MMIC, LOW NOISE, SHUTDOWN FEATURE

# Monolithic Amplifier TSY-173LN+

50Ω 13.5 to 17 GHz

## THE BIG DEAL

- Positive Gain Slope
- Shutdown Feature
- Excellent Noise Figure, 1.2dB Typ.
- Built-In ESD Protection Circuits (Class 1C)
- Low Current Operation, 13.2mA

*Generic photo used for illustration purposes only*

CASE STYLE: MC1630-1

***+RoHS Compliant***

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

## APPLICATIONS

- Point to Point ODU System
- Fixed Satellite
- Radio Location
- Mobile

## PRODUCT OVERVIEW

The TSY-173LN+ is a GaAs E-PHEMT based low noise MMIC Amplifier with shutdown feature with a unique combination of low noise ( 1.2dB Typ.), and Low Current (13.2mA Typ.) It is suitable for receiver application. This design operates on a single supply of 3V. It is well-matched to 50Ω and comes in a tiny, low profile package (2x2mm 6 Lead), accommodating dense circuit board layouts.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Low noise, 1.2dB Typical from 13.5 – 17GHz | Enables lower system noise figure performance. |
| Positive Gain Slope vs. Frequency<br>+0.6 dB/GHz from 13.5 GHz to 15 GHz<br>+0.4 dB/GHz from 15 GHz to 17 GHz | Useful for compensating negative gain slope of most wideband microwave components and eliminating the need for equalization. |
| Shutdown Feature | Allow users to turn on and off the amplifier with pulsed signals while keeping the power supply at constant voltage. |
| Integrated DC Blocks and Bias-Tee | Saves motherboard space and minimizes overall cost. Very User Friendly. |
| Small Size (2x2 mm 6L MCLP) | Tiny footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. |

REV. A
ECO-011994
TSY-173LN+
MCL NY
220222

# Monolithic Amplifier TSY-173LN+

## ELECTRICAL SPECIFICATIONS[1] AT 25°C, 50Ω, UNLESS NOTED

| Parameter | Condition (GHz) | Amplifier - ON | | | Amplifier- OFF | Units |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Typ. | |
| Frequency range | | 13.5 | | 17 | 13.5-17 | GHz |
| Noise Figure | 13.5 | | 1.2 | | — | dB |
| | 14 | | 1.2 | | — | |
| | 15 | | 1.1 | | — | |
| | 16 | | 1.2 | | — | |
| | 17 | | 1.2 | | — | |
| Gain | 13.5 | 14.2 | 15.6 | 17 | -14.8 | dB |
| | 14 | | 16 | | -14.7 | |
| | 15 | 15.1 | 16.5 | 18 | -15.1 | |
| | 16 | | 16.8 | | -15.6 | |
| | 17 | 15.2 | 16.7 | 18.2 | -16.7 | |
| Input Return Loss | 13.5 | | 16.4 | | 2.6 | dB |
| | 14 | | 18.9 | | 2.7 | |
| | 15 | | 18.8 | | 3.1 | |
| | 16 | | 15.4 | | 3.3 | |
| | 17 | | 16.6 | | 3.2 | |
| Output Return Loss | 13.5 | | 11.7 | | 8.8 | dB |
| | 14 | | 14.9 | | 8.0 | |
| | 15 | | 21.4 | | 6.0 | |
| | 16 | | 20.3 | | 5.9 | |
| | 17 | | 16 | | 5.2 | |
| Output P1dB (AMP-ON) | 13.5 | | 9.3 | | — | dBm |
| | 14 | | 9.4 | | — | |
| | 15 | | 8.7 | | — | |
| | 16 | | 8.4 | | — | |
| | 17 | | 6.6 | | — | |
| Output IP3 (Pout = -10 dBm/Tone) | 13.5 | | 22.4 | | — | dBm |
| | 14 | | 22.9 | | — | |
| | 15 | | 24.2 | | — | |
| | 16 | | 21.9 | | — | |
| | 17 | | 21 | | — | |
| Device Operating Voltage(VDD) | | 2.75 | 3 | 3.25 | 3 | V |
| Device Operating Current (IDD) | | | 13.2 | 19 | 0.00012 | mA |
| Control Voltage (VC) | | 2.25 | 2.5 | 2.75 | 0 | V |
| Control Current (IC) | | | 0.56 | | 0 | mA |
| DC Current (IDD) Variation Vs. Temperature[2] | | | 11.54 | | — | uA/degC |
| DC Current (IDD) Variation Vs. Voltage[3] | | | 0.014 | | — | mA/mV |
| Thermal Resistance | | | 106.7 | | — | degC/W |

1. Measured on Mini-Circuits Characterization Test Board TB-TSY-173LN+. See Characterization Test & Application Circuit (Fig. 1)
2. Device Current Variation vs. Temperature= (Current in mA at 85°C - Current in mA at -45°C)/130°C
3. Device Current Variation vs. Voltage = (Current in mA at 3.25V – Current in mA at 2.75V) / ((3.25V-2.75V)*1000 mA/mV)

## MAXIMUM RATINGS[4]

| Parameter | Ratings |
|---|---|
| Operating temperature (ground lead) | -40°C to 85°C |
| Storage temperature | -65°C to 150°C |
| Junction Temperature | 130°C |
| Total power dissipation | 0.42W |
| Input power (CW) | +22 dBm |
| DC voltage at VC | 3V |
| DC voltage at VDD | 8V |

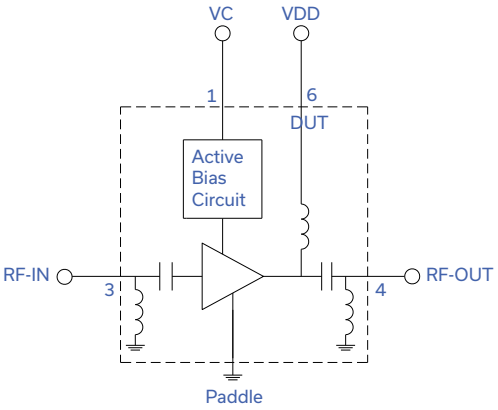
4. Permanent damage may occur if any of those limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.

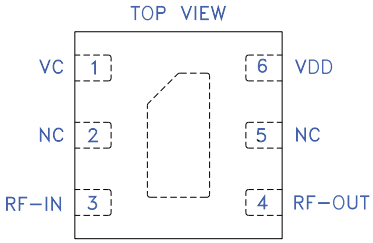
## TRUTH TABLE + SWITCHING TIME SPECIFICATION

| Truth Table | | VC Min. | VC Typ. | VC Max. | Units |
|---|---|---|---|---|---|
| Amplifier- ON | | 2.25 | 2.5 | 2.75 | V |
| Amplifier -OFF | | | 0 | 0.2 | V |
| **Switching Time Parameter** | | **Min.** | **Typ.** | **Max.** | **Units** |
| Amplifier ON to OFF | OFF Time (50% Control to 10% RF) | | 13.7 | | ns |
| | FALL Time (90% RF to 10% RF) | | 8.8 | | ns |
| Amplifier OFF to ON | ON Time (50% Control to 90% RF) | | 52.4 | | ns |
| | RISE Time (10% RF to 90% RF) | | 38.8 | | ns |
| Control Voltage Leakage (Rising Edge) | | | 0.64 | | mV |
| Control Voltage Leakage (Falling Edge) | | | 1.45 | | mV |

# Monolithic Amplifier TSY-173LN+

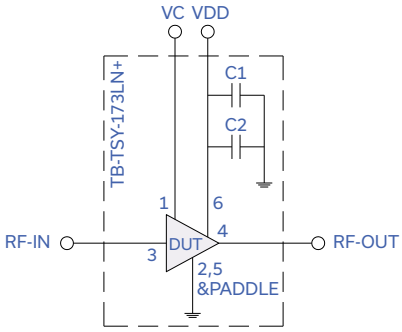
## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION




| Function | Pad Number | Description (Fig 1) |
|---|---|---|
| VC | 1 | Control Voltage Pad for Shutdown (VC) |
| RF - IN | 3 | RF Input Pad |
| RF-OUT | 4 | RF Output Pad |
| VDD | 6 | DC Power Supply (VDD) |
| No Connection | 2 & 5 | Not used internally. Connected to ground on Test Board |
| Ground | Paddle | Soldered to Ground |

## CHARACTERIZATION TEST & APPLICATION CIRCUIT

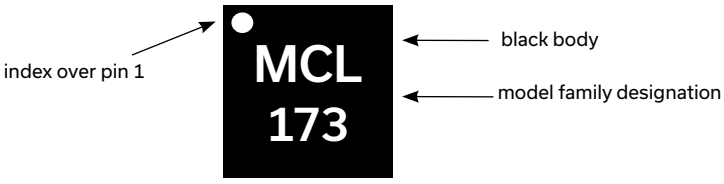



| Component | Size | Value | Part Number | Manufacturer |
|---|---|---|---|---|
| C1 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |
| C2 | 0402 | 100pF | GRM1555C1H101JA01D | Murata |

Fig 1. Application and Characterization Circuit
Note: This block diagram is used for characterization. (DUT is soldered on Mini-Circuits Characterization test board TB-TSY-173LN+)
Gain, Return loss, Output power at 1dB compression (P1dB), output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:
1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, -10 dBm/tone at output.
3. Switching Time: RF Signal: Pin = -10dBm, fRF =15GHz
VDD = 3V, VC = Pulse Signal at 100Hz with Vhigh =2.5V and Vlow =0V & 50% Duty Cycle.

