



## MMIC SURFACE MOUNT

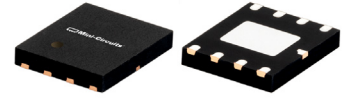
# Dual Matched Amplifier

# PHA-22+

50Ω 0.05 to 1.5 GHz

### THE BIG DEAL

- Dual matched amplifier for push-pull & balanced amplifiers
- High IP2 and IP3
- Gain, 16 dB typ. at 0.8 GHz
- P1dB, +22 dBm typ. at 0.8 GHz
- Low noise figure, 1.8 dB typ. at 0.8 GHz
- Two matched amplifiers in one package
- May be used as a replacement to WJ AH22<sup>a,b</sup>



Generic photo used for illustration purposes only

CASE STYLE: DL1020

### +RoHS Compliant

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

### APPLICATIONS

- CATV
- FTTH
- Optical networks
- Base station infrastructure
- Balanced amplifiers
- 75 Ohm push-pull and balanced amplifiers

### PRODUCT OVERVIEW

Mini-Circuits PHA-22+ is a dual matched wideband amplifier fabricated using advanced E-PHEMT\* technology, offering high dynamic range (High IP3 and Low NF) for use in 50 and 75 ohm applications. Exceptionally high IP2 has been demonstrated in wideband 50 and 75 ohm amplifiers evaluation boards. Combining this with low noise figure to enable it for use in exceptionally high dynamic range amplifiers.

### KEY FEATURES

| Feature   | Advantages  |
|---|---|
| Broadband   | Covers Cable TV band and communication bands such as Cellular, Cable TV, PCS, WiMAX etc.  |
| Matched pair for use in exceptionally high IP2 amplifiers | Typical gain match of 0.2 dB and phase match of 1.6 deg. enables it to be used in push-pull amplifiers. Outstanding IP2.          |
| High IP3, up to +43 dBm                                   | Ideal for suppressing unwanted intermods in the presence of multi carriers, which is common in present day communication systems. |
| Low Noise Figure: 1.8 dB typical                          | Compare this to the competitors, which is in the range of 4-6 dB. Mini-Circuits amplifier improves the dynamic range.             |
| High P1dB: +22 dBm  | High P1dB enables the amplifier to operate in linear region in the presence of strong interfering signals.                        |

\* Enhancement mode pseudomorphic High Electron Mobility Transistor.

a. Suitability for model replacement within a particular system must be determined by and is solely the responsibility of the customer based on, among other things, electrical performance criteria, stimulus conditions, application, compatibility with other components and environmental conditions and stresses.

b. The WJ part number is used for identification and comparison purposes only.

REV. C  
ECO-010399  
PHA-22+  
MCL NY  
240722



**ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, Z<sub>0</sub>=50Ω AND DEVICE VOLTAGE +5V, UNLESS NOTED OTHERWISE**

(Specifications (other than Matching or where defined as push-pull) are for each of the two matched amplifiers in the package)

| Parameter  | Condition (GHz)     | Min.  | Typ.  | Max. | Units |
|--|---------------------|-------|-------|------|-------|
| Frequency Range  |                     | 0.05  |       | 1.5  | GHz   |
| Gain   | 0.05                | —     | 17.7  | —    | dB    |
|  | 0.8                 | 14.5  | 16.1  | 17.7 |       |
|  | 1.5                 | —     | 15.4  | —    |       |
| Input Return Loss  | 0.05                |       | 11.3  |      | dB    |
|  | 0.8                 |       | 17.0  |      |       |
|  | 1.5                 |       | 11.7  |      |       |
| Output Return Loss                                       | 0.05                |       | 14.1  |      | dB    |
|  | 0.8                 |       | 18.8  |      |       |
|  | 1.5                 |       | 13.1  |      |       |
| Output Power @1 dB compression <sup>2</sup>              | 0.05                |       | +22.4 |      | dBm   |
|  | 0.8                 |       | +22.5 |      |       |
|  | 1.5                 |       | +22.5 |      |       |
| Output IP3 <sup>6</sup>                                  | 0.05                | —     | +41.4 |      | dBm   |
|  | 0.8                 | +37.0 | +41.5 |      |       |
|  | 1.5                 | —     | +42.9 |      |       |
| Noise Figure   | 0.05                |       | 1.8   |      | dB    |
|  | 0.8                 |       | 1.8   |      |       |
|  | 1.5                 |       | 2.0   |      |       |
| Matching between A1, A2                                  | Amplitude Unbalance | 0.05  | 0.11  | —    | dB    |
|  |                     | 0.8   | 0.12  | 0.6  |       |
|  |                     | 1.5   | 0.22  | —    |       |
|  | Phase Unbalance     | 0.05  | 0.3   | —    | deg.  |
|  |                     | 0.8   | 1.0   | 5.0  |       |
|  |                     | 1.5   | 1.6   | —    |       |
| Device Operating Voltage                                 |                     | +4.8  | +5.0  | +5.2 | V     |
| Device Operating Current (each amplifier)                |                     | 110   | 146   | 180  | mA    |
| Device Current Variation vs. Temperature                 |                     |       | 23    |      | μA/°C |
| Device Current Variation vs Voltage                      |                     |       | 0.053 |      | mA/mV |
| Thermal Resistance, junction-to-ground lead <sup>7</sup> |                     |       | 34    |      | °C/W  |

**ABSOLUTE MAXIMUM RATINGS<sup>4</sup>**

| Parameter                            | Ratings        |
|--------------------------------------|----------------|
| Operating Temperature <sup>5</sup>   | -40°C to 85°C  |
| Storage Temperature                  | -55°C to 150°C |
| Operating Current at 5V <sup>6</sup> | 200 mA         |
| Power Dissipation <sup>6</sup>       | 1000 mW        |
| Input Power (CW)                     | +24 dBm        |
| DC Voltage (pads 5,8)                | +6 V           |

**PUSH-PULL AMPLIFIER TYPICAL PERFORMANCE<sup>3</sup>**

| Frequency (GHz) | TB-566-75+ (75Ω) |                  |                  | TB-566-50+ (50Ω) |                  |                  |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                 | Gain (dB)        | Output IP3 (dBm) | Output IP2 (dBm) | Gain (dB)        | Output IP3 (dBm) | Output IP2 (dBm) |
| 0.05            | 14.2             | 45.0             | 79.0             | 15.2             | 45.0             | 82.0             |
| 0.25            | 13.7             | 43.0             | 79.0             | 13.8             | 45.0             | 84.0             |
| 0.45            | 14.0             | 42.0             | 81.0             | 13.8             | 44.0             | 81.0             |
| 0.85            | 14.1             | 43.0             | 72.0             | 13.0             | 44.0             | 76.0             |
| 1.20            | 13.8             | 40.6             | 78.0             | 12.0             | 43.0             | 72.0             |
| 1.30            | 13.5             | 40.3             | 78.0             | --               | --               | --               |

1. Measured on Mini-Circuits Test Board TB-561-22+ (characterization test circuit, Fig 1a).

2. Current increases at P1dB

3. Measured on evaluation boards (push-pull amplifiers) TB-566-50+ (50Ω) and TB-566-75+ (75Ω). See Characterization Test Circuit (Fig. 1b)

4. Permanent damage may occur if any of these limits are exceeded. These ratings are not intended for continuous normal operation.

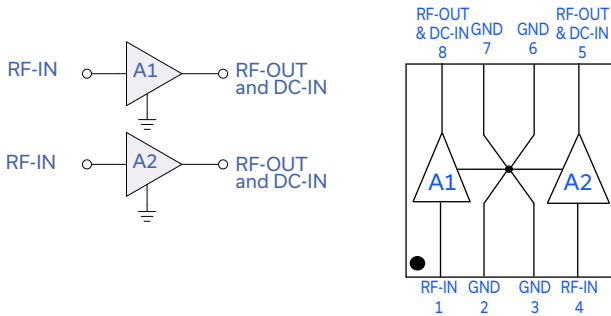
5. Defined with reference to ground pad temperature.

6. Per single ended amplifier

7. θ<sub>jc</sub>= Junction Temperature-85°C / Voltage X sum of current in A1 & A2



### SIMPLIFIED SCHEMATIC (EACH OF A1, A2) AND PIN DESCRIPTION



| Function             | Pin Number       | Description  |
|----------------------|------------------|--|
| RF-IN, A1            | 1                | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application Circuit, Fig 2.)  |
| RF-OUT and DC-IN, A1 | 8                | RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2 |
| RF IN, A2            | 4                | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. (see Application Circuit, Fig 2.)  |
| RF-OUT and DC-IN, A2 | 5                | RF output and bias pin. DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation. An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig 2 |
| GND                  | 2,3,6,7 & paddle | Connections to ground. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.  |



### CHARACTERIZATION TEST CIRCUIT

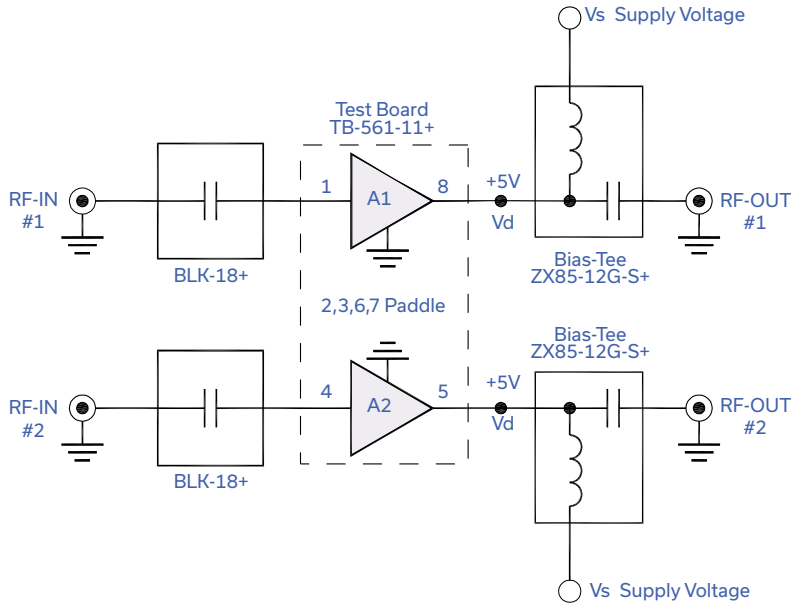


Fig 1a. Block Diagram of Test Circuit used for characterization. (DUT tested in Mini-Circuits Test board TB-561-22+, except for IP2) Gain, Return loss, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss:  $P_{IN} = -25\text{dBm}$
2. Output IP3 (OIP3): Two tones, spaced 1MHz apart, 5 dBm/tone at output.

