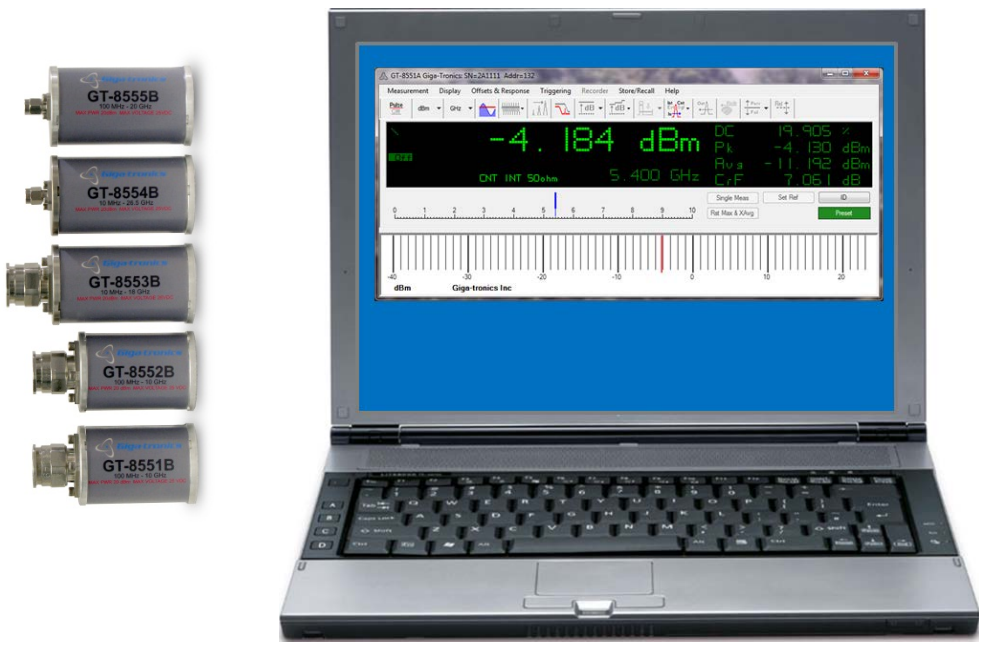
GT-8550B Series USB Power Sensors



Operation Manual

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Regulatory compliance information

This product complies with the essential requirements of the following applicable European Directives, and carries the CE mark accordingly.

89/336/EEC and 73/23/EEC	EMC Directive and Low Voltage Directive
EN61010-1 (1993)	Electrical Safety
EN61326-1 (1997)	EMC – Emissions and Immunity

Manufacturer's Name:
Giga-tronics, Incorporated

Manufacturer's Address
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U.S.A.

Type of Equipment:
USB Power Sensor

Model Series Number
GT-8550B

Model Numbers:
GT-8551B, GT-8552B, GT-8553B, GT-8554B and GT-8555B

Declaration of Conformity on file. Contact Giga-tronics at the following:

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1 Safety and Manual Conventions

This manual contains conventions regarding safety and equipment usage as described below.

1.1 Product Reference

Throughout this manual, the term "GT-8550B" refers to all models of power sensors within the GT-8550B Series, unless a specific model power sensor is referenced.

1.2 Personal Safety Alert

WARNING

WARNING: Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

1.3 Equipment Safety Alert

CAUTION

CAUTION: Indicates a situation which can damage or adversely affect the GT-8550B or associated equipment.

1.4 Notes

Notes are denoted and used as follows:

NOTE: Highlights or amplifies an essential operating or maintenance procedure, practice, condition or statement.

2 Introduction

1.1 Overview

NOTE: In this manual, the GT-8550 Series USB Power Sensors are often referred to as the "GT-8550B" for simplicity. The specific model of power sensor is used where necessary.

This manual provides information about the installation and operation of the GT-8550B Series USB Power Sensors. Product description, specifications, and support are included. The GT-8550B series feature a frequency range to 26.5 GHz, wide dynamic range and fast measurement speed, and connect directly to a desktop or laptop computer using a standard USB port and USB cable. A separate power meter is not required. The GT-8550B Series USB Power Sensors allow for immediate conversion of RF and microwave power into digital data right at the point of power sensing.

The companion application software provides a Graphical User Interface (GUI) to make power and other measurements. The benefits of this Software are:

- Familiar Microsoft® Windows Interface
- Easy to read numbers and bar graphs
- Fast update rate allows real time circuit tuning
- Internal zero and cal – the sensor powers up ready to make measurements

A Dynamic Link Library (DLL) is included with the software media that ships with the GT-8550B for programming the GT-8550B for remote control. Information for programming the GT-8550B is found in the GT-8550B Series USB Power Sensors Remote Operation and Programming Manual.

Sensor zeroing and meter reference calibration are not required. There is no user calibration. This reduces setup time and simplifies programming. Recommended calibration cycle is one (1) year.

A typical setup for measuring RF power using the GT-8550B Series Power Sensor is shown in Figure 1.

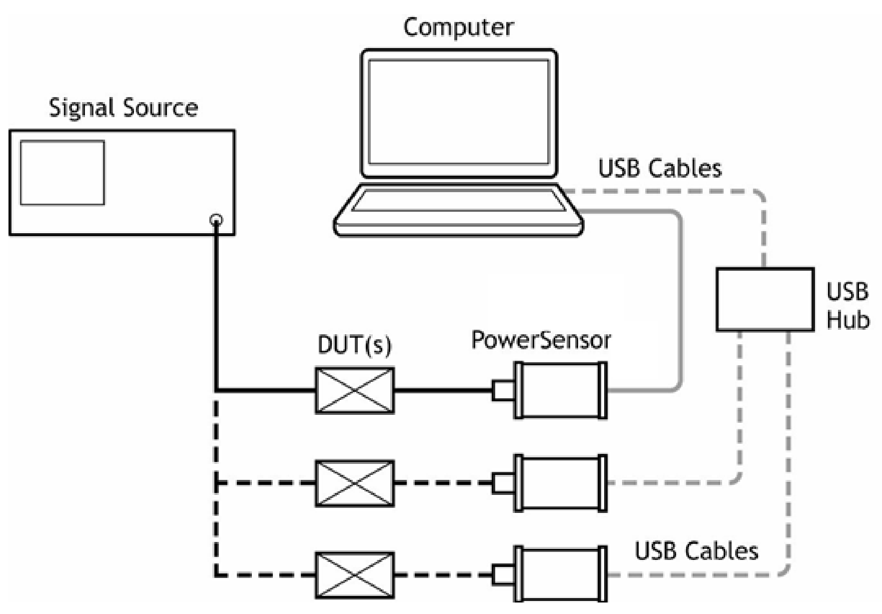


Figure 1. GT-8550B Series Power Sensor Measurement Setup

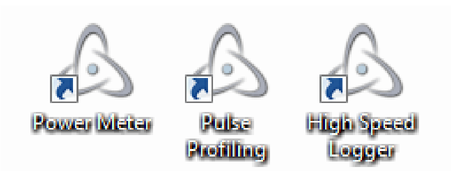
Important NOTE:

The GT-8550B series USB Power Sensors replace the GT-8550A series USB Power Sensors.

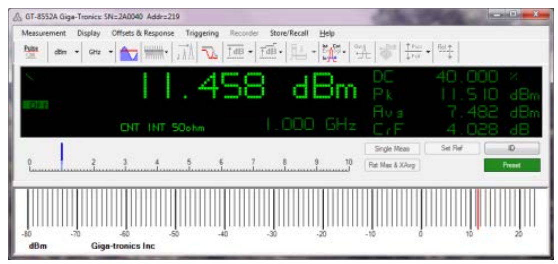
The software for the GT-8550B series USB Power Sensors is different, but will in most cases, recognize and work with the GT-8550A series USB Power Sensors. The new software will work with the old hardware. The programming commend sets are different, and are not backwards code compatible.

The GT-8550A series USB Power Sensor application software (Measurement Xpress) is now obsolete, and that software will **not** work with the new GT-8550B series USB Power Sensors.

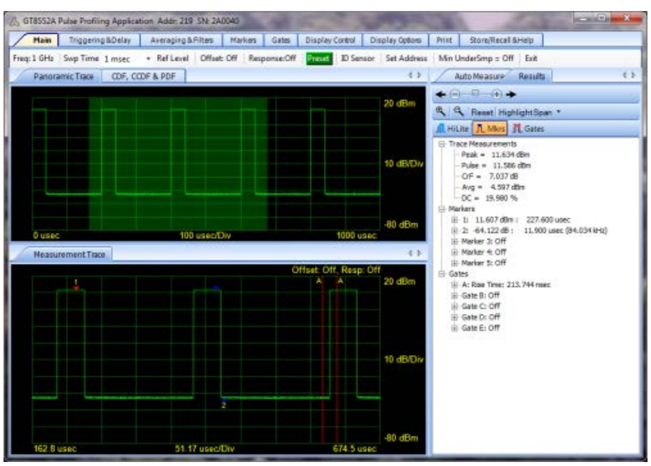
The new GT-8550B software comes in three separate software applications (GUIs):



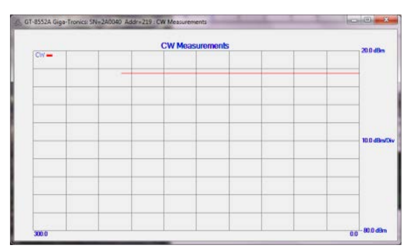
The "**Power Meter**" application is the primary GUI:



The "**Pulse Profiling**" application provides a power versus time display:



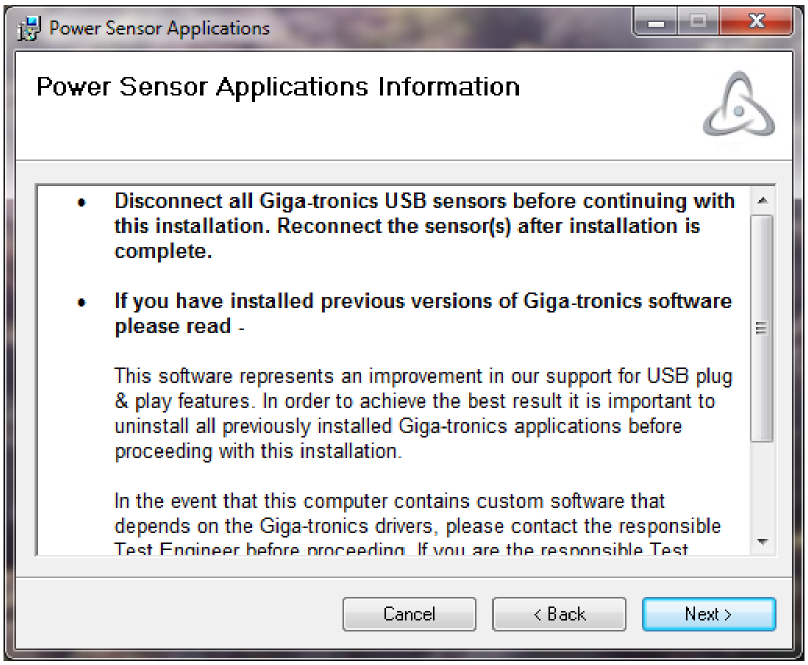
The "**High Speed Logger**" application provides a "strip chart" display:



Important NOTE:

If you have previously installed the old GT-8550A series USB Power Sensor software on your computer, you should remove (uninstall) all previously installed Giga-tronics USB power sensor software, before installing the new GT-8550B software.

The following message will appear during the initial installation of the GT-8550B software:



NOTE: Software MUST be installed on the computer BEFORE the GT-8550B Series USB Power Sensors are connected to the computer.

2.2 Sensors in the GT-8550B Series

The table below lists the basic parameters of the five models of power sensor in the GT-8550B Series.

Table 1: GT-8550B Series Power Sensors: Basic Specifications and Applications

GT-8550B Series Power Sensors: Basic Specifications and Applications				
Parameter	**Power Sensor Model**			
	GT-8551B	**GT-8552B**	**GT-8553B, GT-8554B**	**GT-8555B**
Frequency Range	100 MHz to 8 GHz [1]	100 MHz to 8 GHz [1]	10 MHz to 18 GHz 10 MHz to 26.5 GHz	100 MHz to 20 GHz
Measurements	CW, Peak (Pulse) • Average Power • Peak Power	CW, Peak (Pulse) • Pulse Profiling • Markers • Gating	CW • True-Average Power	CW, Peak (Pulse) • Pulse Profiling • Markers • Gating
Dynamic range	-60 to +20 dBm	-60 to +20 dBm	-50 to +20 dBm	-40 to +20 dBm
Applications	Wireless communications and component testing that use modulated signals.	• Aerospace and defense: EW, ECM, ECCM, and radar testing • Features Pulse Profiling	Accurate power measurement of continuous wave (CW) RF and microwave signals	• Aerospace and defense: EW, ECM, ECCM, and radar testing • Features Pulse Profiling

[1] Operational to 10 GHz
[2] These are explained in section 2.5 on page 6.

2.3 Receiving and Inspection

Upon arrival, inspect the contents of the GT-8550B shipping container. The GT-8550B consists of:

Sensor: there are five models of power sensors to choose from. These are described in

- Table 1 on the previous page.
- USB cable to connect the sensor to a computer (supplied with sensor)
- Software media containing:
    - Software (this may also be downloaded from the website www.gigatronics.com)
    - Files to enable programming the GT-8550B Series USB Power Sensor.
    - Electronic documentation

2.4 Computer Requirements for the Software

Table 2 below shows the requirements of the computer used with the GT-8550B Series USB Power Sensors.

Table 2: Computer Requirements for Software

Computer Requirement for Software	
Parameter	**Specification**
Type of computer	IBM-compatible
Operating System [1]	Microsoft® Windows XP or Windows Vista or Windows 7 [2]
Processor speed	> 1 GHz
RAM	> 1 GB
USB interface [3]	USB 2.0

[1] There are separate installation files for 32 bit and 64 bit Operating Systems.

[2] Microsoft® .Net Framework 4.0 (or above) is required on 64 bit Operating Systems.

[3] See section 2.6 on page 9 for USB considerations. The USB port or hub *must* supply 500 mA @ 5 V for power sensor operation.

2.5 Measurement Capabilities

Measurement capabilities differ between different models. All of the instruments accept RF or microwave signals, detect the envelope, convert the power into digital values, and send measurements to a PC over a USB connection. All models are capable of producing 2000 settled measurements per second.

The GT-8553B and GT-8554B models are true average instruments that are well-suited for making accurate average power measurements on both narrowband and wideband signals. There are two software applications that work with these instruments: the Power Meter application and the High Speed Logger application. When these instruments are used with those applications, only CW (average) measurements are available.

The GT-8551B, GT-8552B and GT-8555B models also measure average power, but also capable of measuring pulse and peak power. These sensors are intended for use on pulsed or bursted repetitive signals with a modulation bandwidth less than 10 MHz. In addition to CW, pulse, and peak power measurements, 13 other common time domain measurements can be made using the Pulse Profiling application software. The Pulse Profiling software is designed for time domain analysis of pulses and other modulated signal formats. This software is used to display a trace of a pulsed RF signal envelope versus time and can make up to 13 different measurements on the power envelope.

2.5.1 Continuous Wave (CW) / Average Power Measurements

All model of sensors are capable of measuring average or CW power. The GT-8551B, GT-8552B and GT-8555B read average power, while the GT-8553B and GT-8554B read true-RMS power.

The **GT-8553B** and **GT-8554B** instruments measure “true RMS power”, which means they integrate the broadband power contained in the signal under test. Although the measurement hardware is different, the results are similar to a thermal sensor.

The **GT-8551B, GT-8552B and GT-8555B** models also measure average power accurately, however the sampling technology that enables them to also make pulse measurements also limits the modulation bandwidth to 10 MHz.

2.5.2 Pulse and Peak Power Measurements

NOTE. This information applies to the GT-8551B, GT-8552B and GT-8555B models.

In addition to average power measurements, the GT-8551B, GT-8552B and GT-8555B models can also measure pulse and peak power. These models measure and report the following measurements:

- Average power within the pulse
- Peak power
- Average power of the entire signal
- Duty cycle
- Crest factor (or peak-to-average power ratio)

Averaging and extended averaging can be used to increase the measurement window and to improve the quality of low-level measurements. The detection and sampling system in these instruments make it possible to measure signals with modulation rates up to 10 MHz.

2.5.3 Pulse Profiling

NOTE. This information applies to the GT-8552B and GT-8555B models only.