## PRODUCT MARKING




Marking may contain other features or characters for internal lot control

# Monolithic Amplifier TSY-173LN+

## ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS CLICK HERE

| | |
|---|---|
| **Performance Data** | Data Table<br>Swept Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) |
| **Case Style** | MC1630-1 Plastic package, exposed paddle, lead finish: Matt Tin |
| **Tape & Reel**<br>**Standard quantities available on reel** | F66<br>7" reels with 20, 50, 100, 200, 500 or 2K devices |
| **Suggested Layout for PCB Design** | PL-719 |
| **Evaluation Board** | TB-TSY-173LN+ (Without Connectors)<br>TB-TSY-173LNC+ (With Connectors) |
| **Environmental Ratings** | ENV08T1 |

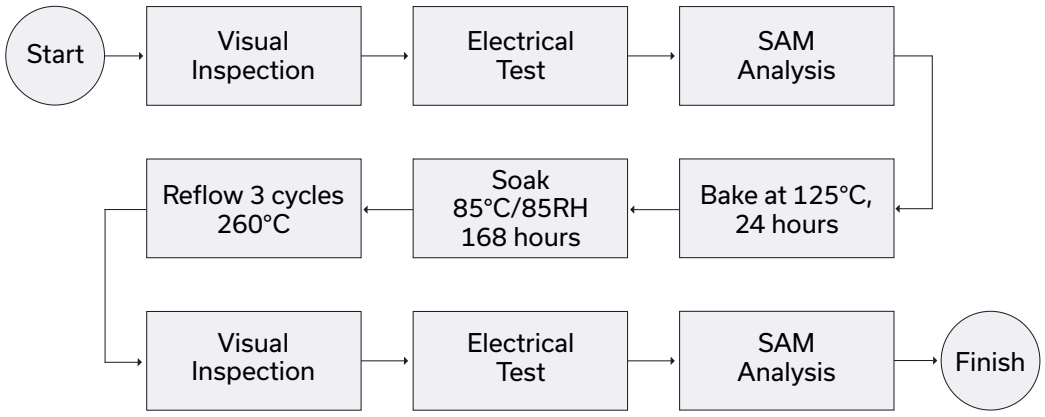
## ESD RATING

Human Body Model (HBM): Class 1C (1000V) in accordance with ANSI/ESD STM 5.1 - 2001

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

## MSL TEST FLOW CHART




NOTES

A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.50V, Vd = 3.00V, Id = 14mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.32 | 26.15 | 11.61 | 7.32 | 1.85 | 0.77 | 21.96 | 8.80 | 1.18 |
| 12200 | 14.50 | 26.12 | 12.21 | 7.74 | 1.85 | 0.78 | 24.16 | 9.01 | 1.19 |
| 12400 | 14.67 | 26.17 | 12.82 | 8.20 | 1.86 | 0.79 | 22.19 | 9.18 | 1.16 |
| 12600 | 14.83 | 26.18 | 13.41 | 8.69 | 1.87 | 0.81 | 21.93 | 9.25 | 1.17 |
| 12800 | 15.00 | 26.26 | 14.06 | 9.28 | 1.89 | 0.82 | 22.95 | 9.13 | 1.14 |
| 13000 | 15.17 | 26.25 | 14.80 | 9.94 | 1.90 | 0.84 | 21.62 | 9.39 | 1.15 |
| 13200 | 15.33 | 26.34 | 15.58 | 10.72 | 1.92 | 0.85 | 22.31 | 9.51 | 1.12 |
| 13400 | 15.50 | 26.40 | 16.51 | 11.68 | 1.93 | 0.87 | 22.51 | 9.41 | 1.13 |
| 13600 | 15.66 | 26.43 | 17.50 | 12.84 | 1.94 | 0.88 | 24.10 | 9.28 | 1.12 |
| 13800 | 15.82 | 26.49 | 18.39 | 14.15 | 1.95 | 0.89 | 22.39 | 9.62 | 1.08 |
| 14000 | 15.97 | 26.61 | 19.36 | 15.84 | 1.96 | 0.91 | 23.32 | 9.37 | 1.09 |
| 14200 | 16.11 | 26.75 | 19.89 | 17.79 | 1.98 | 0.92 | 22.27 | 9.10 | 1.06 |
| 14400 | 16.23 | 26.91 | 20.18 | 20.05 | 2.00 | 0.93 | 22.34 | 9.14 | 1.07 |
| 14600 | 16.34 | 27.08 | 20.11 | 22.04 | 2.02 | 0.93 | 24.02 | 9.23 | 1.07 |
| 14800 | 16.43 | 27.20 | 19.67 | 23.02 | 2.03 | 0.94 | 22.29 | 8.98 | 1.06 |
| 15000 | 16.51 | 27.38 | 19.09 | 22.29 | 2.04 | 0.94 | 23.38 | 8.59 | 1.06 |
| 15200 | 16.57 | 27.50 | 18.34 | 20.92 | 2.05 | 0.94 | 22.71 | 8.42 | 1.09 |
| 15400 | 16.63 | 27.68 | 17.50 | 19.59 | 2.06 | 0.94 | 22.88 | 8.36 | 1.02 |
| 15600 | 16.67 | 27.86 | 16.76 | 18.61 | 2.08 | 0.95 | 22.62 | 8.59 | 1.02 |
| 15800 | 16.71 | 27.93 | 16.12 | 18.15 | 2.08 | 0.95 | 22.41 | 8.09 | 1.05 |
| 16000 | 16.74 | 28.03 | 15.56 | 18.06 | 2.09 | 0.95 | 22.14 | 8.43 | 1.08 |
| 16200 | 16.77 | 28.14 | 15.14 | 18.18 | 2.10 | 0.96 | 20.83 | 8.35 | 1.08 |
| 16400 | 16.77 | 28.06 | 15.11 | 18.58 | 2.09 | 0.96 | 20.72 | 7.67 | 1.15 |
| 16600 | 16.76 | 28.16 | 15.23 | 18.97 | 2.11 | 0.96 | 22.70 | 7.66 | 1.10 |
| 16800 | 16.73 | 28.11 | 15.56 | 18.59 | 2.11 | 0.96 | 20.48 | 7.09 | 1.11 |
| 17000 | 16.61 | 28.06 | 16.19 | 17.08 | 2.12 | 0.95 | 20.47 | 6.69 | 1.14 |
| 17200 | 16.43 | 28.01 | 16.95 | 14.99 | 2.13 | 0.94 | 21.60 | 6.38 | 1.19 |
| 17400 | 16.19 | 27.92 | 17.80 | 12.91 | 2.13 | 0.92 | 20.73 | 5.49 | 1.22 |
| 17600 | 15.90 | 27.90 | 18.24 | 11.09 | 2.14 | 0.89 | 20.91 | 5.15 | 1.23 |
| 17800 | 15.58 | 27.75 | 17.87 | 9.62 | 2.12 | 0.86 | 19.68 | 4.92 | 1.18 |
| 18000 | 15.18 | 27.77 | 17.11 | 8.41 | 2.13 | 0.82 | 18.91 | 4.50 | 1.24 |

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.25V, Vd = 2.75V, Id = 10mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 13.85 | 25.67 | 10.99 | 7.66 | 1.86 | 0.79 | 20.19 | 7.32 | 1.29 |
| 12200 | 14.03 | 25.64 | 11.54 | 8.12 | 1.86 | 0.80 | 21.40 | 7.43 | 1.29 |
| 12400 | 14.20 | 25.65 | 12.09 | 8.63 | 1.87 | 0.81 | 20.51 | 7.59 | 1.24 |
| 12600 | 14.37 | 25.70 | 12.60 | 9.21 | 1.89 | 0.83 | 20.56 | 7.80 | 1.24 |
| 12800 | 14.53 | 25.73 | 13.21 | 9.88 | 1.90 | 0.84 | 21.28 | 7.74 | 1.21 |
| 13000 | 14.69 | 25.74 | 13.86 | 10.64 | 1.91 | 0.86 | 20.55 | 7.99 | 1.20 |
| 13200 | 14.85 | 25.83 | 14.54 | 11.55 | 1.93 | 0.87 | 21.09 | 8.08 | 1.24 |
| 13400 | 15.00 | 25.88 | 15.34 | 12.69 | 1.94 | 0.89 | 20.60 | 8.03 | 1.16 |
| 13600 | 15.16 | 25.92 | 16.19 | 14.07 | 1.95 | 0.90 | 22.85 | 8.03 | 1.17 |
| 13800 | 15.30 | 25.99 | 16.97 | 15.69 | 1.96 | 0.91 | 20.87 | 8.18 | 1.16 |
| 14000 | 15.43 | 26.12 | 17.75 | 17.77 | 1.98 | 0.92 | 22.27 | 8.20 | 1.16 |
| 14200 | 15.55 | 26.25 | 18.19 | 20.37 | 2.00 | 0.93 | 20.26 | 7.95 | 1.07 |
| 14400 | 15.65 | 26.37 | 18.49 | 23.51 | 2.01 | 0.94 | 20.54 | 7.96 | 1.13 |
| 14600 | 15.73 | 26.57 | 18.45 | 25.88 | 2.04 | 0.94 | 20.48 | 7.88 | 1.11 |
| 14800 | 15.80 | 26.76 | 18.09 | 25.11 | 2.06 | 0.95 | 19.85 | 7.75 | 1.11 |
| 15000 | 15.85 | 26.84 | 17.58 | 22.81 | 2.05 | 0.95 | 20.25 | 7.22 | 1.10 |
| 15200 | 15.90 | 27.04 | 16.92 | 20.80 | 2.08 | 0.95 | 19.80 | 6.79 | 1.09 |
| 15400 | 15.93 | 27.20 | 16.21 | 19.37 | 2.09 | 0.96 | 18.87 | 6.35 | 1.08 |
| 15600 | 15.95 | 27.36 | 15.52 | 18.42 | 2.11 | 0.96 | 18.79 | 6.88 | 1.12 |
| 15800 | 15.96 | 27.49 | 14.93 | 17.90 | 2.12 | 0.96 | 18.58 | 6.45 | 1.12 |
| 16000 | 15.96 | 27.65 | 14.43 | 17.82 | 2.15 | 0.97 | 18.89 | 6.41 | 1.13 |
| 16200 | 15.97 | 27.70 | 14.04 | 17.84 | 2.15 | 0.97 | 18.40 | 6.42 | 1.16 |
| 16400 | 15.94 | 27.72 | 13.97 | 17.88 | 2.16 | 0.97 | 18.19 | 5.86 | 1.19 |
| 16600 | 15.90 | 27.70 | 14.03 | 17.72 | 2.17 | 0.97 | 18.16 | 5.84 | 1.21 |
| 16800 | 15.82 | 27.69 | 14.24 | 16.87 | 2.17 | 0.97 | 16.29 | 5.23 | 1.24 |
| 17000 | 15.66 | 27.71 | 14.67 | 15.29 | 2.20 | 0.96 | 16.86 | 4.80 | 1.19 |
| 17200 | 15.46 | 27.71 | 15.19 | 13.47 | 2.22 | 0.95 | 16.58 | 4.49 | 1.26 |
| 17400 | 15.18 | 27.79 | 15.78 | 11.70 | 2.26 | 0.92 | 15.75 | 3.72 | 1.28 |
| 17600 | 14.87 | 27.73 | 16.05 | 10.18 | 2.27 | 0.89 | 15.66 | 3.34 | 1.28 |
| 17800 | 14.52 | 27.75 | 15.79 | 8.92 | 2.29 | 0.86 | 14.75 | 2.90 | 1.29 |
| 18000 | 14.12 | 27.66 | 15.33 | 7.88 | 2.28 | 0.82 | 13.94 | 2.32 | 1.28 |

