Introduction

Amplifier Models

- Broadband
- Multioctave Wideband
- SATCOM and Radar
- Broadband GaN Amplifiers
- Instrumentation and Rack-Mount
- Microwave and Millimeter-Wave
- Pulsed

Outline Drawings

TABLE OF CONTENTS

FEDERAL SUPPLY CODE

Our Federal Supply Code is: 33592

INTRODUCTION

This catalog is intended to provide an overview of MITEQ's Power Amplifier standard products and custom capabilities. The products within this catalog are organized into ten major sections. An overall list by:

- Power Amplifiers
- Broadband PAs
- Multioctave Wideband PAs
- Narrowband SATCOM and Radar PAs
- Broadband GaN Amplifiers
- Instrumentation and Rack-Mount PAs
- Microwave and Millimeter-Wave PAs
- Pulsed PAs

In addition to the detailed product information, we have included typical test data from some of our amplifiers to give a feel for the performance listed in the specification tables. We have also included, for your reference, a section filled with application notes written by our engineers to help in understanding some system design parameters when using our amplifiers. Included in this section is a note on specification definitions. You may also find these especially informative in assuring that your requirements are in line with the catalog specifications.

In all, we think you will find this catalog informative and a useful tool to better understand MITEQ's Power Amplifier models, as well as a good general reference for any amplifier application.

CIRCUIT DESCRIPTIONS

MITEQ's amplifiers incorporate many design techniques commonly used throughout the industry. Through extensive study and years of experience, our engineers have become more proficient in certain subtleties of amplifier design, most notably in the area of noise and broadband performance. With these factors, MITEQ cannot overlook our flexibility to utilize and combine all techniques to meet the customer's specific requirements. Each system requirement has an optimum approach, and MITEQ uses all of the available design and technology options plus a few proprietary techniques, to offer the best performance.

ENVIRONMENTAL TESTING

BALANCED AMPLIFIERS

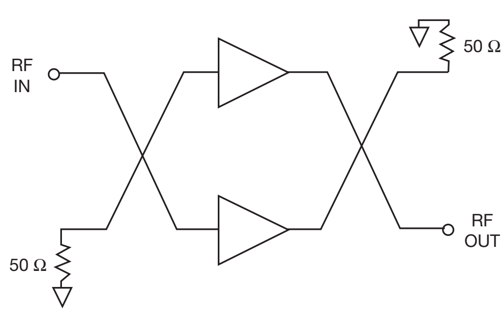
During the early years at MITEQ, the balanced amplifier approach was most widely used. Each amplifier stage in a balanced design employs a 90° hybrid at the input and output to drive two discrete transistors. The advantage of using this topology is:

- Good VSWR characteristics
- Easily cascadable stages and stability
- Easy power matching and combining
- Good broadband performance

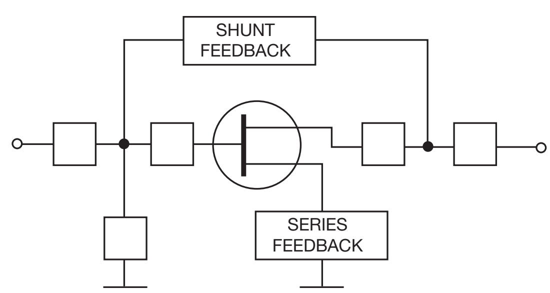
The disadvantages of this type of design are equally as clear. The cost and size are adversely affected because of the two FETs per stage. In addition, if used as the input stage of an amplifier, the loss of the 90° hybrid will degrade the minimum achievable noise figure especially at higher frequencies. Finally, this design is bandwidth limited due to the problems in realizing multi-octave 90° hybrids. AMF series amplifiers that utilize the balanced approach are designated by our "B" series, for example; AMF-2B, AMF-3B, AMF-4B, etc., typically representing 2-, 3- and 4-stage balanced stage amplifier designs.

FEEDBACK DESIGNS

MITEQ has established a technique to counter the deficiencies of the balanced approach and developed an amplifier series based upon a feedback design approach. Our "F" series amplifiers use this approach when its advantages fit the specific applications.



BALANCED AMPLIFIER STAGE



FEEDBACK AMPLIFIER STAGE

MITEQ®
100 Davids Drive, Hauppauge, NY 11788 • TEL: (631) 439-9220 • FAX: (631) 436-7430 • www.miteq.com

Feedback based designs use a single transistor in each stage. The impedance of the FET is matched to the input or output source and load impedance by means of feedback. Two basic types of feedback are applied, series or parallel. Series feedback is also known as "lossless" feedback because there is typically no additional lossy components used. Although difficult to optimize, and prone to instabilities, a lossless feedback design provides the lowest noise figures available today.