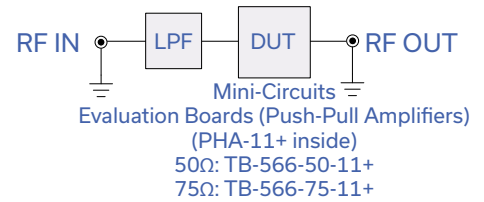


Fig 1b. Block Diagram of Test Set up used for characterization of Gain, IP2, IP3. Measured using Agilent's signal generators E8527D and Spectrum analyzer N9020A.

Conditions:

1. Two tones, spaced 1MHz apart, 5 dBm/tone at output. IP2 is measured at the sum frequency of the tones.

### RECOMMENDED APPLICATION CIRCUIT

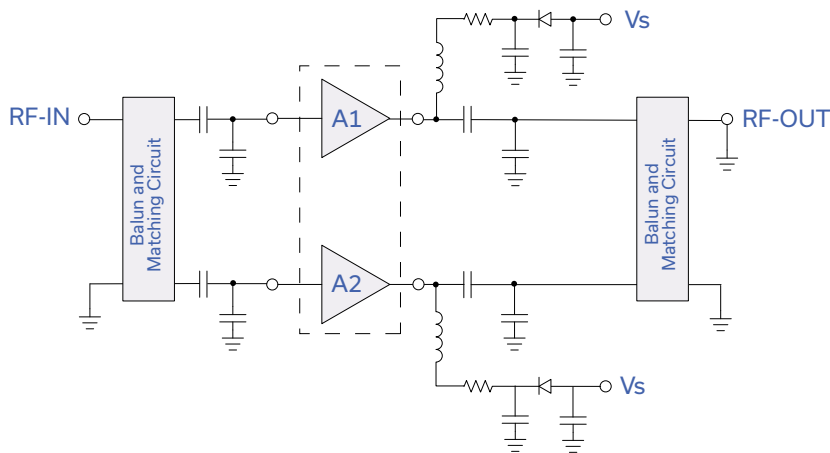
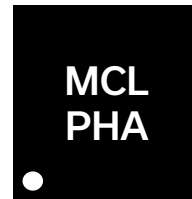


Fig 2. Recommended Application Circuit. Refer to following Mini-Circuits Evaluation Boards for parts list.  
50Ω: TB-566-50-11+  
75Ω: TB-566-75-11+

### PRODUCT MARKING



index over pin 1

Marking may contain other features or characters for internal lot control



MMIC SURFACE MOUNT

# Dual Matched Amplifier

PHA-22+

50Ω 0.05 to 1.5 GHz

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. [CLICK HERE](#)

|  |   |
|--|---|
| Performance Data                                     | Data Table<br>Swept Graphs<br>S-Parameter (S2P Files) Data Set (.zip file)                    |
| Case Style   | DL1020 Plastic package, exposed paddle lead finish: tin/silver/nickel                         |
| Tape & Reel<br>Standard quantities available on reel | F68<br>7" reels with 20, 50, 100, 200, 500 or 1K devices<br>13" reels with 2K, 3K, 4K devices |
| Suggested Layout for PCB Design                      | PL-322  |
| Evaluation Board                                     | TB-566-50+ (50Ω, 0.05-1.2 GHz)<br>TB-566-75+ (75Ω, 0.05-1.3 GHz)                              |
| Environmental Ratings                                | ENV08T2   |

## ESD RATING

Human Body Model (HBM): Class 1A ( 250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (<100V) in accordance with ANSI/ESD STM5.2-1999; passes 25V

## MSL RATING

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

- 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](http://www.minicircuits.com/MCLStore/terms.jsp)



## Typical Performance Data

NOTE: Use PDF Bookmarks to view DATA at required conditions

## Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5.00V, Id1 (A1) = 146.17 mA and Id2 (A2) =138.65 mA @ Temperature = +25degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.70 | 17.61 | 0.09      | 0.36        | 21.61     | 11.56             | 13.97              | 0.98      | 0.67    | 43.22       | 22.44            | 1.75         |
| 100.0  | 16.79 | 16.74 | 0.05      | 0.39        | 20.85     | 15.97             | 18.28              | 1.06      | 0.64    | 43.05       | 22.49            | 1.72         |
| 200.0  | 16.46 | 16.43 | 0.03      | 0.42        | 20.62     | 19.40             | 21.29              | 1.09      | 0.63    | 43.33       | 22.72            | 1.63         |
| 300.0  | 16.36 | 16.34 | 0.02      | 0.52        | 20.56     | 20.05             | 21.83              | 1.10      | 0.63    | 43.94       | 22.79            | 1.75         |
| 400.0  | 16.30 | 16.29 | 0.01      | 0.60        | 20.51     | 19.98             | 21.53              | 1.10      | 0.63    | 42.76       | 22.56            | 1.71         |
| 500.0  | 16.24 | 16.25 | 0.01      | 0.69        | 20.45     | 19.46             | 20.96              | 1.10      | 0.63    | 43.09       | 22.82            | 1.77         |
| 600.0  | 16.18 | 16.20 | 0.02      | 0.79        | 20.37     | 18.75             | 20.24              | 1.09      | 0.63    | 43.81       | 22.76            | 1.78         |
| 700.0  | 16.12 | 16.15 | 0.03      | 0.90        | 20.27     | 17.90             | 19.52              | 1.09      | 0.63    | 43.18       | 22.77            | 1.79         |
| 800.0  | 16.04 | 16.08 | 0.04      | 0.98        | 20.21     | 16.97             | 18.57              | 1.08      | 0.63    | 43.46       | 22.72            | 1.80         |
| 900.0  | 15.96 | 16.02 | 0.06      | 1.05        | 20.12     | 16.10             | 17.61              | 1.08      | 0.63    | 44.68       | 22.92            | 1.82         |
| 1000.0 | 15.87 | 15.94 | 0.07      | 1.09        | 20.01     | 15.22             | 16.74              | 1.07      | 0.63    | 42.01       | 22.49            | 1.88         |
| 1100.0 | 15.77 | 15.86 | 0.09      | 1.15        | 19.92     | 14.38             | 15.96              | 1.06      | 0.63    | 42.90       | 22.71            | 1.93         |
| 1200.0 | 15.66 | 15.77 | 0.11      | 1.18        | 19.81     | 13.58             | 15.18              | 1.06      | 0.63    | 44.60       | 22.83            | 1.97         |
| 1300.0 | 15.53 | 15.67 | 0.14      | 1.16        | 19.72     | 12.84             | 14.44              | 1.05      | 0.63    | 44.00       | 22.69            | 2.01         |
| 1400.0 | 15.41 | 15.55 | 0.14      | 1.17        | 19.61     | 12.10             | 13.75              | 1.04      | 0.63    | 43.41       | 22.72            | 2.04         |
| 1500.0 | 15.26 | 15.43 | 0.17      | 1.14        | 19.53     | 11.40             | 13.13              | 1.04      | 0.64    | 44.57       | 22.81            | 2.09         |

## 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: Vd = 4.75V, Id1 (A1) = 132.48 mA and Id2 (A2) = 125.02 mA @ Temperature = +25degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.62 | 17.56 | 0.06      | 0.50        | 21.48     | 11.51             | 14.07              | 0.98      | 0.67    | 43.79       | 21.92            | 1.76         |
| 100.0  | 16.71 | 16.70 | 0.01      | 0.59        | 20.75     | 15.92             | 18.30              | 1.06      | 0.64    | 43.22       | 21.97            | 1.75         |
| 200.0  | 16.37 | 16.39 | 0.02      | 0.61        | 20.58     | 19.38             | 21.35              | 1.10      | 0.64    | 43.94       | 22.16            | 1.70         |
| 300.0  | 16.27 | 16.30 | 0.03      | 0.69        | 20.47     | 20.01             | 21.92              | 1.10      | 0.63    | 45.75       | 22.24            | 1.76         |
| 400.0  | 16.21 | 16.25 | 0.04      | 0.81        | 20.46     | 19.96             | 21.61              | 1.10      | 0.64    | 43.56       | 22.03            | 1.82         |
| 500.0  | 16.16 | 16.20 | 0.04      | 0.93        | 20.39     | 19.50             | 21.08              | 1.10      | 0.63    | 44.44       | 22.28            | 1.81         |
| 600.0  | 16.10 | 16.15 | 0.05      | 1.05        | 20.30     | 18.83             | 20.29              | 1.09      | 0.63    | 44.12       | 22.21            | 1.85         |
| 700.0  | 16.03 | 16.10 | 0.07      | 1.18        | 20.25     | 17.95             | 19.51              | 1.09      | 0.63    | 43.72       | 22.24            | 1.82         |
| 800.0  | 15.95 | 16.04 | 0.09      | 1.29        | 20.15     | 17.07             | 18.60              | 1.09      | 0.63    | 43.90       | 22.23            | 1.87         |
| 900.0  | 15.87 | 15.97 | 0.10      | 1.37        | 20.07     | 16.20             | 17.69              | 1.08      | 0.63    | 46.32       | 22.39            | 1.84         |
| 1000.0 | 15.79 | 15.90 | 0.11      | 1.46        | 19.97     | 15.30             | 16.84              | 1.07      | 0.63    | 42.59       | 21.98            | 1.92         |
| 1100.0 | 15.68 | 15.81 | 0.13      | 1.54        | 19.88     | 14.43             | 16.01              | 1.07      | 0.63    | 43.09       | 22.18            | 2.01         |
| 1200.0 | 15.58 | 15.73 | 0.15      | 1.59        | 19.77     | 13.64             | 15.25              | 1.06      | 0.63    | 45.50       | 22.29            | 2.02         |
| 1300.0 | 15.46 | 15.62 | 0.16      | 1.61        | 19.66     | 12.91             | 14.53              | 1.05      | 0.63    | 44.05       | 22.15            | 2.07         |
| 1400.0 | 15.33 | 15.50 | 0.17      | 1.65        | 19.56     | 12.16             | 13.83              | 1.04      | 0.63    | 43.27       | 22.20            | 2.06         |
| 1500.0 | 15.18 | 15.38 | 0.20      | 1.64        | 19.49     | 11.45             | 13.20              | 1.04      | 0.64    | 43.64       | 22.26            | 2.11         |