When using the Pulse Profiling application software with the GT-8552B and GT-8555B models, a wide variety of measurements are available. This software shows the RF power envelope versus time. Various time domain measurements can be made. Gates and markers can be placed on the trace, which enables you to measure specific portions. In addition, two different traces can be displayed at the same time which enables you to highlight or zoom in on a certain area of the trace, while viewing the original trace at the same time.

The application provides five (5) pairs of markers and five (5) pairs of time gates that are used to take measurements. The time gates allow characterization of the pulse signal to include the following parameters. There is also an automatic measurement feature, with predefined presets, that allows all of these measurements to be made with a click of a button:

1. Rise time (RT)
2. Fall time (FT)
3. Pulse width (PW)
4. Pulse repetition time (PRT)
5. Pulse repetition frequency (PRF)
6. Duty cycle (DC)
7. Pulse power (Pls)
8. Peak power (Pk)
9. Average power (Avg)
10. Crest factor (CF or CrF)
11. Overshoot (OvSh)
12. Droop (Droop)
13. On/Off ratio

The gates also provide three groups of predefined preset measurements:

1. Power Set (peak power, pulse power and crest factor)
2. Time & Frequency Set (pulse width, pulse repetition time, pulse repetition frequency)
3. Mixed Set (peak power, crest factor, pulse width, pulse repetition frequency)

2.6 USB Considerations

Under normal circumstances, the Universal Serial Bus (USB) provides adequate power for the sensor. However, when the application requires a longer cable (greater than 3 to 5 meters), an active or self-powered hub may be required. The sensor electronics are powered by the USB and typically draws 450 mA at a nominal 5 VDC. An active hub will compensate for the DC voltage drop beyond approximately 3 to 5 meters. An active hub is recommended when using a portable computer to conserve battery life, or when powering multiple sensors.

The GT-8550B Series USB Power Sensors are compliant with USB standard 2.0 and above. The following information is provided for reference when selecting a hub:

USB Hub Considerations:

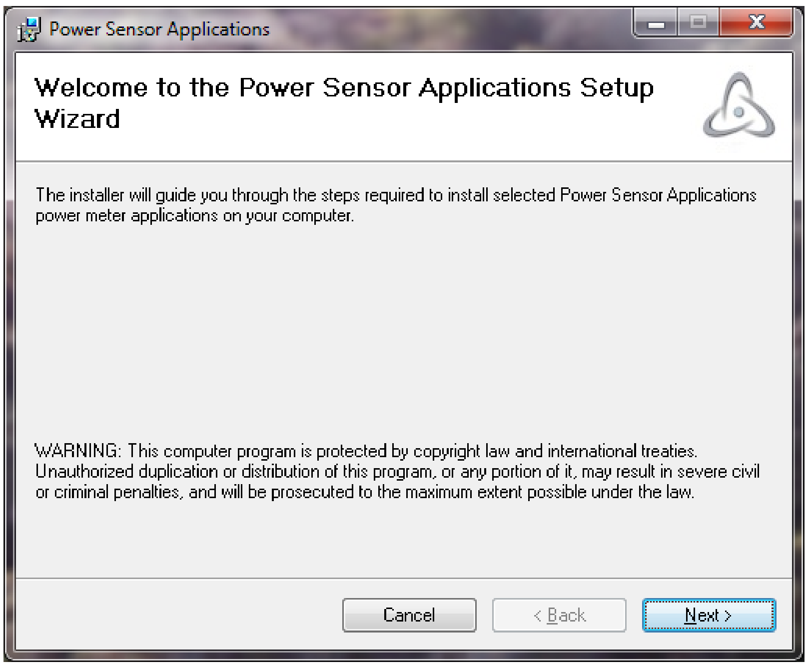
- *Bus-powered hub:* Draws a maximum of 100 mA at power up and 500 mA during normal operation.
- *Self-powered hub:* Draws a maximum of 100 mA and *must* supply 600 mA to each port.
- *Low power, bus-powered functions:* Draws a maximum of 100 mA (often applies to portable computers
- *High power, bus-powered functions:* Self-powered hubs: draws a maximum of 100 mA and *must* supply 500 mA to each port
- *Suspended device:* Draws a maximum of 0.5 mA.

2.7 Install Software

This section describes how to install the Software on a computer.

NOTE: Refer to Table 2 on page 6 for the requirements for the computer in which Software will be installed.

Table 3: Installation Procedure for Software

Install Software	
Step	**Action**
1.	Connect the GT-8550B Flash Drive to a USB port on the computer, or download the software from the Giga-tronics website.
2.	Locate and run (software) on the GT-8550B software media, or download. The first setup window is displayed (see Figure 2).  **Figure 2. Software Installation: Welcome Screen**
3.	Click Next in the setup window.

<table>
<tr><th colspan="2">Install Software</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>4.</td><td>

In the License Agreement window, read the license agreement, then click on “I Agree” then click Next.

Figure 3. Software Installation: License Agreement

</td></tr>
<tr><td>5.</td><td>

In the Select Application window, select the applications, then click Next.

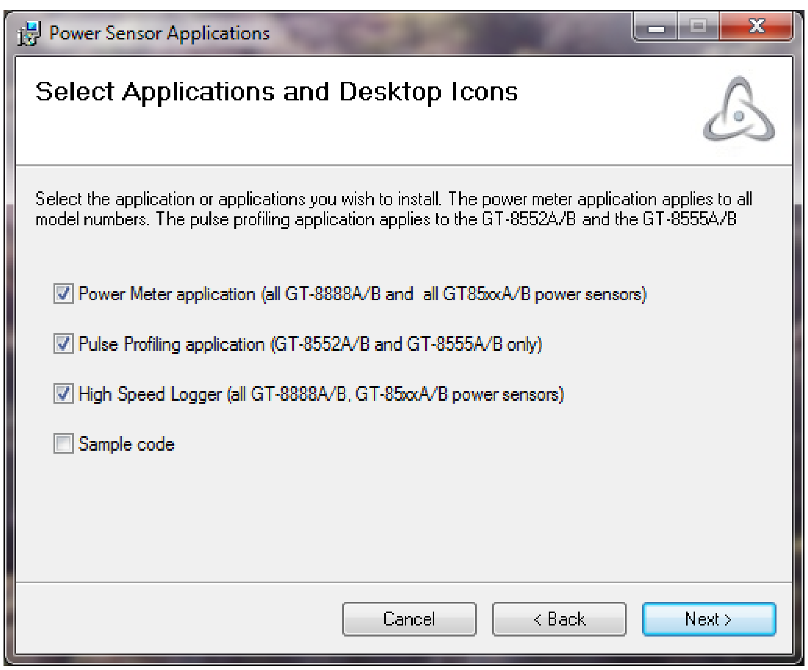


Figure 4. Software Installation: User Information

</td></tr>
</table>

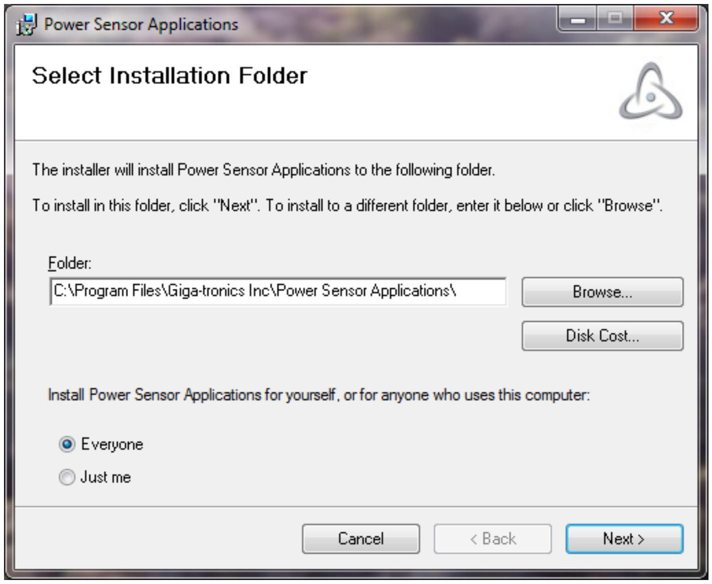
<table>
<tr><th colspan="2">Install Software</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>6.</td><td>In the Destination Folder window, you can leave the destination folder set for the default, or use Browse to select another folder. When you have made your choice, click Next.


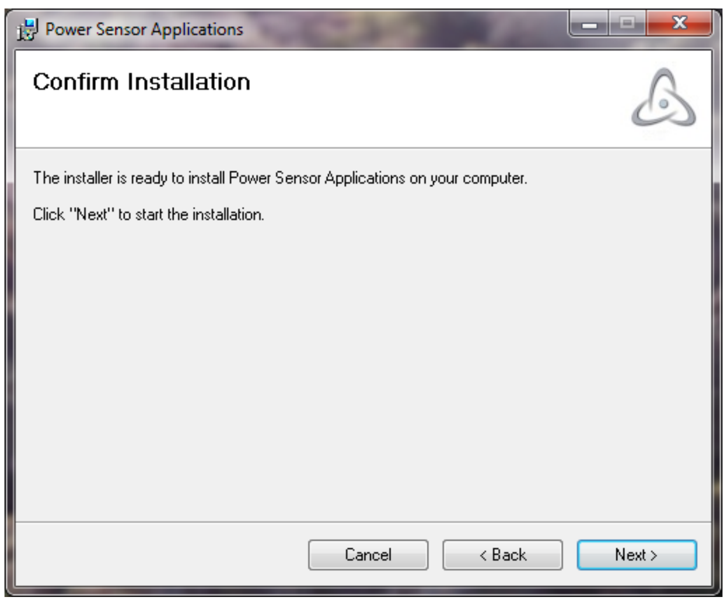
Figure 5. Software Installation: Destination Folder</td></tr>
<tr><td>7.</td><td>In the Ready to Install window, click Next to proceed with the installation.


Figure 6. Software Installation: Ready to Install</td></tr>
</table>

<table>
<tr><th colspan="2">Install Software</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>8.</td><td>Software installs on your computer.

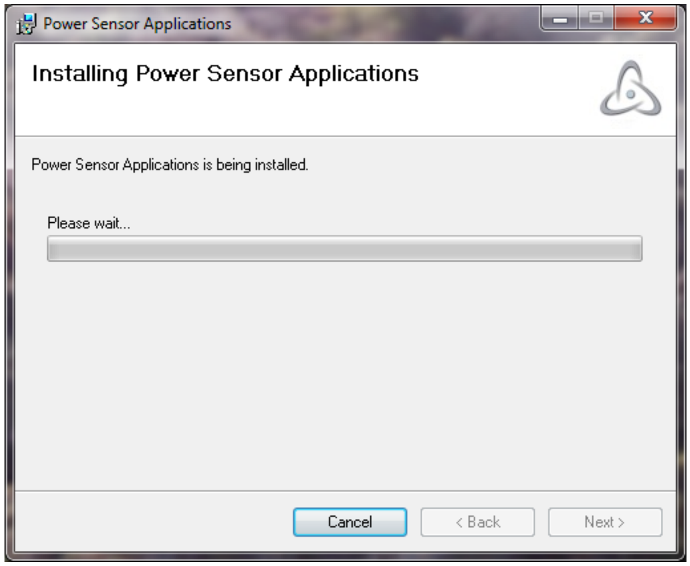


Figure 7. Software Installation: Installation Begins</td></tr>
<tr><td>9.</td><td>The Successful Installation window appears when Software has completed its installation.

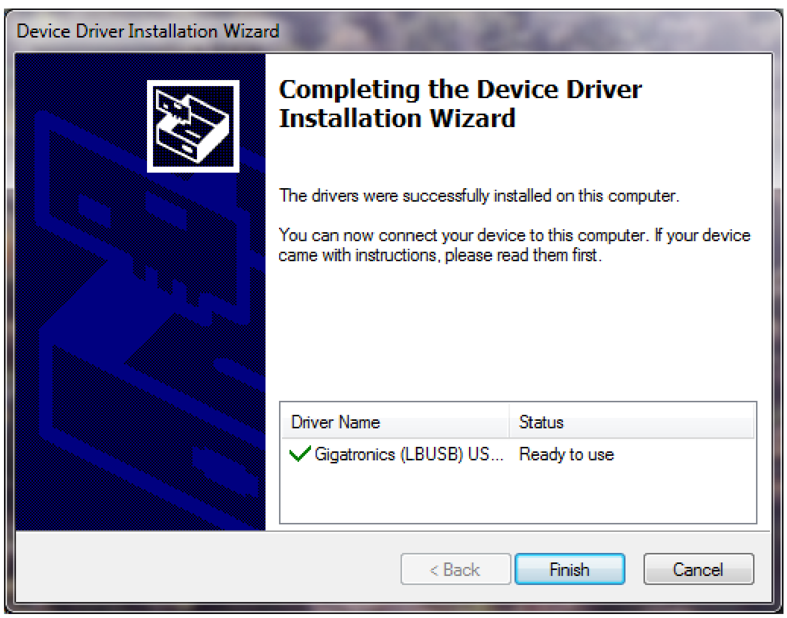


Figure 8. Software: Installation Successful</td></tr>
<tr><td colspan="2">End of Procedure</td></tr>
</table>

2.8 Install the GT-8550B Series USB Power Sensors

CAUTION **ESD-SENSITIVE DEVICE**

Observe Electro-Static Discharge precautions when handling the GT-8550B Series USB Power Sensor:

- Work at an ESD-safe location.
- Keep the power sensor in an anti-static bag when not using it.
- Handle the power sensor with appropriate anti-static clothing and ESD wrist strap, or other discharge path, if operating in a statically active environment.

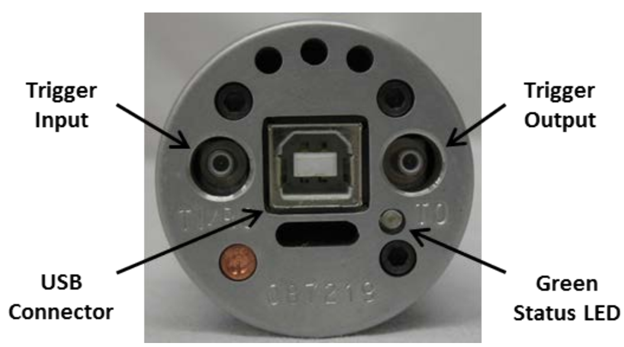
NOTE: Software MUST be installed on the computer BEFORE the GT-8550B Series USB Power Sensors are connected to the computer. After Software has been installed, there are two methods for configuring the computer for using the power sensors (automatic or manual).

Automatic installation: Simply connect the USB power sensor to a USB port on the computer, and follow the prompts in the Hardware Wizard.

Automatic:

- **Table 4 below.**
- Manual installation: Installing the device manually is recommended only if your computer is unable to properly identify the correct driver. To use this method, go to Table 5 on page 15.

Table 4: Power Sensor Installation (Automatic)

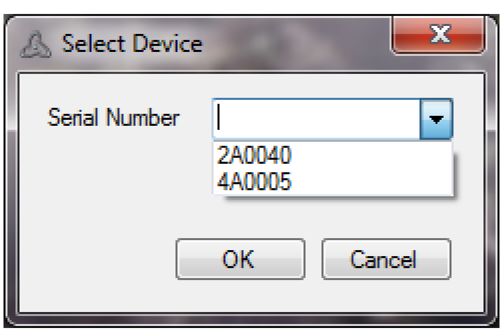
Automatic Installation of a Power Sensor	
Step	**Action**
1.	Verify that Software is installed, but not launched on your computer.
2.	Connect the supplied USB cable to the USB sensor.
3.	Connect the other end of the USB cable to a USB port on your computer. Observe that the green LED on the end of the sensor illuminates. This indicates that the sensor is properly connected to the computer's USB port. (Trigger input applies to GT-8551B, GT-8552B, and GT-8555B only)  **Figure 9. Back End of USB Power Sensor**
4.	The Hardware Wizard opens on the computer.

