

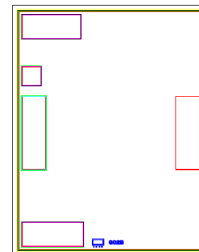
Ultra High Dynamic Range, Shutdown

# Monolithic Amplifier Die TSS-23HLN-D+

50Ω 30 MHz to 2 GHz

## The Big Deal

- Ultra-High IP3, +42.6 dBm typ.
- Medium power, +28.5 dBm typ.
- Excellent Noise Figure, 1.4 dB typ.
- Shutdown feature
- Operates over wide DC input: +3V to +8V



## Product Overview

TSS-23HLN-D+ (RoHS compliant) is an advanced wideband amplifier die with shutdown feature. It is fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the TSS-23HLN-D+ has good input and output return loss over a broad frequency range.

## Key Features

| Feature                                                                       | Advantages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Broad Band: 30MHz to 2GHz                                                     | Broadband covering primary wireless communications bands: VHF, UHF, Cellular                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Extremely High IP3<br>39.6 dBm typical at 30 MHz<br>42.6 dBm typical at 1 GHz | The TSS-23HLN-D+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and E-PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being approximately 13-15 dB above the P1dB point. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none"><li>• Driver amplifiers for complex waveform up converter paths</li><li>• Drivers in linearized transmit systems</li><li>• Secondary amplifiers in ultra-High Dynamic range receivers</li></ul> |
| Shutdown feature                                                              | Allow users to turn on and off the amplifier with pulsed signals while keeping the power supply at constant voltage to minimize DC power consumption                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Low Noise Figure<br>1.4 dB at 1GHz                                            | Enables lower system noise figure performance and along with High OIP3 provides high dynamic range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| High P1dB, 28.5 dBm at 1 GHz                                                  | High P1dB, High OIP3, Low NF results in a very dynamic range preventing amplifier saturation under strong interfering signals.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |



Ultra High Dynamic Range, Shutdown

# Monolithic Amplifier Die

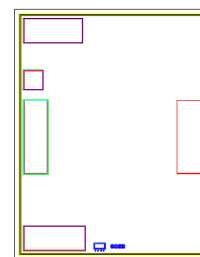
30 MHz to 2 GHz

## Product Features

- High IP3, 42.6 dBm typ. at 1 GHz
- Gain, 21.8 dB typ. at 1 GHz
- Low noise figure, 1.4 dB at 1 GHz
- High P1dB 28.5 dBm 1 GHz
- Shutdown feature
- Operates over wide DC input: +3V to 8V

## Typical Applications

- Base station infrastructure
- CATV
- Cellular



### +RoHS Compliant

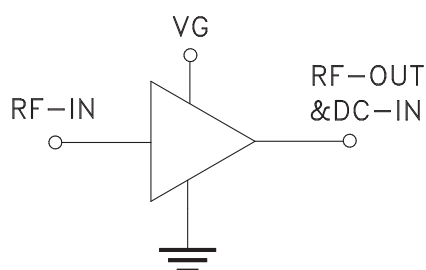
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

Ordering Information: Refer to Last Page

## General Description

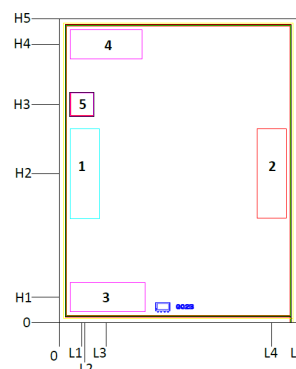
TSS-23HLN-D+ (RoHS compliant) is an advanced wideband amplifier die with shutdown feature. It is fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the TSS-23HLN-D+ has good input and output return loss over a broad frequency range.

## Simplified Schematic and Pad description



| Pad# | Function       |
|------|----------------|
| 1    | RF-IN          |
| 2    | RF-OUT & DC-IN |
| 5    | VG             |
| 3,4  | Ground         |

## Bonding Pad Position



Dimensions in  $\mu\text{m}$ , Typical

| L1   | L2   | L3    | L4    | L5    | H1   | H2    | H3    | H4    | H5     | Thick-ness | Die Size   | Pad Size 1 | Pad Size 2 | Pad Size 3 | Pad Size 4 | Pad Size 5 |
|------|------|-------|-------|-------|------|-------|-------|-------|--------|------------|------------|------------|------------|------------|------------|------------|
| 76.0 | 86.0 | 160.0 | 705.0 | 790.0 | 86.0 | 495.0 | 725.0 | 925.0 | 1010.0 | 100        | 1010 x 900 | 101 x 301  | 98 x 298   | 251 x 101  | 241 x 101  | 81 x 81    |



**Electrical Specifications<sup>1</sup> at 25°C, unless noted**

| Parameter                                | Condition( MHz) | Vd = 8V           |           | Vd = 5V          |           | Vd = 3V         |           | Units   |
|------------------------------------------|-----------------|-------------------|-----------|------------------|-----------|-----------------|-----------|---------|
|                                          |                 | ON State          | OFF State | ON State         | OFF State | ON State        | OFF State |         |
| Frequency Range                          |                 | 30-2000           | 30-2000   | 30-2000          | 30-2000   | 30-2000         | 30-2000   | MHz     |
| Noise Figure                             | 30              | 1.4               | --        | 1.2              | --        | 1.1             | --        | dB      |
|                                          | 500             | 1.4               | --        | 1.2              | --        | 1.2             | --        |         |
|                                          | 1000            | 1.4               | --        | 1.2              | --        | 1.2             | --        |         |
|                                          | 1500            | 1.5               | --        | 1.3              | --        | 1.4             | --        |         |
|                                          | 2000            | 1.6               | --        | 1.4              | --        | 1.5             | --        |         |
| Gain                                     | 30              | 23.3              | -21       | 23.1             | -21       | 22.4            | -21       | dB      |
|                                          | 500             | 22.4              | -21       | 22.2             | -21       | 21.4            | -21       |         |
|                                          | 1000            | 21.8              | -23       | 21.5             | -23       | 20.2            | -24       |         |
|                                          | 1500            | 21.1              | -25       | 20.7             | -26       | 19.1            | -26       |         |
|                                          | 2000            | 20.3              | -28       | 19.9             | -28       | 18              | -27       |         |
| Reversed Isolation                       | 30-2000         | 27                | 26        | 27               | 26        | 27              | 25        | dB      |
| Input Return Loss                        | 30              | 11                | 12        | 12               | 12        | 12              | 12        | dB      |
|                                          | 500             | 12                | 12        | 12               | 12        | 11              | 12        |         |
|                                          | 1000            | 10                | 12        | 10               | 12        | 8               | 12        |         |
|                                          | 1500            | 11                | 15        | 10               | 15        | 8               | 15        |         |
|                                          | 2000            | 12                | 20        | 11               | 19        | 8               | 19        |         |
| Output Return Loss                       | 30              | 15                | 2         | 15               | 2         | 17              | 2         | dB      |
|                                          | 500             | 14                | 2         | 15               | 2         | 19              | 2         |         |
|                                          | 1000            | 12                | 2         | 16               | 2         | 18              | 2         |         |
|                                          | 1500            | 10                | 2         | 12               | 2         | 11              | 2         |         |
|                                          | 2000            | 8                 | 2         | 10               | 2         | 9               | 2         |         |
| Output Power @ 1dB compression AMP-ON    | 30              | 26.2              | --        | 22.8             | --        | 17.1            | --        | dBm     |
|                                          | 500             | 27.9              | --        | 23.8             | --        | 18.9            | --        |         |
|                                          | 1000            | 28.5              | --        | 24.1             | --        | 19              | --        |         |
|                                          | 1500            | 28.1              | --        | 23.5             | --        | 18.8            | --        |         |
|                                          | 2000            | 27.7              | --        | 22.8             | --        | 18.1            | --        |         |
| Output IP3<br>(Pout = 0dBm/Tone)         | 30              | 39.6              | --        | 39.8             | --        | 34.1            | --        | dBm     |
|                                          | 500             | 41.6              | --        | 38               | --        | 33.7            | --        |         |
|                                          | 1000            | 42.6              | --        | 36.4             | --        | 31.8            | --        |         |
|                                          | 1500            | 42.6              | --        | 35.5             | --        | 31.1            | --        |         |
|                                          | 2000            | 41.8              | --        | 34               | --        | 30.3            | --        |         |
| Device Operating Voltage(VDD)            |                 | 8                 | 8         | 5                | 5         | 3               | 3         | V       |
| Device Operating Current(ID)             |                 | 236               | 8         | 139              | 5         | 74              | 3         | mA      |
| Control Voltage (VG)                     |                 | 0                 | 5         | 0                | 5         | 0               | 5         | V       |
| Device Current Variation vs. Temperature |                 | -225 <sup>2</sup> | --        | -13 <sup>3</sup> | --        | 27 <sup>3</sup> | --        | uA/degC |
| Device Current Variation vs. Voltage     |                 | 0.0263            | --        | 0.034            | --        | 0.033           | --        | mA/mV   |
| Thermal Resistance                       |                 | 23.3              | --        | 23.3             | --        | 23.3            | --        | degC/W  |

1. Measured on Mini-Circuits Characterization test board. Die is packaged in 3x3 mm, 12-lead MCL package and soldered on TB-TSS-23HLN+. See Characterization Test Circuit (Fig. 1)

2. (Current at 95°C - Current at -45°C)/140

3. (Current at 105°C - Current at -45°C)/150

**Absolute Maximum Ratings<sup>4</sup>**

| Parameter                           | at 8V                                                                                              | at 3V&5V                                                                                           |
|-------------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Operating Temperature (ground lead) | -40°C to 95°C                                                                                      | -40°C to 105°C                                                                                     |
| Power Dissipation                   | 3.3W                                                                                               | 3.3W                                                                                               |
| Device Operating Current (ID)       | 249mA                                                                                              | 163mA                                                                                              |
| Input Power (CW)                    | +28 dBm (5 minutes max)<br>+15 dBm (continuous) for 0.03-1 GHz<br>+18 dBm (continuous) for 1-2 GHz | +28 dBm (5 minutes max)<br>+10 dBm (continuous) for 0.03-1 GHz<br>+13 dBm (continuous) for 1-2 GHz |
| DC Voltage on Pad 2                 | 10V                                                                                                | 10V                                                                                                |
| DC Voltage on Pad 5                 | 10V                                                                                                | 10V                                                                                                |

