 | 6.5                     | .20      | 7.4                    | 8.9  | 36                      | 28   | 30                      | 24   | 30                                |

1 dB COMP: +14 dBm typ.  
m=mid band ( $2f_L$  to  $f_U/2$ )

## Typical Performance Data

| Frequency (MHz) |         | Conversion Loss (dB) | Isolation L-R (dB) | Isolation L-I (dB) | VSWR RF Port (:1) | VSWR LO Port (:1) |
|-----------------|---------|----------------------|--------------------|--------------------|-------------------|-------------------|
| RF              | LO      | LO +17dBm            | LO +17dBm          | LO +17dBm          | LO +17dBm         | LO +17dBm         |
| 100.00          | 130.00  | 5.64                 | 40.30              | 44.40              | 1.21              | 1.64              |
| 190.71          | 220.71  | 5.86                 | 38.80              | 40.50              | 1.33              | 1.63              |
| 200.00          | 230.00  | 5.82                 | 38.70              | 39.70              | 1.32              | 1.66              |
| 281.42          | 311.42  | 5.94                 | 37.70              | 36.90              | 1.39              | 1.62              |
| 372.14          | 402.14  | 5.98                 | 37.30              | 34.70              | 1.51              | 1.52              |
| 400.00          | 430.00  | 5.98                 | 36.80              | 33.90              | 1.51              | 1.53              |
| 462.85          | 492.85  | 6.05                 | 36.50              | 33.60              | 1.59              | 1.44              |
| 553.57          | 583.57  | 6.01                 | 36.20              | 31.50              | 1.76              | 1.34              |
| 600.00          | 630.00  | 6.02                 | 36.50              | 31.30              | 1.85              | 1.29              |
| 644.28          | 674.28  | 6.15                 | 36.20              | 29.80              | 1.89              | 1.28              |
| 735.00          | 765.00  | 6.43                 | 36.60              | 29.60              | 1.96              | 1.23              |
| 825.71          | 855.71  | 6.45                 | 36.00              | 29.70              | 1.99              | 1.18              |
| 916.42          | 946.42  | 6.66                 | 36.00              | 30.50              | 2.08              | 1.12              |
| 1000.00         | 1030.00 | 6.23                 | 36.50              | 30.60              | 2.06              | 1.09              |
| 1007.14         | 1037.14 | 6.38                 | 36.60              | 30.70              | 2.03              | 1.08              |
| 1097.85         | 1127.85 | 6.36                 | 40.50              | 31.20              | 2.06              | 1.07              |
| 1188.57         | 1218.57 | 6.52                 | 43.10              | 32.50              | 1.94              | 1.08              |
| 1279.28         | 1309.28 | 6.89                 | 41.80              | 34.80              | 2.06              | 1.12              |
| 1340.00         | 1370.00 | 7.18                 | 42.30              | 38.20              | 2.06              | 1.18              |
| 1370.00         | 1400.00 | 7.34                 | 42.10              | 39.80              | 2.10              | 1.18              |

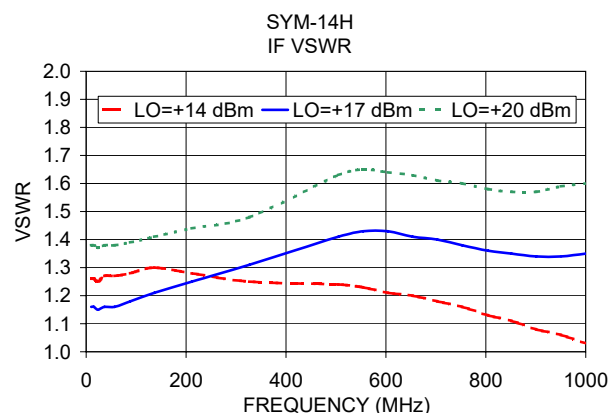
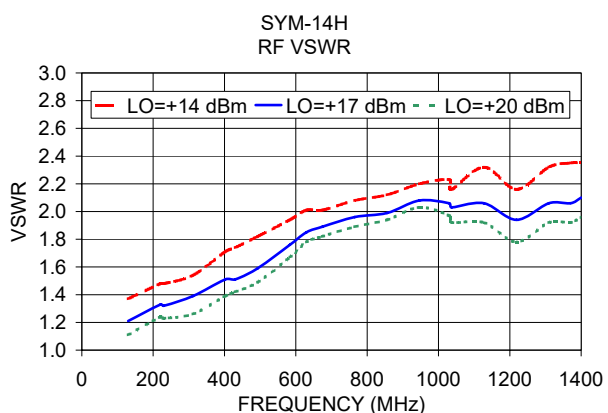
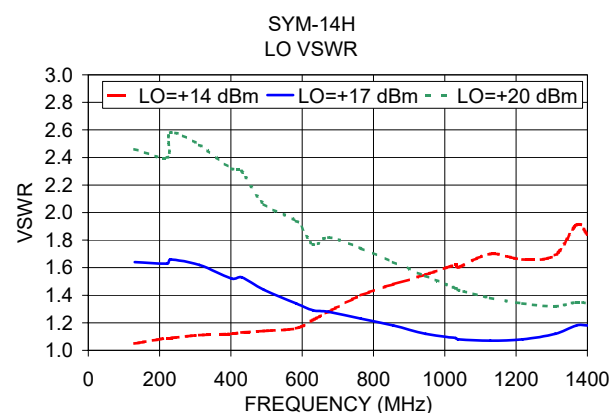
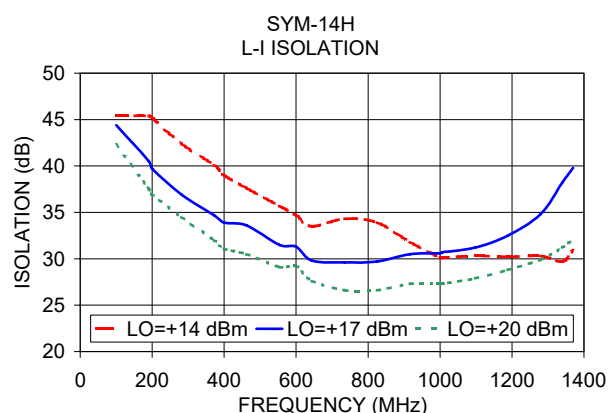
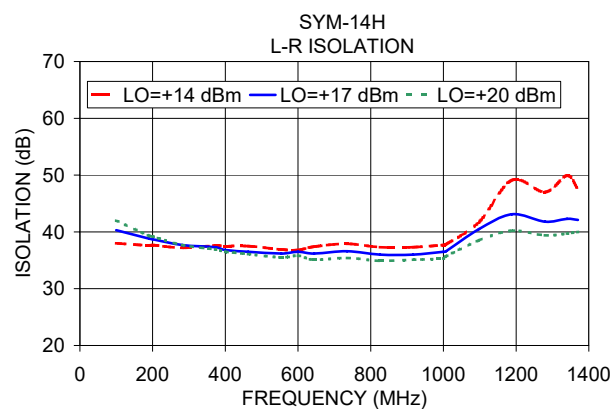
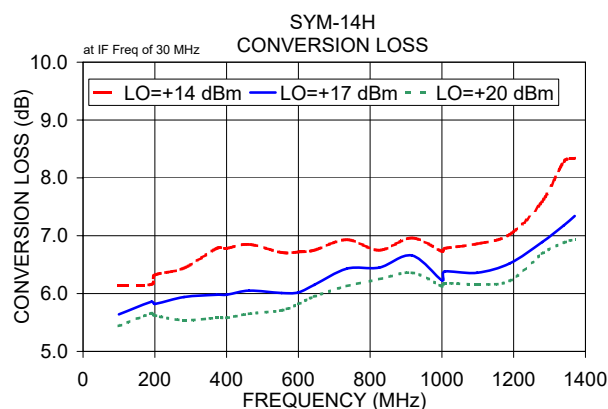
## Electrical Schematic



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M170832  
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DJ/TD/AM  
200813  
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## Notes

