

High IP3

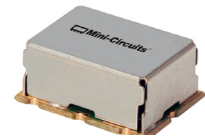
# Frequency Mixer

HJK-251H+

Level 17 (LO Power +17 dBm) 40 to 250 MHz

## The Big Deal

- Low conversion loss, 7.0 dB typ.
- High IP3, 32 dBm typ.
- Excellent L-R isolation, 50 dB typ.



CASE STYLE: TTT881

## Product Overview

Mini-Circuits' HJK-251H+ is a surface mount, level 17 FET-based frequency mixer with an RF frequency range from 40 to 250 MHz, LO frequency range from 10 to 220 MHz, and IF frequency range from 10 to 90 MHz. Its double-balanced FET configuration achieves an outstanding combination of low conversion loss, low noise figure and high IP3 performance without the need for a DC bias current, ideal for sensitive receiver applications including base stations, mobile radio, radar, and more. The mixer comes housed in a miniature, shielded 6-lead package (0.38 x 0.5 x 0.23"), saving space in tight PCB layouts.

## Key Features

| Feature                                                                                                               | Advantages                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High IP3, +32 dBm                                                                                                     | Minimizes third order intermodulation products and improves dynamic range in demanding environments where multiple carriers may be present.                                                                                                                                     |
| Excellent P1dB compression, +20 dBm typ.                                                                              | Whereas the 1-dB compression point of a diode-based mixer is typically 4 to 6 dB lower than the LO power level, the 1-dB compression point of HJK-251H+ FET-based mixer is +20 dBm higher than the LO signal power. This results in excellent linearity and high dynamic range. |
| High isolation: <ul style="list-style-type: none"><li>• L-R isolation, 50 dB</li><li>• L-I isolation, 45 dB</li></ul> | Preserves signal integrity from input to output by reducing undesirable signal responses that can degrade system performance.                                                                                                                                                   |
| Low conversion loss, 7 dB                                                                                             | Low conversion loss results in higher output IP3 and better overall system dynamic range.                                                                                                                                                                                       |
| Small size (0.38 x 0.5 x 0.23")                                                                                       | Saves PCB real estate and accommodates crowded layouts.                                                                                                                                                                                                                         |

### 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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# Frequency Mixer

Level 17 (LO Power +17 dBm) 40 to 250 MHz

HJK-251H+



Generic photo used for illustration purposes only

CASE STYLE: TTT881

**+RoHS Compliant**

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



Available Tape and Reel  
at no extra cost

| Reel Size | Devices/Reel         |
|-----------|----------------------|
| 7"        | 10, 20, 50, 100, 200 |
| 13"       | 500                  |

## Maximum Ratings

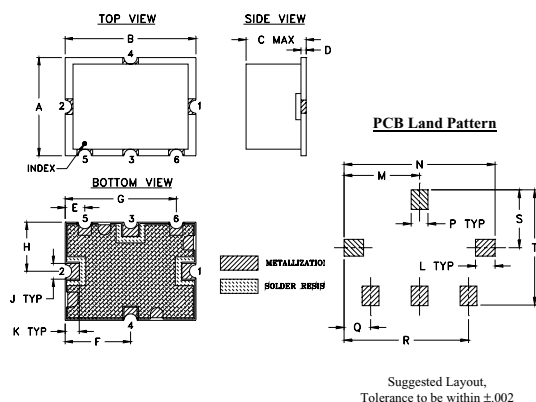
|                       |                |
|-----------------------|----------------|
| Operating Temperature | -40°C to 85°C  |
| Storage Temperature   | -55°C to 100°C |
| LO Power*             | +19 dBm        |
| RF Power              | +20 dBm        |

Permanent damage may occur if any of these limits are exceeded.  
\* Over temperature

## Pad Connections

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

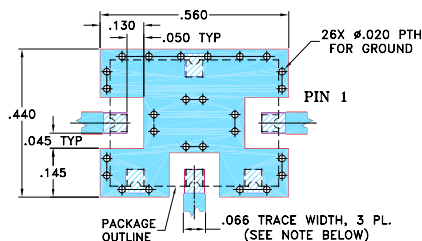
## Outline Drawing



## Outline Dimensions (inch)

| 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

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## Features

- high IP3, 32 dBm typ.
- excellent L-R isolation, 50 dB typ.;
- L-I isolation, 45 dB typ.

## Applications

- base stations
- amateur radio
- aeronautical
- mobile radio
- radar
- emergency

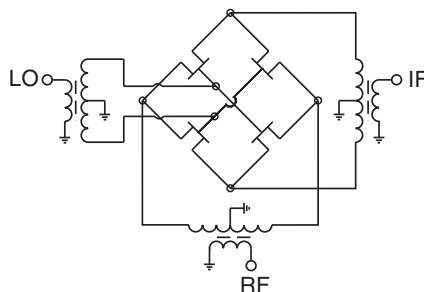
## Electrical Specifications at 25°C

| Parameter                          | Min. | Typ. | Max. | Unit |
|------------------------------------|------|------|------|------|
| Frequency Range, RF                | 40   | —    | 250  | MHz  |
| Frequency Range, LO                | 10   | —    | 220  | MHz  |
| Frequency Range, IF                | 10   | —    | 90   | MHz  |
| Conversion Loss                    | —    | 7.0  | 8.5  | dB   |
| LO to RF Isolation                 | 36   | 50   | —    | dB   |
| LO to IF Isolation                 | 32   | 45   | —    | dB   |
| IP3                                | —    | 32   | —    | dBm  |
| RF Input Power at 1 dB Compression | —    | +20  | —    | dBm  |
| LO Power                           | —    | +17  | +20  | dBm  |

## Typical Performance Data

| Frequency |        | Conversion Loss (dB) | Isolation L-R | Isolation L-I | VSWR RF Port | VSWR LO Port | IP3 (dBm) |
|-----------|--------|----------------------|---------------|---------------|--------------|--------------|-----------|
| RF MHz    | LO MHz | LO +17dBm            | LO +17dBm     | LO +17dBm     | LO +17dBm    | LO +17dBm    | LO +17dBm |
| 40.10     | 10.10  | 6.52                 | 65.14         | 64.99         | 2.40         | 2.19         | 36.56     |
| 52.10     | 22.10  | 6.66                 | 65.97         | 59.83         | 2.36         | 2.23         | 33.25     |
| 64.10     | 34.10  | 6.81                 | 63.22         | 56.26         | 2.30         | 2.27         | 34.75     |
| 79.10     | 49.10  | 7.02                 | 60.32         | 52.67         | 2.30         | 2.33         | 34.43     |
| 91.10     | 61.10  | 7.05                 | 57.80         | 50.17         | 2.27         | 2.39         | 39.59     |
| 106.10    | 76.10  | 6.93                 | 56.82         | 48.33         | 2.24         | 2.50         | 35.00     |
| 118.10    | 88.10  | 6.82                 | 56.80         | 47.71         | 2.20         | 2.59         | 33.89     |
| 130.10    | 100.10 | 6.78                 | 55.93         | 47.18         | 2.18         | 2.70         | 33.58     |
| 145.10    | 115.10 | 6.77                 | 54.76         | 46.40         | 2.13         | 2.82         | 32.73     |
| 157.10    | 127.10 | 6.86                 | 53.76         | 45.29         | 2.13         | 2.93         | 32.58     |
| 172.10    | 142.10 | 7.00                 | 52.76         | 44.04         | 2.08         | 3.04         | 33.52     |
| 184.10    | 154.10 | 7.05                 | 52.05         | 43.57         | 2.05         | 3.12         | 33.10     |
| 196.10    | 166.10 | 7.04                 | 52.05         | 43.50         | 2.03         | 3.18         | 30.97     |
| 211.10    | 181.10 | 6.99                 | 52.45         | 43.72         | 1.99         | 3.25         | 30.11     |
| 223.10    | 193.10 | 6.95                 | 52.57         | 43.65         | 1.95         | 3.28         | 29.58     |
| 238.10    | 208.10 | 6.90                 | 52.53         | 43.42         | 2.01         | 3.31         | 30.89     |
| 250.10    | 220.10 | 6.92                 | 52.06         | 42.97         | 1.95         | 3.31         | 32.31     |

