

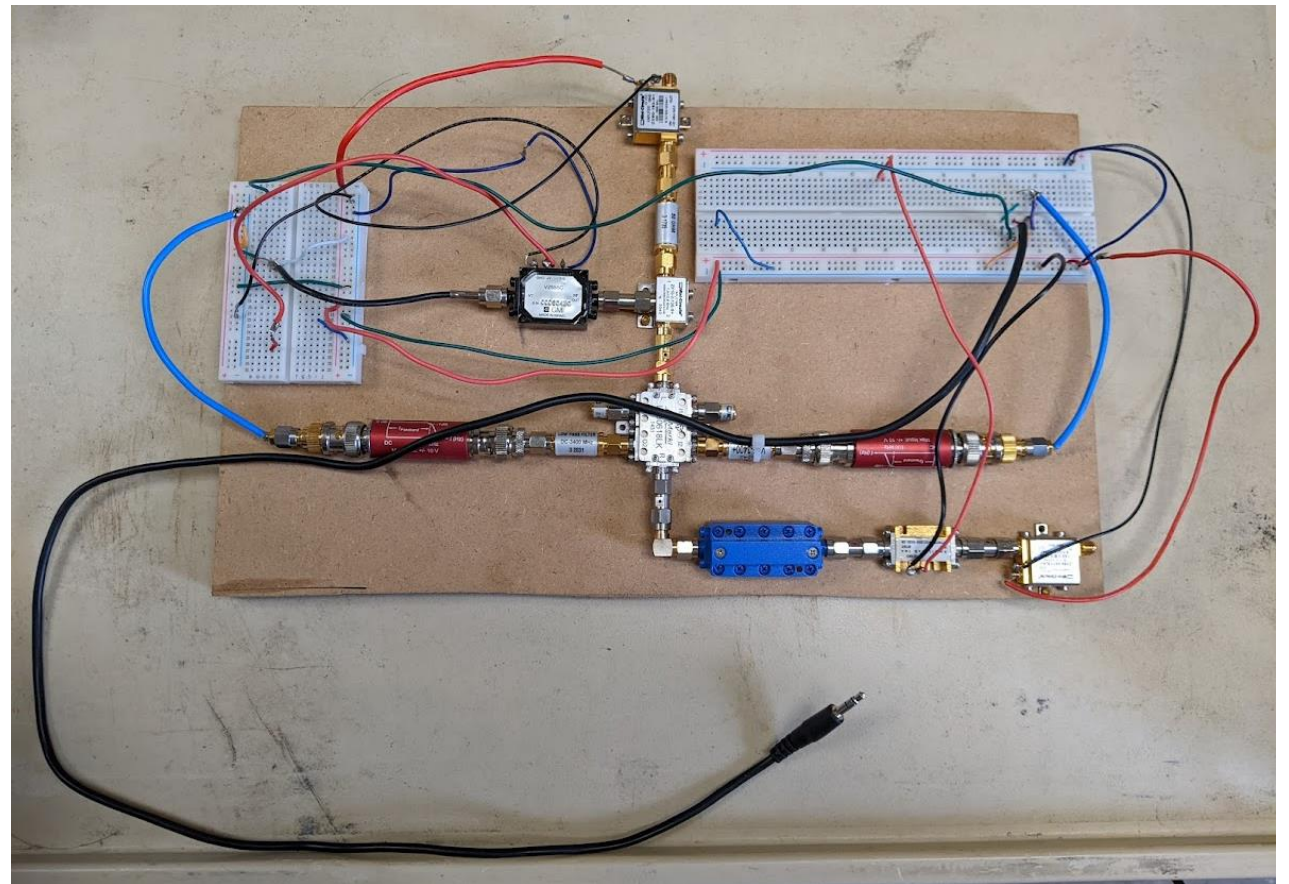
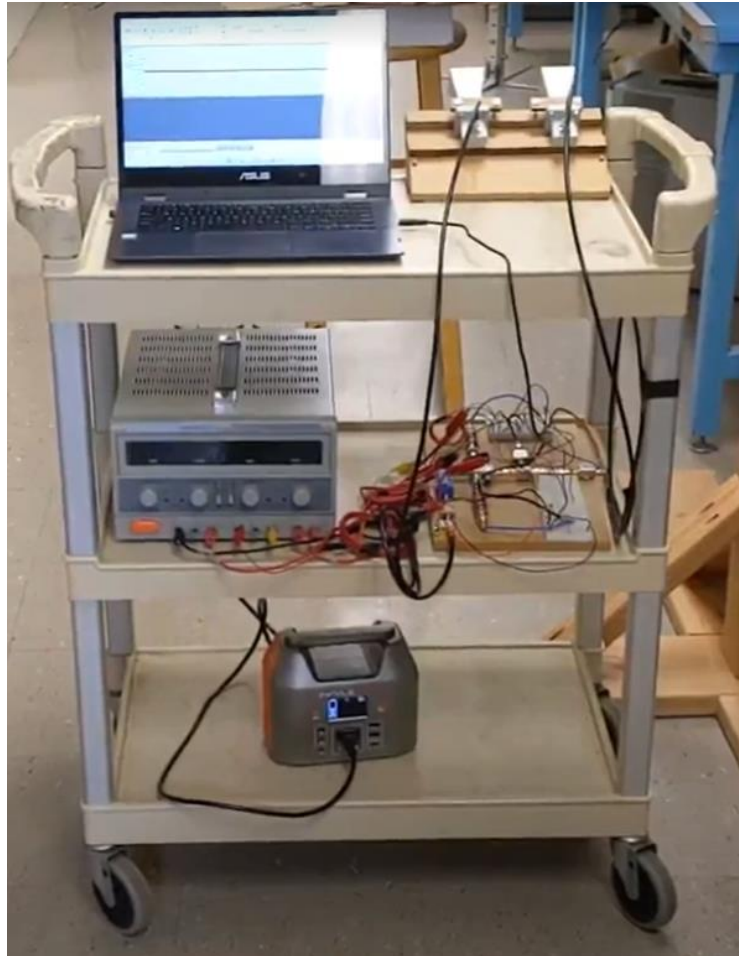
# 10 GHZ CW DOPPLER RADAR