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



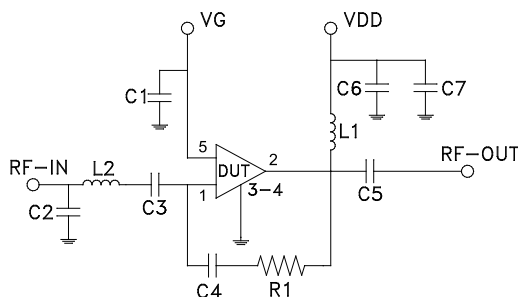
## Switching Specifications

| Parameter                |                                  | 8V<br>Typ | 5V<br>Typ. | 3V<br>Typ. | Units   |
|--------------------------|----------------------------------|-----------|------------|------------|---------|
| Amplifier ON to Shutdown | OFF TIME (50% Control to 10% RF) | 5.3       | 4.8        | 6.2        | $\mu$ s |
|                          | FALL TIME (90 to 10% RF)         | 7.3       | 7.4        | 3.6        |         |
| Amplifier Shutdown to ON | ON TIME (50% Control to 90% RF)  | 77.7      | 95.2       | 144.7      | $\mu$ s |
|                          | RISE TIME (10% to 90% RF)        | 54.2      | 60.0       | 200.7      |         |
| Control Voltage Leakage  |                                  | 633.3     | 482.9      | 311.0      | mV      |

Control Voltage ( $V_G$ ) Fig. 1

|               | Min. | Typ. | Max. | Units |
|---------------|------|------|------|-------|
| Amplifier-ON  | —    | 0    | 0.7  | V     |
| Amplifier-OFF | 1.9  | 5    | —    | V     |

## Characterization Test Circuit / Recommended Application Circuit



| Component | Size | Value         | Part Number        | Manufacturer |
|-----------|------|---------------|--------------------|--------------|
| C1        | 0402 | 0.1 $\mu$ F   | GRM155R71C104KA88D | Murata       |
| C2        | 0402 | 1.2pF         | GRM1555C1H1R2CA1D  | Murata       |
| C3        | 0402 | 0.1 $\mu$ F   | GRM155R71C104KA88D | Murata       |
| C4        | 0402 | 0.1 $\mu$ F   | GRM155R71C104KA88D | Murata       |
| C5        | 0402 | 1000pF        | GRM1555C1H102JA01D | Murata       |
| C6        | 0402 | 10000pF       | GRM155R71E103KA01D | Murata       |
| C7        | 0402 | 0.1 $\mu$ F   | GRM155R71C104KA88D | Murata       |
| L1        | 0805 | 680nH         | 0805LS-681XJLB     | Coilcraft    |
| L2        | 0402 | 1.0nH         | 0402CS-1N0XJLW     | Coilcraft    |
| R1        | 0402 | 1.2K $\Omega$ | RK73H1ETTP1201F    | Koa          |

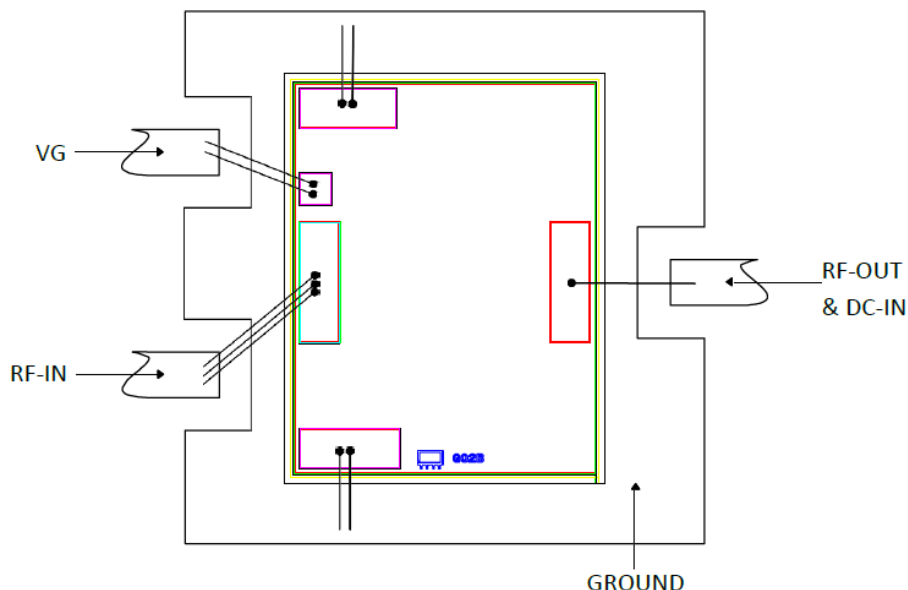
**Fig 1.** Block diagram of Test Circuit used for characterization. (DUT is packaged 3x3mm, 12-lead MCLP package and soldered on Mini-Circuits Characterization test board TB-TSS-23HLN+)

Gain, Return loss, Output power at 1dB compression ( $P_{1dB}$ ), output IP3 (OIP3) and noise figure measured using Agilent's N5242A PNA-X microwave network analyzer.

## Conditions:

- Gain and Return Loss:  $P_{in} = -25$  dBm
- Output IP3 (OIP3): Two tones, spaced 1 MHz apart, +0 dBm/tone at output.
- Switching Time  
RF Signal:  $P_{in} = -25$  dBm,  $f_{RF} = 500$  MHz.  
 $V_{DD} = 8V, 5V$  or  $3V$  DC,  $V_G =$  Pulse signal at 1 KHz with  $V_{HIGH} = 5V$ ,  $V_{LOW} = 0V$ , 50% duty cycle.

## Assembly Diagram



## Assembly and Handling Procedure

1. Storage  
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD  
MMIC E-PHEMT amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach  
The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

| Additional Detailed Technical Information                     |                                                                             |
|---------------------------------------------------------------|-----------------------------------------------------------------------------|
| <i>additional information is available on our dash board.</i> |                                                                             |
| Performance Data                                              | Data Table                                                                  |
|                                                               | Swept Graphs                                                                |
|                                                               | S-Parameter (S2P Files) Data Set with and without port extension(.zip file) |
| Case Style                                                    | Die                                                                         |
| Die Ordering and packaging information                        | Quantity, Package                                                           |
|                                                               | Model No.                                                                   |
|                                                               | Small, Gel - Pak: 5,10,50,100 KGD* TSS-23HLN-DG+                            |
|                                                               | Medium†, Partial wafer: KGD*<1672 TSS-23HLN-DP+                             |
|                                                               | Large†, Full Wafer TSS-23HLN-DF+                                            |
|                                                               | †Available upon request contact sales representative                        |
|                                                               | Refer to <a href="#">AN-60-067</a>                                          |
|                                                               |                                                                             |
| Environmental Ratings                                         | ENV80                                                                       |

\*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

## ESD Rating\*\*

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

\*\* Tested in industry standard 3X3 mm, 12 lead MCLP package.

