

100 kHz - 50 GHz Broadband RF Amplifier

Operating Manual



TA0L50VA

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CENTELLAX



SPEED INNOVATION

3843 Brickway Blvd, Suite 100
Santa Rosa, CA 95403
Tel: 707.568.5900
Fax: 707.568.7647

Email:
sales@centellax.com
support@centellax.com
www.centellax.com



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Note: This product contains no user or factory adjustments. There is no calibration cycle or certificate.

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 Santa Rosa, CA 95403
Tel: 707.568.5900
Fax: 707.568.7647



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sales@centellax.com
support@centellax.com
www.centellax.com

High Performance Broadband RF Amplifier

TA0L50VA Operating Manual

Section 1: Introduction

The TA0L50VA is a versatile RF System Amplifier, which has many uses in research, development, or production-line environments. This amplifier is a useful addition to the laboratory where RF, microwave, or millimeter wave measurements are made. Typical applications include:

- RF Source Amplifier.
- Mixer LO Amplifier.
- Noise Figure LNA and Noise Figure System Amplifier
- Pulse Amplifier and time domain applications
- Digital Communication Systems.
- Antenna research and development.
- General purpose RF gain block.

NOTE

Source-driven RF power amplifiers should always be terminated in an absorbing load. Unterminated outputs will radiate RF energy; this can be dangerous to the operator, may violate FCC laws, and could result in damage to the amplifier.

Centellax is committed to providing amplifiers that have exceptional performance, are unconditionally stable, and will survive accidental laboratory misuse, such as a fully-saturated unterminated output. TA0L50VA System Amplifiers have passed rigorous RF tests which include an RF burnout test. Test conditions are: $P_{out} = 24\text{dBm}$ @ 10 MHz; open output (unterminated).

Internal Power Detector: The TA0L50VA System Amplifier incorporates a power detection feature.

Two matched on-chip GaAs diodes are used:

One of the diodes is RF coupled to the final output stage of the amplifier.

The second is a matched diode, in close proximity to the detector diode, which is not RF coupled but provides a reference voltage that is a function of temperature and biasing.

A differential measurement of these diodes provides a voltage proportional to the amplifier output power level independent of temperature and bias level of the output amplifier chip.

The two diode voltages are provided on the rear panel of the TA0L50VA System Amplifier and can be used to determine the amplifier output power level (as shown in Figure 9).

An application note details the use of these diodes and is available from the Centellax website.

For additional questions, please email: support@centellax.com or call **707-568-5900x11**.

The detector diode is frequency dependant and must be calibrated for each test frequency. The diode is a nonlinear device and its output voltage varies with power. This must also be characterized.

In an ATE environment, calibration of the detector diode is not complicated and may be as simple as measuring the differential voltage at each test frequency and power level. A look up table or curve fit can be used to provide a measure of power delivered.

External ALC Leveling

Establishing a desired power level at the amplified DUT “*Reference Plane*” with power request to the source is often desirable. Many modern sources support “*External Power Leveling*”. This technique involves power leveling using feedback from external sensors (e.g. power meters or detector diodes). Properly configured, these sensors provide feedback to the source that can be used by the source to level the power at a remote reference plane.

Rear Panel

Input: A 2.4 mm input connector is provided on the rear panel of the TA0L50VA.

Power in: 9 Vdc @ ~500 mA, supplied by the included AC supply.

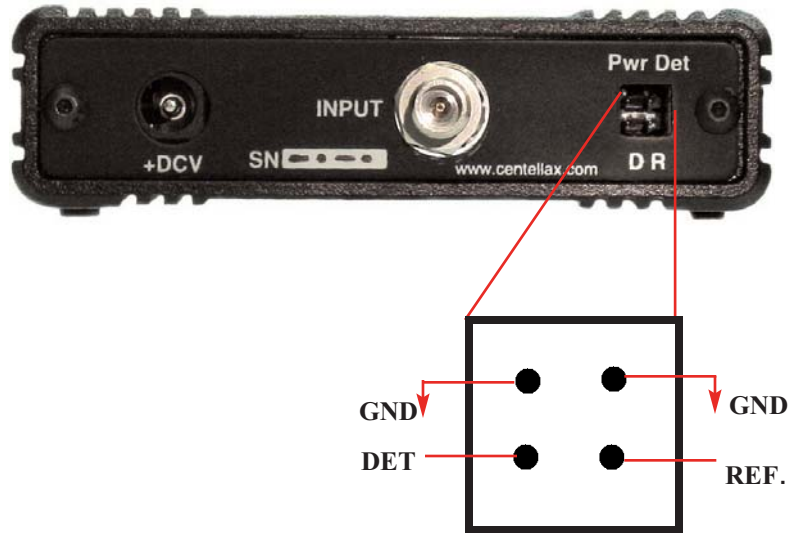
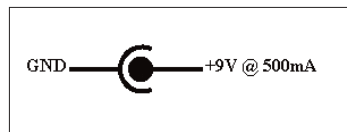


