TIA-525

Optical/Electrical Converter

Manual

TREND NETWORKS

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INTRODUCTION

The TIA-525 Optical to Electrical Converter is a convenient battery-operated detector/amplifier combination that mounts directly on the input of an oscilloscope, digitizer, or other readout device. With a band width of DC to 125 MHz, it accurately provides an electrical replica of the optical signal presented to it. It is fully capable of driving a 50 ohm cable terminated in its characteristic load.

Two basic models of the unit exist; the TIA-525S, containing a silicon detector for use in the spectral region between 400 and 1000 nm, and the TIA-525 I which contains an Indium-Gallium-Arsenide detector and is responsive in the 900 to 1700 nm spectral region. Both units are equipped with an ST fiber optic connector. Custom versions are also available with unconnectorized detectors for free-space beams.

The TIA-525 has selectable transimpedances of 1.4 KΩ and 14 KΩ plus a post amplifier with selectable gains of 1 or 10. Thus the overall responsivity ranges from approximately 1, 000 V/W to 100, 000 V/W at the peak of the detector response curve. Interstage coupling may be switched from DC to AC to avoid saturation of the second stage in those cases where the signal of interest is combined with a relatively large DC optical component

Each unit is powered by a self-contained 9 V lithium battery or a universal wall mount power supply. Battery operation eliminates ground loops and the undesirable effects of conducted radiation that may be present on local power lines.

FEATURES AND BENEFITS

- Capability to drive 50 Ohm output loads
- Operates from Battery or Line Power
- DC to 125 MHz Analog Bandwidth
- Low Noise - 3.0 pW/root-Hz
- Silicon or InGaAs detectors
- Selectable Gain Settings

MADE IN THE USA

Specifications

Detector Type	Silicon or InGaAs (TIA-525S, TIA-525I respectively)
Analog Signal Bandwidth (-3 dB)	DC to 125 MHz (Tr = 1.4 K), DC to 35 MHz (Tr = 14 K)
Selectable Transimpedance settings	1.4 K Ohms, 14 K Ohms
Second Stage Gain Selections	X 1 or X 10
Maximum Linear Input Power	1.2 mW
Maximum Input power without damage	10 mW
Spectral Response	Silicon: 400 to 1000 nm, InGaAs: 850 - 1700 nm
Output Impedance	50 Ohms
Output Connector	Male BNC
Fiber Optic Connector	Specify FC, ST or Free-Space
Input Numerical Aperture	0.29
Inter-stage Coupling	DC or AC (100 Hz Low Frequency Cutoff)
Output Offset Voltage	+/- 0.1 Volt
Noise Level	3.0 pW/ root-Hz at peak responsivity
Maximum Output Voltage	4 V pk-pk, no load, 2 V pk-pk with 50 Ohm Load
Power Requirements	Power Requirements 9 V Lithium Battery or supplied universal wall-mount power supply
Battery Life	Approximately 30 hours, (no load)
Wall-mount Supply Power Requirements	95-260VAC, 50 - 60 Hz, 16 VA Max.
Mains Connectors Supplied	North America, British, Continental Europe, Australian
Dimensions (mm)	63 L x 30.5 W x 32 H
Weight	5.6 oz (0.16 Kg)
LED Annunciators Provided	Power On
Operating Temperature Range	0 - 40 C
Standard Warranty	Two Years, Component and Workmanship, 30 day Satisfaction Guarantee
Accessories Supplied	Transit Case, Universal Power Supply, 9 V ULTRALIFE Lithium Battery, Manual on CD