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# Frequency Mixer

# SYM-14H+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>IF FIXED<br>@IF(OUT)=30MHz<br>(dB) |       |      |
|---------------------|-------------|-------------------------------------------------------|-------|------|
|                     |             | @LO (dBm)                                             |       |      |
|                     |             | +14                                                   | +17   | +20  |
| 10.1                | 40.1        | 5.80                                                  | 5.34  | 5.06 |
| 70.8                | 100.8       | 5.84                                                  | 5.39  | 5.20 |
| 131.5               | 161.5       | 5.98                                                  | 5.51  | 5.30 |
| 192.1               | 222.1       | 6.17                                                  | 5.66  | 5.40 |
| 252.8               | 282.8       | 6.26                                                  | 5.74  | 5.42 |
| 313.5               | 343.5       | 6.46                                                  | 5.80  | 5.44 |
| 374.2               | 404.2       | 6.70                                                  | 5.90  | 5.51 |
| 434.8               | 464.8       | 6.68                                                  | 5.85  | 5.54 |
| 515.7               | 545.7       | 6.71                                                  | 5.90  | 5.61 |
| 576.4               | 606.4       | 6.57                                                  | 5.93  | 5.68 |
| 657.3               | 687.3       | 6.62                                                  | 6.05  | 5.84 |
| 718.0               | 748.0       | 6.65                                                  | 6.20  | 6.02 |
| 798.9               | 828.9       | 6.89                                                  | 6.38  | 6.18 |
| 859.6               | 889.6       | 6.86                                                  | 6.41  | 6.22 |
| 940.5               | 970.5       | 7.08                                                  | 6.49  | 6.26 |
| 1001.2              | 1031.2      | 7.07                                                  | 6.54  | 6.33 |
| 1082.1              | 1112.1      | 7.53                                                  | 6.73  | 6.50 |
| 1142.7              | 1172.7      | 7.64                                                  | 6.89  | 6.65 |
| 1223.6              | 1253.6      | 8.13                                                  | 7.15  | 6.86 |
| 1284.3              | 1314.3      | 8.56                                                  | 7.43  | 7.03 |
| 1365.2              | 1395.2      | 9.25                                                  | 7.91  | 7.36 |
| 1425.9              | 1455.9      | 9.78                                                  | 8.27  | 7.64 |
| 1506.8              | 1536.8      | 10.28                                                 | 8.65  | 7.90 |
| 1567.5              | 1597.5      | 10.75                                                 | 8.89  | 8.13 |
| 1648.4              | 1678.4      | 10.87                                                 | 9.14  | 8.42 |
| 1709.0              | 1739.0      | 11.23                                                 | 9.30  | 8.53 |
| 1789.9              | 1819.9      | 10.82                                                 | 9.26  | 8.54 |
| 1850.6              | 1880.6      | 10.74                                                 | 9.20  | 8.48 |
| 1931.5              | 1961.5      | 10.03                                                 | 8.83  | 8.24 |
| 1992.2              | 2022.2      | 9.94                                                  | 8.75  | 8.18 |
| 2073.1              | 2103.1      | 9.56                                                  | 8.63  | 8.18 |
| 2133.8              | 2163.8      | 9.59                                                  | 8.72  | 8.28 |
| 2214.7              | 2244.7      | 9.58                                                  | 8.74  | 8.25 |
| 2275.4              | 2305.4      | 9.58                                                  | 8.68  | 8.17 |
| 2356.3              | 2386.3      | 9.64                                                  | 8.65  | 8.12 |
| 2416.9              | 2446.9      | 9.84                                                  | 8.82  | 8.22 |
| 2497.8              | 2527.8      | 10.49                                                 | 9.19  | 8.53 |
| 2558.5              | 2588.5      | 10.91                                                 | 9.49  | 8.73 |
| 2639.4              | 2669.4      | 11.83                                                 | 10.01 | 9.12 |
| 2700.1              | 2730.1      | 12.42                                                 | 10.45 | 9.44 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | IP3 INPUT<br>(dBm) |       |       |
|---------------------|-------------|--------------------|-------|-------|
|                     |             | @LO (dBm)          |       |       |
|                     |             | +14                | +17   | +20   |
| 10.1                | 40.1        | 29.82              | 31.82 | 29.22 |
| 70.8                | 100.8       | 24.30              | 25.10 | 25.28 |
| 131.5               | 161.5       | 24.05              | 24.88 | 29.14 |
| 192.1               | 222.1       | 24.35              | 28.95 | 30.70 |
| 252.8               | 282.8       | 25.86              | 27.85 | 27.58 |
| 313.5               | 343.5       | 24.60              | 31.05 | 28.67 |
| 374.2               | 404.2       | 23.64              | 28.16 | 27.14 |
| 434.8               | 464.8       | 24.61              | 26.17 | 29.22 |
| 515.7               | 545.7       | 29.38              | 25.62 | 32.11 |
| 576.4               | 606.4       | 26.32              | 30.92 | 31.91 |
| 657.3               | 687.3       | 25.74              | 31.49 | 33.16 |
| 718.0               | 748.0       | 27.36              | 35.36 | 32.42 |
| 798.9               | 828.9       | 30.02              | 30.82 | 29.89 |
| 859.6               | 889.6       | 29.93              | 30.14 | 28.15 |
| 940.5               | 970.5       | 26.87              | 32.36 | 27.64 |
| 1001.2              | 1031.2      | 33.61              | 28.45 | 28.40 |
| 1082.1              | 1112.1      | 24.68              | 29.51 | 28.38 |
| 1142.7              | 1172.7      | 24.82              | 32.19 | 29.48 |
| 1223.6              | 1253.6      | 21.55              | 27.84 | 29.86 |
| 1284.3              | 1314.3      | 21.77              | 26.22 | 32.22 |
| 1365.2              | 1395.2      | 21.57              | 26.74 | 32.11 |
| 1425.9              | 1455.9      | 22.03              | 27.64 | 34.82 |
| 1506.8              | 1536.8      | 22.90              | 30.90 | 34.57 |
| 1567.5              | 1597.5      | 23.59              | 37.87 | 32.05 |
| 1648.4              | 1678.4      | 26.80              | 30.67 | 34.18 |
| 1709.0              | 1739.0      | 26.94              | 29.55 | 30.78 |
| 1789.9              | 1819.9      | 27.17              | 27.73 | 27.24 |
| 1850.6              | 1880.6      | 28.83              | 25.61 | 26.42 |
| 1931.5              | 1961.5      | 24.09              | 25.42 | 25.93 |
| 1992.2              | 2022.2      | 21.87              | 24.63 | 26.32 |
| 2073.1              | 2103.1      | 20.34              | 23.80 | 24.88 |
| 2133.8              | 2163.8      | 20.75              | 23.77 | 25.18 |
| 2214.7              | 2244.7      | 20.56              | 22.68 | 23.60 |
| 2275.4              | 2305.4      | 20.00              | 21.76 | 22.48 |
| 2356.3              | 2386.3      | 18.41              | 20.99 | 21.92 |
| 2416.9              | 2446.9      | 17.66              | 21.04 | 21.56 |
| 2497.8              | 2527.8      | 16.84              | 20.27 | 21.23 |
| 2558.5              | 2588.5      | 17.28              | 20.23 | 20.58 |
| 2639.4              | 2669.4      | 19.43              | 19.66 | 20.78 |
| 2700.1              | 2730.1      | 25.05              | 19.89 | 20.92 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | COMPRESSION<br>@RF IN=+14dBm<br>(dB) |      |      |
|---------------------|-------------|--------------------------------------|------|------|
|                     |             | @LO (dBm)                            |      |      |
|                     |             | +14                                  | +17  | +20  |
| 10.1                | 40.1        | 1.21                                 | 0.79 | 0.61 |
| 70.8                | 100.8       | 1.14                                 | 0.79 | 0.63 |
| 131.5               | 161.5       | 1.13                                 | 0.77 | 0.59 |
| 192.1               | 222.1       | 1.05                                 | 0.72 | 0.61 |
| 252.8               | 282.8       | 1.07                                 | 0.77 | 0.65 |
| 313.5               | 343.5       | 1.05                                 | 0.84 | 0.73 |
| 374.2               | 404.2       | 1.00                                 | 0.85 | 0.72 |
| 434.8               | 464.8       | 1.01                                 | 0.89 | 0.70 |
| 515.7               | 545.7       | 1.23                                 | 0.96 | 0.73 |
| 576.4               | 606.4       | 1.23                                 | 0.81 | 0.61 |
| 657.3               | 687.3       | 1.17                                 | 0.70 | 0.51 |
| 718.0               | 748.0       | 0.94                                 | 0.58 | 0.46 |
| 798.9               | 828.9       | 0.82                                 | 0.41 | 0.35 |
| 859.6               | 889.6       | 0.65                                 | 0.34 | 0.31 |
| 940.5               | 970.5       | 0.64                                 | 0.28 | 0.24 |
| 1001.2              | 1031.2      | 0.60                                 | 0.29 | 0.27 |
| 1082.1              | 1112.1      | 0.59                                 | 0.32 | 0.27 |
| 1142.7              | 1172.7      | 0.53                                 | 0.32 | 0.27 |
| 1223.6              | 1253.6      | 0.41                                 | 0.38 | 0.33 |
| 1284.3              | 1314.3      | 0.33                                 | 0.36 | 0.37 |
| 1365.2              | 1395.2      | 0.20                                 | 0.32 | 0.40 |
| 1425.9              | 1455.9      | 0.07                                 | 0.28 | 0.37 |
| 1506.8              | 1536.8      | -0.05                                | 0.26 | 0.38 |
| 1567.5              | 1597.5      | -0.16                                | 0.23 | 0.33 |
| 1648.4              | 1678.4      | -0.10                                | 0.24 | 0.29 |
| 1709.0              | 1739.0      | -0.10                                | 0.29 | 0.32 |
| 1789.9              | 1819.9      | 0.27                                 | 0.41 | 0.42 |
| 1850.6              | 1880.6      | 0.43                                 | 0.51 | 0.51 |
| 1931.5              | 1961.5      | 0.94                                 | 0.82 | 0.70 |
| 1992.2              | 2022.2      | 1.28                                 | 1.05 | 0.89 |
| 2073.1              | 2103.1      | 1.79                                 | 1.33 | 1.03 |
| 2133.8              | 2163.8      | 1.96                                 | 1.33 | 1.06 |
| 2214.7              | 2244.7      | 2.15                                 | 1.51 | 1.20 |
| 2275.4              | 2305.4      | 2.47                                 | 1.77 | 1.40 |
| 2356.3              | 2386.3      | 2.86                                 | 2.06 | 1.59 |
| 2416.9              | 2446.9      | 3.12                                 | 2.19 | 1.64 |
| 2497.8              | 2527.8      | 3.21                                 | 2.25 | 1.58 |
| 2558.5              | 2588.5      | 3.09                                 | 2.24 | 1.54 |
| 2639.4              | 2669.4      | 2.80                                 | 2.21 | 1.43 |
| 2700.1              | 2730.1      | 2.43                                 | 2.21 | 1.45 |