Figure 9: Rear panel of TA0L50VA



Section 2: Description

The Centellax TA0L50VA System Amplifier is a high performance, medium power broadband amplifier featuring baseband RF (<100KHz) through millimeter wave (>50 GHz) frequency coverage.

The TA0L50VA is designed to be used as a general purpose RF System Amplifier for laboratory or test system applications. The amplifier's small size (3.5x3.5x1.0 inch) allows close placement to the measurement reference plane, its high gain helps make up for system losses (e.g. cables from remote sources).

The TA0L50VA features 2.4mm 50GHz female connectors at the amplifier's input and output. Adapters to lower frequency connectors e.g. 2.9mm, 3.5mm and SMA are readily available.

The TA0L50VA is self contained and plugs into standard AC power sources.

Features

- Broadband: 100 kHz to 50 GHz
- Saturated Output Power (P_{sat}): ~ 24 dBm @ 2 GHz and ~18 dBm @ 50 GHz
- >27 dB Gain to 45 GHz
- Useful gain to 65 GHz
- <6dB Noise Figure
- Optional Power Detector
- AC Power Supply Included
- Small size: 3.5" x 3.5" x 1"

Section 3: Specifications

Table 1: Performance Specification

Parameter	Description	Min.	Typ.	Max.
S21 (dB)	Small Signal Gain			
	1 to 26 GHz	27	30	—
	26 to 45 GHz	24	27	—
S11/S22 (dB)	In/Output Loss			
	1 to 26 GHz	—	-10	—
	26 to 45 GHz	—	-8	—
P _{sat} (dBm)	Saturated Output Power			
	100 kHz to 26 GHz	+20	+22	—
	@ 40 GHz	—	+20	—
	@ 50 GHz	—	+17	—
NF (dB)	Noise Figure			
	2 to 18 GHz	—	5	—
	30 - 40 GHz	—	6	—
H ₂ (dBc)	2nd Harmonic			
	2 - 25 GHz	—	-30	—

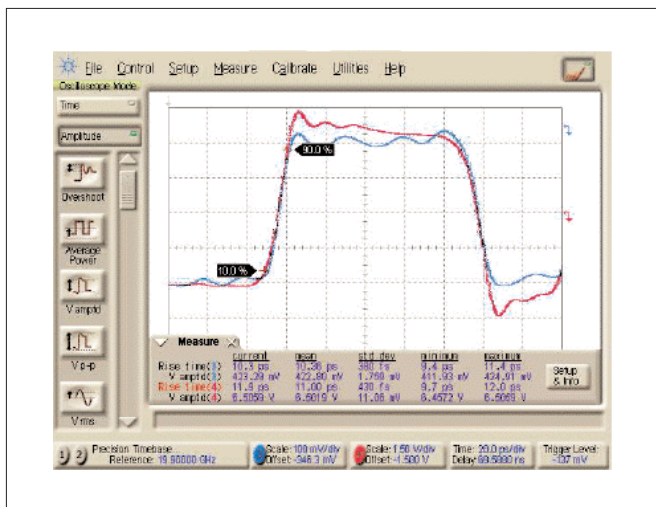


Figure 1: Input Pulse = Ch3, 420 mVppk, 10.4 ps Rise Time
Output Pulse = Ch4, 6.5 Vppk, 11.0 ps Rise Time

Front Panel

Output: The TA0L50VA features a 2.4mm 50GHz female connector at the amplifier's output.