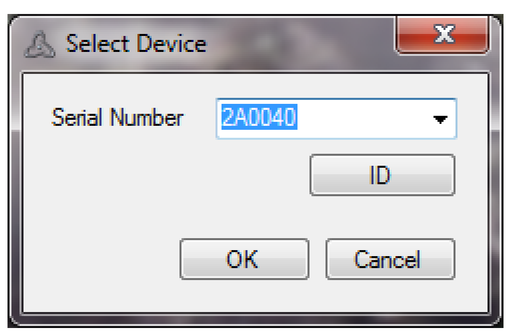
Automatic Installation of a Power Sensor	
Step	**Action**
5.	Click on the Install the Software automatically option, then click Next.
6.	After the software identifies the power sensor device, click Next to complete the installation process.
7.	When the installation completes, select “Finish” to close the Hardware Update Wizard. The power sensor is now ready for use with Software.
End of Procedure	

Table 5: Power Sensor Installation (Manual)

Manual Installation of a Power Sensor	
Step	**Action**
1.	After connecting the USB power sensor, the computer will indicate “Found New Hardware” and automatically open the Hardware Wizard to configure the USB device driver for the power sensor.
2.	Select “Install from a list or specific location (Advanced)” and click Next to continue.
3.	In the following window, select “Don’t search, I will choose the driver to install,” then click Next.
4.	Select the Giga-tronics device, then click “Have Disk”.
5.	Select the software and click Open to continue.
6.	Select “Next” to continue the installation process.
7.	When the installation completes, select “Finish” to close the Hardware Update Wizard. The power sensor is now ready for use with Software.
End of procedure	

Note: ***For Multiple Sensors:*** To install multiple sensors (up to 12), complete the installation procedure separately for each sensor. Individual sensors are selected by serial number. Clicking the ID button will cause the LED on the sensor to blink four times in quick succession.





2.9 Start Software

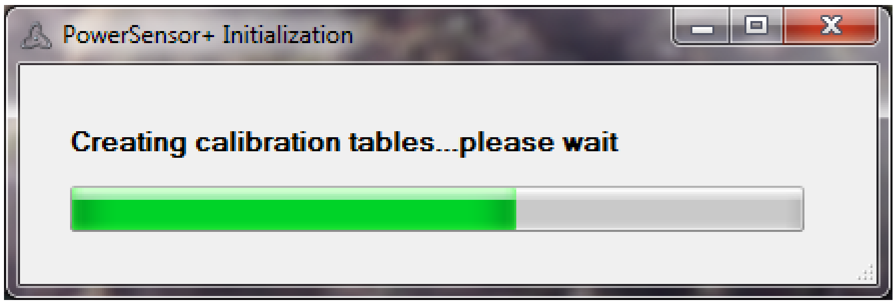
2.9.1 Zeroing and Reference Power Calibration

The design of the power sensor does not require zeroing or power calibration and there is no provision for zeroing or calibration.

NOTE: While zeroing is not required, the sensors require time to thermally stabilize. Little if any warm-up time is required for measurements of power levels above -40.0 dBm. However, to make accurate measurements of power levels below -40 dBm, the sensors should be allowed to thermally stabilize for at least one hour.

Table 6: Starting Software

Start Software	
Step	**Action**
1.	Connect a GT-8550B Power Sensor to a USB port on your computer. The green status LED should illuminate on the sensor, indicating that it is properly connected to the computer.

<table>
<tr><th colspan="2">Start Software</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>2.</td><td>
Click the Power Meter icon, or “Giga-tronics Power Meter” from the Program menu, then select the Power Meter application or click on the Power Meter application shortcut icon on the desktop. During startup, you will see the following figure. Everytime you start the software, calibration tables are created.
Please be patient: This operation may require a few minutes depending on variables such as the PC configuration and number of sensors.


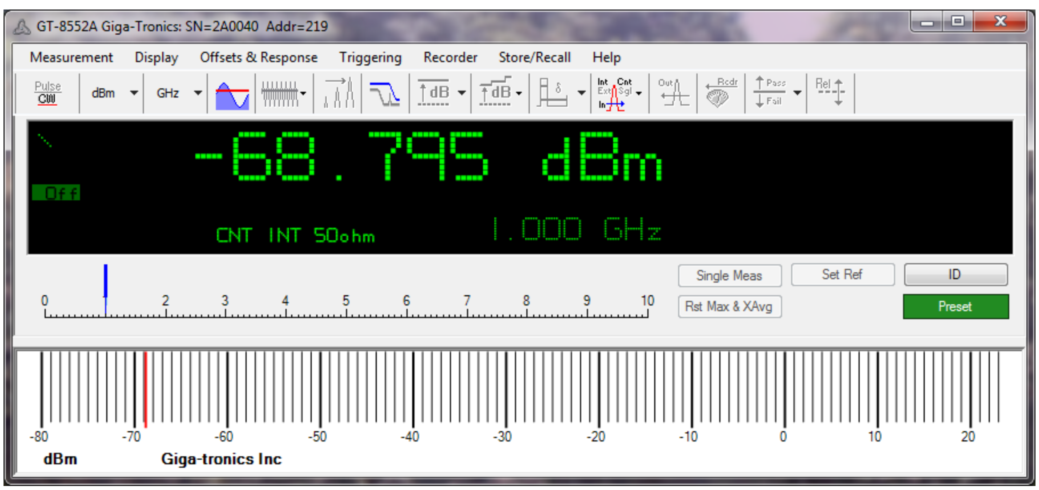


Figure 10. Software Initial Displays
</td></tr>
<tr><td>3.</td><td>If there are multiple sensors connected to the computer, you can open a window for each of them at any time.</td></tr>
<tr><td colspan="2">End of Procedure</td></tr>
</table>

3 Power Meter Application

This chapter describes in detail the Graphical User Interface (GUI) for the Power Meter Application. This software application works with all models of sensors.

1.1 Main Areas of the Graphical User Interface

The main areas of the GUI are highlighted below.

The next sections describe each of the main areas shown in Figure 11.

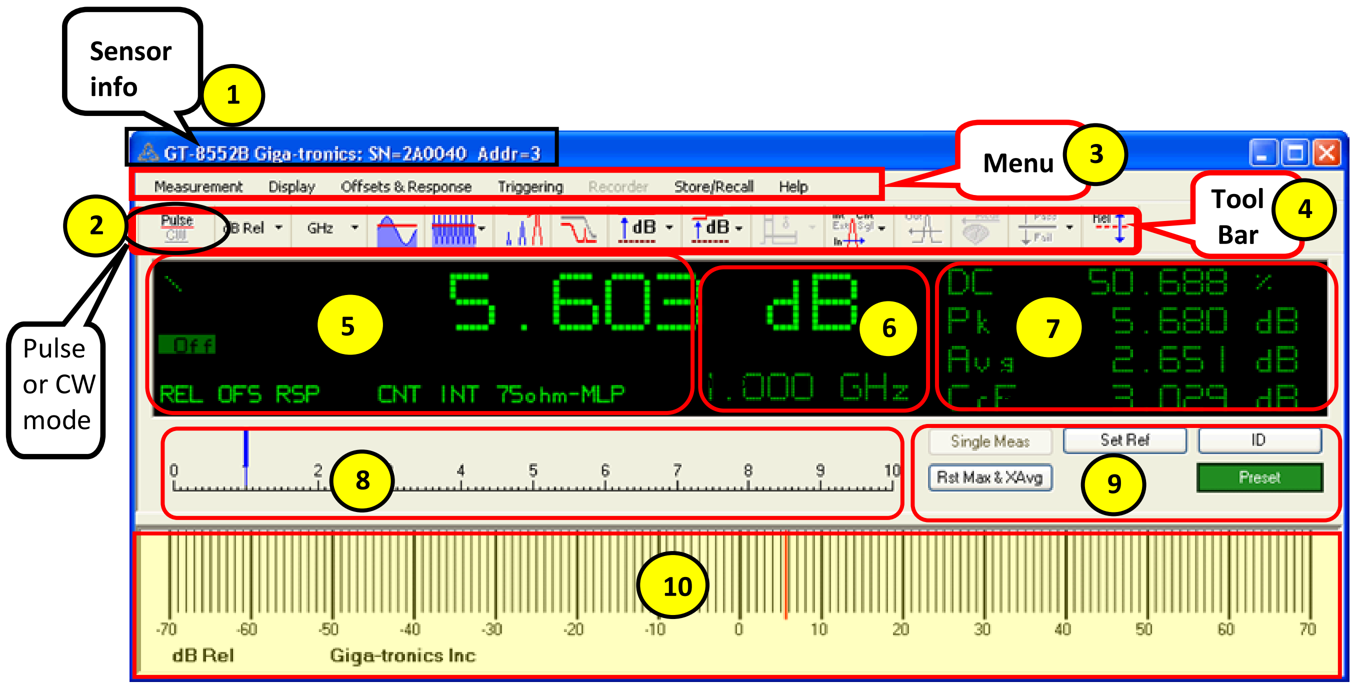
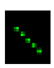


Figure 11. Power Meter Software GUI

NOTE: A separate GUI with unit model, serial number and address will appear for each active device when you open a new instance of the ***Power Meter*** application. The GUI allows identification (ID) of the individual sensor(s) by blinking the LED on the sensor body. Clicking the ID button will cause the LED on the sensor to blink four times in quick succession. The ID and Preset functions are duplicated on the Measurement menu.

Figure 11 shows the Power Meter panel in **Pulse mode**. Pulse mode is only available for GT-8551B, GT-8552B, and GT-8555B sensors. The GUI looks almost the same in CW mode, except the section 7 is not shown because those measurements are only available in Pulse mode.

Figure 11 shows the GUI broken up into 10 sections. Each section will be explained below.

1. **Sensor Info:** This section always displays the model number, serial number and the address of the sensor
2. **Pulse/CW**: This button toggles between CW and Pulse mode. Pulse mode is only shown and selectable for models: GT-8551B, GT-8552B and GT-8555B sensors.
3. **Menu:** drop down menus enable you to select and adjust settings. Many of these settings are also available on the toolbar that is located below the menu.
4. **Toolbar:** The toolbar buttons are short cut keys that allow you that duplicate many of the menu selections or actions. Each function is accessible from the menu bar and some toolbar buttons are simply switches that toggle certain parameters on or off.
5. **Digital readout area:** this section shows the numeric value of the average power in digital format and several indicator messages.
    a. **Numeric value:** this is the average power (the figure above shows it in relative measurement mode). When in Pulse mode, this is the Pulse's average power. This is the power within the pulse (the "ON" portion of the pulse). When in CW mode, this shows the average power of the entire signal. If the signal that is being measured is pulsed and the duty cycle is 50%, then if the mode was toggled from Pulse to CW, this would show a 3 dB difference.
    b. Indicators:
        i. **Limits:** default setting is limits are set to Off and an indicator is displayed on the left side of screen that says **OFF**
        ii. **Trigger:** default is **CNT INT**, which is continuous internal
        iii. **Impedance:** default setting is **50 ohm**
        iv. **Offset:** default setting is off. When off, no message is displayed. If the offset is on, then the **OFS** message will appear.
        v. **Response:** default setting is off. When off, no message is displayed. If the response is on, then **RSP** will be displayed.
        vi. **Relative:** default setting is off. When off, no message is displayed. If relative measurement is on, then **REL** will be displayed.
    c.  (slash symbol): when this is rotating, then this illustrates that the measurement is running.
6. **Frequency and Units:** The current units and frequency is displayed. You can click directly on these spots to change units and/or frequency.
7. When in **Pulse mode**, additional measurements are shown, which are described below:
    a. **DC:** duty cycle
    b. **Pk:** peak power
    c. **Avg:** average power. This is the overall average power of the entire pulse. For example, if the duty cycle of the pulse is 50%, then AVG would be 3 less than the Pulse average power.
    d. **CrF:** crest factor. Also known as peak-to-average power ratio.
8. **Frequency analog read-out and setting**: This value will vary according to model number. Click on the blue bar to select and slide to a new frequency setting.
9. **Buttons:** This section contains 5 buttons, which are described below. The buttons are only active and clickable only for certain settings. Otherwise they are inactive and "grayed out". Many of these functions can also be accessed from the Menu also.
    a. **Single Meas:** When the Trigger is set to "Internal Single", then this button becomes active. Then each time the button is pressed, a single measurement is made.

b. **Set Ref:** set the reference value so that a subsequent power level can be measured relative to this reference level.
c. **ID:** Clicking the ID button shown above will cause the LED on the sensor to blink four times in quick succession.
d. **Rst Max & XAvg:** resets Max hold and Extended averaging. More details about these functions are described in Menu section of the manual.
e. **Preset:** resets instrument back to factory default settings. Factory default settings are explained in the Menu section of the manual.

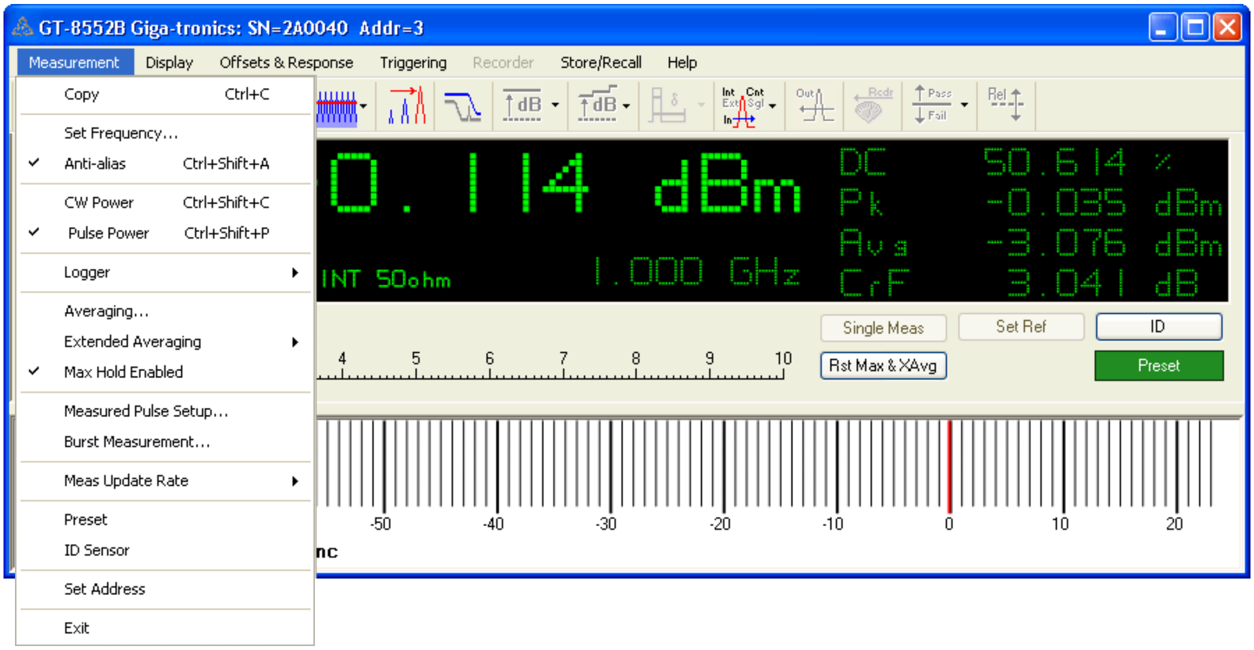
10. **Analog read-out of Power:** displays the measured average power in an analog format. Displays the same numeric value as section 5.

3.2 Menu

This section describes the Menu. The drop down menus enable you to select and adjust settings. Many of these settings are also available on the toolbar. Menus provide the configuration setups related to each functional heading and are directly linked to the toolbar buttons.

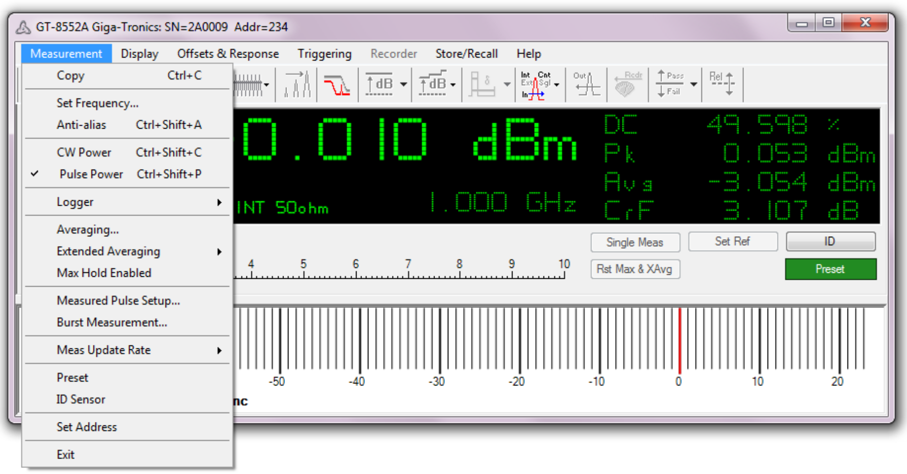
If a check mark is shown next to a menu item, this indicates that that feature is enabled. For example in the figure below, the Anti-alias filter is enabled, Pulse Power is on, and Max Hold is enabled. With some of the setups, (Logger, Extended Averaging, Limits, Offset, Response, Duty Cycle, Trigger Out, Recorder), they *must* be enabled for functionality. Some features may also be enabled from the Toolbar also.

