What can B&Z Technologies do for your company?

When you're talking about low noise and medium power amplifier requirements, we can do a lot! B&Z Technologies' amplifier products offer performance that simply cannot be matched!

We have a lineup of standard COTS[1] products that match many applications. Our standard 3-year warranty and our less than 1% return rate allow you to have confidence in our products. Many of the B&Z wideband amplifier models have performance that is normally only available in narrow band amplifiers. Often, one B&Z amplifier model can take the place of several narrow band models.

B&Z *really* excels in custom specification amplifiers. Our unique circuit topology and standard package allows our engineers to create amplifier designs that exactly match your system requirement. And, we do this with price and delivery similar to our standard products.

The engineers at B&Z have developed a new and unique circuit topology that allows them to create and test design iterations in hours, not weeks and months. This design freedom allows them to refine designs until they exactly meet or exceed the required performance.

Please contact B&Z with your specific requirement today!
You can discuss your application with one of our design engineers.

Notes:

1. COTS = Commercial Off The Shelf

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Amplifier Specifications

B&Z amplifier performance is defined by several industry standard specifications. The following specifications are listed for all of our catalog amplifier products:

- Frequency Range
- Gain
- Noise Figure (or Temperature)
- Output Power at 1dB compression
- Gain Flatness
- Input VSWR
- Output VSWR

In addition to these specifications, the engineers at B&Z can design and build amplifiers to meet your other requirements as well. Some of the other requirements may specify the following:

- Gain Window
- AM to PM conversion
- Third Order Intercept Point
- Second order Intercept Point
- Temperature Compensation
- Out of Band Performance
- Unit to Unit:
  - Phase Matching
  - Gain Matching

Custom Specification Amplifiers

Nearly 50% of the amplifiers manufactured by B&Z are built to our customer's specifications. We have a unique circuit topology that does not rely on “model specific” elements. Our “building block” approach allows our engineers to design and build custom specification amplifiers in days instead of the weeks or months required with more conventional techniques. Please contact us with your amplifier requirements for a fast quote. There is a “Custom Specification Amplifier Worksheet” on page 10 and on our website.

MEASUREMENT OF AMPLIFIER PERFORMANCE

The following short technical description discusses the most frequently encountered problems associated in measuring amplifier performance parameters. It is a short summary of problems that we as design engineers have encountered, and also problems that our customers have faced in trying to correlate their measurements with data supplied by amplifier manufacturers. We hope that the discussion will be helpful to system engineers who treat amplifiers just as one of the many system "building blocks" and do not get involved with the fine details and nuances of measurement techniques. We also hope that the discussion will serve as a common denominator between B&Z Technologies as the manufacturer and you, as the customer, in correlating our test results to yours. We have kept theoretical derivations to a minimum except in areas where they provide a greater insight and better understanding.

Key Specifications of Low Noise Amplifiers

- Noise figure
- Gain
- Gain variation as a function of frequency and temperature
- Input/output VSWR
- Output 1dB Power compression
- Dynamic range (K-factor, 3rd order intercept)

Only accurately calibrated test equipment and carefully constructed test setups will enable the engineer to separate the amplifier performance characteristics from errors introduced by the test equipment calibration uncertainties and by the test setups. The following short synopsis points out the most frequently encountered pitfalls and outlines test setups and test methods that minimize these measurement errors.

Noise Figure

B&Z Technologies' unique circuit topology, using existing commercially available HEMT transistors, has enabled our engineers to design amplifiers with less than 0.5 dB (35K) noise figure at frequencies up to 4 GHz, less than 1.2 dB (92K) noise figure at frequencies up to 22 GHz and less than 2.5 dB (225K) noise figure at frequencies up to 40 GHz.

Cooling the amplifier will result in a further reduction in noise figure.

Measuring these very low noise figures has imposed additional burdens on the absolute calibration accuracy of the test equipment, and also on the care exercised by the operator in performing noise figure measurements. Advances in microwave test equipment technology have in some cases eliminated measurement errors and in other cases have minimized them. This development in itself has increased the correlation between the test data supplied by the amplifier manufacturer and that measured by the end user. However, along with the improvement in test equipment accuracies, customer specifications have also become more stringent. Discrepancies between the test data supplied by the manufacturer and that measured at customer premises can result from two main causes:

1. In ultra-low noise amplifiers where calibration uncertainties can substantially affect the absolute measurement accuracy, a ± .1 dB uncertainty can result in a 0.9 dB to 1.1 dB measurement in a 1 dB noise figure amplifier.
2. Measurement errors caused by carelessly constructed test setups, instabilities in test setup gains, or simply mistakes termed in the industry as "operator errors".

The most widely used and accurate measurement technique is the Y factor method. This technique assumes a known input-noise power change, and measures the amplifier output noise power change as the function of input noise power change. The noise figure is derived from that information. The accuracy of the measurement depends on the following assumptions:

- Accurately known input noise power change.
- Constant amplifier and test setup gain during the measurement.
- Constant impedance of the noise source.

The most commonly used noise power references are the noise diode and the hot/cold noise source. The noise diode in its off condition is at room temperature (290K), and in its on condition the nominal noise power output is increased to level specified by the noise diode manufacturer. The hot and cold noise standard has two well-matched 50 ohm terminations, one cooled to 78°K and the other heated to 373°K. In standard commercially available noise diodes the absolute excess noise power as well as the noise power spectral density is guaranteed to about ±0.2 dB accuracy from its nominal value depending on the model and frequency. This ± 0.2 dB uncertainty in excess noise ratio in low noise amplifier measurements can introduce intolerable measurement errors. The hot/cold noise standards are accurate to ±0.1dB accuracy.

To minimize the errors introduced by the noise diode, the diode can be calibrated by the manufacturer at a discrete frequency, or the calibration can be done in the laboratory if both the noise diode and the hot/cold noise source are available. For instance, the noise diode can be calibrated against the hot/cold source by simultaneous measurement of a low noise (<2dB noise figure) amplifier noise figure with the hot/

cold source as the standard. By this method noise diodes can be calibrated to within 0.1 dB of the hot/cold reference. For the most accurate measurement of noise figures, always use a hot/cold noise source; or a well-calibrated noise diode with low source impedance change when the diode is switched from off to on. For instance, Agilent low ENR Noise Sources are designed for that purpose. If a commercial hot/cold noise source is not available, a very accurate cold source can be constructed by immersing a 50 ohm SMA termination in liquid nitrogen in a Styrofoam coffee cup through a short low loss coaxial cable (be sure to measure the performance of the termination in liquid nitrogen by measuring its VSWR while it is immersed). For the “Hot” temperature use either a termination at room temperature or one heated to T2.

When using a noise diode, the noise figure of the amplifier can be computed from:

Where:

$$F = \frac{\frac{T_2}{T_0} - 1}{Y - 1}$$

T_2 = effective temperature of the noise generator in the on condition

T_0 = 290K (standard reference temperature)

Y = ratio of the noise output of the device under test with the noise source switched on to the output with it off

The noise figure (in dB) is given by:

$$F_{dB} = 10\ log\left(\frac{T_2}{T_0} - 1\right) - 10 \log\left(Y - 1\right)$$

where is the excess noise ratio of the source (i $10\ log\left(\frac{T_2}{T_0} - 1\right)$

Since the Y factor method is based on known input noise power change, gain changes during measurement (when the noise diode is turned from its off condition to its on condition, or the amplifier input termination is changed from cold to hot) can adversely affect the accuracy of the measurement. Gain changes can be caused by:

- Amplifier gain change caused by the source impedance change as the noise diode is switched from off to on condition.
- Gain compression of noise peaks in test setups with insufficient amplifier or test setup dynamic range.
- Test setup gain instability caused by equipment warm-up.
- Source impedance uncertainties.

The most commonly encountered and most frequently overlooked error is introduced by amplifier gain modulation caused by the noise diode source impedance modulation as the diode is switched from off to on. Normally, amplifier noise figure is optimized by employing a noise figure meter. Unless proper precautions are taken to eliminate or minimize the gain modulation effects, the "minimized" noise figure might include a substantial error introduced by amplifier gain modulation. If the amplifier gain increases as the noise diode is switched from off to on, the "minimized" noise figure is too "optimistic”, while a gain decrease when the diode is turned from off to on results in a "pessimistic" noise figure. The source impedance modulation is most prevalent when noise diodes are used. Its effects can be minimized by use of well-matched, low-loss isolators when making measurements at high frequencies, and well-calibrated pads in lower frequencies. Agilent low ENR noise sources minimize the impedance variation for mismatch sensitive devices like GaAs FET amplifiers.

Mathematically:

$$Y = \frac{G_1\,(T_H + T_E)}{G_2\,(T_C + T_E)}$$

Where:

G_1 = effective amplifier gain with the noise source switched on

G_2 = effective amplifier gain with the noise source switched off

T_H = "on" noise temperature

T_C = "off" noise temperature

T_E = effective amplifier input noise temperature

As we can see, the gain change cannot be separated from its effect on the measurement result.

A significant number of noise peaks can be as much as 10 dB higher than the RMS noise power (crest factor). For instance, a test setup saturation point 10 dB above the RMS noise level can still yield an error of 0.1 dB due to noise peak clipping. Again, this error is more predominant with high ENR noise diodes because of their higher excess noise power.

Conventional measurement techniques convert a spot (nominally 1 MHz bandwidth) noise power at the microwave frequency to a fixed IF frequency of the measuring instrument by mixing the RF noise power with a local oscillator. In a mixer an additional measurement error can be introduced when measuring a high gain wideband microwave amplifier when the conversion loss of the mixer changes as the noise diode is switched from off to on condition.

To avoid these errors, make sure that the test setup has sufficient dynamic range. If a noise figure meter is used, make sure that the input noise power change is within the dynamic range of the receiver. For more accurate measurements a precision receiver attenuator should be used. For instance, a noise figure meter can introduce an additional ±0.15 to ±0.25 dB measurement error, while a precision attenuator is accurate to within 0.1 dB. The noise figure meter is most useful for noise figure optimizations during the amplifier development phase.

Noise Figure Dependence on Source Impedance

The noise figure of a GaAs and HEMT FET amplifiers is a very sensitive function of its source impedance. Lowest noise figure does not generally occur at the best input power match. Quite the contrary, lowest noise figures are obtained when the amplifier and the source are highly mismatched. This condition can generate additional new design problems to the system engineer, such as high gain ripple and large delay distortions as a function of frequency. For that reason, amplifier manufacturers use various design techniques where simultaneous noise match (lowest noise figure) and power match (minimum power reflection) is approximated. At B&Z Technologies, three basic design techniques are applied:

1. By using feedback techniques at frequency ranges where it is theoretically possible to achieve power match with minimum degradation to noise figure. This technique is used in amplifier designs up to the C-band region.
2. Balanced designs where two noise-matched transistors are coupled through 90° 3dB hybrid. The reflected power from the transistor input is dissipated in the 50 ohm termination of the coupler and the amplifier input port is power matched. The input power match depends on the identicalness of the transistor input impedance and the

performance of the input coupler. Typically, this approach results in less than 2:1 VSWR for octave band designs, and 1.5:1 VSWR for moderate bandwidth designs.

3. Use of low loss isolators at the input of the amplifier. The isolator acts in the same manner as the 3 dB hybrid by absorbing the reflected power in the termination.

If the source impedance of the amplifier in its actual system application differs from 50 ohms, the system sensitivity can be degraded as a result.

Gain (S21)

Errors in insertion gain measurements can be caused by:

1. Source and load VSWR mismatches
2. Saturation effects in amplifiers with high gain or when measurements are performed at excessively high input signal levels
3. Measurements made where output power levels exceed the test equipment receiver's linear region

Mathematically, the gain variation produced by VSWR interaction between the signal generator and the amplifier input port or the amplifier output port and the detector can be expressed as follows:

$$\text{P} - \text{P ripple} = 20\log_{10}(1 \pm |\Gamma\text{A}\ \Gamma\text{B}|)\text{dB}$$

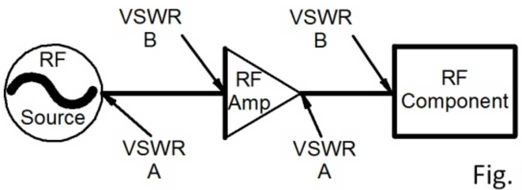


Fig. 1

When amplifiers are measured with output signal levels close to the 1 dB gain compression point (P1dB), additional errors are introduced because wideband amplifiers normally do not saturate uniformly as a function of frequency. Typically, small signal gain measurements should be performed more than 10 dB below the 1 dB compression point.

B&Z Technologies' amplifiers are specified in the terms of minimum gain and maximum peak-to-peak gain variation over the operating frequency range at 23 °C.

Dynamic Range

Dynamic range of an amplifier is limited in the low signal levels by internally generated amplifier noise and in the high end by transistor nonlinearities. The amplifier noise level determines the magnitude of the minimum useable signal. The maximum signal level is usually governed by the presence of nonlinearities in the transistors produces internally generated signals that can interfere with incoming low level signals or can be falsely interpreted as incoming signals.

Noise level is a function of the amplifier noise figure and of the predetection bandwidth. The presence of transistor nonlinearities produces harmonics of the incoming signals and intermodulation products when more than one signal is present. The most troublesome of the intermodulation products is the third order product generated internally by the fundamental of one signal mixing with the second harmonic of another signal. Third order intermodulation products will occur at $2F_1 - F_2$ and $2F_2 - F_1$. The level of that intermodulation product can be predicted when either the third order intercept point or the 1 dB compression point of the amplifier is known. Typically the third order intercept point is approximately 8 to 10 dB above the 1 dB compression point.