## Additional Notes

- 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.
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## 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 = 2.75V, Id = 64mA @ 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)         |
| 20    | 22.55 | 25.80     | 10.51             | 15.85              | 1.03      | 0.53    | 30.81       | 14.56            | 1.13         |
| 30    | 22.27 | 25.29     | 12.15             | 16.81              | 1.03      | 0.50    | 33.06       | 15.77            | 1.07         |
| 40    | 22.07 | 25.00     | 13.12             | 16.48              | 1.03      | 0.48    | 32.74       | 16.96            | 1.04         |
| 50    | 21.92 | 25.08     | 14.05             | 15.81              | 1.04      | 0.50    | 32.52       | 17.66            | 1.09         |
| 60    | 21.86 | 24.80     | 14.18             | 15.84              | 1.04      | 0.47    | 32.93       | 17.76            | 1.08         |
| 70    | 21.81 | 24.75     | 14.40             | 15.66              | 1.04      | 0.47    | 33.12       | 17.98            | 1.09         |
| 80    | 21.77 | 24.66     | 14.56             | 15.63              | 1.04      | 0.46    | 33.16       | 17.97            | 1.13         |
| 90    | 21.74 | 24.76     | 14.68             | 15.57              | 1.04      | 0.47    | 33.59       | 18.03            | 1.16         |
| 100   | 21.71 | 24.68     | 14.74             | 15.54              | 1.04      | 0.46    | 33.89       | 18.02            | 1.15         |
| 150   | 21.64 | 24.73     | 14.61             | 15.65              | 1.05      | 0.48    | 33.29       | 18.18            | 1.22         |
| 200   | 21.58 | 24.76     | 14.20             | 15.93              | 1.05      | 0.50    | 34.22       | 18.24            | 1.17         |
| 250   | 21.53 | 24.78     | 13.65             | 16.37              | 1.05      | 0.51    | 33.83       | 18.33            | 1.16         |
| 300   | 21.47 | 24.84     | 13.05             | 16.85              | 1.05      | 0.53    | 33.09       | 18.46            | 1.16         |
| 350   | 21.40 | 24.90     | 12.39             | 17.53              | 1.05      | 0.56    | 32.82       | 18.44            | 1.19         |
| 400   | 21.32 | 25.04     | 11.77             | 18.29              | 1.06      | 0.59    | 32.84       | 18.36            | 1.21         |
| 450   | 21.23 | 25.16     | 11.17             | 19.18              | 1.06      | 0.62    | 32.38       | 18.19            | 1.18         |
| 500   | 21.13 | 25.29     | 10.57             | 20.16              | 1.07      | 0.66    | 32.51       | 17.98            | 1.20         |
| 550   | 21.02 | 25.45     | 10.05             | 21.11              | 1.07      | 0.70    | 31.91       | 18.26            | 1.20         |
| 600   | 20.90 | 25.54     | 9.57              | 21.97              | 1.07      | 0.73    | 31.67       | 18.09            | 1.26         |
| 650   | 20.78 | 25.66     | 9.13              | 22.43              | 1.08      | 0.76    | 31.19       | 18.17            | 1.27         |
| 700   | 20.65 | 25.82     | 8.78              | 22.44              | 1.08      | 0.79    | 31.21       | 18.06            | 1.25         |
| 750   | 20.50 | 25.93     | 8.44              | 22.00              | 1.09      | 0.82    | 31.08       | 17.93            | 1.24         |
| 800   | 20.36 | 26.01     | 8.17              | 21.12              | 1.09      | 0.85    | 30.91       | 17.88            | 1.32         |
| 850   | 20.22 | 26.18     | 7.94              | 20.09              | 1.10      | 0.87    | 30.65       | 18.02            | 1.27         |
| 900   | 20.09 | 26.30     | 7.72              | 19.00              | 1.10      | 0.90    | 30.36       | 17.94            | 1.27         |
| 950   | 19.97 | 26.41     | 7.52              | 17.98              | 1.10      | 0.92    | 30.62       | 17.89            | 1.27         |
| 1000  | 19.84 | 26.48     | 7.39              | 17.01              | 1.11      | 0.93    | 30.35       | 18.08            | 1.26         |
| 1100  | 19.59 | 26.66     | 7.18              | 15.28              | 1.11      | 0.96    | 30.13       | 17.89            | 1.31         |
| 1200  | 19.35 | 26.80     | 7.10              | 13.84              | 1.12      | 0.97    | 30.04       | 17.89            | 1.36         |
| 1300  | 19.12 | 26.93     | 7.13              | 12.70              | 1.12      | 0.98    | 30.00       | 17.66            | 1.36         |
| 1400  | 18.92 | 27.01     | 7.24              | 11.71              | 1.13      | 0.98    | 29.87       | 17.67            | 1.37         |
| 1500  | 18.73 | 27.07     | 7.43              | 10.88              | 1.13      | 0.97    | 29.76       | 17.80            | 1.38         |
| 1600  | 18.54 | 27.11     | 7.68              | 10.18              | 1.13      | 0.96    | 29.41       | 17.58            | 1.39         |
| 1700  | 18.36 | 27.17     | 7.96              | 9.63               | 1.14      | 0.96    | 29.28       | 17.18            | 1.42         |
| 1800  | 18.15 | 27.21     | 8.19              | 9.20               | 1.14      | 0.95    | 29.49       | 17.42            | 1.42         |
| 1900  | 17.90 | 27.27     | 8.28              | 8.86               | 1.15      | 0.96    | 29.08       | 17.32            | 1.44         |
| 2000  | 17.60 | 27.37     | 8.13              | 8.62               | 1.16      | 0.97    | 28.98       | 17.12            | 1.50         |
| 2100  | 17.22 | 27.51     | 7.69              | 8.47               | 1.17      | 1.00    | 28.57       | 17.00            | 1.57         |
| 2200  | 16.77 | 27.80     | 6.99              | 8.38               | 1.19      | 1.04    | 28.54       | 16.80            | 1.71         |
| 2300  | 16.22 | 28.15     | 6.18              | 8.32               | 1.22      | 1.09    | 28.14       | 16.76            | 1.86         |
| 2400  | 15.57 | 28.46     | 5.35              | 8.31               | 1.24      | 1.14    | 27.77       | 16.54            | 2.03         |
| 2500  | 14.86 | 28.93     | 4.57              | 8.31               | 1.28      | 1.20    | 27.84       | 16.53            | 3.00         |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## 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 = 3.00V, Id = 73mA @ 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)         |
| 20    | 22.74 | 25.90     | 10.52             | 15.57              | 1.03      | 0.52    | 32.76       | 15.76            | 1.16         |
| 30    | 22.45 | 25.37     | 12.04             | 16.35              | 1.03      | 0.49    | 34.88       | 16.98            | 1.13         |
| 40    | 22.24 | 25.17     | 12.91             | 15.92              | 1.03      | 0.48    | 33.86       | 18.16            | 1.08         |
| 50    | 22.09 | 25.43     | 13.62             | 15.26              | 1.05      | 0.51    | 34.02       | 18.75            | 1.08         |
| 60    | 22.03 | 25.00     | 13.85             | 15.29              | 1.04      | 0.47    | 34.94       | 18.84            | 1.09         |
| 70    | 21.97 | 24.92     | 14.08             | 15.11              | 1.04      | 0.46    | 34.98       | 18.95            | 1.11         |
| 80    | 21.93 | 24.80     | 14.20             | 15.08              | 1.04      | 0.45    | 34.69       | 18.91            | 1.13         |
| 90    | 21.91 | 24.87     | 14.30             | 15.00              | 1.04      | 0.46    | 34.66       | 18.98            | 1.18         |
| 100   | 21.88 | 24.84     | 14.35             | 15.00              | 1.04      | 0.46    | 35.65       | 19.04            | 1.17         |
| 150   | 21.81 | 24.84     | 14.27             | 15.08              | 1.04      | 0.47    | 34.88       | 19.11            | 1.12         |
| 200   | 21.75 | 24.91     | 13.98             | 15.32              | 1.05      | 0.49    | 36.52       | 19.25            | 1.17         |
| 250   | 21.70 | 24.86     | 13.49             | 15.72              | 1.05      | 0.49    | 35.19       | 19.34            | 1.17         |
| 300   | 21.65 | 24.96     | 13.03             | 16.13              | 1.05      | 0.52    | 34.53       | 19.40            | 1.16         |
| 350   | 21.59 | 25.02     | 12.47             | 16.71              | 1.05      | 0.54    | 34.69       | 19.38            | 1.17         |
| 400   | 21.52 | 25.18     | 11.94             | 17.36              | 1.06      | 0.58    | 34.35       | 19.29            | 1.18         |
| 450   | 21.44 | 25.23     | 11.39             | 18.10              | 1.06      | 0.60    | 33.97       | 19.14            | 1.19         |
| 500   | 21.35 | 25.41     | 10.83             | 18.97              | 1.06      | 0.64    | 33.79       | 18.92            | 1.21         |
| 550   | 21.25 | 25.51     | 10.36             | 19.81              | 1.07      | 0.67    | 33.11       | 19.23            | 1.21         |
| 600   | 21.15 | 25.62     | 9.88              | 20.69              | 1.07      | 0.70    | 32.96       | 19.04            | 1.26         |
| 650   | 21.03 | 25.71     | 9.46              | 21.40              | 1.07      | 0.73    | 32.91       | 19.04            | 1.27         |
| 700   | 20.91 | 25.85     | 9.11              | 21.87              | 1.08      | 0.76    | 32.61       | 18.94            | 1.24         |
| 750   | 20.78 | 25.97     | 8.78              | 21.93              | 1.09      | 0.79    | 32.36       | 18.89            | 1.23         |
| 800   | 20.64 | 26.11     | 8.50              | 21.55              | 1.09      | 0.82    | 32.23       | 18.77            | 1.19         |
| 850   | 20.52 | 26.27     | 8.26              | 20.89              | 1.10      | 0.85    | 32.18       | 19.01            | 1.25         |
| 900   | 20.39 | 26.35     | 8.03              | 20.02              | 1.10      | 0.87    | 31.73       | 18.94            | 1.23         |
| 950   | 20.28 | 26.53     | 7.83              | 19.05              | 1.11      | 0.89    | 31.91       | 18.80            | 1.25         |
| 1000  | 20.15 | 26.57     | 7.68              | 18.06              | 1.11      | 0.91    | 31.67       | 19.02            | 1.25         |
| 1100  | 19.91 | 26.76     | 7.46              | 16.26              | 1.12      | 0.94    | 31.41       | 18.92            | 1.31         |
| 1200  | 19.67 | 26.92     | 7.36              | 14.71              | 1.13      | 0.95    | 31.52       | 18.93            | 1.32         |
| 1300  | 19.45 | 27.07     | 7.39              | 13.43              | 1.14      | 0.96    | 31.27       | 18.71            | 1.33         |
| 1400  | 19.25 | 27.16     | 7.49              | 12.32              | 1.14      | 0.96    | 31.15       | 18.64            | 1.34         |
| 1500  | 19.07 | 27.24     | 7.69              | 11.41              | 1.15      | 0.96    | 31.08       | 18.80            | 1.37         |
| 1600  | 18.90 | 27.34     | 7.98              | 10.62              | 1.16      | 0.95    | 30.82       | 18.59            | 1.40         |
| 1700  | 18.73 | 27.32     | 8.33              | 9.99               | 1.16      | 0.94    | 30.49       | 18.09            | 1.42         |
| 1800  | 18.54 | 27.35     | 8.66              | 9.49               | 1.16      | 0.93    | 30.88       | 18.49            | 1.40         |
| 1900  | 18.33 | 27.42     | 8.87              | 9.08               | 1.16      | 0.94    | 30.42       | 18.42            | 1.46         |
| 2000  | 18.06 | 27.56     | 8.83              | 8.79               | 1.18      | 0.95    | 30.48       | 18.13            | 1.48         |
| 2100  | 17.73 | 27.66     | 8.46              | 8.60               | 1.19      | 0.97    | 29.90       | 18.14            | 1.56         |
| 2200  | 17.31 | 27.89     | 7.72              | 8.51               | 1.20      | 1.01    | 29.88       | 17.86            | 1.71         |
| 2300  | 16.78 | 28.22     | 6.80              | 8.47               | 1.23      | 1.06    | 29.49       | 17.83            | 1.86         |
| 2400  | 16.15 | 28.66     | 5.85              | 8.47               | 1.27      | 1.12    | 29.16       | 17.53            | 2.08         |
| 2500  | 15.43 | 29.10     | 4.97              | 8.51               | 1.31      | 1.18    | 29.36       | 17.68            | 2.36         |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## 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 = 3.25V, Id = 81mA @ 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)         |
| 20    | 22.87 | 25.93     | 10.51             | 15.50              | 1.02      | 0.51    | 33.20       | 16.78            | 1.11         |
| 30    | 22.57 | 25.45     | 11.98             | 15.94              | 1.02      | 0.48    | 35.23       | 18.08            | 1.06         |
| 40    | 22.37 | 25.23     | 12.79             | 15.47              | 1.03      | 0.47    | 34.63       | 19.16            | 1.02         |
| 50    | 22.21 | 25.81     | 13.40             | 14.83              | 1.06      | 0.53    | 34.99       | 19.72            | 1.07         |
| 60    | 22.15 | 25.11     | 13.67             | 14.86              | 1.04      | 0.46    | 36.53       | 19.79            | 1.07         |
| 70    | 22.09 | 25.00     | 13.88             | 14.70              | 1.04      | 0.45    | 35.67       | 19.82            | 1.10         |
| 80    | 22.05 | 24.92     | 13.99             | 14.66              | 1.03      | 0.44    | 35.38       | 19.76            | 1.10         |
| 90    | 22.02 | 24.98     | 14.08             | 14.57              | 1.04      | 0.45    | 36.43       | 19.83            | 1.13         |
| 100   | 22.00 | 24.90     | 14.13             | 14.57              | 1.04      | 0.45    | 35.11       | 19.89            | 1.14         |
| 150   | 21.93 | 24.98     | 14.10             | 14.61              | 1.04      | 0.46    | 36.98       | 19.95            | 1.21         |
| 200   | 21.87 | 25.00     | 13.87             | 14.86              | 1.05      | 0.48    | 35.92       | 20.02            | 1.16         |
| 250   | 21.83 | 25.00     | 13.47             | 15.24              | 1.05      | 0.49    | 35.49       | 20.13            | 1.17         |
| 300   | 21.78 | 25.09     | 13.09             | 15.63              | 1.05      | 0.51    | 36.50       | 20.26            | 1.16         |
| 350   | 21.72 | 25.17     | 12.59             | 16.18              | 1.05      | 0.54    | 35.92       | 20.24            | 1.17         |
| 400   | 21.66 | 25.26     | 12.12             | 16.81              | 1.06      | 0.56    | 35.57       | 20.16            | 1.19         |
| 450   | 21.59 | 25.36     | 11.62             | 17.56              | 1.06      | 0.59    | 34.76       | 20.01            | 1.17         |
| 500   | 21.50 | 25.45     | 11.10             | 18.39              | 1.06      | 0.62    | 35.31       | 19.71            | 1.19         |
| 550   | 21.41 | 25.56     | 10.64             | 19.24              | 1.07      | 0.65    | 34.01       | 20.12            | 1.19         |
| 600   | 21.31 | 25.69     | 10.19             | 20.10              | 1.07      | 0.68    | 33.75       | 19.92            | 1.24         |
| 650   | 21.21 | 25.82     | 9.80              | 20.87              | 1.08      | 0.72    | 33.91       | 19.94            | 1.25         |
| 700   | 21.10 | 25.95     | 9.45              | 21.39              | 1.08      | 0.75    | 33.53       | 19.83            | 1.23         |
| 750   | 20.97 | 26.06     | 9.12              | 21.62              | 1.09      | 0.77    | 33.03       | 19.71            | 1.23         |
| 800   | 20.85 | 26.21     | 8.86              | 21.38              | 1.10      | 0.80    | 33.23       | 19.59            | 1.28         |
| 850   | 20.73 | 26.26     | 8.63              | 20.86              | 1.10      | 0.82    | 32.76       | 19.85            | 1.24         |
| 900   | 20.62 | 26.42     | 8.41              | 20.06              | 1.11      | 0.85    | 32.51       | 19.78            | 1.25         |
| 950   | 20.51 | 26.52     | 8.22              | 19.13              | 1.11      | 0.87    | 32.92       | 19.64            | 1.21         |
| 1000  | 20.40 | 26.62     | 8.07              | 18.19              | 1.11      | 0.88    | 32.66       | 19.88            | 1.24         |
| 1100  | 20.17 | 26.79     | 7.86              | 16.40              | 1.12      | 0.91    | 32.44       | 19.79            | 1.30         |
| 1200  | 19.96 | 26.95     | 7.77              | 14.84              | 1.13      | 0.93    | 32.16       | 19.81            | 1.33         |
| 1300  | 19.76 | 27.06     | 7.82              | 13.59              | 1.14      | 0.93    | 32.20       | 19.60            | 1.35         |
| 1400  | 19.57 | 27.17     | 7.94              | 12.50              | 1.14      | 0.93    | 32.24       | 19.53            | 1.34         |
| 1500  | 19.40 | 27.26     | 8.15              | 11.59              | 1.15      | 0.93    | 31.97       | 19.70            | 1.33         |
| 1600  | 19.23 | 27.34     | 8.44              | 10.84              | 1.15      | 0.93    | 31.45       | 19.41            | 1.39         |
| 1700  | 19.07 | 27.40     | 8.76              | 10.23              | 1.16      | 0.92    | 31.29       | 18.97            | 1.37         |
| 1800  | 18.88 | 27.45     | 9.05              | 9.77               | 1.16      | 0.92    | 31.53       | 19.40            | 1.37         |
| 1900  | 18.66 | 27.55     | 9.18              | 9.39               | 1.17      | 0.93    | 30.94       | 19.24            | 1.40         |
| 2000  | 18.38 | 27.69     | 9.03              | 9.12               | 1.18      | 0.94    | 31.06       | 19.03            | 1.47         |
| 2100  | 18.05 | 27.85     | 8.55              | 8.95               | 1.20      | 0.97    | 30.66       | 18.96            | 1.52         |
| 2200  | 17.64 | 28.07     | 7.76              | 8.84               | 1.21      | 1.01    | 30.59       | 18.75            | 1.63         |
| 2300  | 17.13 | 28.33     | 6.83              | 8.79               | 1.22      | 1.06    | 30.19       | 18.66            | 1.78         |
| 2400  | 16.53 | 28.73     | 5.88              | 8.77               | 1.25      | 1.12    | 29.86       | 18.36            | 1.95         |
| 2500  | 15.86 | 29.14     | 5.00              | 8.76               | 1.27      | 1.18    | 29.89       | 18.47            | 2.24         |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