This section will describe each of the items in the Menu. Many of these same features are available through the Toolbar.



3.2.1 Measurement

The first item in the menu bar is the **Measurement** selection:

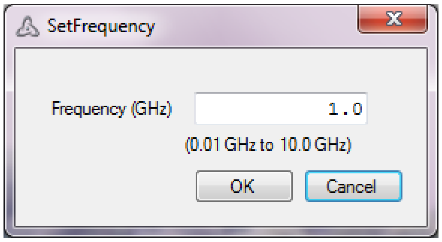


Copy

Copies the current measured values (average power, pulse power, peak power, duty cycle and crest factor) onto the clipboard, for pasting into another document.

Set Frequency

Brings up the set frequency window which displays the current frequency setting and allows the user to enter a new frequency selection. The center frequency *must* be updated when the incoming signal frequency changes as this frequency setting is used to correct amplitude for frequency variation. The best measurement accuracy requires the frequency to be set and not doing so can be a significant source of error.



Anti-Alias

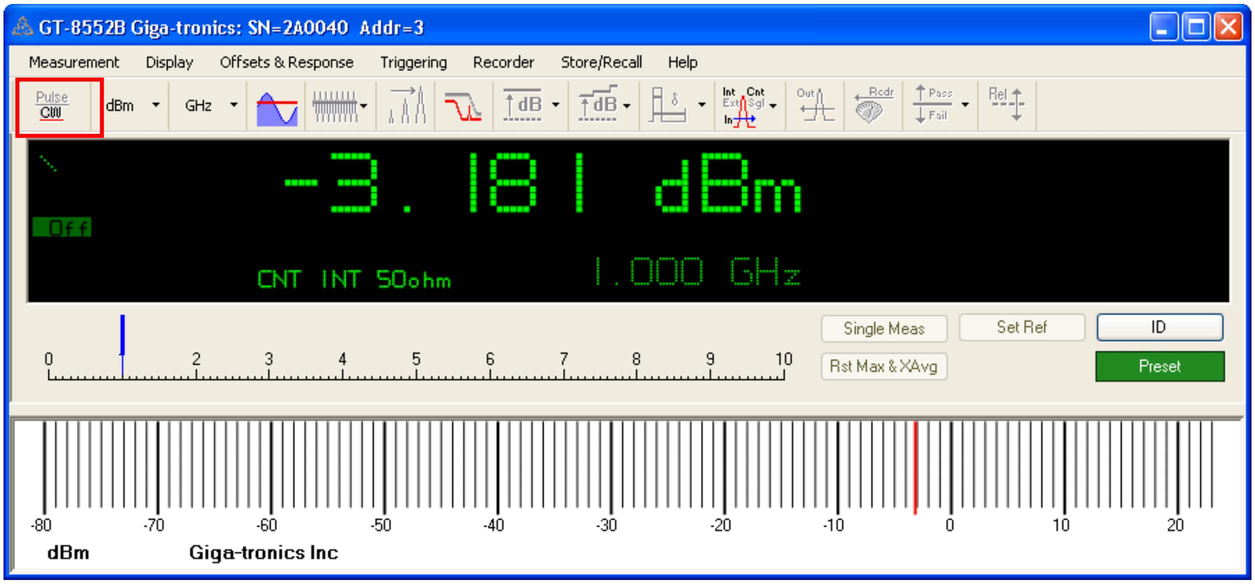
This toggles the anti-alias filter from Off to On. Enable the anti-alias control for input modulation bandwidths greater than 200 kHz. Disable it for modulation bandwidths less than 200 kHz. This button is used for CW and continuous pulse power measurements *only* to provide the greatest measurement accuracy. This control feature can best be described as a low/high pass filter switch and actually relates to the sampling method that is employed for the particular modulation bandwidth - either narrow or wide.

Normally the sampling is 500 kHz. As the baseband signals approach the Nyquist criteria (realistically about 200 kHz in this case) problems arise. There are several approaches that can be used to resolve this problem. We use an anti-aliasing capability that randomizes the sample period. This randomization does have some affect on the rapidity of acquiring the data.

As a result, the anti-aliasing algorithm is normally turned off. However, if you are measuring signals that have baseband content greater than about 200 kHz we recommend turning on the anti-aliasing feature.

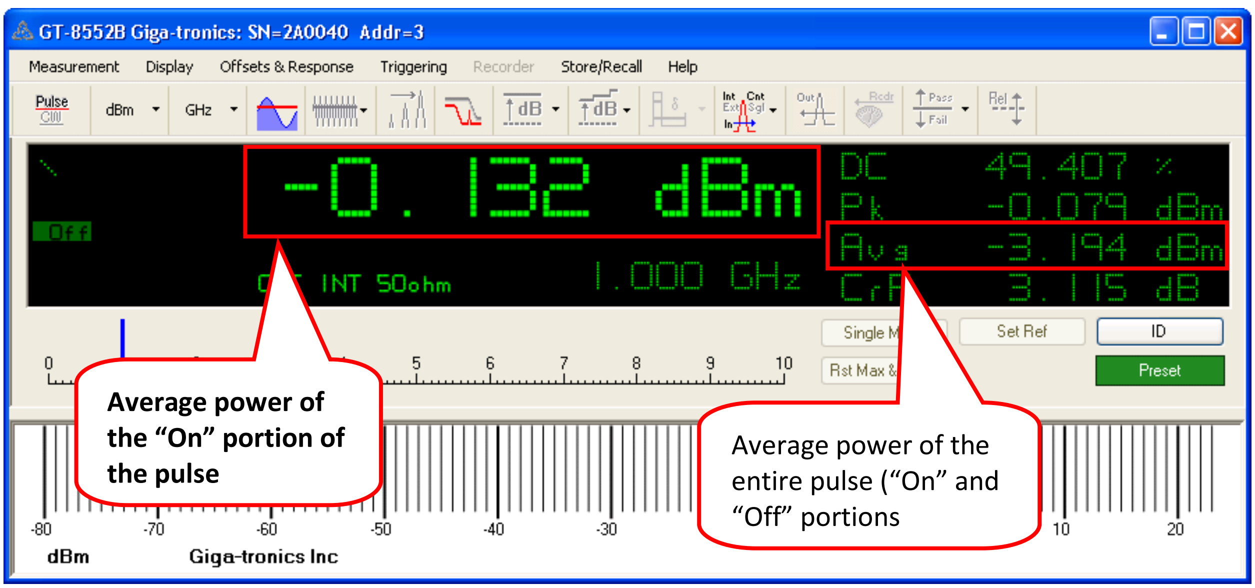
CW Power

Measure CW (average) power. This shows the average power of the signal. The Pulse/CW button on the tool bar can also be toggled. Pulse mode is not available on the GT-8553B and GT-8554B models.



Pulse Power

Measure Pulse power. The Pulse/CW button on the toolbar can also be toggled. This mode is only available on GT-8551B, GT-8552B and GT-8555B sensors.



The following measurements are made:

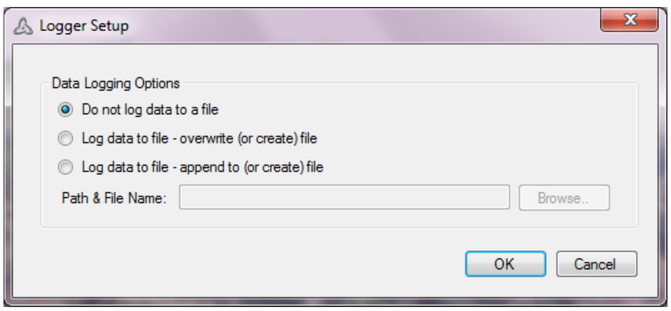
- **Pulse Power:** the large numeric value in the middle of the display is the Pulse's average power. This is the average power contained within the pulse. In the screen shot above, the input signal is a pulsed signal with an output power of 0 dBm and a 50% duty cycle. The pulse power measured is -0.132 dBm and the average power is 3 dB lower than the pulse power. This is the average power of the entire pulse and for a 50% duty cycle, half the power is in the off portion, which would make a difference of 3 dB.

Parameters on the right side of the display:

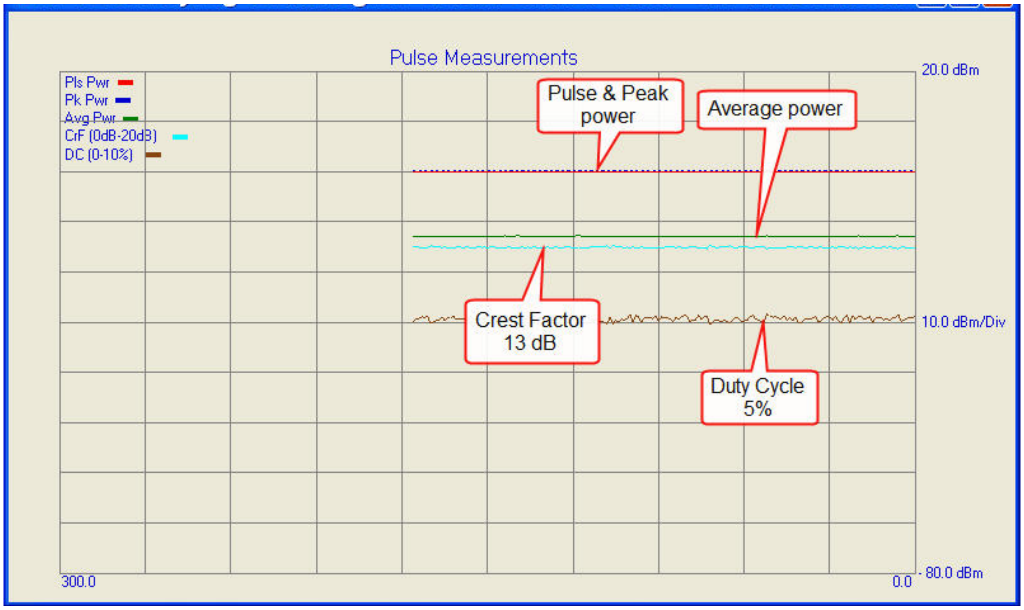
- **DC**: duty cycle
- **Pk:** peak power
- **Avg:** average power. This is the overall average power of the entire pulse. For example, if the duty cycle of the pulse is 50%, then AVG would be 3 less than the Pulse average power.
- **CrF:** crest factor. Also known as peak-to-average power ratio.

Logger

There is a separate Hi Speed Logger application that has many more features than the feature within the Power Meteapplication. More information about the "Hi Speed Logger" application can be found later in this document. To use logger, Select ***Measurement > Logger > Setup*** to display and record data to file as shown below. Browse to and enter a path and file name to log data. There is provision to overwrite an existing file or append data to file by checking the appropriate box.



Once a valid path/file has been established, select ***Measurement > Logger > Enabled*** to start logging data. The recorder will start graphing from 0 to 300 readings (bottom scale, right to left). The duty cycle is scaled vertically from 0 to 10% (1% per division). Crest Factor is scaled vertically from 0 to 20 dB (2 dB per division). The graph below shows a duty cycle of 5% (center line); peak and pulse power are approximately 0 dBm; and Crest Factor is approximately 13 dBm.



An example of tabular data saved to file is shown below when in pulse power mode. The file will indicate date/time, frequency, and offsets in addition to the measured values with time stamp.

log.txt - Notepad

File opened: 3/2/2009:1:12 PM

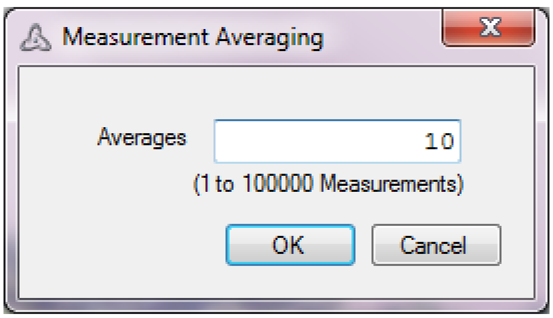
Frequency: 1 GHz
Offset = 0 dB
Peak Criteria: 3.0 dB
Response Offset = 0 dB
Relative: OFF

Time	PLS		PK		AVG		CrF		DC	
1:12:38 PM	0.039	dBm	0.139	dBm	-12.897	dBm	13.036	dB	5.016	%
1:12:39 PM	0.055	dBm	0.148	dBm	-12.841	dBm	12.990	dB	5.058	%
1:12:39 PM	0.035	dBm	0.139	dBm	-12.852	dBm	12.991	dB	5.069	%
1:12:40 PM	0.033	dBm	0.139	dBm	-12.821	dBm	12.960	dB	5.111	%
1:12:40 PM	0.037	dBm	0.129	dBm	-12.844	dBm	12.973	dB	5.090	%
1:12:41 PM	0.029	dBm	0.144	dBm	-12.809	dBm	12.953	dB	5.132	%
1:12:41 PM	0.052	dBm	0.142	dBm	-12.899	dBm	13.042	dB	4.974	%
1:12:42 PM	0.059	dBm	0.138	dBm	-12.889	dBm	13.026	dB	4.995	%
1:12:42 PM	0.029	dBm	0.132	dBm	-12.873	dBm	13.005	dB	5.048	%
1:12:43 PM	0.046	dBm	0.132	dBm	-12.867	dBm	12.999	dB	5.048	%
1:12:43 PM	0.038	dBm	0.145	dBm	-12.824	dBm	12.969	dB	5.111	%
1:12:44 PM	0.039	dBm	0.139	dBm	-12.868	dBm	13.006	dB	5.037	%
1:12:45 PM	0.048	dBm	0.132	dBm	-12.823	dBm	12.955	dB	5.090	%
1:12:45 PM	0.026	dBm	0.135	dBm	-12.853	dBm	12.988	dB	5.079	%
1:12:46 PM	0.054	dBm	0.139	dBm	-12.794	dBm	12.932	dB	5.132	%
1:12:46 PM	0.041	dBm	0.135	dBm	-12.856	dBm	12.992	dB	5.058	%
1:12:47 PM	0.031	dBm	0.145	dBm	-12.862	dBm	13.006	dB	5.069	%
1:12:47 PM	0.037	dBm	0.138	dBm	-12.840	dBm	12.978	dB	5.079	%
1:12:48 PM	0.034	dBm	0.129	dBm	-12.851	dBm	12.980	dB	5.079	%
1:12:48 PM	0.041	dBm	0.138	dBm	-12.859	dBm	12.996	dB	5.037	%
1:12:49 PM	0.040	dBm	0.144	dBm	-12.824	dBm	12.967	dB	5.111	%
1:12:49 PM	0.047	dBm	0.132	dBm	-12.846	dBm	12.977	dB	5.069	%
1:12:50 PM	0.047	dBm	0.139	dBm	-12.847	dBm	12.986	dB	5.058	%
1:12:50 PM	0.042	dBm	0.139	dBm	-12.871	dBm	13.010	dB	5.058	%
1:12:51 PM	0.034	dBm	0.138	dBm	-12.842	dBm	12.980	dB	5.079	%
1:12:51 PM	0.044	dBm	0.141	dBm	-12.861	dBm	13.002	dB	5.079	%
1:12:52 PM	0.057	dBm	0.134	dBm	-12.833	dBm	12.967	dB	5.048	%
1:12:52 PM	0.050	dBm	0.144	dBm	-12.854	dBm	12.998	dB	5.037	%
1:12:53 PM	0.052	dBm	0.134	dBm	-12.870	dBm	13.004	dB	5.026	%

NOTE: There is a separate High Speed Logger application available. This functionality is described at the end of this manual.

Averaging

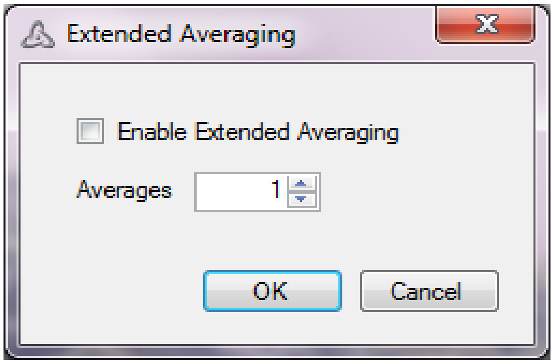
brings up the averaging window which displays the current setting and allows the user to enter a new value. ***Averaging*** sets the number of data buffers that are averaged. The default state is 75 averages and it takes about 0.25 msec to collect one buffer of data. The number of averages or buffers is settable from the ***Measurement*** menu shown below or alternately, by clicking the averaging button on the toolbar and entering a value from 1 to 30000. The number of averages depends on signal stability and power level. More averaging may be required for low-level signals. Increasing the number of averages also increases the measurement time.