Third Order Intercept Point

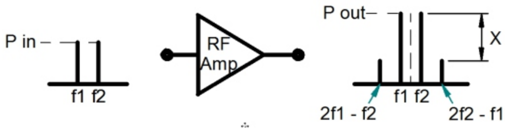


Fig. 2

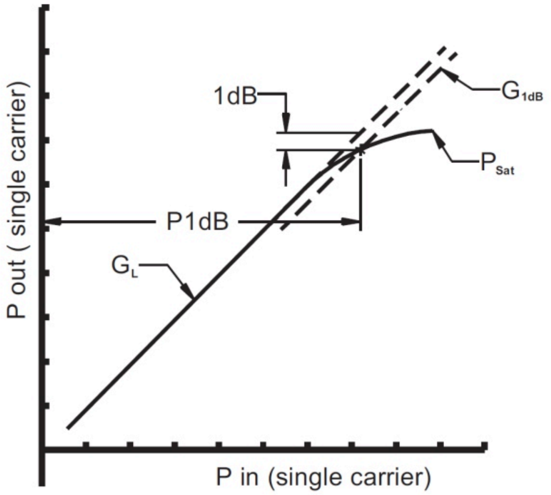


Fig. 3

Output Power & Gain

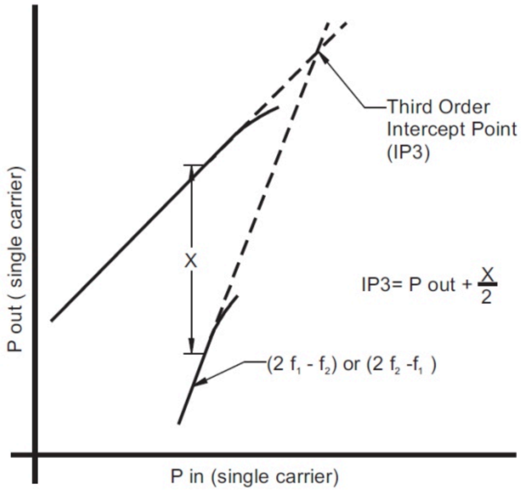


Fig. 4

P1dB: Output Power at 1dB Gain Compression.

G_L : Small Signal Gain (Linear Region)

P_{Sat} : Output Power at Saturation

Noise Figure and Gain Dependence on Temperature

Amplifier noise figure and gain are two of the most susceptible performance parameters to temperature variations. The noise temperature of a GaAs FET is proportional to its active region temperature and inversely proportional to its transconductance. Consequently, the noise figure of a GaAs FET amplifier decreases as temperature decreases, and increases as a function of increasing temperature. The sensitivity of the changes (ΔF) is plotted on Fig. 5 as a function of amplifier noise figure.

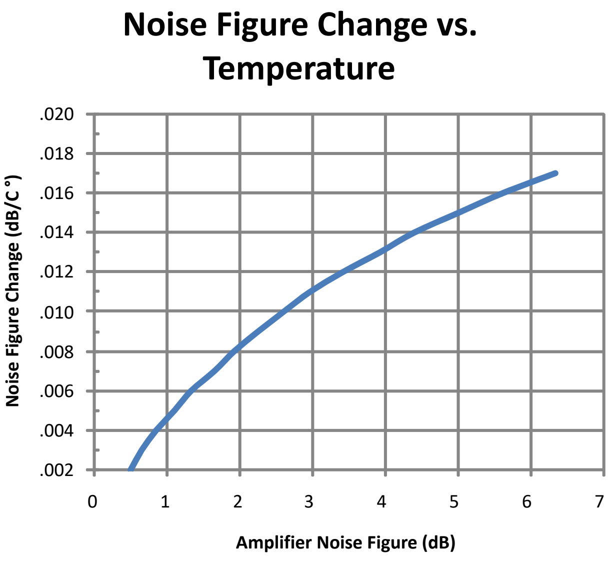


Fig. 5

(cont.)

The actual gain and frequency response of an amplifier is the combined function of its active and passive circuit elements including stray reactances. While the temperature effect on active components can be predicted fairly accurately, the behavior of passive circuit elements in temperature and their effect on the overall amplifier frequency response is a much more complicated function of temperature. The gain of a transistor chip is inversely proportional to the square root of temperature. This results in gain variations in the order of .01-.02 dB per °C per stage (see Fig. 6).

Input Power Handling and Input Power Limiters

Excessive RF input power can permanently degrade the performance of an amplifier. Low noise GaAs FET gain stages will withstand input power levels between + 17 and + 20 dBm. HEMT gain stages will withstand +15 to -17 dBm. Additional care is required with high gain amplifiers, above 40 dB, to protect the output gain stages from overload damage. Applying a -10 dBm signal at the input of a 50 dB gain amplifier may subject the output stages to an input level over +20 dBm resulting in damage. Single-ended low noise designs are more susceptible to burnout than balanced designs. The ability of the amplifiers to withstand pulsed input signals depends on the pulse level, duration and duty cycle of the incoming signal. For instance, a +30 dBm 1 μsec pulsed input signal with a .001 duty cycle will not degrade the amplifier performance. For higher input power levels B&Z can supply input limiters integrated into the amplifier input circuitry. For instance, limiters for +30 dBm CW or +50 dBm one microsecond input pulse; at .00 I duty cycle can be supplied. It is advisable to consult the factory to discuss your application.

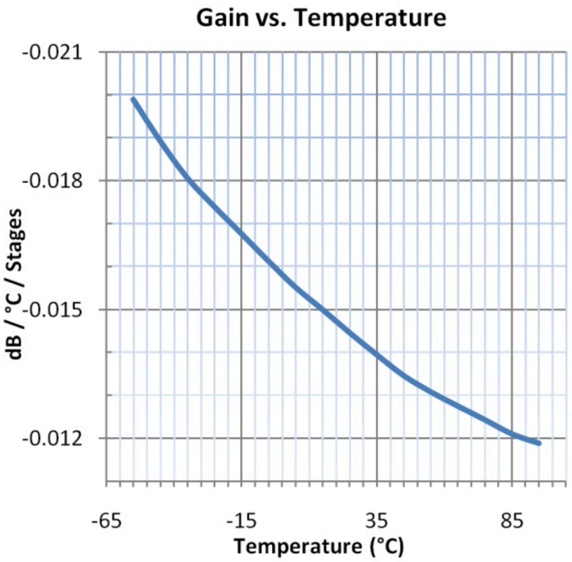


Fig. 6

Installation and Operation

Unless otherwise specified, all performance specifications are guaranteed at 23°C case temperature.

All standard B&Z amplifiers have an internal DC voltage regulator. The regulator protects the amplifier's circuitry from too high DC bias voltage and transient pulses. All standard amplifiers also feature a reverse polarity protection diode.

Heatsinking

Operating an amplifier requires consideration of its thermal dissipation. Typically, B&Z Technologies amplifiers should not be operated without an adequate heatsink. This could be a length of commercially available extruded heatsink material, or mounting in a system that provides a suitable conducted thermal path so the amplifier operates within its specified operating temperature range. It is best to consider the power requirement of the amplifier as the required thermal dissipation. For example, a typical amplifier operating at 15V, 200mA will dissipate 3W (15×.2=3). B&Z offers general purpose heatsink for our amplifiers. See the outlines on page 52.

Custom Specification Amplifiers

Overview

Many customers take advantage of B&Z's Custom Specification Amplifier program. In fact, almost 50% of the amplifiers we ship are built to custom specifications. B&Z has invented a unique circuit topology that, when combined with our standard Ultra Chassis, allows it's engineers and technicians to evaluate new design iterations in hours instead of the usual days and weeks. Our Custom Amplifier Program can supply customized amplifier performance with delivery and price points that are competitive with our catalog products. Please contact B&Z to interface with one of our engineers to discuss your

Customizable Parameters

- Frequency Range
- Noise Figure
- Return Loss (V.S.W.R)
- Output Power Gain
- Amplitude Flatness
- Gain vs. Frequency Tilt
- Input Power Limiter
- Unit to Unit Gain Matching
- Unit to Unit Phase Matching
- Cryogenic Temperature Operation

Custom Specification Amplifier

Frequency Range: Specify Ghz or MHz

_______________ Start _______________ Stop

Output 1dB Compression Point (dBm): ________ Minimum

Noise Figure (dB): ________ Maximum

Gain (dB): ___________ Specify Minimum, or Range

Gain versus Frequency Flatness (dB): ________ Minimum

VSWR or Return Loss (dB): Input ______ Output ______ Maximum

Other Performance Requirements:

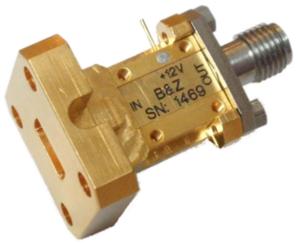
Standard Coaxial Amplifiers

This category of amplifiers have coaxial RF input and output connections. The connector types are typically SMA Female for frequencies up to 18 GHz, and 2.92mm from 18 to 40 GHz. Male connectors are available as an option. For amplifiers that operate above 40 Ghz, please consult the factory for the connector type.

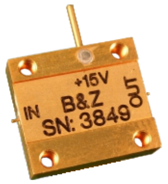
We are continuously adding models. We also have many units in stock for quick delivery.

To see our full listing, visit our website: www.bnztech.com

Outdoor Enclosure
WR22 Waveguide
In/Out Same Plane

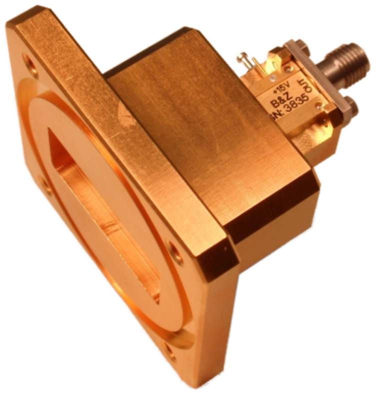


WR28 Waveguide

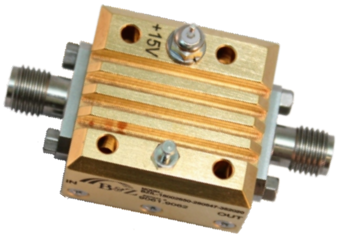


Drop-In Housing

Standard Housing



WR112 Waveguide



Cascaded Housing
For High Gain Amps

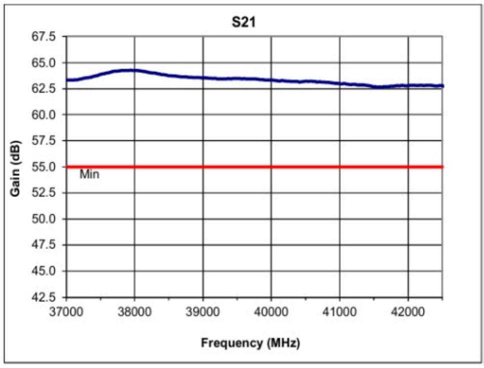
Outdoor Enclosure
WR42 Waveguide

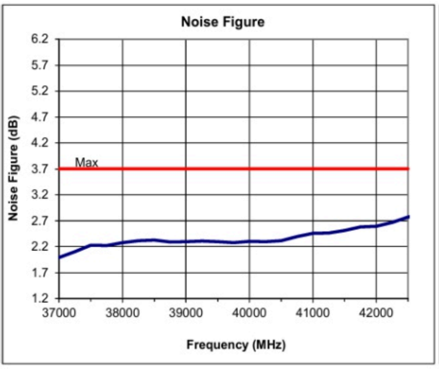
Featured Amplifiers

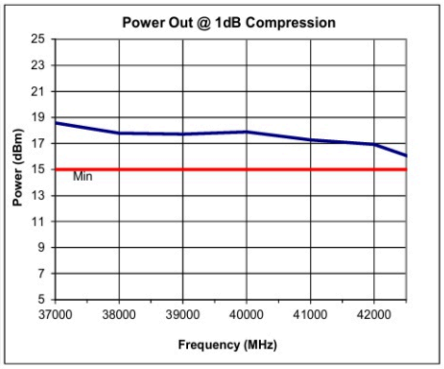
Some of the latest models developed by B&Z.