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Bryan Tsang

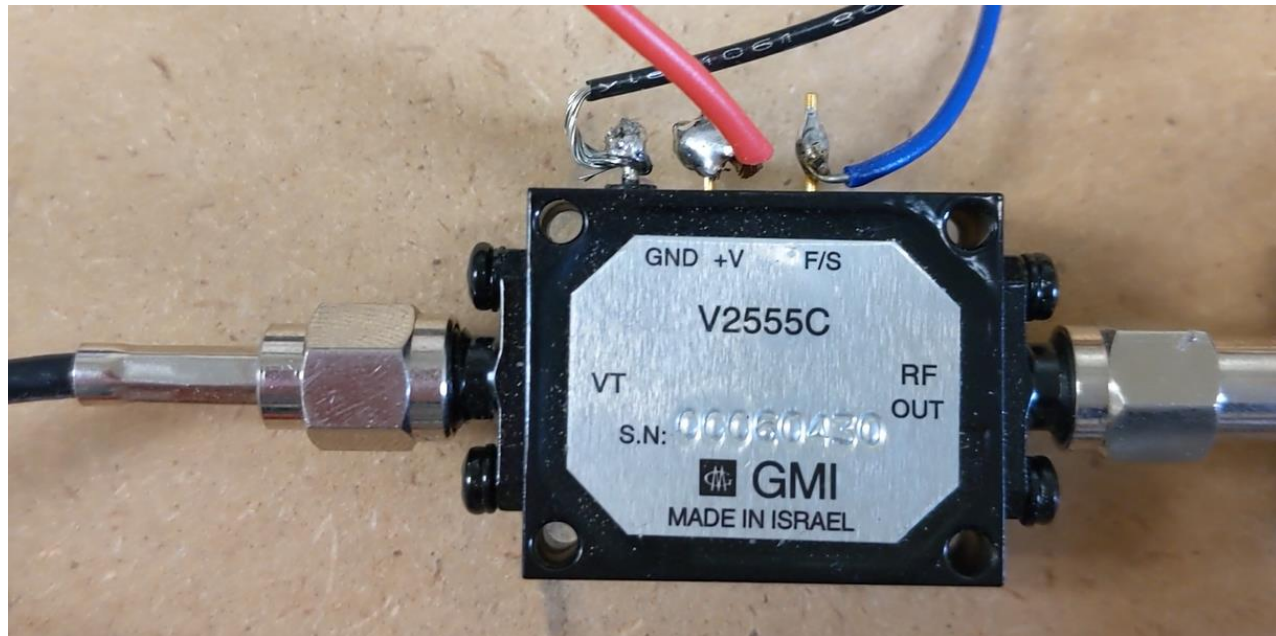


# THE RADAR SYSTEM





# VOLTAGE CONTROLLED OSCILLATOR



GENERAL MICROWAVE CORP. Thu Sep 28 16:24:52 2000

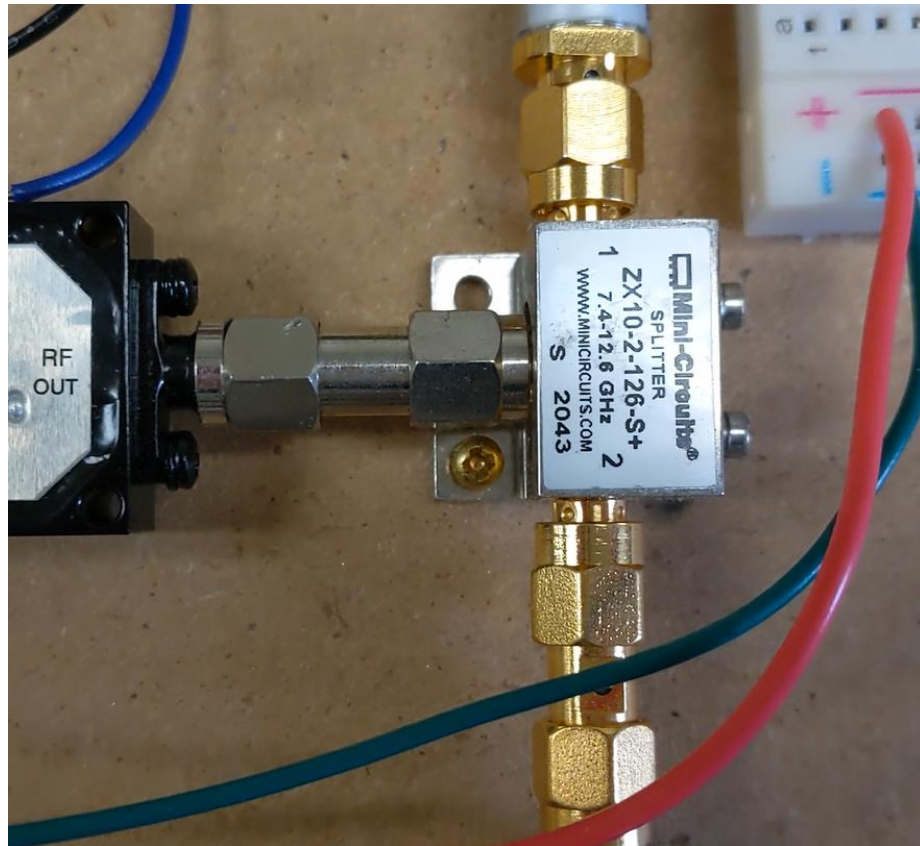
TEST DATA SHEETS FOR  
ACCEPTANCE TEST PROCEDURE (SHEET 1 OF 1)

MODEL: V2555C S/N: 00060653

DATE: 28.09.00  
TESTED BY: EREZ

| #   | MEASUREMENT   | DATA           | SPEC               | UNITS |
|-----|---|----------------|--------------------|-------|
| 1.1 | F/S=TTL low Center Freq. (RF_LOW)                   | 9.95328        | 9.95328            | GHz   |
| 1.2 | F/S=TTL high Center Freq. (RF_HIGH)                 | 10.66423       | 10.66423           | GHz   |
| 2.1 | Tuning Voltage (RF_LOW): @25°C<br>Over Temperature  | 3.876<br>4.007 | 3 - 6.5<br>2 - 7.5 | Volt  |
| 2.2 | Tuning Voltage (RF_HIGH): @25°C<br>Over Temperature | 5.444<br>5.641 | 3 - 6.5<br>2 - 7.5 | Volt  |
| 3.1 | Output Power (RF_LOW):                              | 12.6           | 13.6 10 - 14       | dBm   |
| 3.2 | Output Power (RF_HIGH):                             | 12.2           | 13.4 10 - 14       | dBm   |
| 4.1 | Nominal Sensitivity (RF_LOW):                       |                | 17.6 15 - 22       | MHz/V |
| 4.2 | Nominal Sensitivity (RF_HIGH):                      |                | 18.8 15 - 22       | MHz/V |
| 4.3 | Sensitivity Ratio(max) (RF_HIGH/RF_LOW)             | 1.1            | 1.4:1              |       |
| 5.1 | MSR Over ±10 MHz Deviation(max) (RF_LOW)            | 1.07           | 1.2:1              |       |
| 5.2 | MSR Over ±10 MHz Deviation(max) (RF_HIGH)           | 1.05           | 1.2:1              |       |