Extended Averaging

enables, resets and brings up the extended averaging setup window. Set, enable, reset extended averaging from the drop down. Extended averaging should be seen as an adjunct to averaging.

Extended averaging uses exponential averaging in addition to normal averaging. This provides frequent updates and more stable readings. The extended averaging setup window displays the current setting and allows the user to enter a new value.



This function is reset by the front panel button labeled ***Rst Max & XAvg***. This button resets or restarts both the max hold and extended averaging functions.

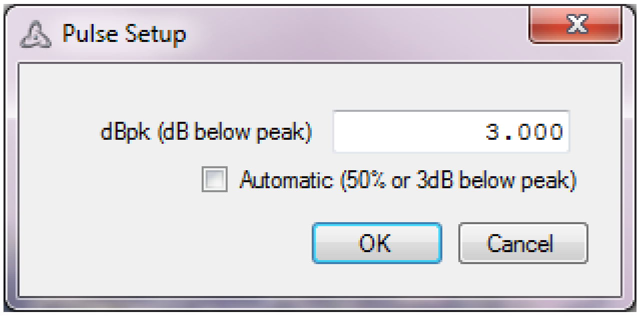
Max Hold

This enables the Max hold function. Clicking this selection toggles the max hold function from Off to On. When this function is enabled, it retains the maximum measured value until reset or deactivated. For pulse measurements, each reading (Pulse, Peak, CrF, Avg, DC) is held at its maximum value independent of the other readings. This function is reset by the front panel button labeled ***Rst Max & XAvg*** . This button resets or restarts both the max hold and extended averaging functions.

Measured Pulse Setup

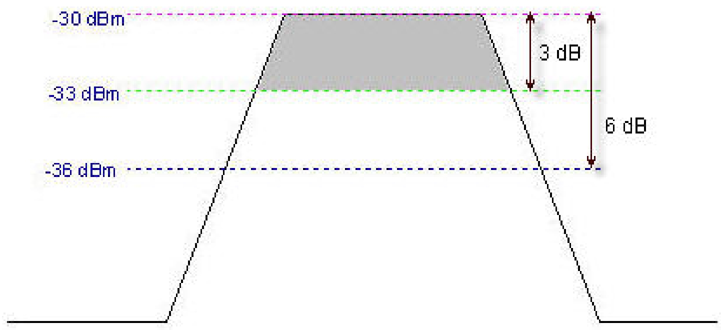
This menu item relates to the Pulse Power mode.

This value determines the portion of the pulse to be used to measure pulse power. The default or automatic value is 3 dB below the measured peak value or the 50% down points.



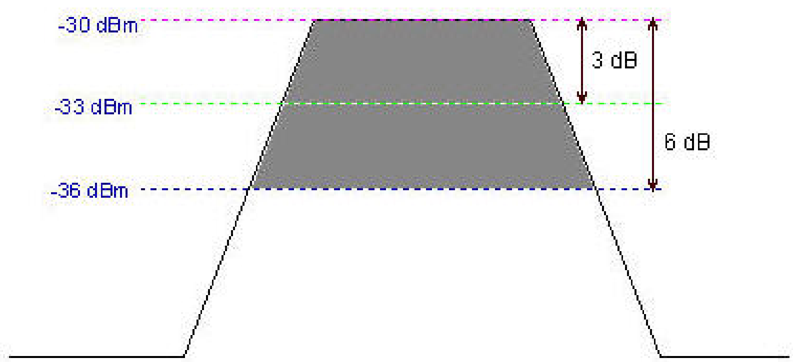
You can also set the criteria and leave the automatic feature on. Then by turning the auto feature on and off you can switch between the automatic value (dB) and the value you have chosen. For instance, if you set the criteria to 6 dB and turn the auto criteria on and off, you will be toggling between 3 dB and 6 dB below peak. This can also give you some sense of rise time or slope and the sensitivity to this criteria.

Pulse criteria is assumed to be specified as "dB below peak." If the peak value is -30 dBm and the criteria is 3 dB, then the pulse criteria will be -33 dB during the measurement. Normally you will specify a positive value. Likewise, if you chose 6 dB you would be using -36 dB as the criteria. Provided overshoot is minimal and rise time is relatively steep, the automatic criteria is adequate for most applications. The diagrams below are intended to help clarify pulse criteria.



A. Three dB Pulse Criteria

In diagram A, the peak value is -30 dBm and the pulse criteria is 3 dB. The shaded area represents the portion of the pulse that will be used to determine pulse power and duty cycle.

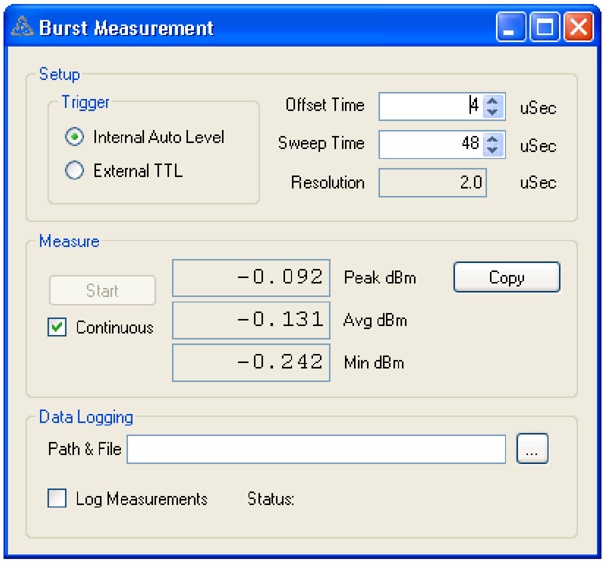


B. Six dB Pulse Criteria

In diagram B, the peak value remains -30 dBm and the darkly shaded area represents the portion of the pulse that will be used to determine pulse power and duty cycle using a 6 dB peak criteria. You can see that the average in diagram B will be lower than the average in diagram A.

Burst Measurement

brings up the burst measurement setup window which displays the current settings and allows the user to enter new values. You can specify a trigger, a delay relative to the trigger, and the sweep time over which the power measurement is taken. The instrument will then display the peak power, average power, and minimum power measured during the qualified duration.



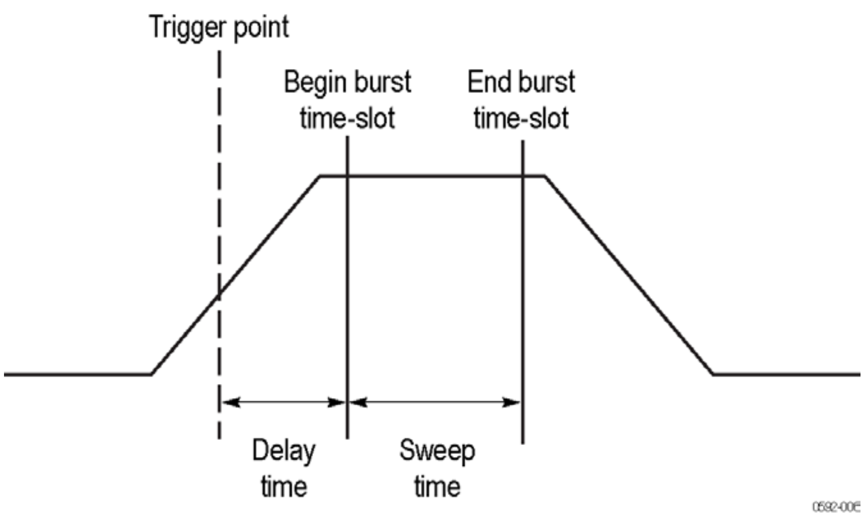


Figure 12 Diagram of Burst

Trigger. The measurement can be triggered by the incoming RF signal, or from an external TTL source. When using the Internal Auto Level setting, the trigger level is automatically set to approximately half the pulse amplitude.

Delay. The delay time determines how long after the trigger the sweep time begins.

Sweep Time. The sweep time defines the duration of the measurement.

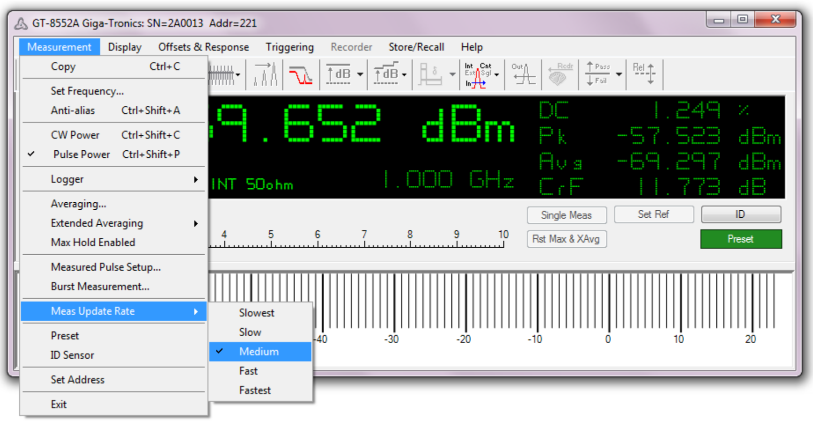
Resolution. The power measurement data is taken at the real-time sample rate of the instrument, which is 500 kS/s. This results in a fixed resolution of 2 µs.

Measure. The measurements consist of peak power, average power, and minimum power observed during the specified sweep time. Measurements can be set to update continuously by selecting the Continuous check box. Deselect the check box to stop taking measurements. For a single set of measurements, click on the Start button. The Copy button transfers the three measurements to the clipboard so you can paste them into a document.

Data Logging. Burst measurements can be logged to a text file. To do this, type in or browse to a file, and then enable logging by selecting the Log Measurements check box.

Measurement Update Rate

select display rate as desired: The application will take longer to respond to mouse clicks and data entry as the measurement rate is increased.



Preset

The ***Preset*** button returns the unit to the following default state:

Mode = CW

Frequency = 1 GHz

Frequency units = GHz

Power units = dBm

Averaging = 75

Measured Pulse Setup = 3 dB

Measurement Update Rate = medium

Display = default

Sweep Time = 1 msec

Offset = 0 dB, disabled

Response = 0 dB, disabled

Duty Cycle = 10%, disabled

Trigger Mode = Internal Continuous

Trigger Out = disabled

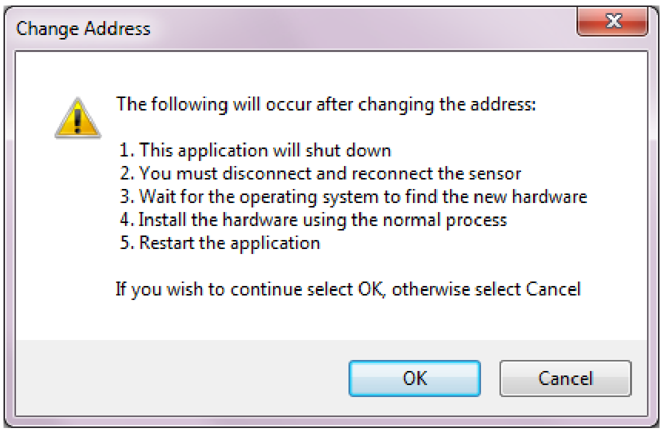
Note: the minimum loss pad (75 ohm) is not selected. Preset will not change the input impedance if checked (enabled). Application launch sets the input to 50 ohms.

ID Sensor

will cause the LED on the sensor to blink four times in quick succession.

Set Address

brings up the following message:



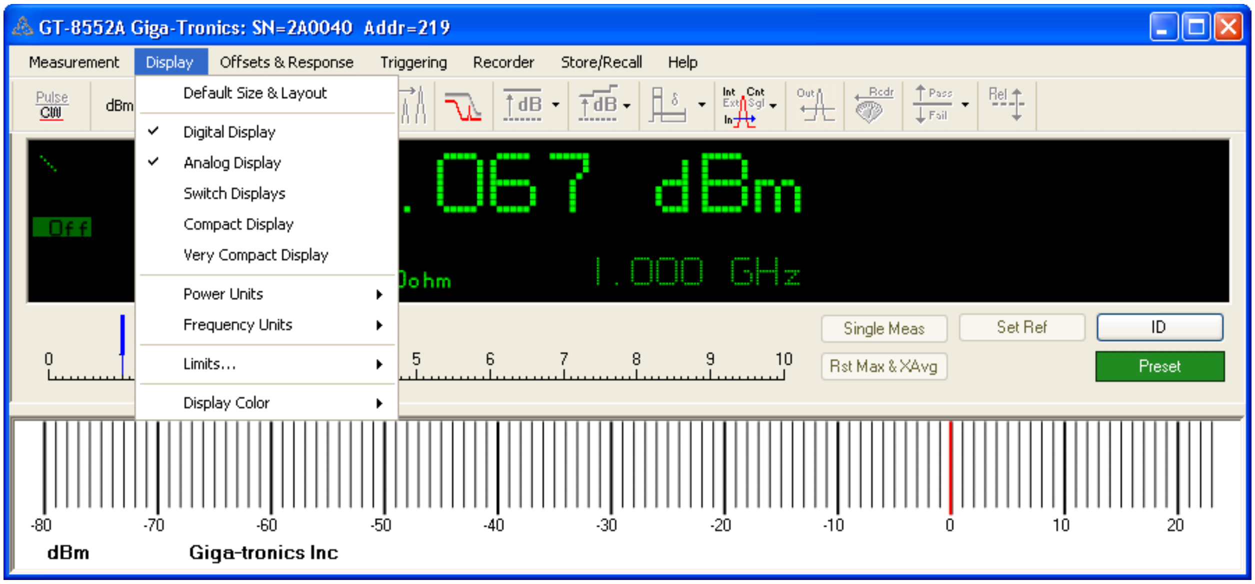
The Set Address facility allows the address of the sensor(s) to be assigned from 1 to 255. Changing the address requires an automatic re-start of the application. You will see a sequence of windows when changing the address. Follow the instructions as stated to change the address and to disconnect and reconnect the sensor.

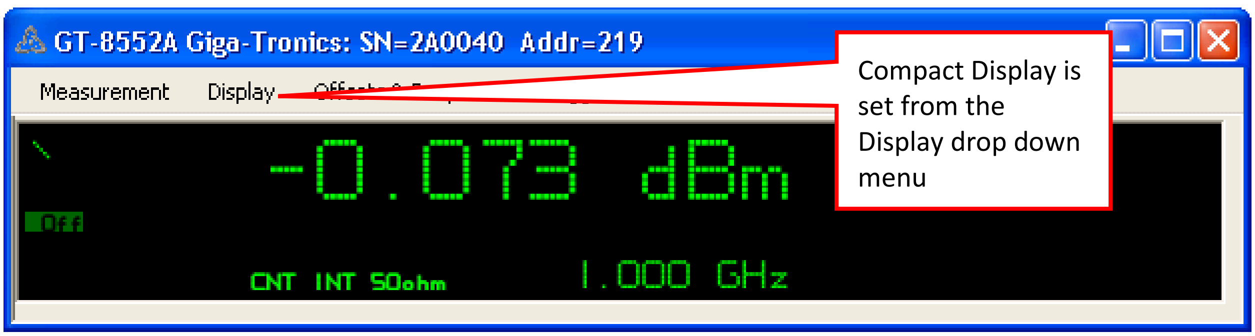
Exit

closes the application.