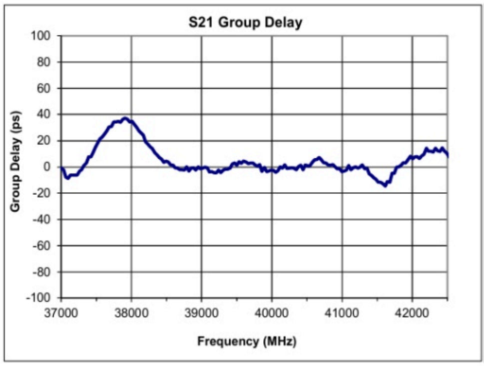
1. BZWP-RY-37004250-371555-252525-WR22INOUT (37 to 42.5GHz)

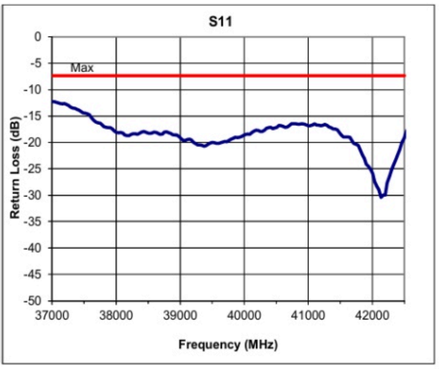
Parameter	Min	Typ	Max	Units
Frequency Range	37	-	42.5	GHz
Noise Figure*	-	3	3.7	dB
Gain	55	60	-	dB
Gain Flatness (+/-)	-	± 1.5	± 2.5	dB
P1 Output Power	+15	+17	-	dBm
Input VSWR	-	2.3:1	2.5:1	
Output VSWR	-	2.3:1	2.5:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	375		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	WR22 / WR22			
Dimensions	See outline 100400-3			

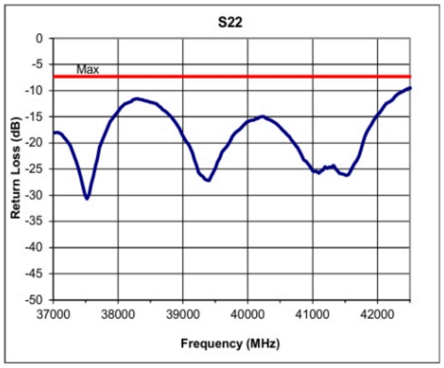






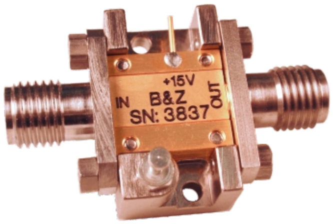


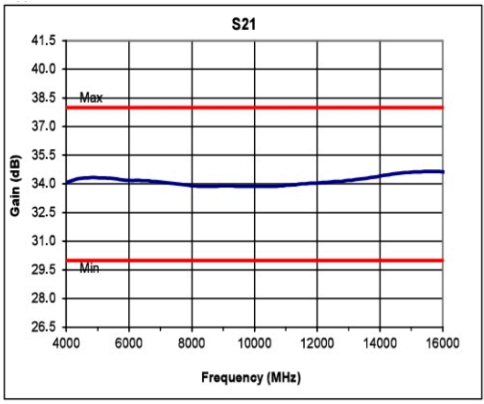


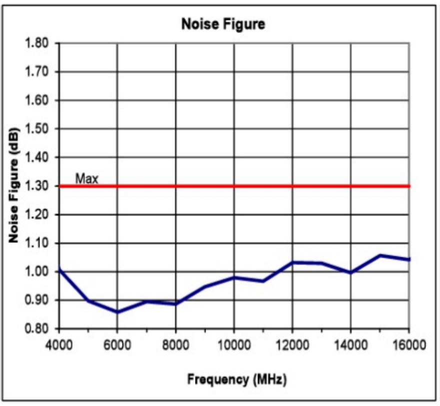


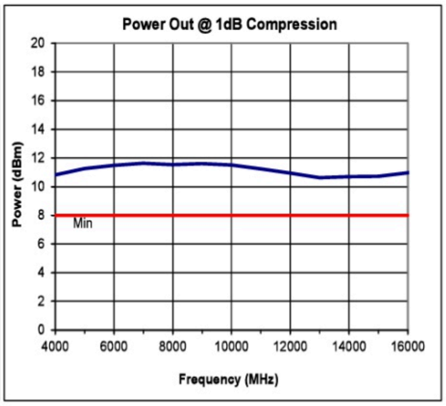
2. BZT-04001600-130830-152020 (4 to 16 GHz)

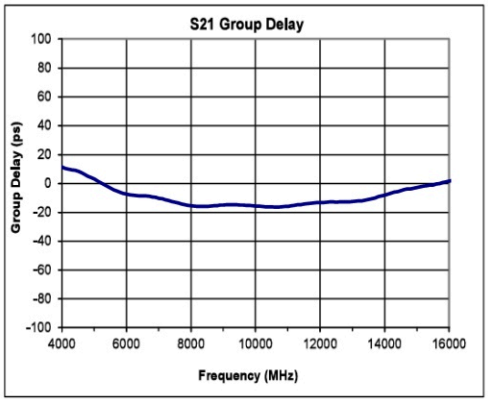
Parameter	Min	Typ	Max	Units
Frequency Range	4	-	16	GHz
Noise Figure*	-	1.2	1.3	dB
Gain	30	32	38	dB
Gain Flatness (+/-)	-	± 1	± 1.5	dB
P1 Output Power	8	10	-	dBm
Input VSWR	-	1.8:1	2.0:1	
Output VSWR	-	1.8:1	2.0:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+9	+9	+15	VDC
Current	-	100		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	2.92 mm FEMALE			
Dimensions	See outline 100114D			

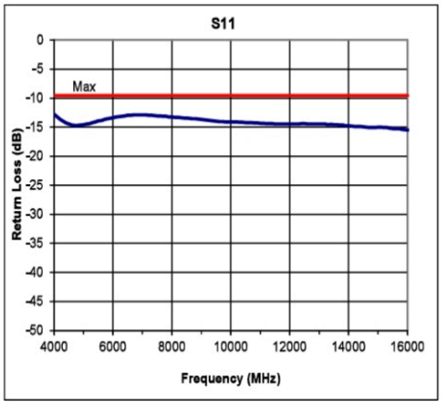


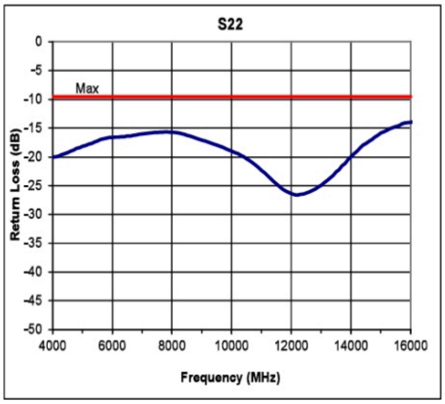






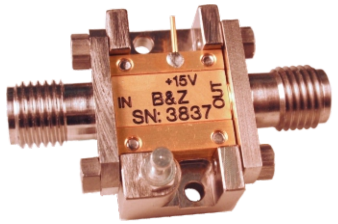


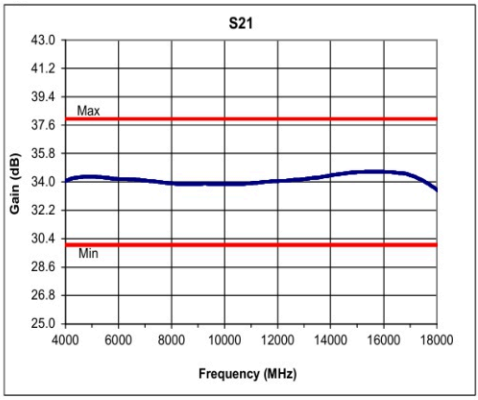


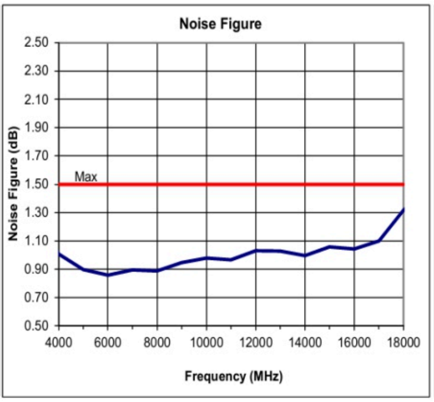


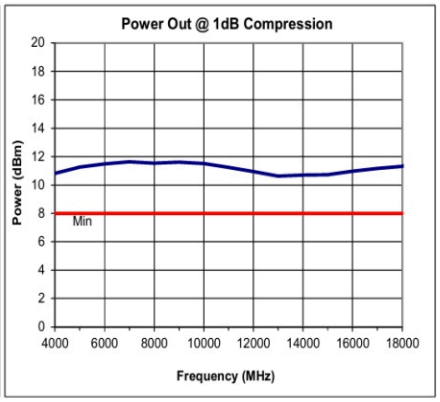
3. BZT-04001800-150830-182020 (4 to 18 GHz)

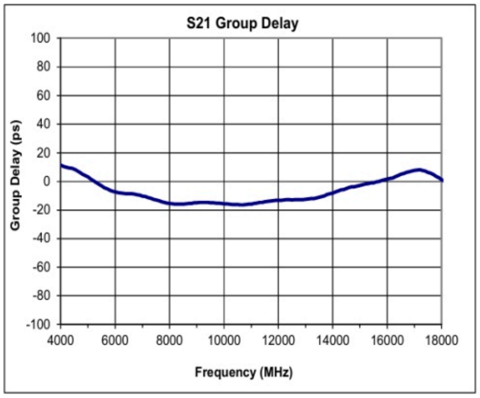
Parameter	Min	Typ	Max	Units
Frequency Range	4	-	18	GHz
Noise Figure*	-	1.4	1.5	dB
Gain	30	32	38	dB
Gain Flatness (+/-)	-	± 1.5	± 1.8	dB
P1 Output Power	8	10	-	dBm
Input VSWR	-	1.8:1	2.0:1	
Output VSWR	-	1.8:1	2.0:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+9	+9	+15	VDC
Current	-	100		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA FEMALE			
Dimensions	See outline 100114D			

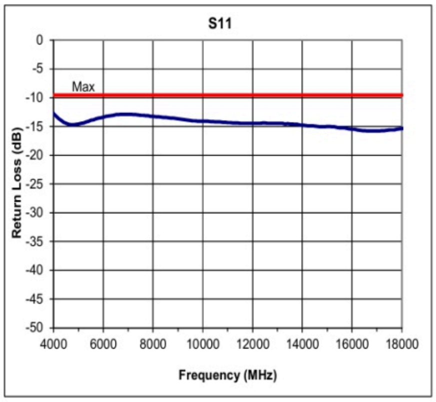


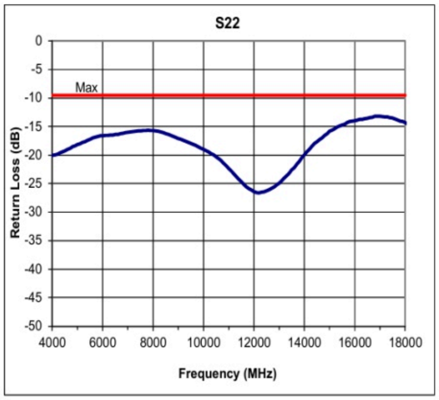






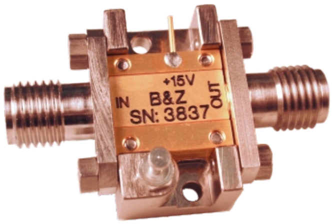


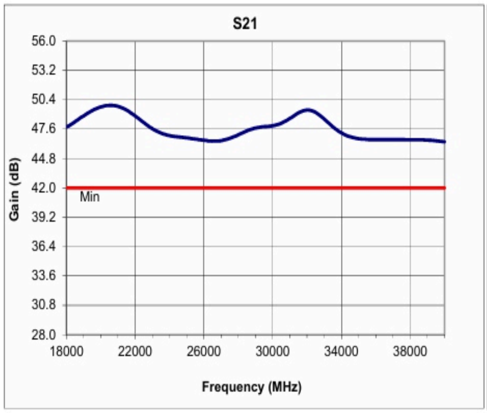




4. BZN-18004000-270842-282525 (18 to 40 GHz)

Parameter	Min	Typ	Max	Units
Frequency Range	18	-	40	GHz
Noise Figure*	-	2.5	2.7	dB
Gain	42	45	55	dB
Gain Flatness (+/-)	-	± 2	± 2.8	dB
P1 Output Power	8	10	-	dBm
Input VSWR	-	2.3:1	2.5:1	
Output VSWR	-	2.3:1	2.5:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+8	+8	+15	VDC
Current	-	195		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	2.92 mm FEMALE			
Dimensions	See outline 100114D			

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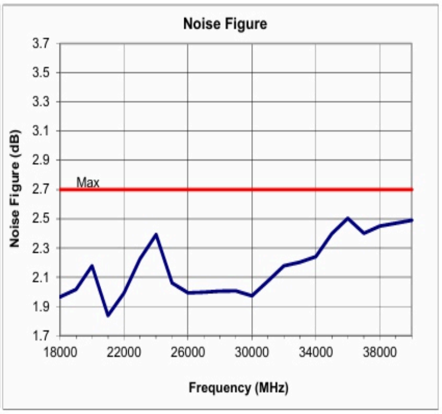
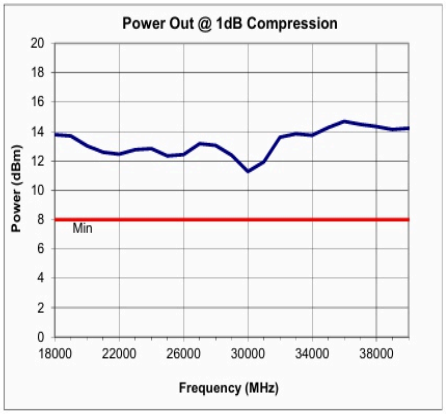
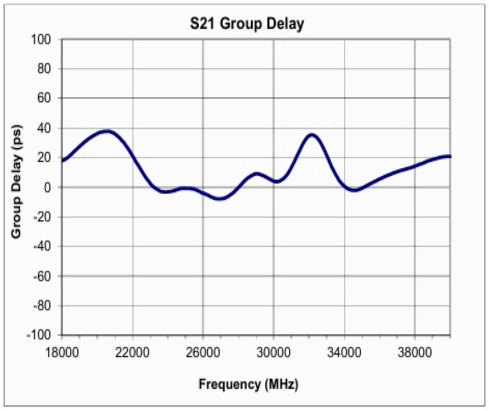
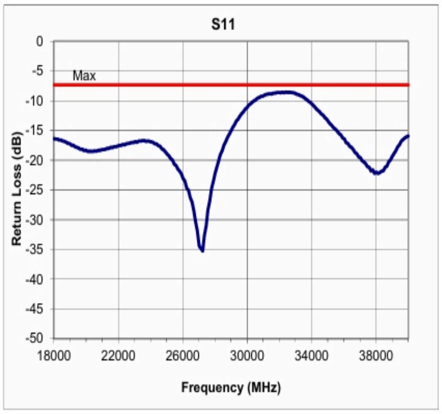
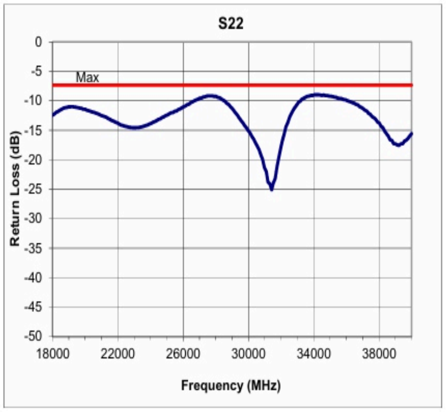