UNPACKING AND INSPECTION

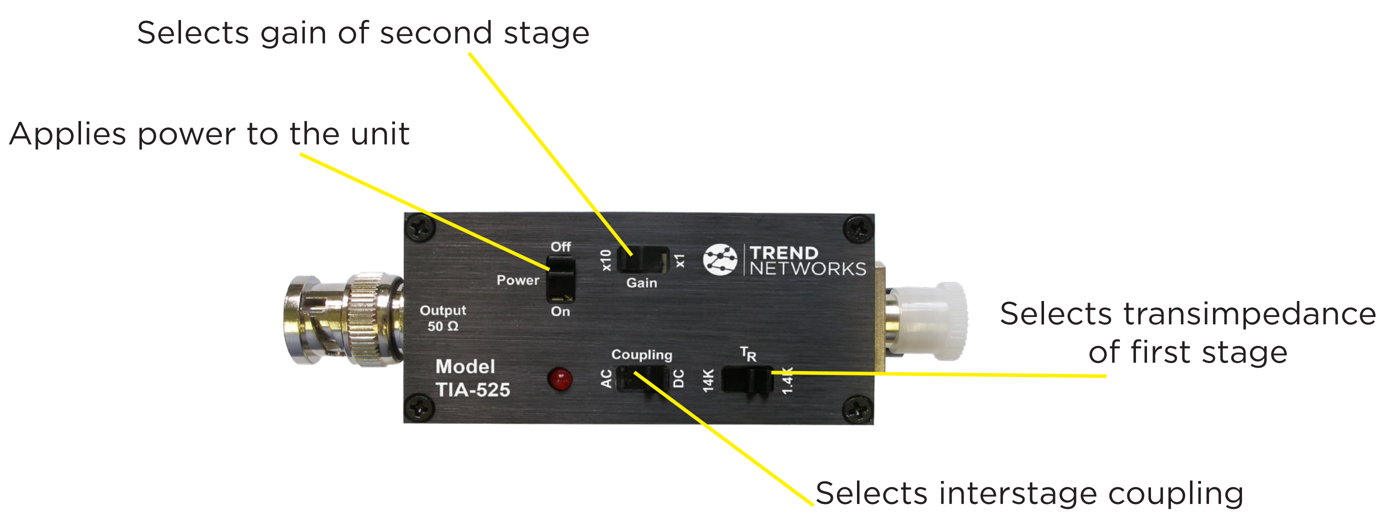
Prior to shipment this instrument was inspected and found to be free of mechanical and electrical defects. Upon acceptance by the carrier he assumes responsibility for its safe arrival. After unpacking, examine the unit for any evidence of shipping damage. Should you receive this instrument in a damaged condition, apparent or concealed, it must be noted on the freight bill or express receipt and signed by the carrier's agent. Failure to do so could result in the carrier refusing to honor the claim. Upon filing a claim TREND Networks should be notified.

BATTERY REPLACEMENT

Each unit comes equipped with a 9 V Lithium battery that provides power to the unit for approximately 30 hours of operation. It is recommended that the battery be replaced whenever the output signal becomes clipped at 1 volt or less. When replacing the battery, a Lithium unit should be used. Conventional 9 V alkaline batteries may be used if so desired but the useful life will only be about 25% (8 hours) of that of the much higher capacity Lithium types. TREND Networks can supply these batteries if desired. Replacement of the battery may be accomplished by removing the four 2-56 Philips flat head screws that retain the bottom cover of the TIA-525. DO NOT attempt to remove the top cover. Take care to replace all screws tightly. This will provide optimum shielding of the unit from ambient radio frequency noise or interference.

The TIA-525 is also supplied with a universal power supply that operates from 90 to 240 VAC, 50-60 Hz. Each unit is equipped with four interchangeable power plugs that equip the unit for use in North America, Europe, the UK or Australia. Plugging the power supply into the unit disconnects the internal battery.

CONTROLS



OPERATIONAL CONSIDERATIONS

The TIA-500 is comprised of a fiber coupled detector and two amplifier stages. The first amplifier is a transimpedance stage which converts the detector output current to a voltage by passing it through a resistor of 1 400 or 14000 ohms. Additional amplification is optionally provided by the second stage which also serves to provide 50 ohm drive capability. Either AC or DC coupling between the stages may be selected.

The overall bandwidth of the unit is determined by the first stage transimpedance. It is in excess of 125 MHz when the TR switch is in the 1.4 K position and is 35 MHz in the 14 K position. The overall responsivity of the unit in terms of Volts/Watt is the current responsivity of the detector multiplied by the transimpedance and further multiplied by the second stage gain. For example, the sensitivity of the unit at a wavelength of 1300 nm would be 0.7 A/W x 1400 V/A x 10 = 10, 000V/W. It is evident that the same responsivity may be obtained by using a transimpedance of 14 K and a second stage gain of one. However, the first setting will provide a bandwidth of 125 MHz while the second will provide a bandwidth of 35 Mhz. Since the overall peak-to-peak output noise increases with bandwidth, it is desirable to use the higher transimpedance setting assuming that the signal of interest does not exceed 35 MHz.

The selection of AC interstage coupling is useful when the user needs to examine a small signal in the presence of a large DC optical component, (e.g. Baseband fiber optic video). This will preclude the last stage from saturating on the DC component. Otherwise, DC coupling should be employed.