3.2.2 Display

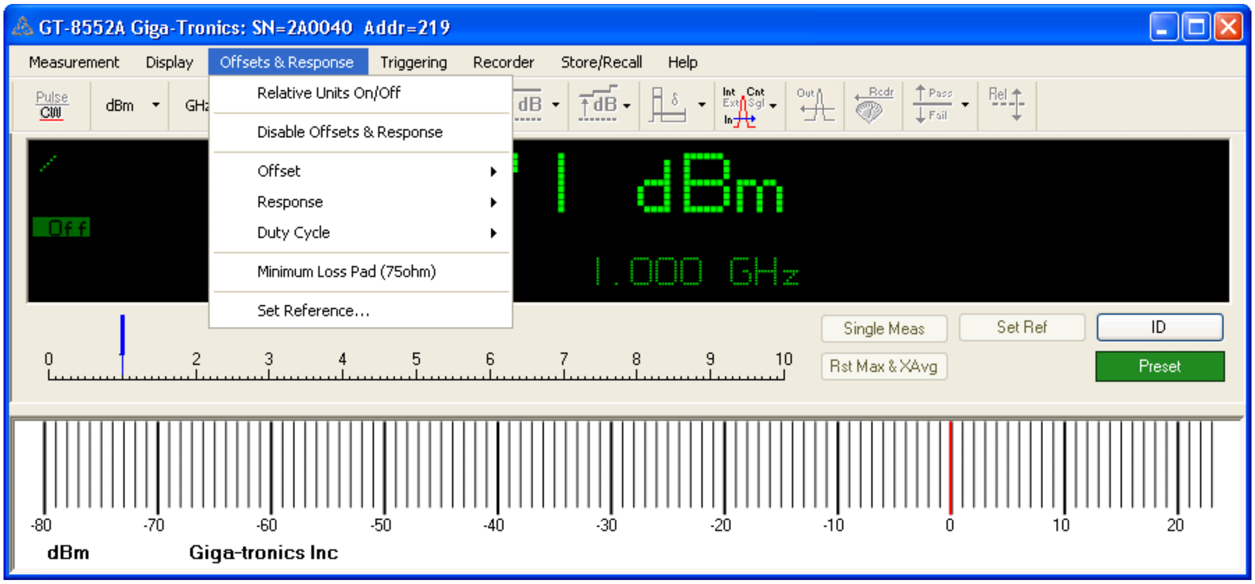
Select the display preferences and the measurement units (power and frequency) from the ***Display*** menu. There are selections for digital or analog presentations of frequency and power; an analog frequency scale; and an analog power scale. You can switch between displays and size the display as needed between compact and very compact.





3.2.3 Offsets & Response

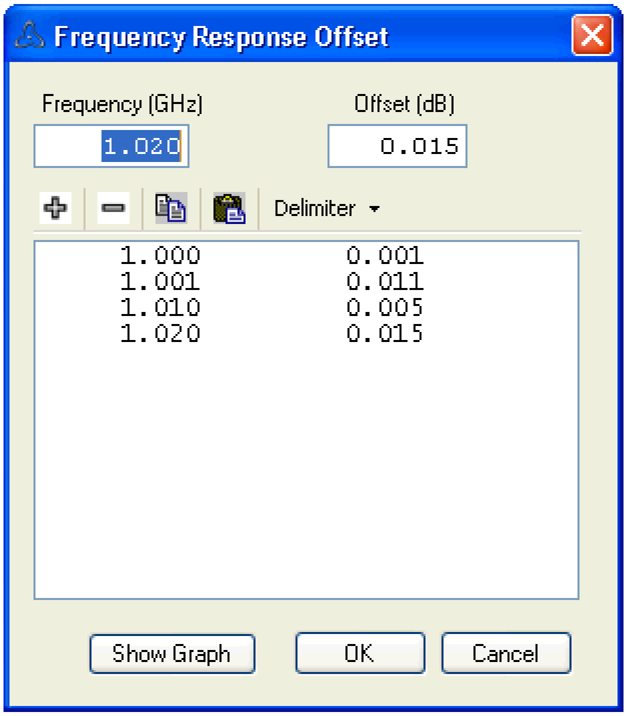
This menu allows you to turn Relative Units On or Off, Enable or Disable Offsets and Responses, set an Offset, set a Response, enter the Duty Cycle, chose to use a 75 Ohm Minimum Loss Pad, or Set Reference. Some of the specific features are discussed below.



Offset: This allows you to apply correction values. Offsets can compensate for signal loss or gain in the measurement path outside the sensor. For example, the offset function is helpful when an attenuator or amplifier is in front of the sensor. This offset is fixed and is not a function of frequency. If you need an offset that is a function of frequency use the response correction tool. *(See Response (frequency response correction) feature below.*

You can also find this item on the Offsets & Response toolbar An OFS indicator will appear on the digital display when Offset is enabled.

Response: This is the frequency response correction. This allows you to set frequency dependent gain or loss offsets to be applied to measurements. This is a frequency sensitive offset, so as you change the measurement frequency the response changes accordingly. Response amplitude is always expressed in dB and the frequency is expressed in Hz. The interpolation is linear with respect to frequency and dB. The frequency response feature must be enabled before it will have an affect. A frequency response (RSP) indicator will appear on the digital display readout when response correction is enabled. The frequency response correction factors are specified as frequency and amplitude pairs. To load the correction factors go to the Frequency Response Offset window. Click Add after each frequency and offset entry to build the table. Then select Show Graph to get a graphical presentation of the frequency offsets that were entered in the table. The Response setup allows up to 201 points to be entered. You can also find this item in the Offsets & Response drop down menu.



Duty Cycle:

These sensors can make the more traditional pulse measurement using an assumed duty cycle as an adjustment to the indicated power. This type of measurement is less accurate and more prone to error (versus using Pulse mode) because of the pulse shape factor; and because the duty cycle is assumed. However, this a useful measurement approach using the True RMS sensors because other the other methods are not available.

Using this method, the duty cycle correction is calculated as follows:

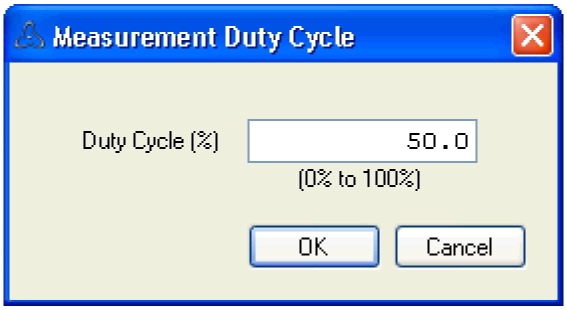
Pulse Power = Measured Power + Duty Cycle Adjustment

The duty cycle adjustment is: - (10Log$_{10}$ (Duty Cycle))

For instance, if you measured an average power of -20 dBm and assumed a duty cycle of 10% (0.10) then the pulse power would be calculated as follows:

Pulse Power = -20 dBm + -(10Log$_{10}$ (Duty Cycle)) = -20 dBm + (10 dB) = -10dBm

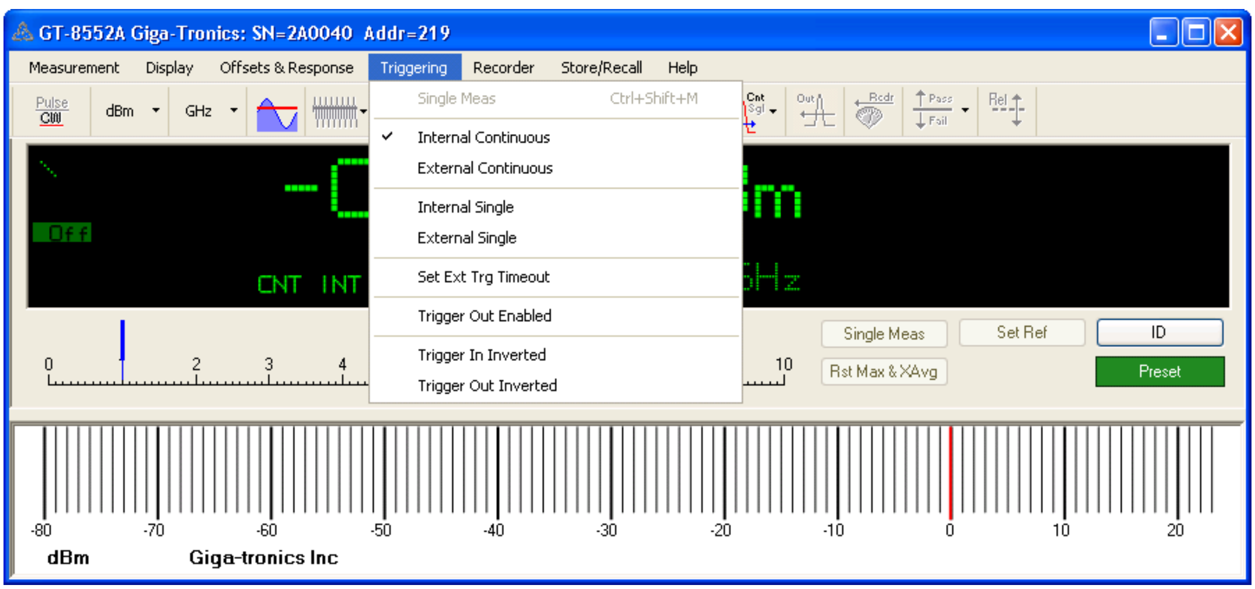
The sensor must be placed in CW Power mode to access this style of duty cycle measurement.   In Pulse mode and Pulse profiling mode, the actual peak power value is measured and not calculated and is the suggested method when using the GT-8551B, GT-8552B, and GT-8555B sensors.



Minimum Loss Pad:
The instrument has a 50 Ω input impedance. However, for applications requiring a 75 Ω input impedance, you may attach a 75 Ω minimum loss pad (MLP) to the input. You can correct for the pad by selecting 75 ohm MLP from the Offsets & Response menu. The instrument will adjust its measurements accordingly and the display will indicate "75ohm-MLP", if selected.

3.2.4 Triggering

Triggering setup menu allows you to set an internal or external continuous, and internal or external single trigger. You can also set the TTL trigger in/out, inverted trigger, and trigger timeout.



Single Meas:

Enable this button from the Triggering drop down menu by selecting **Internal Single** or **External Single** triggering. Click the button to initiate a single measurement.

External Continuous and External Single: They both use the external trigger in.

Trigger In: External input triggering capability is available on the GT-8552B, GT-8555B and GT-8551B sensors. The trigger is assumed to be a TTL level and positive edge triggered. The trigger-in can be enabled, disabled or inverted.

The trigger-in defines or controls the start of a measurement cycle. After the trigger is detected the measurement will commence and will continue for the specified number of averages. Once a measurement is requested the system will monitor the trigger-in port. If a trigger is not detected in the allotted time, the system will time out and return an invalid measurement.

Trigger In Inverted: inverts the trigger input. When the trigger-in is inverted the system will look for a negative edge (instead of a positive edge) and begin the measurement when a negative edge is detected. There is provision for setting a timeout period for an external trigger input (up to 30 seconds).

Trigger Out:

The trigger-out is compatible with TTL levels. It can be enabled, disabled and inverted (or normal). The trigger-out occurs at the beginning of a measurement. This means that if the measurement is untriggered (i.e. trigger-in is disabled) and trigger-out is enabled, a trigger will be produced each time a measurement is made. If the trigger-in is enabled then the trigger will be passed through when it is received.

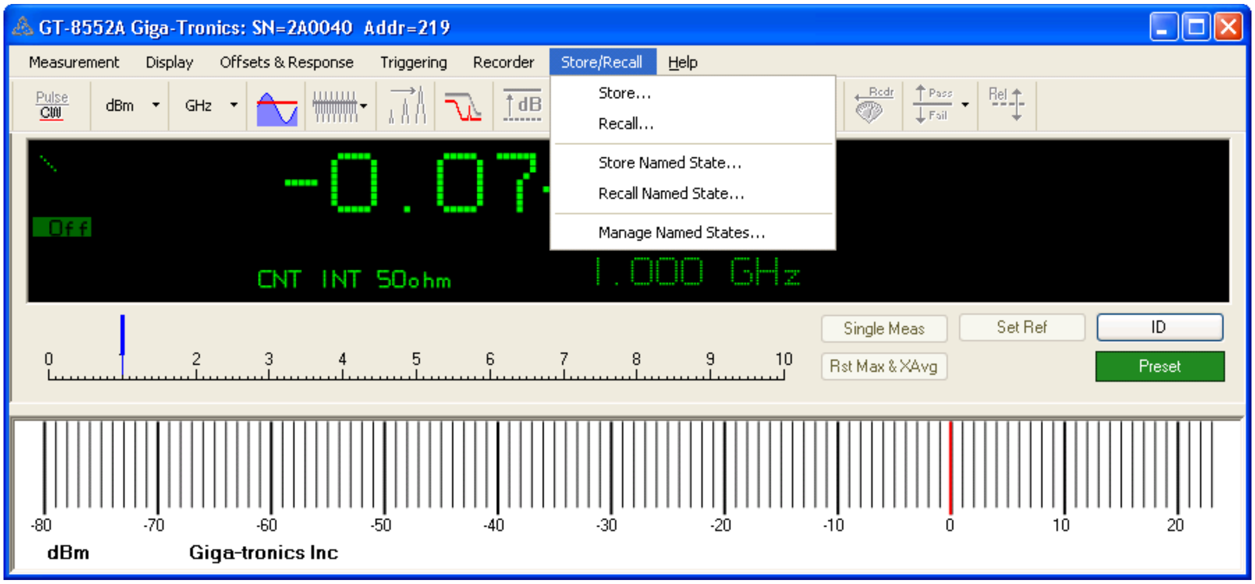
A trigger output is normally low. When a trigger is produced it begins with a positive-going edge and stays at a TTL level for a few microseconds then returns to ground potential. If the trigger-out is inverted, it will transition from a high to a low TTL level. When a trigger is produced a negative edge will be produced going to a TTL low. Then after a few microseconds it will return to a TTL high.

Note: ***NOTE:*** The application software handles the trigger condition for each sensor in serial fashion. When multiple sensors are running, the absence of a trigger in one instance will force a wait state and cause the other sensors to update at a slower rate. This would occur if a sensor lost its external trigger source for example.

3.2.5 Recorder

This is an unimplemented feature and will appear “grayed out” and will not be functional.

3.2.6 Store/Recall

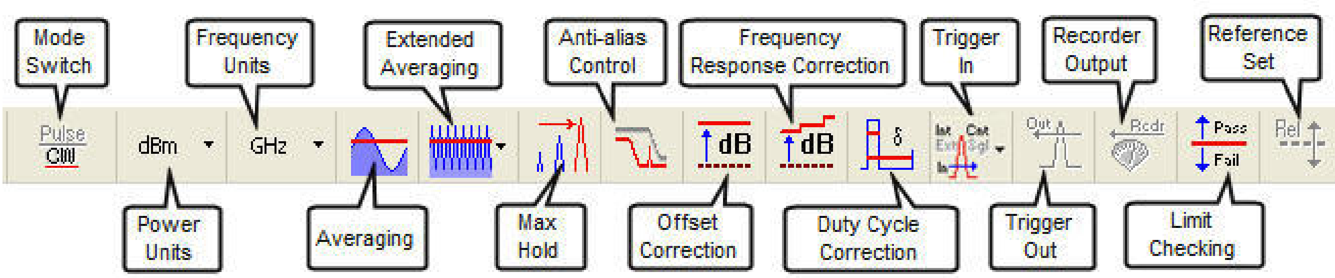


The ***Store/Recall*** menu is not included on the toolbar. There are 20 Store/Recall registers and each register holds an entire state. However, the states are not held in the instrument but reside on the local PC in a basic text file. The files are named by model number and address and are retained in the Giga-tronics application directory. This means that saved states can be saved, copied or moved between PCs.

3.3 Toolbar

This section describes in detail the icons on the Toolbar.

The toolbar is shown below. Notice that each toolbar button has a label if you hover over it with the mouse cursor. The toolbar buttons are like hot keys that duplicate many of the Menu selections or actions and make it easier to manipulate the meter settings. Each function is accessible from the Menu bar and some toolbar buttons are simply switches that turn features on or off. This section has a very brief description of the buttons. More details of these features may be available in the Menu section of this document.



3.3.1 Mode

Switch between Average (CW) and Pulse Power modes of operation. This button is not present for GT-8553B or GT-8554B

3.3.2 Power

Select the power units (dBm, dBW, dBkW, dBuV, dBmV, dBV, W, V, dB Relative).

3.3.3 Frequency

Select the frequency units (MHz or GHz). The center frequency *must* be updated when the incoming signal frequency changes as this frequency setting is used to correct amplitude for frequency variation. The best measurement accuracy requires the frequency to be set and not doing so can be a significant source of error.

3.3.4 Averaging

Select averaging from 1 to 30000 measurements. The number of averages depends on signal stability and power level. More averaging may be required for low-level signals. Increasing the number of averages also increases the measurement time.

3.3.5 Extended Averaging

Set, enable, reset extended averaging from the drop down. Extended averaging should be seen as an adjunct to averaging. Extended averaging is an exponential average of the last n readings where n is the number of extended averages. This function is reset by the front panel button labeled ***Rst Max & XAvg***. This button resets or restarts both the max hold and extended averaging functions.

3.3.6 Max Hold

Retains the maximum measured value until reset or deactivated. For pulse measurements, each reading (Pulse, Peak, CrF, Avg, DC) is held at its maximum value independent of the other readings. This function is reset by the front panel button labeled ***Rst Max & XAvg*** . This button resets or restarts both the max hold and extended averaging functions.