# Frequency Mixer

# SYM-14H+

## Typical Performance Data

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=685.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=100.1MHz<br>(dB) | IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=1370.1MHz<br>(dB) |
|----------------------|-------------|-----------------------------------------------------------------|----------------------|-------------|-----------------------------------------------------------------|----------------------|-------------|------------------------------------------------------------------|
|                      |             | @LO (dBm)                                                       |                      |             | @LO (dBm)                                                       |                      |             | @LO (dBm)                                                        |
|                      |             | +17                                                             |                      |             | +17                                                             |                      |             | +17                                                              |
| 485.0                | 200.1       | 6.78                                                            | 10.0                 | 110.1       | 5.40                                                            | 1000.0               | 370.1       | 8.84                                                             |
| 472.8                | 212.3       | 6.75                                                            | 30.2                 | 130.3       | 5.47                                                            | 979.8                | 390.3       | 8.78                                                             |
| 460.6                | 224.5       | 6.68                                                            | 50.4                 | 150.5       | 5.48                                                            | 959.6                | 410.5       | 8.84                                                             |
| 448.5                | 236.6       | 6.69                                                            | 70.6                 | 170.7       | 5.55                                                            | 939.4                | 430.7       | 8.83                                                             |
| 436.3                | 248.8       | 6.79                                                            | 90.8                 | 190.9       | 5.48                                                            | 919.2                | 450.9       | 8.61                                                             |
| 424.1                | 261.0       | 6.83                                                            | 111.0                | 211.1       | 5.57                                                            | 899.0                | 471.1       | 8.67                                                             |
| 411.9                | 273.2       | 6.75                                                            | 131.2                | 231.3       | 5.56                                                            | 878.8                | 491.3       | 8.64                                                             |
| 399.7                | 285.4       | 6.71                                                            | 151.4                | 251.5       | 5.52                                                            | 858.6                | 511.5       | 8.41                                                             |
| 387.6                | 297.5       | 6.74                                                            | 171.6                | 271.7       | 5.54                                                            | 838.4                | 531.7       | 8.46                                                             |
| 375.4                | 309.7       | 6.80                                                            | 191.8                | 291.9       | 5.60                                                            | 818.2                | 551.9       | 8.32                                                             |
| 363.2                | 321.9       | 6.83                                                            | 212.0                | 312.1       | 5.58                                                            | 798.0                | 572.1       | 8.28                                                             |
| 351.0                | 334.1       | 6.77                                                            | 232.2                | 332.3       | 5.53                                                            | 777.8                | 592.3       | 8.30                                                             |
| 338.8                | 346.3       | 6.64                                                            | 252.4                | 352.5       | 5.58                                                            | 757.6                | 612.5       | 8.20                                                             |
| 326.7                | 358.4       | 6.67                                                            | 272.7                | 372.8       | 5.49                                                            | 737.3                | 632.8       | 8.15                                                             |
| 314.5                | 370.6       | 6.68                                                            | 292.9                | 393.0       | 5.50                                                            | 717.1                | 653.0       | 8.11                                                             |
| 302.3                | 382.8       | 6.77                                                            | 313.1                | 413.2       | 5.54                                                            | 696.9                | 673.2       | 8.07                                                             |
| 290.1                | 395.0       | 6.75                                                            | 333.3                | 433.4       | 5.46                                                            | 676.7                | 693.4       | 8.02                                                             |
| 277.9                | 407.2       | 6.59                                                            | 353.5                | 453.6       | 5.41                                                            | 656.5                | 713.6       | 8.00                                                             |
| 265.8                | 419.3       | 6.54                                                            | 373.7                | 473.8       | 5.47                                                            | 636.3                | 733.8       | 7.95                                                             |
| 253.6                | 431.5       | 6.69                                                            | 393.9                | 494.0       | 5.38                                                            | 616.1                | 754.0       | 7.86                                                             |
| 241.4                | 443.7       | 6.67                                                            | 434.3                | 534.4       | 5.36                                                            | 575.7                | 794.4       | 7.85                                                             |
| 229.2                | 455.9       | 6.61                                                            | 454.5                | 554.6       | 5.31                                                            | 555.5                | 814.6       | 7.82                                                             |
| 217.1                | 468.0       | 6.48                                                            | 494.9                | 595.0       | 5.33                                                            | 515.1                | 855.0       | 7.76                                                             |
| 204.9                | 480.2       | 6.45                                                            | 515.1                | 615.2       | 5.35                                                            | 494.9                | 875.2       | 7.77                                                             |
| 192.7                | 492.4       | 6.53                                                            | 555.5                | 655.6       | 5.36                                                            | 454.5                | 915.6       | 7.76                                                             |
| 180.5                | 504.6       | 6.50                                                            | 575.7                | 675.8       | 5.38                                                            | 434.3                | 935.8       | 7.72                                                             |
| 168.3                | 516.8       | 6.43                                                            | 616.1                | 716.2       | 5.42                                                            | 393.9                | 976.2       | 7.79                                                             |
| 156.2                | 528.9       | 6.42                                                            | 636.3                | 736.4       | 5.42                                                            | 373.7                | 996.4       | 7.78                                                             |
| 144.0                | 541.1       | 6.34                                                            | 676.7                | 776.8       | 5.48                                                            | 333.3                | 1036.8      | 7.80                                                             |
| 131.8                | 553.3       | 6.31                                                            | 696.9                | 797.0       | 5.51                                                            | 313.1                | 1057.0      | 7.81                                                             |
| 119.6                | 565.5       | 6.34                                                            | 737.3                | 837.4       | 5.57                                                            | 272.7                | 1097.4      | 7.87                                                             |
| 107.4                | 577.7       | 6.30                                                            | 757.6                | 857.7       | 5.61                                                            | 252.4                | 1117.7      | 7.88                                                             |
| 95.3                 | 589.8       | 6.25                                                            | 798.0                | 898.1       | 5.63                                                            | 212.0                | 1158.1      | 7.89                                                             |
| 83.1                 | 602.0       | 6.22                                                            | 818.2                | 918.3       | 5.63                                                            | 191.8                | 1178.3      | 7.88                                                             |
| 70.9                 | 614.2       | 6.18                                                            | 858.6                | 958.7       | 5.63                                                            | 151.4                | 1218.7      | 7.87                                                             |
| 58.7                 | 626.4       | 6.19                                                            | 878.8                | 978.9       | 5.65                                                            | 131.2                | 1238.9      | 7.88                                                             |
| 46.5                 | 638.6       | 6.17                                                            | 919.2                | 1019.3      | 5.65                                                            | 90.8                 | 1279.3      | 7.92                                                             |
| 34.4                 | 650.7       | 6.10                                                            | 939.4                | 1039.5      | 5.67                                                            | 70.6                 | 1299.5      | 7.89                                                             |
| 22.2                 | 662.9       | 6.12                                                            | 979.8                | 1079.9      | 5.69                                                            | 30.2                 | 1339.9      | 7.87                                                             |
| 10.0                 | 675.1       | 6.09                                                            | 1000.0               | 1100.1      | 5.72                                                            | 10.0                 | 1360.1      | 7.80                                                             |

