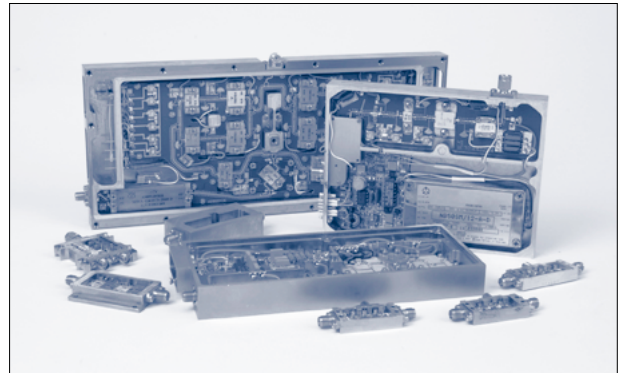


# Amplifiers



- ▶ **Low Noise, Small Signal & Medium Power Microwave Amplifiers**
- ▶ **Microwave Power Amplifiers**
- ▶ **Pulsed Amplifiers**
- ▶ **TWTA Solid State Retrofit**

## GENERAL INFORMATION

### Frequency Range

The inclusive band within which the amplifier will meet all its electrical specifications such as gain, noise figure, power output, intermodulation products, and VSWR.

### Gain

Gain indicated is the minimum gain across the specified frequency range. This is the small signal gain typically measured 20 dB below the 1 dB compression point.

Typical gains are 3 dB above the minimum values specified.

### Gain Flatness

The maximum difference between the minimum and maximum small signal gain across the band at any constant temperature.

### Noise Figure

The noise figure of an amplifier is a direct measure of the noise added by the amplifier to the KTB noise presented at the output. The amplifier KTB noise

plus the amplifier noise figure make up the "white" noise power level at the output of the amplifier. This level establishes a lower limit on the dynamic range of the amplifier, specifically the power level at which a signal can be observed above the noise.

Therefore, 1 dB improvement in noise figure corresponded to a 1 dB improvement in the minimum detectable signal and in the dynamic range of the amplifier.

### Saturated Output Power

Saturated output power is the maximum output power that the amplifier is capable of generating. This power level is typically constant for input drive levels ranging from a sufficient level to cause hard gain compression to a maximum input power, if specified.

This parameter is typically a specified performance characteristic where maximum output power levels are essential and system linearity is of secondary importance.

## RF Burnout

RF burnout is a device failure due to excessive RF overdrive. The input power level which will cause burnout in low noise amplifiers typically varies between 20 and 100 mW. For increased power handling capability, amplifiers can be supplied with RF limiters. However, this feature adds approximately 0.5 to 1 dB to the amplifier noise figure because of limiter insertion loss.

## Output Power at 1 dB Compression Point

This is the output power generated by the amplifier when it is driven by an RF level that is sufficient to cause a gain compression of 1 dB from the amplifier's small signal value. The output power level at 1 dB gain compression is typically 3 dB below the saturated output power level. Sometimes referred to as "linear power", this performance characteristic is generally specified when system linearity of wide dynamic range is most important.

## Voltage Standing Wave Ratio (VSWR)

A measure of the ratio between the power reflected from one port of the amplifier and the power incident upon it, expressed in VSWR units.

## Reverse Isolation

The loss incurred by a signal, incident upon the output of an amplifier as measured at the amplifier input.

## Intercept Point for Intermodulation Products

The intermodulation products are defined as the difference (in dB) between the levels of the fundamental signals and the level of the rejected spurious signals.

The intermodulation product characteristics may be calculated from the intermodulation equation. These characteristics may also be obtained either by using the intercept diagram (See Figure 1) or by direct measurement.

Amplifiers are usually characterized by their 2<sup>nd</sup> and 3<sup>rd</sup> order intercept points.

The 2<sup>nd</sup> and 3<sup>rd</sup> order intercept points are the

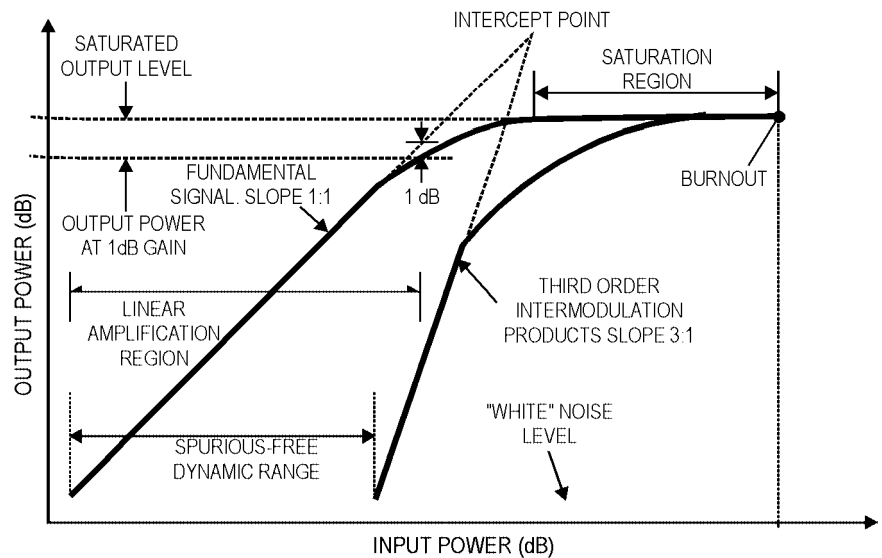


Figure 1.