When implementing this type of design, the engineer must pay particular attention to impedance matching the input stages. The interaction of gain, gain flatness and noise match of the transistor must be optimized over the specified band. This optimization of a feedback amplifier design involves a tradeoff exercise between input VSWR and noise figure performance. The matching techniques utilized are best accomplished in "chip and wire" construction where subtle tuning can be realized. This is an area that requires extensive experience and a detailed knowledge of the bare-die transistor and impedance matching circuits in order to achieve the best possible performance.

It is also possible to make use of input and interstage isolators to provide good VSWR performance while maintaining the best noise match. Although isolators are sometimes used for special applications in our products, MITEQ has been able to achieve both a good gain and optimum noise match without isolators.

DISTRIBUTED AMPLIFIERS

MITEQ also utilizes distributed amplifier approach to support broadband and ultra-broadband applications. While feedback and other single-ended topologies are limited in bandwidth by the cut-off frequencies of the devices used, distributed designs do not have such a limitation.

This technique uses multiple FETs per stage in a "traveling wave" approach to provide each stage with a balanced combination of gain flatness and power. The textbook design of a distributed amplifier uses 50 ohm termination resistors in each stage, which have a negative effect on noise figure. MITEQ's engineers have developed proprietary techniques to implement this approach and still achieve low noise performance.

Our JS, AFS, and "D" series amplifiers utilize the distributed amplifier design approach and achieve multi-octave to ultra-broadband designs beyond 40 GHz.

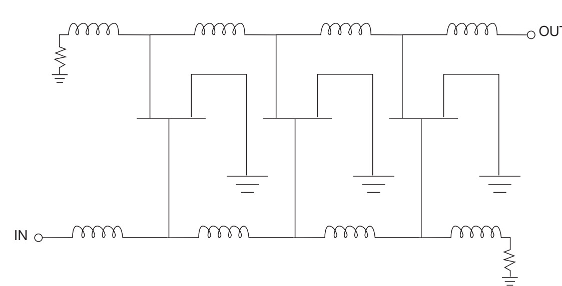
SATCOM AMPLIFIERS

MITEQ's SATCOM LNAs are designed for the ultimate low noise performance in the common satellite bands and have the corresponding waveguide inputs. Typically, feedback is the technique used in the input stage to facilitate impedance matching for an optimum balance of gain, VSWR, and noise figure. Often waveguide isolators are used to meet strict input VSWR requirements.

CUSTOM ENGINEERING

All these circuit approaches are combined to provide an endless array of amplifier designs. The positive and negative features of each design are weighed and combined to meet each customer's specific requirements. In addition to these approaches, MITEQ's Amplifiers integrates other features to meet custom design requirements, including:

- Gain control
- Input limiter protection
- Sloping amplifiers
- Limiting amplifiers
- Extended temperature range
- Switched or pulsed applications
- Detector outputs
- Fault alarms
- In-line filtering
- EMI shielding
- Weather-proofing
- Power supply options
- Heatsinking options



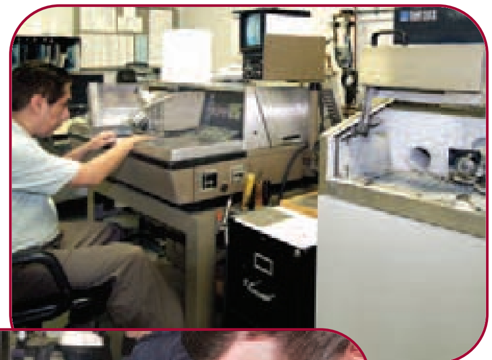
DISTRIBUTED AMPLIFIER STAGE

MITEQ
100 Davids Drive, Hauppauge, NY 11788 • TEL: (631) 439-9220 • FAX: (631) 436-7430 • www.miteq.com

These various design possibilities are best discussed directly with our engineers. MITEQ's engineering personnel not only possess the detailed amplifier knowledge, but also have extensive overall systems background to help customers translate their true requirements into specifications. This direct contact on an "engineer-to-engineer" basis has allowed MITEQ to better support our customer base with information and suggestions to improve the use of our amplifiers in their systems.

CONSTRUCTION

MITEQ's amplifiers are manufactured using our internal thin film hybrid manufacturing process. This type of Microwave Integrated Circuit (MIC) construction was introduced by MITEQ during the early 1970s and has been the main manufacturing technique for our amplifiers ever since. Our expertise in this form of micro-miniature integration has allowed MITEQ to achieve truly state-of-the-art performance, particularly in the areas of low-noise figure, high frequency and broadband amplifier design.