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.75V, Vd = 3.25V, Id = 17mA @ Temperature = +25°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.61 | 26.59 | 12.10 | 7.05 | 1.85 | 0.75 | 23.37 | 9.92 | 1.20 |
| 12200 | 14.80 | 26.54 | 12.73 | 7.42 | 1.85 | 0.76 | 24.54 | 10.11 | 1.17 |
| 12400 | 14.97 | 26.61 | 13.39 | 7.85 | 1.87 | 0.78 | 23.76 | 10.28 | 1.13 |
| 12600 | 15.13 | 26.59 | 14.04 | 8.30 | 1.87 | 0.79 | 24.22 | 10.34 | 1.13 |
| 12800 | 15.31 | 26.67 | 14.79 | 8.83 | 1.89 | 0.81 | 25.10 | 10.05 | 1.10 |
| 13000 | 15.48 | 26.63 | 15.62 | 9.42 | 1.89 | 0.82 | 23.47 | 10.33 | 1.08 |
| 13200 | 15.65 | 26.69 | 16.50 | 10.13 | 1.91 | 0.84 | 23.22 | 10.46 | 1.10 |
| 13400 | 15.83 | 26.82 | 17.60 | 10.99 | 1.93 | 0.85 | 23.73 | 10.32 | 1.08 |
| 13600 | 16.00 | 26.83 | 18.74 | 12.02 | 1.93 | 0.87 | 26.05 | 10.07 | 1.10 |
| 13800 | 16.17 | 26.89 | 19.90 | 13.13 | 1.94 | 0.88 | 23.21 | 10.45 | 1.08 |
| 14000 | 16.34 | 26.85 | 21.09 | 14.58 | 1.93 | 0.89 | 24.74 | 10.29 | 1.06 |
| 14200 | 16.49 | 27.11 | 21.75 | 16.18 | 1.97 | 0.91 | 23.25 | 9.89 | 1.08 |
| 14400 | 16.63 | 27.26 | 22.04 | 17.96 | 1.99 | 0.92 | 23.47 | 9.95 | 1.04 |
| 14600 | 16.75 | 27.42 | 21.92 | 19.57 | 2.00 | 0.92 | 23.70 | 10.05 | 1.02 |
| 14800 | 16.86 | 27.56 | 21.37 | 20.59 | 2.01 | 0.93 | 23.07 | 9.79 | 1.03 |
| 15000 | 16.96 | 27.70 | 20.65 | 20.49 | 2.02 | 0.93 | 24.25 | 9.39 | 1.04 |
| 15200 | 17.04 | 27.84 | 19.78 | 19.73 | 2.02 | 0.93 | 23.69 | 9.10 | 1.03 |
| 15400 | 17.12 | 28.04 | 18.83 | 18.74 | 2.04 | 0.93 | 23.87 | 9.23 | 1.00 |
| 15600 | 17.18 | 28.16 | 17.98 | 17.90 | 2.04 | 0.94 | 25.36 | 9.64 | 1.03 |
| 15800 | 17.23 | 28.31 | 17.31 | 17.48 | 2.06 | 0.94 | 23.90 | 8.87 | 1.02 |
| 16000 | 17.29 | 28.31 | 16.72 | 17.40 | 2.04 | 0.94 | 23.29 | 9.43 | 1.05 |
| 16200 | 17.34 | 28.38 | 16.25 | 17.55 | 2.04 | 0.94 | 23.46 | 9.38 | 1.06 |
| 16400 | 17.37 | 28.43 | 16.24 | 18.12 | 2.05 | 0.94 | 23.91 | 8.69 | 1.07 |
| 16600 | 17.39 | 28.42 | 16.44 | 18.94 | 2.05 | 0.95 | 22.62 | 8.69 | 1.11 |
| 16800 | 17.38 | 28.30 | 16.85 | 19.32 | 2.03 | 0.95 | 23.09 | 8.16 | 1.12 |
| 17000 | 17.30 | 28.28 | 17.71 | 18.31 | 2.04 | 0.94 | 22.27 | 7.76 | 1.13 |
| 17200 | 17.15 | 28.21 | 18.80 | 16.18 | 2.05 | 0.93 | 22.75 | 7.34 | 1.16 |
| 17400 | 16.94 | 28.19 | 20.04 | 13.87 | 2.07 | 0.91 | 21.25 | 6.45 | 1.19 |
| 17600 | 16.66 | 27.99 | 20.63 | 11.82 | 2.04 | 0.89 | 21.07 | 6.14 | 1.19 |
| 17800 | 16.35 | 28.06 | 19.95 | 10.17 | 2.06 | 0.86 | 22.77 | 6.20 | 1.21 |
| 18000 | 15.97 | 27.97 | 18.71 | 8.84 | 2.06 | 0.82 | 22.40 | 5.82 | 1.20 |

## Typical Performance Data

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.50V, Vd = 3.00V, Id = 13mA @ Temperature = -45°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.71 | 26.32 | 11.82 | 6.70 | 1.73 | 0.73 | 21.26 | 8.88 | 0.63 |
| 12200 | 14.90 | 26.28 | 12.58 | 7.11 | 1.74 | 0.74 | 23.29 | 9.10 | 0.66 |
| 12400 | 15.07 | 26.34 | 13.25 | 7.55 | 1.76 | 0.76 | 21.26 | 9.28 | 0.61 |
| 12600 | 15.24 | 26.36 | 13.85 | 8.01 | 1.77 | 0.77 | 21.30 | 9.36 | 0.62 |
| 12800 | 15.41 | 26.40 | 14.62 | 8.51 | 1.79 | 0.79 | 22.40 | 9.28 | 0.60 |
| 13000 | 15.58 | 26.41 | 15.51 | 9.06 | 1.79 | 0.80 | 21.30 | 9.52 | 0.58 |
| 13200 | 15.76 | 26.48 | 16.44 | 9.69 | 1.81 | 0.82 | 21.94 | 9.66 | 0.55 |
| 13400 | 15.94 | 26.49 | 17.56 | 10.46 | 1.81 | 0.83 | 21.73 | 9.57 | 0.55 |
| 13600 | 16.12 | 26.52 | 18.78 | 11.43 | 1.82 | 0.85 | 23.99 | 9.47 | 0.54 |
| 13800 | 16.29 | 26.59 | 19.75 | 12.49 | 1.83 | 0.86 | 21.51 | 9.72 | 0.53 |
| 14000 | 16.47 | 26.68 | 20.63 | 13.75 | 1.84 | 0.88 | 22.93 | 9.58 | 0.51 |
| 14200 | 16.62 | 26.81 | 20.96 | 15.06 | 1.85 | 0.89 | 21.45 | 9.33 | 0.50 |
| 14400 | 16.75 | 26.97 | 21.10 | 16.36 | 1.87 | 0.90 | 21.99 | 9.38 | 0.51 |
| 14600 | 16.88 | 27.07 | 21.18 | 17.49 | 1.87 | 0.90 | 22.48 | 9.39 | 0.47 |
| 14800 | 17.00 | 27.24 | 20.94 | 18.02 | 1.88 | 0.91 | 21.55 | 9.14 | 0.48 |
| 15000 | 17.11 | 27.38 | 20.63 | 17.97 | 1.89 | 0.91 | 22.96 | 8.89 | 0.47 |
| 15200 | 17.20 | 27.49 | 20.37 | 17.73 | 1.89 | 0.91 | 22.37 | 8.60 | 0.51 |
| 15400 | 17.30 | 27.64 | 20.04 | 17.46 | 1.89 | 0.91 | 21.60 | 8.58 | 0.45 |
| 15600 | 17.39 | 27.81 | 19.71 | 17.14 | 1.91 | 0.91 | 21.92 | 8.80 | 0.50 |
| 15800 | 17.48 | 27.93 | 19.42 | 17.03 | 1.91 | 0.92 | 21.94 | 8.11 | 0.48 |
| 16000 | 17.55 | 27.94 | 19.23 | 16.92 | 1.90 | 0.91 | 21.25 | 8.49 | 0.48 |
| 16200 | 17.62 | 28.05 | 18.71 | 16.62 | 1.90 | 0.92 | 21.13 | 8.52 | 0.50 |
| 16400 | 17.67 | 28.08 | 18.17 | 16.65 | 1.89 | 0.92 | 21.51 | 7.91 | 0.53 |
| 16600 | 17.71 | 28.06 | 17.97 | 16.96 | 1.88 | 0.92 | 20.88 | 7.92 | 0.52 |
| 16800 | 17.73 | 27.87 | 17.81 | 17.50 | 1.85 | 0.92 | 20.53 | 7.40 | 0.54 |
| 17000 | 17.70 | 27.89 | 18.37 | 17.39 | 1.86 | 0.92 | 21.13 | 6.94 | 0.53 |
| 17200 | 17.60 | 27.83 | 19.41 | 16.01 | 1.86 | 0.91 | 20.45 | 6.55 | 0.59 |
| 17400 | 17.44 | 27.77 | 20.65 | 14.05 | 1.86 | 0.90 | 20.48 | 5.68 | 0.63 |
| 17600 | 17.19 | 27.67 | 22.10 | 11.70 | 1.85 | 0.86 | 20.16 | 5.21 | 0.61 |
| 17800 | 16.90 | 27.56 | 21.12 | 9.75 | 1.82 | 0.82 | 19.85 | 5.10 | 0.62 |
| 18000 | 16.53 | 27.51 | 19.48 | 8.23 | 1.80 | 0.78 | 18.92 | 4.57 | 0.60 |