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# Frequency Mixer

# SYM-14H+

## Typical Performance Data

| LO<br>(MHz) | LO-RF ISOLATION<br>(dB) |       |       | LO-IF ISOLATION<br>(dB) |       |       |
|-------------|-------------------------|-------|-------|-------------------------|-------|-------|
|             | @LO (dBm)               |       |       | @LO (dBm)               |       |       |
|             | +14                     | +17   | +20   | +14                     | +17   | +20   |
| 10.1        | 37.89                   | 40.47 | 43.41 | 45.58                   | 48.89 | 53.25 |
| 70.8        | 38.13                   | 40.97 | 43.50 | 45.34                   | 46.49 | 45.52 |
| 131.5       | 38.45                   | 41.15 | 42.41 | 45.96                   | 43.72 | 41.30 |
| 192.1       | 39.09                   | 40.54 | 40.76 | 47.12                   | 41.42 | 38.48 |
| 252.8       | 39.54                   | 39.98 | 39.81 | 46.40                   | 39.32 | 36.11 |
| 313.5       | 39.88                   | 39.90 | 39.25 | 43.74                   | 37.30 | 34.21 |
| 374.2       | 40.52                   | 40.01 | 38.82 | 40.98                   | 35.35 | 32.38 |
| 434.8       | 40.93                   | 39.91 | 38.60 | 39.18                   | 34.58 | 31.64 |
| 515.7       | 42.98                   | 40.93 | 38.83 | 37.03                   | 32.60 | 29.86 |
| 576.4       | 44.99                   | 42.10 | 39.34 | 35.74                   | 31.89 | 28.98 |
| 657.3       | 48.67                   | 43.07 | 39.81 | 34.39                   | 30.82 | 28.22 |
| 718.0       | 52.35                   | 44.25 | 40.22 | 33.27                   | 30.34 | 27.27 |
| 798.9       | 54.45                   | 44.69 | 40.92 | 32.35                   | 29.98 | 27.28 |
| 859.6       | 53.66                   | 45.18 | 40.95 | 31.34                   | 30.40 | 27.33 |
| 940.5       | 49.96                   | 44.84 | 41.35 | 29.60                   | 30.34 | 27.64 |
| 1001.2      | 49.23                   | 46.06 | 41.78 | 27.53                   | 30.28 | 27.41 |
| 1082.1      | 48.03                   | 47.14 | 43.38 | 27.91                   | 29.93 | 27.54 |
| 1142.7      | 44.97                   | 49.70 | 46.47 | 26.59                   | 30.92 | 28.32 |
| 1223.6      | 43.92                   | 49.95 | 53.31 | 27.78                   | 33.18 | 29.78 |
| 1284.3      | 41.67                   | 47.01 | 54.71 | 26.94                   | 35.71 | 31.11 |
| 1365.2      | 40.21                   | 44.45 | 51.13 | 27.92                   | 40.04 | 34.31 |
| 1425.9      | 38.77                   | 42.11 | 47.21 | 26.22                   | 35.88 | 40.02 |
| 1506.8      | 38.11                   | 40.95 | 44.53 | 25.99                   | 33.26 | 44.54 |
| 1567.5      | 37.59                   | 40.34 | 43.61 | 25.01                   | 30.81 | 38.32 |
| 1648.4      | 37.89                   | 41.04 | 44.88 | 25.19                   | 30.52 | 35.06 |
| 1709.0      | 38.09                   | 41.84 | 45.81 | 25.15                   | 29.73 | 33.09 |
| 1789.9      | 37.76                   | 41.88 | 44.46 | 25.14                   | 29.36 | 31.62 |
| 1850.6      | 37.38                   | 40.24 | 42.03 | 25.39                   | 28.82 | 30.48 |
| 1931.5      | 36.18                   | 38.54 | 39.98 | 25.10                   | 28.07 | 28.98 |
| 1992.2      | 35.80                   | 38.02 | 39.57 | 25.44                   | 27.70 | 28.20 |
| 2073.1      | 35.97                   | 38.81 | 40.91 | 24.89                   | 26.68 | 27.13 |
| 2133.8      | 38.16                   | 42.46 | 44.20 | 24.16                   | 25.82 | 26.47 |
| 2214.7      | 41.07                   | 44.06 | 41.89 | 23.10                   | 24.53 | 25.18 |
| 2275.4      | 42.90                   | 42.29 | 39.49 | 22.73                   | 24.06 | 24.74 |
| 2356.3      | 43.71                   | 41.12 | 38.18 | 21.36                   | 22.90 | 23.67 |
| 2416.9      | 44.94                   | 39.69 | 36.86 | 20.48                   | 22.00 | 23.05 |
| 2497.8      | 44.78                   | 38.52 | 35.83 | 19.65                   | 21.27 | 22.46 |
| 2558.5      | 43.35                   | 38.02 | 35.65 | 19.04                   | 20.73 | 22.10 |
| 2639.4      | 41.40                   | 38.11 | 35.79 | 17.93                   | 20.08 | 21.52 |
| 2700.1      | 39.32                   | 37.82 | 36.12 | 17.36                   | 19.53 | 21.23 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF-IF ISOLATION<br>(dB) |       |       |
|---------------------|-------------|-------------------------|-------|-------|
|                     |             | @LO (dBm)               |       |       |
|                     |             | +14                     | +17   | +20   |
| 10.1                | 40.1        | 36.33                   | 36.20 | 38.74 |
| 70.8                | 100.8       | 35.90                   | 36.78 | 37.30 |
| 131.5               | 161.5       | 36.64                   | 37.08 | 37.25 |
| 192.1               | 222.1       | 37.53                   | 38.43 | 39.08 |
| 252.8               | 282.8       | 38.74                   | 39.36 | 39.86 |
| 313.5               | 343.5       | 40.02                   | 40.22 | 40.93 |
| 374.2               | 404.2       | 41.42                   | 41.26 | 42.06 |
| 434.8               | 464.8       | 41.59                   | 42.25 | 43.63 |
| 515.7               | 545.7       | 41.84                   | 43.09 | 43.27 |
| 576.4               | 606.4       | 43.80                   | 44.15 | 43.26 |
| 657.3               | 687.3       | 44.59                   | 43.27 | 42.01 |
| 718.0               | 748.0       | 43.65                   | 41.83 | 40.64 |
| 798.9               | 828.9       | 43.55                   | 41.52 | 40.60 |
| 859.6               | 889.6       | 44.45                   | 43.24 | 41.60 |
| 940.5               | 970.5       | 48.48                   | 46.32 | 44.10 |
| 1001.2              | 1031.2      | 53.99                   | 47.52 | 44.56 |
| 1082.1              | 1112.1      | 52.47                   | 48.36 | 44.49 |
| 1142.7              | 1172.7      | 48.83                   | 45.21 | 42.46 |
| 1223.6              | 1253.6      | 43.74                   | 41.73 | 39.70 |
| 1284.3              | 1314.3      | 39.85                   | 38.01 | 36.56 |
| 1365.2              | 1395.2      | 35.40                   | 34.10 | 33.47 |
| 1425.9              | 1455.9      | 33.73                   | 32.72 | 32.40 |
| 1506.8              | 1536.8      | 32.62                   | 32.05 | 32.07 |
| 1567.5              | 1597.5      | 32.87                   | 32.34 | 32.32 |
| 1648.4              | 1678.4      | 33.56                   | 33.31 | 32.71 |
| 1709.0              | 1739.0      | 34.39                   | 33.83 | 33.15 |
| 1789.9              | 1819.9      | 34.69                   | 34.09 | 33.22 |
| 1850.6              | 1880.6      | 34.62                   | 34.12 | 33.17 |
| 1931.5              | 1961.5      | 34.22                   | 33.91 | 33.31 |
| 1992.2              | 2022.2      | 34.23                   | 34.33 | 33.88 |
| 2073.1              | 2103.1      | 33.94                   | 34.27 | 33.94 |
| 2133.8              | 2163.8      | 32.10                   | 32.58 | 32.93 |
| 2214.7              | 2244.7      | 30.24                   | 30.43 | 30.86 |
| 2275.4              | 2305.4      | 29.43                   | 29.19 | 29.01 |
| 2356.3              | 2386.3      | 28.81                   | 28.05 | 27.46 |
| 2416.9              | 2446.9      | 28.63                   | 27.49 | 26.69 |
| 2497.8              | 2527.8      | 27.87                   | 26.52 | 25.65 |
| 2558.5              | 2588.5      | 26.49                   | 25.42 | 24.69 |
| 2639.4              | 2669.4      | 24.92                   | 24.29 | 23.93 |
| 2700.1              | 2730.1      | 23.84                   | 23.57 | 23.60 |