THIN FILM LAB

Most balanced amplifiers made by MITEQ are constructed using a carrier technique. Carriers are typically assembled by high speed automated equipment and stocked per model and band. These carriers are then cascaded in the final chassis to achieve the total specified parameters of the amplifier. Final alignment and test is performed within the overall chassis to ensure compliance to these specifications.

The distributed amplifiers and the feedback designs use a technique where the FETs are mounted directly to the chassis. This technique allows MITEQ to achieve a physically smaller mechanical interface between the input stage and the coaxial transition, making lower noise figures possible. Also, the tighter interstage tolerances assist in achieving broader bandwidths, as required by both of these series.

To accomplish the manufacturing and testing of our cutting edge amplifiers, equally state-of-the-art equipment must be utilized. This includes machining equipment to manufacture tight tolerance chassis for our millimeter-wave amplifiers, glass furnace equipment to control the process of glass sealing, latest microwave test equipment, seam-sealing equipment, thermal/humidity chambers, PIND, shock, and vibration stations for environmental screening.

SPECIFICATION DEFINITIONS

GENERAL SPECIFICATIONS

Most of the amplifiers listed in this catalog are classified by several specifications. They are based on operation at normal room ambient conditions of 23°C. For other parameters as amplifier requirements at other temperatures and environments, please consult the factory or your local representative.

- Operating frequency range
- Gain
- Gain flatness
- Noise figure or noise temperature
- Output power at 1 dB compression
- Input and output VSWR
- DC supply voltage and current consumption

We also can provide data upon request on other parameters such as phase linearity, intermodulation and harmonics, amplitude linearity or temperature variations.

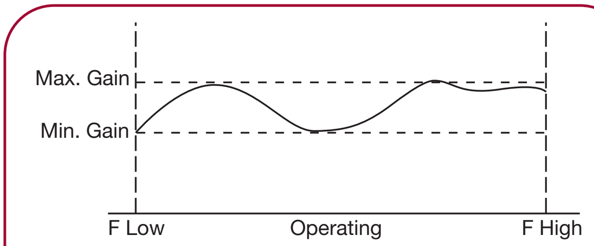
OPERATING FREQUENCY RANGE

The operating frequency range is the range of frequencies over which the amplifier will meet or exceed the specification parameters. The amplifier may perform beyond this frequency range, and in cases where the amplifier is specified over less than an octave, the actual frequency response may be significantly greater than the specified operating frequency range.

PLEASE NOTE: If an engineer is interested in limiting the response beyond the specified operating frequency range, this should be defined as a separate specification item. In this case, MITEQ can usually incorporate band-limiting elements to meet the desired response.

GAIN

Gain is defined as the ratio of the power measured at the output of an amplifier to the power provided to the input port. It is usually expressed in decibels and is typically measured in a swept fashion across the operating frequency range. Unless specified, 100% test data supplied by MITEQ will include gain data taken at several points within the band; however, in all cases, the amplifier gain has been measured in a swept fashion with performance verified over the entire frequency band. Gain stability over much larger bandwidths are also verified by measurement especially for new models and over temperature.



GAIN FLATNESS = $\pm \frac{(\text{Max. Gain} - \text{Min. Gain})}{2}$

Test data supplied with our amplifiers will include swept gain plots taken at least 100 to 1600 points within the band. Tabular data can also be supplied if required.

GAIN FLATNESS

Gain flatness describes the variation in an amplifier's gain over the operating frequency range at any fixed temperature within the operating temperature range. As such, it does not include the variation of gain as a function of temperature (see Gain Variation vs. Temperature).

The gain flatness of an amplifier is measured by viewing the swept gain and determining the difference between the minimum gain and the maximum gain recorded over the specified frequency range. Unless the amplifier is specified to operate over a defined temperature range, this measurement is performed at room ambient temperature (23°C). If a range of temperatures is specified, the measurement must also be verified at the temperature extremes.