## Electrical Schematic



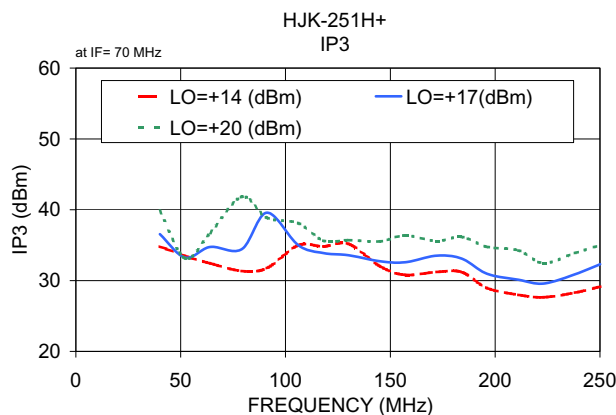
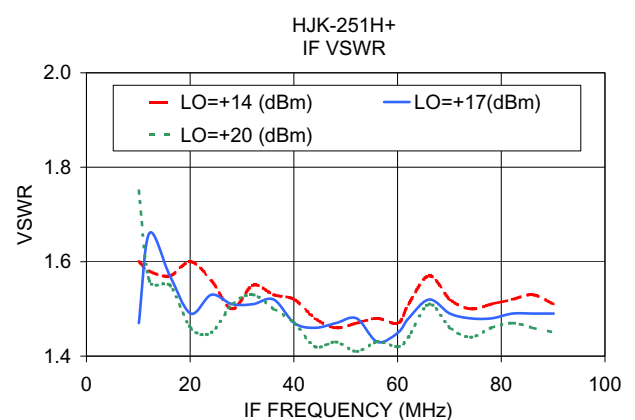
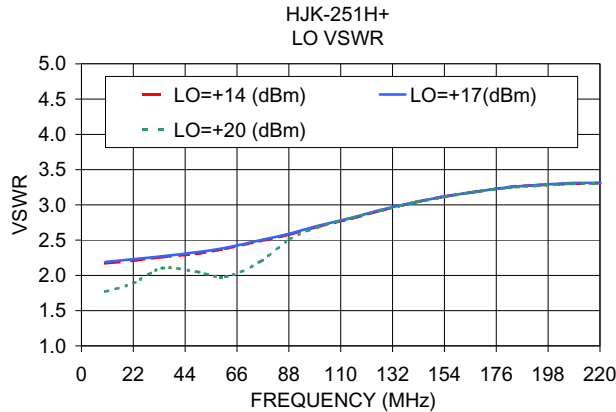
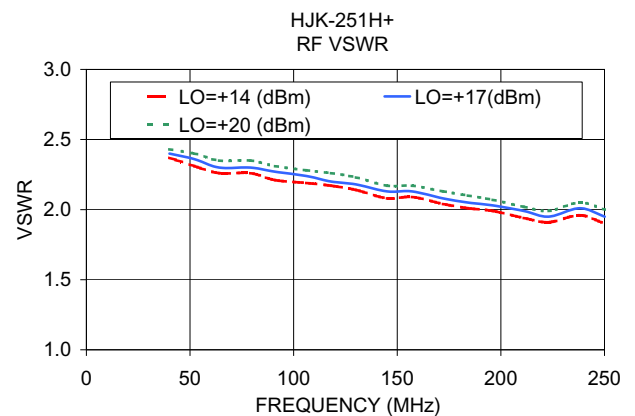
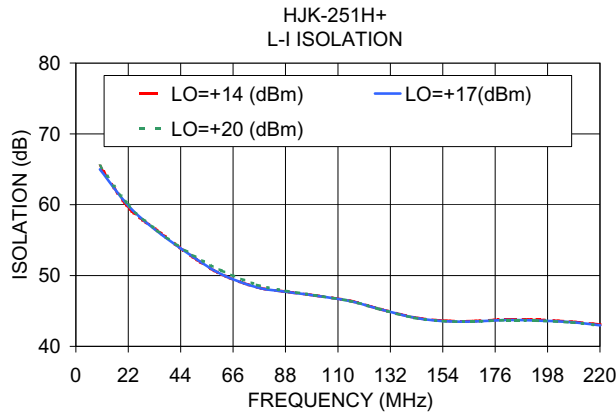
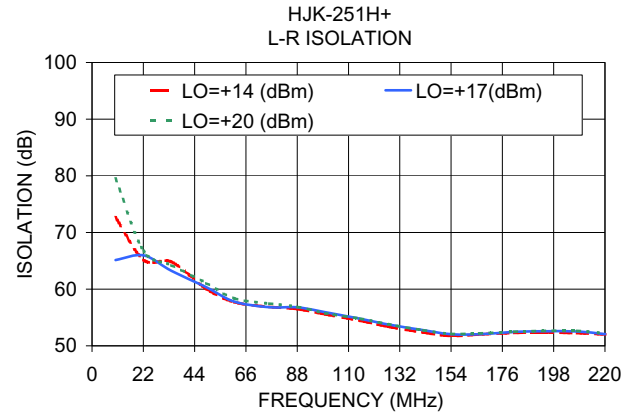
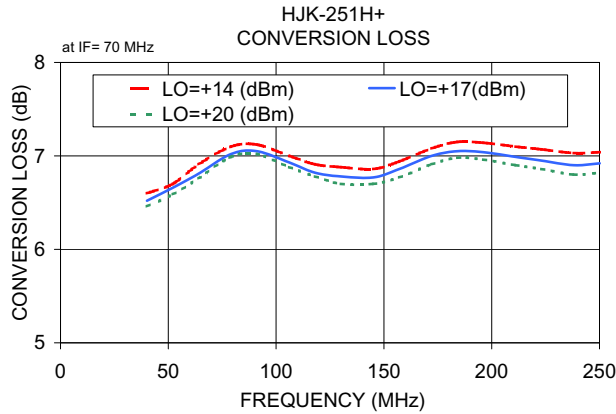
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HJK-251H+  
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160304  
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# Performance Charts

## HJK-251H+



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# Frequency Mixer

# HJK-251H+

## Typical Performance Data

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>IF FIXED<br>@IF(OUT)=30MHz<br>(dB) |      |      | RF<br>(IN)<br>(MHz) | LO<br>(MHz) | IP-3 INPUT<br>(dBm) |       |       | RF<br>(IN)<br>(MHz) | LO<br>(MHz) | COMPRESSION<br>@RF IN=+20dBm<br>(dB) |      |      |
|---------------------|-------------|-------------------------------------------------------|------|------|---------------------|-------------|---------------------|-------|-------|---------------------|-------------|--------------------------------------|------|------|
|                     |             | @LO (dBm)                                             |      |      |                     |             | @LO (dBm)           |       |       |                     |             | @LO (dBm)                            |      |      |
|                     |             | +14                                                   | +17  | +20  |                     |             | +14                 | +17   | +20   |                     |             | +14                                  | +17  | +20  |
| 40.1                | 10.1        | 6.60                                                  | 6.52 | 6.46 | 40.1                | 10.1        | 34.86               | 38.45 | 41.82 | 40.1                | 10.1        | 0.28                                 | 0.12 | 0.08 |
| 52.1                | 22.1        | 6.70                                                  | 6.66 | 6.59 | 52.1                | 22.1        | 33.64               | 34.87 | 32.92 | 52.1                | 22.1        | 0.35                                 | 0.13 | 0.06 |
| 64.1                | 34.1        | 6.91                                                  | 6.81 | 6.76 | 64.1                | 34.1        | 31.76               | 34.66 | 36.86 | 64.1                | 34.1        | 0.36                                 | 0.20 | 0.09 |
| 79.1                | 49.1        | 7.10                                                  | 7.02 | 6.99 | 79.1                | 49.1        | 31.83               | 35.07 | 39.42 | 79.1                | 49.1        | 0.30                                 | 0.14 | 0.05 |
| 91.1                | 61.1        | 7.12                                                  | 7.05 | 7.02 | 91.1                | 61.1        | 32.41               | 39.88 | 36.28 | 91.1                | 61.1        | 0.30                                 | 0.14 | 0.06 |
| 106.1               | 76.1        | 7.00                                                  | 6.93 | 6.88 | 106.1               | 76.1        | 34.46               | 34.95 | 36.79 | 106.1               | 76.1        | 0.33                                 | 0.16 | 0.10 |
| 118.1               | 88.1        | 6.91                                                  | 6.82 | 6.78 | 118.1               | 88.1        | 34.12               | 33.76 | 36.29 | 118.1               | 88.1        | 0.34                                 | 0.17 | 0.07 |
| 130.1               | 100.1       | 6.88                                                  | 6.78 | 6.70 | 130.1               | 100.1       | 35.29               | 33.03 | 35.15 | 130.1               | 100.1       | 0.37                                 | 0.16 | 0.08 |
| 145.1               | 115.1       | 6.86                                                  | 6.77 | 6.70 | 145.1               | 115.1       | 32.00               | 32.47 | 34.83 | 145.1               | 115.1       | 0.49                                 | 0.22 | 0.11 |
| 157.1               | 127.1       | 6.94                                                  | 6.86 | 6.77 | 157.1               | 127.1       | 31.07               | 32.36 | 35.50 | 157.1               | 127.1       | 0.45                                 | 0.20 | 0.11 |
| 172.1               | 142.1       | 7.08                                                  | 7.00 | 6.91 | 172.1               | 142.1       | 31.10               | 33.05 | 36.47 | 172.1               | 142.1       | 0.37                                 | 0.15 | 0.08 |
| 184.1               | 154.1       | 7.15                                                  | 7.05 | 6.98 | 184.1               | 154.1       | 30.72               | 33.32 | 35.55 | 184.1               | 154.1       | 0.48                                 | 0.21 | 0.11 |
| 196.1               | 166.1       | 7.14                                                  | 7.04 | 6.96 | 196.1               | 166.1       | 28.91               | 30.87 | 34.35 | 196.1               | 166.1       | 0.58                                 | 0.26 | 0.12 |
| 211.1               | 181.1       | 7.10                                                  | 6.99 | 6.90 | 211.1               | 181.1       | 28.11               | 30.38 | 33.89 | 211.1               | 181.1       | 0.69                                 | 0.29 | 0.15 |
| 223.1               | 193.1       | 7.07                                                  | 6.95 | 6.86 | 223.1               | 193.1       | 27.55               | 29.45 | 32.55 | 223.1               | 193.1       | 0.88                                 | 0.35 | 0.16 |
| 238.1               | 208.1       | 7.03                                                  | 6.90 | 6.80 | 238.1               | 208.1       | 28.19               | 30.87 | 33.31 | 238.1               | 208.1       | 1.04                                 | 0.42 | 0.20 |
| 250.1               | 220.1       | 7.04                                                  | 6.92 | 6.82 | 250.1               | 220.1       | 29.22               | 32.12 | 34.71 | 250.1               | 220.1       | 0.91                                 | 0.36 | 0.18 |
| 262.1               | 232.1       | 7.16                                                  | 7.03 | 6.93 | 262.1               | 232.1       | 28.12               | 30.89 | 33.08 | 262.1               | 232.1       | 1.00                                 | 0.37 | 0.17 |
| 277.1               | 247.1       | 7.27                                                  | 7.13 | 7.04 | 277.1               | 247.1       | 27.18               | 29.30 | 31.23 | 277.1               | 247.1       | 1.46                                 | 0.51 | 0.21 |
| 289.1               | 259.1       | 7.30                                                  | 7.16 | 7.05 | 289.1               | 259.1       | 26.60               | 28.76 | 31.13 | 289.1               | 259.1       | 1.70                                 | 0.60 | 0.26 |
| 304.1               | 274.1       | 7.34                                                  | 7.19 | 7.05 | 304.1               | 274.1       | 26.49               | 28.75 | 31.07 | 304.1               | 274.1       | 2.35                                 | 0.85 | 0.33 |
| 316.1               | 286.1       | 7.36                                                  | 7.19 | 7.05 | 316.1               | 286.1       | 26.03               | 28.62 | 31.69 | 316.1               | 286.1       | 3.00                                 | 1.25 | 0.40 |
| 331.1               | 301.1       | 7.32                                                  | 7.16 | 7.03 | 331.1               | 301.1       | 24.37               | 27.19 | 32.19 | 331.1               | 301.1       | 3.06                                 | 1.31 | 0.40 |
| 343.1               | 313.1       | 7.40                                                  | 7.23 | 7.10 | 343.1               | 313.1       | 23.69               | 26.59 | 31.07 | 343.1               | 313.1       | 3.01                                 | 1.29 | 0.38 |
| 355.1               | 325.1       | 7.57                                                  | 7.41 | 7.28 | 355.1               | 325.1       | 22.96               | 25.93 | 30.24 | 355.1               | 325.1       | 3.59                                 | 1.71 | 0.46 |
| 370.1               | 340.1       | 7.69                                                  | 7.53 | 7.39 | 370.1               | 340.1       | 21.36               | 23.49 | 25.81 | 370.1               | 340.1       | 4.27                                 | 2.27 | 0.73 |
| 382.1               | 352.1       | 7.76                                                  | 7.59 | 7.45 | 382.1               | 352.1       | 20.11               | 21.64 | 23.31 | 382.1               | 352.1       | 4.55                                 | 2.58 | 0.96 |
| 397.1               | 367.1       | 7.88                                                  | 7.69 | 7.56 | 397.1               | 367.1       | 19.28               | 20.32 | 21.54 | 397.1               | 367.1       | 5.32                                 | 3.26 | 1.46 |
| 409.1               | 379.1       | 7.78                                                  | 7.56 | 7.38 | 409.1               | 379.1       | 19.19               | 20.48 | 22.01 | 409.1               | 379.1       | 5.88                                 | 3.75 | 1.85 |
| 421.1               | 391.1       | 7.70                                                  | 7.43 | 7.23 | 421.1               | 391.1       | 19.13               | 21.21 | 23.73 | 421.1               | 391.1       | 5.93                                 | 3.78 | 1.92 |
| 436.1               | 406.1       | 7.76                                                  | 7.45 | 7.21 | 436.1               | 406.1       | 18.34               | 19.70 | 21.92 | 436.1               | 406.1       | 5.84                                 | 3.76 | 1.96 |
| 448.1               | 418.1       | 7.83                                                  | 7.51 | 7.26 | 448.1               | 418.1       | 18.63               | 19.51 | 20.27 | 448.1               | 418.1       | 6.22                                 | 4.03 | 2.09 |
| 463.1               | 433.1       | 7.84                                                  | 7.53 | 7.30 | 463.1               | 433.1       | 18.96               | 20.46 | 21.45 | 463.1               | 433.1       | 6.57                                 | 4.36 | 2.35 |
| 475.1               | 445.1       | 7.97                                                  | 7.64 | 7.40 | 475.1               | 445.1       | 18.58               | 20.80 | 22.54 | 475.1               | 445.1       | 6.80                                 | 4.60 | 2.58 |
| 487.1               | 457.1       | 8.10                                                  | 7.75 | 7.48 | 487.1               | 457.1       | 18.29               | 20.90 | 23.28 | 487.1               | 457.1       | 7.24                                 | 5.03 | 2.95 |
| 502.1               | 472.1       | 8.19                                                  | 7.79 | 7.52 | 502.1               | 472.1       | 17.95               | 20.91 | 23.68 | 502.1               | 472.1       | 7.69                                 | 5.51 | 3.39 |
| 514.1               | 484.1       | 8.24                                                  | 7.84 | 7.55 | 514.1               | 484.1       | 17.48               | 20.36 | 23.43 | 514.1               | 484.1       | 7.61                                 | 5.43 | 3.35 |
| 529.1               | 499.1       | 8.35                                                  | 7.93 | 7.60 | 529.1               | 499.1       | 17.30               | 20.19 | 23.57 | 529.1               | 499.1       | 7.64                                 | 5.45 | 3.35 |
| 541.1               | 511.1       | 8.41                                                  | 7.94 | 7.64 | 541.1               | 511.1       | 17.15               | 19.99 | 23.57 | 541.1               | 511.1       | 7.59                                 | 5.35 | 3.25 |
| 556.1               | 526.1       | 8.62                                                  | 8.14 | 7.81 | 556.1               | 526.1       | 16.45               | 19.01 | 22.28 | 556.1               | 526.1       | 7.63                                 | 5.45 | 3.44 |