*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, Id = 134mA @ Temperature = +25°C

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 20    | 23.37 | 26.36     | 10.44                   | 14.76                    | 1.02      | 0.49    | 36.40          | 21.36                  | 1.17            |
| 30    | 23.04 | 25.86     | 11.65                   | 14.81                    | 1.02      | 0.46    | 39.34          | 22.32                  | 1.09            |
| 40    | 22.82 | 25.61     | 12.23                   | 14.31                    | 1.02      | 0.44    | 39.72          | 23.00                  | 1.04            |
| 50    | 22.66 | 25.97     | 12.77                   | 13.69                    | 1.04      | 0.49    | 36.78          | 23.36                  | 1.09            |
| 60    | 22.60 | 25.46     | 12.83                   | 13.68                    | 1.03      | 0.43    | 38.54          | 23.32                  | 1.11            |
| 70    | 22.54 | 25.38     | 12.97                   | 13.54                    | 1.03      | 0.42    | 41.60          | 23.32                  | 1.10            |
| 80    | 22.49 | 25.36     | 13.02                   | 13.48                    | 1.03      | 0.42    | 38.21          | 23.24                  | 1.15            |
| 90    | 22.47 | 25.40     | 13.12                   | 13.41                    | 1.04      | 0.43    | 40.48          | 23.38                  | 1.14            |
| 100   | 22.44 | 25.36     | 13.17                   | 13.39                    | 1.04      | 0.43    | 38.87          | 23.36                  | 1.15            |
| 150   | 22.37 | 25.36     | 13.21                   | 13.38                    | 1.04      | 0.43    | 39.42          | 23.44                  | 1.24            |
| 200   | 22.33 | 25.36     | 13.19                   | 13.51                    | 1.04      | 0.44    | 42.51          | 23.59                  | 1.18            |
| 250   | 22.30 | 25.36     | 13.06                   | 13.73                    | 1.04      | 0.45    | 39.89          | 23.73                  | 1.18            |
| 300   | 22.27 | 25.45     | 12.93                   | 13.96                    | 1.05      | 0.47    | 37.61          | 23.81                  | 1.16            |
| 350   | 22.23 | 25.47     | 12.73                   | 14.25                    | 1.05      | 0.48    | 39.37          | 23.81                  | 1.20            |
| 400   | 22.19 | 25.58     | 12.51                   | 14.59                    | 1.05      | 0.50    | 37.85          | 23.71                  | 1.19            |
| 450   | 22.15 | 25.65     | 12.25                   | 14.97                    | 1.06      | 0.52    | 38.47          | 23.52                  | 1.18            |
| 500   | 22.09 | 25.72     | 11.91                   | 15.39                    | 1.06      | 0.55    | 37.80          | 23.31                  | 1.19            |
| 550   | 22.04 | 25.85     | 11.62                   | 15.77                    | 1.07      | 0.57    | 38.31          | 23.76                  | 1.20            |
| 600   | 21.97 | 25.94     | 11.30                   | 16.17                    | 1.07      | 0.59    | 37.76          | 23.47                  | 1.25            |
| 650   | 21.90 | 26.04     | 10.99                   | 16.49                    | 1.08      | 0.62    | 36.69          | 23.53                  | 1.25            |
| 700   | 21.83 | 26.14     | 10.72                   | 16.76                    | 1.08      | 0.64    | 36.68          | 23.43                  | 1.23            |
| 750   | 21.74 | 26.22     | 10.45                   | 16.97                    | 1.09      | 0.66    | 36.40          | 23.23                  | 1.21            |
| 800   | 21.65 | 26.42     | 10.23                   | 17.04                    | 1.10      | 0.69    | 35.79          | 23.23                  | 1.23            |
| 850   | 21.57 | 26.50     | 10.04                   | 17.10                    | 1.10      | 0.71    | 36.35          | 23.44                  | 1.22            |
| 900   | 21.49 | 26.62     | 9.83                    | 16.98                    | 1.11      | 0.73    | 35.67          | 23.27                  | 1.24            |
| 950   | 21.41 | 26.69     | 9.64                    | 16.73                    | 1.11      | 0.74    | 35.09          | 23.16                  | 1.25            |
| 1000  | 21.33 | 26.84     | 9.50                    | 16.39                    | 1.12      | 0.76    | 36.12          | 23.55                  | 1.20            |
| 1100  | 21.16 | 27.02     | 9.30                    | 15.52                    | 1.14      | 0.79    | 35.59          | 23.35                  | 1.27            |
| 1200  | 21.00 | 27.26     | 9.24                    | 14.55                    | 1.15      | 0.81    | 35.31          | 23.40                  | 1.30            |
| 1300  | 20.84 | 27.47     | 9.30                    | 13.62                    | 1.17      | 0.82    | 34.86          | 23.01                  | 1.32            |
| 1400  | 20.70 | 27.69     | 9.47                    | 12.77                    | 1.19      | 0.83    | 34.81          | 22.95                  | 1.33            |
| 1500  | 20.57 | 27.82     | 9.75                    | 11.97                    | 1.20      | 0.83    | 34.64          | 23.15                  | 1.31            |
| 1600  | 20.44 | 27.99     | 10.13                   | 11.33                    | 1.21      | 0.83    | 34.11          | 22.77                  | 1.34            |
| 1700  | 20.31 | 28.18     | 10.60                   | 10.79                    | 1.23      | 0.84    | 33.13          | 22.07                  | 1.33            |
| 1800  | 20.17 | 28.35     | 11.05                   | 10.36                    | 1.25      | 0.84    | 34.08          | 22.88                  | 1.36            |
| 1900  | 20.00 | 28.55     | 11.36                   | 10.01                    | 1.27      | 0.85    | 33.55          | 22.74                  | 1.38            |
| 2000  | 19.80 | 28.69     | 11.26                   | 9.75                     | 1.27      | 0.87    | 33.32          | 22.42                  | 1.42            |
| 2100  | 19.54 | 28.92     | 10.68                   | 9.56                     | 1.29      | 0.90    | 33.93          | 22.45                  | 1.48            |
| 2200  | 19.22 | 29.28     | 9.65                    | 9.42                     | 1.31      | 0.95    | 32.50          | 22.07                  | 1.59            |
| 2300  | 18.81 | 29.70     | 8.43                    | 9.33                     | 1.34      | 1.00    | 32.51          | 22.11                  | 1.73            |
| 2400  | 18.32 | 30.14     | 7.19                    | 9.23                     | 1.37      | 1.06    | 32.16          | 21.68                  | 1.89            |
| 2500  | 17.75 | 30.53     | 6.05                    | 9.15                     | 1.38      | 1.12    | 32.50          | 21.90                  | 2.16            |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## 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, Id = 143mA @ 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)         |
| 20    | 23.44 | 26.51     | 10.42             | 14.74              | 1.02      | 0.50    | 38.03       | 21.98            | 1.20         |
| 30    | 23.11 | 25.94     | 11.59             | 14.76              | 1.02      | 0.46    | 38.75       | 22.79            | 1.16         |
| 40    | 22.88 | 25.69     | 12.12             | 14.23              | 1.02      | 0.44    | 39.63       | 23.39            | 1.10         |
| 50    | 22.72 | 25.49     | 12.71             | 13.77              | 1.03      | 0.42    | 39.07       | 23.80            | 1.09         |
| 60    | 22.65 | 25.47     | 12.70             | 13.63              | 1.03      | 0.43    | 39.61       | 23.70            | 1.11         |
| 70    | 22.59 | 25.40     | 12.83             | 13.47              | 1.03      | 0.42    | 42.10       | 23.76            | 1.11         |
| 80    | 22.55 | 25.47     | 12.89             | 13.42              | 1.03      | 0.43    | 40.26       | 23.69            | 1.14         |
| 90    | 22.52 | 25.31     | 12.99             | 13.37              | 1.03      | 0.41    | 42.01       | 23.76            | 1.17         |
| 100   | 22.50 | 25.38     | 13.02             | 13.33              | 1.03      | 0.42    | 37.95       | 23.80            | 1.19         |
| 150   | 22.43 | 25.35     | 13.07             | 13.32              | 1.04      | 0.42    | 41.98       | 23.82            | 1.16         |
| 200   | 22.38 | 25.39     | 13.03             | 13.43              | 1.04      | 0.44    | 40.57       | 23.97            | 1.18         |
| 250   | 22.35 | 25.46     | 12.94             | 13.59              | 1.04      | 0.45    | 37.96       | 24.11            | 1.16         |
| 300   | 22.33 | 25.47     | 12.82             | 13.79              | 1.05      | 0.46    | 38.94       | 24.25            | 1.16         |
| 350   | 22.29 | 25.57     | 12.64             | 14.03              | 1.05      | 0.48    | 36.74       | 24.19            | 1.18         |
| 400   | 22.25 | 25.60     | 12.45             | 14.30              | 1.05      | 0.49    | 36.45       | 24.17            | 1.21         |
| 450   | 22.22 | 25.67     | 12.21             | 14.59              | 1.06      | 0.51    | 37.28       | 23.98            | 1.19         |
| 500   | 22.16 | 25.75     | 11.91             | 14.93              | 1.06      | 0.53    | 38.33       | 23.78            | 1.19         |
| 550   | 22.11 | 25.87     | 11.67             | 15.22              | 1.07      | 0.56    | 38.08       | 24.14            | 1.20         |
| 600   | 22.05 | 25.94     | 11.35             | 15.53              | 1.07      | 0.58    | 37.21       | 23.93            | 1.28         |
| 650   | 21.98 | 26.06     | 11.06             | 15.77              | 1.08      | 0.60    | 37.95       | 24.00            | 1.28         |
| 700   | 21.91 | 26.17     | 10.82             | 15.98              | 1.08      | 0.62    | 37.12       | 23.81            | 1.23         |
| 750   | 21.83 | 26.34     | 10.56             | 16.14              | 1.09      | 0.65    | 36.45       | 23.70            | 1.23         |
| 800   | 21.74 | 26.40     | 10.34             | 16.22              | 1.10      | 0.67    | 36.52       | 23.62            | 1.20         |
| 850   | 21.67 | 26.50     | 10.16             | 16.29              | 1.10      | 0.69    | 36.32       | 23.83            | 1.22         |
| 900   | 21.59 | 26.59     | 9.94              | 16.22              | 1.11      | 0.71    | 36.16       | 23.76            | 1.23         |
| 950   | 21.52 | 26.73     | 9.77              | 16.07              | 1.12      | 0.73    | 35.94       | 23.66            | 1.23         |
| 1000  | 21.44 | 26.83     | 9.63              | 15.81              | 1.12      | 0.74    | 36.80       | 24.05            | 1.22         |
| 1100  | 21.27 | 27.07     | 9.41              | 15.11              | 1.14      | 0.77    | 36.25       | 23.74            | 1.26         |
| 1200  | 21.11 | 27.34     | 9.32              | 14.29              | 1.16      | 0.80    | 35.24       | 23.79            | 1.32         |
| 1300  | 20.95 | 27.58     | 9.38              | 13.46              | 1.18      | 0.81    | 35.24       | 23.51            | 1.32         |
| 1400  | 20.81 | 27.76     | 9.53              | 12.66              | 1.20      | 0.82    | 35.32       | 23.45            | 1.30         |
| 1500  | 20.68 | 27.94     | 9.81              | 11.90              | 1.21      | 0.82    | 35.24       | 23.53            | 1.35         |
| 1600  | 20.55 | 28.15     | 10.22             | 11.26              | 1.23      | 0.82    | 34.29       | 23.27            | 1.34         |
| 1700  | 20.43 | 28.27     | 10.76             | 10.72              | 1.24      | 0.82    | 33.98       | 22.46            | 1.34         |
| 1800  | 20.30 | 28.48     | 11.34             | 10.28              | 1.26      | 0.83    | 34.57       | 23.39            | 1.34         |
| 1900  | 20.15 | 28.64     | 11.80             | 9.91               | 1.28      | 0.83    | 34.35       | 23.26            | 1.42         |
| 2000  | 19.97 | 28.98     | 11.92             | 9.63               | 1.31      | 0.85    | 33.93       | 22.85            | 1.44         |
| 2100  | 19.74 | 29.21     | 11.47             | 9.42               | 1.33      | 0.88    | 34.05       | 22.90            | 1.51         |
| 2200  | 19.44 | 29.52     | 10.42             | 9.29               | 1.35      | 0.92    | 33.06       | 22.43            | 1.65         |
| 2300  | 19.05 | 29.90     | 9.07              | 9.19               | 1.37      | 0.97    | 33.40       | 22.47            | 1.78         |
| 2400  | 18.56 | 30.34     | 7.70              | 9.12               | 1.40      | 1.03    | 32.57       | 22.04            | 1.96         |
| 2500  | 17.99 | 30.83     | 6.45              | 9.03               | 1.43      | 1.10    | 32.95       | 22.25            | 2.24         |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package