NOISE FIGURE

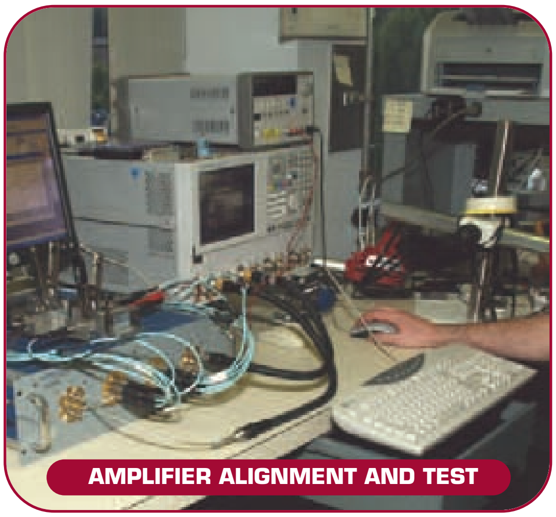
Noise figure is classically defined as the ratio of the signal to noise ratio at the input divided by the signal to noise ratio at the output with the input noise equivalent to that from a matched load at 290 degrees Kelvin. All physical bodies emit noise related to its physical temperature. This noise for a matched load is given by the formula kTB, where k is Boltzman's constant, T is the temperature in degrees Kelvin, and B is the Bandwidth. For example, a 1 MHz bandwidth, and T = 290 degrees K, the noise power is –114 dBm.

Noise figure =

$$\frac{S_i/N_i}{S_o/N_o} = \frac{\text{Signal-to-noise ratio at the amplifier input}}{\text{Signal-to-noise ratio at the amplifier output}}$$

Since all amplifiers add thermal noise, the signal-to-noise ratio at the output will be degraded. Therefore, the noise figure will be a ratio greater than one, or when expressed in decibels, a positive number i.e. NF dB = 10 Log_{10} (NF Ratio). The additive noise of an amplifier can also be expressed in a parameter referred to as noise temperature. In this approach, the noise temperature of the amplifier is equal to the temperature (in Kelvin) of a 50 ohm termination at the input of an ideal noiseless amplifier with the same gain and generating the same output noise power.

Note that in the case of low noise amplifiers that have lower frequency range extending to about 200 MHz or lower, one may expect an increase in the NF at the lowest frequencies. This happens as a result of the naturally occurring 1/f noise in semiconductor junctions, which usually has a corner frequency of 100-200 MHz, may show some variation with technology and device vendor and though it is only measurable for very low noise amplifiers, it is very difficult to control or predict. MITEQ has developed proprietary circuit techniques that reduce this effect considerably.


AMPLIFIER ALIGNMENT AND TEST

NOISE TEMPERATURE

Noise figure was defined at a time when the background noise and system physical temperatures were close to 290 degrees K. With satellite applications, however, the space background temperature is near 4 degrees Kelvin and the noise sources in front of the amplifier are small. In this case, the relationship of the signal-to-noise ratio at the input vs. the signal-to-noise ratio at the output is not simply related to the noise figure definition. It is more intuitive to work with what is called noise temperature. By definition, all noise sources in an amplifier are referred to the input. The noise temperature of the amplifier is defined as the temperature (in Kelvin) of a matched termination at the input of an ideal noiseless amplifier with the same gain and (the load) generating the same output noise power.

The relationship between noise figure and noise temperature is:

$$\text{Noise Figure} = 10\ \text{Log}_{10} \left\{ \frac{\text{Noise Temp. (K)}}{290\ \text{K}} \right\} +1$$

Noise figure or noise temperature data is measured at discrete frequencies throughout the band. Test data is supplied at +23°C unless specified otherwise.

OUTPUT POWER AT 1 dB COMPRESSION

The 1 dB output compression point of an amplifier, or P1dB is simply defined as the output power level at which the gain drops 1 dB below the small signal level.

All active components have a linear dynamic range. This is the range over which the output power varies linearly with respect to the input power. As the output power increases to near its maximum, the device will begin to saturate. The point at which the saturation effects are 1 dB from linear is defined as the 1 dB compression point. Because of the nonlinear relation between the input and output power at this point, the following relationship holds:

$$\text{P1dB} = P_{IN}\ 1\ \text{dB} + \text{Linear Gain} - 1\ \text{dB}$$

Note that for amplifiers that exhibit very soft compression or even gain expansion, the exact definition of P1dB can be ambiguous or misrepresent a power amplifiers capability.

INPUT AND OUTPUT VSWR

Most RF and microwave systems are designed around a 50-ohm impedance system. An amplifier's impedance is always designed to be as close as possible to 50 ohms; however, this is not always possible, especially when attempting to simultaneously achieve a good noise figure. The Voltage Standing Wave Ratio (VSWR) of an amplifier is a measure of an amplifier's actual impedance (Z) with respect to the desired impedance (Zo), in most cases 50 ohms.