Led Indicator: One LED annunciator on the front panel indicates the System Amplifier is powered.



Figure 8: Front panel of TA0L50VA

Note: Always terminate the RF driven amplifier output !

When the system is calibrated the actual power delivered to the input "Reference Plane" is read on the power meter display for power sensor A. Sensor A is used to monitor and provide feedback to the user or an ATE system in order to set the "Reference Plane" power level. The power level is set by adjusting the RF Source power level control.

Calibration of the system is accomplished by removing the DUT and connecting sensor B to the input "Reference Plane" in order to determine the coupler's coupling coefficient and the other losses to the reference plane.

These losses are: **PmB - PmA**. These losses are frequency dependant and must be measured at each test frequency.

Coupler through losses and their coupling coefficients are very linear over their rated power range and therefore only need to be measured at one power level.

The frequency dependant losses (**PmB-PmA**) are then provided to the power meter in the form of a display offset for **PmA**.

The calibration is complete and the DUT input power level is displayed directly on the power meter sensor A display.

This setup is quick and easy to calibrate and represents a good test bench for the R&D laboratory, where a manual control system is sufficient to evaluate performance.

Understanding the compression characteristics of the TA0L50VA System Amplifier is important in these situations and can often be compensated for in the Automated Test Environment (ATE) by using an iterative set and measure routine to set the input reference plane power level close to the desired level.

Since the incident power is always accurately provided by a **PmA** measurement, the setting does not always need to be exact for accurate characterization of a DUT.

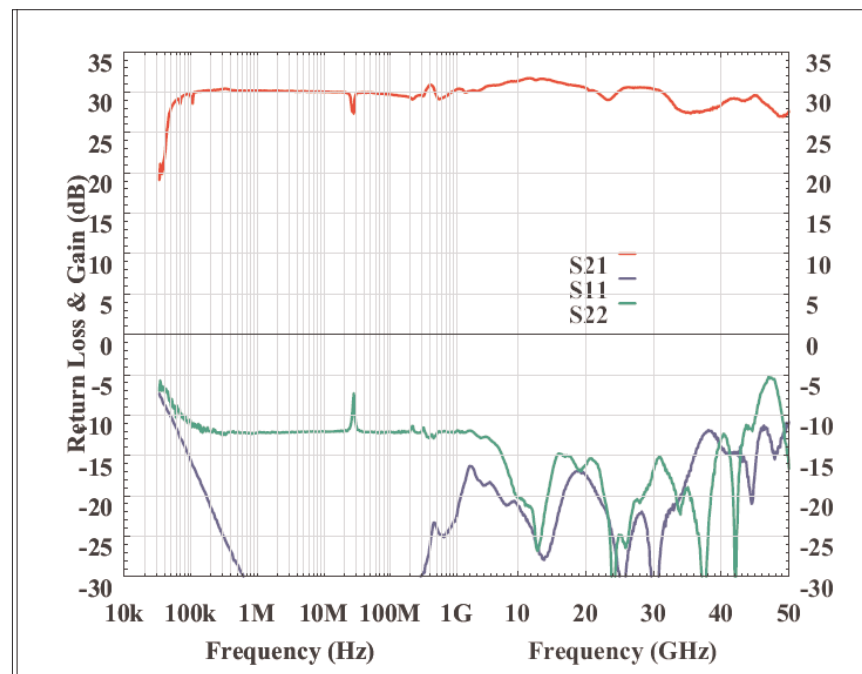


Figure 2: Small Signal Parameters vs Frequency

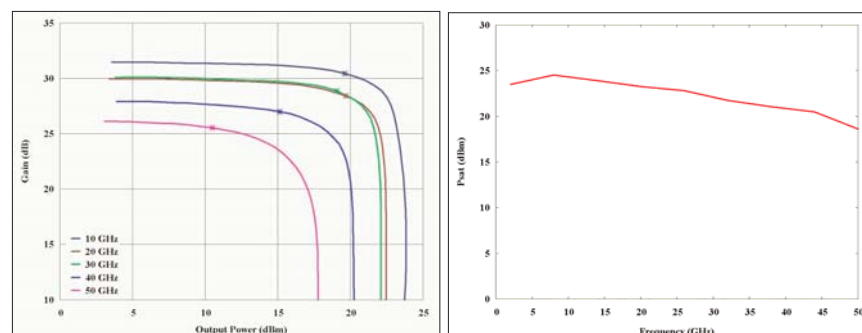


Figure 3: Gain vs Output Power (P_{1dB} indicated with *)

Figure 4: Saturated Output Power

Section 4: Performance Verification

The Figures below show the setup used to verify the performance of the TA0L50VA System Amplifier.