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IF/RF MICROWAVE COMPONENTS

REV. OR  
TSS-23HLN-D+  
6/6/2019  
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*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, Id = 151mA @ Temperature = +25°C

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 20    | 23.47 | 26.51     | 10.43                   | 14.70                    | 1.02      | 0.49    | 35.45          | 22.49                  | 1.22            |
| 30    | 23.14 | 25.93     | 11.56                   | 14.74                    | 1.02      | 0.45    | 40.19          | 23.18                  | 1.14            |
| 40    | 22.91 | 25.70     | 12.11                   | 14.19                    | 1.02      | 0.44    | 38.43          | 23.84                  | 1.10            |
| 50    | 22.75 | 25.25     | 12.57                   | 13.72                    | 1.02      | 0.39    | 40.22          | 24.20                  | 1.14            |
| 60    | 22.68 | 25.51     | 12.66                   | 13.55                    | 1.03      | 0.43    | 38.35          | 24.16                  | 1.14            |
| 70    | 22.62 | 25.46     | 12.79                   | 13.41                    | 1.03      | 0.42    | 44.88          | 24.15                  | 1.11            |
| 80    | 22.58 | 25.52     | 12.85                   | 13.35                    | 1.04      | 0.43    | 39.98          | 24.08                  | 1.15            |
| 90    | 22.55 | 25.36     | 12.94                   | 13.31                    | 1.03      | 0.41    | 39.60          | 24.22                  | 1.17            |
| 100   | 22.52 | 25.37     | 12.98                   | 13.26                    | 1.03      | 0.42    | 37.44          | 24.20                  | 1.20            |
| 150   | 22.46 | 25.42     | 13.06                   | 13.24                    | 1.04      | 0.43    | 42.74          | 24.28                  | 1.24            |
| 200   | 22.41 | 25.44     | 13.04                   | 13.33                    | 1.04      | 0.44    | 39.31          | 24.44                  | 1.18            |
| 250   | 22.39 | 25.52     | 12.97                   | 13.50                    | 1.04      | 0.45    | 37.42          | 24.58                  | 1.19            |
| 300   | 22.36 | 25.48     | 12.87                   | 13.68                    | 1.04      | 0.46    | 41.52          | 24.66                  | 1.20            |
| 350   | 22.32 | 25.61     | 12.69                   | 13.92                    | 1.05      | 0.48    | 38.79          | 24.67                  | 1.21            |
| 400   | 22.29 | 25.65     | 12.52                   | 14.17                    | 1.05      | 0.49    | 38.50          | 24.66                  | 1.22            |
| 450   | 22.25 | 25.69     | 12.32                   | 14.48                    | 1.06      | 0.51    | 39.29          | 24.47                  | 1.22            |
| 500   | 22.20 | 25.81     | 12.02                   | 14.80                    | 1.06      | 0.53    | 38.38          | 24.20                  | 1.21            |
| 550   | 22.15 | 25.92     | 11.77                   | 15.07                    | 1.07      | 0.56    | 38.41          | 24.64                  | 1.22            |
| 600   | 22.09 | 25.98     | 11.49                   | 15.35                    | 1.07      | 0.57    | 38.87          | 24.44                  | 1.29            |
| 650   | 22.02 | 26.06     | 11.20                   | 15.57                    | 1.07      | 0.59    | 37.71          | 24.43                  | 1.28            |
| 700   | 21.96 | 26.19     | 10.96                   | 15.70                    | 1.08      | 0.62    | 38.09          | 24.33                  | 1.26            |
| 750   | 21.87 | 26.29     | 10.70                   | 15.82                    | 1.09      | 0.64    | 37.14          | 24.13                  | 1.24            |
| 800   | 21.79 | 26.46     | 10.50                   | 15.85                    | 1.10      | 0.66    | 36.78          | 24.15                  | 1.28            |
| 850   | 21.72 | 26.52     | 10.32                   | 15.84                    | 1.10      | 0.68    | 37.58          | 24.36                  | 1.28            |
| 900   | 21.64 | 26.64     | 10.13                   | 15.73                    | 1.11      | 0.70    | 36.57          | 24.29                  | 1.24            |
| 950   | 21.57 | 26.73     | 9.94                    | 15.54                    | 1.11      | 0.71    | 36.09          | 24.20                  | 1.25            |
| 1000  | 21.50 | 26.85     | 9.82                    | 15.26                    | 1.12      | 0.73    | 36.88          | 24.59                  | 1.26            |
| 1100  | 21.34 | 27.11     | 9.62                    | 14.56                    | 1.14      | 0.76    | 36.16          | 24.29                  | 1.29            |
| 1200  | 21.19 | 27.34     | 9.56                    | 13.77                    | 1.16      | 0.78    | 36.24          | 24.35                  | 1.35            |
| 1300  | 21.04 | 27.55     | 9.64                    | 13.00                    | 1.17      | 0.79    | 35.78          | 23.97                  | 1.34            |
| 1400  | 20.90 | 27.78     | 9.83                    | 12.26                    | 1.19      | 0.80    | 35.37          | 23.91                  | 1.35            |
| 1500  | 20.78 | 28.02     | 10.13                   | 11.58                    | 1.21      | 0.81    | 36.00          | 24.10                  | 1.36            |
| 1600  | 20.65 | 28.17     | 10.53                   | 11.01                    | 1.23      | 0.81    | 35.15          | 23.73                  | 1.37            |
| 1700  | 20.54 | 28.43     | 11.05                   | 10.54                    | 1.25      | 0.81    | 34.28          | 22.91                  | 1.37            |
| 1800  | 20.40 | 28.59     | 11.56                   | 10.16                    | 1.27      | 0.82    | 35.20          | 23.85                  | 1.37            |
| 1900  | 20.25 | 28.93     | 11.90                   | 9.82                     | 1.30      | 0.84    | 35.11          | 23.72                  | 1.38            |
| 2000  | 20.05 | 29.16     | 11.83                   | 9.58                     | 1.32      | 0.86    | 34.23          | 23.39                  | 1.44            |
| 2100  | 19.81 | 29.46     | 11.21                   | 9.39                     | 1.34      | 0.89    | 34.68          | 23.43                  | 1.50            |
| 2200  | 19.51 | 29.82     | 10.12                   | 9.23                     | 1.37      | 0.93    | 33.76          | 22.85                  | 1.61            |
| 2300  | 19.12 | 30.24     | 8.81                    | 9.10                     | 1.39      | 0.98    | 33.42          | 22.89                  | 1.76            |
| 2400  | 18.65 | 30.64     | 7.50                    | 8.98                     | 1.41      | 1.04    | 32.60          | 22.47                  | 1.94            |
| 2500  | 18.11 | 31.18     | 6.32                    | 8.84                     | 1.44      | 1.10    | 33.09          | 22.82                  | 3.16            |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## 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 = 7.60V, Id = 224mA @ 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)         |
| 20    | 23.64 | 26.42     | 10.43             | 14.93              | 1.02      | 0.46    | 37.10       | 25.81            | 1.43         |
| 30    | 23.29 | 26.11     | 11.40             | 14.80              | 1.02      | 0.46    | 37.46       | 25.89            | 1.34         |
| 40    | 23.06 | 25.81     | 11.84             | 14.20              | 1.02      | 0.43    | 42.33       | 27.04            | 1.29         |
| 50    | 22.88 | 26.31     | 12.33             | 13.56              | 1.05      | 0.50    | 38.72       | 27.41            | 1.33         |
| 60    | 22.82 | 25.68     | 12.28             | 13.54              | 1.03      | 0.43    | 42.21       | 27.07            | 1.30         |
| 70    | 22.76 | 25.60     | 12.37             | 13.37              | 1.03      | 0.42    | 41.75       | 26.92            | 1.30         |
| 80    | 22.71 | 25.55     | 12.41             | 13.31              | 1.03      | 0.42    | 39.46       | 27.17            | 1.34         |
| 90    | 22.68 | 25.60     | 12.48             | 13.23              | 1.04      | 0.43    | 43.53       | 27.22            | 1.36         |
| 100   | 22.66 | 25.54     | 12.51             | 13.20              | 1.03      | 0.42    | 37.86       | 27.20            | 1.34         |
| 150   | 22.59 | 25.59     | 12.56             | 13.09              | 1.04      | 0.43    | 42.24       | 27.31            | 1.42         |
| 200   | 22.55 | 25.61     | 12.57             | 13.12              | 1.04      | 0.44    | 42.46       | 27.45            | 1.37         |
| 250   | 22.52 | 25.58     | 12.54             | 13.19              | 1.04      | 0.44    | 38.55       | 27.57            | 1.34         |
| 300   | 22.49 | 25.64     | 12.51             | 13.21              | 1.05      | 0.45    | 41.92       | 27.73            | 1.32         |
| 350   | 22.46 | 25.68     | 12.41             | 13.30              | 1.05      | 0.46    | 41.61       | 27.71            | 1.35         |
| 400   | 22.43 | 25.84     | 12.30             | 13.36              | 1.05      | 0.48    | 41.84       | 27.72            | 1.38         |
| 450   | 22.40 | 25.86     | 12.16             | 13.43              | 1.06      | 0.49    | 43.02       | 27.61            | 1.34         |
| 500   | 22.35 | 25.91     | 11.95             | 13.52              | 1.06      | 0.51    | 42.72       | 27.47            | 1.37         |
| 550   | 22.30 | 26.04     | 11.76             | 13.52              | 1.07      | 0.53    | 44.56       | 27.81            | 1.39         |
| 600   | 22.25 | 26.16     | 11.55             | 13.55              | 1.07      | 0.55    | 47.18       | 27.72            | 1.43         |
| 650   | 22.19 | 26.23     | 11.34             | 13.49              | 1.08      | 0.56    | 41.99       | 27.76            | 1.43         |