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.25V, Vd = 2.75V, Id = 9mA @ Temperature = -45°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.25 | 25.79 | 11.14 | 7.02 | 1.74 | 0.75 | 18.71 | 7.18 | 0.66 |
| 12200 | 14.44 | 25.79 | 11.81 | 7.47 | 1.76 | 0.76 | 20.03 | 7.29 | 0.68 |
| 12400 | 14.61 | 25.81 | 12.40 | 7.96 | 1.77 | 0.78 | 19.18 | 7.46 | 0.68 |
| 12600 | 14.78 | 25.86 | 12.92 | 8.47 | 1.79 | 0.79 | 18.51 | 7.56 | 0.65 |
| 12800 | 14.94 | 25.86 | 13.56 | 9.04 | 1.79 | 0.81 | 19.08 | 7.63 | 0.64 |
| 13000 | 15.11 | 25.90 | 14.29 | 9.67 | 1.80 | 0.82 | 18.72 | 7.89 | 0.60 |
| 13200 | 15.28 | 25.97 | 15.01 | 10.40 | 1.82 | 0.84 | 19.30 | 7.86 | 0.57 |
| 13400 | 15.45 | 26.02 | 15.93 | 11.30 | 1.83 | 0.85 | 18.74 | 7.92 | 0.58 |
| 13600 | 15.62 | 26.02 | 16.83 | 12.43 | 1.83 | 0.87 | 20.44 | 7.98 | 0.60 |
| 13800 | 15.78 | 26.12 | 17.57 | 13.70 | 1.85 | 0.88 | 18.87 | 8.01 | 0.53 |
| 14000 | 15.94 | 26.24 | 18.23 | 15.18 | 1.86 | 0.89 | 19.45 | 8.03 | 0.53 |
| 14200 | 16.07 | 26.35 | 18.53 | 16.87 | 1.88 | 0.91 | 18.60 | 7.95 | 0.55 |
| 14400 | 16.19 | 26.52 | 18.64 | 18.51 | 1.90 | 0.91 | 18.96 | 7.83 | 0.52 |
| 14600 | 16.29 | 26.66 | 18.73 | 19.76 | 1.91 | 0.92 | 19.32 | 7.76 | 0.53 |
| 14800 | 16.38 | 26.76 | 18.54 | 20.05 | 1.91 | 0.92 | 18.53 | 7.64 | 0.56 |
| 15000 | 16.47 | 26.96 | 18.22 | 19.53 | 1.92 | 0.93 | 18.80 | 7.11 | 0.51 |
| 15200 | 16.54 | 27.06 | 17.94 | 18.88 | 1.92 | 0.93 | 18.77 | 6.80 | 0.54 |
| 15400 | 16.62 | 27.22 | 17.63 | 18.26 | 1.93 | 0.93 | 17.52 | 6.53 | 0.52 |
| 15600 | 16.68 | 27.37 | 17.30 | 17.68 | 1.94 | 0.93 | 17.78 | 6.55 | 0.50 |
| 15800 | 16.74 | 27.49 | 17.02 | 17.33 | 1.95 | 0.93 | 17.62 | 6.14 | 0.50 |
| 16000 | 16.79 | 27.55 | 16.85 | 17.01 | 1.95 | 0.93 | 17.65 | 6.27 | 0.52 |
| 16200 | 16.83 | 27.59 | 16.43 | 16.62 | 1.94 | 0.93 | 17.30 | 6.14 | 0.53 |
| 16400 | 16.85 | 27.64 | 16.05 | 16.53 | 1.94 | 0.93 | 17.31 | 5.65 | 0.57 |
| 16600 | 16.85 | 27.72 | 15.85 | 16.60 | 1.96 | 0.94 | 17.28 | 5.65 | 0.60 |
| 16800 | 16.83 | 27.62 | 15.73 | 16.66 | 1.94 | 0.94 | 15.60 | 5.09 | 0.55 |
| 17000 | 16.76 | 27.66 | 16.06 | 15.90 | 1.95 | 0.94 | 16.02 | 4.74 | 0.59 |
| 17200 | 16.61 | 27.57 | 16.63 | 14.35 | 1.95 | 0.92 | 15.83 | 4.35 | 0.62 |
| 17400 | 16.41 | 27.58 | 17.33 | 12.56 | 1.96 | 0.91 | 15.13 | 3.48 | 0.61 |
| 17600 | 16.13 | 27.48 | 18.15 | 10.60 | 1.95 | 0.87 | 15.00 | 3.08 | 0.63 |
| 17800 | 15.81 | 27.42 | 18.03 | 8.98 | 1.93 | 0.83 | 14.17 | 2.65 | 0.64 |
| 18000 | 15.43 | 27.44 | 17.37 | 7.68 | 1.93 | 0.78 | 13.47 | 2.06 | 0.61 |

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.75V, Vd = 3.25V, Id = 17mA @ Temperature = -45°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.99 | 26.55 | 12.24 | 6.49 | 1.71 | 0.71 | 22.96 | 10.16 | 0.67 |
| 12200 | 15.18 | 26.64 | 13.08 | 6.87 | 1.74 | 0.73 | 24.68 | 10.26 | 0.62 |
| 12400 | 15.35 | 26.61 | 13.81 | 7.27 | 1.74 | 0.74 | 23.76 | 10.44 | 0.62 |
| 12600 | 15.51 | 26.67 | 14.49 | 7.69 | 1.76 | 0.76 | 23.56 | 10.49 | 0.58 |
| 12800 | 15.68 | 26.71 | 15.34 | 8.16 | 1.77 | 0.77 | 23.94 | 10.34 | 0.60 |
| 13000 | 15.86 | 26.71 | 16.33 | 8.66 | 1.78 | 0.79 | 23.61 | 10.50 | 0.53 |
| 13200 | 16.04 | 26.75 | 17.42 | 9.23 | 1.79 | 0.80 | 23.56 | 10.65 | 0.55 |
| 13400 | 16.23 | 26.77 | 18.81 | 9.92 | 1.79 | 0.82 | 23.82 | 10.53 | 0.58 |
| 13600 | 16.41 | 26.83 | 20.31 | 10.78 | 1.80 | 0.83 | 26.32 | 10.37 | 0.55 |
| 13800 | 16.59 | 26.87 | 21.56 | 11.74 | 1.81 | 0.85 | 23.45 | 10.78 | 0.52 |
| 14000 | 16.78 | 26.98 | 22.77 | 12.83 | 1.82 | 0.86 | 25.15 | 10.51 | 0.51 |
| 14200 | 16.94 | 27.09 | 23.16 | 13.98 | 1.83 | 0.88 | 23.38 | 10.13 | 0.51 |
| 14400 | 17.09 | 27.22 | 23.21 | 15.10 | 1.84 | 0.89 | 23.84 | 10.20 | 0.50 |
| 14600 | 17.24 | 27.37 | 23.39 | 16.10 | 1.85 | 0.89 | 24.96 | 10.33 | 0.51 |
| 14800 | 17.37 | 27.51 | 22.98 | 16.66 | 1.86 | 0.90 | 23.62 | 10.08 | 0.51 |
| 15000 | 17.49 | 27.65 | 22.64 | 16.73 | 1.86 | 0.90 | 24.83 | 9.69 | 0.48 |
| 15200 | 17.60 | 27.71 | 22.40 | 16.68 | 1.85 | 0.90 | 23.63 | 9.40 | 0.49 |
| 15400 | 17.72 | 27.92 | 22.01 | 16.54 | 1.87 | 0.90 | 23.70 | 9.48 | 0.49 |
| 15600 | 17.83 | 28.00 | 21.66 | 16.39 | 1.86 | 0.90 | 24.93 | 10.00 | 0.47 |
| 15800 | 17.93 | 28.13 | 21.32 | 16.42 | 1.87 | 0.90 | 23.29 | 9.13 | 0.50 |
| 16000 | 18.03 | 28.24 | 21.15 | 16.41 | 1.87 | 0.90 | 24.26 | 9.76 | 0.53 |
| 16200 | 18.12 | 28.24 | 20.43 | 16.22 | 1.85 | 0.90 | 23.68 | 9.71 | 0.50 |
| 16400 | 18.19 | 28.22 | 19.76 | 16.30 | 1.83 | 0.90 | 23.22 | 9.10 | 0.55 |
| 16600 | 18.25 | 28.20 | 19.64 | 16.74 | 1.82 | 0.91 | 23.05 | 9.11 | 0.54 |
| 16800 | 18.30 | 28.11 | 19.48 | 17.58 | 1.80 | 0.91 | 23.39 | 8.74 | 0.55 |
| 17000 | 18.31 | 27.98 | 20.36 | 18.14 | 1.78 | 0.91 | 21.82 | 8.18 | 0.57 |
| 17200 | 18.24 | 27.93 | 21.88 | 17.21 | 1.78 | 0.90 | 23.39 | 7.65 | 0.57 |
| 17400 | 18.12 | 27.76 | 24.22 | 15.34 | 1.77 | 0.89 | 20.52 | 6.77 | 0.65 |
| 17600 | 17.90 | 27.63 | 26.64 | 12.68 | 1.75 | 0.86 | 20.72 | 6.34 | 0.61 |
| 17800 | 17.63 | 27.65 | 23.51 | 10.44 | 1.75 | 0.82 | 23.75 | 6.43 | 0.63 |
| 18000 | 17.28 | 27.61 | 20.34 | 8.71 | 1.73 | 0.78 | 22.70 | 6.06 | 0.59 |