Noise Figure


Power Out @ 1dB Compression

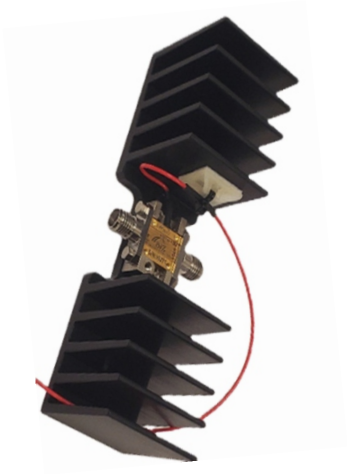

S21 Group Delay

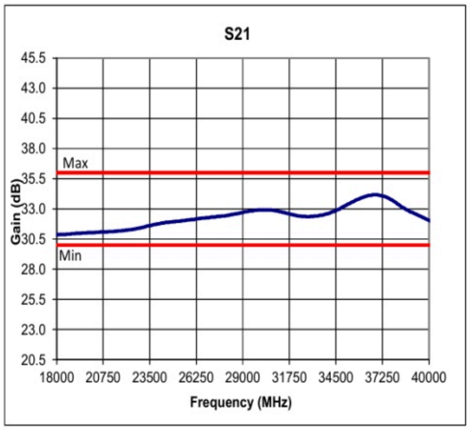

S11

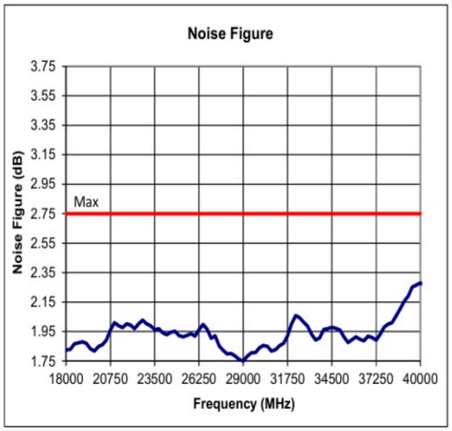

S22

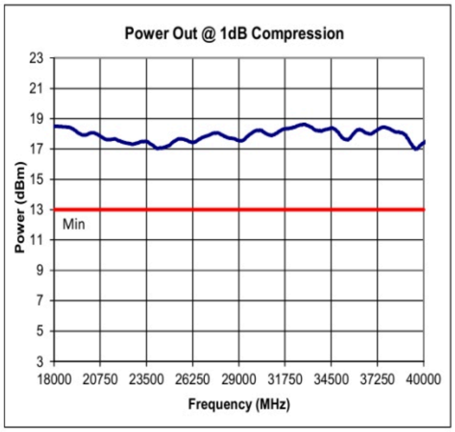
5. BZT-18004000-27133036-202525 (18 to 40 GHz)

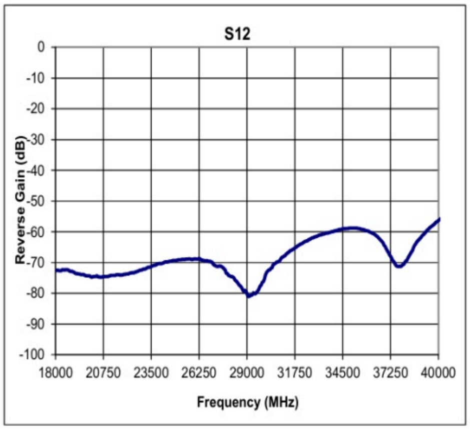
Parameter	Min	Typ	Max	Units
Frequency Range	18	-	40	GHz
Noise Figure*	-	2.3	2.75	dB
Gain	30	32	36	dB
Gain Flatness (+/-)	-	± 2	± 2.5	dB
P1 Output Power	+13	15	-	dBm
Input VSWR	-	2.3:1	2.5:1	
Output VSWR	-	2.3:1	2.5:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	250		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	2.92 mm FEMALE			
Dimensions	See outline 100169A			

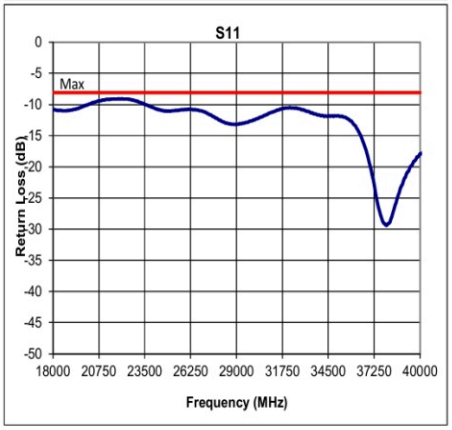


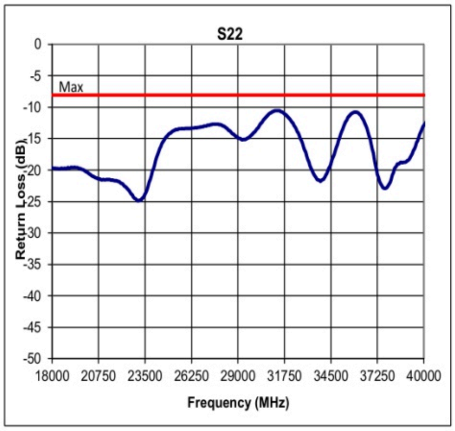






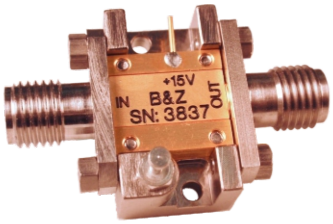


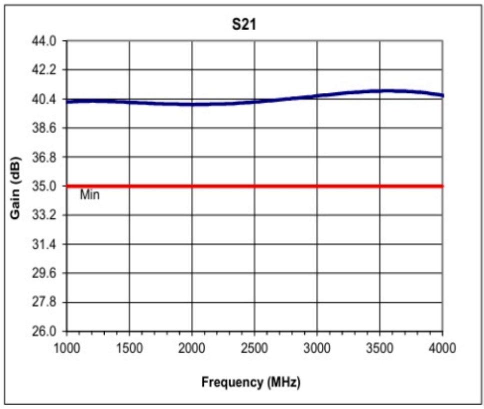


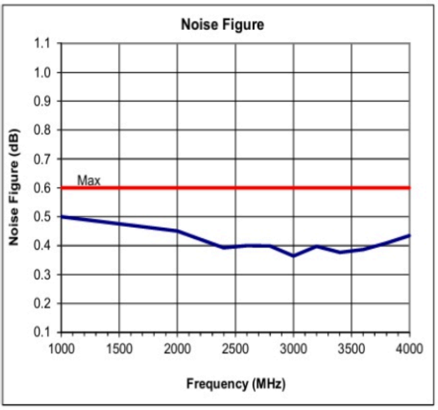


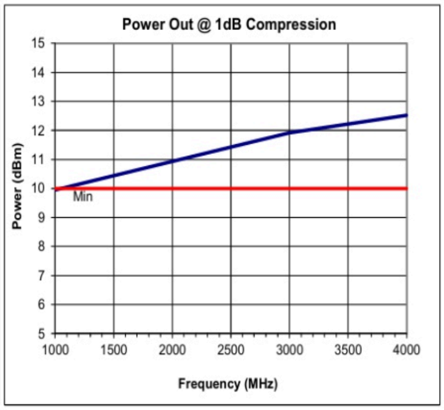
6. BZT-01000400-061035-182020 (1 to 4 GHz)

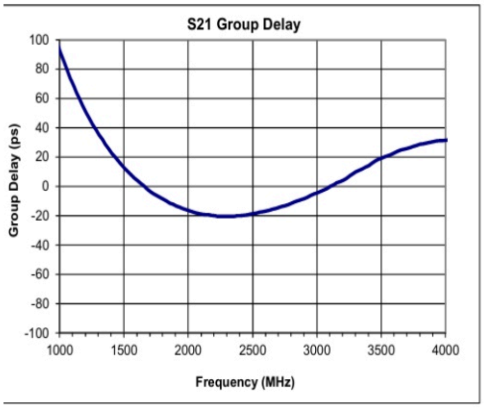
Parameter	Min	Typ	Max	Units
Frequency Range	1	-	4	GHz
Noise Figure*	-	0.5	0.6	dB
Gain	35	38	45	dB
Gain Flatness (+/-)	-	± 1.5	± 1.8	dB
P1 Output Power	10	13	-	dBm
Input VSWR	-	1.8:1	2.0:1	
Output VSWR	-	1.8:1	2.0:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+8	+8	+15	VDC
Current	-	140		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA FEMALE			
Dimensions	See outline 100114D			

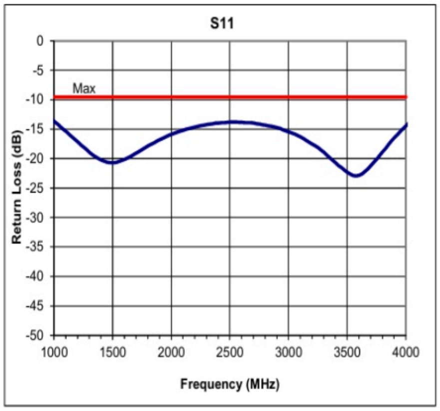


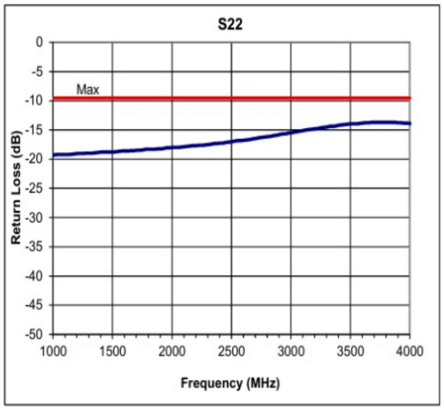






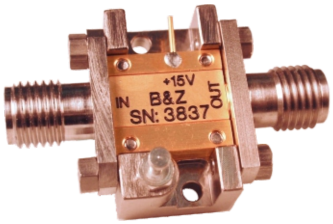


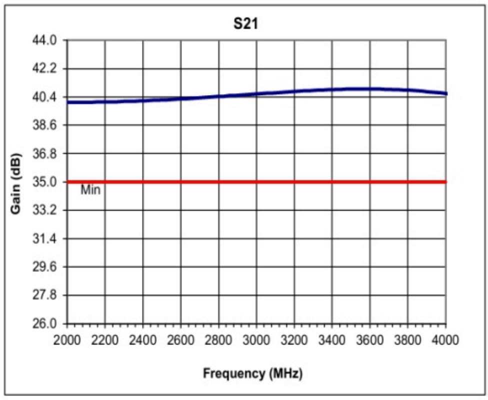


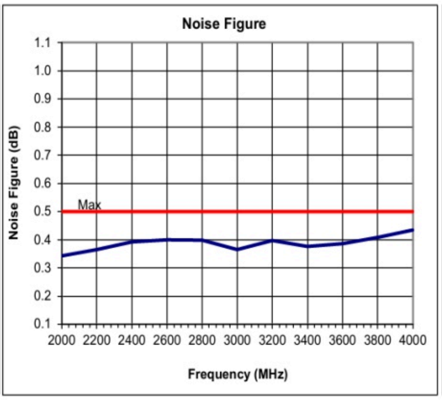


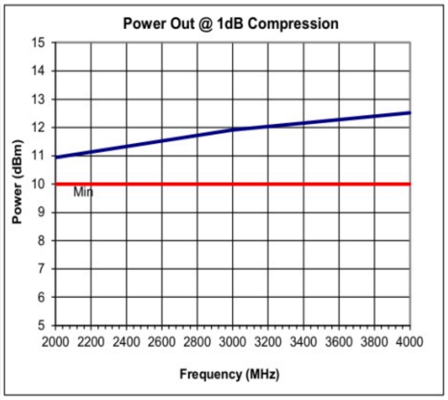
7. BZT-02000400-051035-152020 (2 to 4 GHz)

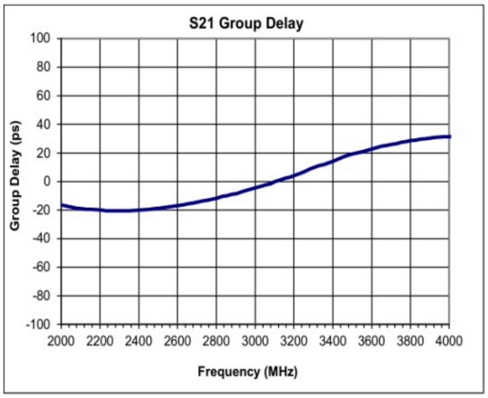
Parameter	Min	Typ	Max	Units
Frequency Range	2	-	4	GHz
Noise Figure*	-	0.4	0.5	dB
Gain	35	38	45	dB
Gain Flatness (+/-)	-	± 1	± 1.5	dB
P1 Output Power	10	13	-	dBm
Input VSWR	-	1.8:1	2.0:1	
Output VSWR	-	1.8:1	2.0:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+8	+8	+15	VDC
Current	-	130		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA FEMALE			
Dimensions	See outline 100114D			