| 700   | 22.13 | 26.38     | 11.14             | 13.40              | 1.08      | 0.58    | 43.66       | 27.68            | 1.40         |
| 750   | 22.06 | 26.47     | 10.93             | 13.31              | 1.09      | 0.60    | 42.19       | 27.59            | 1.40         |
| 800   | 21.99 | 26.63     | 10.78             | 13.16              | 1.10      | 0.62    | 42.07       | 27.56            | 1.41         |
| 850   | 21.92 | 26.74     | 10.63             | 13.04              | 1.11      | 0.63    | 42.16       | 27.83            | 1.41         |
| 900   | 21.86 | 26.83     | 10.46             | 12.86              | 1.11      | 0.64    | 40.39       | 27.72            | 1.40         |
| 950   | 21.79 | 26.98     | 10.31             | 12.66              | 1.12      | 0.66    | 42.83       | 27.75            | 1.41         |
| 1000  | 21.73 | 27.11     | 10.20             | 12.41              | 1.13      | 0.67    | 42.72       | 28.04            | 1.37         |
| 1100  | 21.58 | 27.37     | 10.04             | 11.90              | 1.15      | 0.69    | 41.55       | 27.85            | 1.43         |
| 1200  | 21.44 | 27.63     | 10.02             | 11.38              | 1.17      | 0.71    | 43.81       | 27.93            | 1.46         |
| 1300  | 21.30 | 27.95     | 10.14             | 10.84              | 1.19      | 0.73    | 41.71       | 27.82            | 1.43         |
| 1400  | 21.17 | 28.20     | 10.36             | 10.36              | 1.21      | 0.74    | 44.66       | 27.76            | 1.49         |
| 1500  | 21.06 | 28.49     | 10.71             | 9.88               | 1.24      | 0.74    | 43.71       | 27.81            | 1.50         |
| 1600  | 20.94 | 28.78     | 11.18             | 9.48               | 1.26      | 0.75    | 41.74       | 27.56            | 1.49         |
| 1700  | 20.83 | 29.16     | 11.75             | 9.15               | 1.30      | 0.76    | 45.53       | 26.99            | 1.50         |
| 1800  | 20.70 | 29.46     | 12.32             | 8.85               | 1.33      | 0.77    | 44.51       | 27.65            | 1.51         |
| 1900  | 20.55 | 29.85     | 12.68             | 8.57               | 1.36      | 0.79    | 43.38       | 27.42            | 1.55         |
| 2000  | 20.36 | 30.28     | 12.55             | 8.34               | 1.40      | 0.81    | 43.23       | 27.32            | 1.60         |
| 2100  | 20.13 | 30.67     | 11.83             | 8.12               | 1.43      | 0.84    | 42.43       | 27.13            | 1.72         |
| 2200  | 19.85 | 31.25     | 10.61             | 7.90               | 1.48      | 0.88    | 43.11       | 27.07            | 1.83         |
| 2300  | 19.48 | 31.89     | 9.21              | 7.68               | 1.54      | 0.92    | 41.64       | 26.82            | 1.97         |
| 2400  | 19.05 | 32.54     | 7.83              | 7.45               | 1.59      | 0.97    | 41.69       | 26.24            | 2.17         |
| 2500  | 18.54 | 33.13     | 6.58              | 7.19               | 1.61      | 1.02    | 42.32       | 26.73            | 2.47         |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## 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 = 8.00V, Id = 236mA @ Temperature = +25°C

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 20    | 23.65 | 26.47     | 10.44                   | 14.98                    | 1.02      | 0.46    | 37.83          | 26.16                  | 1.52            |
| 30    | 23.29 | 26.02     | 11.37                   | 14.91                    | 1.02      | 0.45    | 39.91          | 26.25                  | 1.73            |
| 40    | 23.06 | 25.93     | 11.78                   | 14.24                    | 1.03      | 0.45    | 40.11          | 27.45                  | 1.35            |
| 50    | 22.89 | 25.32     | 11.99                   | 13.75                    | 1.02      | 0.38    | 39.72          | 27.75                  | 1.37            |
| 60    | 22.82 | 25.64     | 12.17                   | 13.61                    | 1.03      | 0.43    | 41.71          | 27.43                  | 1.36            |
| 70    | 22.76 | 25.68     | 12.28                   | 13.43                    | 1.03      | 0.43    | 47.00          | 27.26                  | 1.35            |
| 80    | 22.71 | 25.61     | 12.32                   | 13.36                    | 1.03      | 0.43    | 46.38          | 27.52                  | 1.38            |
| 90    | 22.68 | 25.60     | 12.36                   | 13.31                    | 1.03      | 0.43    | 41.24          | 27.87                  | 1.42            |
| 100   | 22.66 | 25.63     | 12.40                   | 13.25                    | 1.04      | 0.43    | 39.34          | 27.57                  | 1.42            |
| 150   | 22.59 | 25.59     | 12.46                   | 13.18                    | 1.04      | 0.43    | 42.26          | 27.69                  | 1.38            |
| 200   | 22.55 | 25.61     | 12.45                   | 13.16                    | 1.04      | 0.44    | 43.06          | 27.80                  | 1.40            |
| 250   | 22.52 | 25.66     | 12.40                   | 13.20                    | 1.04      | 0.45    | 40.83          | 27.90                  | 1.36            |
| 300   | 22.49 | 25.69     | 12.37                   | 13.22                    | 1.05      | 0.46    | 41.47          | 28.06                  | 1.38            |
| 350   | 22.46 | 25.77     | 12.26                   | 13.25                    | 1.05      | 0.47    | 38.36          | 28.08                  | 1.38            |
| 400   | 22.43 | 25.78     | 12.16                   | 13.30                    | 1.05      | 0.48    | 40.73          | 28.09                  | 1.42            |
| 450   | 22.39 | 25.91     | 12.03                   | 13.32                    | 1.06      | 0.50    | 41.80          | 27.94                  | 1.39            |
| 500   | 22.35 | 25.92     | 11.82                   | 13.37                    | 1.06      | 0.50    | 42.10          | 27.86                  | 1.40            |
| 550   | 22.30 | 26.07     | 11.67                   | 13.35                    | 1.07      | 0.53    | 44.94          | 28.18                  | 1.40            |
| 600   | 22.25 | 26.20     | 11.45                   | 13.33                    | 1.07      | 0.55    | 41.73          | 28.04                  | 1.47            |
| 650   | 22.19 | 26.28     | 11.23                   | 13.26                    | 1.08      | 0.56    | 42.95          | 28.15                  | 1.47            |
| 700   | 22.14 | 26.37     | 11.05                   | 13.17                    | 1.08      | 0.57    | 40.51          | 28.06                  | 1.45            |
| 750   | 22.06 | 26.45     | 10.85                   | 13.04                    | 1.09      | 0.59    | 44.14          | 27.98                  | 1.42            |
| 800   | 21.99 | 26.62     | 10.69                   | 12.92                    | 1.10      | 0.61    | 42.21          | 27.96                  | 1.42            |
| 850   | 21.92 | 26.74     | 10.55                   | 12.79                    | 1.10      | 0.63    | 41.75          | 28.15                  | 1.42            |
| 900   | 21.86 | 26.88     | 10.39                   | 12.62                    | 1.11      | 0.64    | 43.41          | 28.12                  | 1.42            |
| 950   | 21.79 | 26.99     | 10.23                   | 12.45                    | 1.12      | 0.65    | 42.74          | 28.16                  | 1.44            |
| 1000  | 21.72 | 27.09     | 10.12                   | 12.21                    | 1.13      | 0.67    | 41.51          | 28.43                  | 1.41            |
| 1100  | 21.57 | 27.41     | 9.95                    | 11.73                    | 1.15      | 0.69    | 42.36          | 28.22                  | 1.47            |
| 1200  | 21.43 | 27.69     | 9.90                    | 11.22                    | 1.17      | 0.71    | 43.66          | 28.30                  | 1.47            |
| 1300  | 21.28 | 27.98     | 10.01                   | 10.73                    | 1.19      | 0.73    | 41.50          | 28.20                  | 1.51            |
| 1400  | 21.15 | 28.31     | 10.21                   | 10.26                    | 1.22      | 0.74    | 41.93          | 28.13                  | 1.51            |
| 1500  | 21.03 | 28.63     | 10.55                   | 9.79                     | 1.25      | 0.75    | 42.47          | 28.10                  | 1.51            |
| 1600  | 20.91 | 28.87     | 11.03                   | 9.39                     | 1.27      | 0.75    | 42.06          | 27.93                  | 1.54            |
| 1700  | 20.80 | 29.23     | 11.64                   | 9.03                     | 1.31      | 0.76    | 42.90          | 27.39                  | 1.54            |
| 1800  | 20.67 | 29.57     | 12.31                   | 8.73                     | 1.34      | 0.77    | 43.16          | 28.00                  | 1.56            |
| 1900  | 20.53 | 29.89     | 12.83                   | 8.45                     | 1.37      | 0.78    | 44.21          | 27.78                  | 1.62            |
| 2000  | 20.35 | 30.38     | 12.93                   | 8.21                     | 1.42      | 0.80    | 41.42          | 27.69                  | 1.67            |
| 2100  | 20.13 | 30.85     | 12.33                   | 7.97                     | 1.47      | 0.83    | 40.45          | 27.51                  | 1.76            |
| 2200  | 19.85 | 31.39     | 11.10                   | 7.77                     | 1.51      | 0.86    | 41.81          | 27.48                  | 1.91            |
| 2300  | 19.48 | 32.02     | 9.61                    | 7.55                     | 1.57      | 0.91    | 43.52          | 27.23                  | 2.06            |
| 2400  | 19.04 | 32.62     | 8.14                    | 7.32                     | 1.62      | 0.95    | 43.56          | 26.77                  | 2.30            |
| 2500  | 18.51 | 33.30     | 6.82                    | 7.07                     | 1.67      | 1.00    | 45.11          | 27.22                  | 2.56            |

Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

*Typical Performance Data***Definitions:**

Input Return Loss = -S11 (dB)

Gain(Power Gain) = S21 (dB)

Reverse Isolation = -S12 (dB)

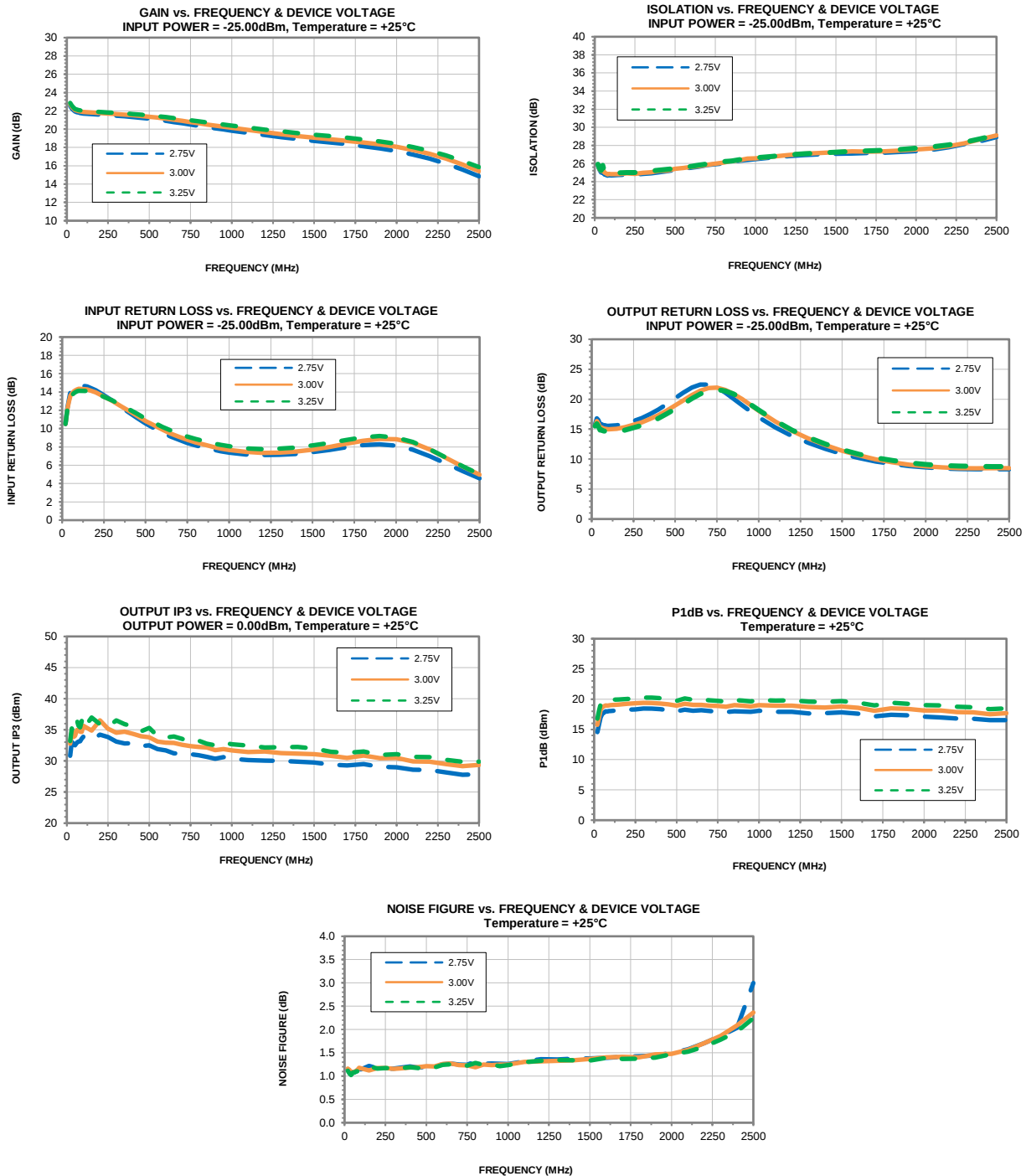
Output Return Loss = -S22 (dB)

TEST CONDITIONS: Vd = 8.40V, Id = 245mA @ Temperature = +25°C

| FREQ  | Gain  | Isolation | Input<br>Return<br>Loss | Output<br>Return<br>Loss | Stability |         | IP-3<br>Output | 1dB<br>Comp.<br>Output | Noise<br>Figure |
|-------|-------|-----------|-------------------------|--------------------------|-----------|---------|----------------|------------------------|-----------------|
| (MHz) | (dB)  | (dB)      | (dB)                    | (dB)                     | K         | Measure | (dBm)          | (dBm)                  | (dB)            |
| 20    | 23.61 | 26.56     | 10.45                   | 15.05                    | 1.02      | 0.48    | 36.92          | 26.78                  | 1.58            |
| 30    | 23.26 | 26.14     | 11.38                   | 14.95                    | 1.02      | 0.47    | 40.85          | 26.80                  | 1.45            |
| 40    | 23.03 | 25.84     | 11.79                   | 14.35                    | 1.02      | 0.44    | 38.34          | 28.15                  | 1.42            |
| 50    | 22.86 | 26.24     | 11.99                   | 13.68                    | 1.05      | 0.50    | 40.17          | 28.31                  | 1.45            |
| 60    | 22.79 | 25.72     | 12.18                   | 13.67                    | 1.03      | 0.44    | 39.45          | 28.03                  | 1.43            |
| 70    | 22.73 | 25.68     | 12.26                   | 13.50                    | 1.03      | 0.44    | 42.62          | 27.78                  | 1.42            |
| 80    | 22.69 | 25.56     | 12.32                   | 13.43                    | 1.03      | 0.42    | 41.87          | 28.20                  | 1.45            |
| 90    | 22.66 | 25.65     | 12.36                   | 13.35                    | 1.04      | 0.44    | 40.70          | 28.50                  | 1.47            |
| 100   | 22.63 | 25.59     | 12.37                   | 13.31                    | 1.04      | 0.43    | 38.77          | 28.06                  | 1.50            |
| 150   | 22.57 | 25.66     | 12.45                   | 13.21                    | 1.04      | 0.44    | 41.54          | 28.32                  | 1.53            |
| 200   | 22.52 | 25.65     | 12.45                   | 13.20                    | 1.04      | 0.45    | 39.84          | 28.43                  | 1.46            |
| 250   | 22.49 | 25.60     | 12.41                   | 13.27                    | 1.04      | 0.45    | 38.43          | 28.52                  | 1.46            |
| 300   | 22.47 | 25.67     | 12.38                   | 13.27                    | 1.05      | 0.46    | 41.71          | 28.68                  | 1.47            |
| 350   | 22.43 | 25.69     | 12.28                   | 13.32                    | 1.05      | 0.47    | 41.32          | 28.70                  | 1.49            |
| 400   | 22.40 | 25.81     | 12.18                   | 13.35                    | 1.05      | 0.48    | 41.08          | 28.71                  | 1.49            |
| 450   | 22.37 | 25.88     | 12.07                   | 13.38                    | 1.06      | 0.50    | 42.61          | 28.60                  | 1.47            |
| 500   | 22.32 | 26.00     | 11.84                   | 13.43                    | 1.06      | 0.52    | 42.73          | 28.50                  | 1.47            |
| 550   | 22.28 | 26.08     | 11.67                   | 13.39                    | 1.07      | 0.53    | 42.93          | 28.79                  | 1.50            |
| 600   | 22.22 | 26.17     | 11.46                   | 13.38                    | 1.07      | 0.55    | 42.51          | 28.73                  | 1.53            |
| 650   | 22.16 | 26.30     | 11.25                   | 13.28                    | 1.08      | 0.57    | 40.91          | 28.83                  | 1.56            |
| 700   | 22.11 | 26.47     | 11.08                   | 13.15                    | 1.09      | 0.59    | 43.00          | 28.71                  | 1.53            |
| 750   | 22.03 | 26.56     | 10.87                   | 13.04                    | 1.09      | 0.60    | 41.92          | 28.64                  | 1.49            |
| 800   | 21.96 | 26.69     | 10.71                   | 12.87                    | 1.10      | 0.62    | 42.55          | 28.68                  | 1.52            |
| 850   | 21.89 | 26.82     | 10.58                   | 12.72                    | 1.11      | 0.63    | 43.78          | 28.83                  | 1.52            |
| 900   | 21.83 | 26.90     | 10.42                   | 12.52                    | 1.12      | 0.64    | 42.43          | 28.80                  | 1.52            |
| 950   | 21.77 | 26.99     | 10.28                   | 12.31                    | 1.12      | 0.65    | 42.76          | 28.88                  | 1.53            |
| 1000  | 21.70 | 27.19     | 10.17                   | 12.07                    | 1.13      | 0.67    | 41.46          | 29.05                  | 1.50            |
| 1100  | 21.55 | 27.46     | 10.03                   | 11.54                    | 1.15      | 0.69    | 44.14          | 28.83                  | 1.55            |
| 1200  | 21.41 | 27.70     | 10.01                   | 11.03                    | 1.17      | 0.71    | 41.99          | 28.91                  | 1.57            |
| 1300  | 21.28 | 28.01     | 10.12                   | 10.51                    | 1.19      | 0.72    | 40.31          | 28.83                  | 1.56            |
| 1400  | 21.15 | 28.32     | 10.35                   | 10.05                    | 1.22      | 0.73    | 41.65          | 28.74                  | 1.62            |
| 1500  | 21.03 | 28.62     | 10.71                   | 9.58                     | 1.25      | 0.74    | 41.73          | 28.69                  | 1.59            |
| 1600  | 20.92 | 28.94     | 11.17                   | 9.21                     | 1.28      | 0.75    | 41.42          | 28.54                  | 1.64            |
| 1700  | 20.80 | 29.25     | 11.73                   | 8.88                     | 1.30      | 0.76    | 42.42          | 28.09                  | 1.65            |
| 1800  | 20.67 | 29.56     | 12.29                   | 8.58                     | 1.33      | 0.76    | 43.53          | 28.60                  | 1.63            |
| 1900  | 20.52 | 29.87     | 12.62                   | 8.31                     | 1.36      | 0.78    | 39.87          | 28.36                  | 1.68            |
| 2000  | 20.33 | 30.45     | 12.46                   | 8.08                     | 1.42      | 0.81    | 42.01          | 28.27                  | 1.73            |
| 2100  | 20.10 | 30.94     | 11.72                   | 7.85                     | 1.46      | 0.83    | 40.20          | 28.08                  | 1.81            |
| 2200  | 19.81 | 31.50     | 10.51                   | 7.62                     | 1.51      | 0.87    | 42.19          | 28.07                  | 1.93            |
| 2300  | 19.44 | 32.08     | 9.11                    | 7.40                     | 1.55      | 0.91    | 44.11          | 27.80                  | 2.15            |
| 2400  | 19.00 | 32.70     | 7.74                    | 7.16                     | 1.59      | 0.96    | 43.76          | 27.36                  | 2.34            |
| 2500  | 18.49 | 33.34     | 6.53                    | 6.90                     | 1.63      | 1.00    | 40.11          | 27.67                  | 2.63            |