# 2-WAY POWER SPLITTER



DC Pass

## Power Splitter/Combiner

ZX10-2-126-S+

2 Way-0° 50Ω 7400 to 12600 MHz

### Maximum Ratings

|   |                             |
|---|-----------------------------|
| Operating Temperature   | -40°C to 85°C               |
| Storage Temperature   | -55°C to 100°C              |
| Power Input (as a splitter)                                     | 1.0W max.                   |
| Internal Dissipation (as a combiner)                            | 0.1W max.                   |
| DC Current  | 1.0 A (500mA for each port) |
| Permanent damage may occur if any of these limits are exceeded. |                             |

### Coaxial Connections

|          |   |
|----------|---|
| SUM PORT | 3 |
| PORT 1   | 1 |
| PORT 2   | 2 |

### Features

- low insertion loss, 0.3 dB typ.
- excellent amplitude unbalance
- very good phase unbalance
- small size
- low cost
- protected under U.S. Patent 6,790,049 & 6,963,255

### Applications

- SHF
- defense
- cable tv relay
- DECT
- DBS



Generic photo used for illustration purposes only

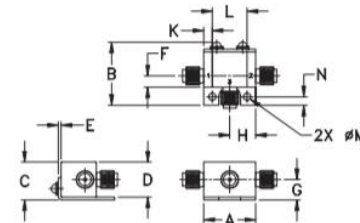
CASE STYLE: FL905

Connectors Model  
SMA ZX10-2-126-S+

+RoHS Compliant

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

### Outline Drawing



### Outline Dimensions (inch/mm)

| A     | B     | C     | D     | E    | F    | G     |
|-------|-------|-------|-------|------|------|-------|
| .74   | .90   | .54   | .50   | .04  | .16  | .29   |
| 18.80 | 22.86 | 13.72 | 12.70 | 1.02 | 4.06 | 7.37  |
| H     | J     | K     | L     | M    | N    | wt    |
| .37   | --    | .122  | .496  | .106 | .122 | grams |
| 9.40  | --    | 3.10  | 12.60 | 2.69 | 3.10 | 20.0  |

### Electrical Specifications (T<sub>AMB</sub> = 25°C)

| FREQ. RANGE (MHz)              | ISOLATION (dB) |      | INSERTION LOSS (dB) ABOVE 3.0 dB |      | PHASE UNBALANCE (Degrees) | AMPLITUDE UNBALANCE (dB) |
|--------------------------------|----------------|------|----------------------------------|------|---------------------------|--------------------------|
| f <sub>1</sub> -f <sub>2</sub> | Typ.           | Min. | Typ.                             | Max. | Max.                      | Max.                     |
| 7400-12600                     | 23             | 10   | 0.3                              | 1.3  | 10.0                      | 0.5                      |
| 9000-11000                     | 23             | 16   | 0.3                              | 0.6  | 5.0                       | 0.3                      |

### Typical Performance Data

| Frequency (MHz) | Total Loss <sup>1</sup> (dB) |      | Amplitude Unbalance (dB) | Isolation (dB) | Phase Unbalance (deg.) | VSWR S | VSWR 1 | VSWR 2 |
|-----------------|------------------------------|------|--------------------------|----------------|------------------------|--------|--------|--------|
|                 | S-1                          | S-2  |                          |                |                        |        |        |        |
| 7400.00         | 3.29                         | 3.35 | 0.06                     | 12.36          | 1.98                   | 1.43   | 1.24   | 1.29   |
| 7800.00         | 3.28                         | 3.32 | 0.04                     | 13.52          | 1.83                   | 1.37   | 1.28   | 1.31   |
| 8200.00         | 3.27                         | 3.29 | 0.01                     | 14.99          | 2.03                   | 1.35   | 1.30   | 1.32   |
| 8600.00         | 3.28                         | 3.28 | 0.00                     | 16.88          | 1.79                   | 1.35   | 1.31   | 1.31   |
| 9000.00         | 3.27                         | 3.26 | 0.01                     | 19.06          | 1.68                   | 1.35   | 1.30   | 1.27   |
| 9400.00         | 3.19                         | 3.20 | 0.01                     | 21.66          | 1.72                   | 1.31   | 1.26   | 1.21   |
| 9800.00         | 3.19                         | 3.18 | 0.01                     | 24.06          | 1.73                   | 1.22   | 1.20   | 1.13   |
| 10200.00        | 3.18                         | 3.18 | 0.00                     | 25.09          | 1.85                   | 1.11   | 1.13   | 1.08   |
| 10600.00        | 3.19                         | 3.22 | 0.03                     | 24.40          | 1.79                   | 1.13   | 1.09   | 1.13   |
| 11000.00        | 3.25                         | 3.30 | 0.05                     | 23.18          | 2.16                   | 1.33   | 1.13   | 1.22   |
| 11400.00        | 3.30                         | 3.33 | 0.03                     | 22.41          | 2.79                   | 1.58   | 1.21   | 1.33   |
| 11800.00        | 3.42                         | 3.45 | 0.03                     | 21.96          | 3.14                   | 1.87   | 1.32   | 1.43   |
| 12200.00        | 3.56                         | 3.50 | 0.07                     | 20.36          | 4.21                   | 2.14   | 1.45   | 1.55   |
| 12600.00        | 3.80                         | 3.69 | 0.11                     | 18.35          | 4.86                   | 2.41   | 1.61   | 1.68   |