The VSWR is derived from the reflection coefficient Γ, which is a ratio of the normalized impedance:

$$\Gamma = \frac{Z - Zo}{Z + Zo}$$

and:

$$VSWR = \frac{1 + |\Gamma|}{1 - |\Gamma|}$$

VSWR is measured with either a scalar or vector network analyzer. The reflection coefficients are determined by comparing the incident power and the reflected power at both ports of the device which in turn are converted and displayed as a VSWR. The ratio of the reflected power to the incident power is also known as the return loss usually expressed in dBs.

AUTOMATED TEST STATION

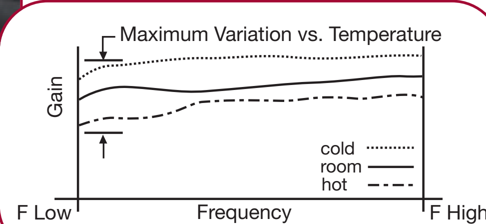
DC SUPPLY VOLTAGE AND CURRENT CONSUMPTION

Amplifiers, being active devices, require DC power for their operation. MITEQ's amplifiers typically require +15 volts and include an internal voltage regulator. The use of a regulator allows for specification compliant operation even in the presence of power supply voltage variations, as long as minimum voltage supplied is greater than the specified drop-out voltage of the regulator. MITEQ also includes reverse voltage protection to prevent damage due to the accidental application of a negative DC voltage. Internal regulation is present in all MITEQ amplifiers which help eliminate most noise and ripple that may be present on the supply lines. Most power amplifiers are also protected against over-current and over-temperature conditions. With a few exceptions almost all MITEQ amplifiers require a single positive voltage, typically 15V, to operate. Other voltages and AC supply options are also available.

ADDITIONAL SPECIFICATIONS

In addition to the electrical specifications for most of the models within this catalog, there are additional specifications that may be of concern to the engineer designing around stringent system requirements:

- Gain variation vs. temperature
- Overall gain window
- Group delay and flatness
- Output intercept point
- Dynamic range
- Amplifier de-sense
- Reverse isolation
- Phase linearity
- Phase and amplitude matching and tracking
- AM to PM conversion
- Phase noise
- Pulse conditions
- Maximum input power
- RFI immunity
- Environmental requirements



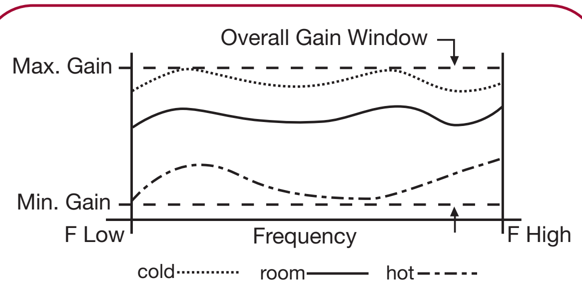
GAIN VARIATION VS. TEMPERATURE

Gain variation versus temperature defines the maximum allowable variation of the linear gain due to temperature at any discrete frequency. As a result, this parameter does not account for drift over frequency. Gain variation versus temperature is measured by performing swept gain measurements at the specified temperature extremes and comparing the deviations between the two sweeps at a particular frequency to determine the greatest change. When a ± value is used, then the delta is taken at both temperature extremes with respect to room temperature (23°C). (For typical gain variation values vs. temperature see Thermal Considerations section.)

OVERALL GAIN WINDOW

An overall gain window specification defines the absolute minimum and maximum gain values over both temperature and frequency.

In reality, it is the most complete way to specify an amplifier; however, it does impact the price due to the additional testing and alignment required by adding this constraining parameter.

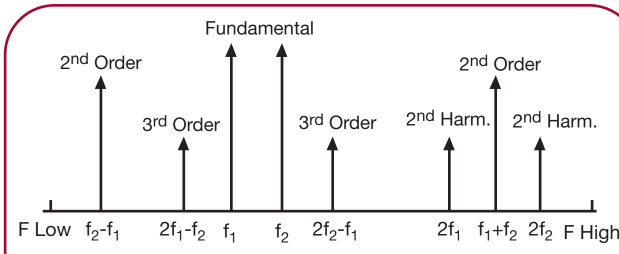


GROUP DELAY AND FLATNESS

Group delay is a measure of the transit time of a signal through a device versus frequency. It is a useful measure of phase distortion and is calculated by differentiating the insertion phase of the device with respect to frequency. The linear portion of the phase response represents the average signal transmit time and deviations from this constant represent distortion. For many radar and communication applications, such distortions need to be kept below a threshold.