# Frequency Mixer

SYM-14H+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF VSWR<br>(:1) |      |      | LO<br>(MHz) | LO VSWR<br>(:1) |      |      |        | IF<br>(OUT)<br>(MHz) | IF VSWR<br>@LO=1370.1MHz<br>(:1) |      |  |
|---------------------|-------------|-----------------|------|------|-------------|-----------------|------|------|--------|----------------------|----------------------------------|------|--|
|                     |             | @LO (dBm)       |      |      |             | @LO (dBm)       |      |      |        |                      | @LO (dBm)                        |      |  |
|                     |             | +14             | +17  | +20  |             | +14             | +17  | +20  | +14    |                      | +17                              | +20  |  |
| 10.1                | 40.1        | 1.36            | 1.20 | 1.10 | 10.1        | 1.02            | 1.60 | 2.35 | 10.0   | 1.15                 | 1.39                             | 1.61 |  |
| 70.8                | 100.8       | 1.37            | 1.23 | 1.14 | 70.8        | 1.10            | 1.61 | 2.39 | 30.2   | 1.21                 | 1.27                             | 1.56 |  |
| 131.5               | 161.5       | 1.42            | 1.28 | 1.19 | 131.5       | 1.13            | 1.67 | 2.48 | 50.4   | 1.21                 | 1.24                             | 1.62 |  |
| 192.1               | 222.1       | 1.50            | 1.36 | 1.27 | 192.1       | 1.17            | 1.66 | 2.37 | 70.6   | 1.24                 | 1.24                             | 1.64 |  |
| 252.8               | 282.8       | 1.56            | 1.41 | 1.32 | 252.8       | 1.21            | 1.57 | 2.28 | 90.8   | 1.26                 | 1.25                             | 1.58 |  |
| 313.5               | 343.5       | 1.67            | 1.50 | 1.40 | 313.5       | 1.24            | 1.57 | 2.21 | 111.0  | 1.25                 | 1.24                             | 1.54 |  |
| 374.2               | 404.2       | 1.82            | 1.62 | 1.52 | 374.2       | 1.24            | 1.57 | 2.23 | 131.2  | 1.24                 | 1.27                             | 1.60 |  |
| 434.8               | 464.8       | 1.91            | 1.71 | 1.62 | 434.8       | 1.24            | 1.47 | 2.04 | 151.4  | 1.26                 | 1.27                             | 1.62 |  |
| 515.7               | 545.7       | 2.05            | 1.84 | 1.75 | 515.7       | 1.32            | 1.38 | 1.94 | 171.6  | 1.28                 | 1.25                             | 1.58 |  |
| 576.4               | 606.4       | 2.08            | 1.92 | 1.85 | 576.4       | 1.38            | 1.32 | 1.82 | 191.8  | 1.26                 | 1.28                             | 1.58 |  |
| 657.3               | 687.3       | 2.17            | 2.02 | 1.95 | 657.3       | 1.49            | 1.32 | 1.73 | 212.0  | 1.27                 | 1.31                             | 1.59 |  |
| 718.0               | 748.0       | 2.23            | 2.11 | 2.04 | 718.0       | 1.65            | 1.32 | 1.65 | 232.2  | 1.29                 | 1.30                             | 1.58 |  |
| 798.9               | 828.9       | 2.35            | 2.20 | 2.11 | 798.9       | 1.76            | 1.32 | 1.55 | 252.4  | 1.28                 | 1.29                             | 1.59 |  |
| 859.6               | 889.6       | 2.38            | 2.23 | 2.14 | 859.6       | 1.89            | 1.32 | 1.46 | 272.7  | 1.28                 | 1.34                             | 1.63 |  |
| 940.5               | 970.5       | 2.52            | 2.29 | 2.19 | 940.5       | 1.92            | 1.31 | 1.36 | 292.9  | 1.30                 | 1.35                             | 1.61 |  |
| 1001.2              | 1031.2      | 2.53            | 2.32 | 2.21 | 1001.2      | 2.22            | 1.34 | 1.28 | 313.1  | 1.30                 | 1.33                             | 1.57 |  |
| 1082.1              | 1112.1      | 2.68            | 2.37 | 2.22 | 1082.1      | 2.07            | 1.33 | 1.17 | 333.3  | 1.27                 | 1.36                             | 1.62 |  |
| 1142.7              | 1172.7      | 2.68            | 2.39 | 2.22 | 1142.7      | 2.40            | 1.38 | 1.11 | 353.5  | 1.28                 | 1.38                             | 1.65 |  |
| 1223.6              | 1253.6      | 2.73            | 2.42 | 2.24 | 1223.6      | 2.20            | 1.35 | 1.09 | 373.7  | 1.28                 | 1.35                             | 1.62 |  |
| 1284.3              | 1314.3      | 2.77            | 2.45 | 2.27 | 1284.3      | 2.43            | 1.43 | 1.17 | 393.9  | 1.27                 | 1.35                             | 1.61 |  |
| 1365.2              | 1395.2      | 2.84            | 2.54 | 2.37 | 1365.2      | 2.25            | 1.47 | 1.30 | 434.3  | 1.27                 | 1.38                             | 1.62 |  |
| 1425.9              | 1455.9      | 2.92            | 2.63 | 2.46 | 1425.9      | 2.51            | 1.58 | 1.41 | 454.5  | 1.25                 | 1.36                             | 1.61 |  |
| 1506.8              | 1536.8      | 3.00            | 2.75 | 2.56 | 1506.8      | 2.35            | 1.64 | 1.57 | 494.9  | 1.24                 | 1.38                             | 1.63 |  |
| 1567.5              | 1597.5      | 3.02            | 2.77 | 2.59 | 1567.5      | 2.46            | 1.73 | 1.67 | 515.1  | 1.23                 | 1.34                             | 1.59 |  |
| 1648.4              | 1678.4      | 2.94            | 2.72 | 2.59 | 1648.4      | 2.30            | 1.77 | 1.81 | 555.5  | 1.21                 | 1.37                             | 1.62 |  |
| 1709.0              | 1739.0      | 2.90            | 2.68 | 2.55 | 1709.0      | 2.27            | 1.83 | 1.88 | 575.7  | 1.22                 | 1.34                             | 1.58 |  |
| 1789.9              | 1819.9      | 2.80            | 2.62 | 2.49 | 1789.9      | 2.22            | 1.88 | 2.00 | 616.1  | 1.19                 | 1.33                             | 1.60 |  |
| 1850.6              | 1880.6      | 2.76            | 2.58 | 2.43 | 1850.6      | 2.13            | 1.92 | 2.06 | 636.3  | 1.20                 | 1.32                             | 1.57 |  |
| 1931.5              | 1961.5      | 2.59            | 2.43 | 2.30 | 1931.5      | 2.08            | 1.98 | 2.13 | 676.7  | 1.17                 | 1.29                             | 1.54 |  |
| 1992.2              | 2022.2      | 2.48            | 2.31 | 2.18 | 1992.2      | 2.02            | 2.02 | 2.20 | 696.9  | 1.18                 | 1.29                             | 1.56 |  |
| 2073.1              | 2103.1      | 2.29            | 2.12 | 2.03 | 2073.1      | 1.97            | 2.03 | 2.24 | 737.3  | 1.16                 | 1.26                             | 1.52 |  |
| 2133.8              | 2163.8      | 2.23            | 2.09 | 1.99 | 2133.8      | 1.92            | 2.05 | 2.27 | 757.6  | 1.15                 | 1.27                             | 1.50 |  |
| 2214.7              | 2244.7      | 2.22            | 2.10 | 1.97 | 2214.7      | 1.88            | 2.06 | 2.28 | 798.0  | 1.16                 | 1.22                             | 1.48 |  |
| 2275.4              | 2305.4      | 2.19            | 2.07 | 1.92 | 2275.4      | 1.91            | 2.13 | 2.37 | 818.2  | 1.14                 | 1.24                             | 1.52 |  |
| 2356.3              | 2386.3      | 2.09            | 1.95 | 1.81 | 2356.3      | 1.91            | 2.15 | 2.36 | 858.6  | 1.16                 | 1.21                             | 1.44 |  |
| 2416.9              | 2446.9      | 2.00            | 1.85 | 1.73 | 2416.9      | 1.94            | 2.19 | 2.40 | 878.8  | 1.15                 | 1.22                             | 1.44 |  |
| 2497.8              | 2527.8      | 1.93            | 1.77 | 1.65 | 2497.8      | 1.99            | 2.22 | 2.41 | 919.2  | 1.17                 | 1.18                             | 1.45 |  |
| 2558.5              | 2588.5      | 1.89            | 1.73 | 1.60 | 2558.5      | 2.03            | 2.25 | 2.43 | 939.4  | 1.17                 | 1.17                             | 1.43 |  |
| 2639.4              | 2669.4      | 1.89            | 1.70 | 1.53 | 2639.4      | 2.05            | 2.28 | 2.45 | 979.8  | 1.18                 | 1.16                             | 1.37 |  |
| 2700.1              | 2730.1      | 1.85            | 1.64 | 1.48 | 2700.1      | 2.10            | 2.31 | 2.47 | 1000.0 | 1.20                 | 1.14                             | 1.36 |  |