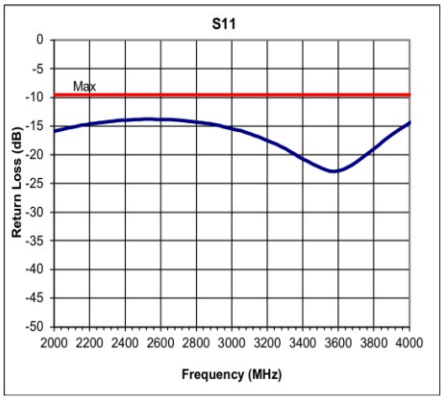


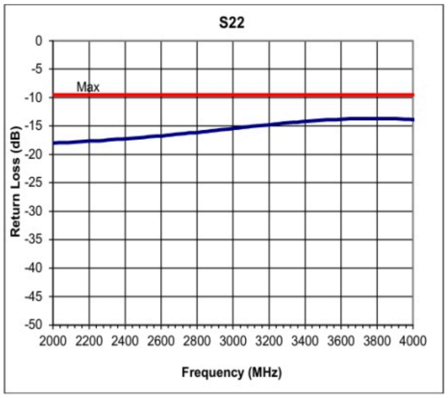






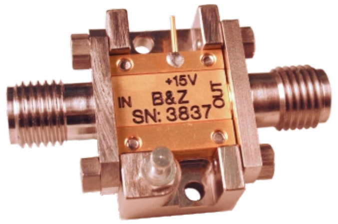


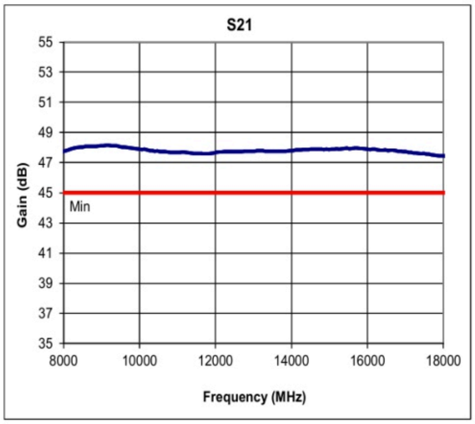


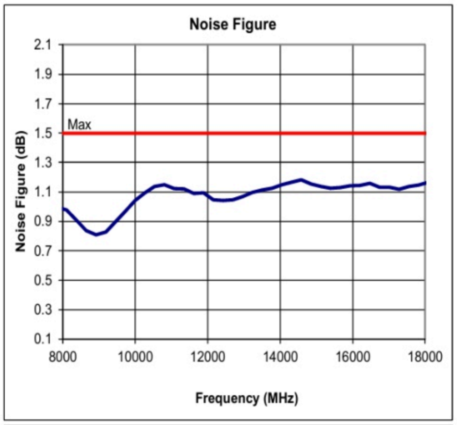


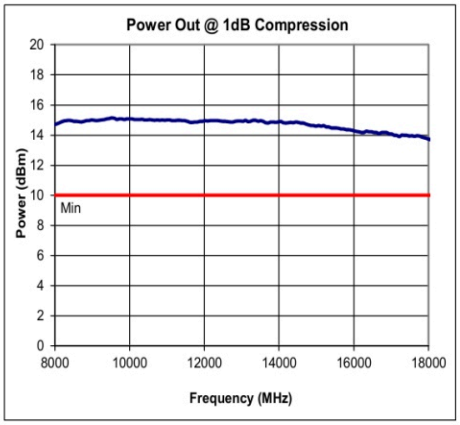
8. BZR-08001800-131043-152020 (8 to 18 GHz)

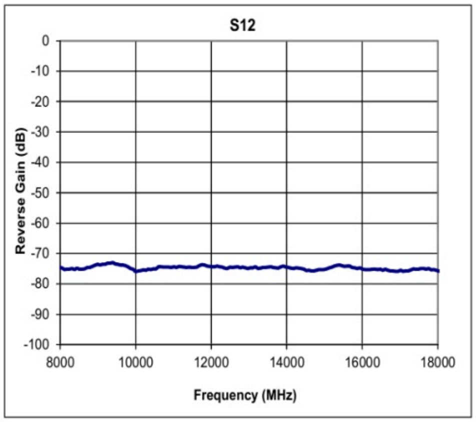
Parameter	Min	Typ	Max	Units
Frequency Range	8	-	18	GHz
Noise Figure*	-	1.2	1.3	dB
Gain	43	45	54	dB
Gain Flatness (+/-)	-	± 1	± 1.8	dB
P1 Output Power	10	13	-	dBm
Input VSWR	-	1.8:1	2.0:1	
Output VSWR	-	1.8:1	2.0:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	165		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA - FEMALE			
Dimensions	See outline 100114D			

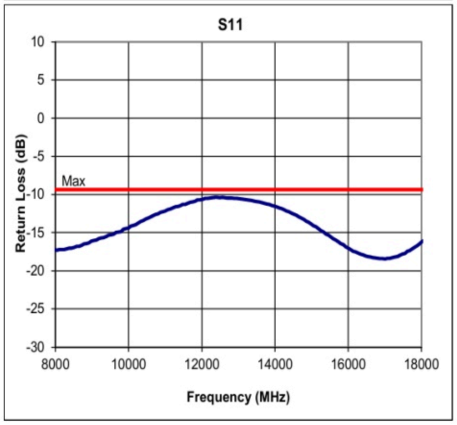


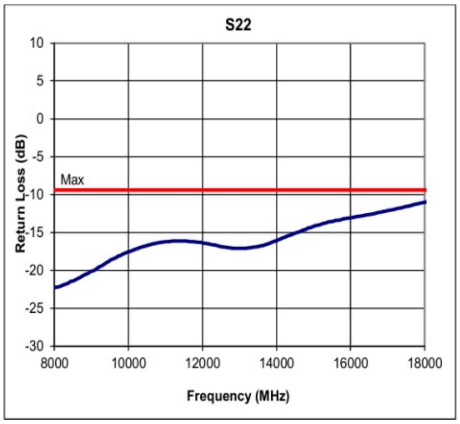






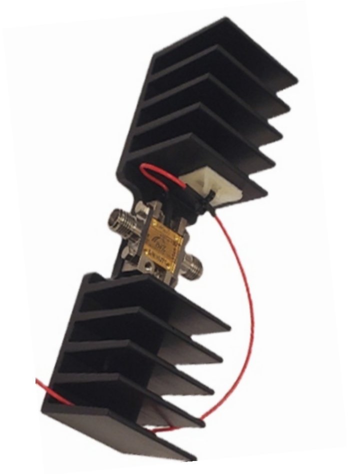


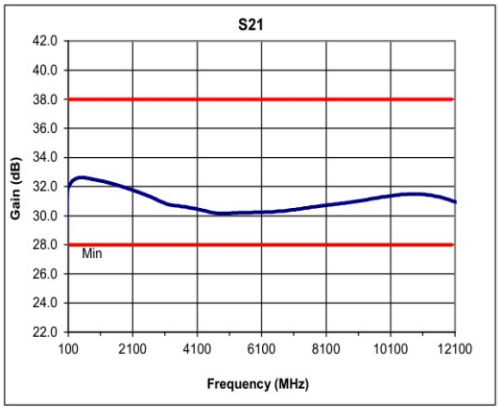


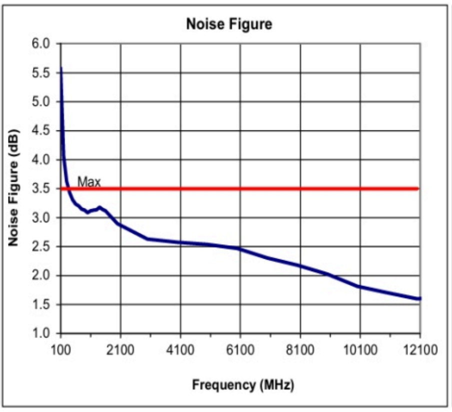


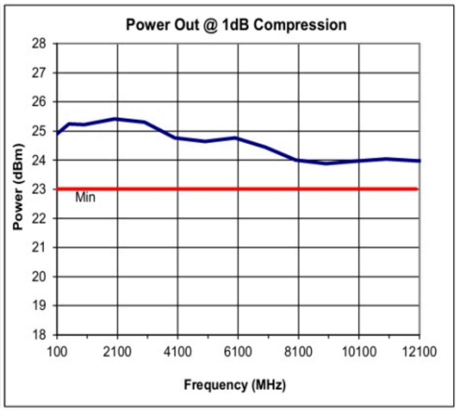
9. BZT-00101200-352328-202323 (1 to 12 GHz)

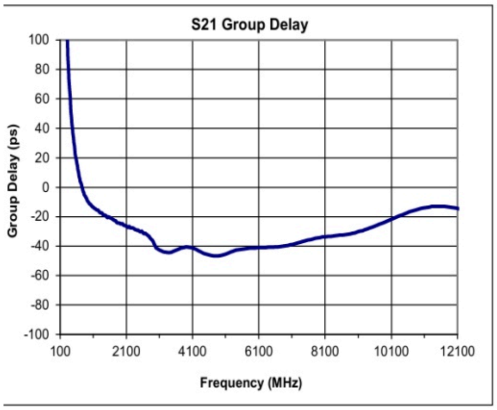
Parameter	Min	Typ	Max	Units
Frequency Range	.1	-	12	GHz
Noise Figure*	-	2.5	3.5	dB
Gain	28	30	38	dB
Gain Flatness (+/-)	-	± 1.5	± 2.5	dB
P1 Output Power	23	24	-	dBm
Input VSWR	-	2.0:1	2.3:1	
Output VSWR	-	2.0:1	2.3:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	250		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA - FEMALE			
Dimensions	See outline 100169A			

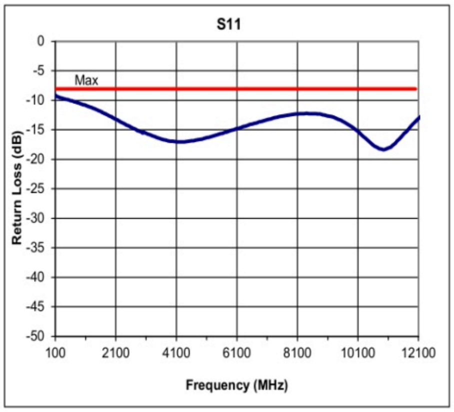


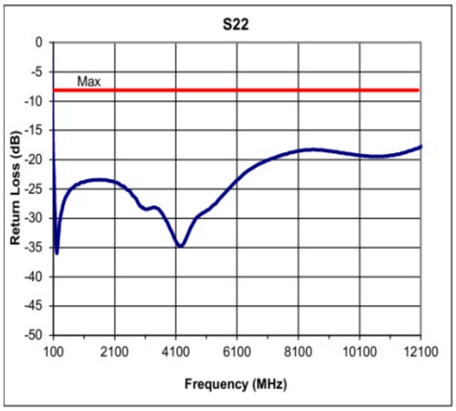






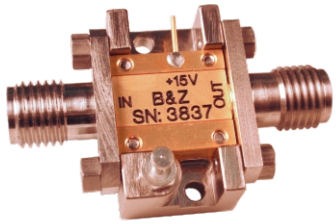


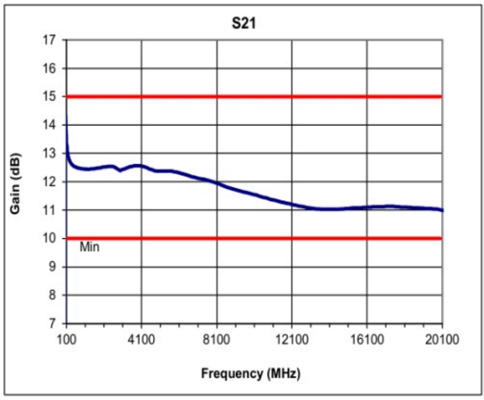


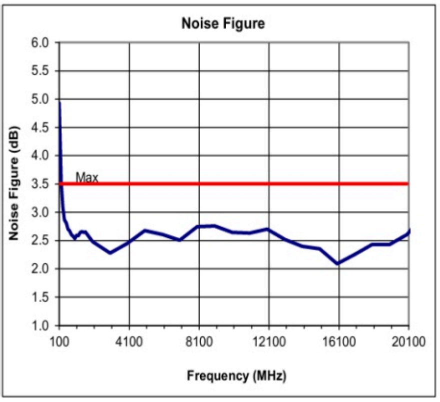


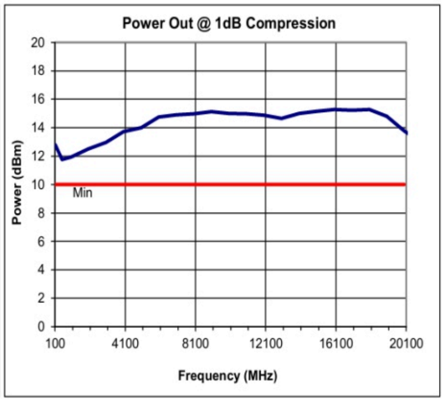
10. BZU-00102000-351010-152323 (0.1 to 20 GHz)