OUTPUT INTERCEPT POINT

Solid state amplifiers use transistors and/or MMICs, to provide gain. Although these devices are generally used in a linear mode (except in the case of other than a Class A amplifier), they still exhibit nonlinear phenomenon, such as intermodulation effects and harmonic generation. These effects are evident in intermodulation products present at the output. In the case of the single-tone input condition, the nonlinear output signal components are the harmonics of the fundamental input signal. In the case of the two-tone input condition, the intermodulation products are generated as a result of mixing of two input tones at the frequencies f_1 and f_2. The most common are the second order and the third order two-tone products.



INTERMODULATION SPURIOUS FREQUENCY SPECTRUM

Second order two-tone spurs are the sum and difference product of the fundamental input frequencies, i.e.,

$$f_{SPUR} = f_1 \pm f_2$$

These spurious signals are only of concern when the band is greater than one octave. If the frequency range is less than one octave, the two-tone second order spurs will be out of band.

These spurious signals are characterized with respect to the input signal by means of a theoretical tool called an intercept point. These points are defined as the point where the linear curve of input vs. output power of the fundamental would intersect with the linear curve of the spurious signal if saturation effects would not limit the output levels of these signals. Since it is known that the second order spurious products have a slope of 2:1 with respect to the fundamental input power, the value of the spurs can be estimated if the input signal power (P_{IN}) and the output second order intercept point (OIP_2) are known. The relationship is as follows:

$$\text{Two-tone second order spurious suppression} = OIP_2 - (P_{IN} + G)$$

$$\text{Two-tone second order spurious level} = 2\,(P_{IN} + G) - OIP_2$$

Third order spurious products result from combinations of the fundamental signal and the second harmonics.

$$f_{SPUR} = |2f_1 \pm f_2| \pm |f_1 \pm 2f_2|$$

The slope of third order spurious signal is 3:1 with respect to the fundamental input power, and again the value of the spurs can be estimated if the input signal power (P_{IN}) and the output third order intercept point (OIP_3) are known. The relationship is as follows:

$$\text{Two-tone third order spurious suppression} = 2\,\{OIP_3 - (P_{IN} + G)\}$$

$$\text{Two-tone third order spurious level} = 3\,(P_{IN} + G) - 2\,OIP_3$$

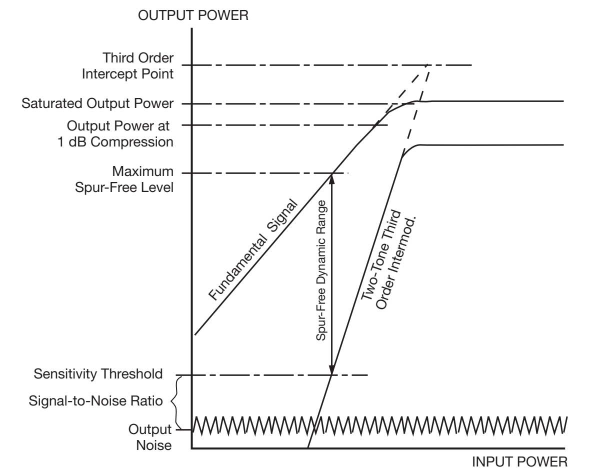
A rule of thumb is that the OIP_3 is 10 dB above the 1 dB compression point, but this is often not the case. In many amplifiers, compression is not monatomic (such as with gain expansion) vs. input level. This depends upon the type of FET and to some degree its bias conditions. When this happens, the third order intercept is degraded. Degradation of the third order intercept can also occur when two or more stages are compressing at the same time as a result of improper design or biasing. Also, there can be significant measurement error. This is possible as more than one stage is contributing to the generation of spurs, and depending on the phase of the separately generated spur, the sum of the two sources may cancel or add at certain signal levels of temperature.

DYNAMIC RANGE

Dynamic range can be defined in several ways. The two classical methods are to define the linear dynamic range and the spurious free dynamic range.

The linear dynamic range defines the difference between the Minimum Detectable Signal (MDS), referred to the input of the amplifier or receiver and the maximum signal level at which the amplifier remains linear. This is typically defined by the input 1 dB compression point (P1dB - G). The minimum detectable signal is defined by system constraints, such as noise figure, bandwidth and minimum signal-to-noise ratio required for operation.

Spurious free dynamic range is defined as the difference between the minimum detectable signal at the input and the input level at which the intermodulation signals generated from two equal tones would either equal this MDS or some other acceptable level. The dynamic range can then be estimated by the following relationship:



DYNAMIC RANGE AND INTERCEPT POINT

$$\text{Two-tone spurious free dynamic range} = (2/3)\,(IIP^3 - MDS)$$

MDS (dBm) = -114 +10 Log_{10} (BW in MHz) + N.F. + SNR

Where SNR is the required signal to noise ratio of the system for proper operation. Note that spurious-free does not actually mean totally distortion free, but where the distortion that is present is below the detectable levels.