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## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |     |     |     |     |     |     |     |     |     |     |
|----|--------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | -      | -      | 6   | 25  | 7   | 39  | 12  | 38  | 23  | 38  | 26  | 49  |
| 1  | -      | 36     | +0  | 48  | 13  | 45  | 24  | 52  | 44  | 51  | 41  | 59  |
| 2  | 88     | 58     | 54  | 53  | 49  | 62  | 49  | 77  | 52  | 70  | 52  | 69  |
| 3  | >100   | 91     | 71  | 87  | 78  | 84  | 80  | 83  | 67  | 85  | 78  | 85  |
| 4  | >100   | >93    | 88  | >93 | 87  | >93 | 85  | >93 | 88  | >93 | >93 | >93 |
| 5  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 6  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 7  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 8  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 9  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 10 | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
|    | RF CAL | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

### LO HARMONICS ORDER

Test conditions: RF IN: 750.1 MHz; -1.00 dBm.  
LO IN: 780.01 MHz; +17.00 dBm  
IF OUT: 29.91 MHz; -7.38 dBm

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |      |      |      |      |      |      |     |      |     |      |
|----|--------|--------|------|------|------|------|------|------|-----|------|-----|------|
| 0  | -      | -      | 16   | 36   | 18   | 48   | 24   | 52   | 36  | 54   | 39  | 69   |
| 1  | -      | 37     | +0   | 49   | 13   | 45   | 25   | 55   | 45  | 54   | 45  | 64   |
| 2  | 73     | 47     | 45   | 42   | 40   | 50   | 40   | 62   | 43  | 62   | 46  | 60   |
| 3  | >100   | 84     | 45   | 71   | 57   | 75   | 52   | 65   | 51  | 69   | 59  | 65   |
| 4  | >100   | 71     | 77   | 73   | 69   | 73   | 65   | 74   | 58  | 71   | 72  | 71   |
| 5  | >100   | 83     | 63   | 82   | 60   | 83   | 63   | 81   | 60  | 87   | 69  | 90   |
| 6  | >100   | 93     | 83   | 82   | 81   | 85   | 80   | 81   | 75  | 81   | 88  | 80   |
| 7  | >100   | 94     | 92   | 97   | 77   | 97   | 81   | 92   | 77  | 91   | 77  | >103 |
| 8  | >100   | >103   | 98   | >103 | 97   | >103 | 95   | >103 | 89  | 101  | 90  | 97   |
| 9  | >100   | >103   | >103 | >103 | >103 | 102  | 93   | 103  | 95  | 102  | 92  | 101  |
| 10 | >100   | >103   | >103 | >103 | >103 | >103 | >103 | >103 | 102 | >103 | 102 | 102  |
|    | RF CAL | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7   | 8    | 9   | 10   |

### LO HARMONICS ORDER

Test conditions: RF IN: 750.1 MHz; 9.00 dBm.  
LO IN: 780.01 MHz; +17.00 dBm  
IF OUT: 29.91 MHz; 2.54 dBm

- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.  
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.  
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

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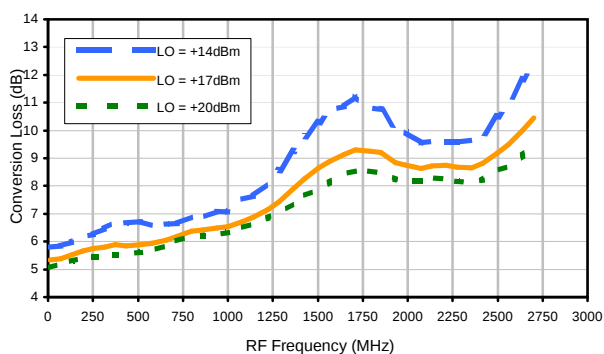