## Typical Performance Data

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.50V, Vd = 3.00V, Id = 14mA @ Temperature = +85°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 13.97 | 26.27 | 11.65 | 7.72 | 1.98 | 0.79 | 22.46 | 8.59 | 1.68 |
| 12200 | 14.16 | 26.28 | 12.19 | 8.12 | 1.98 | 0.81 | 23.40 | 8.81 | 1.67 |
| 12400 | 14.33 | 26.35 | 12.76 | 8.59 | 2.00 | 0.82 | 23.37 | 8.98 | 1.65 |
| 12600 | 14.49 | 26.41 | 13.31 | 9.12 | 2.02 | 0.83 | 21.81 | 9.03 | 1.63 |
| 12800 | 14.66 | 26.37 | 13.98 | 9.75 | 2.02 | 0.85 | 23.05 | 8.92 | 1.61 |
| 13000 | 14.83 | 26.41 | 14.72 | 10.48 | 2.03 | 0.86 | 22.12 | 9.04 | 1.58 |
| 13200 | 14.99 | 26.47 | 15.44 | 11.32 | 2.04 | 0.87 | 22.92 | 9.29 | 1.61 |
| 13400 | 15.15 | 26.53 | 16.29 | 12.38 | 2.06 | 0.89 | 22.87 | 9.19 | 1.58 |
| 13600 | 15.31 | 26.60 | 17.15 | 13.71 | 2.07 | 0.90 | 24.86 | 8.93 | 1.57 |
| 13800 | 15.46 | 26.75 | 17.90 | 15.18 | 2.10 | 0.92 | 23.04 | 9.29 | 1.54 |
| 14000 | 15.60 | 26.80 | 18.62 | 17.13 | 2.11 | 0.93 | 23.09 | 9.11 | 1.55 |
| 14200 | 15.73 | 27.03 | 19.01 | 19.43 | 2.14 | 0.94 | 22.44 | 8.70 | 1.55 |
| 14400 | 15.84 | 27.10 | 19.28 | 22.11 | 2.15 | 0.94 | 22.75 | 8.74 | 1.54 |
| 14600 | 15.94 | 27.29 | 19.24 | 24.19 | 2.17 | 0.95 | 23.64 | 8.82 | 1.50 |
| 14800 | 16.02 | 27.42 | 18.88 | 23.90 | 2.18 | 0.95 | 22.02 | 8.55 | 1.52 |
| 15000 | 16.08 | 27.58 | 18.47 | 22.16 | 2.19 | 0.95 | 24.04 | 8.28 | 1.50 |
| 15200 | 16.13 | 27.80 | 17.86 | 20.44 | 2.22 | 0.96 | 23.56 | 8.10 | 1.53 |
| 15400 | 16.17 | 27.96 | 17.09 | 19.05 | 2.24 | 0.96 | 22.69 | 8.08 | 1.49 |
| 15600 | 16.19 | 28.10 | 16.38 | 18.04 | 2.25 | 0.96 | 23.02 | 8.40 | 1.53 |
| 15800 | 16.21 | 28.20 | 15.76 | 17.50 | 2.26 | 0.96 | 22.69 | 7.73 | 1.52 |
| 16000 | 16.21 | 28.22 | 15.19 | 17.44 | 2.26 | 0.96 | 22.29 | 8.06 | 1.56 |
| 16200 | 16.20 | 28.40 | 14.70 | 17.50 | 2.30 | 0.97 | 22.18 | 8.05 | 1.57 |
| 16400 | 16.17 | 28.45 | 14.56 | 17.78 | 2.32 | 0.97 | 20.96 | 7.40 | 1.59 |
| 16600 | 16.11 | 28.41 | 14.58 | 18.09 | 2.33 | 0.98 | 23.00 | 7.32 | 1.60 |
| 16800 | 16.02 | 28.41 | 14.72 | 17.76 | 2.35 | 0.98 | 21.01 | 6.88 | 1.64 |
| 17000 | 15.86 | 28.35 | 15.15 | 16.28 | 2.36 | 0.97 | 20.40 | 6.43 | 1.62 |
| 17200 | 15.63 | 28.30 | 15.70 | 14.23 | 2.38 | 0.95 | 20.81 | 5.91 | 1.69 |
| 17400 | 15.35 | 28.35 | 16.21 | 12.25 | 2.42 | 0.93 | 19.74 | 5.16 | 1.68 |
| 17600 | 15.02 | 28.38 | 16.35 | 10.53 | 2.45 | 0.90 | 20.50 | 4.79 | 1.73 |
| 17800 | 14.64 | 28.29 | 15.96 | 9.16 | 2.44 | 0.87 | 19.98 | 4.71 | 1.74 |
| 18000 | 14.22 | 28.16 | 15.49 | 8.07 | 2.44 | 0.83 | 19.10 | 4.30 | 1.73 |

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.25V, Vd = 2.75V, Id = 10mA @ Temperature = +85°C

| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 13.51 | 25.75 | 11.05 | 8.04 | 1.98 | 0.81 | 20.85 | 7.16 | 1.74 |
| 12200 | 13.69 | 25.74 | 11.57 | 8.50 | 1.98 | 0.82 | 21.99 | 7.39 | 1.75 |
| 12400 | 13.86 | 25.81 | 12.09 | 9.03 | 2.00 | 0.84 | 21.03 | 7.55 | 1.67 |
| 12600 | 14.02 | 25.84 | 12.61 | 9.64 | 2.01 | 0.85 | 20.83 | 7.63 | 1.69 |
| 12800 | 14.19 | 25.82 | 13.22 | 10.36 | 2.02 | 0.87 | 21.24 | 7.69 | 1.72 |
| 13000 | 14.35 | 25.90 | 13.90 | 11.20 | 2.04 | 0.88 | 20.78 | 7.80 | 1.68 |
| 13200 | 14.50 | 25.97 | 14.56 | 12.19 | 2.06 | 0.89 | 21.12 | 7.91 | 1.69 |
| 13400 | 14.65 | 26.06 | 15.34 | 13.46 | 2.08 | 0.91 | 20.84 | 7.96 | 1.68 |
| 13600 | 14.81 | 26.07 | 16.11 | 15.05 | 2.08 | 0.92 | 23.35 | 7.80 | 1.65 |
| 13800 | 14.94 | 26.20 | 16.77 | 16.91 | 2.10 | 0.93 | 20.63 | 8.09 | 1.61 |
| 14000 | 15.06 | 26.34 | 17.42 | 19.43 | 2.13 | 0.94 | 23.01 | 7.95 | 1.64 |
| 14200 | 15.17 | 26.44 | 17.79 | 22.61 | 2.14 | 0.95 | 20.66 | 7.67 | 1.60 |
| 14400 | 15.25 | 26.67 | 18.00 | 26.13 | 2.18 | 0.95 | 21.22 | 7.68 | 1.60 |
| 14600 | 15.33 | 26.82 | 18.01 | 26.76 | 2.19 | 0.96 | 21.16 | 7.61 | 1.55 |
| 14800 | 15.38 | 26.97 | 17.71 | 23.88 | 2.21 | 0.96 | 20.40 | 7.45 | 1.60 |
| 15000 | 15.43 | 27.18 | 17.35 | 21.28 | 2.24 | 0.96 | 20.98 | 7.04 | 1.59 |
| 15200 | 15.45 | 27.39 | 16.75 | 19.48 | 2.27 | 0.96 | 20.38 | 6.84 | 1.56 |
| 15400 | 15.47 | 27.45 | 16.08 | 18.25 | 2.26 | 0.96 | 19.03 | 6.60 | 1.58 |
| 15600 | 15.46 | 27.65 | 15.42 | 17.38 | 2.30 | 0.97 | 19.20 | 6.72 | 1.57 |
| 15800 | 15.46 | 27.74 | 14.82 | 16.89 | 2.31 | 0.97 | 19.07 | 6.23 | 1.62 |
| 16000 | 15.43 | 27.85 | 14.31 | 16.81 | 2.33 | 0.97 | 19.20 | 6.44 | 1.64 |
| 16200 | 15.40 | 27.97 | 13.84 | 16.80 | 2.36 | 0.98 | 18.37 | 6.29 | 1.66 |
| 16400 | 15.33 | 27.99 | 13.68 | 16.84 | 2.38 | 0.98 | 18.38 | 5.74 | 1.69 |
| 16600 | 15.24 | 28.02 | 13.64 | 16.76 | 2.41 | 0.99 | 18.44 | 5.66 | 1.66 |
| 16800 | 15.12 | 27.97 | 13.72 | 16.14 | 2.42 | 0.98 | 16.47 | 5.17 | 1.72 |
| 17000 | 14.92 | 28.02 | 14.01 | 14.71 | 2.46 | 0.97 | 16.70 | 4.70 | 1.74 |
| 17200 | 14.66 | 28.06 | 14.39 | 12.95 | 2.51 | 0.96 | 16.63 | 4.31 | 1.76 |
| 17400 | 14.36 | 28.05 | 14.73 | 11.24 | 2.54 | 0.93 | 15.82 | 3.55 | 1.80 |
| 17600 | 14.00 | 27.94 | 14.83 | 9.72 | 2.53 | 0.90 | 15.51 | 3.14 | 1.84 |
| 17800 | 13.61 | 27.90 | 14.55 | 8.54 | 2.54 | 0.86 | 14.69 | 2.73 | 1.82 |
| 18000 | 13.18 | 27.89 | 14.21 | 7.56 | 2.56 | 0.83 | 13.78 | 2.28 | 1.82 |

## *Typical Performance Data*

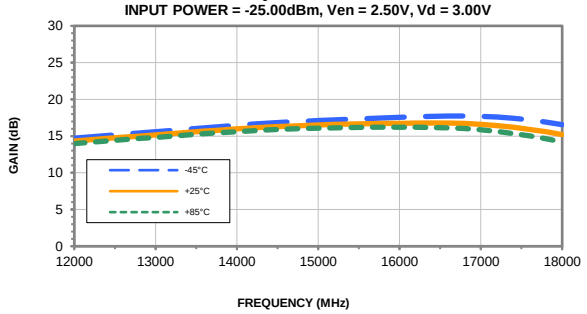
**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Ven = 2.75V, Vd = 3.25V, Id = 17mA @ Temperature = +85°C