# Frequency Mixer

# HJK-251H+

## Typical Performance Data

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=182.1MHz<br>(dB) |
|----------------------|-------------|-----------------------------------------------------------------|
|                      |             | @LO (dBm)                                                       |
|                      |             | +17                                                             |
| 172.0                | 10.1        | 6.91                                                            |
| 164.0                | 18.1        | 6.92                                                            |
| 156.0                | 26.1        | 6.93                                                            |
| 148.0                | 34.1        | 6.98                                                            |
| 139.0                | 43.1        | 7.05                                                            |
| 131.0                | 51.1        | 7.03                                                            |
| 123.0                | 59.1        | 7.02                                                            |
| 115.0                | 67.1        | 7.01                                                            |
| 106.0                | 76.1        | 7.07                                                            |
| 98.0                 | 84.1        | 7.04                                                            |
| 89.0                 | 93.1        | 6.91                                                            |
| 81.0                 | 101.1       | 6.93                                                            |
| 72.0                 | 110.1       | 7.06                                                            |
| 64.0                 | 118.1       | 7.08                                                            |
| 56.0                 | 126.1       | 7.12                                                            |
| 48.0                 | 134.1       | 7.08                                                            |
| 39.0                 | 143.1       | 7.08                                                            |
| 31.0                 | 151.1       | 7.07                                                            |
| 23.0                 | 159.1       | 7.09                                                            |
| 15.0                 | 167.1       | 7.21                                                            |
| 10.0                 | 192.1       | 7.58                                                            |
| 26.0                 | 208.1       | 7.22                                                            |
| 42.0                 | 224.1       | 7.13                                                            |
| 58.0                 | 240.1       | 7.11                                                            |
| 74.0                 | 256.1       | 7.07                                                            |
| 90.0                 | 272.1       | 7.06                                                            |
| 106.0                | 288.1       | 7.30                                                            |
| 122.0                | 304.1       | 7.26                                                            |
| 138.0                | 320.1       | 7.39                                                            |
| 154.0                | 336.1       | 7.34                                                            |
| 170.0                | 352.1       | 7.34                                                            |
| 186.0                | 368.1       | 7.52                                                            |
| 202.0                | 384.1       | 7.53                                                            |
| 218.0                | 400.1       | 7.52                                                            |
| 234.0                | 416.1       | 7.61                                                            |
| 250.0                | 432.1       | 7.65                                                            |
| 266.0                | 448.1       | 7.70                                                            |
| 282.0                | 464.1       | 7.82                                                            |
| 298.0                | 480.1       | 7.81                                                            |
| 314.0                | 496.1       | 7.93                                                            |

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=145.1MHz<br>(dB) |
|----------------------|-------------|-----------------------------------------------------------------|
|                      |             | @LO (dBm)                                                       |
|                      |             | +17                                                             |
| 11.0                 | 156.1       | 7.22                                                            |
| 16.0                 | 161.1       | 6.94                                                            |
| 26.0                 | 171.1       | 6.95                                                            |
| 36.0                 | 181.1       | 6.91                                                            |
| 46.0                 | 191.1       | 6.89                                                            |
| 56.0                 | 201.1       | 6.86                                                            |
| 66.0                 | 211.1       | 6.88                                                            |
| 76.0                 | 221.1       | 6.77                                                            |
| 86.0                 | 231.1       | 6.85                                                            |
| 96.0                 | 241.1       | 6.90                                                            |
| 101.0                | 246.1       | 6.93                                                            |
| 111.0                | 256.1       | 6.89                                                            |
| 121.0                | 266.1       | 6.96                                                            |
| 131.0                | 276.1       | 6.99                                                            |
| 141.0                | 286.1       | 7.08                                                            |
| 151.0                | 296.1       | 7.13                                                            |
| 161.0                | 306.1       | 7.15                                                            |
| 171.0                | 316.1       | 7.23                                                            |
| 181.0                | 326.1       | 7.20                                                            |
| 191.0                | 336.1       | 7.25                                                            |
| 196.0                | 341.1       | 7.25                                                            |
| 206.0                | 351.1       | 7.19                                                            |
| 216.0                | 361.1       | 7.28                                                            |
| 226.0                | 371.1       | 7.24                                                            |
| 236.0                | 381.1       | 7.27                                                            |
| 246.0                | 391.1       | 7.18                                                            |
| 256.0                | 401.1       | 7.24                                                            |
| 266.0                | 411.1       | 7.25                                                            |
| 276.0                | 421.1       | 7.36                                                            |
| 286.0                | 431.1       | 7.32                                                            |
| 291.0                | 436.1       | 7.31                                                            |
| 301.0                | 446.1       | 7.46                                                            |
| 311.0                | 456.1       | 7.58                                                            |
| 321.0                | 466.1       | 7.66                                                            |
| 331.0                | 476.1       | 7.64                                                            |
| 341.0                | 486.1       | 7.75                                                            |
| 351.0                | 496.1       | 7.86                                                            |
| 361.0                | 506.1       | 7.86                                                            |
| 371.0                | 516.1       | 7.94                                                            |
| 381.0                | 526.1       | 7.94                                                            |