AMPLIFIER DE-SENSE

It is a measure of the amplifiers ability to function properly in the presence of a strong interferer. It is typically defined as the level of signal present somewhere in the passband of the amplifier that will cause a gain degradation of a specific amount, say 0.1 dB, for the desired signal.

REVERSE ISOLATION

Reverse isolation simply defines the isolation between the input and output of an amplifier. It is tested by injecting a signal into the output port and measuring its level at the input. Ideally, the isolation should be at least 10 dB greater and preferably 15 dB greater than the amplifiers gain. With low isolation, the load VSWR can affect the input VSWR and possibly affect the gain flatness and phase. Single stage amplifiers will often have lower isolation, and should be considered in a system's design.

PHASE LINEARITY

The phase of a signal versus frequency will be distorted due to the nonlinear phase elements within the amplifier. This distortion is called phase linearity and is measured by means of a vector network analyzer across the operating frequency range.

The phase non-linearity of a device can be defined as the deviation in phase from that of a matched transmission line of the same average electrical length. This is equivalent to variations in the transit time through a device as a function of frequency. This variation causes the distortion of modulated signals.

Phase linearity in an amplifier is affected by the internal interaction of reactance's, some types of feedback, and impedance mismatches (reflections). Thus narrow bandwidth amplifiers will have worse phase linearity than broadband designs as narrow bandwidth amplifiers require more tuned (reactive) circuits.

In general, MITEQ amplifier designs are inherently broadband, which results in excellent phase linearity and low amplitude ripple.

PHASE MATCHING

Phase matching, in the strict sense, is defined as the difference in insertion phase between any two or more units over a specific frequency range. This parameter is usually defined across the operating frequency band, however, in some cases it is defined over frequency segments (Δf) within the overall operating band.

In the case of the definition over the entire band, the insertion phase is measured by means of a vector network analyzer, stepped across the band. The values at each frequency for two amplifiers are subtracted to provide a delta plot across frequency. Since each system has its own peculiarities, there are a wide variety of variations of this definition. Therefore, if your system requirements are such that this definition does not accurately meet your needs, or if this level of definition exceeds your real need and results in higher cost, you should contact MITEQ's engineering staff to discuss the most cost effective options.

PHASE TRACKING

Phase tracking is very similar to phase matching. However, an arbitrary fixed offset exists between the amplifiers that can usually be compensated by the system software. The offset, sometimes referred to as the DC component (because all that remains is the phase versus frequency ripple and slope), is calculated at each temperature based upon an average over the band. As with phase matching, there are many variations on this theme that also should be discussed with MITEQ's engineering before committing to a final specification.

AMPLITUDE MATCHING

Same as phase matching, except substitute gain for phase.

AMPLITUDE TRACKING

Same as phase tracking, except substitute gain for phase.

AM TO PM CONVERSION

This specification parameter defines the change in phase at any fixed frequency within the operating band relative to the input signal power. It is usually defined in terms of degrees per dB (°/dB) over a specified input dynamic range. Most GaAs FET amplifiers exhibit well-behaved AM/PM conversion (less than 1°/dB) up to a few dB below the 1 dB compression point. Beyond the 1 dB compression point, the variation can be quite large, depending on the devices and biasing conditions used.

AM to PM is primarily due to the changes in the input and output VSWR of the various stages and their interaction. This can be visualized as phase shifts due to the changing reflections between stages. As a rough rule of thumb, the phase shift increases 1 or 2 degrees per 1 dB of compression.

PHASE NOISE

Phase noise is the frequency domain representation of rapid, short-term, random fluctuations in the phase of a waveform. It is mostly a concern for sources and oscillators but it may be important in some applications to take into account the phase noise contribution of amplifiers also. Since any active component is capable of contributing to the phase noise of a signal, amplifiers will add a phase noise component, however small, to any signal passing through them. This noise is typically measured and characterized at a certain offset from the carrier and expressed in terms of dBc/Hz. A typical amplifier will have around –140 dBc/Hz at 10 kHz for example. MITEQ offers a family of low-phase noise amplifiers up to 18 GHz.

PULSE CONDITIONS

A variety of pulse conditions can be specified for an amplifier, including amplitude or phase overshoot and ringing, amplitude or phase settling time, droop, rise and fall times, recovery time, etc. In general, our broadband amplifiers have excellent pulse recovery characteristics. We build many special pulse amplifiers with rise times as low as in the tens of pico-seconds. We have amplifiers for high-data rates such as for 15 Gb/s applications with rise times near 30 pS.