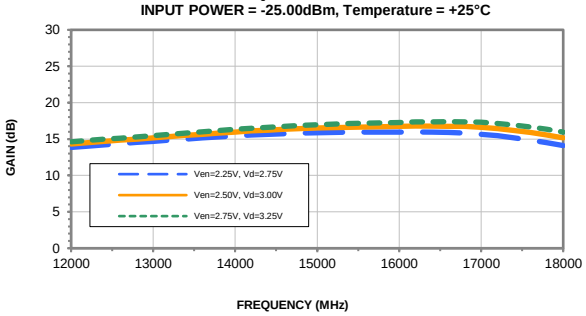
| FREQ | Gain | Isolation | Input Return Loss | Output Return Loss | Stability | | IP-3 Output | 1dB Comp. Output | Noise Figure |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | (dB) | (dB) | (dB) | K | Measure | (dBm) | (dBm) | (dB) |
| 12000 | 14.28 | 26.66 | 12.11 | 7.43 | 1.97 | 0.78 | 24.14 | 9.70 | 1.62 |
| 12200 | 14.47 | 26.64 | 12.69 | 7.80 | 1.97 | 0.79 | 23.40 | 9.78 | 1.63 |
| 12400 | 14.64 | 26.69 | 13.31 | 8.23 | 1.99 | 0.80 | 23.43 | 9.94 | 1.60 |
| 12600 | 14.81 | 26.74 | 13.91 | 8.70 | 2.00 | 0.82 | 23.01 | 9.98 | 1.60 |
| 12800 | 14.98 | 26.79 | 14.64 | 9.28 | 2.02 | 0.83 | 23.88 | 9.70 | 1.59 |
| 13000 | 15.16 | 26.85 | 15.44 | 9.92 | 2.03 | 0.84 | 23.06 | 9.94 | 1.57 |
| 13200 | 15.32 | 26.92 | 16.25 | 10.68 | 2.05 | 0.86 | 24.02 | 10.09 | 1.56 |
| 13400 | 15.49 | 27.00 | 17.22 | 11.63 | 2.07 | 0.88 | 24.05 | 9.96 | 1.55 |
| 13600 | 15.67 | 26.96 | 18.22 | 12.77 | 2.06 | 0.89 | 24.96 | 9.67 | 1.56 |
| 13800 | 15.83 | 27.13 | 19.08 | 14.05 | 2.09 | 0.90 | 23.26 | 10.06 | 1.52 |
| 14000 | 15.99 | 27.20 | 19.92 | 15.68 | 2.10 | 0.91 | 24.15 | 9.74 | 1.51 |
| 14200 | 16.13 | 27.39 | 20.38 | 17.54 | 2.13 | 0.93 | 23.53 | 9.42 | 1.50 |
| 14400 | 16.26 | 27.52 | 20.66 | 19.65 | 2.14 | 0.93 | 23.36 | 9.36 | 1.50 |
| 14600 | 16.37 | 27.64 | 20.66 | 21.39 | 2.15 | 0.94 | 24.09 | 9.46 | 1.51 |
| 14800 | 16.47 | 27.82 | 20.23 | 21.97 | 2.17 | 0.94 | 22.80 | 9.18 | 1.49 |
| 15000 | 16.55 | 28.02 | 19.73 | 21.20 | 2.19 | 0.95 | 24.74 | 8.90 | 1.47 |
| 15200 | 16.62 | 28.12 | 19.03 | 19.98 | 2.19 | 0.95 | 23.46 | 8.61 | 1.49 |
| 15400 | 16.68 | 28.37 | 18.19 | 18.80 | 2.23 | 0.95 | 23.39 | 8.76 | 1.47 |
| 15600 | 16.71 | 28.43 | 17.40 | 17.77 | 2.22 | 0.95 | 24.57 | 9.25 | 1.48 |
| 15800 | 16.76 | 28.60 | 16.73 | 17.29 | 2.24 | 0.95 | 22.70 | 8.32 | 1.49 |
| 16000 | 16.78 | 28.68 | 16.10 | 17.19 | 2.25 | 0.95 | 23.72 | 8.85 | 1.52 |
| 16200 | 16.79 | 28.75 | 15.62 | 17.31 | 2.26 | 0.96 | 22.18 | 8.87 | 1.52 |
| 16400 | 16.78 | 28.79 | 15.49 | 17.73 | 2.27 | 0.96 | 22.93 | 8.20 | 1.56 |
| 16600 | 16.75 | 28.67 | 15.54 | 18.42 | 2.26 | 0.96 | 23.37 | 8.13 | 1.59 |
| 16800 | 16.69 | 28.58 | 15.75 | 18.62 | 2.25 | 0.96 | 22.64 | 7.72 | 1.61 |
| 17000 | 16.56 | 28.53 | 16.34 | 17.44 | 2.27 | 0.96 | 21.53 | 7.19 | 1.60 |
| 17200 | 16.35 | 28.52 | 17.04 | 15.28 | 2.30 | 0.95 | 21.00 | 6.65 | 1.65 |
| 17400 | 16.10 | 28.54 | 17.75 | 13.08 | 2.33 | 0.93 | 21.08 | 5.90 | 1.71 |
| 17600 | 15.78 | 28.50 | 17.89 | 11.16 | 2.34 | 0.90 | 21.63 | 5.55 | 1.68 |
| 17800 | 15.42 | 28.32 | 17.37 | 9.64 | 2.31 | 0.87 | 24.40 | 5.65 | 1.71 |
| 18000 | 15.00 | 28.16 | 16.67 | 8.44 | 2.30 | 0.83 | 23.30 | 5.38 | 1.69 |

## *Typical Performance Curves*

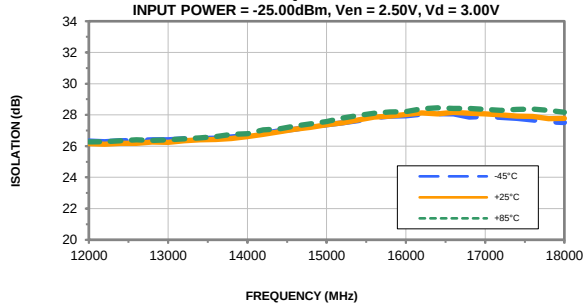
GAIN vs. FREQUENCY & TEMPERATURE
INPUT POWER = -25.00dBm, Ven = 2.50V, Vd = 3.00V



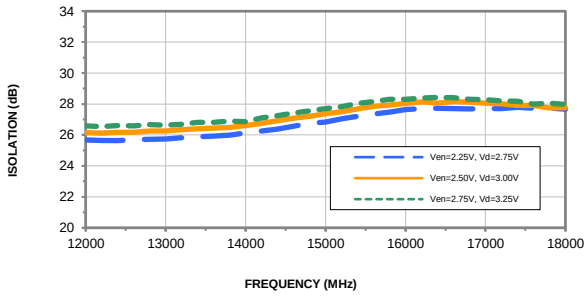

GAIN vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



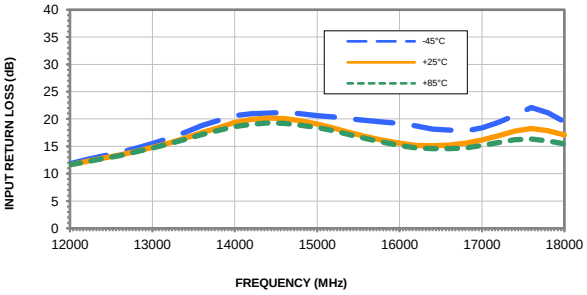

ISOLATION vs. FREQUENCY & TEMPERATURE
INPUT POWER = -25.00dBm, Ven = 2.50V, Vd = 3.00V



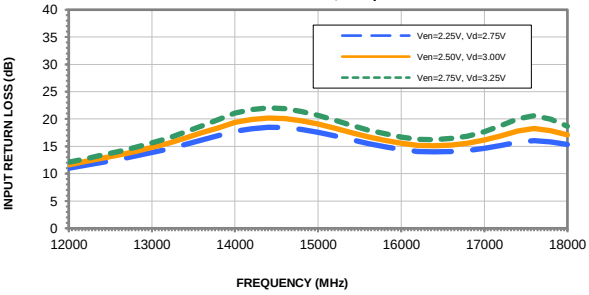

ISOLATION vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C



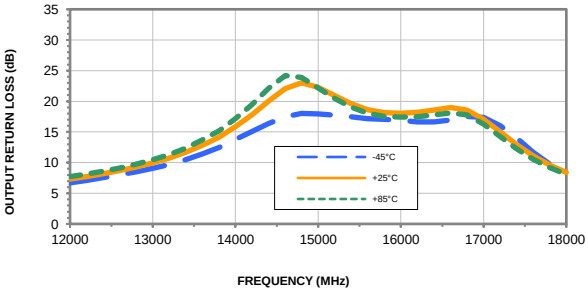

INPUT RETURN LOSS vs. FREQUENCY & TEMPERATURE
INPUT POWER = -25.00dBm, Ven = 2.50V, Vd = 3.00V



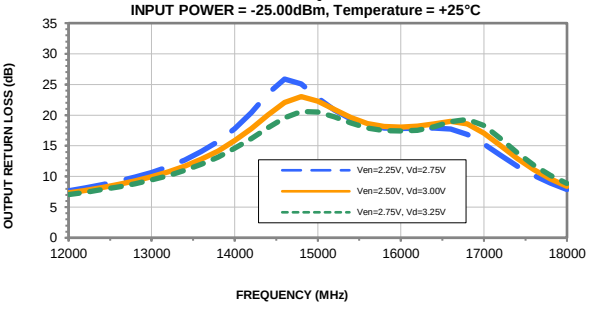

INPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C




OUTPUT RETURN LOSS vs. FREQUENCY & TEMPERATURE
INPUT POWER = -25.00dBm, Ven = 2.50V, Vd = 3.00V

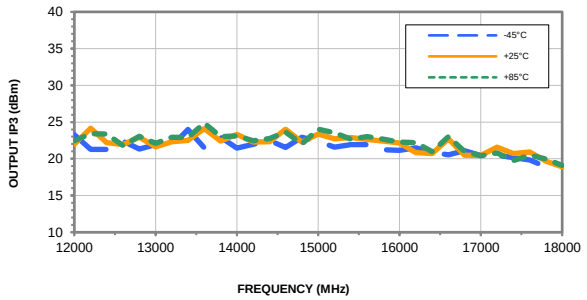



OUTPUT RETURN LOSS vs. FREQUENCY & DEVICE VOLTAGE
INPUT POWER = -25.00dBm, Temperature = +25°C

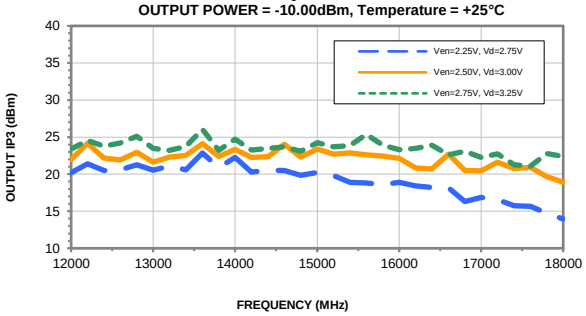


## *Typical Performance Curves*

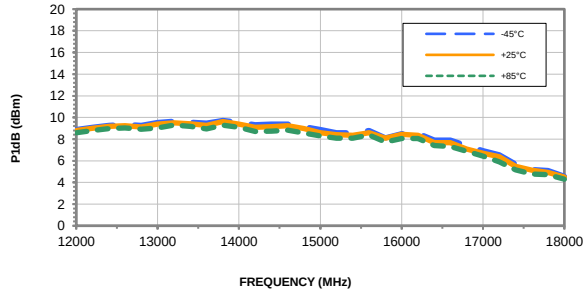
**OUTPUT IP3 vs. FREQUENCY & TEMPERATURE**
**OUTPUT POWER = -10.00dBm, Ven = 2.50V, Vd = 3.00V**