| IF<br>(OUT)<br>(MHz) | LO<br>(MHz) | CONVERSION LOSS<br>VS. IF FREQUENCY<br>@RF(IN)=220.1MHz<br>(dB) |
|----------------------|-------------|-----------------------------------------------------------------|
|                      |             | @LO (dBm)                                                       |
|                      |             | +17                                                             |
| 210.0                | 10.1        | 6.72                                                            |
| 206.0                | 14.1        | 6.73                                                            |
| 200.0                | 20.1        | 6.73                                                            |
| 196.0                | 24.1        | 6.75                                                            |
| 190.0                | 30.1        | 6.76                                                            |
| 186.0                | 34.1        | 6.76                                                            |
| 180.0                | 40.1        | 6.84                                                            |
| 176.0                | 44.1        | 6.85                                                            |
| 170.0                | 50.1        | 6.86                                                            |
| 166.0                | 54.1        | 6.87                                                            |
| 160.0                | 60.1        | 6.86                                                            |
| 156.0                | 64.1        | 6.86                                                            |
| 150.0                | 70.1        | 6.88                                                            |
| 144.0                | 76.1        | 6.89                                                            |
| 140.0                | 80.1        | 6.87                                                            |
| 134.0                | 86.1        | 6.87                                                            |
| 130.0                | 90.1        | 6.87                                                            |
| 124.0                | 96.1        | 6.90                                                            |
| 120.0                | 100.1       | 6.91                                                            |
| 114.0                | 106.1       | 6.93                                                            |
| 108.0                | 112.1       | 6.80                                                            |
| 102.0                | 118.1       | 6.82                                                            |
| 98.0                 | 122.1       | 6.83                                                            |
| 92.0                 | 128.1       | 6.90                                                            |
| 88.0                 | 132.1       | 6.88                                                            |
| 82.0                 | 138.1       | 6.90                                                            |
| 76.0                 | 144.1       | 6.93                                                            |
| 72.0                 | 148.1       | 6.93                                                            |
| 66.0                 | 154.1       | 6.93                                                            |
| 62.0                 | 158.1       | 6.95                                                            |
| 56.0                 | 164.1       | 6.93                                                            |
| 52.0                 | 168.1       | 6.95                                                            |
| 46.0                 | 174.1       | 6.98                                                            |
| 42.0                 | 178.1       | 6.97                                                            |
| 36.0                 | 184.1       | 7.02                                                            |
| 32.0                 | 188.1       | 7.01                                                            |
| 26.0                 | 194.1       | 7.02                                                            |
| 22.0                 | 198.1       | 7.01                                                            |
| 16.0                 | 204.1       | 7.05                                                            |
| 10.0                 | 210.1       | 7.43                                                            |

# Frequency Mixer

# HJK-251H+

## 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        | 72.66                   | 65.14 | 79.51 | 65.44                   | 64.99 | 65.48 |
| 22.1        | 65.16                   | 65.97 | 66.75 | 59.60                   | 59.83 | 59.98 |
| 34.1        | 64.80                   | 63.22 | 64.21 | 56.37                   | 56.26 | 56.36 |
| 49.1        | 60.03                   | 60.32 | 61.05 | 52.62                   | 52.67 | 52.89 |
| 61.1        | 57.70                   | 57.80 | 58.35 | 50.16                   | 50.17 | 50.69 |
| 76.1        | 56.87                   | 56.82 | 57.45 | 48.34                   | 48.33 | 48.68 |
| 88.1        | 56.48                   | 56.80 | 56.88 | 47.72                   | 47.71 | 47.83 |
| 100.1       | 55.56                   | 55.93 | 55.74 | 47.20                   | 47.18 | 47.22 |
| 115.1       | 54.42                   | 54.76 | 54.78 | 46.42                   | 46.40 | 46.40 |
| 127.1       | 53.37                   | 53.76 | 53.80 | 45.32                   | 45.29 | 45.29 |
| 142.1       | 52.35                   | 52.76 | 52.75 | 44.08                   | 44.04 | 44.02 |
| 154.1       | 51.74                   | 52.05 | 52.11 | 43.63                   | 43.57 | 43.56 |
| 166.1       | 52.00                   | 52.05 | 52.21 | 43.57                   | 43.50 | 43.49 |
| 181.1       | 52.28                   | 52.45 | 52.50 | 43.80                   | 43.72 | 43.71 |
| 193.1       | 52.36                   | 52.57 | 52.62 | 43.75                   | 43.65 | 43.63 |
| 208.1       | 52.23                   | 52.53 | 52.65 | 43.48                   | 43.42 | 43.37 |
| 220.1       | 52.00                   | 52.06 | 52.18 | 43.08                   | 42.97 | 42.94 |
| 232.1       | 51.24                   | 51.28 | 51.38 | 42.82                   | 42.72 | 42.66 |
| 247.1       | 51.31                   | 51.35 | 51.42 | 43.06                   | 42.96 | 42.91 |
| 259.1       | 51.87                   | 51.88 | 52.05 | 43.44                   | 43.33 | 43.28 |
| 274.1       | 51.79                   | 51.79 | 51.83 | 43.89                   | 43.76 | 43.68 |
| 286.1       | 51.20                   | 51.23 | 51.34 | 43.96                   | 43.79 | 43.72 |
| 301.1       | 51.03                   | 50.93 | 51.03 | 43.66                   | 43.48 | 43.37 |
| 313.1       | 50.76                   | 50.59 | 50.63 | 43.44                   | 43.23 | 43.11 |
| 325.1       | 50.60                   | 50.33 | 50.26 | 43.35                   | 43.13 | 42.99 |
| 340.1       | 51.36                   | 51.18 | 51.22 | 43.65                   | 43.39 | 43.23 |
| 352.1       | 52.64                   | 52.35 | 52.30 | 44.04                   | 43.78 | 43.59 |
| 367.1       | 55.07                   | 54.75 | 54.63 | 44.64                   | 44.33 | 44.13 |
| 379.1       | 57.50                   | 57.88 | 58.38 | 44.99                   | 44.69 | 44.47 |
| 391.1       | 58.49                   | 58.54 | 58.36 | 45.49                   | 45.14 | 44.88 |
| 406.1       | 58.23                   | 57.96 | 57.68 | 45.94                   | 45.52 | 45.23 |
| 418.1       | 58.00                   | 57.49 | 56.89 | 46.67                   | 46.24 | 45.93 |
| 433.1       | 56.92                   | 56.24 | 55.54 | 47.70                   | 47.24 | 46.91 |
| 445.1       | 55.91                   | 55.18 | 54.51 | 48.95                   | 48.41 | 48.00 |
| 457.1       | 55.36                   | 54.61 | 53.91 | 50.25                   | 49.70 | 49.25 |
| 472.1       | 54.40                   | 53.58 | 52.93 | 51.63                   | 50.87 | 50.30 |
| 484.1       | 55.28                   | 54.40 | 53.66 | 53.10                   | 52.30 | 51.60 |
| 499.1       | 52.54                   | 51.74 | 51.11 | 56.20                   | 54.83 | 53.67 |
| 511.1       | 53.01                   | 52.11 | 51.55 | 58.13                   | 56.09 | 54.49 |
| 526.1       | 52.01                   | 51.20 | 50.65 | 59.78                   | 57.09 | 55.11 |

| RF<br>(IN)<br>(MHz) | LO<br>(MHz) | RF-IF ISOLATION<br>(dB) |       |       |
|---------------------|-------------|-------------------------|-------|-------|
|                     |             | @LO (dBm)               |       |       |
|                     |             | +14                     | +17   | +20   |
| 40.1                | 10.1        | 52.94                   | 49.44 | 54.77 |
| 52.1                | 22.1        | 47.18                   | 46.47 | 47.96 |
| 64.1                | 34.1        | 62.29                   | 63.24 | 64.83 |
| 79.1                | 49.1        | 57.41                   | 57.81 | 58.57 |
| 91.1                | 61.1        | 56.91                   | 55.65 | 56.49 |
| 106.1               | 76.1        | 54.34                   | 50.47 | 55.49 |
| 118.1               | 88.1        | 58.29                   | 57.94 | 58.21 |
| 130.1               | 100.1       | 54.32                   | 54.50 | 54.22 |
| 145.1               | 115.1       | 54.76                   | 52.78 | 50.88 |
| 157.1               | 127.1       | 53.78                   | 53.50 | 53.82 |
| 172.1               | 142.1       | 52.82                   | 53.53 | 53.00 |
| 184.1               | 154.1       | 52.79                   | 51.92 | 50.23 |
| 196.1               | 166.1       | 53.11                   | 52.41 | 51.61 |
| 211.1               | 181.1       | 48.23                   | 49.41 | 49.47 |
| 223.1               | 193.1       | 48.46                   | 48.76 | 48.88 |
| 238.1               | 208.1       | 48.26                   | 48.27 | 48.11 |
| 250.1               | 220.1       | 46.69                   | 46.87 | 46.61 |
| 262.1               | 232.1       | 48.30                   | 48.56 | 48.96 |
| 277.1               | 247.1       | 50.44                   | 50.77 | 51.75 |
| 289.1               | 259.1       | 49.07                   | 49.84 | 50.04 |
| 304.1               | 274.1       | 46.57                   | 47.19 | 47.77 |
| 316.1               | 286.1       | 45.64                   | 45.68 | 46.19 |
| 331.1               | 301.1       | 43.19                   | 43.24 | 42.88 |
| 343.1               | 313.1       | 40.97                   | 40.97 | 40.72 |
| 355.1               | 325.1       | 39.56                   | 39.07 | 38.88 |
| 370.1               | 340.1       | 37.15                   | 36.67 | 36.20 |
| 382.1               | 352.1       | 35.60                   | 34.92 | 34.44 |
| 397.1               | 367.1       | 36.00                   | 35.74 | 35.51 |
| 409.1               | 379.1       | 35.62                   | 35.45 | 34.50 |
| 421.1               | 391.1       | 35.45                   | 35.72 | 35.60 |
| 436.1               | 406.1       | 35.84                   | 36.05 | 36.02 |
| 448.1               | 418.1       | 35.63                   | 35.90 | 35.90 |
| 463.1               | 433.1       | 35.02                   | 35.14 | 35.30 |
| 475.1               | 445.1       | 33.86                   | 33.77 | 33.52 |
| 487.1               | 457.1       | 33.06                   | 32.91 | 32.33 |
| 502.1               | 472.1       | 31.73                   | 31.30 | 30.97 |
| 514.1               | 484.1       | 30.30                   | 29.67 | 29.10 |
| 529.1               | 499.1       | 28.79                   | 27.97 | 27.58 |
| 541.1               | 511.1       | 27.97                   | 27.25 | 26.86 |
| 556.1               | 526.1       | 27.00                   | 26.04 | 25.43 |

