USER MANUAL

T-Rad | THz Radiometer

gentec-eo
PARTNERS for ACCURACY

121-103452

WARRANTY

The Gentec-EO T-RAD THz Radiometer carries a one-year warranty (from date of shipment) against material and/or workmanship defects, when used under normal operating conditions. The warranty does not cover damages related to misuse.

Gentec-EO Inc. will repair or replace, at Gentec-EO Inc.'s option, any T-RAD that proves to be defective during the warranty period, except in the case of product misuse.

Any attempt by an unauthorized person to alter or repair the product voids the warranty.

The manufacturer is not liable for consequential damages of any kind.

In case of malfunction, contact your local Gentec-EO distributor or nearest Gentec-EO Inc. office to obtain a return authorization number. The material should be returned to:

Gentec Electro-Optics, Inc.
445, St-Jean-Baptiste, Suite 160
Québec, QC
Canada G2E 5N7

Tel: (418) 651-8003
Fax: (418) 651-1174
e-mail: service@gentec-eo.com

Website: www.gentec-eo.com

CLAIMS

To obtain warranty service, contact your nearest Gentec-EO agent or send the product, with a description of the problem, and prepaid transportation and insurance, to the nearest Gentec-EO agent. Gentec-EO Inc. assumes no risk for damage during transit. Gentec-EO Inc. will, at its option, repair or replace the defective product free of charge or refund your purchase price. However, if Gentec-EO Inc. determines that the failure is caused by misuse, alterations, accident or abnormal conditions of operation or handling, you will be billed for the repair and the repaired product will be returned to you, transportation prepaid.

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1.1 GENERAL INFORMATION

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1.1.1 System Overview

Welcome to the T-RAD Application Software. This software, when coupled with a Gentec-EO T-RAD, provides the user with a versatile measurement system. There are multiple THz sensors available for the system. When a sensor is mated to the USB module, and the software is started, the module reads the sensor type, sensor calibration, sensor wavelength response, and configures the hardware appropriately.

The Applications Software communicates with the host PC via a USB port. The system uses the T-RAD Command Set to do this.

Data is sent to the host PC when the instrument has had its data gate turned on. The data is sent to the application at 5Hz.

1.1.2 Specifications

The following specifications are based on a one-year calibration cycle, an operating temperature of 18 to 28ºC (64 to 82ºF) and a relative humidity not to exceed 80%.

Table 1-1 List of Specifications

	Power meter specifications T-RAD	
Power Scales **(depends on THZ-B probe model)**	<u>6 scales</u>: 200 nW, 2uW, 20 uW, 200 uW, , 2 mW, 20 mW, 200 mW.	
Resolution (digital)	Current scale/3000	
Accuracy	±1%±3uV from 10% to full scale[1]	
Integration Time range	0.1 to 50 sec	
Data Transfer Rate	5 Hz	
Statistics	Current value, Max, Min, Average, Std Dev.	
Data Storage	Limited to PC hard drive free space	
	General Specifications T-RAD	
Digital Display	Computer screen	
Display Rate	5 Hz	

[1] The accuracy will be limited by the head noise floor and the integration time.

Data Displays	Real time, Strip chart, Tuning, Statistics
User input correction factors	1 multiplier (transmission adjustment) (7 digits floating point)
Positive External trigger	4.5 to 10 V @ 20 mA, optically isolated
External trigger pulse width	80 ms
Analog-out	AC signal of the ADC input.
Internet Upgrades	Yes
PC Serial Commands	Yes
Dimensions **(connectors included)**	147 (L) x 106 (W) x 34 (H) mm
Weight	0.424 kg
Power Over USB	Yes
T-RAD	1 Channel

1.2 Lock In Amplifier Theory of Operation

The operation of a Lock In Amplifier can seem mysterious given its ability to pull a useful signal out of noise and interference, but the basics of operation are not complex. A lock in amplifier's operation can be explained in three ways: mathematically, in the time domain, or in the frequency domain. While all explanations are equally useful, the one that makes sense to the user is the most useful, so a brief description of all three will be presented.

1.2.1 Mathematical Description of a Lock In Amplifier.

Fourier Theory tells us that all repetitive signals can be broken down into a series of sine's and cosines. Because of this fact, we can describe the lock in operation using a signal that is a pure cosine wave. To go further, even if the input signal is not a pure cosine wave, the lock will extract the pure cosine wave component of the signal anyway, so the approach is justified. Consider an input signal, v (t), given by:

$$\boxed{v(t) = A \cdot \cos(\omega \cdot t) \quad \omega = 2 \cdot \pi \cdot f}$$

Now consider a second signal, the reference signal, given by:

$$\boxed{vref(t) = B \cdot \cos(\omega \cdot t + \phi) \quad \omega = 2 \cdot \pi \cdot f \quad \phi \ \textit{is the phase difference between the two signals}}$$

This reference signal is at the same frequency as the input signal and is supplied by the lock in.

If we multiply the two signals, we get

$$v(t)\cdot vref(t) = Vpsd(t) A\cdot\cos(\omega\cdot t)\cdot B\cdot\cos(\omega\cdot t+\phi)$$
$$Vpsd(t) = A\cdot B\cdot\cos(\omega\cdot t)\cdot\left[\cos(\omega\cdot t)\cdot\cos(\phi) - \sin(\omega\cdot t)\cdot\sin(\phi)\right]$$
$$Vpsd(t) = A\cdot B\cdot\left[\cos^2(\omega\cdot t)\cdot\cos(\phi) - \cos(\omega\cdot t)\cdot\sin(\omega\cdot t)\cdot\sin(\phi)\right]$$
$$Vpsd(t) = A\cdot B\cdot\left[\left(\frac{1}{2}+\frac{1}{2}\cdot\cos(2\cdot\omega\cdot t)\right)\cdot\cos(\phi) - \frac{1}{2}\cdot\sin(2\cdot\omega\cdot t)\cdot\sin(\phi)\right]$$
$$Vpsd(t) = \frac{1}{2}\cdot A\cdot B\cdot\cos(\phi) + \frac{1}{2}\cdot A\cdot B\cdot\cos(2\cdot\omega\cdot t)$$

If we set B to unity and hold it constant, then the result is a signal that is:

1. Proportional to the A, the amplitude of the input signal.
2. Proportional to the cosine of the phase angle between the two signals.
3. Modulated at two times the input signal frequency.

If we set the phase difference to zero degrees then the resulting signal can be passed through a low pass filter with a time constant of tau and the result will be:

$$Vout(t) = \frac{1}{2}\cdot A\cdot\left(1 - e^{\frac{-t}{tau}}\right)$$

This shows that once the filter has settled, the signal is a DC representation of the original input. We can now set the filter time constant as high as needed to block out unwanted noise and interference. The details of how the lock in implements this math can be found in the literature.

One subject of interest arises from the requirement to set the phase difference to zero degrees. In practice, the phase difference is not known. Since the cosine function returns values between one and negative one as the phase is changed, the phase is simply adjusted until the signal maximizes. It is actually easier to adjust the phase until the signal goes to zero and then shift the phase by 90 degrees. If the signal goes negative, shift the phase 180 degrees. The signal will now be maximized.

If this seems like a bother, it is. The Gentec-EO Lock In Amplifier uses a dual phase approach which relieves the user of the need to adjust the phase. A sine wave signal is generated by the instrument at the reference frequency, and at the reference frequency plus 90 degrees, or pi divided by 2. The input signal is multiplied by both reference signals. The results of those multiplications are then squared, summed, and the square root is taken. Look at the final equation for the output after the multiplication, ignoring the second term:

$$Vpsd(t) = \frac{1}{2}\cdot A\cdot B\cdot\cos(\phi)$$

The output of the second multiplication will be:

$$Vpsd(t) = \frac{1}{2}\cdot A\cdot B\cdot\cos\left(\phi+\frac{\pi}{2}\right) = \frac{1}{2}\cdot A\cdot B\cdot\sin(\phi)$$

If we square these and add them together we obtain:

$$Vsum(t) = \frac{1}{4} \cdot A^2 \cdot B^2 \cdot \cos^2(\phi) + \frac{1}{4} \cdot A^2 \cdot B^2 \cdot \sin^2(\phi)$$
$$Vsum(t) = \frac{1}{4} \cdot A^2 \cdot B^2 \cdot \left(\cos^2(\phi) + \sin^2(\phi)\right) = \frac{1}{4} \cdot A^2 \cdot B^2$$

Now taking the square root gives:

$$Vpsd(t) = \frac{1}{2} \cdot A \cdot B$$

The output of the multiplication is no longer phase dependent.