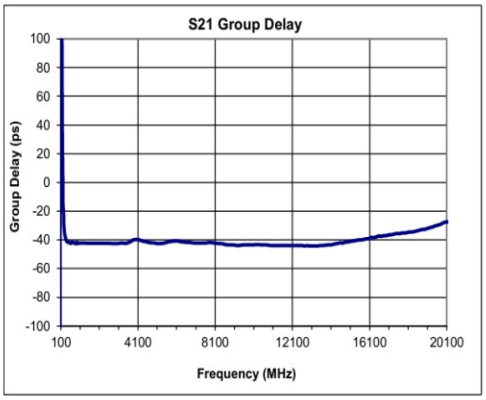
Parameter	Min	Typ	Max	Units
Frequency Range	0.1	-	20	GHz
Noise Figure*	-	3	3.5	dB
Gain	10	11	15	dB
Gain Flatness (+/-)	-	± 1.0	± 1.5	dB
P1 Output Power	+10	+11	-	dBm
Input VSWR	-	2.0:1	2.3:1	
Output VSWR	-	2.0:1	2.3:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+100	°C
RF Input Power (no-damage)	-	-	+20	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+8	+8	+20	VDC
Current	-	75		mA
Input Impedance	50			Ohms
RF Connector (IN/OUT)	3.5mm SMA - Female			1060K
Dimensions	29.9 x 18.7 x 7.6			mm

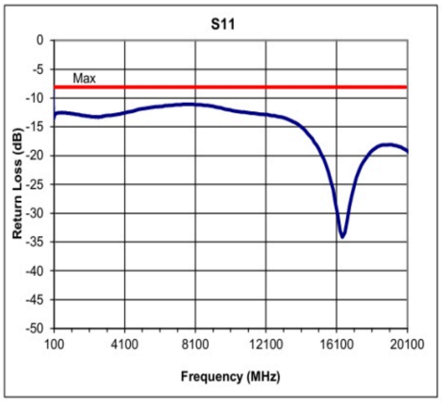


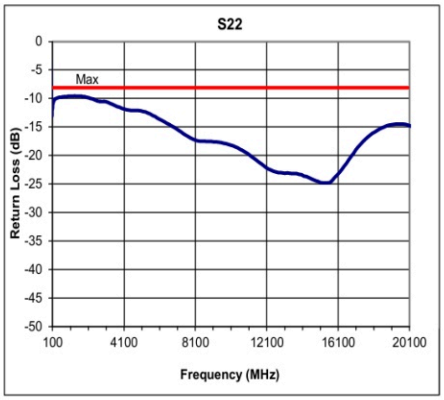






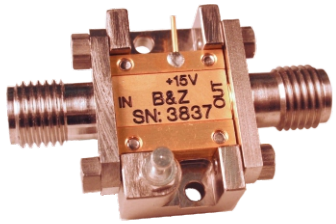


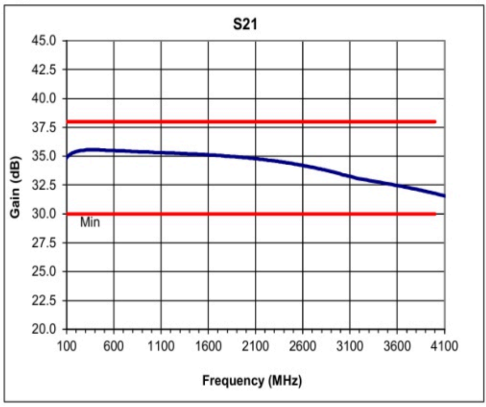


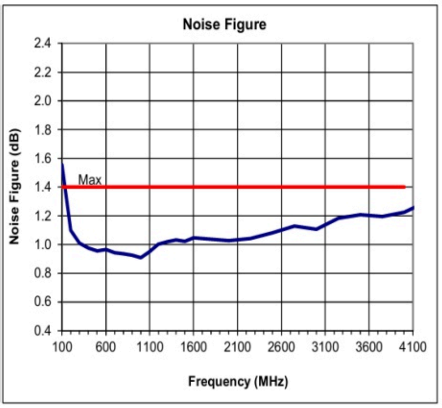


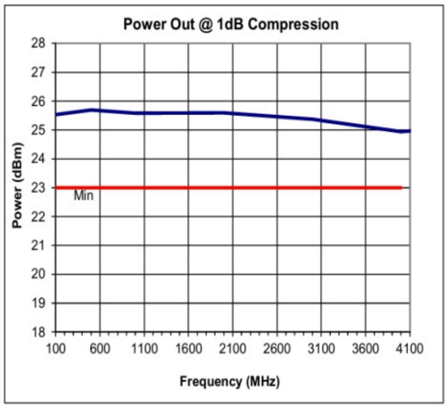
11. BZY-00100400-142330-252020(1 to 4 GHz)

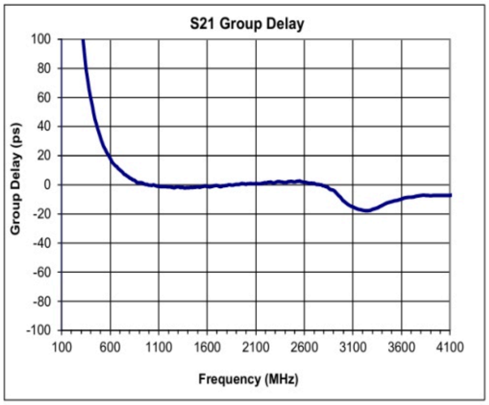
Parameter	Min	Typ	Max	Units
Frequency Range	.1	-	4	GHz
Noise Figure*	-	1.2	1.4	dB
Gain	30	32	38	dB
Gain Flatness (+/-)	-	± 2	± 2.5	dB
P1 Output Power	23	25	-	dBm
Input VSWR	-	1.5:1	2:1	
Output VSWR	-	1.5:1	2:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+15	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	200		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA - Female			
Dimensions	See outline 100114D			

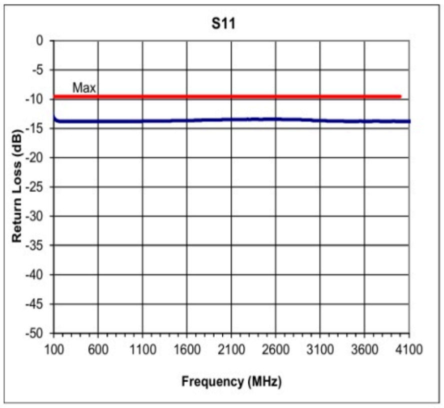


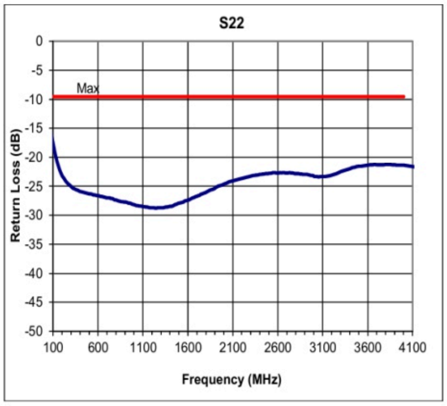






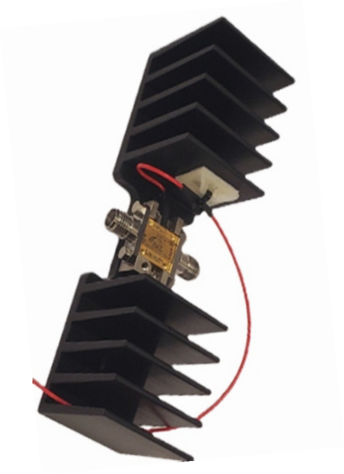


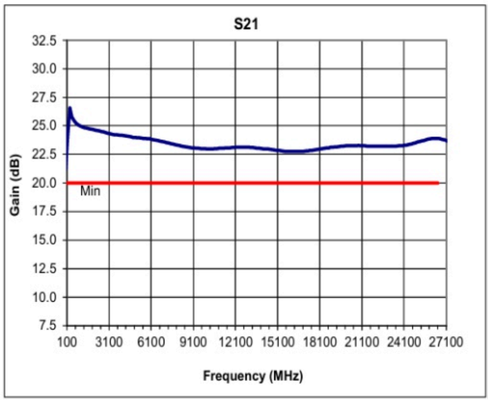


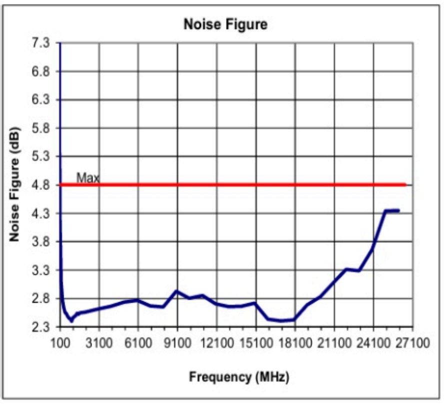


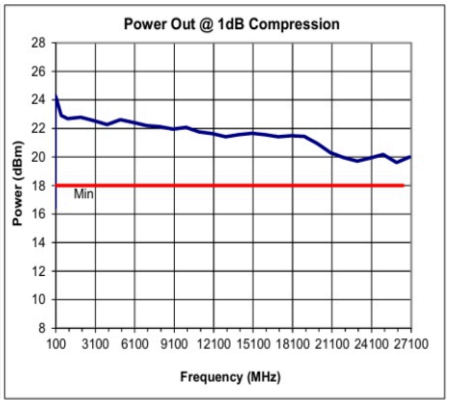
12. BZY-00102650-481820-252525 (0.1 to 26.5 GHz)

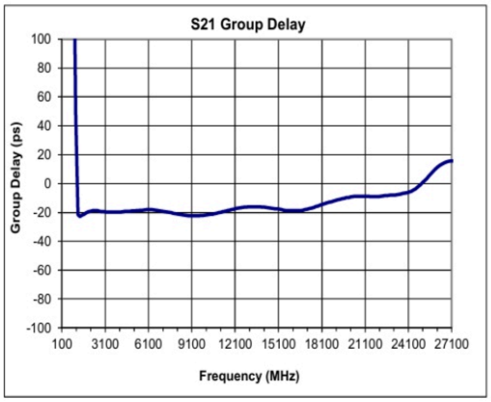
Parameter	Min	Typ	Max	Units
Frequency Range	.1	-	26.5	GHz
Noise Figure*	-	4.5	4.8	dB
Gain	20	22	30	dB
Gain Flatness (+/-)	-	± 2.0	± 2.5	dB
P1 Output Power	18	20	-	dBm
Input VSWR	-	2.3:1	2.5:1	
Output VSWR	-	2.3:1	2.5:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+13	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	265		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	2.92 mm FEMALE			
Dimensions	See outline 100169A			

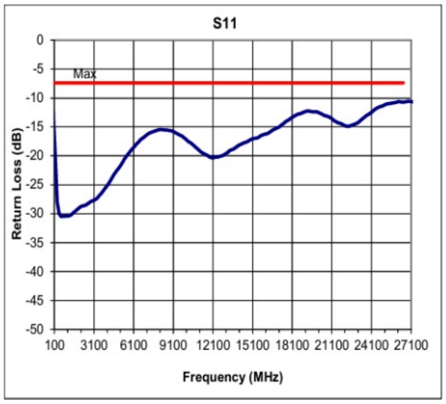


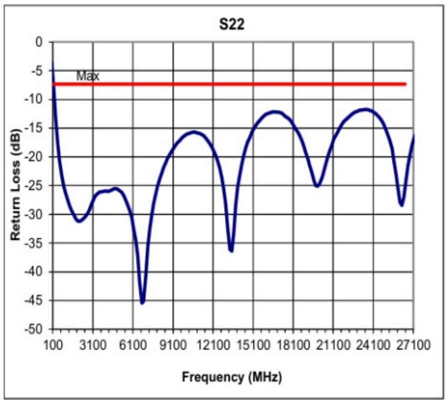






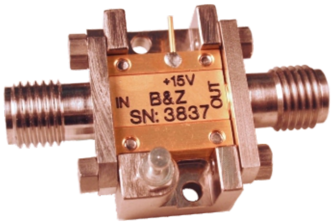


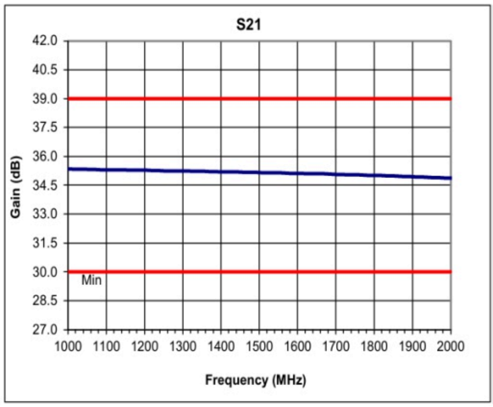


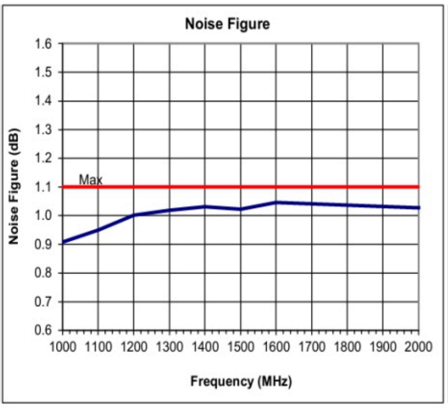


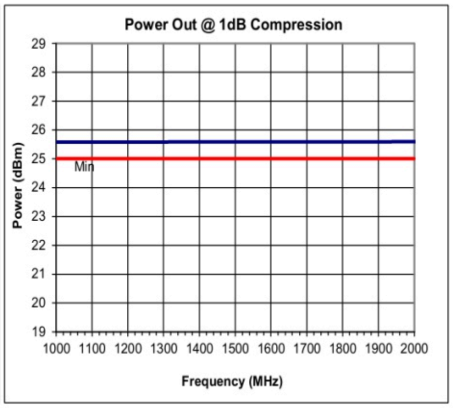
13. BZY-01000200-112530-152020 (1 to 20 GHz)