# Frequency Mixer

# HJK-251H+

## 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=190MHz<br>(:1) |      |      |
|---------------------|-------------|-----------------|------|------|-------------|-----------------|------|------|----------------------|-------------------------------|------|------|
|                     |             | @LO (dBm)       |      |      |             | @LO (dBm)       |      |      |                      | @LO (dBm)                     |      |      |
|                     |             | +14             | +17  | +20  |             | +14             | +17  | +20  |                      | +14                           | +17  | +20  |
| 40.1                | 10.1        | 2.37            | 2.40 | 2.43 | 10.1        | 2.17            | 2.19 | 1.77 | 10.1                 | 1.60                          | 1.47 | 1.75 |
| 52.1                | 22.1        | 2.31            | 2.36 | 2.40 | 22.1        | 2.21            | 2.23 | 1.89 | 12.1                 | 1.58                          | 1.66 | 1.56 |
| 64.1                | 34.1        | 2.26            | 2.30 | 2.35 | 34.1        | 2.26            | 2.27 | 2.10 | 16.1                 | 1.57                          | 1.57 | 1.55 |
| 79.1                | 49.1        | 2.26            | 2.30 | 2.35 | 49.1        | 2.31            | 2.33 | 2.05 | 20.1                 | 1.60                          | 1.49 | 1.46 |
| 91.1                | 61.1        | 2.21            | 2.27 | 2.31 | 61.1        | 2.38            | 2.39 | 1.98 | 24.1                 | 1.56                          | 1.53 | 1.45 |
| 106.1               | 76.1        | 2.19            | 2.24 | 2.28 | 76.1        | 2.49            | 2.50 | 2.20 | 28.1                 | 1.50                          | 1.51 | 1.51 |
| 118.1               | 88.1        | 2.17            | 2.20 | 2.26 | 88.1        | 2.58            | 2.59 | 2.51 | 32.1                 | 1.55                          | 1.51 | 1.53 |
| 130.1               | 100.1       | 2.14            | 2.18 | 2.23 | 100.1       | 2.69            | 2.70 | 2.68 | 36.1                 | 1.53                          | 1.52 | 1.50 |
| 145.1               | 115.1       | 2.08            | 2.13 | 2.17 | 115.1       | 2.81            | 2.82 | 2.82 | 40.1                 | 1.52                          | 1.47 | 1.47 |
| 157.1               | 127.1       | 2.09            | 2.13 | 2.17 | 127.1       | 2.92            | 2.93 | 2.92 | 44.1                 | 1.48                          | 1.46 | 1.42 |
| 172.1               | 142.1       | 2.04            | 2.08 | 2.13 | 142.1       | 3.04            | 3.04 | 3.04 | 48.1                 | 1.46                          | 1.47 | 1.43 |
| 184.1               | 154.1       | 2.01            | 2.05 | 2.10 | 154.1       | 3.12            | 3.12 | 3.11 | 52.1                 | 1.47                          | 1.48 | 1.41 |
| 196.1               | 166.1       | 1.99            | 2.03 | 2.07 | 166.1       | 3.18            | 3.18 | 3.18 | 56.1                 | 1.48                          | 1.43 | 1.43 |
| 211.1               | 181.1       | 1.94            | 1.99 | 2.02 | 181.1       | 3.25            | 3.25 | 3.24 | 60.1                 | 1.47                          | 1.45 | 1.42 |
| 223.1               | 193.1       | 1.91            | 1.95 | 1.99 | 193.1       | 3.28            | 3.28 | 3.27 | 62.1                 | 1.51                          | 1.48 | 1.44 |
| 238.1               | 208.1       | 1.96            | 2.01 | 2.05 | 208.1       | 3.30            | 3.31 | 3.30 | 66.1                 | 1.57                          | 1.52 | 1.51 |
| 250.1               | 220.1       | 1.90            | 1.95 | 2.00 | 220.1       | 3.31            | 3.31 | 3.30 | 70.1                 | 1.52                          | 1.49 | 1.46 |
| 262.1               | 232.1       | 1.89            | 1.94 | 1.98 | 232.1       | 3.31            | 3.31 | 3.30 | 74.1                 | 1.50                          | 1.48 | 1.44 |
| 277.1               | 247.1       | 1.87            | 1.92 | 1.97 | 247.1       | 3.28            | 3.28 | 3.27 | 78.1                 | 1.51                          | 1.48 | 1.46 |
| 289.1               | 259.1       | 1.83            | 1.88 | 1.93 | 259.1       | 3.25            | 3.25 | 3.25 | 82.1                 | 1.52                          | 1.49 | 1.47 |
| 304.1               | 274.1       | 1.80            | 1.84 | 1.89 | 274.1       | 3.21            | 3.21 | 3.21 | 86.1                 | 1.53                          | 1.49 | 1.46 |
| 316.1               | 286.1       | 1.78            | 1.82 | 1.86 | 286.1       | 3.18            | 3.18 | 3.17 | 90.1                 | 1.51                          | 1.49 | 1.45 |
| 331.1               | 301.1       | 1.71            | 1.74 | 1.78 | 301.1       | 3.12            | 3.12 | 3.12 | 94.1                 | 1.51                          | 1.49 | 1.46 |
| 343.1               | 313.1       | 1.70            | 1.73 | 1.76 | 313.1       | 3.08            | 3.08 | 3.08 | 98.1                 | 1.53                          | 1.49 | 1.46 |
| 355.1               | 325.1       | 1.67            | 1.69 | 1.71 | 325.1       | 3.04            | 3.04 | 3.03 | 102.1                | 1.53                          | 1.51 | 1.47 |
| 370.1               | 340.1       | 1.62            | 1.63 | 1.64 | 340.1       | 2.96            | 2.96 | 2.95 | 106.1                | 1.53                          | 1.50 | 1.48 |
| 382.1               | 352.1       | 1.65            | 1.65 | 1.66 | 352.1       | 2.91            | 2.91 | 2.90 | 110.1                | 1.55                          | 1.53 | 1.51 |
| 397.1               | 367.1       | 1.67            | 1.67 | 1.68 | 367.1       | 2.85            | 2.84 | 2.83 | 112.1                | 1.54                          | 1.52 | 1.50 |
| 409.1               | 379.1       | 1.70            | 1.71 | 1.73 | 379.1       | 2.80            | 2.79 | 2.78 | 116.1                | 1.54                          | 1.51 | 1.49 |
| 421.1               | 391.1       | 1.75            | 1.77 | 1.79 | 391.1       | 2.77            | 2.76 | 2.75 | 120.1                | 1.56                          | 1.51 | 1.50 |
| 436.1               | 406.1       | 1.83            | 1.85 | 1.88 | 406.1       | 2.72            | 2.71 | 2.70 | 124.1                | 1.54                          | 1.51 | 1.48 |
| 448.1               | 418.1       | 1.85            | 1.88 | 1.92 | 418.1       | 2.69            | 2.68 | 2.67 | 128.1                | 1.51                          | 1.49 | 1.47 |
| 463.1               | 433.1       | 1.91            | 1.95 | 2.00 | 433.1       | 2.65            | 2.65 | 2.64 | 132.1                | 1.49                          | 1.48 | 1.46 |
| 475.1               | 445.1       | 1.94            | 1.99 | 2.05 | 445.1       | 2.62            | 2.61 | 2.60 | 136.1                | 1.50                          | 1.47 | 1.44 |
| 487.1               | 457.1       | 1.95            | 2.01 | 2.08 | 457.1       | 2.58            | 2.58 | 2.57 | 140.1                | 1.48                          | 1.46 | 1.44 |
| 502.1               | 472.1       | 2.00            | 2.05 | 2.12 | 472.1       | 2.54            | 2.54 | 2.53 | 144.1                | 1.49                          | 1.46 | 1.43 |
| 514.1               | 484.1       | 2.04            | 2.10 | 2.17 | 484.1       | 2.50            | 2.50 | 2.49 | 148.1                | 1.50                          | 1.48 | 1.44 |
| 529.1               | 499.1       | 2.06            | 2.13 | 2.20 | 499.1       | 2.47            | 2.46 | 2.46 | 152.1                | 1.52                          | 1.49 | 1.46 |
| 541.1               | 511.1       | 2.11            | 2.18 | 2.25 | 511.1       | 2.43            | 2.43 | 2.42 | 156.1                | 1.54                          | 1.52 | 1.48 |
| 556.1               | 526.1       | 2.13            | 2.20 | 2.27 | 526.1       | 2.39            | 2.39 | 2.38 | 160.1                | 1.54                          | 1.51 | 1.49 |



## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (dBc)  |        |        |        |        |        |        |        |        |        |        |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | ---    | ---    | 17.16  | 35.04  | 43.12  | 41.75  | 38.25  | 33.50  | 42.64  | 35.38  | 51.62  | 39.99  |
| 1  | ---    | 44.24  | ---    | 60.75  | 9.90   | 61.44  | 15.41  | 54.30  | 19.01  | 67.21  | 24.50  | 72.62  |
| 2  | 104.19 | 55.42  | 62.67  | 57.33  | 85.33  | 57.51  | 68.55  | 55.62  | 67.47  | 54.54  | 71.45  | 56.28  |
| 3  | 112.54 | 78.77  | 78.21  | 81.76  | 70.12  | 80.53  | 67.36  | 79.80  | 61.06  | 79.18  | 60.42  | 78.28  |
| 4  | 121.67 | 89.49  | 95.69  | 90.84  | 97.46  | 90.63  | 116.04 | 94.52  | 97.23  | 87.71  | 92.86  | 85.19  |
| 5  | 121.38 | 88.98  | 84.53  | 89.35  | 81.22  | 89.37  | 86.89  | 89.85  | 86.90  | 89.39  | 80.60  | 88.44  |
| 6  | 120.63 | 100.59 | 115.09 | 97.42  | 115.19 | 94.42  | 114.46 | 90.24  | 105.37 | 102.10 | 110.63 | 103.41 |
| 7  | 122.71 | 104.72 | 92.65  | 101.92 | 90.14  | 101.92 | 89.61  | 100.88 | 90.87  | 102.93 | 90.90  | 102.46 |
| 8  | 122.31 | 118.46 | 116.92 | 113.45 | 115.31 | 107.74 | 117.71 | 103.91 | 115.81 | 94.37  | 117.37 | 95.72  |
| 9  | 121.37 | 115.06 | 109.70 | 115.56 | 104.28 | 112.74 | 105.14 | 114.09 | 101.68 | 110.57 | 99.85  | 114.33 |
| 10 | 121.61 | 117.97 | 117.84 | 115.84 | 119.32 | 118.28 | 115.01 | 117.40 | 116.19 | 118.49 | 116.82 | 113.37 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |

### LO HARMONICS ORDER

Test conditions: RF IN: 183 MHz; 0 dBm.  
LO IN: 153 MHz; +17.00 dBm  
IF OUT: 30 MHz; - 7.06 dBm

RF HARMONICS ORDER

|    | (-dBm) | (dBc)  |        |        |        |        |       |       |       |        |       |        |
|----|--------|--------|--------|--------|--------|--------|-------|-------|-------|--------|-------|--------|
| 0  | ---    | ---    | 21.10  | 28.50  | 41.10  | 39.13  | 43.08 | 38.87 | 50.06 | 41.73  | 64.38 | 44.81  |
| 1  | ---    | 30.34  | ---    | 49.77  | 10.11  | 55.83  | 15.97 | 52.68 | 20.36 | 76.89  | 26.59 | 69.31  |
| 2  | 93.53  | 45.66  | 50.51  | 46.77  | 58.16  | 47.37  | 57.40 | 47.06 | 62.36 | 47.41  | 72.41 | 51.43  |
| 3  | 103.31 | 72.32  | 56.63  | 74.11  | 50.90  | 73.81  | 47.66 | 71.80 | 43.74 | 70.21  | 42.51 | 81.52  |
| 4  | 107.59 | 68.35  | 67.68  | 69.64  | 65.20  | 71.54  | 66.62 | 70.59 | 64.77 | 65.55  | 65.90 | 63.39  |
| 5  | 105.17 | 84.32  | 68.45  | 85.14  | 75.46  | 84.50  | 67.95 | 84.45 | 65.32 | 82.27  | 69.65 | 80.76  |
| 6  | 106.43 | 78.97  | 86.02  | 80.81  | 82.47  | 80.38  | 82.00 | 84.91 | 82.49 | 86.88  | 80.49 | 82.69  |
| 7  | 106.21 | 87.81  | 77.24  | 86.22  | 80.64  | 87.78  | 81.17 | 86.28 | 79.09 | 85.70  | 80.05 | 85.11  |
| 8  | 106.72 | 92.20  | 104.83 | 90.77  | 115.60 | 89.82  | 99.99 | 89.83 | 99.49 | 94.36  | 97.50 | 93.15  |
| 9  | 106.96 | 96.19  | 86.01  | 94.03  | 85.12  | 91.36  | 79.96 | 91.52 | 83.44 | 90.65  | 82.97 | 90.15  |
| 10 | 107.62 | 109.13 | 101.78 | 110.74 | 99.69  | 106.38 | 96.15 | 99.92 | 97.74 | 100.29 | 97.03 | 105.82 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5     | 6     | 7     | 8      | 9     | 10     |

### LO HARMONICS ORDER

Test conditions: RF IN: 183 MHz; 10 dBm.  
LO IN: 153 MHz; +17.00 dBm  
IF OUT: 30 MHz; 2.73 dBm

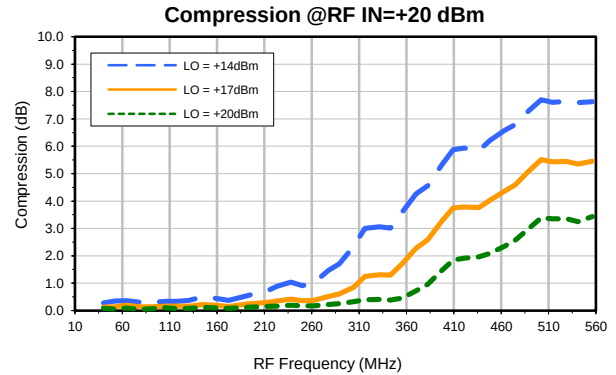
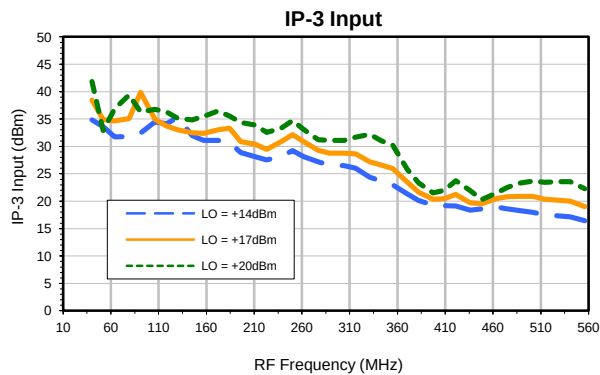
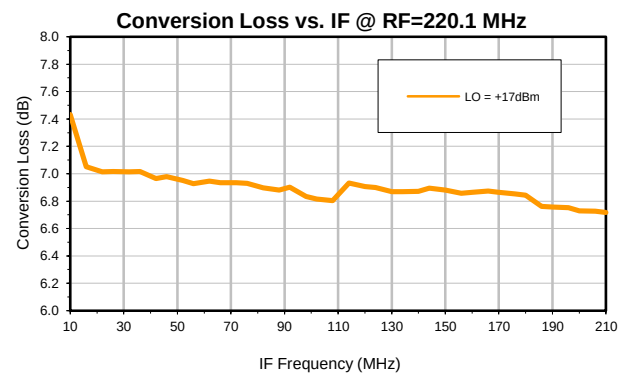
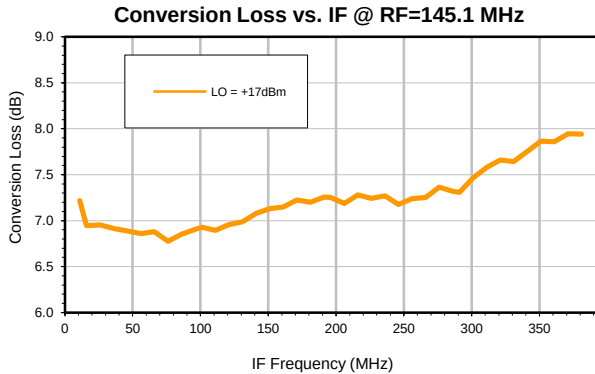
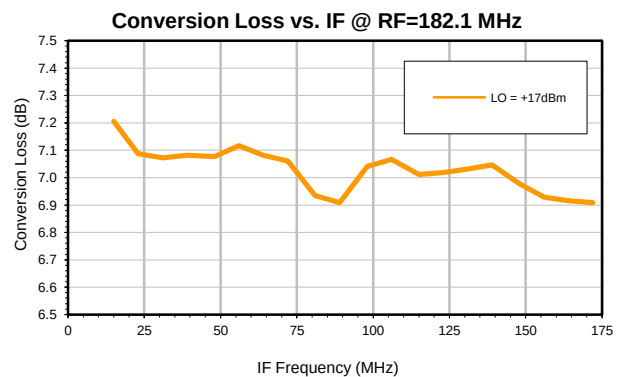
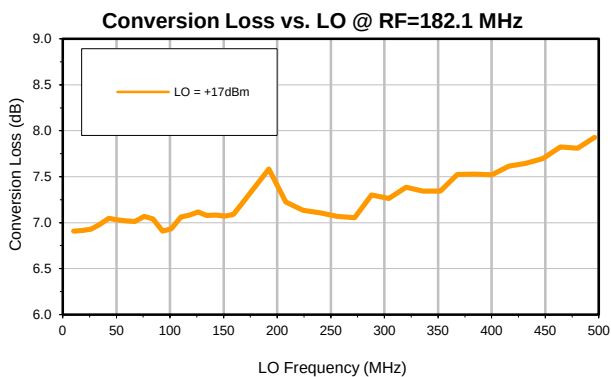
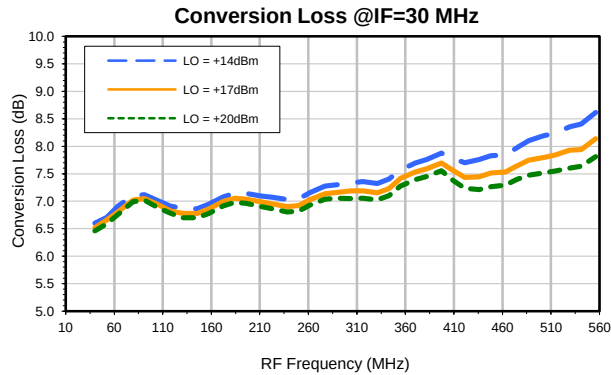
- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT  
2. + entry denotes harmonics are in (dBc) above IF OUTPUT  
3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer



# Frequency Mixer

## Typical Performance Curves

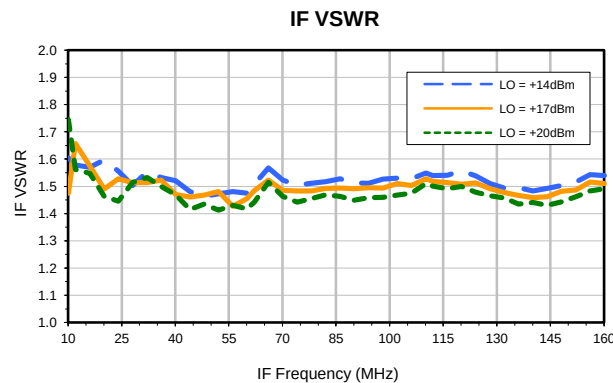
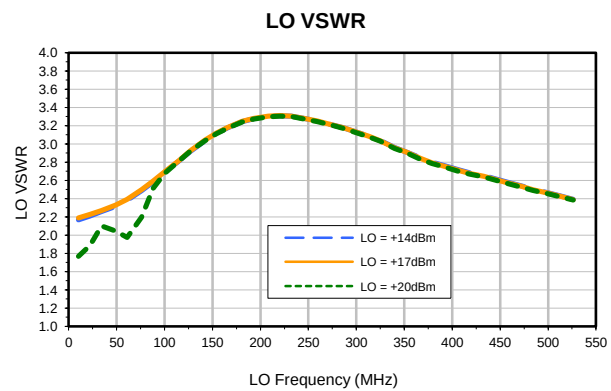
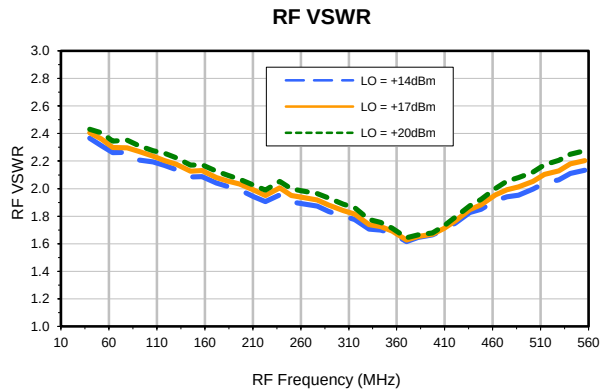
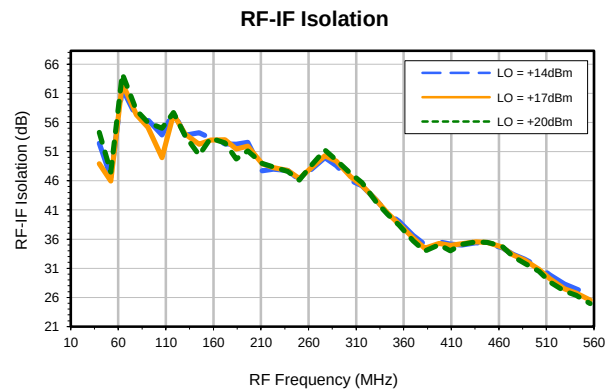
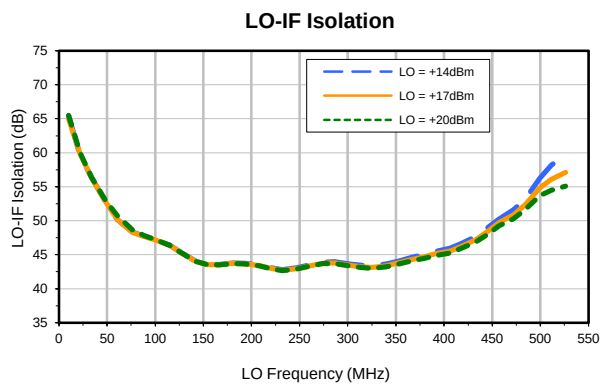
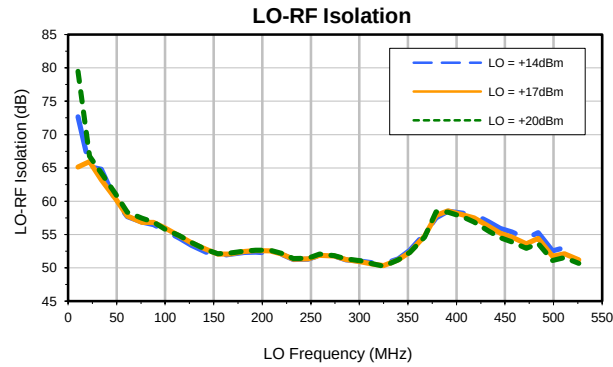
HJK-251H+



# Frequency Mixer

## Typical Performance Curves

HJK-251H+



## Harmonics Tables

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |        |        |        |        |        |        |
|----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0  | ---    | ---    | 17.16  | 35.04  | 43.12  | 41.75  | 38.25  | 33.50  | 42.64  | 35.38  | 51.62  | 39.99  |
| 1  | ---    | 44.24  | ---    | 60.75  | 9.90   | 61.44  | 15.41  | 54.30  | 19.01  | 67.21  | 24.50  | 72.62  |
| 2  | 104.19 | 55.42  | 62.67  | 57.33  | 85.33  | 57.51  | 68.55  | 55.62  | 67.47  | 54.54  | 71.45  | 56.28  |
| 3  | 112.54 | 78.77  | 78.21  | 81.76  | 70.12  | 80.53  | 67.36  | 79.80  | 61.06  | 79.18  | 60.42  | 78.28  |
| 4  | 121.67 | 89.49  | 95.69  | 90.84  | 97.46  | 90.63  | 116.04 | 94.52  | 97.23  | 87.71  | 92.86  | 85.19  |
| 5  | 121.38 | 88.98  | 84.53  | 89.35  | 81.22  | 89.37  | 86.89  | 89.85  | 86.90  | 89.39  | 80.60  | 88.44  |
| 6  | 120.63 | 100.59 | 115.09 | 97.42  | 115.19 | 94.42  | 114.46 | 90.24  | 105.37 | 102.10 | 110.63 | 103.41 |
| 7  | 122.71 | 104.72 | 92.65  | 101.92 | 90.14  | 101.92 | 89.61  | 100.88 | 90.87  | 102.93 | 90.90  | 102.46 |
| 8  | 122.31 | 118.46 | 116.92 | 113.45 | 115.31 | 107.74 | 117.71 | 103.91 | 115.81 | 94.37  | 117.37 | 95.72  |
| 9  | 121.37 | 115.06 | 109.70 | 115.56 | 104.28 | 112.74 | 105.14 | 114.09 | 101.68 | 110.57 | 99.85  | 114.33 |
| 10 | 121.61 | 117.97 | 117.84 | 115.84 | 119.32 | 118.28 | 115.01 | 117.40 | 116.19 | 118.49 | 116.82 | 113.37 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |

### LO HARMONICS ORDER

Test conditions: RF IN: 183 MHz; 0 dBm.  
LO IN: 153 MHz; +17.00 dBm  
IF OUT: 30 MHz; - 7.06 dBm

RF HARMONICS ORDER

|    | (-dBm) | (-dBc) |        |        |        |        |       |       |       |        |       |        |
|----|--------|--------|--------|--------|--------|--------|-------|-------|-------|--------|-------|--------|
| 0  | ---    | ---    | 21.10  | 28.50  | 41.10  | 39.13  | 43.08 | 38.87 | 50.06 | 41.73  | 64.38 | 44.81  |
| 1  | ---    | 30.34  | ---    | 49.77  | 10.11  | 55.83  | 15.97 | 52.68 | 20.36 | 76.89  | 26.59 | 69.31  |
| 2  | 93.53  | 45.66  | 50.51  | 46.77  | 58.16  | 47.37  | 57.40 | 47.06 | 62.36 | 47.41  | 72.41 | 51.43  |
| 3  | 103.31 | 72.32  | 56.63  | 74.11  | 50.90  | 73.81  | 47.66 | 71.80 | 43.74 | 70.21  | 42.51 | 81.52  |
| 4  | 107.59 | 68.35  | 67.68  | 69.64  | 65.20  | 71.54  | 66.62 | 70.59 | 64.77 | 65.55  | 65.90 | 63.39  |
| 5  | 105.17 | 84.32  | 68.45  | 85.14  | 75.46  | 84.50  | 67.95 | 84.45 | 65.32 | 82.27  | 69.65 | 80.76  |
| 6  | 106.43 | 78.97  | 86.02  | 80.81  | 82.47  | 80.38  | 82.00 | 84.91 | 82.49 | 86.88  | 80.49 | 82.69  |
| 7  | 106.21 | 87.81  | 77.24  | 86.22  | 80.64  | 87.78  | 81.17 | 86.28 | 79.09 | 85.70  | 80.05 | 85.11  |
| 8  | 106.72 | 92.20  | 104.83 | 90.77  | 115.60 | 89.82  | 99.99 | 89.83 | 99.49 | 94.36  | 97.50 | 93.15  |
| 9  | 106.96 | 96.19  | 86.01  | 94.03  | 85.12  | 91.36  | 79.96 | 91.52 | 83.44 | 90.65  | 82.97 | 90.15  |
| 10 | 107.62 | 109.13 | 101.78 | 110.74 | 99.69  | 106.38 | 96.15 | 99.92 | 97.74 | 100.29 | 97.03 | 105.82 |
|    | RF CAL | 0      | 1      | 2      | 3      | 4      | 5     | 6     | 7     | 8      | 9     | 10     |

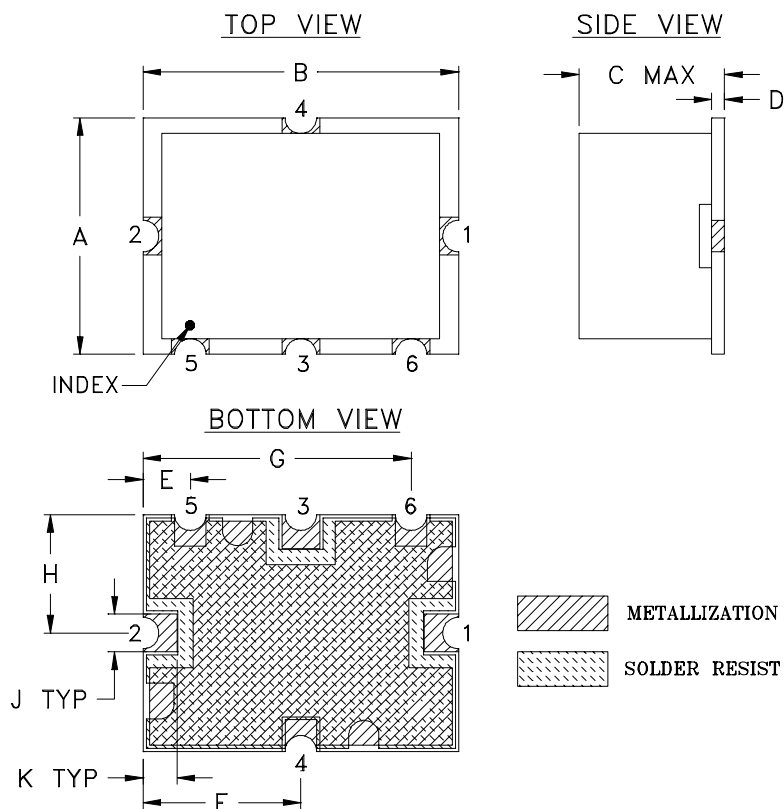
### LO HARMONICS ORDER

Test conditions: RF IN: 183 MHz; 10 dBm.  
LO IN: 153 MHz; +17.00 dBm  
IF OUT: 30 MHz; 2.73 dBm