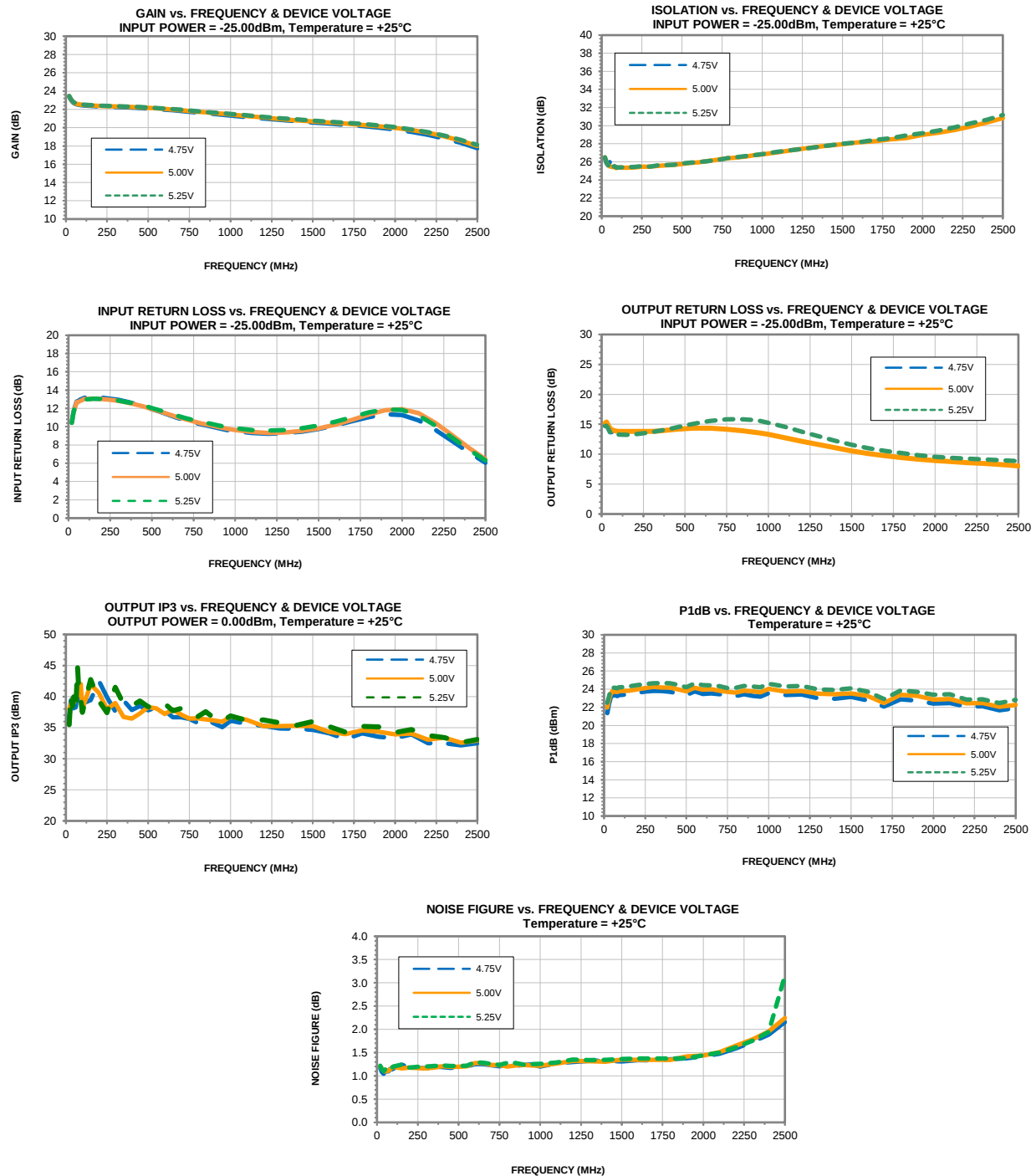
Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## Typical Performance Curves



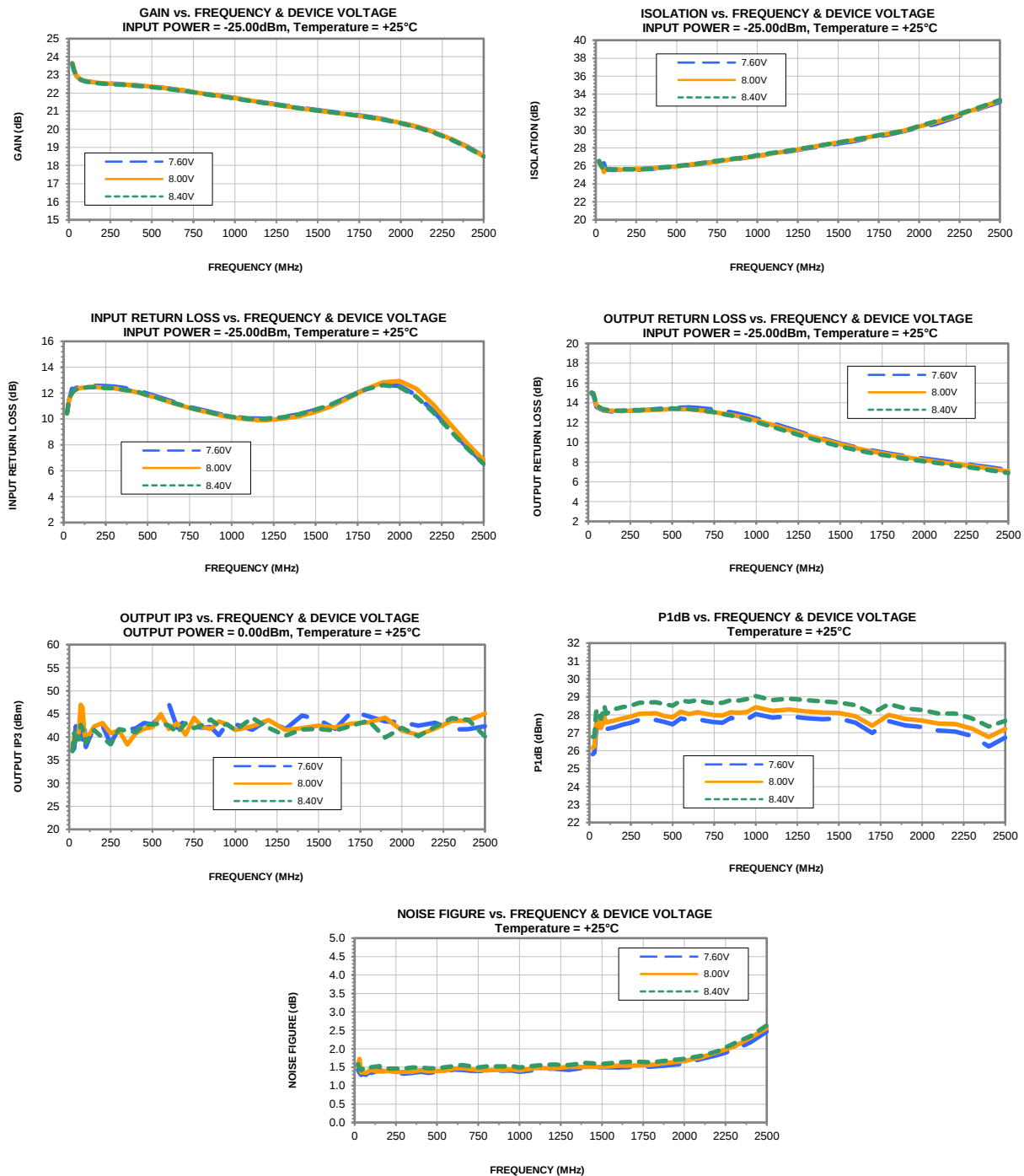
Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## Typical Performance Curves



Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package

## Typical Performance Curves



Note: Test data of Die packaged in industry standard 3x3 mm, 12-lead MCL package



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 -40° to 105° C or -55° to 105° C<br>Ambient Environment | Refer to Individual Model Data Sheet |
| Storage Environment   | 20° to 35° C and 40 to 60% humidity<br>(In Factory Shipped Package)      | Individual Model Data Sheet          |