1. Total Loss = Insertion Loss + 3dB splitter loss.

1 – Transmit Signal

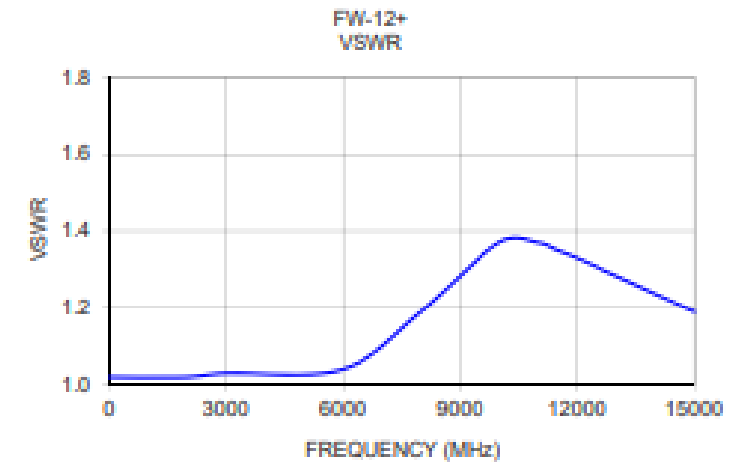
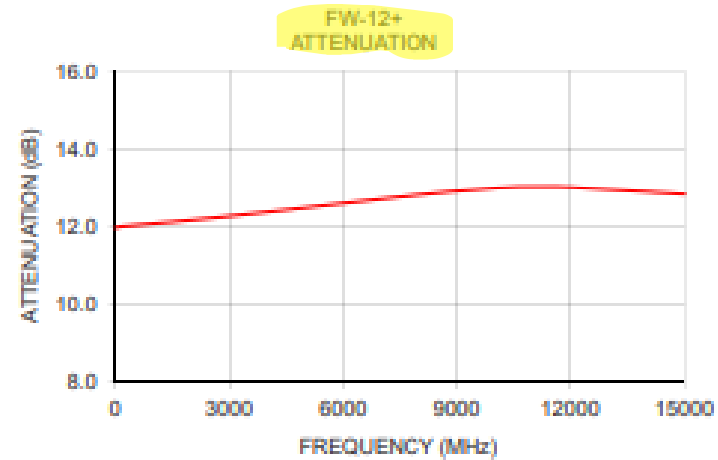
2 – Reference signal for Mixer

# ATTENUATOR



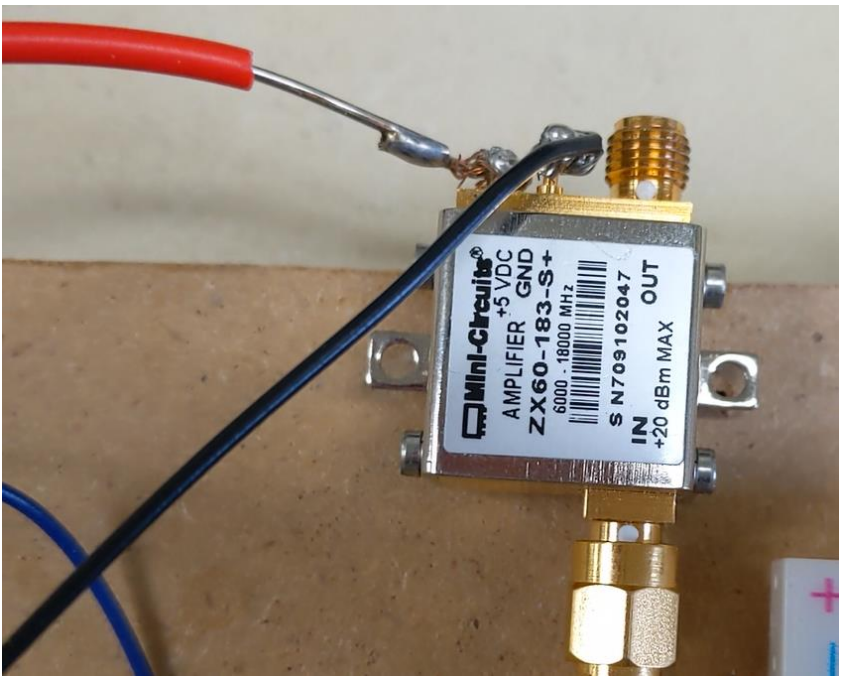
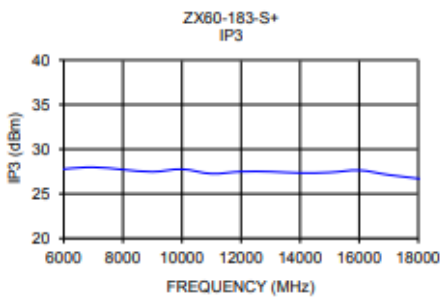
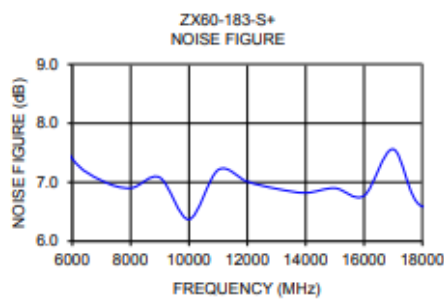
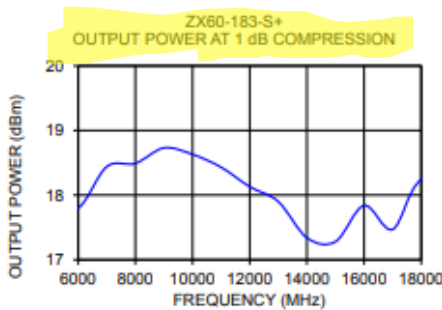
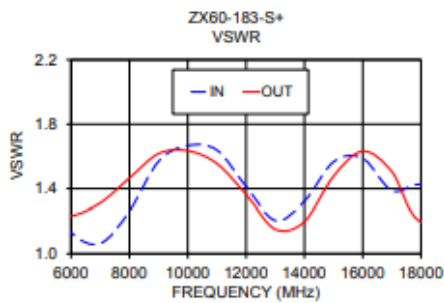
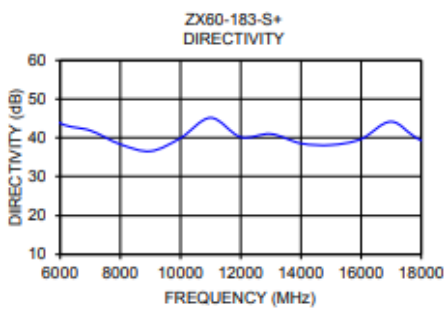
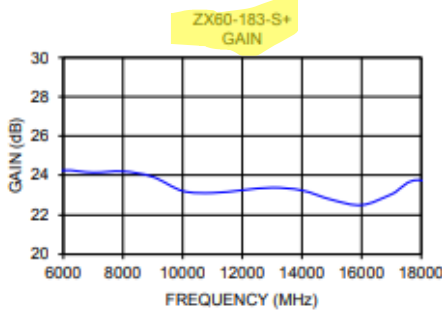
Typical Performance Data

| Frequency (MHz) | Attenuation (dB) | VSWR (:1) |
|-----------------|------------------|-----------|
| 10.00           | 11.97            | 1.02      |
| 100.00          | 12.00            | 1.02      |
| 2000.00         | 12.17            | 1.02      |
| 3000.00         | 12.27            | 1.03      |
| 6000.00         | 12.60            | 1.04      |
| 8000.00         | 12.82            | 1.19      |
| 10000.00        | 13.00            | 1.37      |
| 11000.00        | 13.03            | 1.37      |
| 11500.00        | 13.03            | 1.35      |
| 12000.00        | 13.02            | 1.33      |
| 15000.00        | 12.84            | 1.19      |