## 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: Vd = 5.25V, Id1 (A1) = 159.58mA and Id2 (A2) = 151.78 mA @ Temperature = +25degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.73 | 17.69 | 0.04      | 0.54        | 21.33     | 11.48             | 13.99              | 0.97      | 0.64    | 42.95       | 22.97            | 1.87         |
| 100.0  | 16.83 | 16.83 | 0.00      | 0.61        | 20.84     | 16.06             | 18.35              | 1.06      | 0.64    | 42.47       | 22.98            | 1.79         |
| 200.0  | 16.50 | 16.53 | 0.03      | 0.61        | 20.69     | 19.53             | 21.37              | 1.09      | 0.63    | 42.42       | 23.21            | 1.73         |
| 300.0  | 16.40 | 16.44 | 0.04      | 0.68        | 20.56     | 20.17             | 21.90              | 1.10      | 0.63    | 43.83       | 23.31            | 1.79         |
| 400.0  | 16.34 | 16.39 | 0.05      | 0.81        | 20.54     | 20.09             | 21.66              | 1.10      | 0.63    | 41.70       | 23.04            | 1.83         |
| 500.0  | 16.29 | 16.35 | 0.06      | 0.92        | 20.49     | 19.62             | 21.11              | 1.10      | 0.63    | 42.34       | 23.31            | 1.85         |
| 600.0  | 16.23 | 16.30 | 0.07      | 1.04        | 20.43     | 18.90             | 20.38              | 1.10      | 0.63    | 42.84       | 23.25            | 1.85         |
| 700.0  | 16.16 | 16.25 | 0.09      | 1.15        | 20.37     | 18.05             | 19.61              | 1.09      | 0.63    | 42.32       | 23.25            | 1.87         |
| 800.0  | 16.08 | 16.18 | 0.10      | 1.25        | 20.28     | 17.15             | 18.69              | 1.09      | 0.63    | 42.20       | 23.19            | 1.88         |
| 900.0  | 16.01 | 16.12 | 0.11      | 1.35        | 20.17     | 16.27             | 17.82              | 1.08      | 0.63    | 43.17       | 23.42            | 1.90         |
| 1000.0 | 15.92 | 16.05 | 0.13      | 1.42        | 20.09     | 15.37             | 16.97              | 1.07      | 0.63    | 41.14       | 22.93            | 1.97         |
| 1100.0 | 15.81 | 15.96 | 0.15      | 1.50        | 19.99     | 14.49             | 16.14              | 1.07      | 0.63    | 42.11       | 23.16            | 2.04         |
| 1200.0 | 15.71 | 15.87 | 0.16      | 1.55        | 19.91     | 13.70             | 15.39              | 1.06      | 0.63    | 43.12       | 23.30            | 2.03         |
| 1300.0 | 15.59 | 15.77 | 0.18      | 1.58        | 19.81     | 12.97             | 14.68              | 1.05      | 0.63    | 42.38       | 23.11            | 2.08         |
| 1400.0 | 15.47 | 15.66 | 0.19      | 1.60        | 19.64     | 12.21             | 13.97              | 1.04      | 0.63    | 42.39       | 23.17            | 2.12         |
| 1500.0 | 15.32 | 15.53 | 0.21      | 1.58        | 19.63     | 11.50             | 13.34              | 1.04      | 0.64    | 43.28       | 23.26            | 2.16         |



## 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: Vd = 5.00V, Id1 (A1) = 140.16 mA and Id2 (A2) = 133.54 mA @ Temperature = -45degC

| FREQ   | A1    | A2    | A1 & A2   |             | A1        |                   |                    |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.43 | 17.36 | 0.07      | 0.55        | 21.02     | 11.79             | 13.32              | 0.95      | 0.65    | 42.66       | 22.52            | 1.63         |
| 100.0  | 16.31 | 16.30 | 0.01      | 0.71        | 20.30     | 16.45             | 16.48              | 1.05      | 0.63    | 40.64       | 22.67            | 1.56         |
| 200.0  | 15.88 | 15.90 | 0.02      | 0.70        | 20.08     | 20.38             | 18.43              | 1.09      | 0.62    | 40.34       | 22.81            | 1.49         |
| 300.0  | 15.76 | 15.80 | 0.04      | 0.76        | 19.98     | 21.10             | 18.49              | 1.10      | 0.62    | 40.43       | 22.87            | 1.53         |
| 400.0  | 15.70 | 15.75 | 0.05      | 0.89        | 19.96     | 20.82             | 18.25              | 1.10      | 0.62    | 39.22       | 22.73            | 1.51         |
| 500.0  | 15.66 | 15.71 | 0.05      | 1.02        | 19.91     | 20.27             | 18.08              | 1.10      | 0.62    | 40.08       | 22.96            | 1.52         |
| 600.0  | 15.61 | 15.67 | 0.06      | 1.14        | 19.86     | 19.37             | 17.54              | 1.10      | 0.61    | 39.69       | 22.90            | 1.51         |
| 700.0  | 15.55 | 15.63 | 0.08      | 1.25        | 19.80     | 18.25             | 16.84              | 1.10      | 0.61    | 39.38       | 22.95            | 1.51         |
| 800.0  | 15.49 | 15.57 | 0.08      | 1.37        | 19.76     | 17.25             | 16.30              | 1.10      | 0.61    | 39.46       | 22.93            | 1.54         |
| 900.0  | 15.42 | 15.53 | 0.11      | 1.49        | 19.66     | 16.35             | 15.79              | 1.09      | 0.61    | 40.47       | 23.08            | 1.54         |
| 1000.0 | 15.35 | 15.47 | 0.12      | 1.59        | 19.59     | 15.38             | 15.07              | 1.09      | 0.61    | 38.69       | 22.77            | 1.60         |
| 1100.0 | 15.26 | 15.39 | 0.13      | 1.68        | 19.55     | 14.48             | 14.41              | 1.08      | 0.61    | 39.27       | 22.96            | 1.64         |
| 1200.0 | 15.17 | 15.32 | 0.15      | 1.75        | 19.49     | 13.68             | 13.92              | 1.08      | 0.61    | 40.20       | 23.02            | 1.68         |
| 1300.0 | 15.07 | 15.24 | 0.17      | 1.79        | 19.38     | 12.89             | 13.32              | 1.07      | 0.60    | 39.63       | 22.93            | 1.69         |
| 1400.0 | 14.96 | 15.13 | 0.17      | 1.85        | 19.31     | 12.15             | 12.73              | 1.06      | 0.60    | 39.36       | 22.99            | 1.72         |
| 1500.0 | 14.84 | 15.03 | 0.19      | 1.87        | 19.26     | 11.49             | 12.24              | 1.06      | 0.61    | 40.13       | 23.06            | 1.78         |

## 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: Vd = 4.75V, Id1 (A1) = 127.58 mA and Id2 (A2) = 118.02 mA @ Temperature = -45degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.37 | 17.29 | 0.08      | 0.44        | 21.16     | 11.69             | 13.46              | 0.96      | 0.67    | 42.17       | 21.87            | 1.62         |
| 100.0  | 16.28 | 16.25 | 0.03      | 0.59        | 20.28     | 16.36             | 16.76              | 1.05      | 0.63    | 40.87       | 21.97            | 1.55         |
| 200.0  | 15.86 | 15.86 | 0.00      | 0.64        | 20.05     | 20.37             | 18.91              | 1.09      | 0.62    | 40.69       | 22.12            | 1.45         |
| 300.0  | 15.75 | 15.76 | 0.01      | 0.71        | 20.03     | 21.19             | 18.97              | 1.10      | 0.63    | 41.38       | 22.18            | 1.47         |
| 400.0  | 15.69 | 15.71 | 0.02      | 0.85        | 19.95     | 20.97             | 18.76              | 1.10      | 0.62    | 39.73       | 22.05            | 1.48         |
| 500.0  | 15.65 | 15.68 | 0.03      | 0.99        | 19.88     | 20.40             | 18.58              | 1.10      | 0.62    | 40.62       | 22.29            | 1.55         |
| 600.0  | 15.60 | 15.64 | 0.04      | 1.12        | 19.84     | 19.52             | 17.99              | 1.10      | 0.62    | 40.56       | 22.23            | 1.51         |
| 700.0  | 15.55 | 15.60 | 0.05      | 1.24        | 19.78     | 18.39             | 17.24              | 1.10      | 0.61    | 40.06       | 22.30            | 1.50         |
| 800.0  | 15.48 | 15.54 | 0.06      | 1.35        | 19.72     | 17.40             | 16.67              | 1.09      | 0.61    | 40.21       | 22.27            | 1.53         |
| 900.0  | 15.42 | 15.50 | 0.08      | 1.48        | 19.65     | 16.49             | 16.12              | 1.09      | 0.61    | 41.40       | 22.40            | 1.54         |
| 1000.0 | 15.34 | 15.44 | 0.10      | 1.57        | 19.57     | 15.49             | 15.36              | 1.08      | 0.61    | 39.39       | 22.13            | 1.57         |
| 1100.0 | 15.25 | 15.36 | 0.11      | 1.68        | 19.49     | 14.56             | 14.66              | 1.08      | 0.61    | 39.70       | 22.31            | 1.68         |
| 1200.0 | 15.17 | 15.29 | 0.12      | 1.73        | 19.43     | 13.77             | 14.13              | 1.07      | 0.61    | 40.70       | 22.36            | 1.63         |
| 1300.0 | 15.07 | 15.20 | 0.13      | 1.79        | 19.34     | 12.96             | 13.52              | 1.07      | 0.61    | 40.12       | 22.30            | 1.68         |
| 1400.0 | 14.96 | 15.10 | 0.14      | 1.85        | 19.29     | 12.22             | 12.91              | 1.06      | 0.61    | 39.84       | 22.35            | 1.70         |
| 1500.0 | 14.83 | 15.00 | 0.17      | 1.87        | 19.23     | 11.53             | 12.40              | 1.06      | 0.61    | 40.74       | 22.41            | 1.76         |