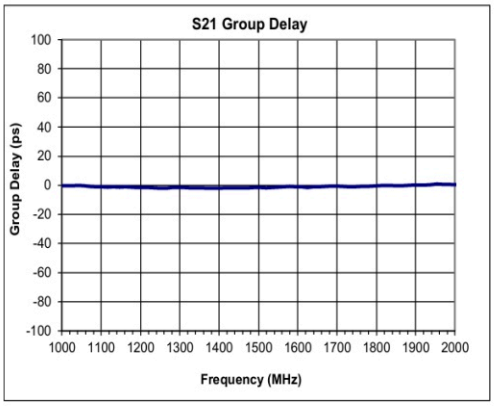
Parameter	Min	Typ	Max	Units
Frequency Range	1	-	2	GHz
Noise Figure*	-	1	1.1	dB
Gain	30	33	38	dB
Gain Flatness (+/-)	-	± 1	± 1.5	dB
P1 Output Power	25	26	-	dBm
Input VSWR	-	1.5:1	2:1	
Output VSWR	-	1.5:1	2:1	
Operating Temperature	-55	-	+85	°C
Non-Operating Temp Range	-65	-	+85	°C
RF Input Power (no-damage)	-	-	+15	dBm
Humidity (non-condensing)	-	-	95	%
Voltage	+12	+12	+15	VDC
Current	-	200		mA
Input/Output Impedance	50			Ohms
RF Connector (IN / OUT)	3.5mm SMA - Female			
Dimensions	See outline 100114D			

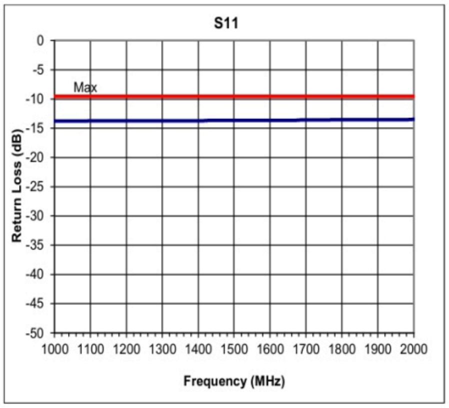


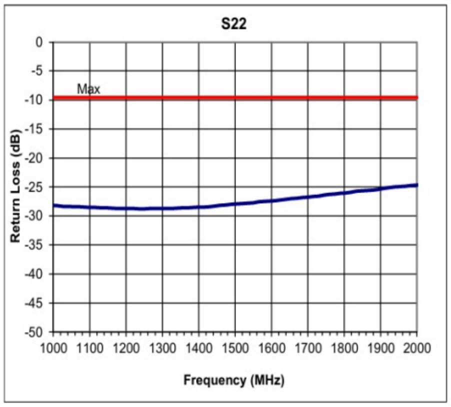


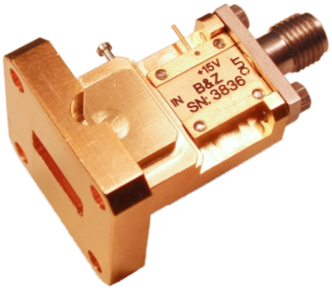


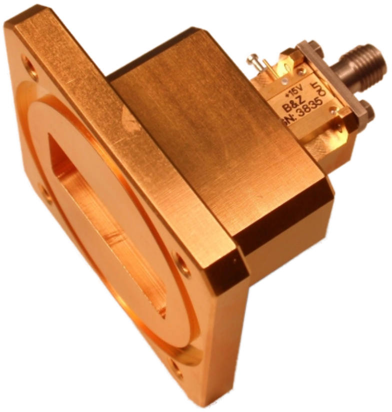












Waveguide Input Amplifiers

B&Z Technologies offers waveguide input amplifiers with the lowest noise figures and noise temperatures in the industry. B&Z's Ultra-Low Noise amplifiers are incorporated in our unique waveguide packages. This allows our engineers to tune the amplifier's input stage to provide the best possible match with the waveguide structure.

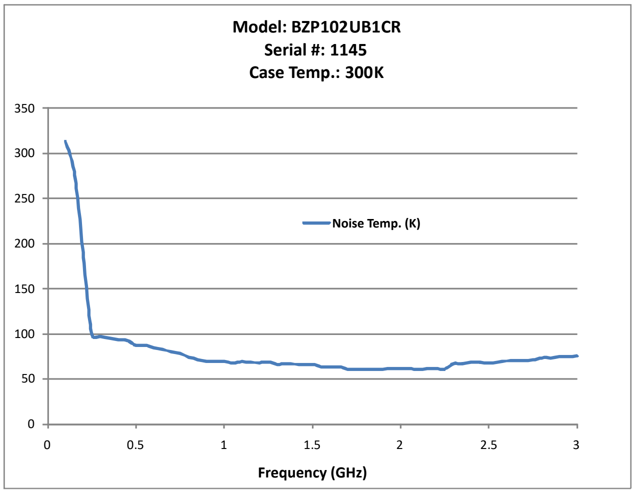
All of our Waveguide Input Amplifiers are available in indoor and outdoor versions.

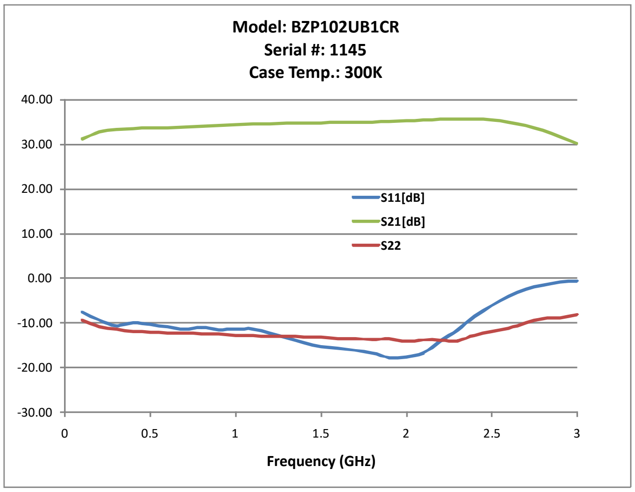
If one of the models listed does not match your application, please contact us. We are very happy to quote an amplifier to match your exact specifications.

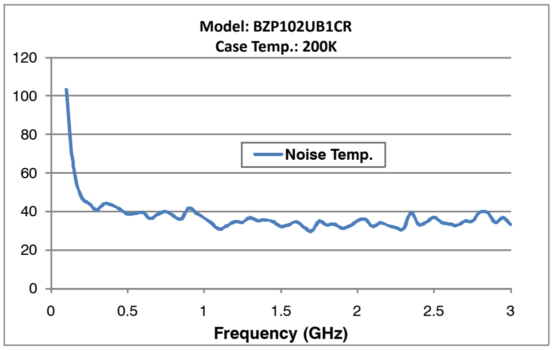
Cryogenic Amplifiers

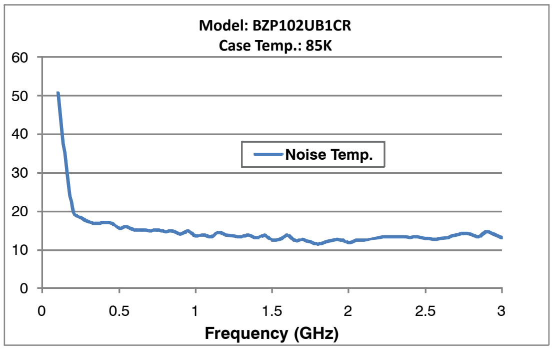
We offer cryogenic amplifiers suitable for low temperature applications. For optimum performance, the voltage is normally not regulated. While we provide data for these models at 77K (the temperature of liquid nitrogen), many of these units may also be used down to 4K (the temperature of liquid helium).