1.2.2 Time Domain Description of a Lock In Amplifier.

The input signal has peak amplitude of 5V (10V peak to peak) and a frequency of 25Hz and is shown in figure 1.

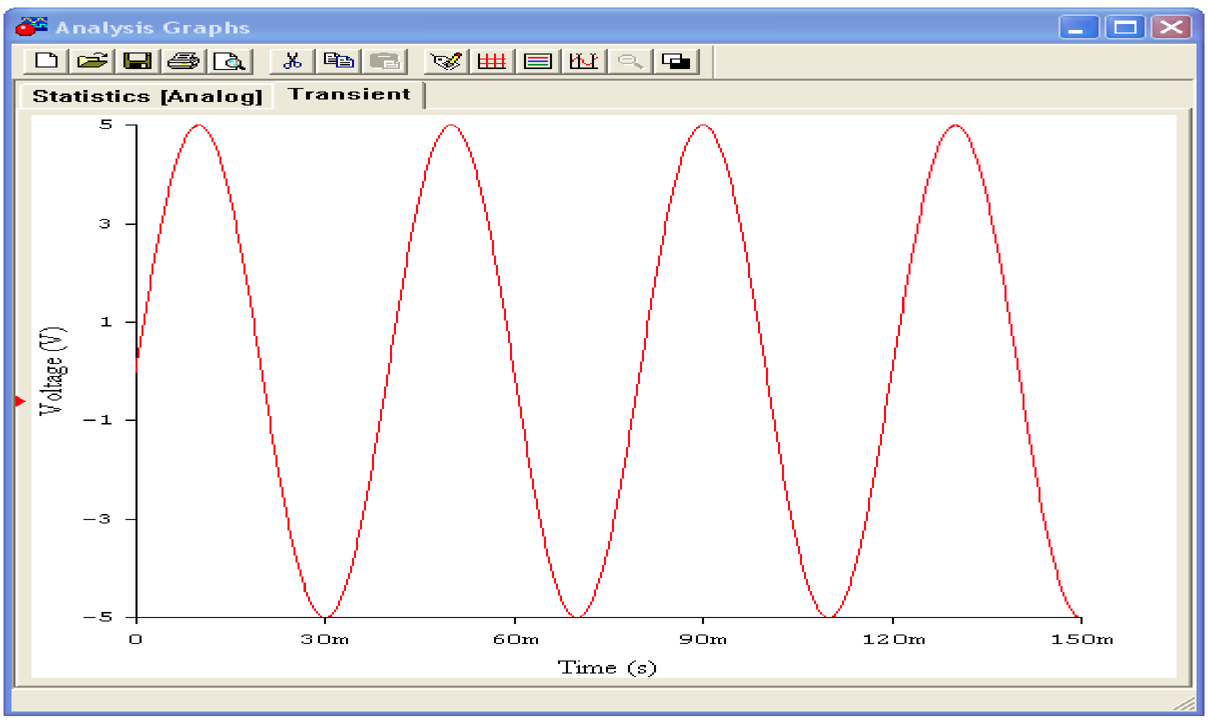


Figure 1 Input Signal

The reference signal supplied by the lock in signal has peak amplitude of 1V and a frequency of 25Hz and is shown in figure 2.

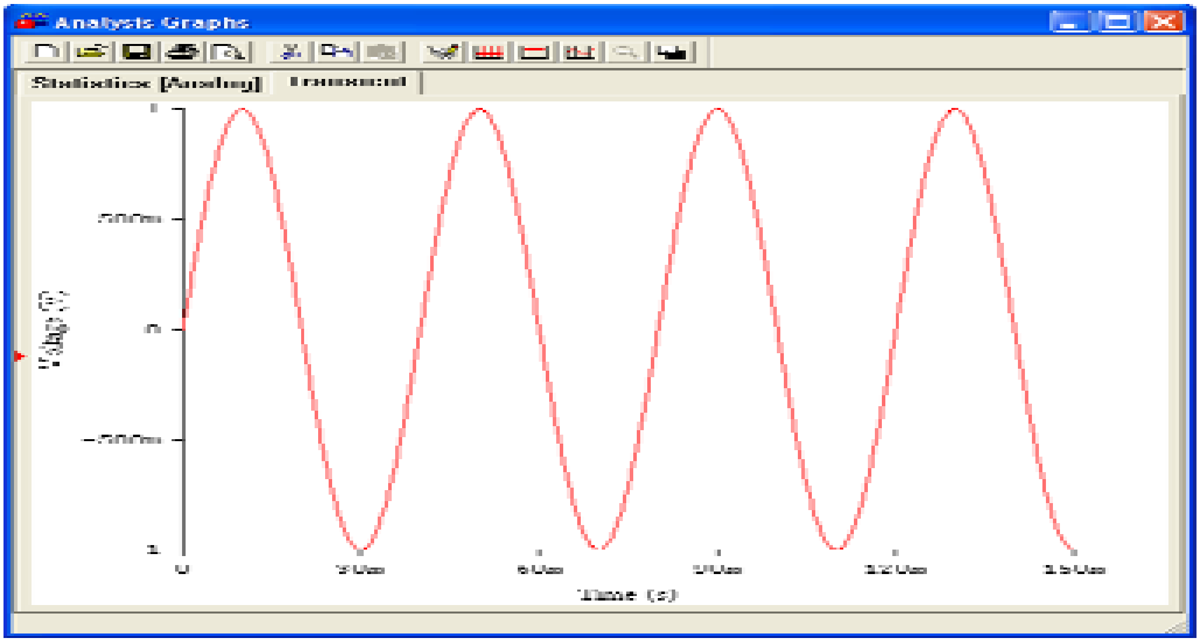


Figure 2 Reference Signal

After multiplying the two signals using a circuit called a Phase Specific Detector in an analog lock in, or by direct math in a digital lock in, the output signal is shown in figure3. Note that its peak to peak amplitude is 5V, or ½ of the input and its frequency is 50Hz,or twice the input frequency. Also note it now has a DC offset of the peak voltage of the input signal divided by 2 as predicted. This DC offset is what the low pass filter will pull from figure 3.

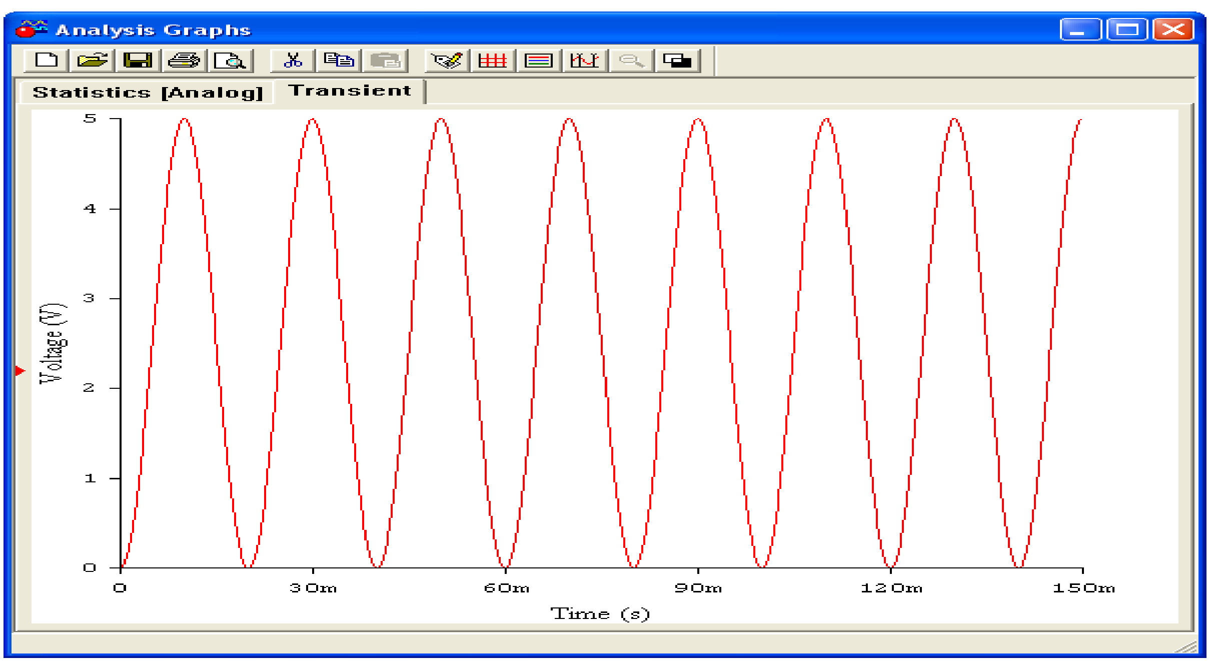


Figure 3 Result of Multiplication

Figure 4 shows the output using a 100ms time constant. Note that the ripple is still visible on the DC level.