When using the TIA-525 mounted on an oscilloscope, the scope may have its input set to either 50 or 1 Meg ohm input impedance. If driving a coaxial cable, the cable should have a 50 ohm characteristic impedance and be terminated with a 50 ohm load. Note that the signal amplitude will be reduced by a factor of two.
Spectral Response

The following table summarizes the operation of the unit under various operating conditions.

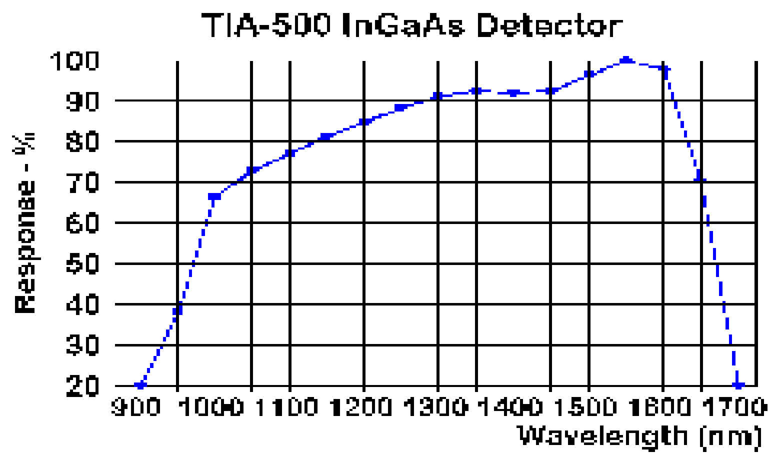
Signal / Setting	TR	AC/DC Coupling	2nd Stage
Small Signal on large DC Components	**1.4K**	**AC**	**X1, X10 As Needed**
High Frequency signal, >35 MHz	**1.4K**	**DC**	**X1, X10 As Needed**
Low Level Signal<35 MHz	**14K**	**DC**	**X1, X10 As Needed**
Low Level, High Frequency Signal	**1.4K**	**DC**	**X10**

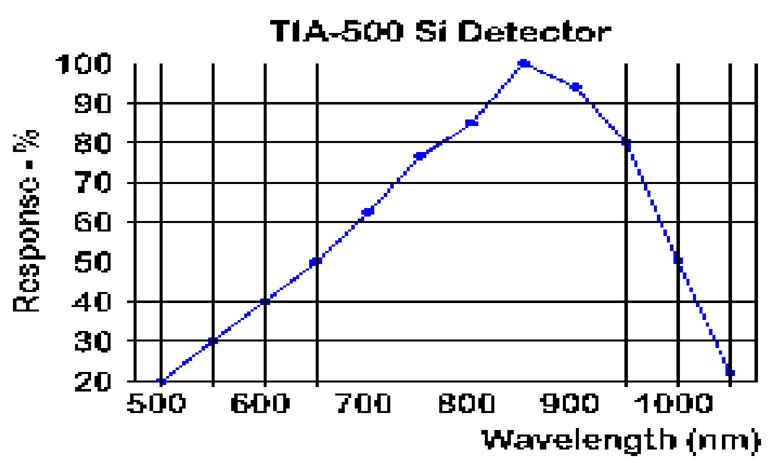
SPECTRAL RESPONSE

The approximate relative response curves of the detectors employed is as shown below. Note that these are representative curves and do not necessarily correspond to the exact response of the particular detector in use.
The approximate power at the detector surface is given by:

$$\text{Input power in watts (InGaAs)} = \frac{\text{Peak output voltage (no load)}}{0.8\ \text{A/W} \times T_R \times \%\ \text{Relative response from graph}/100}$$

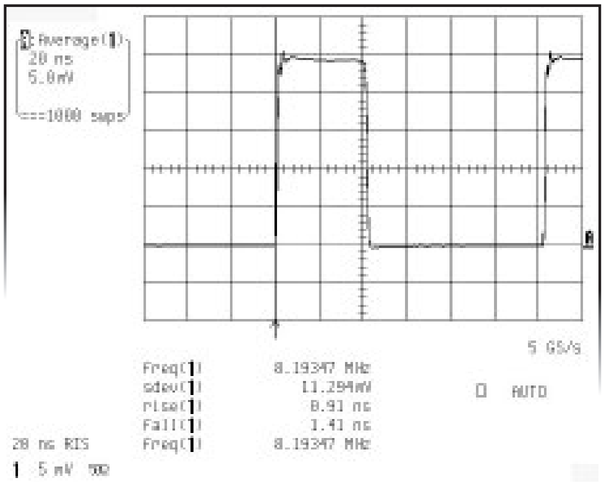
$$\text{Input power in watts (Si)} = \frac{\text{Peak output voltage (no load)}}{0.55\ \text{A/W} \times T_R \times \%\ \text{Relative response from graph}/100}$$