## 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: Vd =5.25V, Id1 A1) = 156.08 mA and Id2 (A2) =146.41 mA @ Temperature = -45degC

| FREQ   | A1    | A2    | A1 & A2   |             | A1        |                   |                    |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.50 | 17.44 | 0.06      | 0.43        | 21.02     | 11.88             | 13.50              | 0.95      | 0.64    | 44.48       | 23.10            | 1.66         |
| 100.0  | 16.41 | 16.40 | 0.01      | 0.58        | 20.34     | 16.45             | 16.69              | 1.05      | 0.62    | 40.49       | 23.21            | 1.59         |
| 200.0  | 15.99 | 16.01 | 0.02      | 0.62        | 20.17     | 20.42             | 18.66              | 1.09      | 0.62    | 40.20       | 23.36            | 1.50         |
| 300.0  | 15.88 | 15.91 | 0.03      | 0.69        | 20.12     | 21.18             | 18.67              | 1.10      | 0.62    | 40.58       | 23.42            | 1.50         |
| 400.0  | 15.82 | 15.86 | 0.04      | 0.81        | 20.10     | 20.89             | 18.47              | 1.11      | 0.62    | 39.25       | 23.25            | 1.56         |
| 500.0  | 15.77 | 15.82 | 0.05      | 0.92        | 20.00     | 20.32             | 18.30              | 1.10      | 0.62    | 39.78       | 23.47            | 1.56         |
| 600.0  | 15.72 | 15.79 | 0.07      | 1.05        | 19.95     | 19.46             | 17.74              | 1.10      | 0.61    | 39.97       | 23.42            | 1.57         |
| 700.0  | 15.67 | 15.74 | 0.07      | 1.17        | 19.90     | 18.31             | 17.02              | 1.10      | 0.61    | 39.49       | 23.45            | 1.53         |
| 800.0  | 15.60 | 15.68 | 0.08      | 1.27        | 19.82     | 17.30             | 16.47              | 1.09      | 0.61    | 39.52       | 23.42            | 1.54         |
| 900.0  | 15.54 | 15.64 | 0.10      | 1.38        | 19.78     | 16.42             | 15.96              | 1.09      | 0.61    | 40.43       | 23.59            | 1.58         |
| 1000.0 | 15.46 | 15.58 | 0.12      | 1.47        | 19.69     | 15.41             | 15.20              | 1.08      | 0.61    | 38.81       | 23.24            | 1.63         |
| 1100.0 | 15.37 | 15.50 | 0.13      | 1.55        | 19.62     | 14.50             | 14.54              | 1.08      | 0.61    | 39.15       | 23.43            | 1.65         |
| 1200.0 | 15.29 | 15.43 | 0.14      | 1.62        | 19.57     | 13.72             | 14.02              | 1.08      | 0.61    | 40.36       | 23.52            | 1.69         |
| 1300.0 | 15.18 | 15.34 | 0.16      | 1.64        | 19.45     | 12.91             | 13.43              | 1.07      | 0.60    | 39.56       | 23.40            | 1.72         |
| 1400.0 | 15.07 | 15.23 | 0.16      | 1.71        | 19.41     | 12.17             | 12.82              | 1.06      | 0.60    | 39.49       | 23.46            | 1.75         |
| 1500.0 | 14.94 | 15.13 | 0.19      | 1.70        | 19.35     | 11.48             | 12.33              | 1.06      | 0.61    | 40.05       | 23.54            | 1.77         |

## 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: Vd = 5.00V, Id1(A1) = 144.79 mA and Id2 (A2) = 136.99 mA @ Temperature = +85degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.81 | 17.77 | 0.04      | 0.59        | 21.73     | 11.26             | 14.12              | 0.99      | 0.66    | 43.39       | 22.40            | 2.10         |
| 100.0  | 17.04 | 17.06 | 0.02      | 0.64        | 21.19     | 15.23             | 19.18              | 1.07      | 0.65    | 44.53       | 22.42            | 1.99         |
| 200.0  | 16.76 | 16.80 | 0.04      | 0.61        | 20.98     | 17.86             | 23.13              | 1.10      | 0.64    | 44.27       | 22.62            | 1.92         |
| 300.0  | 16.66 | 16.71 | 0.05      | 0.67        | 20.89     | 17.87             | 24.16              | 1.10      | 0.64    | 45.90       | 22.73            | 2.05         |
| 400.0  | 16.60 | 16.66 | 0.06      | 0.77        | 20.82     | 17.85             | 24.39              | 1.10      | 0.64    | 43.41       | 22.43            | 2.09         |
| 500.0  | 16.54 | 16.61 | 0.07      | 0.89        | 20.78     | 17.74             | 23.32              | 1.10      | 0.65    | 44.93       | 22.70            | 2.10         |
| 600.0  | 16.48 | 16.56 | 0.08      | 1.00        | 20.69     | 17.30             | 22.29              | 1.09      | 0.65    | 44.35       | 22.63            | 2.11         |
| 700.0  | 16.41 | 16.50 | 0.09      | 1.08        | 20.57     | 16.64             | 21.54              | 1.08      | 0.65    | 44.94       | 22.63            | 2.11         |
| 800.0  | 16.32 | 16.43 | 0.11      | 1.20        | 20.47     | 16.02             | 20.49              | 1.08      | 0.65    | 44.28       | 22.57            | 2.13         |
| 900.0  | 16.23 | 16.36 | 0.13      | 1.28        | 20.35     | 15.41             | 19.18              | 1.07      | 0.65    | 46.02       | 22.80            | 2.19         |
| 1000.0 | 16.14 | 16.28 | 0.14      | 1.34        | 20.26     | 14.71             | 18.12              | 1.06      | 0.65    | 43.06       | 22.34            | 2.20         |
| 1100.0 | 16.03 | 16.18 | 0.15      | 1.42        | 20.13     | 13.96             | 17.28              | 1.05      | 0.65    | 44.54       | 22.60            | 2.29         |
| 1200.0 | 15.91 | 16.09 | 0.18      | 1.47        | 20.00     | 13.27             | 16.44              | 1.04      | 0.65    | 45.90       | 22.72            | 2.31         |
| 1300.0 | 15.78 | 15.98 | 0.20      | 1.46        | 19.91     | 12.62             | 15.55              | 1.04      | 0.66    | 44.96       | 22.51            | 2.35         |
| 1400.0 | 15.65 | 15.85 | 0.20      | 1.48        | 19.77     | 11.96             | 14.79              | 1.03      | 0.66    | 44.36       | 22.59            | 2.37         |
| 1500.0 | 15.50 | 15.72 | 0.22      | 1.49        | 19.66     | 11.30             | 14.11              | 1.02      | 0.66    | 45.18       | 22.66            | 2.46         |

## 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: Vd = 4.75V, Id1(A1) = 131.62 mA and Id2 (A2) = 124.37 mA @ Temperature = +85degC

| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.77 | 17.71 | 0.06      | 0.53        | 21.46     | 11.09             | 14.24              | 0.98      | 0.64    | 42.68       | 21.88            | 2.08         |
| 100.0  | 17.01 | 17.01 | 0.00      | 0.53        | 21.08     | 15.01             | 19.16              | 1.06      | 0.64    | 43.83       | 21.89            | 2.00         |
| 200.0  | 16.73 | 16.75 | 0.02      | 0.52        | 20.93     | 17.50             | 23.22              | 1.09      | 0.64    | 45.51       | 22.09            | 1.87         |
| 300.0  | 16.63 | 16.67 | 0.04      | 0.60        | 20.90     | 17.55             | 24.22              | 1.10      | 0.65    | 46.21       | 22.17            | 1.98         |
| 400.0  | 16.58 | 16.62 | 0.04      | 0.72        | 20.85     | 17.55             | 24.44              | 1.10      | 0.65    | 45.09       | 21.91            | 2.04         |
| 500.0  | 16.52 | 16.57 | 0.05      | 0.83        | 20.76     | 17.43             | 23.52              | 1.09      | 0.65    | 46.12       | 22.16            | 2.07         |
| 600.0  | 16.45 | 16.51 | 0.06      | 0.92        | 20.67     | 17.04             | 22.42              | 1.09      | 0.65    | 46.95       | 22.10            | 2.06         |
| 700.0  | 16.38 | 16.45 | 0.07      | 1.02        | 20.55     | 16.43             | 21.66              | 1.08      | 0.65    | 46.24       | 22.11            | 2.09         |
| 800.0  | 16.29 | 16.38 | 0.09      | 1.13        | 20.42     | 15.83             | 20.64              | 1.07      | 0.65    | 46.08       | 22.05            | 2.11         |
| 900.0  | 16.21 | 16.31 | 0.10      | 1.19        | 20.33     | 15.25             | 19.26              | 1.07      | 0.65    | 48.55       | 22.25            | 2.16         |
| 1000.0 | 16.10 | 16.23 | 0.13      | 1.26        | 20.21     | 14.59             | 18.22              | 1.06      | 0.65    | 44.11       | 21.83            | 2.18         |
| 1100.0 | 16.00 | 16.13 | 0.13      | 1.36        | 20.10     | 13.89             | 17.37              | 1.05      | 0.65    | 46.64       | 22.05            | 2.24         |
| 1200.0 | 15.88 | 16.04 | 0.16      | 1.39        | 19.97     | 13.20             | 16.51              | 1.04      | 0.66    | 46.95       | 22.18            | 2.28         |
| 1300.0 | 15.75 | 15.93 | 0.18      | 1.37        | 19.85     | 12.57             | 15.61              | 1.03      | 0.66    | 47.18       | 22.00            | 2.34         |
| 1400.0 | 15.62 | 15.80 | 0.18      | 1.39        | 19.71     | 11.90             | 14.84              | 1.02      | 0.66    | 45.84       | 22.07            | 2.32         |
| 1500.0 | 15.46 | 15.67 | 0.21      | 1.37        | 19.62     | 11.28             | 14.18              | 1.02      | 0.66    | 49.07       | 22.15            | 2.44         |

## Typical Performance Data

### Definitions:

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

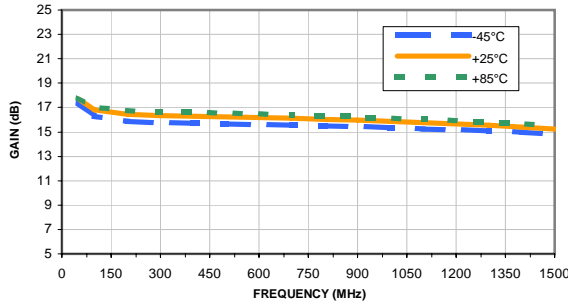
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 5.25V, Id1(A1) = 157.33 mA and Id2 (A2) = 149.61 mA @ Temperature = +85degC