A calibrated power splitter (or calibrated coupler) connected to the amplifier input reference plane and to power sensor A, as shown, establishes the input power level. The output power is measured on power sensor B. Measurements of gain vs output power at frequencies of interest establish the amplifier performance.

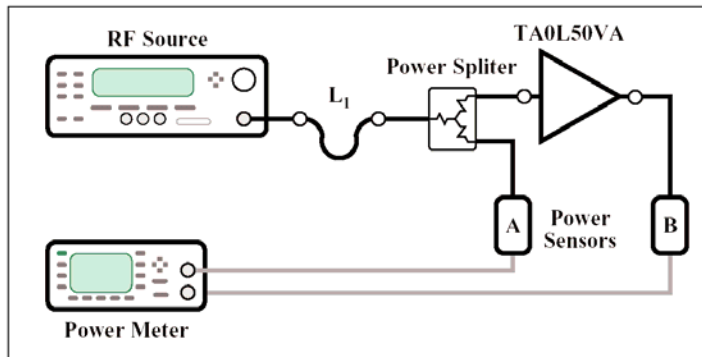


Figure 5: Verification setup with a power splitter

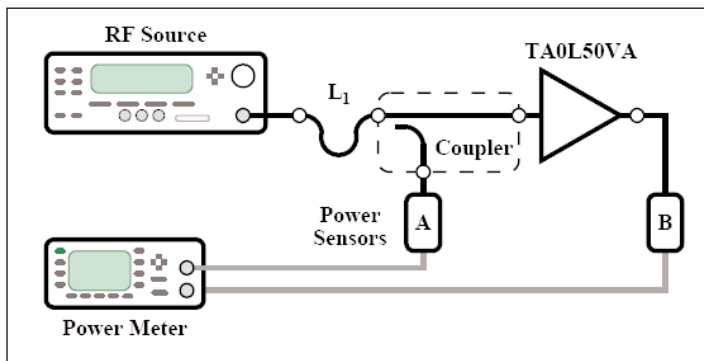


Figure 6: Verification setup with a calibrated coupler

Section 5: Operation

Example Application:

The TA0L50VA System Amplifier amplifies the RF Source output power to the level needed to characterize DUT performance.

The small size of TA0L50VA System Amplifier is easy to place close to the DUT input “Reference Plane”. The high gain of the System Amplifier easily overcomes the cable losses from the remote RF Source.

The Figure 7 shows an amplified RF power measurement system using the TA0L50VA System Amplifier.

The DUT is characterized by setting the power level at the DUT input

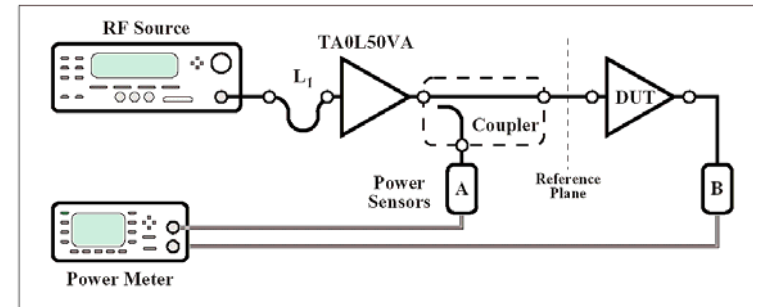


Figure 7: Example of an Amplified RF Power Measurement System

“Reference Plane” and measuring the output power at various input power levels for each test frequency.

The RF Source, used in this example, is a laboratory grade Synthesized Source or Signal Generator with precise amplitude control, (e.g. Agilent 83650L RF Source, or Anritsu MG3694A). The power levels are measured using a power meter with two measurement port sensors (A and B), (e.g. Agilent E4419B).

An RF power coupler provides a small, proportional amount of the amplified power to power sensor A as shown in Figure 7.