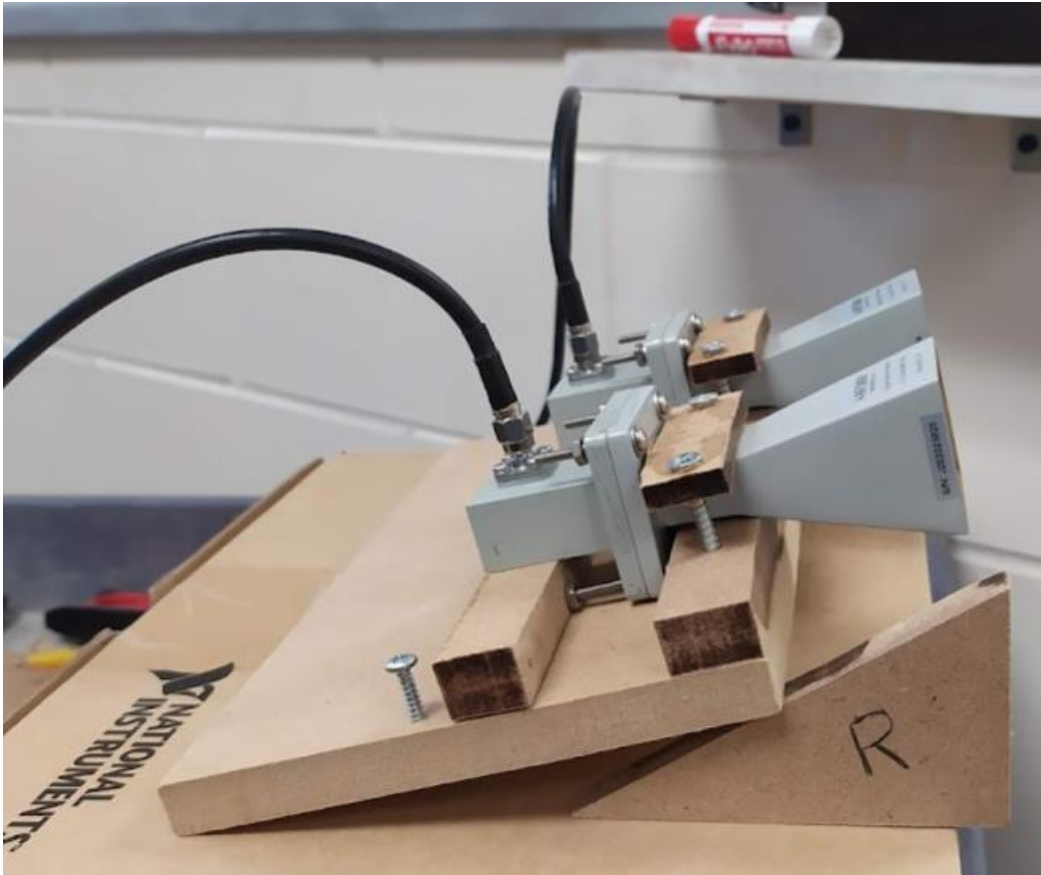


# POWER AMPLIFIER

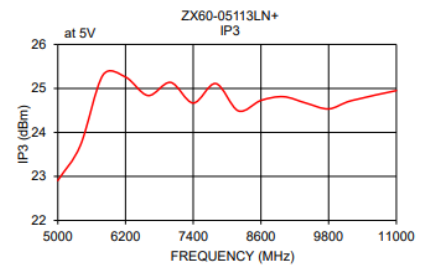
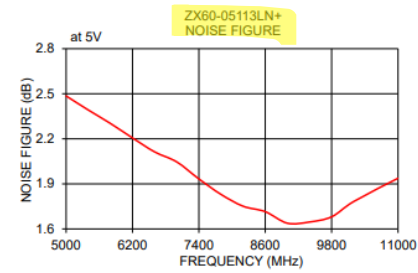
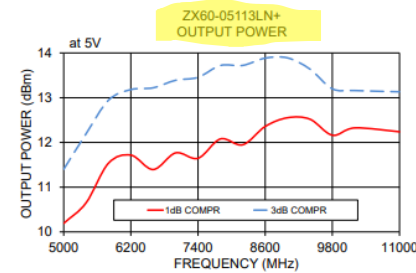
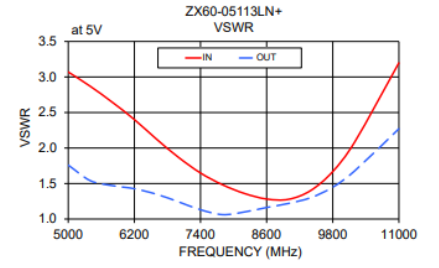
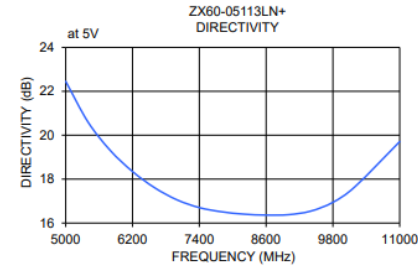
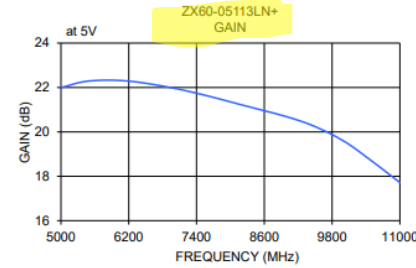
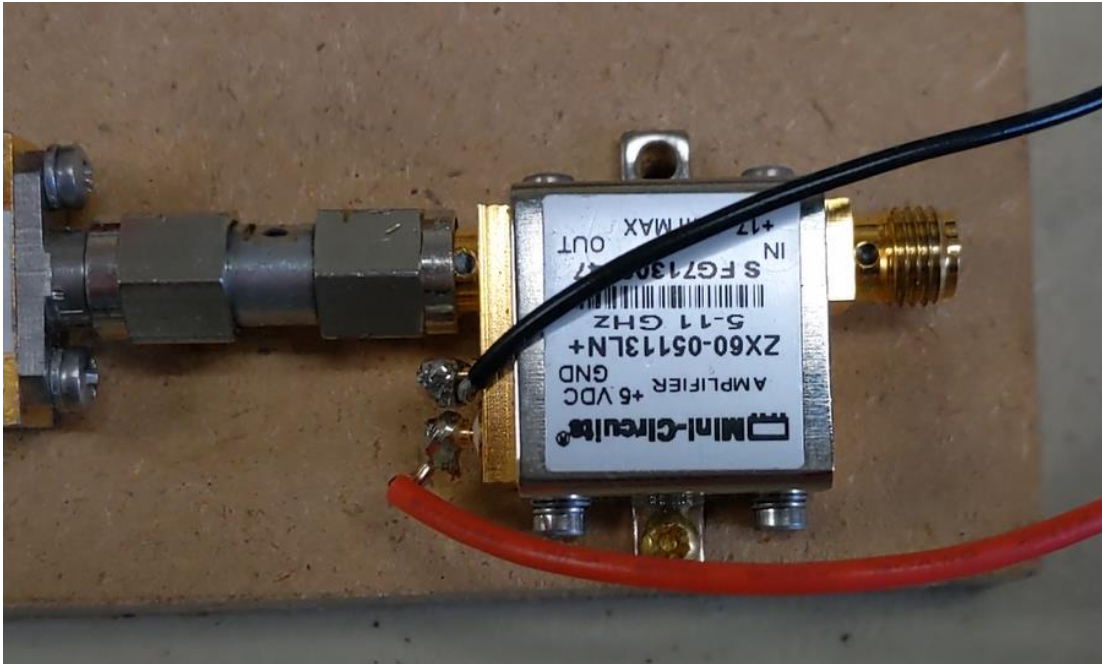