# Frequency Mixer

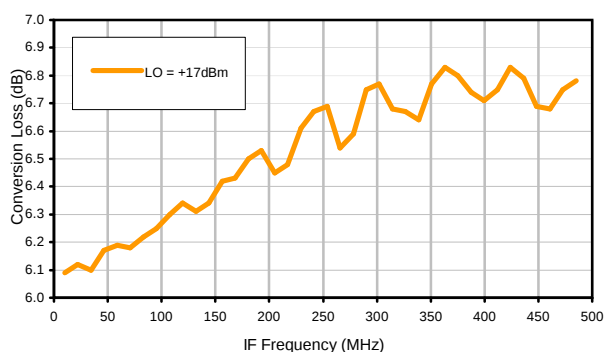
SYM-14H+

## Typical Performance Curves

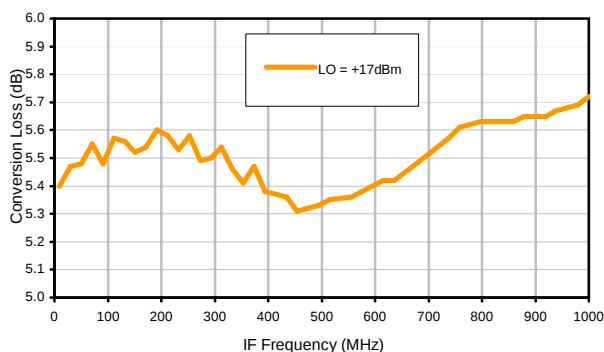
Conversion Loss @ IF=30MHz



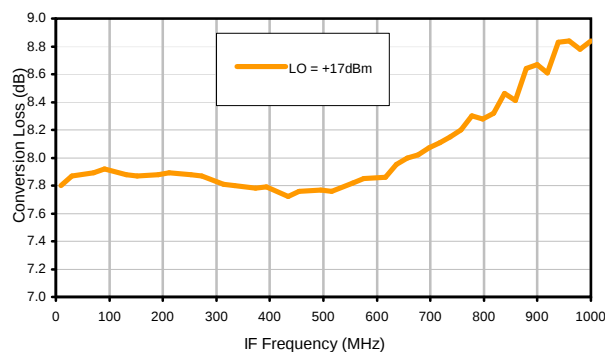
Conversion Loss vs. IF @ RF=685.1MHz



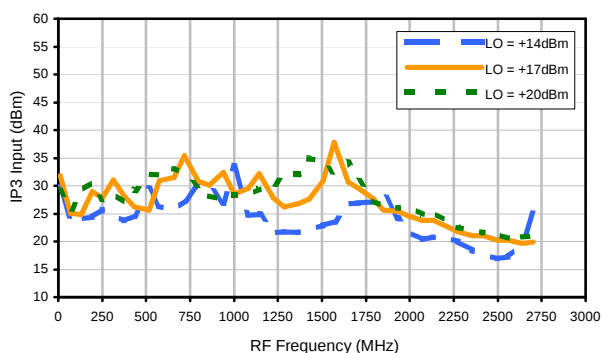
Conversion Loss vs. IF @ RF=100.1MHz



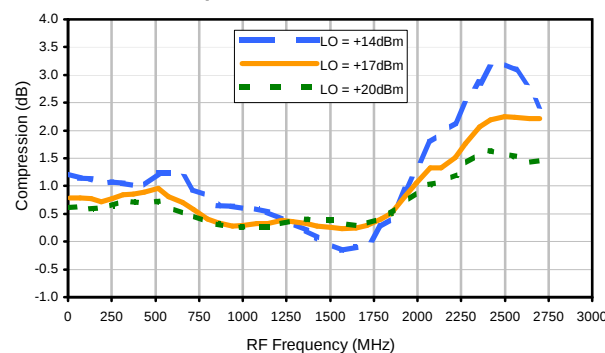
Conversion Loss vs. IF @ RF=1370.1MHz



IP3 Input

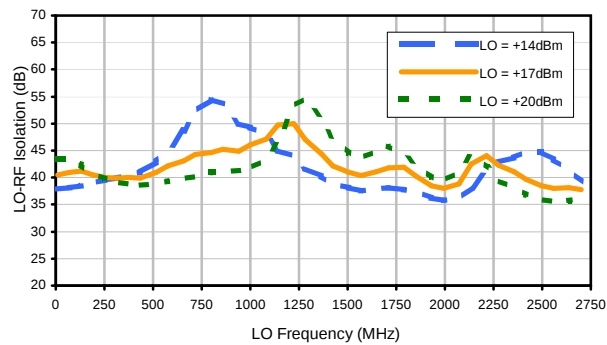


Compression @ RF IN=+14dBm

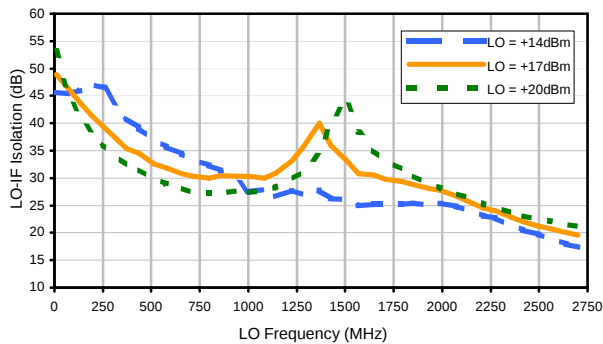


## Typical Performance Curves

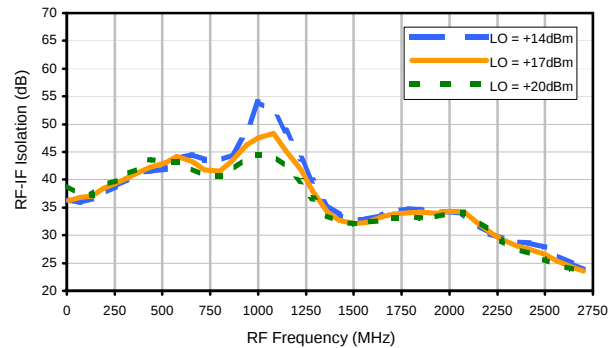
LO-RF Isolation



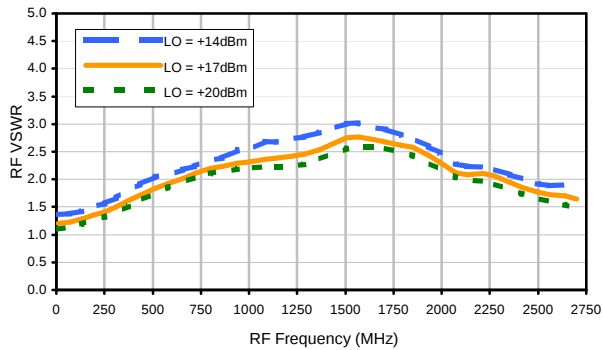
LO-IF Isolation



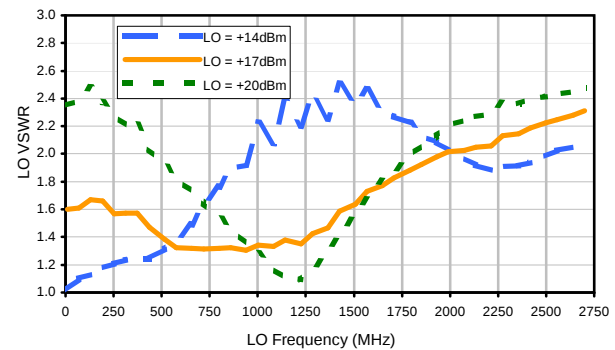
RF-IF Isolation



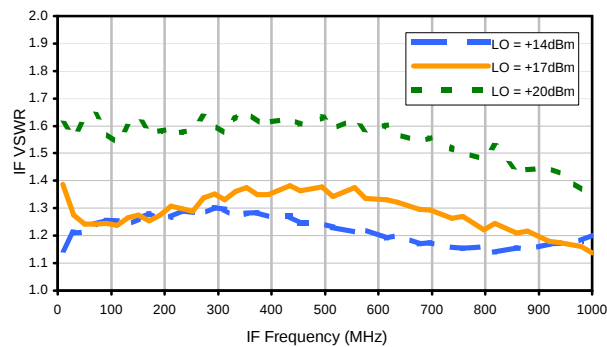
RF VSWR



LO VSWR



IF VSWR



## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |     |     |     |     |     |     |     |     |     |     |
|----|--------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0  | -      | -      | 6   | 25  | 7   | 39  | 12  | 38  | 23  | 38  | 26  | 49  |
| 1  | -      | 36     | +0  | 48  | 13  | 45  | 24  | 52  | 44  | 51  | 41  | 59  |
| 2  | 88     | 58     | 54  | 53  | 49  | 62  | 49  | 77  | 52  | 70  | 52  | 69  |
| 3  | >100   | 91     | 71  | 87  | 78  | 84  | 80  | 83  | 67  | 85  | 78  | 85  |
| 4  | >100   | >93    | 88  | >93 | 87  | >93 | 85  | >93 | 88  | >93 | >93 | >93 |
| 5  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 6  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 7  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 8  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 9  | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
| 10 | >100   | >93    | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 | >93 |
|    | RF CAL | 0      | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  |