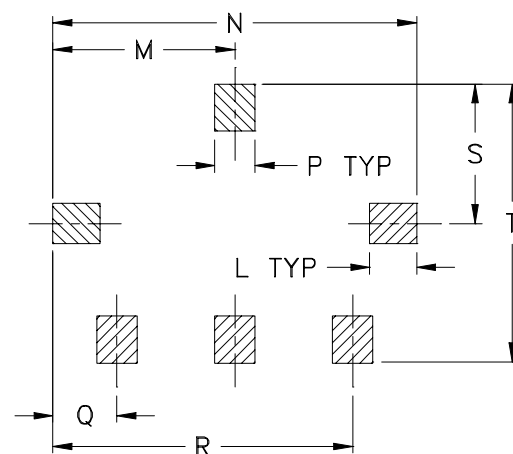
- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT  
2. + entry denotes harmonics are in (dBc) above IF OUTPUT  
3. RF Cal represents the Harmonics level of the RF Input Signal to the mixer

## Outline Dimensions

TTT881



## PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm 0.002$

| CASE # | A             | B              | C             | D              | E              | F              | G               | H              | J              | K              | L              | M              | N               |
|--------|---------------|----------------|---------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| TTT881 | .38<br>(9.65) | .50<br>(12.70) | .23<br>(5.84) | .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) |

| CASE # | P              | Q              | R               | S              | T               | WT.<br>GRAM |
|--------|----------------|----------------|-----------------|----------------|-----------------|-------------|
| TTT881 | .060<br>(1.52) | .095<br>(2.41) | .445<br>(11.30) | .208<br>(5.28) | .415<br>(10.54) | .8          |

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

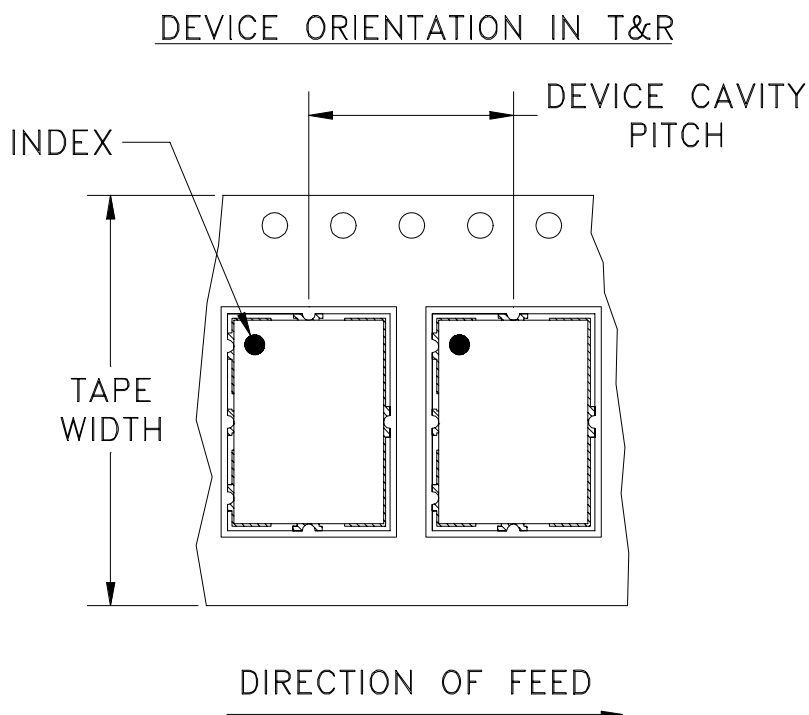
### Note:

- Case material: Nickel-Silver alloy.
- 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.



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 Mini-Circuits ISO 9001 & ISO 14001 Certified

# 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)



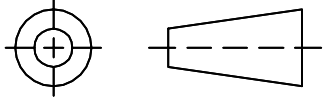
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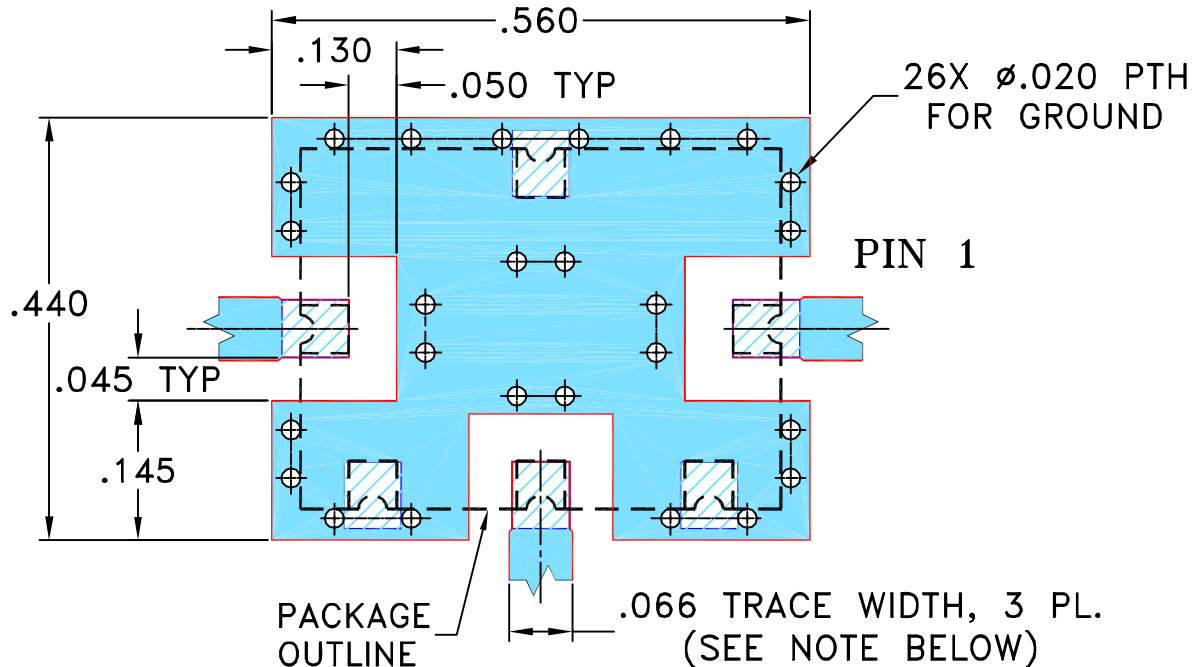
## THIRD ANGLE PROJECTION



## 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   |

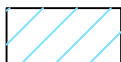
**SUGGESTED MOUNTING CONFIGURATION FOR  
TTT166/167 CASE STYLE, "hk"/"lp"/"lq"  
"x"/"ck"/"ec" PIN CONNECTIONS**

**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  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-079

REV:  
D

FILE: 98PL079

SCALE: 5:1

SHEET: 1 OF 1

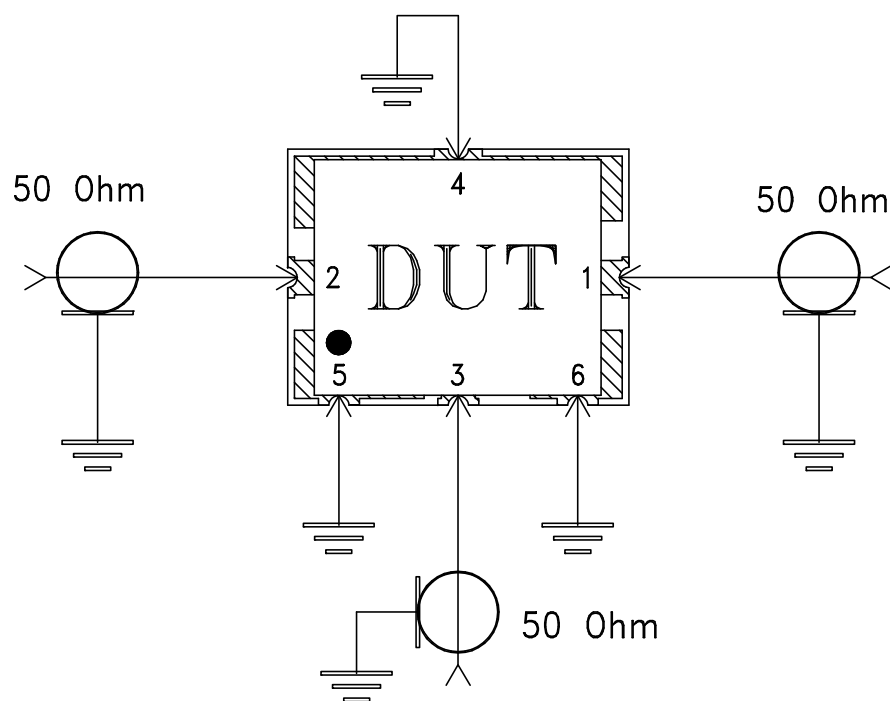
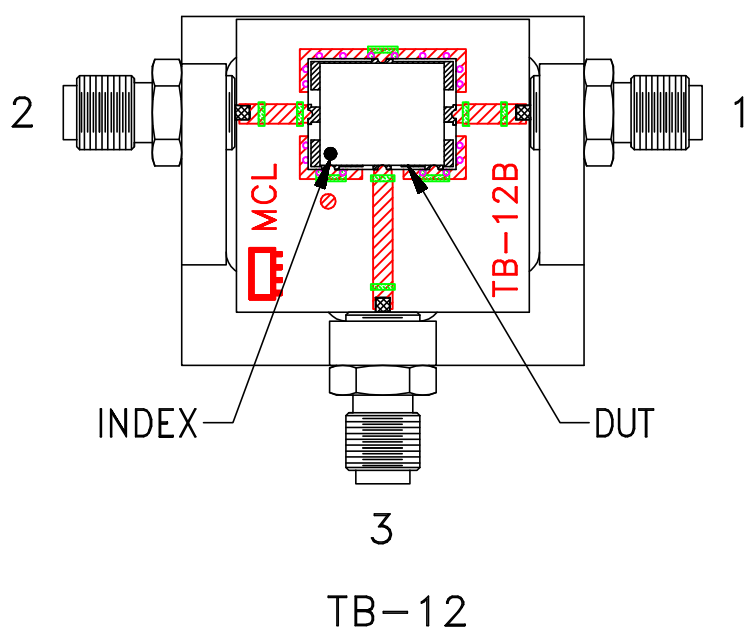
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ASHEETA1.DWG REV:A DATE:01/12/95

# 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                                                                              |