|                                 |      |      |      |     |     |
|---------------------------------|------|------|------|-----|-----|
|                                 | 18.0 |      | 11.0 |     |     |
|                                 | 6.0  |      | 15.6 |     |     |
|                                 | 8.0  | 10.0 | 22.2 | —   |     |
| Output Return Loss              | 10.0 |      | 17.2 | —   |     |
|                                 | 12.0 | 10.0 | 13.8 | —   | dB  |
|                                 | 14.0 | 10.0 | 15.9 | —   |     |
|                                 | 16.0 |      | 22.8 | —   |     |
|                                 | 18.0 | 10.0 | 15.0 | —   |     |
|                                 |      |      | 26.6 |     |     |
|                                 | 6.0  |      | 27.4 |     |     |
|                                 | 8.0  |      | 27.7 |     |     |
| Output IP3                      | 10.0 |      | 27.9 |     | dBm |
|                                 | 12.0 |      | 27.2 |     |     |
|                                 | 14.0 |      | 26.9 |     |     |
|                                 | 16.0 |      | 27.1 |     |     |
|                                 | 18.0 |      | 26.4 |     |     |
|                                 | 6.0  |      | 18.0 |     |     |
|                                 | 8.0  |      | 18.3 |     |     |
|                                 | 10.0 | 16.0 | 18.5 | —   | dBm |
| Output Power @ 1 dB compression | 12.0 |      | 18.1 |     |     |
|                                 | 14.0 |      | 17.6 |     |     |
|                                 | 16.0 |      | 18.0 |     |     |
|                                 | 18.0 |      | 18.0 |     |     |
|                                 | 6.0  |      | 8.2  |     |     |
|                                 | 8.0  |      | 6.9  |     |     |
|                                 | 10.0 |      | 6.3  |     |     |
| Noise Figure                    | 12.0 |      | 6.9  |     | dB  |
|                                 | 14.0 |      | 6.8  |     |     |
|                                 | 16.0 |      | 6.8  |     |     |
|                                 | 18.0 |      | 6.5  |     |     |
| Directivity (Isolation-Gain)    |      |      | 38   |     | dB  |
| DC Voltage                      |      |      | 5.0  |     | V   |
| DC Current                      |      |      | 260  | 290 | mA  |