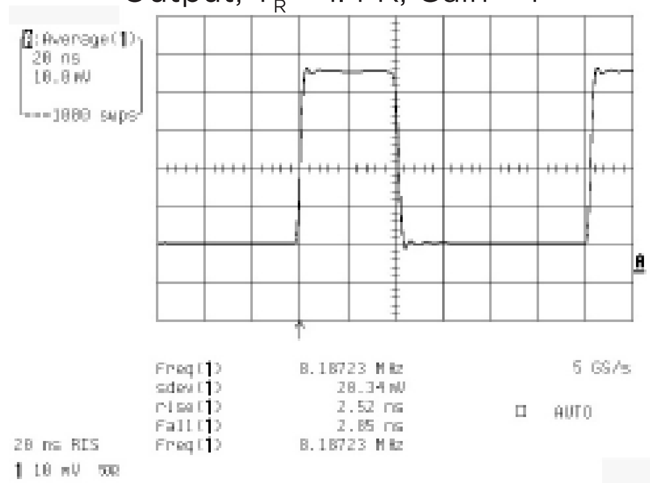


Typical Waveforms

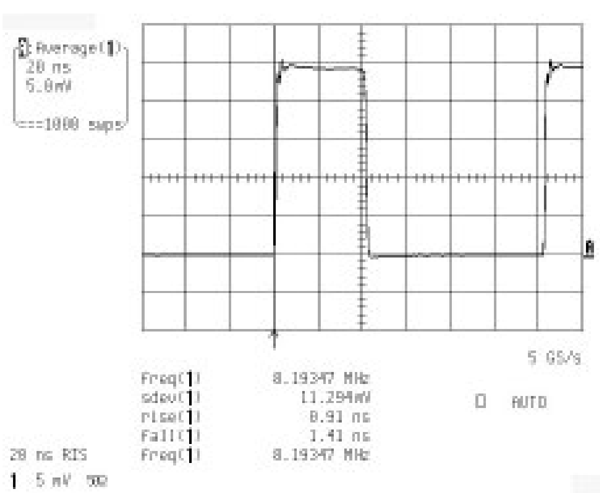
Optical Input



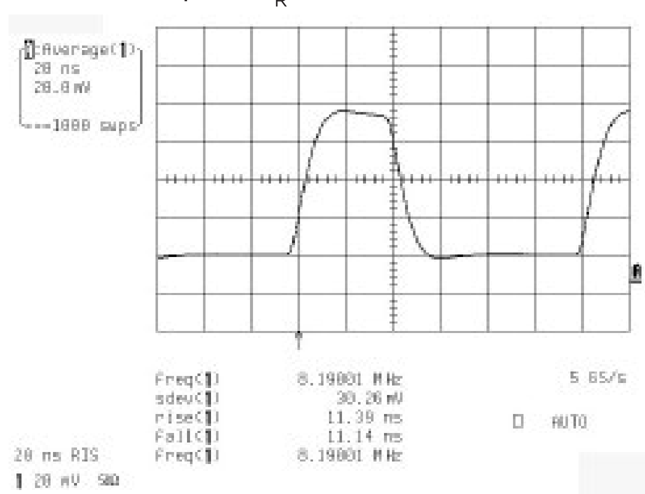
Output; T_R = 1.4 K, Gain = 1



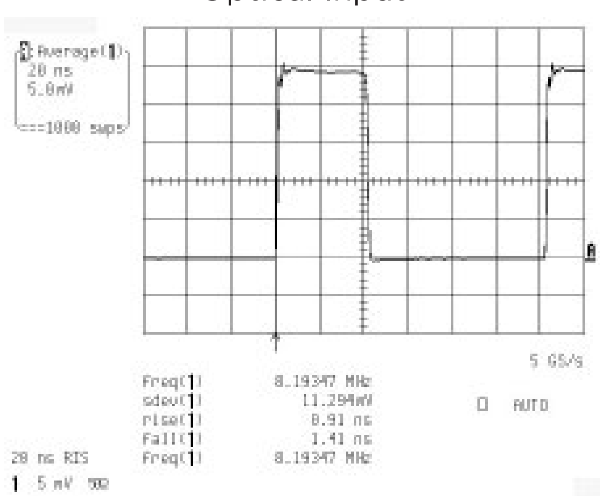
Optical Input



Output; T_R = 14 K, Gain = 1



Optical Input



Output; T_R = 1.4 K, Gain = 10