3.3.7 Anti-alias Control

The toolbar button is toggle on/off. Enable anti-alias control for input modulation bandwidths greater than 200 kHz. Disable it for modulation bandwidths less than 200 kHz.

3.3.8 Offset Correction

The toolbar button is toggle on/off. The ***Offsets & Response*** setup menu allows gain or loss offsets to be entered as part of the measurement setup.

3.3.9 Frequency Response Correction

The toolbar button is toggle on/off. The ***Offsets & Response*** setup menu allows frequency dependent gain or loss offsets to be entered as part of the measurement setup.

3.3.10 Duty Cycle Correction

The toolbar button is toggle on/off and determines the pulse on/off time at a specified rate and duration when in average power or CW mode only. The button is inactive when in Pulse mode. In Pulse mode, the duty cycle is determined automatically. The duty cycle correction setup is accessible from the ***Offsets & Response*** menu and allows entry of pulse duty cycle from 1 to 100%.

3.3.11 Trigger In

TTL compatible. Provision is made for various trigger sources from the drop down. The trigger menu and toolbar button will not appear for the GT-8553B or GT-8554B. See data sheet for parameters.

3.3.12 Trigger Out

TTL compatible. The trigger menu and toolbar button will not appear for the GT-8553B or GT-8554B. See data sheet for parameters.

3.3.13 Recorder Output

This option is currently not available, and will appear grayed out.

3.3.14 Limit Checking

Provision is made for setting measurement limit specifications with pass or fail (High/Low) indicators shown on the display. The ***Limits*** setup is accessible from the ***Display*** menu.

3.3.15 Rel

The REL indicator will show in the display when activated and the power units will change to “dB relative”. This tool works in conjunction with the ***Set Ref*** button on the front panel to set the reference value so that a subsequent power level can be measured relative to this reference level.

3.4 Making a CW Measurement

This section describes how to use the Power Meter application software to make simple CW power measurements.

Table 7 Configure the GT-8550B Series USB Power Sensor

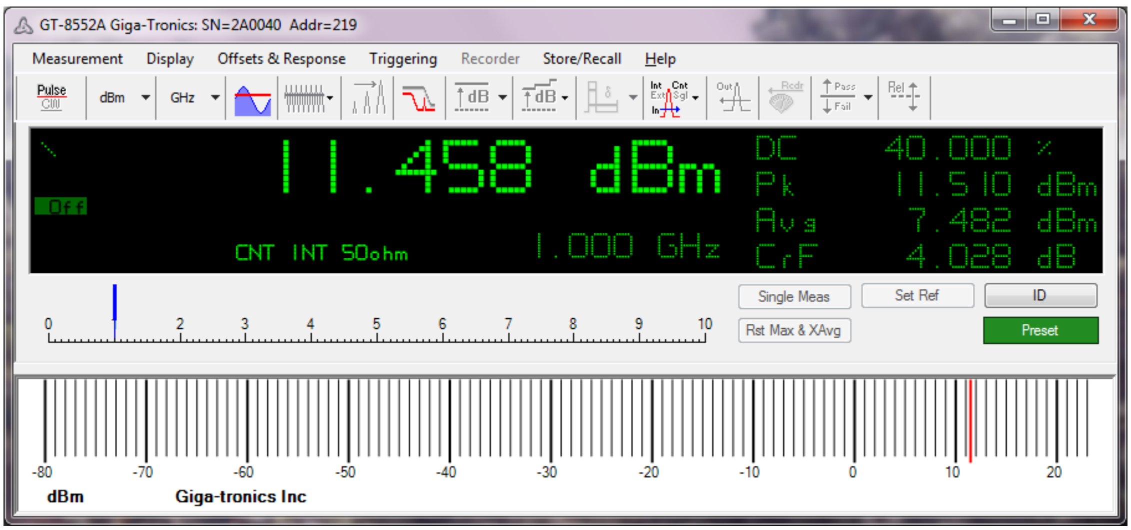
Configure the GT-8550B Series USB Power Sensors	
Step	**Action**
1.	Launch the software. See sections 2.7, 2.8 and 2.9 for information on installing the software, sensor, and starting the software.
2.	Install the GT-8550B Power Sensors as described in section 2.8 on page 14.
3.	Start Software as described in section 2.9 on page 16.
4.	Open a sensor window for each sensor connected to the computer:  **Figure 12. Opening Sensor Windows**
5.	Repeat the previous step until all sensors connected to the computer have an open sensor windows. It is recommended that you do not open the pulse profiling application or the high speed logger (strip chart) applications, until after verifying that the signal is present in the Power Meter application window.
6.	Configure the sensor using the measurement Menu bar or Toolbar.
End of Procedure	

Table 8 Measure CW Power

Measure CW Power		
Step	**Action**	
1.	If necessary, do the following: • Connect the GT-8550B USB Power Sensors to the computer (see section 2.8 on page 14). • Configure the sensors (see section **Error! Reference source not found.** on page **Error! Bookmark not defined.**).	
CAUTION		**DO NOT APPLY EXCESSIVE POWER TO THE GT-8550B SERIES USB POWER SENSORS.** **Read the specifications for the power sensor.** • Table 1 on page 5) • Know the approximate power level of the signal of interest before applying it to the GT-8550B.
2.	Before connecting the RF signal to the GT-8550B Power Sensor, de-energize (turn OFF) the RF signal.	
3.	Connect the GT-8550B Power Sensor to the RF source.	
4.	Run the power meter application. The sensor will begin making measurements as soon as the software application is launched.	
End of Procedure		

3.4.1 Zeroing and Reference Power Calibration

The design of the power sensor does not require zeroing or power calibration and there is no provision for zeroing or calibration.

NOTE: While zeroing is not required, the sensors require time to thermally stabilize. Little if any warm-up time is required for measurements of power levels above -40.0 dBm. However, to make accurate measurements of power levels below -40 dBm, the sensors should be allowed to thermally stabilize for at least one hour.

3.4.2 Setting the Center Frequency

The center frequency *must* be set whenever the incoming signal frequency changes. Measurement accuracy requires the frequency to be set and not doing so can be a significant source of error. The frequency can also be set by sliding the analog frequency scale pointer just below the active display. The pointer will change color from blue to red when the center frequency is beyond the measurement range of the sensor. The pointer is less accurate but more convenient than entering a frequency value. You can also set the frequency by selecting ***Measurement > Set Frequency*** from the menu bar.

3.4.3 Display Preferences and Measurement Units

Select the display preferences and the measurement units (power and frequency) from the ***Display*** menu. There are selections for digital or analog presentations of frequency and power; an analog frequency scale; and an analog power scale. You can switch between displays and size the display as needed between compact and very compact. Refer to the GUI functions section of this manual for an explanation of Limits.

The power and frequency units are also selectable from the toolbar, or you can change the power units by clicking on the units label to the right of the power reading itself. You can also change the center frequency by clicking anywhere on the frequency reading in the active display.

NOTE: The amplitude resolution is fixed to a thousandth of a measurement unit.

3.5 Measure Pulse Power

To measure pulse power, toggle the Pulse/CW button to “Pulse”. Or select **Measurement > Pulse Power.**

Once the mode is set to Pulse Power, setup the threshold value. This value determines the portion of the pulse to be used to measure pulse power. Select **Measurement > Measured Pulse Setup** from the menu bar to access this facility as shown below. The default or automatic value is 3 dB below the measured peak value or the 50% down points. You can also set the criteria and leave the automatic feature on. See the Menu section of this document for more details on setting the threshold value.

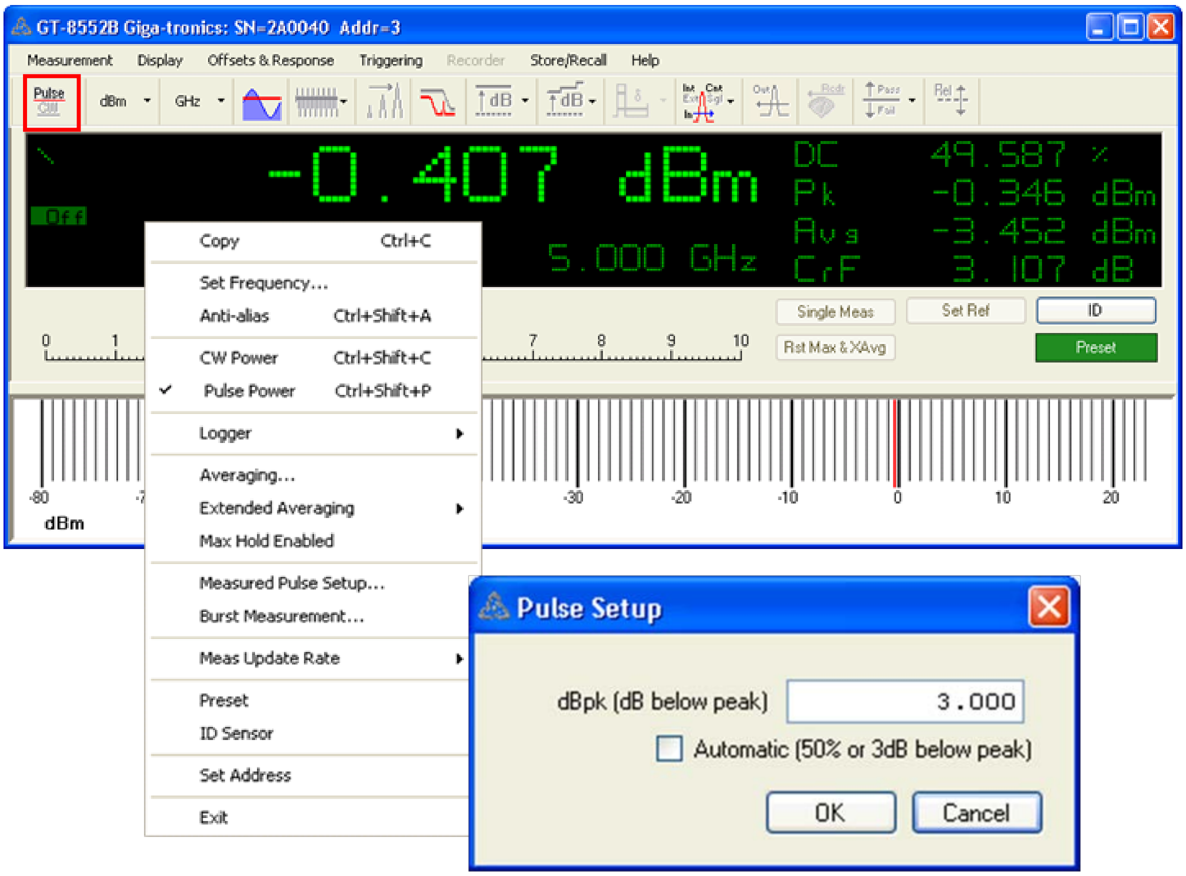
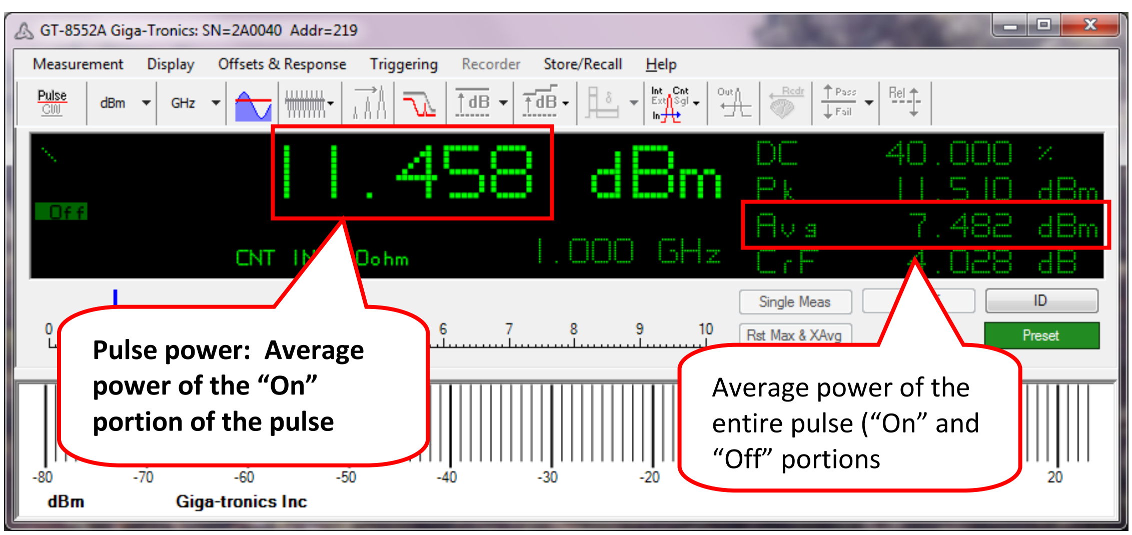
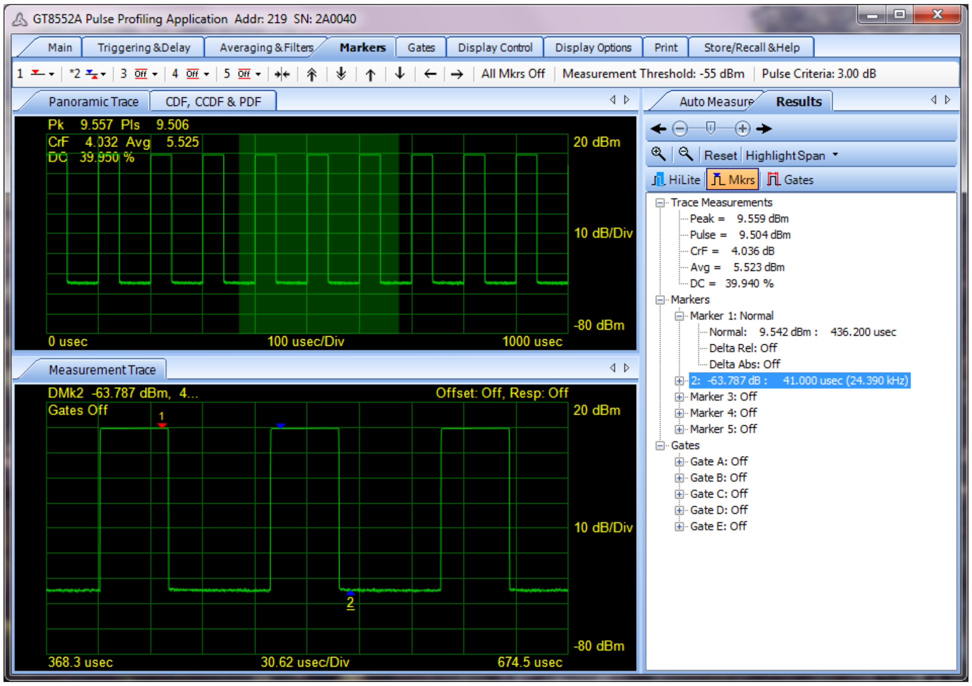


Table 9 Measure Pulse Power

Measure Pulse Power	
Step	**Action**
1.	If necessary, do the following: • Connect the appropriate GT-8550B Series USB Power Sensors to the computer (see section 2.8 on page 14). • Configure the sensors for making pulse measurements according to your test needs (see section **Error! Reference source not found.** on page **Error! Bookmark not defined.**).
CAUTION	**DO NOT APPLY EXCESSIVE POWER TO THE GT-8550B SERIES USB POWER SENSORS.** **Read the specifications for the power sensor (see** • Table 1 on page 5) • Know the approximate power level of the signal of interest before applying it to the GT-8550B.
2.	Before connecting the RF signal to the GT-8550B Power Sensor, de-energize (turn OFF) the RF signal.
3.	Connect the GT-8550B Power Sensor to the RF source.
4.	Energize the RF signal. Configure the source for a pulse waveform.
5.	Figure 13 shows the Power Meter application window with the pulse measurements displayed: • Main display: Pulse power • Side display: Duty Cycle (DC), Peak (Pk) power, Average (Avg) power, Crest Factor (CrF).  **Figure 13. Sensor Window with Pulse Parameters**

Measure Pulse Power	
Step	**Action**
6.	You may also use the Pulse Profiling Pulse Profiling application to measure pulse parameters also. The lower display is a user selected (highlighted) portion of the upper display. More details about Pulse Profiling are in the next section.  **Figure 134. Pulse Profiling application window**
End of Procedure	