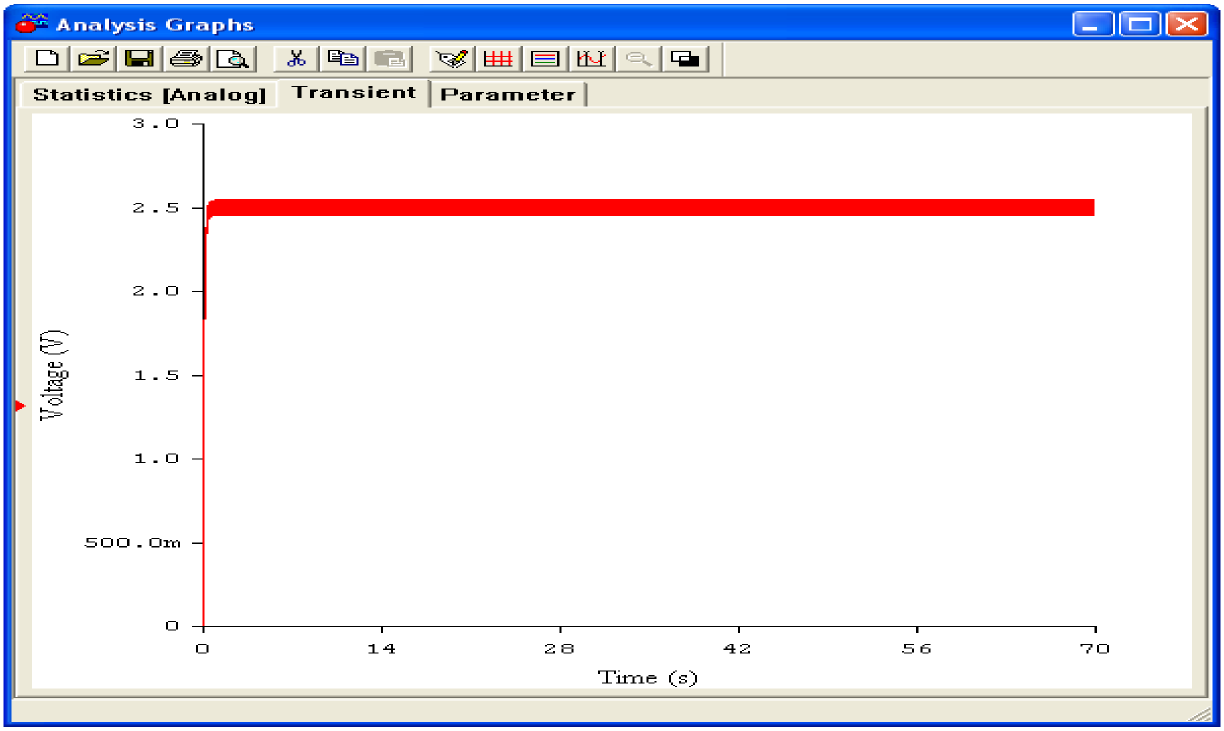


Figure 4 Output with 100ms Time Constant

Figure 5 shows the output using a 1s time constant. Note that the ripple is greatly reduced.

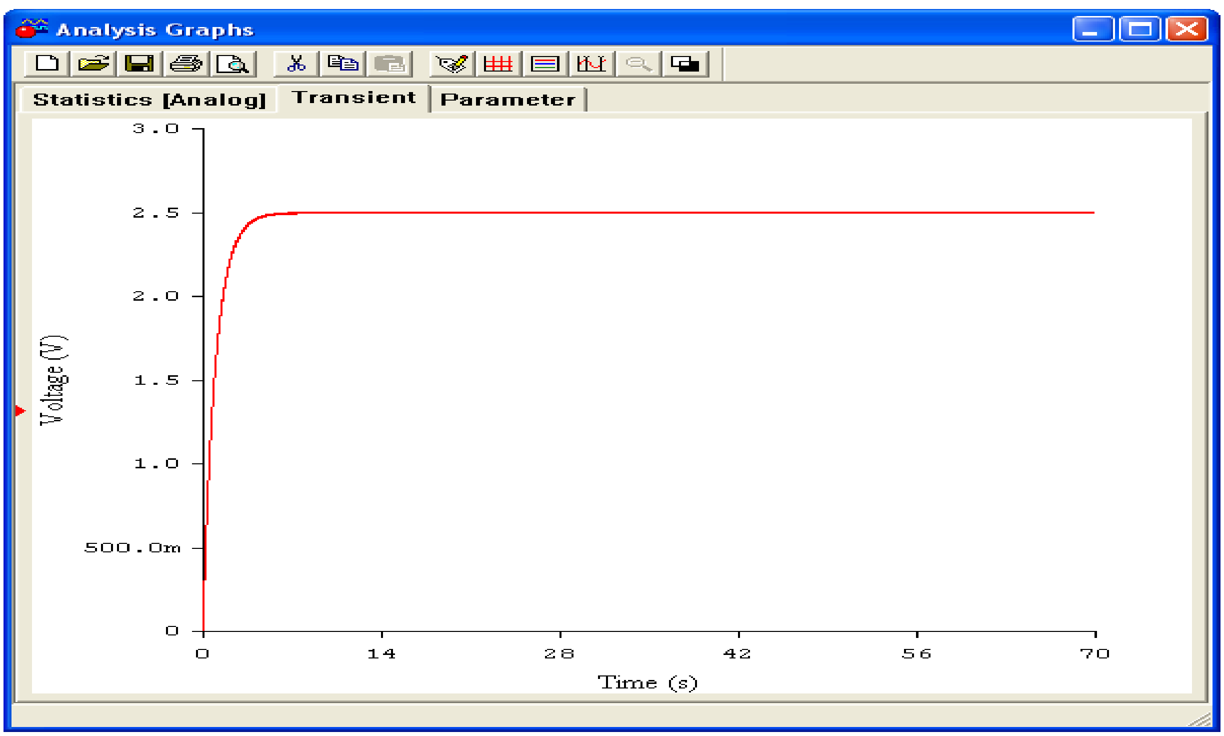


Figure 5, Output with 1s Time Constant

1.2.3 Frequency Domain Description of a Lock In Amplifier.

Figure 6 shows the frequency contents of a 25Hz square wave with a 60Hz interference signal and broadband noise at about 1% of the signal.

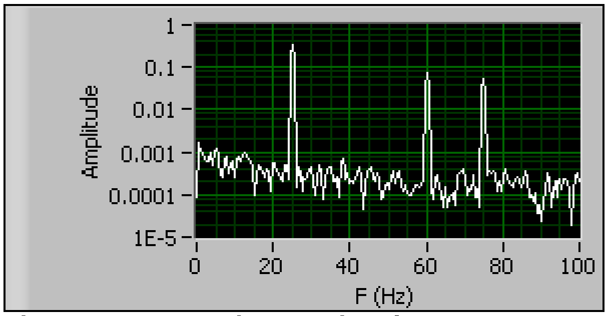


Figure 6 Corrupted Input Signal

Since the input is a square wave, there are only odd harmonics. The fundamental is seen at 25Hz, the 3rd harmonic is seen at 75Hz, and the 60Hz interference is seen. Remember when we said that even if the input signal is not a pure sine wave, the lock will extract the pure sine wave component of the signal? Figure 6 shows why this is so. The reference signal is a pure sine wave at the same frequency as the input signal so only the fundamental sine wave component of the input signal is extracted. Of course this statement depends on the purity of the reference sine wave. In an analog system, a pure sine wave cannot be generated due to distortion and phase noise as well as frequency jitter. All of these combine to decrease the accuracy of the instrument. Since the Gentec-EO Lock In Amplifier is a digital device, the reference sine wave is pure to a much greater extent and these errors are minimized.