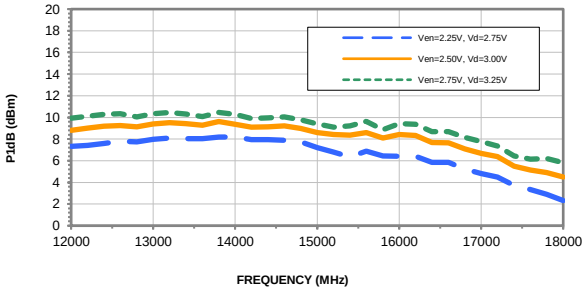

**OUTPUT IP3 vs. FREQUENCY & DEVICE VOLTAGE**
**OUTPUT POWER = -10.00dBm, Temperature = +25°C**



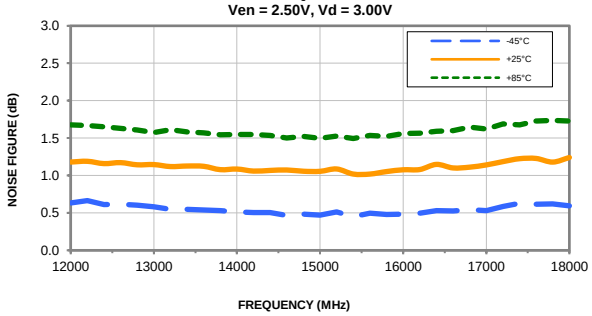

**P1dB vs. FREQUENCY & TEMPERATURE**
**Ven = 2.50V, Vd = 3.00V**



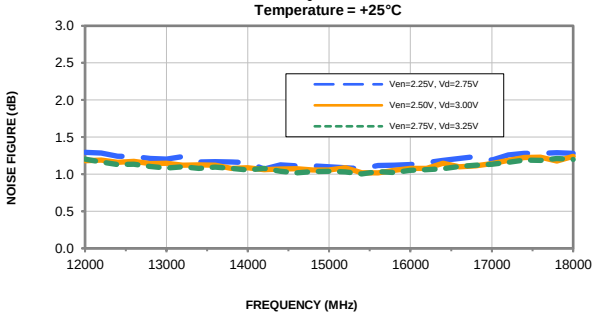

**P1dB vs. FREQUENCY & DEVICE VOLTAGE**
**Temperature = +25°C**



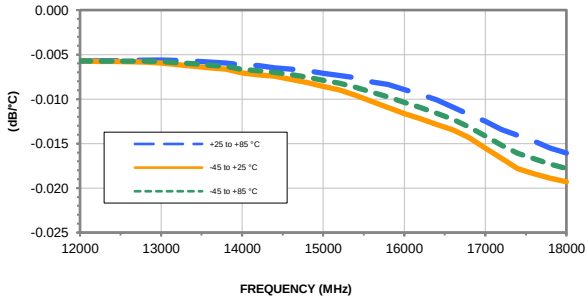

**NOISE FIGURE vs. FREQUENCY & TEMPERATURE**
**Ven = 2.50V, Vd = 3.00V**




**NOISE FIGURE vs. FREQUENCY & DEVICE VOLTAGE**
**Temperature = +25°C**




**GAIN VARIANTS VS FREQUENCY & TEMPERATURE**
**INPUT POWER = -25.00dBm, Ven = 2.50V, Vd = 3.00V**

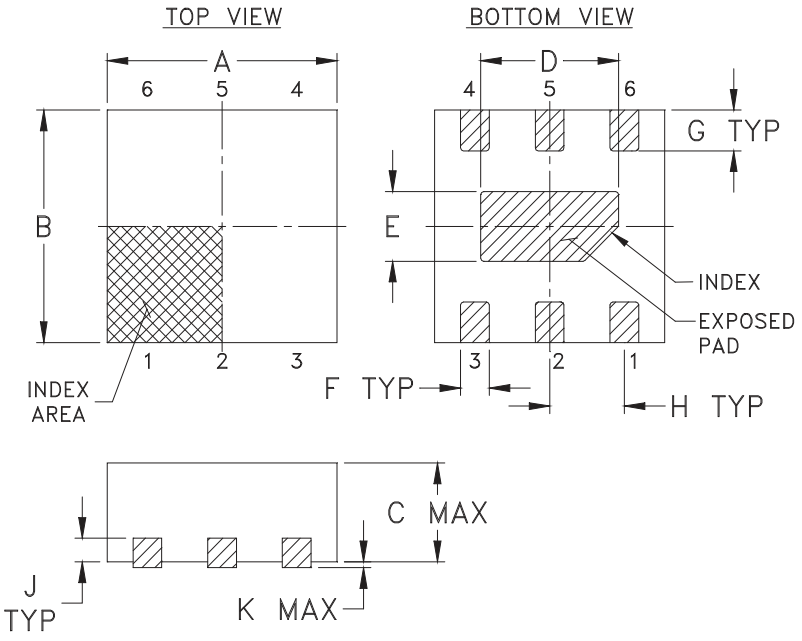


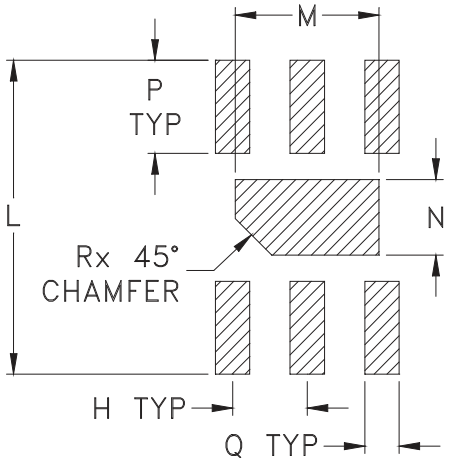
# Case Style MC

**MC1630-1**

## Outline Dimensions

**PCB Land Pattern**




Suggested Layout,
Tolerance to be within ±.002

| CASE #. | A | B | C | D | E | F | G | H | J | K | L | M | N | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MC1630-1 | .079 (2.00) | .079 (2.00) | .039 (1.00) | .047 (1.20) | .024 (.60) | .010 (.25) | .014 (.35) | .026 (.65) | .008 (.20) | .002 (.05) | .106 (2.70) | .049 (1.25) | .026 (.65) | .031 (.80) |

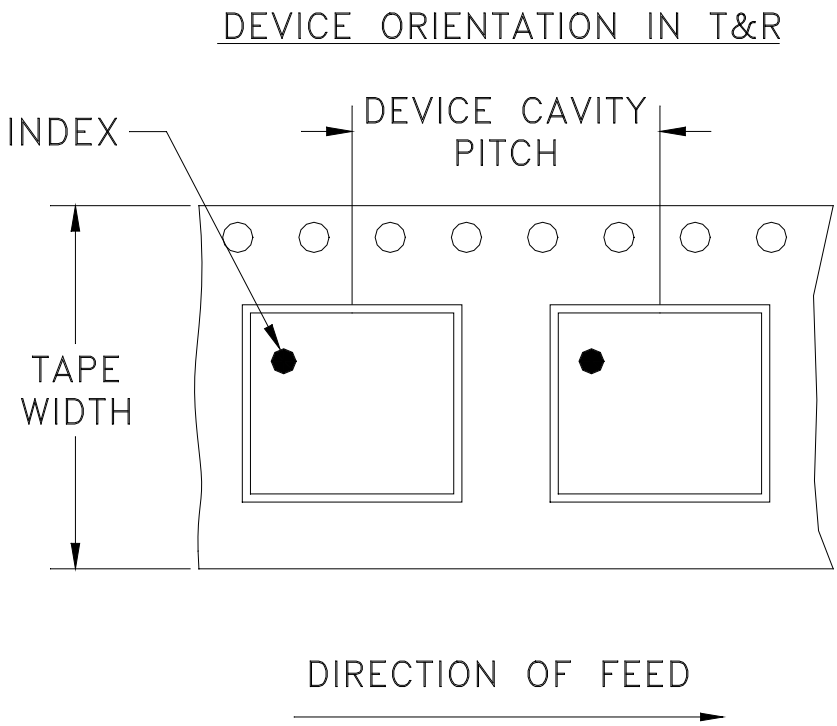
| CASE #. | Q | R | WT, GRAM |
|---|---|---|---|
| MC1630-1 | .012 (.30) | .012 (.30) | .006 |

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

**Notes:**

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin-Silver over Nickel plated or Matte-Tin plated (See Data sheet).
   All models, (+) suffix.
3. Lead #1 identifier shall be located in the cross-hatched area shown.
   Identifier may be either a molded or marked feature.

# Tape & Reel Packaging TR-F66




| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel see note | |
|---|---|---|---|---|
| 8 | 4 | 7 | Small quantity standard | 20 |
| | | | | 50 |
| | | | | 100 |
| | | | | 200 |
| | | | | 500 |
| | | 7 | Standard | 1000, 2000, 3000 |

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

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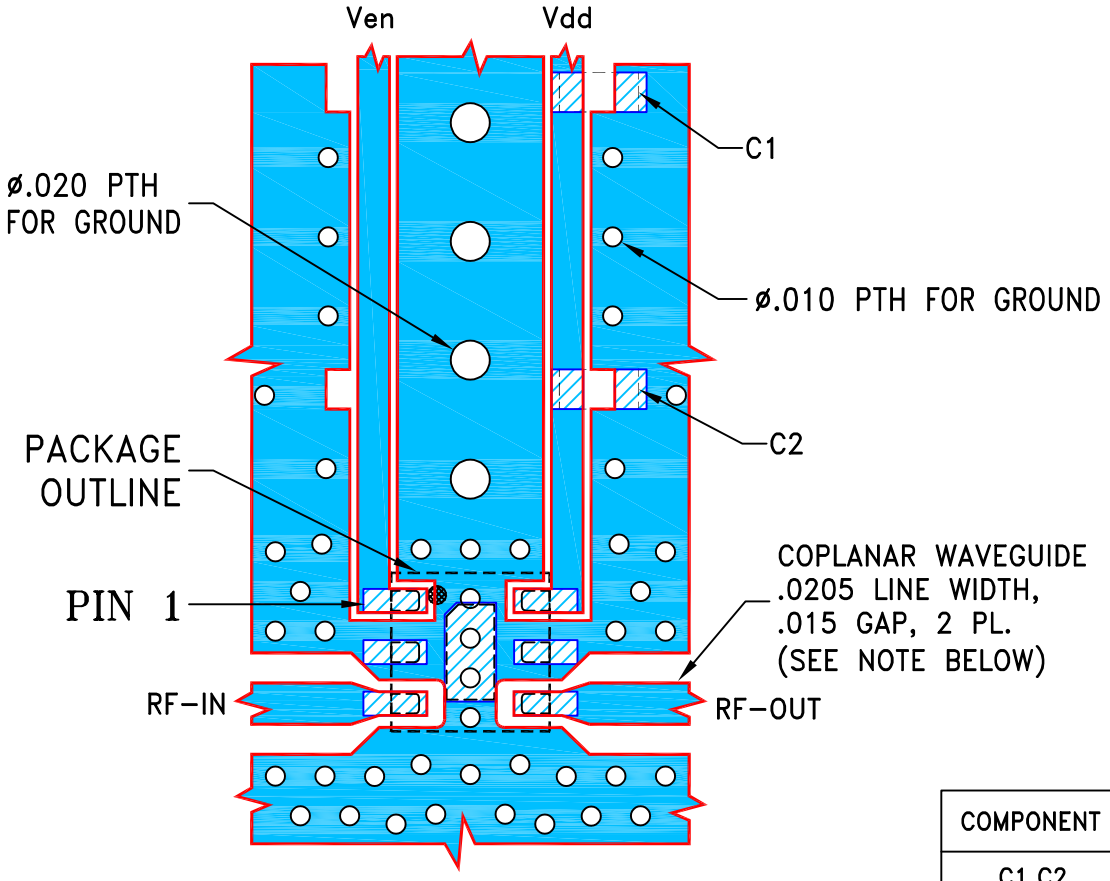
THIRD ANGLE PROJECTION