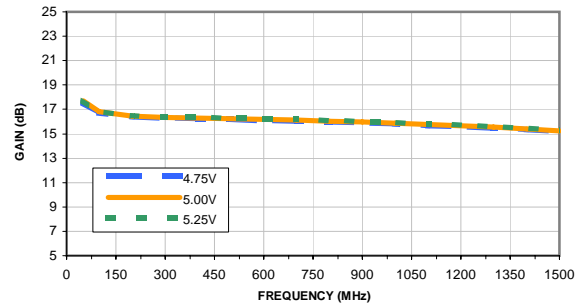
| FREQ   | A1    |       | A2        |             | A1 & A2   |                   | A1                 |           |         |             |                  |              |
|--------|-------|-------|-----------|-------------|-----------|-------------------|--------------------|-----------|---------|-------------|------------------|--------------|
|        | Gain  |       | Amp Unbal | Phase Unbal | Isolation | Input Return Loss | Output Return Loss | Stability |         | IP-3 Output | 1dB Comp. Output | Noise Figure |
| (MHz)  | (dB)  | (dB)  | (dB)      | (Deg)       | (dB)      | (dB)              | (dB)               | K         | Measure | (dBm)       | (dBm)            | (dB)         |
| 50.0   | 17.87 | 17.83 | 0.04      | 0.53        | 21.97     | 11.24             | 14.31              | 1.00      | 0.68    | 43.71       | 22.88            | 2.20         |
| 100.0  | 17.13 | 17.13 | 0.00      | 0.51        | 21.24     | 15.11             | 19.26              | 1.07      | 0.65    | 43.46       | 22.86            | 2.07         |
| 200.0  | 16.85 | 16.88 | 0.03      | 0.52        | 21.07     | 17.59             | 23.41              | 1.10      | 0.64    | 44.49       | 23.05            | 2.07         |
| 300.0  | 16.76 | 16.80 | 0.04      | 0.58        | 20.96     | 17.61             | 24.47              | 1.10      | 0.64    | 45.65       | 23.16            | 2.07         |
| 400.0  | 16.70 | 16.75 | 0.05      | 0.68        | 20.94     | 17.59             | 24.68              | 1.10      | 0.65    | 43.51       | 22.84            | 2.09         |
| 500.0  | 16.64 | 16.70 | 0.06      | 0.80        | 20.85     | 17.47             | 23.82              | 1.09      | 0.64    | 43.83       | 23.10            | 2.16         |
| 600.0  | 16.57 | 16.64 | 0.07      | 0.91        | 20.77     | 17.07             | 22.70              | 1.09      | 0.65    | 44.39       | 23.03            | 2.15         |
| 700.0  | 16.50 | 16.58 | 0.08      | 1.01        | 20.68     | 16.45             | 21.91              | 1.08      | 0.65    | 44.35       | 23.03            | 2.12         |
| 800.0  | 16.42 | 16.52 | 0.10      | 1.11        | 20.56     | 15.86             | 20.90              | 1.08      | 0.65    | 43.80       | 22.97            | 2.19         |
| 900.0  | 16.33 | 16.44 | 0.11      | 1.18        | 20.47     | 15.28             | 19.50              | 1.07      | 0.65    | 44.41       | 23.20            | 2.23         |
| 1000.0 | 16.23 | 16.36 | 0.13      | 1.27        | 20.36     | 14.62             | 18.43              | 1.06      | 0.65    | 42.45       | 22.72            | 2.26         |
| 1100.0 | 16.12 | 16.27 | 0.15      | 1.34        | 20.21     | 13.90             | 17.62              | 1.05      | 0.65    | 43.28       | 22.95            | 2.32         |
| 1200.0 | 16.01 | 16.17 | 0.16      | 1.36        | 20.10     | 13.21             | 16.73              | 1.04      | 0.66    | 44.32       | 23.11            | 2.36         |
| 1300.0 | 15.87 | 16.06 | 0.19      | 1.37        | 19.99     | 12.56             | 15.83              | 1.04      | 0.66    | 43.19       | 22.91            | 2.41         |
| 1400.0 | 15.74 | 15.94 | 0.20      | 1.37        | 19.86     | 11.90             | 15.06              | 1.03      | 0.66    | 43.49       | 22.98            | 2.46         |
| 1500.0 | 15.59 | 15.81 | 0.22      | 1.38        | 19.74     | 11.29             | 14.36              | 1.02      | 0.66    | 44.19       | 23.07            | 2.51         |

## Typical Performance Curves

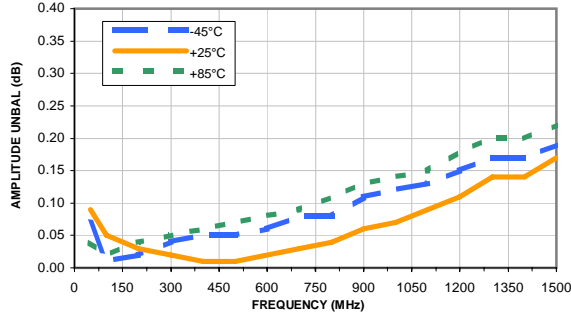
**GAIN vs. FREQUENCY & TEMPERATURE**  
INPUT POWER = -25dBm, Vd = 5.00V



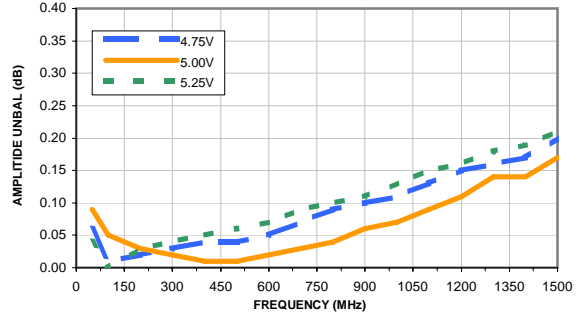
**GAIN vs. FREQUENCY & DEVICE VOLTAGE**  
INPUT POWER = -25dBm, Temperature = +25°C



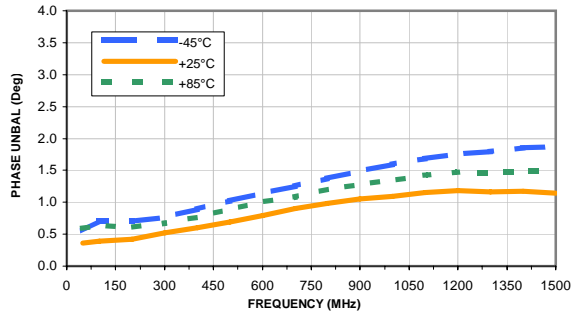
**AMPLITUDE UNBALANCE vs. FREQUENCY & TEMPERATURE**  
INPUT POWER = -25dBm, Vd = 5.00V



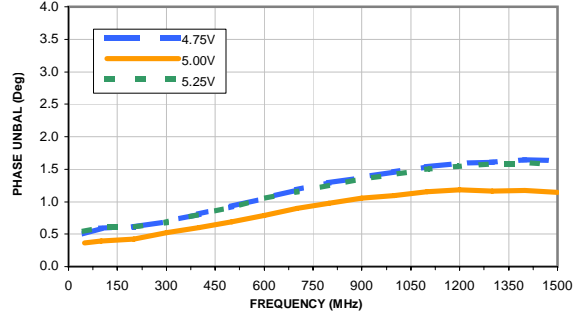
**AMPLITUDE UNBALANCE vs. FREQUENCY & DEVICE VOLTAGE**  
INPUT POWER = -25dBm, Temperature = +25°C



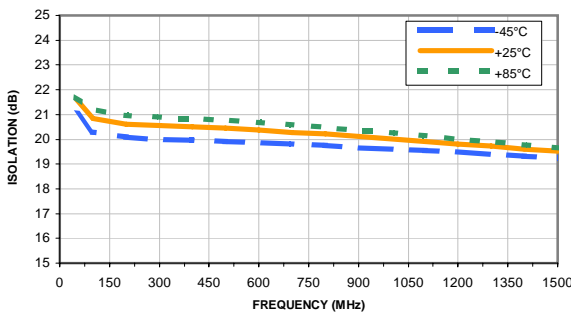
**PHASE UNBALANCE vs. FREQUENCY & TEMPERATURE**  
INPUT POWER = -25dBm, Vd = 5.00V



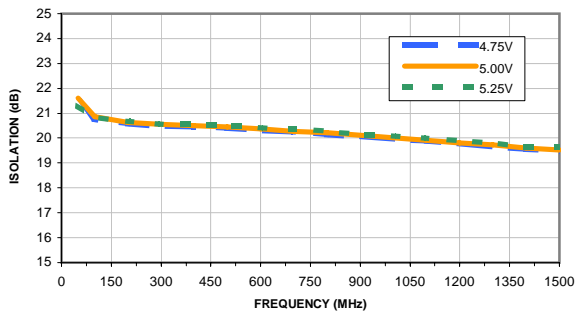
**PHASE UNBALANCE vs. FREQUENCY & DEVICE VOLTAGE**  
INPUT POWER = -25dBm, Temperature = +25°C