Figure 7 shows the spectrum of the signal after it has been passed through a band pass filter set to 25Hz.

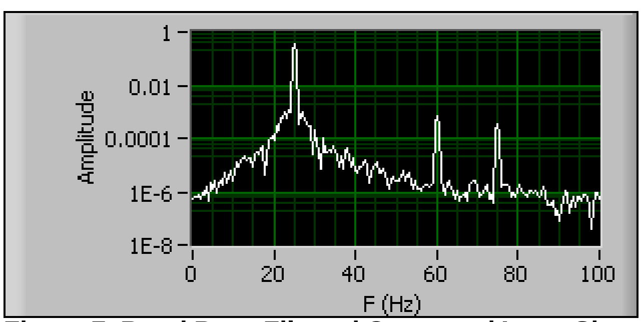


Figure 7 Band Pass Filtered Corrupted Input Signal

Note that the relative amplitude of the 60Hz and 75Hz signals have been reduced by the band pass filter. The noise floor has also taken on the shape of the filter. Figure 8 shows the spectrum of the multiplied signal.

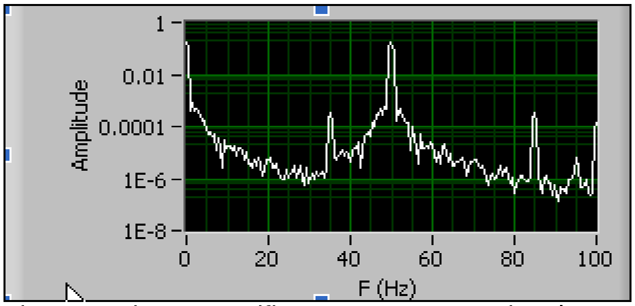


Figure 8 Phase Specific Detector Output Signal

The multiplier action moves the signal to the frequencies at the sum and difference of the signal and the reference frequency at 25Hz. Therefore the signal at 25Hz will move to 0Hz and 50Hz, as seen. The 60Hz interference will move to 85Hz and -35Hz, not shown here. The odd harmonic of the input signal at 75Hz moved to 100Hz and 50Hz, where it will add to the frequency shifted signal. These signals can now be low pass filtered to extract the DC component.

1.3 Communications with Host PC

The T-RAD communicates with the host PC via a USB port. The device supports full speed USB 2.0. The implementation of the port in the host PC is accomplished via a Virtual Com Port, or VCP. This in effect mimics a standard com port so that the user can take advantage of the ease of developing custom applications with existing terminal emulators.

The Ports Settings are:

Baud Rate: 921600
Data Bits: 8
Stop Bits: 1
Parity: None
Flow Control: None

If the host PC cannot supply a baud rate of 921600, the T-Rad will adjust its baud rate to match the fastest one available from the PC. The host PC must have a terminal emulator as well as the T-RAD USB drivers installed. These drivers are installed by the disc supplied with the T-RAD instrument.

The command set for the T-RAD instrument is shown below.
All commands and replies are followed by a carriage return (0x0D) and a line feed (0x0A). If a command is used with no arguments it will become a query.

All commands except STR1 reply with:

Ok if the command executed correctly.

Err if the command could not be executed.

All Queries reply with the item that was queried or Err if the query could not be executed.

With the exception noted above, the host software should wait for an instrument reply before executing a subsequent command or query.

VER	Queries the Firmware Version. No arguments are used. Example. Send: verCRLF Reply: 1.00.00CRLF
RNG	Sets or Queries the instrument range Example. Send rng27CRLF sets the range to index 27, the 30mW range. See table below for ranges versus indices rngCRLF queries the current range. Example rngCRLF returns the range index Reply 27CRLF
STR	Starts or stops the data flow. Example. Send str1CRLF The T-Rad will send data to the com port. Data is sent at 5Hz for power. Send str0CRLF T-Rad will stop sending data and reply Ok. Data is the hexadecimal data string. See the note below for how to decode this value.
MAX	Query only. Returns the maximum range index for the head in use. Example Send maxCRLF Reply 27CRLF
MIN	Query only. Returns the minimum range index for the head in use. Example Send minCRLF Reply 20CRLF
ZRO	Command only. Sets the DC offset of the signal to the desired value.

	Example Send zroCRLF Reply 27,2350,2048CRLF The values used are for example only. 2048 counts represent 1.25V of offset. All heads use this value. 0 counts is 0V, 4095 counts is 2.5V. The reply is Offset DAC0, Offset DAC1 code, ADC counts.
MRD	Query only. Returns the maximum reading for the head in use. Example Send mrdCRLF Reply 216.7E-6CRLF, The maximum reading is 216.7uW.
TAU	Sets or Queries the time constant used by the Lock In Amplifier. The argument is in seconds. Example. Send tau1.3CRLF sets the time constant to 1.3 seconds tauCRLF queries the current time constant. Example tauCRLF returns the current time constant. Reply 1.3CRLF
USN	Sets or Queries the User Serial Number Example. Send usnMySerialCRLF sets the user serial number to MySerial This value is stored in Flash and allows a unique user specified serial number to be assigned to each instrument. usnCRLF queries the user serial number
UCD	Sets or Queries the User Calibration Date Example. Send ucdMM/DD/YYYYCRLF sets the local calibration date to MM/DD/YYYY. The date must be in this format. This value is stored in Flash and allows a unique user specified calibration date to be assigned to each instrument. ucdCRLF queries the user calibration date

Scale	Index	Range
2fW	00	*2 femptowatt*
20fW	01	*20 femptowatts*
200fW	02	*200 femptowatts*
2pW	03	*2 picotowatts*
20pW	04	*20picowatts*
200pW	05	*200 picowatts*
2nW	06	*2 nanowatt*
20nW	07	*20 nanowatts*
200nW	08	*200 nanowatts*
2uW	09	*2 microwatts*
20uW	10	*20 microwatts*
200uW	11	*200microwatts*
2mW	12	*2 milliwatts*
20mW	13	*20milliwatts*
200mW	14	*200 milliwatts*
2W	15	*2 Watts*

1.4 Data Format

Measurement Data is sent from the T-RAD as an Hexadecimal string.

PPPP,DDDCRLF

PPPP is the pulse period counts. 1 million counts represent 1 second.

DDD is the pulse data in ADC counts with 3276 being full scale.

Example:

Data = 99F9,1B4CRLF and T-Rad is in the 2mW range (index 12)

The pulse is 0x1B4, or 436 counts.

The reading will be 436 / 3276 x 2mW = 0.266mW

The period is 0x99F9, or 39417 counts.

1E6 counts / second / 39417 counts = 25.37Hz.

1.5 Instrument Connections

The T-RAD is connected to the host PC with a supplied USB cable. The instrument communicates with the host PC via this cable, and the host PC supplies the power required by the instrument.

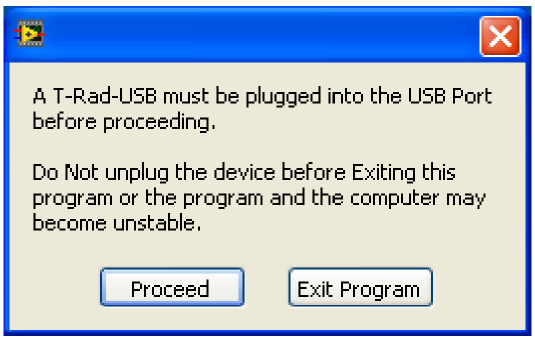
There are two BNC's and one DB15 connector on the instrument. The probe in use is plugged into the DB15 connector and must be plugged in before connecting the USB cable. One BNC is labeled Detector Output; the other is labeled External Trigger In.