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | ECO-011113 | NEW RELEASE | 12/16/21 | ITG | IL |
| | | | | | |
| | | | | | |
| | | | | | |

# SUGGESTED MOUNTING CONFIGURATION FOR MC1630-1 CASE STYLE




| COMPONENT | SIZE |
|---|---|
| C1,C2 | 0402 |

NOTES:

1. TRACE WIDTH AND GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010";
   COPPER: 1/2 OZ. EACH SIDE.
   FOR OTHER MATERIALS LINE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. CHIP COMPONENT FOOT PRINTS SHOWN FOR REFERENCE. FOR COMPONENT VALUES REFER TO TB-TSY-173LN+.
3. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

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

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

| UNLESS OTHERWISE SPECIFIED | | INITIALS | DATE |
|---|---|---|---|
| DIMENSIONS ARE IN INCHES | DRAWN | ITG | 12/16/21 |
| TOLERANCES ON: | CHECKED | GF | 12/16/21 |
| 2 PL DECIMALS ± | APPROVED | IL | 12/16/21 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± | | | |
| FRACTIONS ± | | | |

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

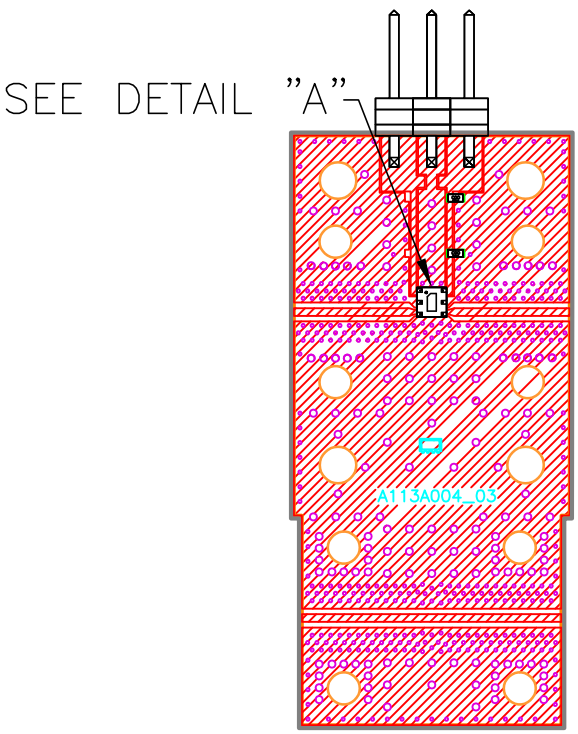
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

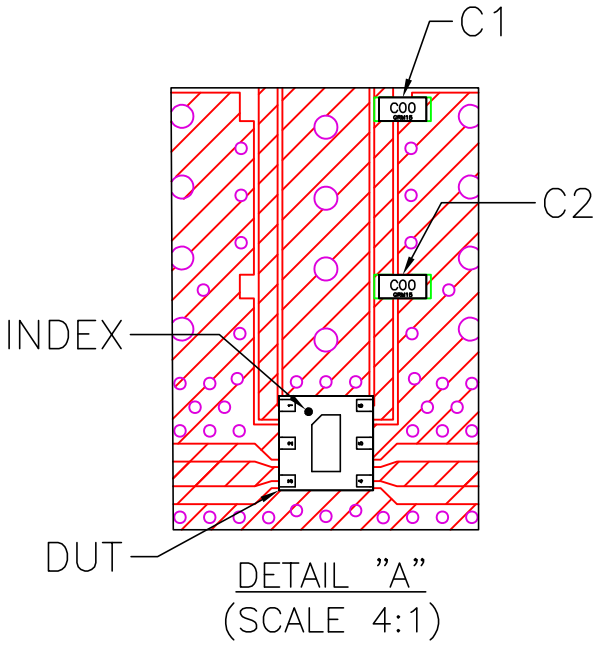
PL, MC1630-1, TB-TSY-173LN+/173LNC+

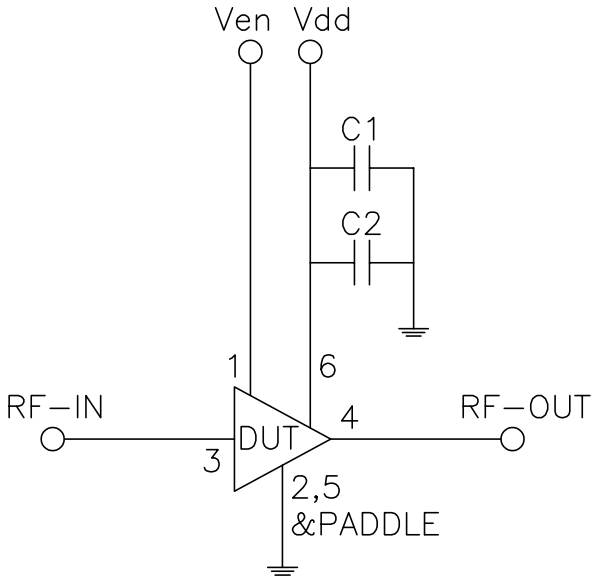
| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-719 | OR |

| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL719 | 10:1 | 1 OF 1 |

# Evaluation Board and Circuit




SCHEMATIC DIAGRAM

| Component | Size | Value | Part Number | Manufacturer |
|---|---|---|---|---|
| C1 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |
| C2 | 0402 | 100pF | GRM1555C1H101JA01D | Murata |

NOTES:

1. PCB Material: Roger RO4350B or equivalent, Dielectric constant=3.5, Thickness=0.010 inch

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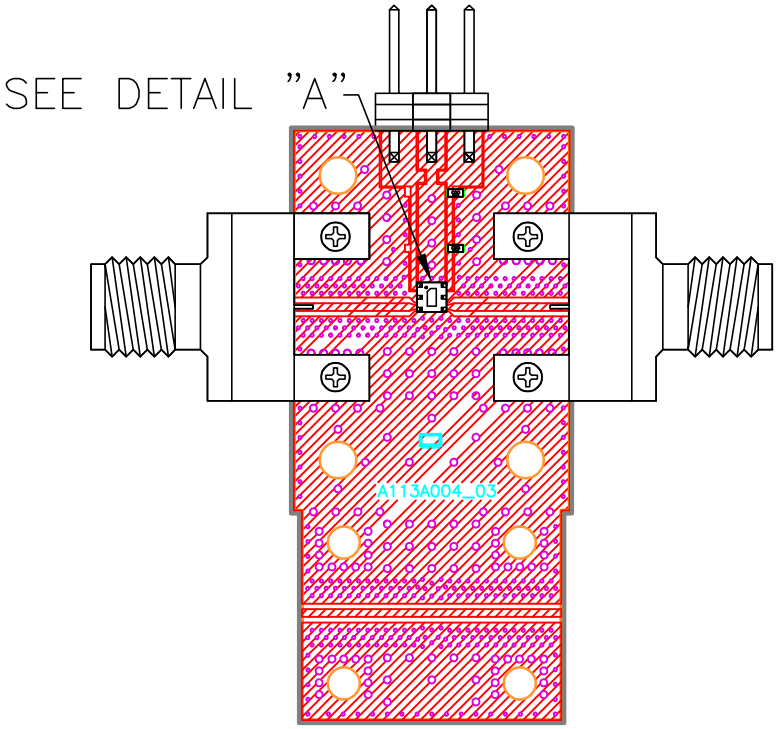
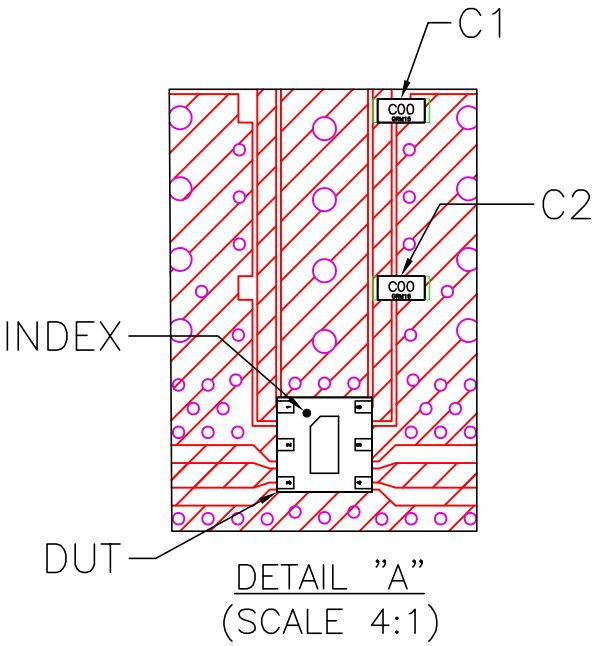
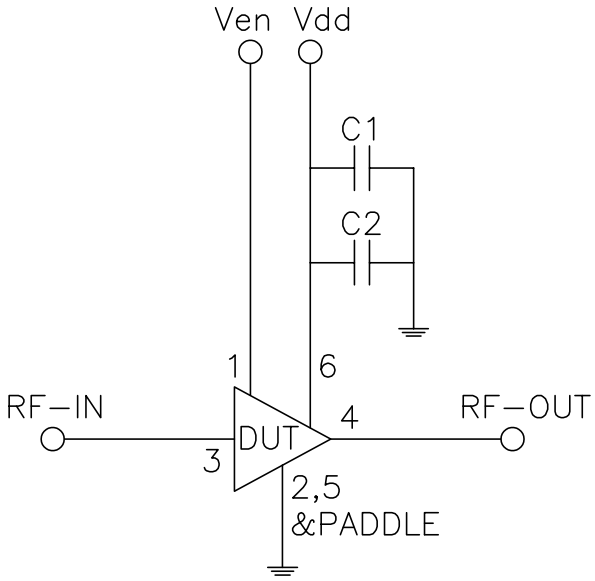
# Evaluation Board and Circuit




SCHEMATIC DIAGRAM

| Component | Size | Value | Part Number | Manufacturer |
|---|---|---|---|---|
| C1 | 0402 | 0.1uF | GRM155R71C104KA88D | Murata |
| C2 | 0402 | 100pF | GRM1555C1H101JA01D | Murata |

NOTES:

1. 2.92mm Female Connectors.
2. PCB Material: Roger RO4350B or equivalent, Dielectric constant=3.5, Thickness=0.010 inch

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# Environmental Specifications ENV08T1

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

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

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

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