### LO HARMONICS ORDER

Test conditions: RF IN: 750.1 MHz; -1.00 dBm.  
LO IN: 780.01 MHz; +17.00 dBm  
IF OUT: 29.91 MHz; -7.38 dBm

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |      |      |      |      |      |      |     |      |     |      |
|----|--------|--------|------|------|------|------|------|------|-----|------|-----|------|
| 0  | -      | -      | 16   | 36   | 18   | 48   | 24   | 52   | 36  | 54   | 39  | 69   |
| 1  | -      | 37     | +0   | 49   | 13   | 45   | 25   | 55   | 45  | 54   | 45  | 64   |
| 2  | 73     | 47     | 45   | 42   | 40   | 50   | 40   | 62   | 43  | 62   | 46  | 60   |
| 3  | >100   | 84     | 45   | 71   | 57   | 75   | 52   | 65   | 51  | 69   | 59  | 65   |
| 4  | >100   | 71     | 77   | 73   | 69   | 73   | 65   | 74   | 58  | 71   | 72  | 71   |
| 5  | >100   | 83     | 63   | 82   | 60   | 83   | 63   | 81   | 60  | 87   | 69  | 90   |
| 6  | >100   | 93     | 83   | 82   | 81   | 85   | 80   | 81   | 75  | 81   | 88  | 80   |
| 7  | >100   | 94     | 92   | 97   | 77   | 97   | 81   | 92   | 77  | 91   | 77  | >103 |
| 8  | >100   | >103   | 98   | >103 | 97   | >103 | 95   | >103 | 89  | 101  | 90  | 97   |
| 9  | >100   | >103   | >103 | >103 | >103 | 102  | 93   | 103  | 95  | 102  | 92  | 101  |
| 10 | >100   | >103   | >103 | >103 | >103 | >103 | >103 | >103 | 102 | >103 | 102 | 102  |
|    | RF CAL | 0      | 1    | 2    | 3    | 4    | 5    | 6    | 7   | 8    | 9   | 10   |

### LO HARMONICS ORDER

Test conditions: RF IN: 750.1 MHz; 9.00 dBm.  
LO IN: 780.01 MHz; +17.00 dBm  
IF OUT: 29.91 MHz; 2.54 dBm

- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.  
2. + entry denotes harmonics are in (dBc) above IF OUTPUT.  
3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

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## Outline Dimensions

TTT166  
TTT167



## PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

| CASE # | A             | B              | C             | D              | E              | F              | G               | H              | J              | K              | L              | M              | N               |
|--------|---------------|----------------|---------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| TTT166 | .38<br>(9.65) | .50<br>(12.70) | .15<br>(3.81) | .020<br>(0.51) | .075<br>(1.91) | .250<br>(6.35) | .425<br>(10.80) | .187<br>(4.75) | .050<br>(1.27) | .050<br>(1.27) | .070<br>(1.78) | .270<br>(6.86) | .540<br>(13.72) |
| TTT167 |               |                | .23<br>(5.84) |                |                |                |                 |                |                |                |                |                |                 |

| CASE # | P              | Q              | R               | S              | T               | WT. GRAM |
|--------|----------------|----------------|-----------------|----------------|-----------------|----------|
| TTT166 | .060<br>(1.52) | .095<br>(2.41) | .445<br>(11.30) | .208<br>(5.28) | .415<br>(10.54) | .8       |
| TTT167 |                |                |                 |                |                 | .8       |

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

### Note:

- Case material: Plastic.
- Base material: Printed wiring laminate.
- Termination finish:
  - For RoHS Case Styles: 3-5  $\mu$  inch (.08-.13 microns) Gold over 120-240  $\mu$  inch (3.05-6.10 microns) Nickel plate. All models, (+) suffix.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.

# Tape & Reel Packaging TR-F12



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel                    |     |
|----------------|-------------------------|-------------------|-------------------------------------|-----|
| 24             | 12                      | 7                 | Small quantity standards (see note) | 10  |
|                |                         |                   |                                     | 20  |
|                |                         |                   |                                     | 50  |
|                |                         |                   |                                     | 100 |
|                |                         |                   |                                     | 200 |
|                |                         | 13                | Standard                            | 500 |

Note: Please Consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



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## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION                 | DATE     | DR  | AUTH |
|-----|---------|-----------------------------|----------|-----|------|
| A   | M86762  | ADDED CONNECTIONS "lp & lq" | 05/23/03 | MMG | WL   |
| B   | M94598  | ADDED CONNECTION "hk"       | 10/08/04 | MMG | HY   |
| C   | M102713 | UPDATED NOTES & DESCRIPTION | 01/14/06 | GF  | IL   |
| D   | M132989 | UPDATED NOTE 2              | 08/24/11 | GF  | DJ   |

**SUGGESTED MOUNTING CONFIGURATION FOR  
TTT166/167 CASE STYLE, "hk"/"lp"/"lq"  
"x"/"ck"/"ec" PIN CONNECTIONS**

**NOTE:**

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030"  $\pm$  .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. THE USE OF SOLDER MASK OVER THE GROUND AREA UNDER THE UNIT AS SHOWN IS RECOMMENDED TO PREVENT POTENTIAL SHORTING. IF USER CHOOSES TO EXPOSE METAL UNDER THE ENTIRE UNIT GROUND PAD FOR IMPROVED GROUNDING, IT IS RECOMMENDED A SOLDER MASK DAM BE APPLIED AROUND EACH GROUND PAD TO ENSURE FILLET AND CONNECTION AT GROUND PADS.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.



DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER), SEE NOTE 2.



DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

UNLESS OTHERWISE SPECIFIED

INITIALS

DATE

DIMENSIONS ARE IN INCHES

TOLERANCES ON:

2 PL DECIMALS  $\pm$ 3 PL DECIMALS  $\pm$  .005ANGLES  $\pm$ FRACTIONS  $\pm$ 

DRAWN

GF

03/18/03

CHECKED

IL

04/15/03

APPROVED

DJ

04/15/03

**Mini-Circuits®**13 Neptune Avenue  
Brooklyn NY 11235

PL, hk/lp/lq/x/ck/ec, TTT166/167,  
SYM/HJK/SYAS/SYPD, TB-12

SIZE  
ACODE IDENT  
15542DRAWING NO:  
98-PL-079REV:  
D

FILE: 98PL079

SCALE: 5:1

SHEET: 1 OF 1

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ASHEETA1.DWG REV:A DATE:01/12/95

# Evaluation Board and Circuit

For Pin Connections Refer to Data Sheet of the DUT



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.030 inch.

 **Mini-Circuits®**



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<br>Ambient Environment                                                                                                                             | Individual Model Data Sheet                                                                          |
| Storage Temperature            | -55° to 100° C<br>Ambient Environment                                                                                                                           | Individual Model Data Sheet                                                                          |
| Humidity                       | 90 to 95% RH, 240 hours, 50°C                                                                                                                                   | MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours |
| Thermal Shock                  | -55° to 100°C, 100 cycles                                                                                                                                       | MIL-STD-202, Method 107, Condition A-3, except +100°C                                                |
| Solder Reflow Heat             | Sn-Pb Eutetic Process: 225°C peak<br>Pb-Free Process 245° - 250°C peak                                                                                          | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1                                                        |
| Solderability                  | 10X Magnification                                                                                                                                               | J-STD-002, 95% Coverage                                                                              |
| 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               | 50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes                                                                                               | MIL-STD-202, Method 213, Condition A                                                                 |
| 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                                                                              |