The Detector Output BNC supplies a buffered signal that is the same value sampled by the instrument's ADC. The output impedance of this connector is 100Ω.

The External Trigger Input is the connection for the reference chopping frequency. This signal's frequency is measured by the instrument and used to generate the reference sine wave described in the Theory of Operation section. This BNC must be connected to the Sync Output BNC of the chopper controller in use before starting the Applications Software.

1.6 Using the Instrument

To use the T-RAD, connect the probe to the instrument first, then plug the instrument into the USB connector on the PC that is running the Applications Software. For the T-RAD Monitor with a DB-15, use the PC-T-RAD - V2.00.00 software or the most recent. Connect the chopper frequency reference to the External Trigger Input BNC. Do not remove the External trigger while the software is running. Now start the software. A window will appear, as shown below.



Press the Proceed button. The software will examine the available communications ports and establish communications with the instrument. When the WAIT prompt disappears from the data display, the software and instrument are ready to use. The T-RAD is not a triggered device. It is always taking data, but it will not send data to the application until asked to do so. Pressing the Data Collection Button causes data to be sent to the application where the lock in algorithm is implemented. The user need only select an appropriate range and filter time constant.

The Frequency Range indicator will display the correct chop rate to use. If the range is 24.5 Hz to 25.5 Hz, set the chopper to 25 Hz. Caution: For stable readings the chopping frequency must be stable to +/- 0.1 Hz or better. The instrument will extract the signal at the reference frequency. Note that if there is any other signal with components at the reference frequency, they will be measure along with the desired signal. The longer the filter time constant, the longer it will take to settle on a reading, but the more noise and interference will be rejected. The user must make a tradeoff between measurement time and accuracy when using a lock in amplifier. It will take 5 time constants for the reading to settle to 1%, 7 time constant for the reading to settle to 0.1%. Fluctuations in the signal after this amount of time are not due to the lock in settling time but are real signal variations.

The subsequent sections explain in detail how to use the Applications Software to makes measurements.

1.7 Using the Applications Software

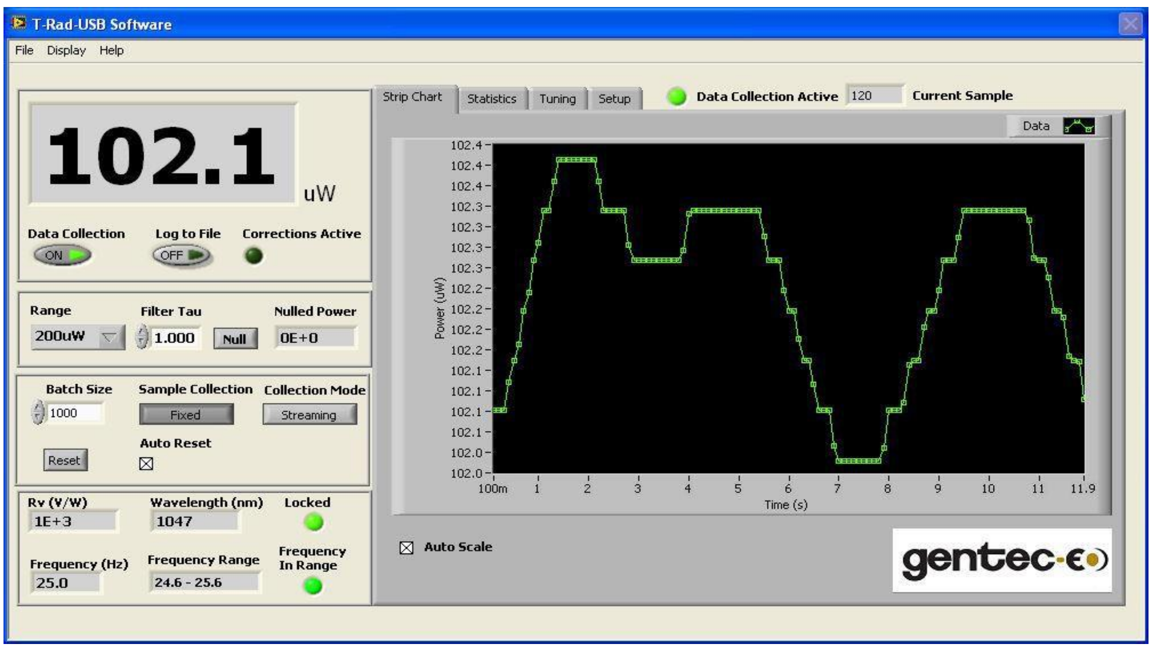
1.7.1 The Main Display Panel

The Main Display Panel has five display regions. They are:

1. The Digital Display which is always visible.
2. The Strip Chart, which is on a user selectable tab.
3. The Statistics Display, which is on a user selectable tab.
4. The Tuning Needles, which are on a user selectable tab.
5. The Setup Controls, which are on a user selectable tab.

1.7.2 The Digital Display

The Digital Display is always visible to the user. It contains Controls and Indicators. A control is an input to the application set by the user. An indicator is an output from the application for use by the user.



1.7.3 Digital Controls

The Controls on the Digital Display area are:

Data Collection
Log to File
Range
Filter Tau
Null
Batch Size
Reset
Auto Reset
Sample Collection
Collection Mode
Time Interval

1.7.4 Data Collection

Data Collection Control. When active the data is collected for display if the device is triggered. Data Collection is suspended if another control is activated, then resumed when the other control is released. This is done to prevent the communications buffers from overflowing.

Do Not disconnect the device when Data Collection is active.

1.7.5 Log to File

Log data to selected file. if no file is currently open, a prompt will request the file to log data to.
Data files can be opened, saved, closed and viewed via the File menu.

1.7.6 Range

Selects the desired device measurement range.

1.7.7 Filter Tau

Sets the time constant of the low pass filter used in the Lock In Amplifier.

1.7.8 Null

Subtracts the value of displayed Power or Irradiance when pressed from the subsequent measured values. Releasing the control returns to normal measurements.

Note that the total maximum displayed measurement, that is the measured value plus the Nulled value, cannot exceed the selected Range when Null is active.

1.7.9 Batch Size

The Batch Size to collect in Fixed Sample Collection Mode. Resets with the Reset Button or Auto Reset.

If the Current Sample exceeds the Batch Size when Fixed Sample Collection is selected, a Reset must be issued to start the new batch.

1.7.10 Reset

The Reset button resets the current data set in all collection modes.

1.7.11 Auto Reset

Resets the batch when the Current Sample meets the Batch Size if in Fixed Sample Collection mode.

1.7.12 Sample Collection

Sample Collection is:

Continuous. Data is streamed whenever Data Collection is on. Always only withTime Interval Collection mode.

Fixed. Data is collected whenever Data Collection is on until the Current Sample meets the Batch Size.

1.7.13 Collection Mode

Collection Mode is:

Streaming. Data is streamed at the data frequency rate. Always only with Fixed Data Sample Collection mode.

Time Interval. Data is collected when the selected time interval is met. The Time Interval control is shown when Collection Mode is set to Time Interval.

1.7.14 Time Interval (s)

The Time Interval to wait between taking a data point. Intervening data points are discarded.

1.7.15 Digital Indicators

The Indicators on the Digital Display area are:

Live Data
Rv
Wavelength (nm)
Frequency (Hz)
Frequency Range
Frequency In Range
Locked
Current Sample
Corrections Active

1.7.16 Live Data

The Main Display for:
Power (W) or Irradiance (W/cm^2) .

1.7.17 Rv

Responsivity in V/W of the sensor for the selected Range.

1.7.18 Wavelength (nm)

The wavelength of the light source being measured. Enter this value on the Setup Tab.

1.7.19 Frequency (Hz)

The frequency of the measured data in Hz. Resolution is 0.1Hz.

1.7.20 Frequency Range

The allowed range of chopper (Radiometers) frequencies.

1.7.21 Frequency in Range

Illuminates when the Frequency is within the calibrated range.

1.7.22 Locked

Illuminates when the device is Locked to the synthesized reference frequency used by the Digital Lock In algorithm and Data Collection is active.