# HORN ANTENNAS



# LOW NOISE AMPLIFIER

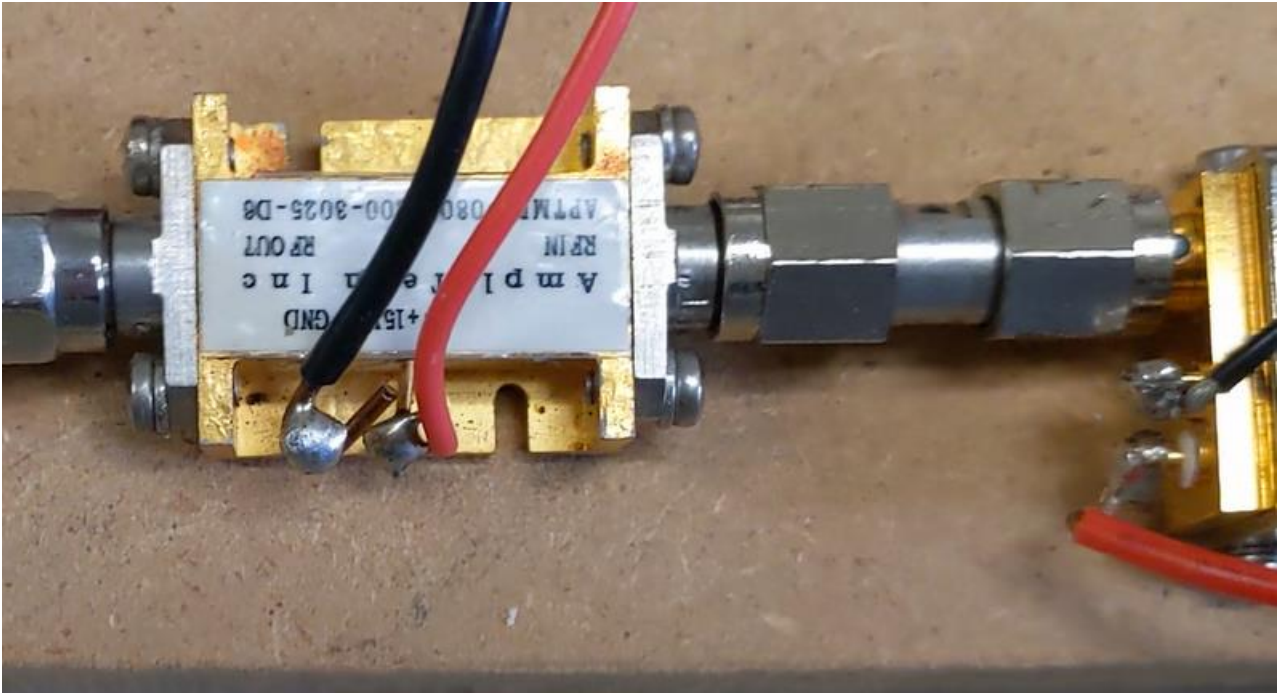


Electrical Specifications at 25°C and 5V, unless noted

| Parameter                                      | Condition (GHz) | V <sub>DD</sub> =5.0 |      |      | Units |
|--|-----------------|----------------------|------|------|-------|
|  |                 | Min.                 | Typ. | Max. |       |
| Frequency Range                                |                 | 0.5                  |      | 11.0 | GHz   |
| Noise Figure                                   | 5.0-7.0         |                      | 2.3  |      | dB    |
|  | 7.0-9.0         |                      | 1.8  |      |       |
|  | 9.0-11.0        |                      | 1.7  |      |       |
| Gain   | 5.0-7.0         |                      | 22.2 |      | dB    |
|  | 7.0-9.0         | 17.5                 | 21.4 |      |       |
|  | 9.0-11.0        |                      | 20.1 |      |       |
| Input Return Loss                              | 5.0-7.0         |                      | 6.7  |      | dB    |
|  | 7.0-9.0         |                      | 12.1 |      |       |
|  | 9.0-11.0        |                      | 9.0  |      |       |
| Output Return Loss                             | 5.0-7.0         |                      | 13.0 |      | dB    |
|  | 7.0-9.0         |                      | 17.0 |      |       |
|  | 9.0-11.0        |                      | 11.5 |      |       |
| Output Power at 1dB Compression <sup>(1)</sup> | 5.0-7.0         |                      | 12.4 |      | dBm   |
|  | 7.0-9.0         |                      | 13.0 |      |       |
|  | 9.0-11.0        |                      | 13.0 |      |       |
| Output IP3                                     | 5.0-7.0         |                      | 25.0 |      | dBm   |
|  | 7.0-9.0         |                      | 24.5 |      |       |
|  | 9.0-11.0        |                      | 24.0 |      |       |
| Device Operating Voltage (V <sub>DD</sub> )    | —               | 4.9                  | 5.0  | 9.0  | V     |
| Device Operating Current (I <sub>DD</sub> )    | —               |                      | 42   | 53   | mA    |



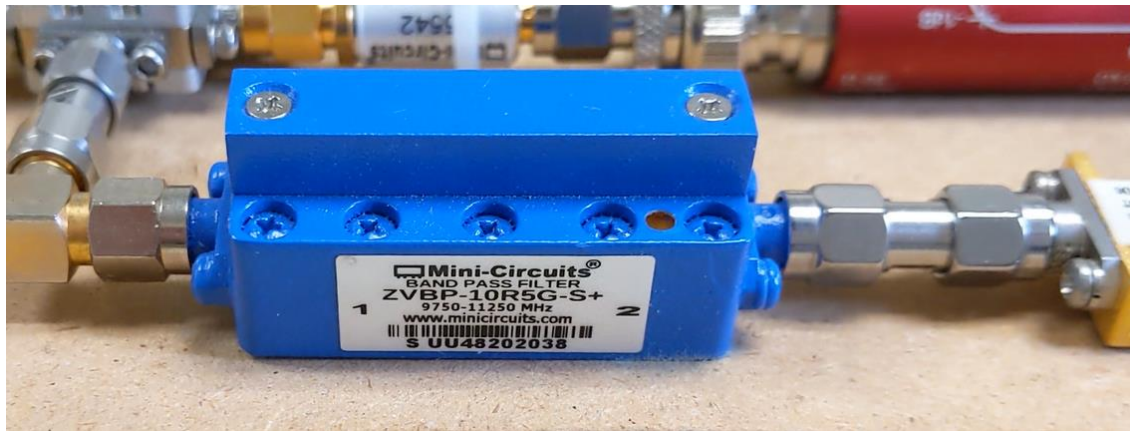
# LNA 2



## Product Specifications

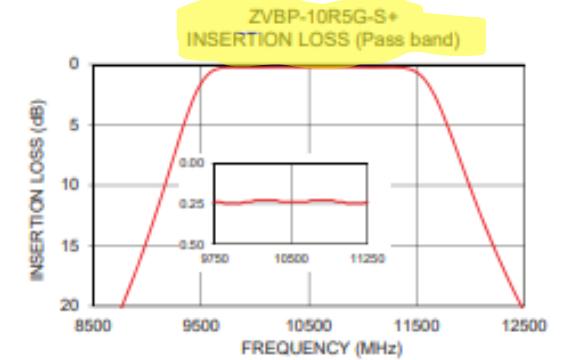
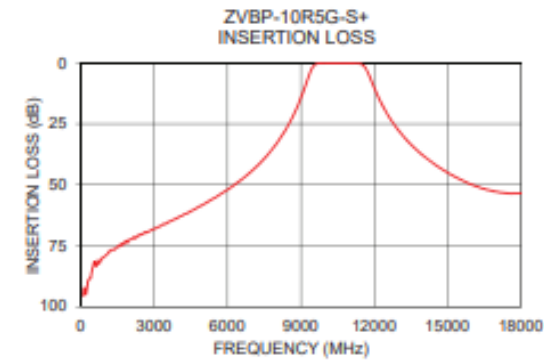
| General Parameters:  |     |
|----------------------|-----|
| Frequency Min (GHz): | 8   |
| Frequency Max (GHz): | 12  |
| Gain (dB):           | 40  |
| Flatness (dB):       | 1.5 |
| Noise Figure (dB):   | 3   |
| Input VSWR:          | 2   |
| Output VSWR:         | 2   |
| P1dB:                | 25  |
| Current:             | 450 |
| Outline:             | D6  |