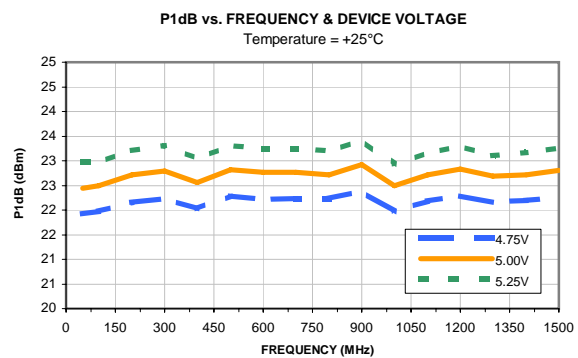
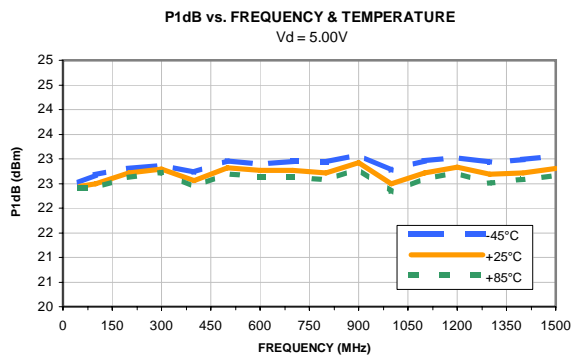
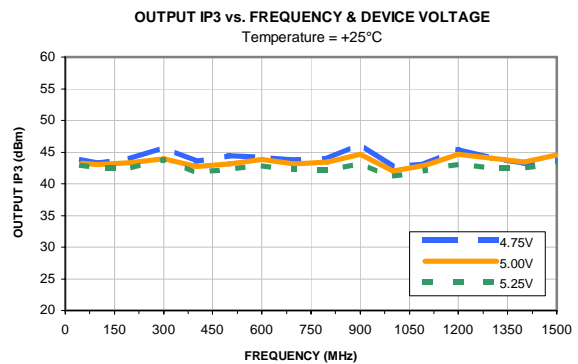
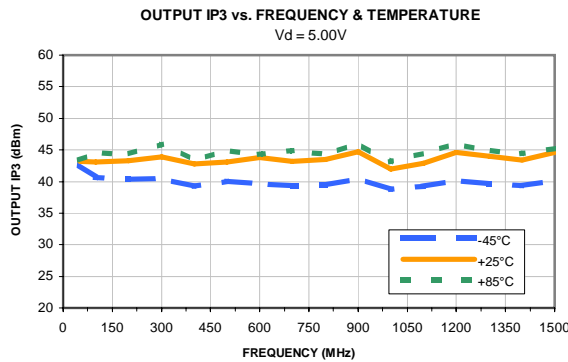
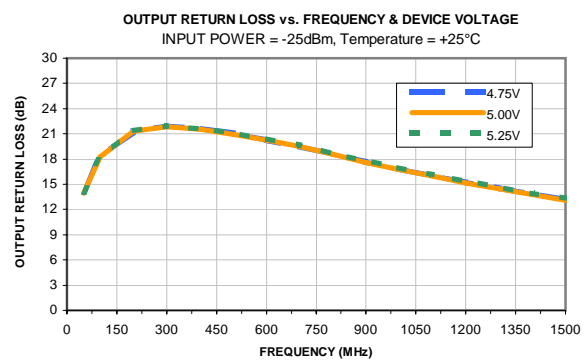
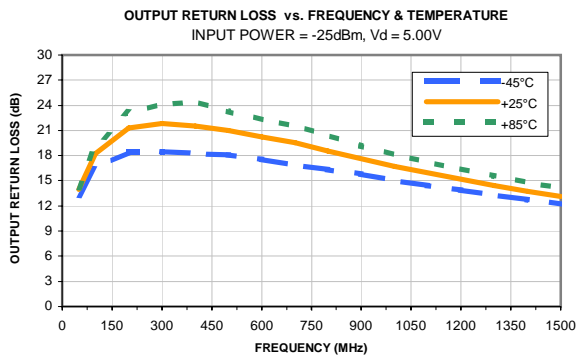
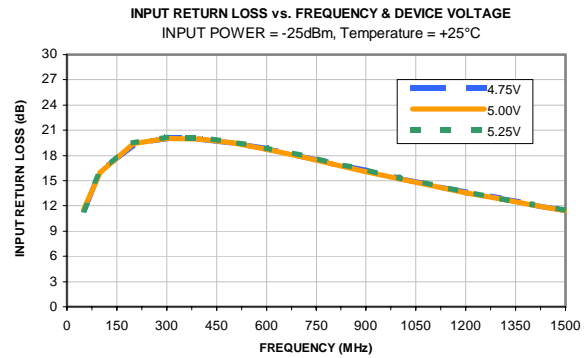
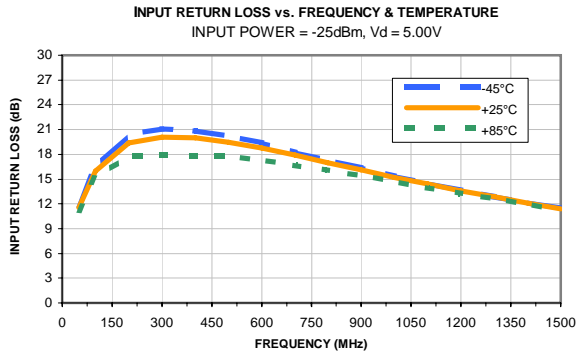
**ISOLATION vs. FREQUENCY & TEMPERATURE**  
INPUT POWER = -25dBm, Vd = 5.00V



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

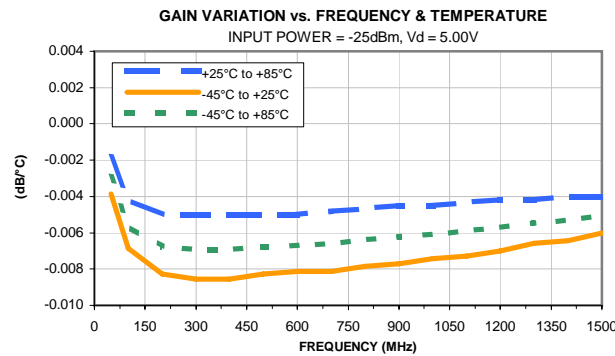
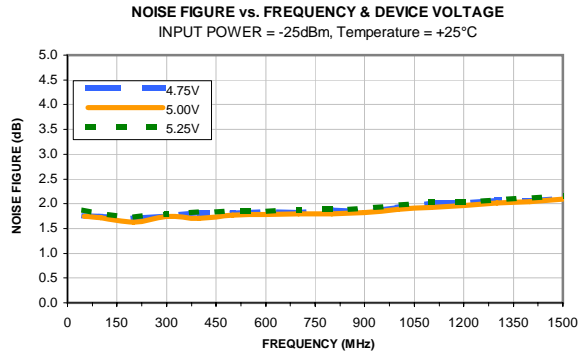
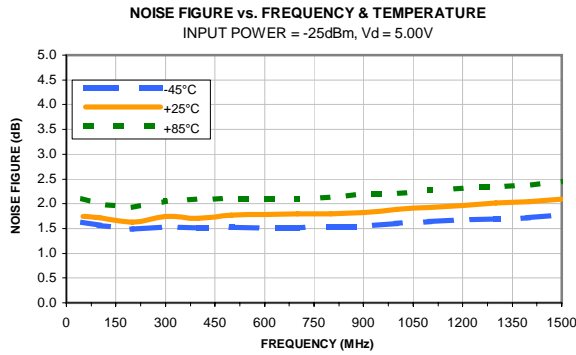


## Typical Performance Curves

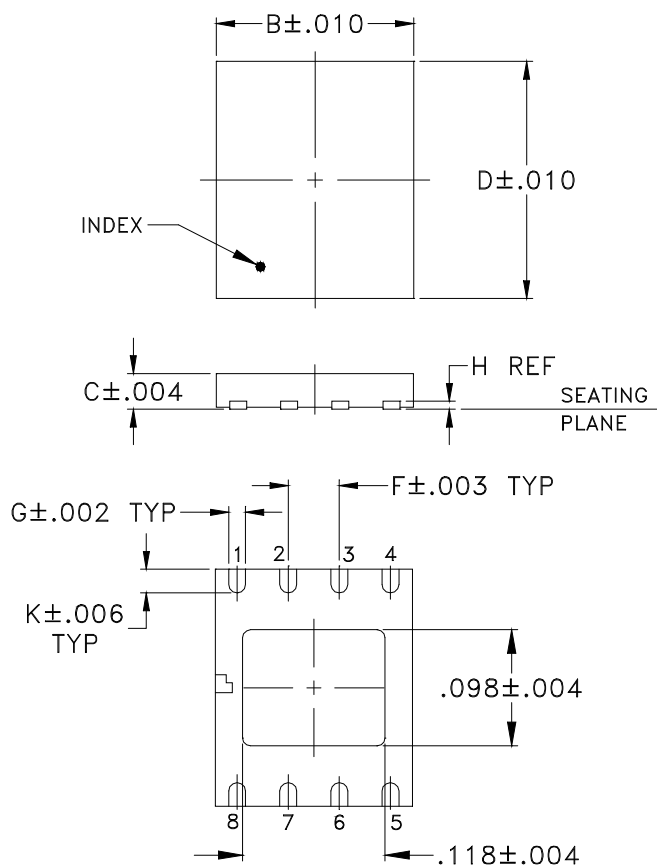




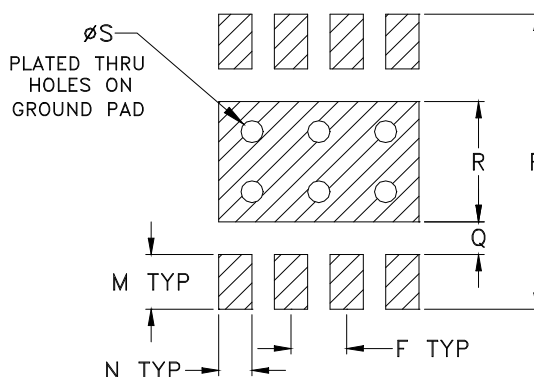
## Typical Performance Curves



### Outline Dimensions



### PCB Land Pattern



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

| CASE # | A  | B              | C              | D              | E  | F              | G              | H              | J  | K              | L  | M              | N              |
|--------|----|----------------|----------------|----------------|----|----------------|----------------|----------------|----|----------------|----|----------------|----------------|
| DL1020 | -- | .193<br>(4.90) | .035<br>(0.90) | .236<br>(6.00) | -- | .050<br>(1.27) | .017<br>(0.42) | .008<br>(0.20) | -- | .024<br>(0.60) | -- | .050<br>(1.27) | .030<br>(0.76) |

| CASE # | P              | Q              | R              | S              | T  | WT. GRAM |
|--------|----------------|----------------|----------------|----------------|----|----------|
| DL1020 | .270<br>(6.86) | .030<br>(0.76) | .110<br>(2.79) | .020<br>(0.51) | -- | .08      |

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .01$ ; 3Pl.  $\pm .004$

#### Notes:

- Case material: Plastic.
- Termination finish:  
For RoHS Case Styles: Tin-Silver alloy plate over Nickel barrier. All models, (+) suffix.  
For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