1.7.23 Current Sample

The current sample in the batch. Resets with the Reset Button or and Auto reset in Fixed Sample Collection Mode.

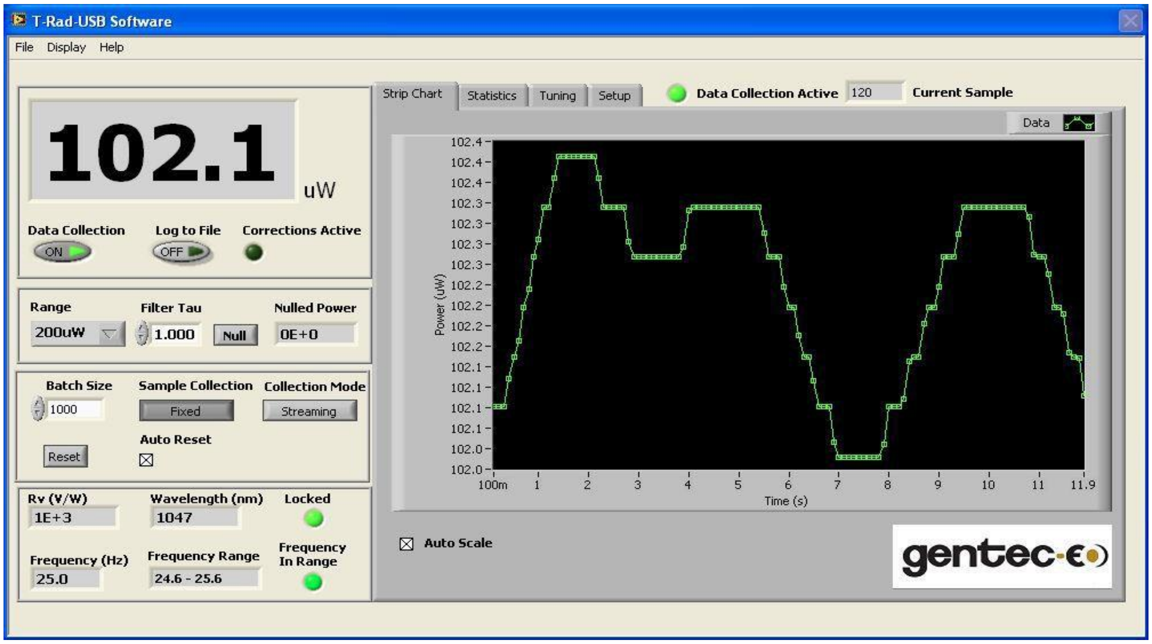
If the Current sample exceeds the batch size when Fixed is selected, a Reset must be issued to start the new batch.

1.7.24 Corrections Active

Illuminates when Wavelength Corrections or Transmissivity Corrections or Area Corrections are active.

1.8 The Strip Chart Display

The Strip Chart Display is visible to the user when its tab is selected. It contains Controls and Indicators for the Strip Chart.



1.8.1 Strip Chart Controls

The Controls on the Strip Chart area are:
Auto Scale
There are more Strip Chart Display controls available in the Display Options Menu

1.8.2 Auto Scale

Auto Scales the Strip Chart Display to the running minimum and maximum values in the data set.

1.8.3 Strip Chart Indicators

The Indicators on the Strip Chart area are:
Strip Chart Plot

1.8.4 Strip Chart Plot

Displays each data point as it is acquired.

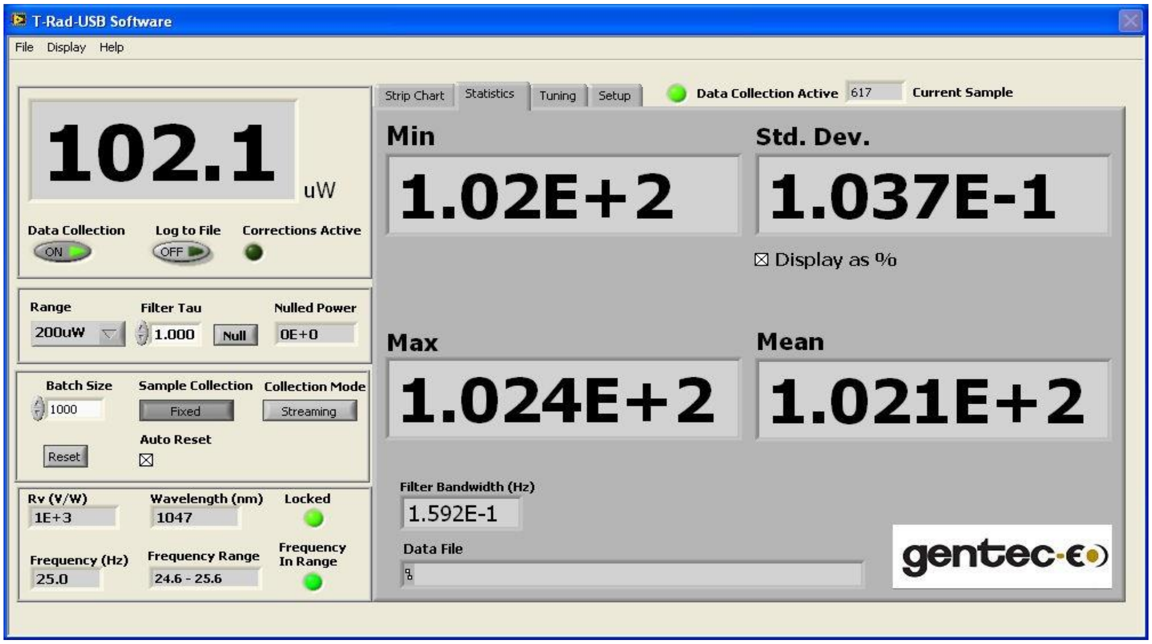
In Continuous Mode the plot functions as a strip chart and fills until Data Collection is turned off.
In Fixed Mode the plot functions as a strip chart and fills until Batch Size is met. On Reset the chart clears and refills with the new batch.

Right click on the Data Icon to set the Plot Options.
Right click on the X-Axis set the X-Axis Options.
Right click on the Y-Axis set the Y-Axis Options.

Min and Max Tracking Cursors can be set using the Display Options Menu.

1.9 The Statistics Display

The Statistics Display is visible to the user when its tab is selected. It contains Controls and Indicators for the statistics on the data set.



1.9.1 Statistics Controls

There is a single control on the Statistics tab; Display as %.

1.9.2 Display as %

Displays the Std. Dev. as a percentage of the Mean.

1.9.3 Statistics Indicators

The Indicators on the Statistics tab are:

Min
Max
Mean
Standard
Deviation Filter
Bandwidth
Data File

1.9.4 Min

The minimum value of the current data set. Resets with the Reset button or an auto reset when in Fixed Sample Collection mode. Updates on each sample.

1.9.5 Max

The maximum value of the current data set. Resets with the Reset</B> button or an auto reset when in Fixed Sample Collection mode. Updates on each sample.

1.9.6 Mean

The Mean of the current data set. Active in Fixed Sample Collection mode. Updates when the Batch Size is met. Resets with the Reset button or an Auto Reset when the Batch Size is met.

1.9.7 Standard Deviation

The standard deviation of the data set. This can be interpreted as the RMS noise.
Standard Deviation and Variance Details:

The VI calculates the output values using the following equations.

$$\mu = \mathop{\mathrm{SUM}}_{i = 0}^{n - 1} [Xi / n]$$

where N is mean and n is the number of elements in X.

standard deviation = Q^2

$$Q^2 = \mathop{\mathrm{SUM}}_{i = 0}^{n - 1} [(Xi - N)^2 /(n - 1)]$$

where Q is variance, N is mean.

1.9.8 Filter Bandwidth

The filter bandwidth that results from the selected filter Tau.

1.9.9 Data File

The path of the currently open data file. If the indicator is empty, no file is currently open to log data.

1.10 The Tuning Needles Display

The Tuning Needles Display is visible to the user when its tab is selected. It contains Controls and Indicators for the Tuning Needles.