# BAND PASS FILTER

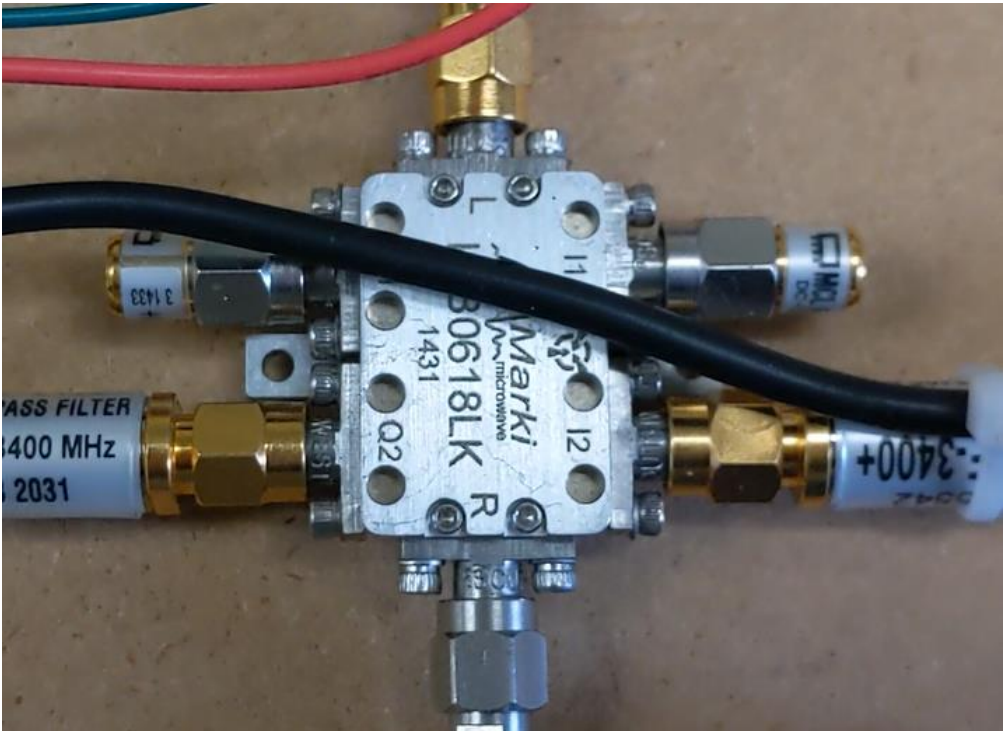


Typical Performance Data at 25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) | Frequency (MHz) | Group Delay (nsec) |
|-----------------|---------------------|-----------|-----------------|--------------------|
| 100             | 95.44               | 1737.18   | 9750            | 0.70               |
| 500             | 83.67               | 173.72    | 9800            | 0.68               |
| 3000            | 68.15               | 248.17    | 9850            | 0.66               |
| 5950            | 52.31               | 96.51     | 9900            | 0.64               |
| 8200            | 30.29               | 91.43     | 9950            | 0.61               |
| 8800            | 19.24               | 75.53     | 10000           | 0.60               |
| 9400            | 3.44                | 5.68      | 10100           | 0.57               |
| 9450            | 2.36                | 4.01      | 10250           | 0.54               |
| 9750            | 0.24                | 1.05      | 10300           | 0.54               |
| 10500           | 0.24                | 1.15      | 10400           | 0.53               |
| 11250           | 0.24                | 1.08      | 10500           | 0.53               |
| 11650           | 2.30                | 3.82      | 10600           | 0.52               |
| 11700           | 3.21                | 5.13      | 10750           | 0.53               |
| 12500           | 20.49               | 75.53     | 10900           | 0.54               |
| 13200           | 30.26               | 102.19    | 11000           | 0.55               |
| 15100           | 45.64               | 72.39     | 11050           | 0.56               |
| 16000           | 49.94               | 62.05     | 11100           | 0.57               |
| 17000           | 52.87               | 57.91     | 11150           | 0.58               |
| 17500           | 53.59               | 57.91     | 11200           | 0.59               |
| 18000           | 53.52               | 54.29     | 11250           | 0.61               |



# I/Q MIXER



**Electrical Specifications** - Specifications guaranteed from -55 to +100°C, measured in a 50-Ohm system.

| Parameter  | LO<br>(GHz) | RF<br>(GHz) | IF<br>(GHz) | Min | Typ | Max | Diode Option<br>LO drive level (dBm) |
|--|-------------|-------------|-------------|-----|-----|-----|--------------------------------------|
| Conversion Loss (dB) (each IF)                   | 6.0-18.0    | 6.0-18.0    | DC-5.0      |     | 12  |     |                                      |
| Image Rejection (dB)                             | 6.0-18.0    | 6.0-18.0    | DC-5.0      |     | 20  |     |                                      |
| I/Q/B Amplitude Deviation (dB)                   | 6.0-18.0    | 6.0-18.0    | DC-5.0      |     | 0.5 |     |                                      |
| I/Q/B Quadrature Phase Deviation (degrees)       | 6.0-18.0    | 6.0-18.0    | DC-5.0      |     | 5   |     |                                      |
| Isolation (dB)                                   |             |             |             |     |     |     |                                      |
| LO-RF  | 6.0-18.0    | 6.0-18.0    |             |     | 20  |     |                                      |
| LO-IF  | 6.0-18.0    | 6.0-18.0    |             |     | 20  |     |                                      |
| RF-IF  | 6.0-18.0    | 6.0-18.0    |             |     | 20  |     |                                      |
| Input 1 dB Compression (dBm)                     | 6.0-18.0    | 6.0-18.0    |             |     | +4  |     | L (+14 to +17)                       |
| Input Two-Tone Third Order Intercept Point (dBm) | 6.0-18.0    | 6.0-18.0    |             |     | +14 |     | L (+14 to +17)                       |



# LOW PASS FILTER



Typical Performance Data at 25°C

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) |
|-----------------|---------------------|-----------|
| 40              | 0.01                | 1.01      |
| 100             | 0.03                | 1.01      |
| 500             | 0.08                | 1.05      |
| 1000            | 0.15                | 1.12      |
| 2000            | 0.29                | 1.29      |
| 3000            | 0.58                | 1.58      |
| 3400            | 0.85                | 1.74      |
| 3800            | 1.61                | 1.83      |
| 3950            | 3.15                | 2.29      |
| 4050            | 6.53                | 3.73      |
| 4150            | 13.83               | 6.91      |
| 4300            | 26.75               | 12.18     |
| 4600            | 24.94               | 20.45     |
| 5050            | 23.14               | 27.16     |
| 6500            | 23.33               | 36.97     |
| 7800            | 29.30               | 45.72     |
| 8300            | 21.56               | 35.46     |