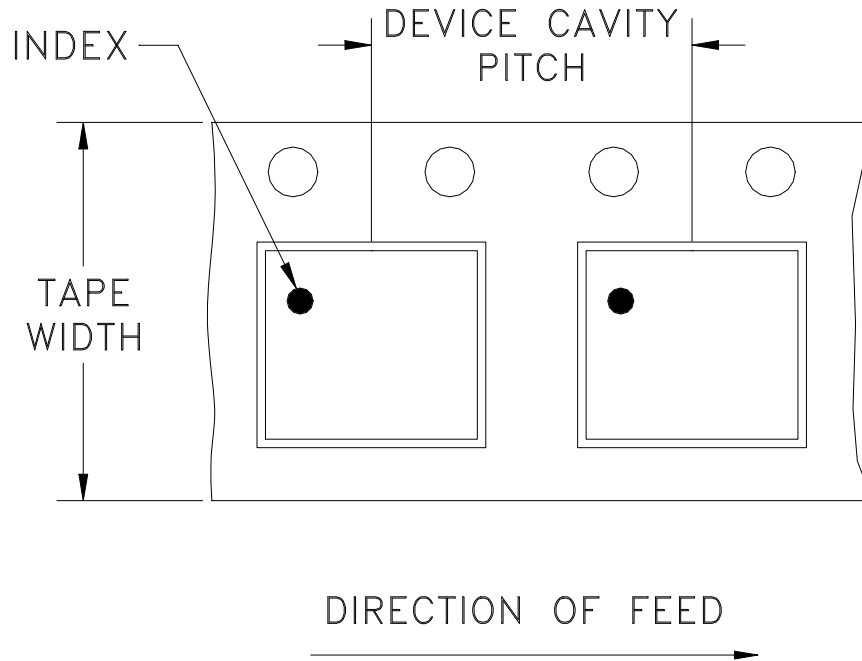


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F68

## DEVICE ORIENTATION IN T&R



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

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)



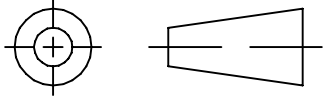
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Mini-Circuits ISO 9001 & ISO 14001 Certified

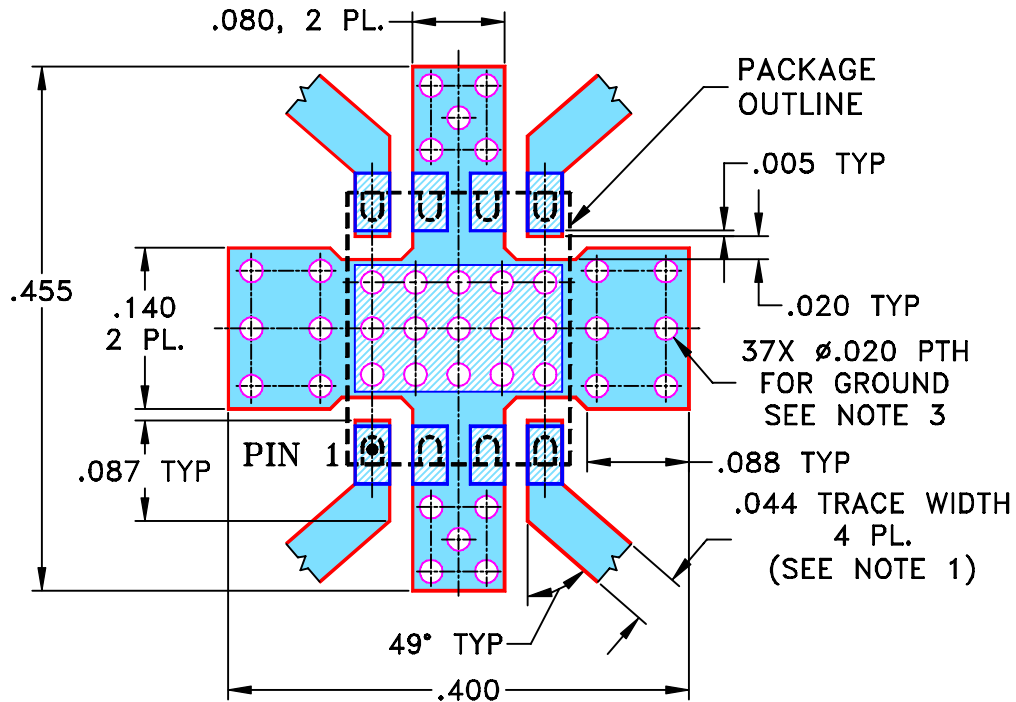
THIRD ANGLE PROJECTION



REVISIONS

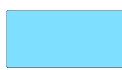
| REV | ECN No. | DESCRIPTION | DATE     | DR  | AUTH |
|-----|---------|-------------|----------|-----|------|
| OR  | M125629 | NEW RELEASE | 04/20/10 | MMG | RD   |
|     |         |             |          |     |      |
|     |         |             |          |     |      |

SUGGESTED MOUNTING CONFIGURATION FOR DL1020 CASE STYLE, "08AM04" PIN CODE



NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .020" ± .0015". COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
3. RECOMMEND TO PLUG 15 PTH UNDER THE UNIT TO AVOID SOLDER WICKING.



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 MMG   | 01/26/10 |
| TOLERANCES ON:             | CHECKED IL  | 04/20/10 |
| 2 PL DECIMALS ±            | APPROVED RD | 04/20/10 |
| 3 PL DECIMALS ± .005       |             |          |
| ANGLES ±                   |             |          |
| FRACTIONS ±                |             |          |



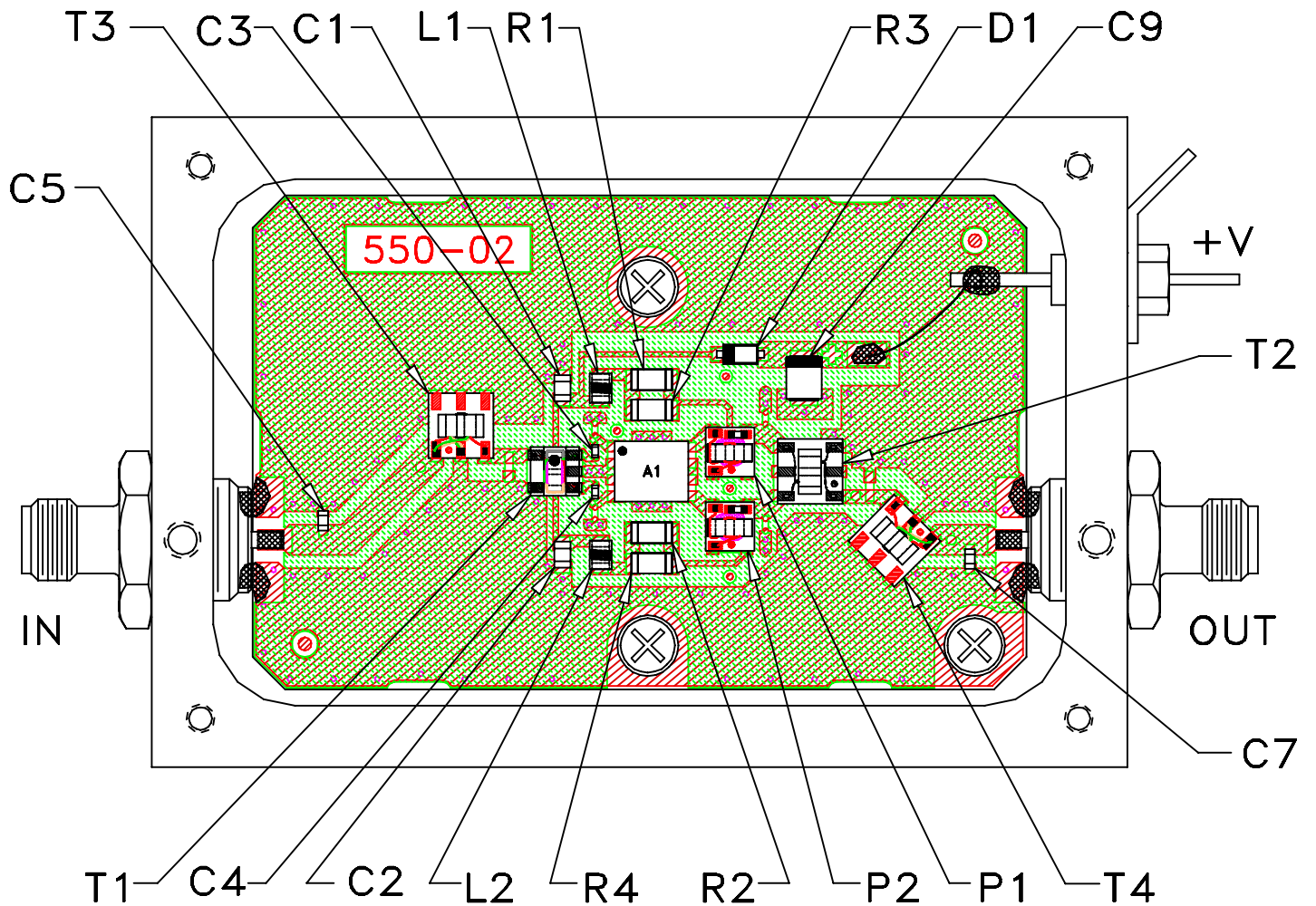
**Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

PL, 08AM04, DL1020

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| SIZE  | CODE IDENT | DRAWING NO: | REV:          |
|-------|------------|-------------|---------------|
| A     | 15542      | 98-PL-322   | OR            |
| FILE: | 98PL322    | SCALE:      | SHEET: 1 OF 1 |


# Evaluation Board and Circuit



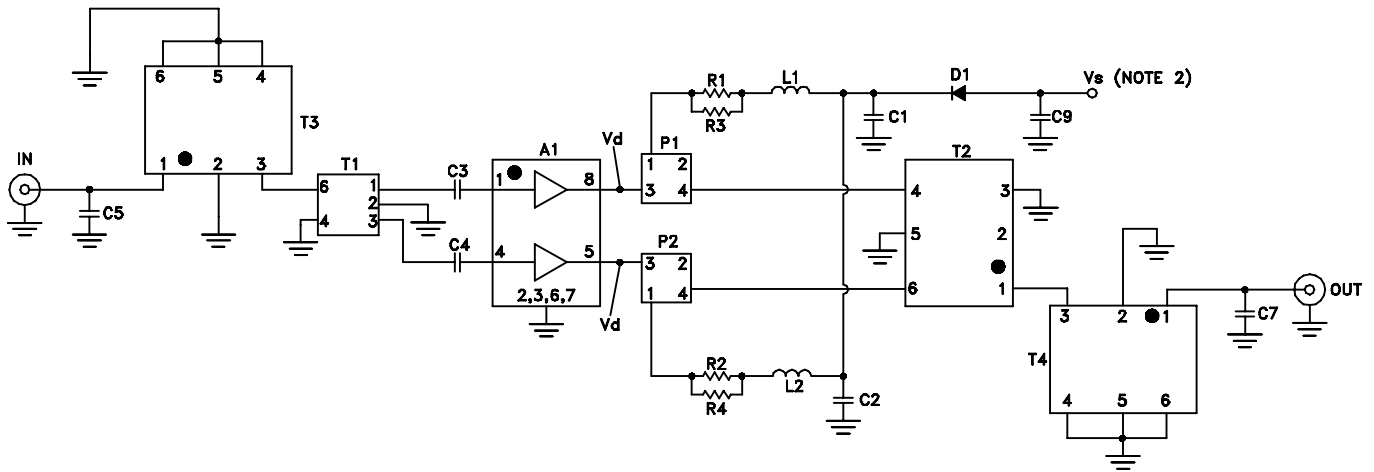
TB-566-50+

**Notes:**

1. 50 Ohm SMA Female connectors.
2. PCB Material: FR4.  
Dielectric Constant=4.7, Thickness=.059 inch.