1.10.1 Tuning Needles Controls

The Controls on the Tuning Needles area are:
Tuning Scale
Reset Needles

1.10.2 Tuning Scale

Use this button to select the scaling range of the tuning meter.

Min - Max: sets the low end of the scale range to the Minimum value in the data set and the high end of the scale range to the Maximum value in the data set since the last Reset Needles.

Zero - Max: sets the scale range from Zero to the Maximum of the measurement Range.

1.10.3 Reset Needles

Resets the Minimum and Maximum to the value of Current.

1.10.4 Tuning Needles Indicators

The Indicators on the Tuning Needles area are:
Tuning Needles
Current
Minimum
Maximum
Current Sample
Data Collection Active

1.10.5 Tuning Needles

Displays the Maximum (Red Needle), Minimum (Blue Needle) and the Current (Black Needle) measured value. Scale Range is set with the Tuning Scale control.
Minimum and Maximum are reset when Reset Needle is pressed.

1.10.6 Current

The Current Measured Value.

1.10.7 Minimum

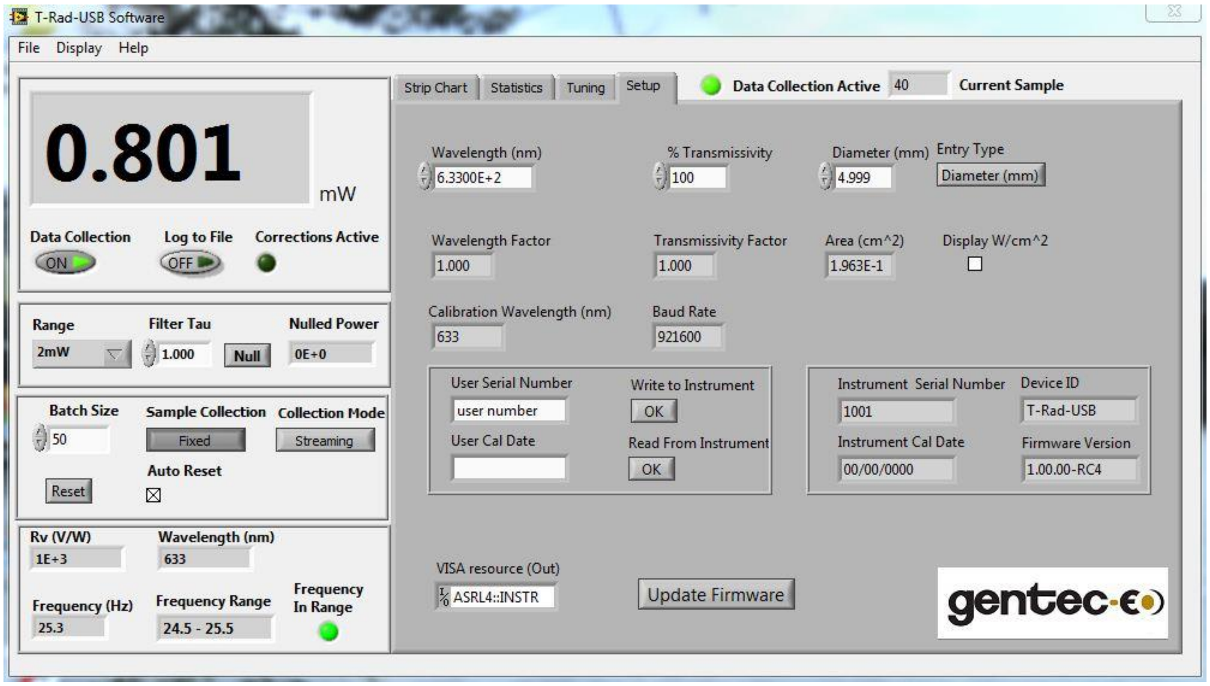
The Minimum Measured Value.

1.10.8 Maximum

The Maximum Measured Value.

1.11 The Setup Display

The Setup Display is visible to the user when its tab is selected. It contains Controls and Indicators for the Setup.



1.11.1 Setup Controls

The Controls on the Setup area are:

Wavelength (nm)
% Transmissivity
Diameter (Area)
Entry Type
Display W/cm^2
User Serial Number
User Calibration Date
Write to Instrument
Read From Instrument
Zero Baseline
Reset Instrument
Update Firmware

1.11.2 Wavelength (nm)

Enter the Wavelength of the light source being measured.

Wavelengths other than the calibration wavelength may result in wavelength corrections being applied. If corrections are applied, the Corrections Active LED will illuminate.

To view the wavelength response of the sensor, use the Display menu item.

Note: The wavelength correction factors are not absolute but rather represent an approximate value.

For complete details on the use of these factors please contact the factory.

1.11.3 % Transmissivity

Enter the Transmissivity of external optics being used

1.11.4 Diameter (mm) or Area (cm2)

Enter the Diameter or the Area, based on the Entry Type, of the light source or external aperture being used.

1.11.5 Entry Type

Change the Diameter control to an Area control.

1.11.6 Display W/cm2

Toggles the data displays from Watts to Irradiance. Uses the Area indicator to compute the values.

1.11.7 User Serial Number

The User Serial Number. Stored in persistent memory

1.11.8 User Calibration Date

The User Calibration Date. Stored in persistent memory

1.11.9 Write to Instrument

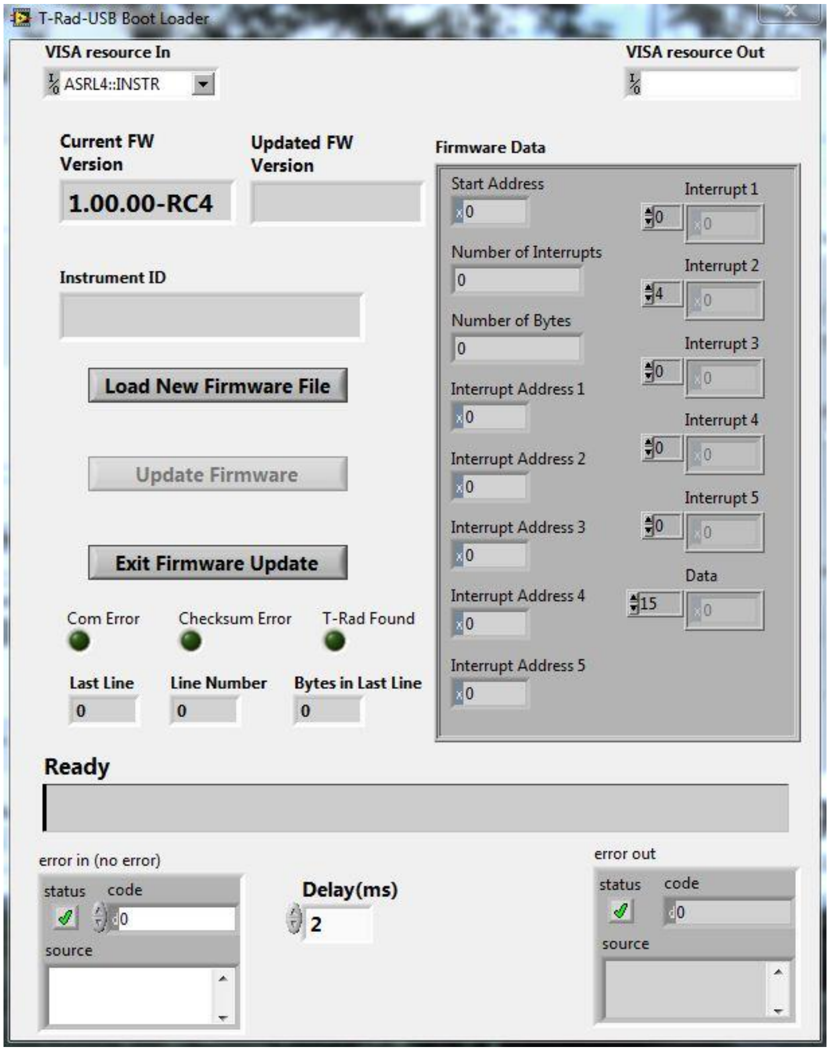
Writes the User Serial Number and the User Cal Date to the persistent memory of the device.

1.11.10 Read From Instrument

Reads the User Serial Number and the User Cal Date from the persistent memory of the device.