points where the transfer curves of the 2<sup>nd</sup> and 3<sup>rd</sup> order intermodulation products intersect the fundamental signal curve. The slope of the fundamental signals is 1:1 while the slopes of the 2<sup>nd</sup> and 3<sup>rd</sup> order products are 2:1 and 3:1, respectively. Therefore, the 2<sup>nd</sup> order products are as far down from the fundamental as the fundamental is from the intercept point and the 3<sup>rd</sup> order products are twice as far down. The relationship between the intermodulation products and the intercept points is provided by the following equation:

$$IMP_{(m)} = (m-1) (IP_{(m)} - P_{out})$$

Where

$IMP_{(m)}$  = The  $m^{\text{th}}$  order intermodulation product

$IP_{(m)}$  = The  $m^{\text{th}}$  order intermodulation point

$P_{(out)}$  = The output power of the fundamental signal.

In the small signal case, the level of the 3<sup>rd</sup> order intermodulation products for two equal input signals may be obtained from the intercept point. This is the point where all orders of harmonically related signals asymptotically intersect (see Figure 2). The output power level of the intermodulation intercept point is typically 10 dB above the output power at the 1 dB gain compression point.

## Dynamic Range (DR)

The dynamic range of an amplifier for a single input signal can be defined as the difference between the input signal level that causes a 1 dB gain compression and the minimum detectable signal (MDS), which is defined as 3 dB above the noise level.

$$\text{MDS} = \text{KT} + 10 \log \text{BW} + \text{NF} + 3$$

Where

$$\text{KT} = -114 \text{ dBm}$$

**BW** = Bandwidth in MHz

**NF** = Amplifier noise figure in dB

Thus

$$\text{DR} = \text{Pin (at 1 dB)} - \text{MDS}$$

## Spurious-Free Dynamic Range (DRS)

Where more than one signal is involved, a spurious free dynamic range (DRS) can be defined as the difference between the input signal level of the intermodulation products and the minimum detectable signal (MDS).

$$\text{DRS}(m) = \frac{(m-1)}{m} (\text{IP}(m) - G - \text{MDS})$$

where

$\text{DRS}_{(m)}$  = The  $m^{\text{th}}$  order DRS

$\text{IP}_{(m)}$  = The  $m^{\text{th}}$  order intercept point

**G** = The amplifier gain

## Power Supply Requirements

For best performance, a solid state amplifier should operate from a regulated DC power source with low ripple content. The ripple from the primary source is harmonically related to the AC line frequency. Thus, for a line frequency of 50Hz, ripple on the DC supply will have components at 50, 100, 200 Hz, etc. This ripple causes certain effects on the RF performance of the amplifier. For applications where well regulated DC is not available, Elisra has standard amplifier models with integral power supplies for operation from the AC line. In situations where DC power is available, but is not regulated, units are supplied with internal regulation.

## Device Specifications

The electrical specifications are based on measurement data at room temperature and contain the major parameters needed for system design.

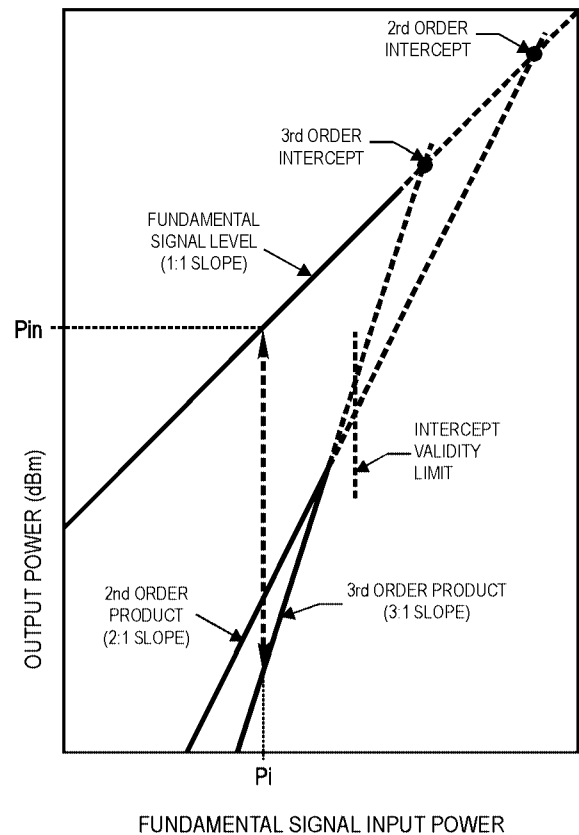


Figure 2. Intercept Diagram

## Mechanical Cases and Outline

- ▶ In order to make the selection easy and to shorten the time of delivery this catalog includes a table consisting of the most popular cases in use.
- ▶ Tables of case styles and detailed mechanical dimensions are contained in this catalog.