 **Mini-Circuits®**

# Evaluation Board and Circuit




## Note:

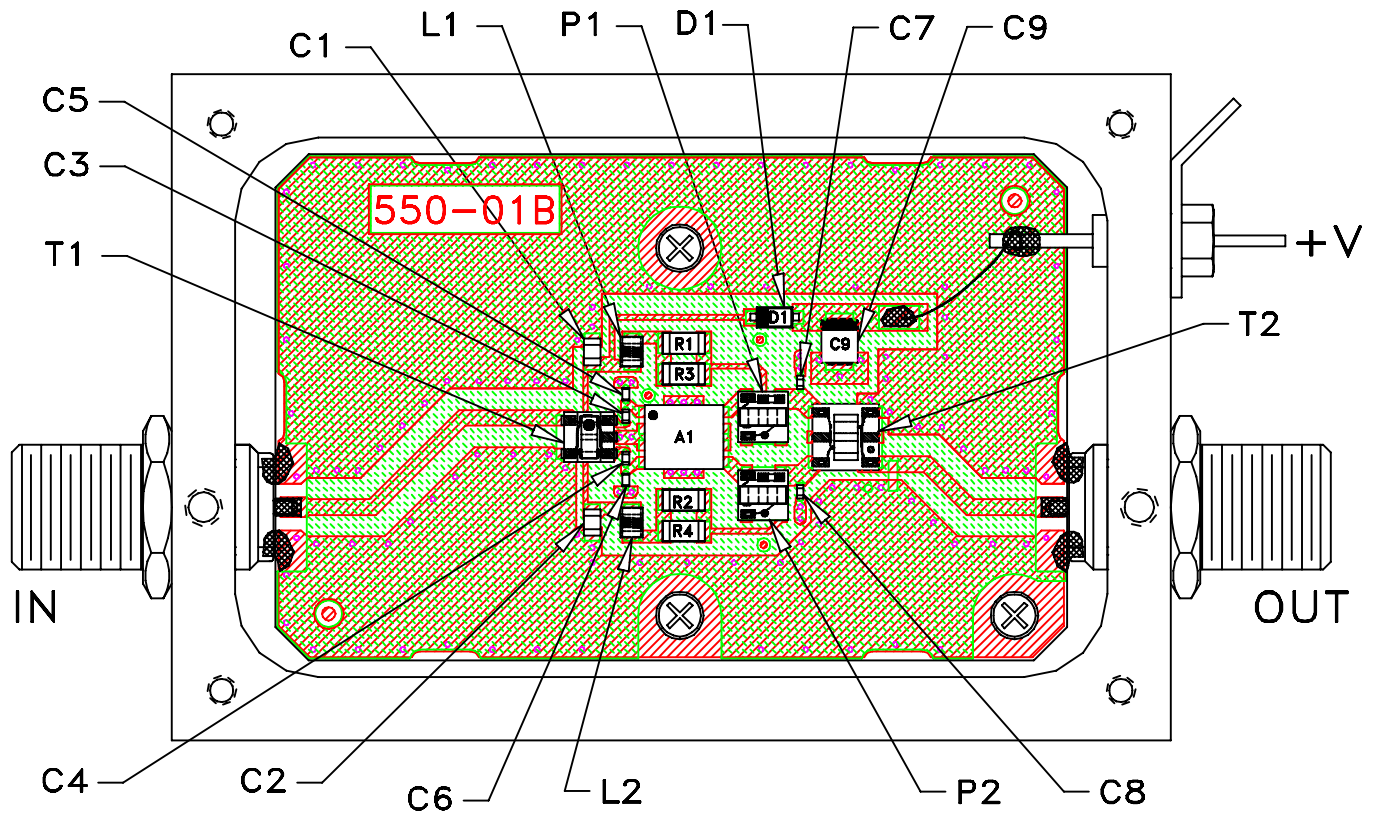
1. Numbers inside the boxes indicate Pin Numbers.
2. Set  $V_s$  to obtain  $V_d=5V$ .

| COMPONENT | VALUE                         |
|-----------|-------------------------------|
| A1        | Mini-Circuits PHA-22+         |
| C1,C2     | .039 uF                       |
| C3,C4     | 1000 pF                       |
| C5        | 0.8 pF                        |
| C7        | 1.1 pF                        |
| C9        | 1.0 uF                        |
| D1        | ON Semiconductor: MBR0520LT1G |
| L1,L2     | 680 nH                        |
| P1,P2     | Mini-Circuits TCBT-6G+        |
| R1,R2     | 11.5 Ohm                      |
| R3,R4     | 7.50 Ohm                      |
| T1        | Mini-Circuits TC1.33-282+     |
| T2        | Mini-Circuits TRS1-23-75+     |
| T3,T4     | Mini-Circuits TRS2-252+       |

## Schematic Diagram

 Mini-Circuits®


# Evaluation Board and Circuit



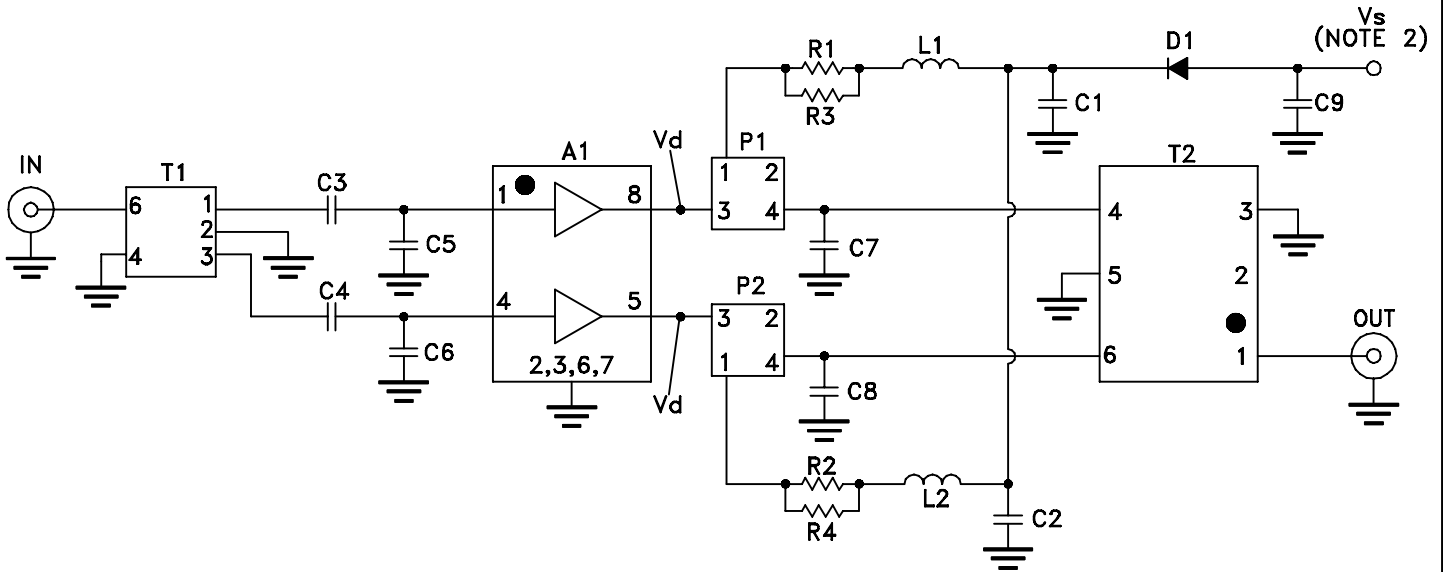
TB-566-75+

## Notes:

1. 75 Ohm F Female connectors.
2. PCB Material: FR4.  
Dielectric Constant=4.7, Thickness=.059 inch.

 Mini-Circuits®

# Evaluation Board and Circuit




## Note:

1. Numbers inside the boxes indicate Pin Numbers.
2. Set  $V_s$  to obtain  $V_d=5V$ .

| COMPONENT | VALUE                         |
|-----------|-------------------------------|
| A1        | Mini-Circuits PHA-22+         |
| C1,C2     | .039 uF                       |
| C3,C4     | 1000 pF                       |
| C5,C6     | .75 pF                        |
| C7,C8     | 1.6 pF                        |
| C9        | 1.0 uF                        |
| D1        | ON Semiconductor: MBR0520LT1G |
| L1,L2     | 680 nH                        |
| P1,P2     | Mini-Circuits TCBT-6G+        |
| R1,R2     | 11.5 Ohm                      |
| R3,R4     | 7.50 Ohm                      |
| T1        | Mini-Circuits TC1.33-282+     |
| T2        | Mini-Circuits TRS1-23-75+     |

## Schematic Diagram

 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          | -45° to 85°C or -40° to 85°C<br>Ambient Environment  | Individual Model Data Sheet                                     |
| Storage Temperature            | -65° to 150° C<br>Ambient Environment  | Individual Model Data Sheet                                     |
| 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   |
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + | MIL-STD-202, Method 215   |



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.

| <b>Specification</b> | <b>Test/Inspection Condition</b> | <b>Reference/Spec</b> |
|----------------------|----------------------------------|-----------------------|
|                      | monoethanolamine at 63°C to 70°C |                       |