1.11.11 Update Firmware

Calls a VI that allows you to update the T-RAD firmware using the USB port and a new firmware file obtained from Gentec-EO. New firmware updates are posted on the Gentec-EO website as they become available.



Press the Load New Firmware File button to select a new firmware file you have downloaded from the Gentec-EO website. You can exit the update with the Exit Firmware Update button. This will leave the current firmware intact. Once the file has been processed, the Update Firmware button will become active. Press it to begin the update. Follow the prompts to complete the update. You must let the update complete and cannot exit the update once this button has been pressed.

1.11.12 Setup Indicators

The Indicators on the Setup area are:

Wavelength
Factor
Transmissivity
Factor Area
(cm^2)
T-RAD Serial Number
T-RAD Calibration Date
Device ID
Firmware
version

1.11.13 Wavelength Factor

The correction factor for the current Wavelength.

1.11.14 Transmissivity Factor

The correction factor for the current Transmissivity.

1.11.15 Area (cm2)

The current Area of the measured beam.

1.11.16 T-RAD Serial Number

The Factory Serial Number.

1.11.17 T-RAD Calibration date

The Factory Calibration Date.

1.11.18 Device ID

The Device ID of the instrument plugged into the USB.

1.11.19 Firmware Version

The Device Internal Firmware Version.

1.11.20 Application Menus

The T-RAD Application Software has three main menu items, each with its own sub menus. They are:
The File Menu
The Display Menu
The Help Menu

1.11.21 The "File" Menu

The File menu is used to open, close, and view data sets. The menu items are:

Open Data File
Close Data File
View Existing Data File
Print Window
Exit

1.11.22 Open Data File

Opens a File too write data to. User is allowed to name a new file or overwrite an old one.

1.11.23 Close Data File

Closes the currently open data file.

1.11.24 View Existing Data File

Allows the user to choose an existing data file for viewing with the Data Analysis Panel.

1.11.25 Print Window

Prints the current window.

1.11.26 Exit

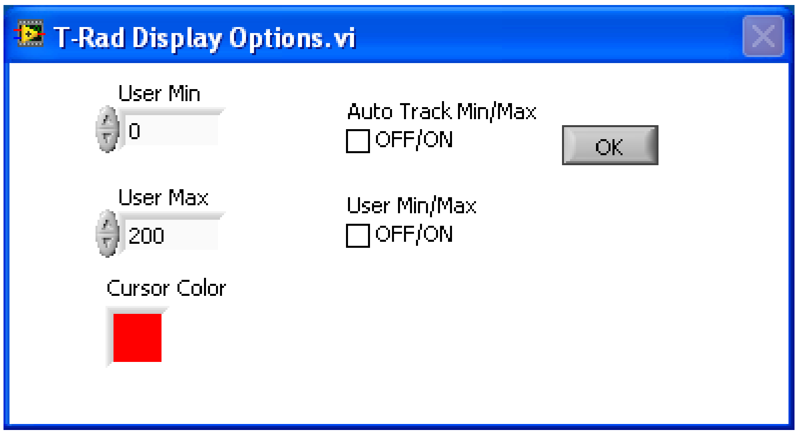
Exits the Application. Closes all open files and stops the T-RAD data stream. Exit saves the state of all Application Controls and restores them on restart.

1.12 The Display Menu

The Display menu is used to modify the characteristics of the Digital Display and the Strip Chart. It also displays the Wavelength Correction Table stored in the sensor. The menu items are:
Display Options
View Wavelength Correction Table

1.12.1 Display Options

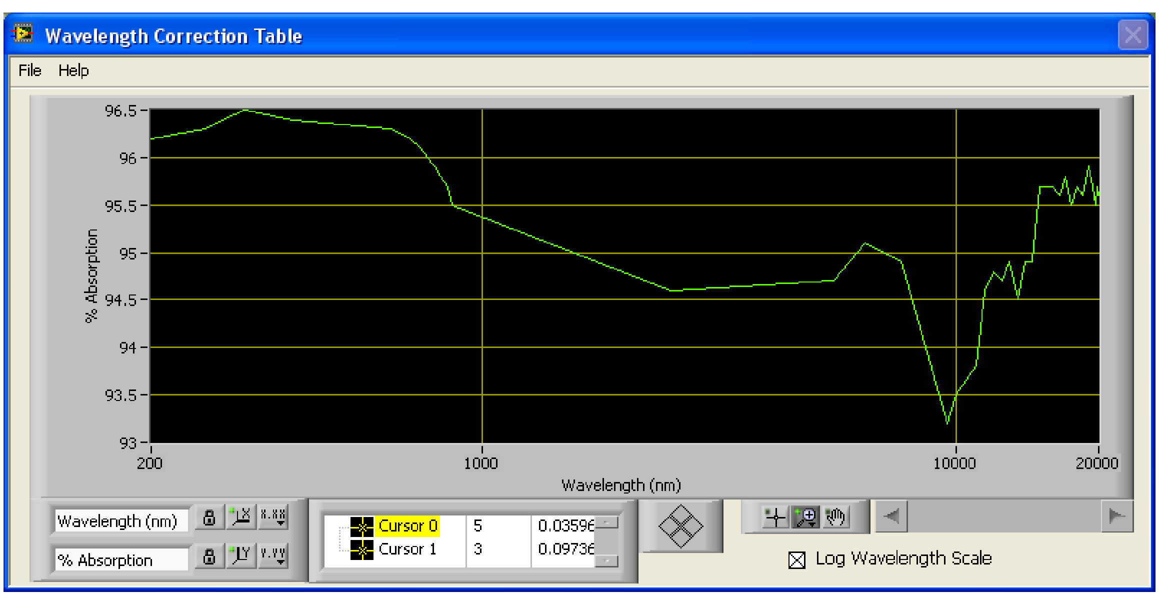
Calls new panel that allows the user to set Cursors on the Strip Chart, Cursor Colors, and Cursor Range.



If Auto Track Min/Max is selected, then the Cursors track the min and max values in the data set.
If User Min/Max is Checked, then User Min and User Max sets the Cursor Range.
Right click on the Cursor Color Box to display a color palette.

1.13 View Wavelength Correction Table

Calls new panel that allows the user to View the Sensor Wavelength Correction Curve.



1.14 The Help Menu

The Help menu is used to display help for the Application. The menu items are:
Help
Show Context Help
About

1.14.1 Help

Calls this Help file.

1.14.2 Show Context Help

Shows a Context Sensitive Help Window when the Mouse Cursor is over a Control or Indicator.

1.14.3 About

Application Information is Displayed.

1.15 Recycling and separation procedure.

This section is used by the recycling center when the monitor is at the end of its life.
Breaking the calibration seal or opening the monitor will void the T-RAD warranty.

The complete Monitor contains

1 Monitor

1 USB cable

1 Instruction manual

1 Calibration certificate

1 Software cdrom

1.15.1 Separation:

Paper: Manual and certificate

Aluminum: Monitor enclosure.

Printed circuit board: inside the monitor.

1.15.2 Dismantling procedure:

To open the monitor:

Remove all the screws on both sides of the monitor:

Remove the PCB by sliding it out of the enclosure.

1.16 DECLARATION OF CONFORMITY

Application of Council Directive(s):	2004/108/EC EMC Directive
Manufacturer's Name:	Gentec Electro Optics, Inc.
Manufacturer's Address:	445 St-Jean Baptiste, suite 160 (Québec), Canada G2E 5N7
Representative's Name:	Laser Component S.A.S
Representative's Address:	45 bis Route des Gardes 92190 Meudon (France)
Type of Equipment:	Laser Power/Energy Meter
Model No.:	T-RAD
Year of test & manufacture:	2011

Standard(s) to which Conformity is declared:
EN 61326-1: 2006 Emission generic standard

Standard	Description	Performance Criteria
CISPR 11 :2009 +A1 2010	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	Class A
EN 61000-4-2:2009	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques- Electrostatic discharge.	Class B
EN 61000-4-3:2006 +A2:2010	Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques- Radiated, Radio Frequency, electromagnetic field immunity test.	Class A

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s)

Place: Québec (Québec)
Date : June 11, 2012

(President)

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