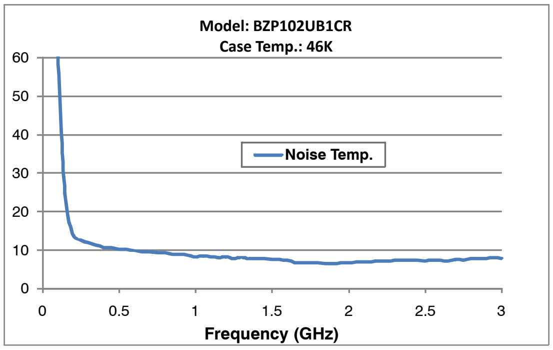
BZP102UB1CR
Typical Performance

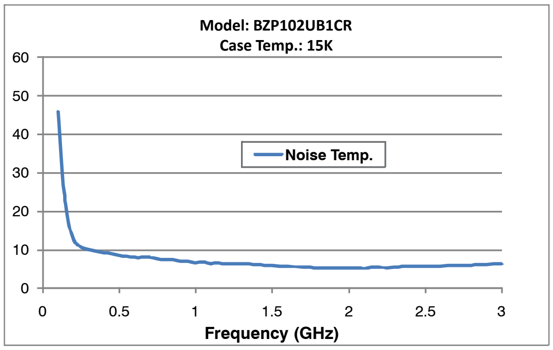




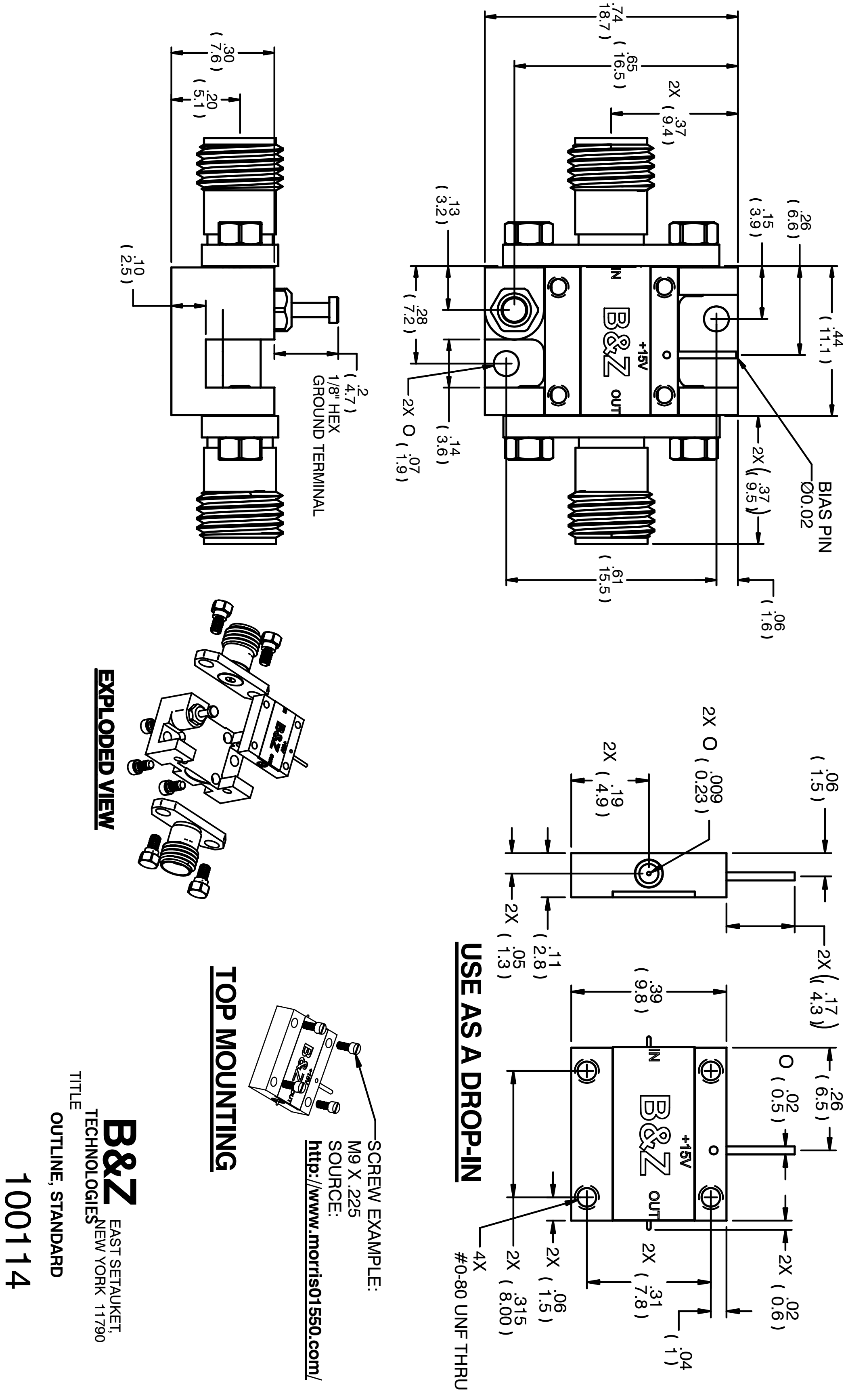




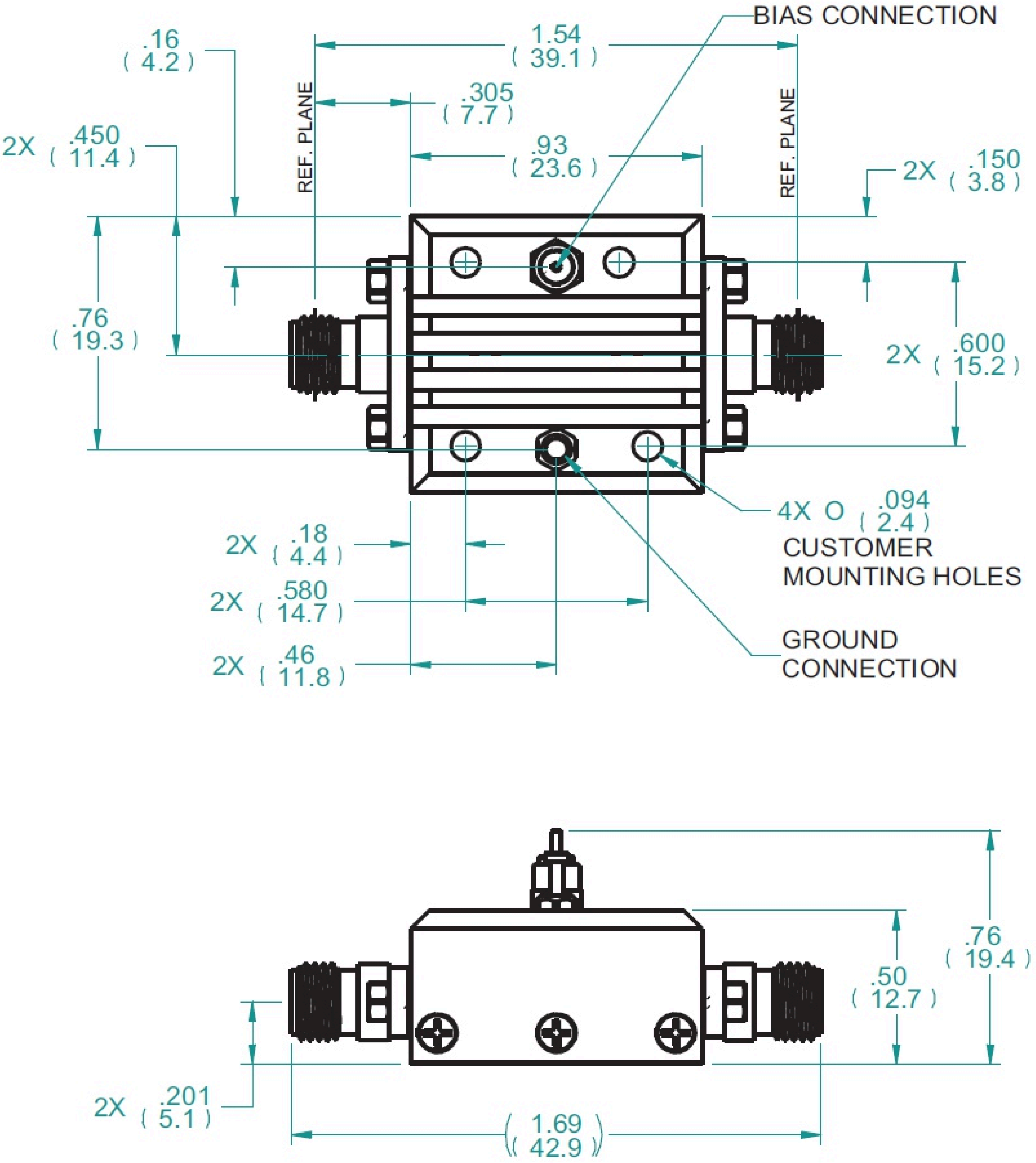


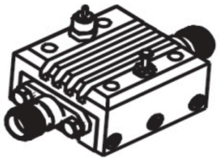


Outline A
Standard Package



Outline B
Cascaded Package

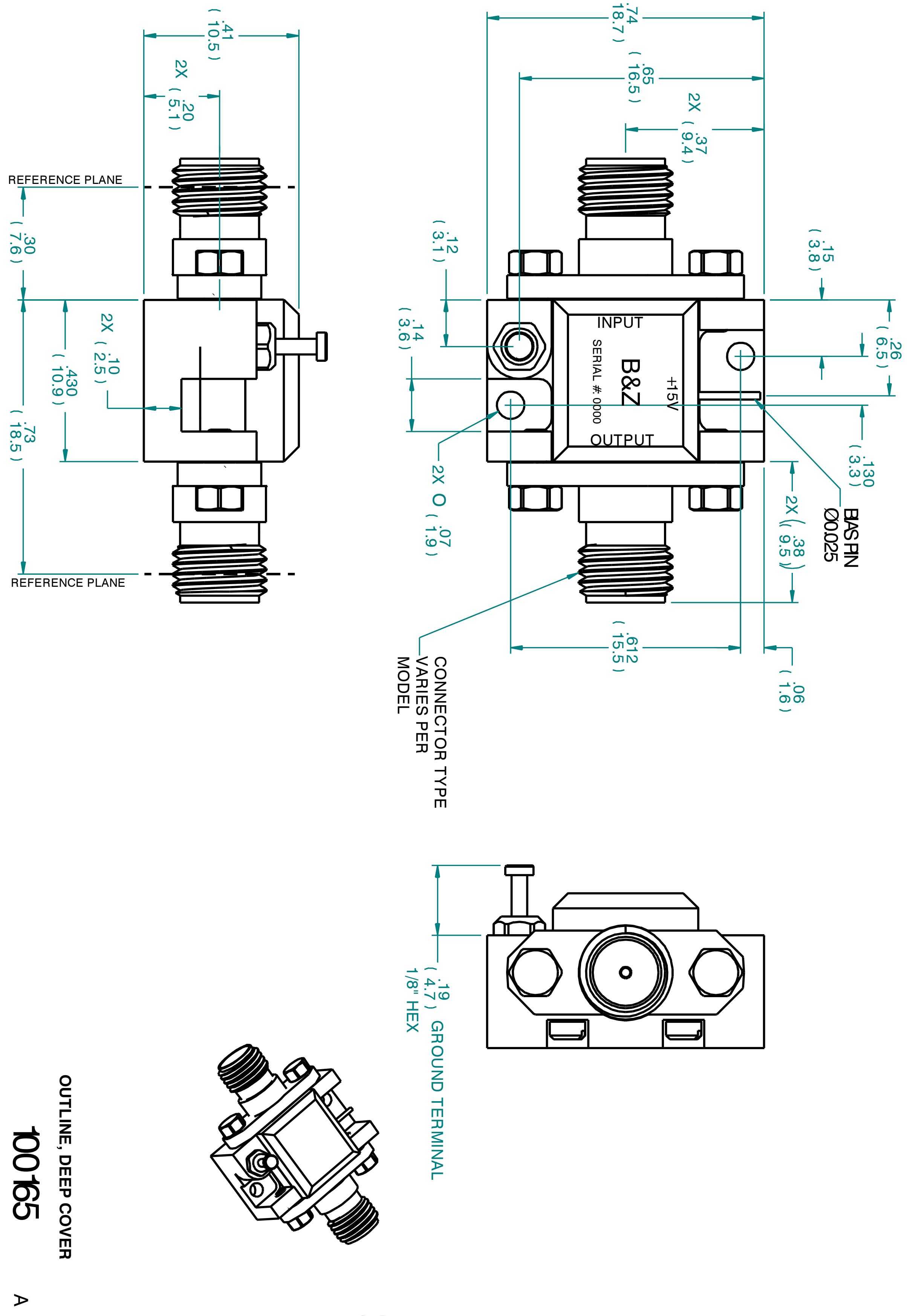




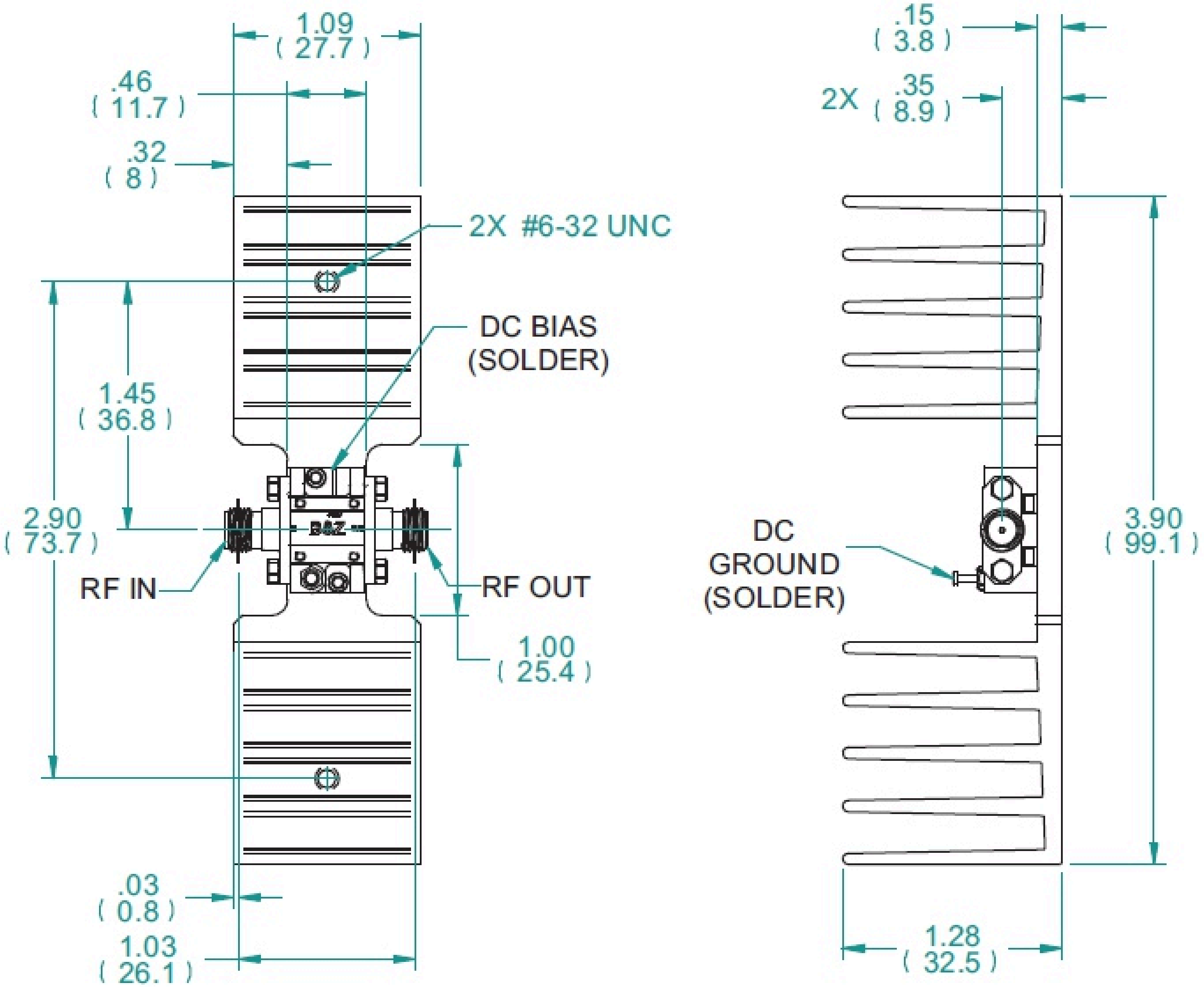
OUTLINE, CASCADED

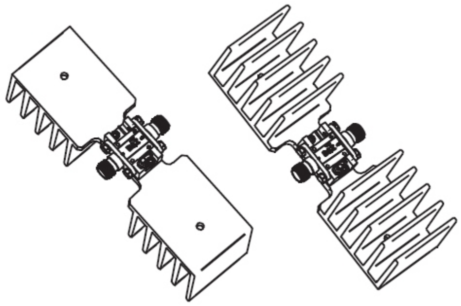
100161

Outline C
Tall Package



Outline D
Amplifier with Heatsink





Notes:

1. Approximate heatsink temperature rise above ambient is 6.5° C/W in still air.

OUTLINE,
STD. AMPLIFIER ON HEATSINK

100169

WARRANTY

B&Z Technologies, LLC warranties its products for a period of three years

Unless otherwise specified B&Z Technologies (seller) warrants each product it manufactures to be free from defects in material and workmanship for a period of three years from date of shipment, as evidenced by Seller's packing list or transportation receipt, to the original purchaser. B&Z Technologies warrants its products to meet the original specifications set forth in the original specification sheet for that product, or the specifications listed and agreed upon in the buyers purchase order that was accepted by B&Z Technologies at the time of the original order.

B&Z Technologies obligation under this warranty shall be limited to the repair or replacement of the product, at Seller's option, which Seller's examination shall prove to its satisfaction to be defective. In no event shall Seller's liability for any breach of warranty exceed the net selling price of the defective product. B&Z Technologies shall not be liable for any direct or consequential injury, loss or damage incurred through the use or the inability to use, any B&Z Technologies product.

All warranty returns must be authorized by a B&Z Technologies representative before the product is returned for repair. The buyer will prepay the shipping charges for all products returned for repair; the seller will pay for the return shipping.

This warranty shall not apply to any product that has been modified, disassembled, abused or physically or electrically damaged. Products damaged by electro-static discharge are not covered by this warranty. Appropriate ESD precautionary measures must be adhered to when handling the product.

B&Z Technologies reserves the right to make design changes to any product without incurring any obligation to make the same changes to previously purchased or delivered units.

Warranty repairs are warranted for a period of three years from the date of original shipment when the product was shipped as a new product.