Other than these high-data-rate applications, MITEQ has also developed a series of pulsed power amplifiers specifically for radar applications.

As with the matching and tracking specifications, pulse operation parameters are typically system dependent and rarely fall into a standard definition. Therefore, it is best to contact MITEQ's engineering staff when attempting to define the operation of an amplifier in the presence of pulsed signals. Pulsed power amplifiers are also a distinct category where not just the RF but the high currents associated can also be switched at high speeds.

MAXIMUM INPUT POWER

Most low noise figure amplifiers will withstand an input level of 13 dBm CW. In the event that you require a higher input level, an input limiter can be added to the front end of the amplifier in order to protect it. The problem with the addition of the limiter is that its insertion loss is directly additive when calculating the overall noise figure. MITEQ can integrate input limiters up to 100W level into many of its amplifiers.

RFI IMMUNITY

RFI can be a serious consideration in certain very low-noise, high gain or very high power applications. It is also important for applications that have the amplifier exposed outdoors, near high-power transmitters or mast-tops where lightning effects need to be taken into account.

The very fact that all MITEQ amplifiers are built in metal housings, with sealed covers and shielded connectors provides a level of immunity from most types of common radiated and conducted interference. Still, there are applications where this typically 60-75 dB range of isolation may not be sufficient. Type of connectors, the way they are assembled, cover thickness and DC feedthru have to be scrutinized for higher levels of isolation. In many telecom applications, there are standards that specify the type of immunity and methods of measurements. All such requirements should be discussed with MITEQ engineering.

ENVIRONMENTAL REQUIREMENTS

While specifying environmental specifications for an amplifier, most important consideration is if a hermetic package is required. Customer needs to identify specifically all the extremes of the final environment. Most applications may require a hermetic seal. Standard environmental seal may be sufficient. If there is 100% condensation, altitude extremes or direct exposure to elements then a hermetic sealed packaging should be requested. In case the amplifier has to withstand direct exposure to elements, then a weatherproof housing is required which may entail special connectors, gasketing, windows for waveguide parts and special paint. Amplifiers can be made weatherproof without the need for hermetic sealing. There are numerous industry standards for environmental testing and screening and such issues should be discussed with MITEQ engineering ahead of time.

MITEQ
100 Davids Drive, Hauppauge, NY 11788 • TEL: (631) 439-9220 • FAX: (631) 436-7430 • www.miteq.com

OPTIONS

Options for a variety of special performance and testing requirements as well as connector types can be identified by adding a suffix to the part number. The table below lists the most commonly requested options. Option requests should be accompanied by a description of the required performance details as applicable. Note that not all options are available for all amplifiers and some options may conflict with each other.

STANDARD OPTIONS	SUFFIX
Input Limiter	–L
Gain Window	–GW
Gain Flatness	–GF
Temperature Compensation	–TC
Phase Match	–PM
Amplitude Match	–AM
Amplitude/Phase Match	–APM
Gain Control	–GC
Hermetic	–H
Bias Through Output	–BTO
Bias Through Input	–BTI
Specific Operating Voltage	–XXDC*
Gain Slope	–GS
Power Supply	–PS
Fault Alarm	–F
Combination of three or more standard options	–S
Waveguide Input	–WG
Weatherized	–WP

STANDARD OPTIONS (CONT.)	SUFFIX
DC On/Off Control	–TTL
Heatsink	–H
DC Pulsed Amplifier	–PLS
Isolator at Output	–ISO**
Detector Output	–DET
Low Phase Noise	–LPN
Amplitude Track	–AT
Phase Track	–PT
Amplitude and Phase Track	–APT

STANDARD CONNECTOR OPTIONS	SUFFIX
N Type Connector	–N
TNC Type Connector–T	
SMA Male Connector	–M
K Type Connector	–K
V Type Connector	–V

* XX is the DC operating voltage
** Some power amplifiers have an isolator at output at output by default.

ORDERING INFORMATION

General amplifier model naming rules:

AMF – 3B – 02001800 – 24 – 30P– ____ – ____

- Series → AMF
- Gain Stages → 3
- Circuit Type → B
  - **B**alanced
  - **F**eedback
  - **D**istributed
- Frequency GHz → 02001800
- Noise Figure dB → 24
- Output Power dBm → 30
- Standard Options — Fill in option suffix if required. (Refer to standard option chart above)
  - First option (if required)
  - Second option (if required)
  - For three or more standard options use **S** only