4 Pulse Profiling Application

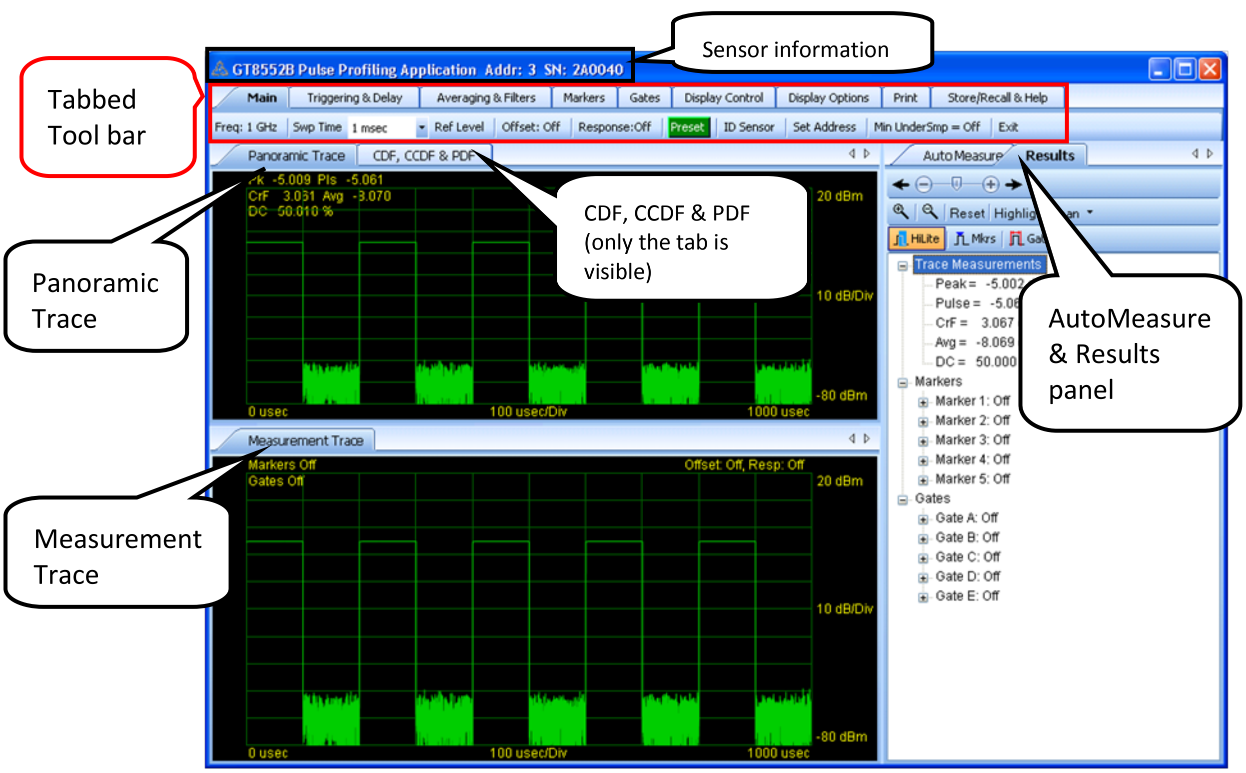
1.1 Graphical User Interface

This section describes the parameters you can set and view using the Pulse Profiling software.

Note: Pulse Profiling software will only work with models GT-8552B or GT-8555B USB Power Sensors.

The GUI consists of two parts:

- Five dock able windows or panels: Panoramic Trace; Measurement Trace; Auto Measure; Results; CDF, CCDF & PDF. In the figure below, only the "CDF, CCDF & PDF" selection tab is shown. Its panel is behind the Panoramic Trace panel. For "AutoMeasure", only the selection tab is shown and its panel is behind the Results window.
- The Toolbar consists of 9 tabbed menus, whose headings are as follows: Main, Triggering & Delay, Averaging and Filters, Markers, Gates, Display Control, Display Options, Print, Store/Recall & Help. When one of the tabs is selected, the selections appear below the main heading.



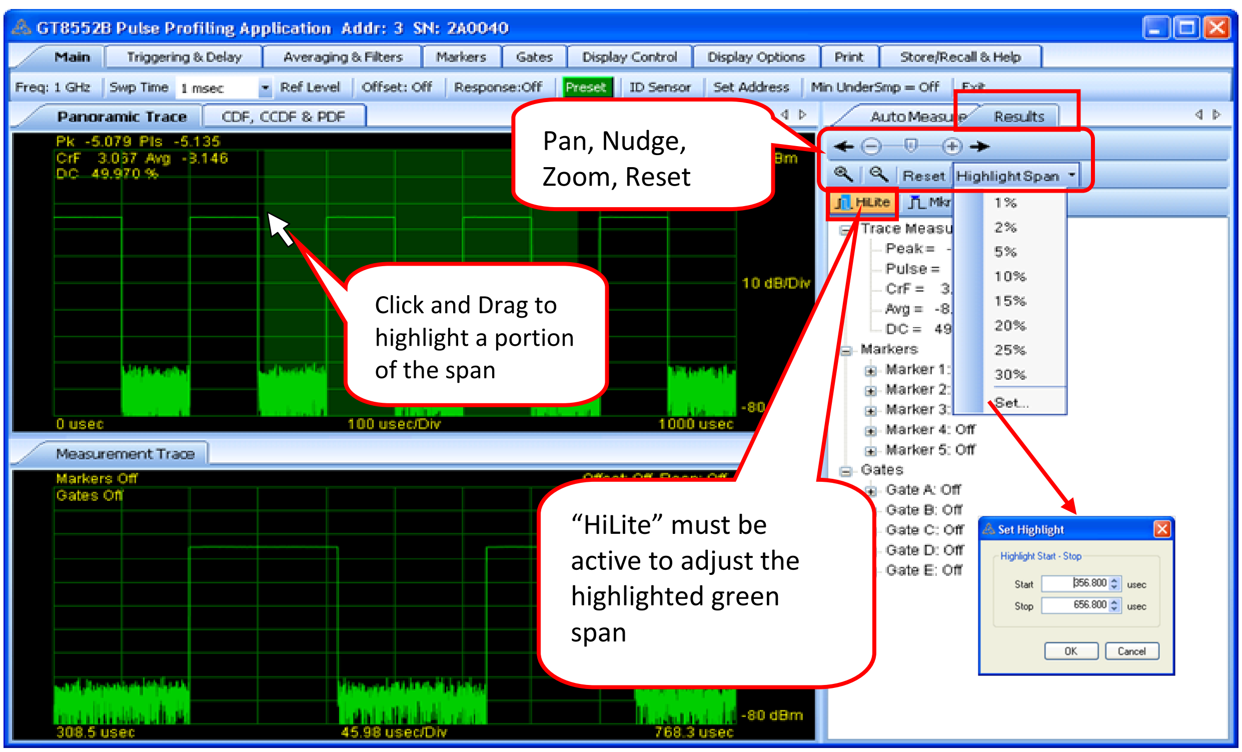
4.2 Panels

4.2.1 Traces

These two dock able panels or windows give visual presentation of measured signal. Both of these traces are designed to work in tandem to help the user identify and investigate areas of interest easily and quickly. Both these traces display 10 vertical divisions that indicate power and 10 horizontal divisions that represent time.

Panoramic and Measurement Traces:

In the figure below, the panoramic trace is the top trace and the measurement trace is the bottom one. You can highlight a portion of the panoramic trace by clicking and dragging the cursor directly on the Panoramic Trace panel. This highlighted time segment will then appear in the Measurement Trace window below. This allows for a more detailed examination of the signal using time markers and time gates. The Highlight span can be adjusted by dragging the cursor or by selecting the Highlight Span tab on the Results pane.



Setting the "Highlight" portion of the trace

There are different ways to set the "Highlight" portion. You can highlight or select a portion of the trace using the following techniques:

1. **Panoramic Trace:** Click and drag the mouse over a portion of the Panoramic Trace. Only the portion selected by the mouse movement will be viewed in the Measurement Trace window.

2. **Measurement Trace:** Click and drag the mouse over a portion of the Measurement Trace. Only the portion selected by the mouse movement will be viewed in the Measurement Trace window. This technique allows you to zoom in on the trace. The mouse pointer must be in Highlight mode.

3. "**Highlight Span":** Click the Highlight Span drop down on the Results pane (or Display Control toolbar) and then select the percentage of interest. The selected portion will be viewable in the Measurement Trace window. If a portion of the Panoramic trace is currently selected, then the percentage will be centered on the current selection. If a portion of the trace is not selected, then the percentage will be centered around the middle of the Panoramic trace.

4. "**Set Highlight":** To select a precise portion of the trace, click the "Highlight Span" drop down

and then select "Set Start". Enter the beginning of the measurement trace in microseconds

5. **Zoom In and Zoom out buttons** *(Magnifying Glass):* Click on the magnifying glass picture to zoom in and zoom out.
6. **– and + buttons and slider:** Click on the – and + buttons above the magnifying glass picture, or the center slider, to move the highlighted span left or right.

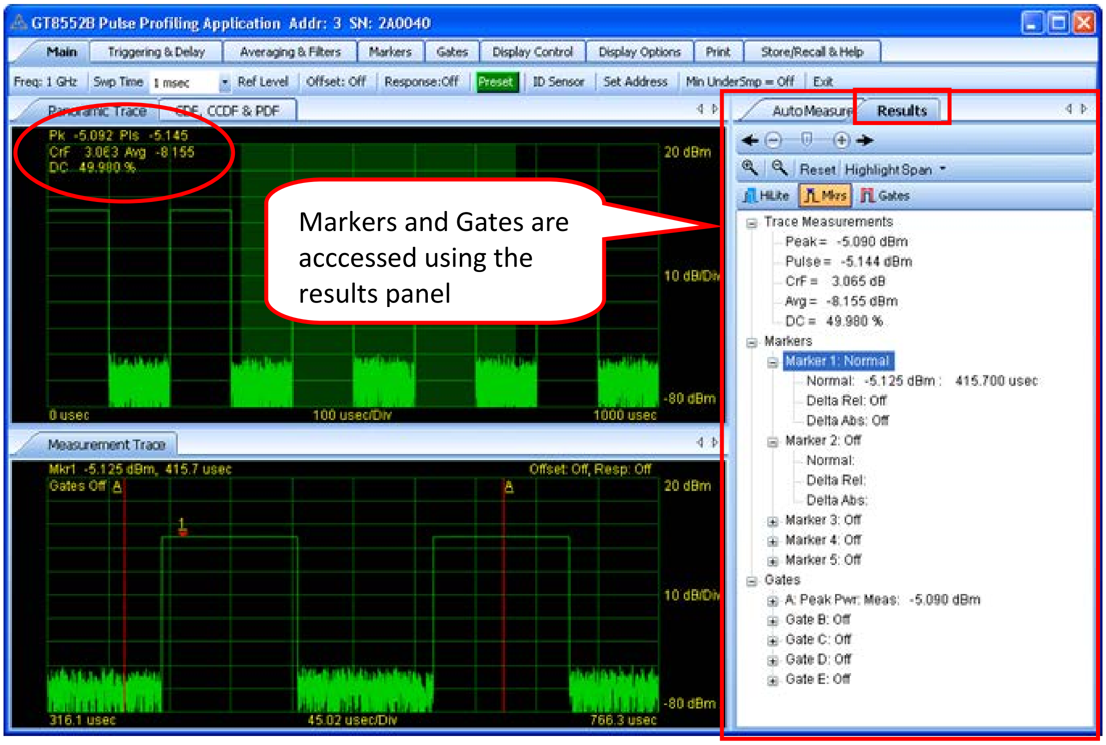
.

4.2.2 Measurement Panels:

These two panels show measurement results.

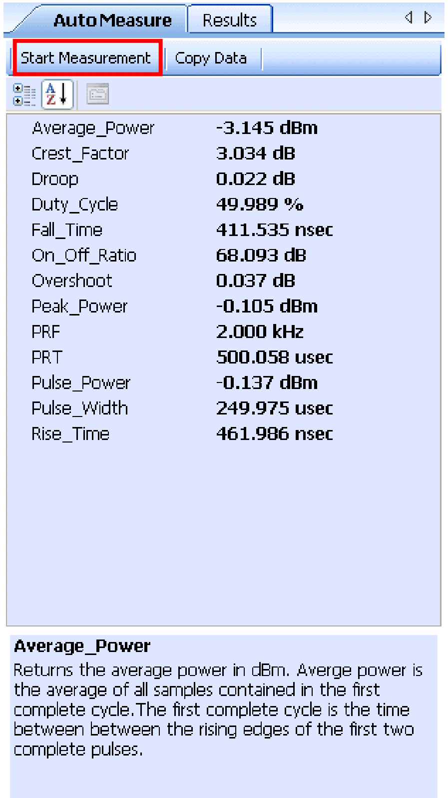
Results

This window allows you to manually setup the markers and gates for a given measurement. This panel shows the measurement readings that include the current trace values and the marker and gate values. The current trace values are also listed above the grid in the Panoramic Trace (circled). The **Results** panel provides convenient access to the tools needed to manipulate the signal display in the Measurement Trace panel. You can scroll left and right; zoom in and out; reset or highlight the span; and select the pointer mode. Details about setting and markers will be discussed in the Toolbar section.



Auto Measure:

This window allows you to make a comprehensive list of measurements based on the Measurement Trace window by clicking the "**Start Measurement**" button. While using AutoMeasure, you must press the"**Start Measurement**" button for each measurement.

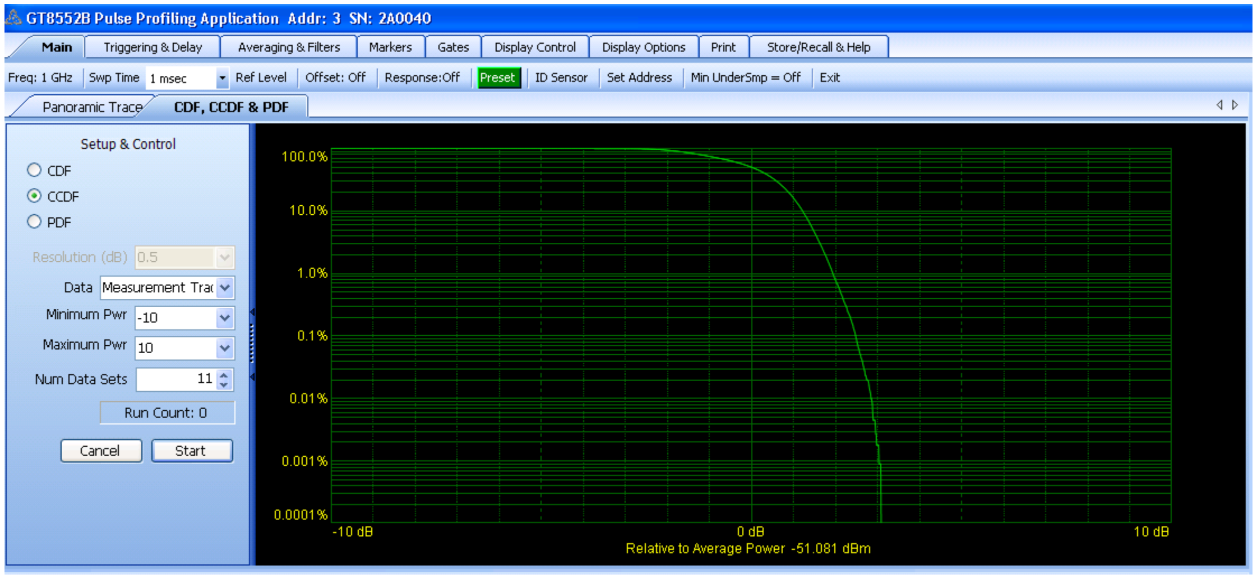


The **Auto Measure** feature requires at least two complete cycles of the pulse to be viewable in the **Measurement Trace** window in order to make an accurate measurement. Otherwise, you will see indeterminate numbers for the measured values. The **Auto Measure** panel comes up by default next to the **Results** panel. Shown below is an example of an automatic measurement using our example input. The automatic measurement feature is very convenient and gives a complete characterization of the pulse with a click of a button based on the selected sweep time

- **Start Measurement**: Click this button to capture the instantaneous values shown below. The readings will not continuously update but will make a single sweep of the trace. You must click **Start Measurement** each time to update the measured readings. A description of each measurement is shown at the bottom of the pane when you click on the measurement label
- **Copy Data**: Click this button to copy the measurement results to the clipboard then paste it to your document of choice.

4.2.3 CDF, CCDF & PDF:

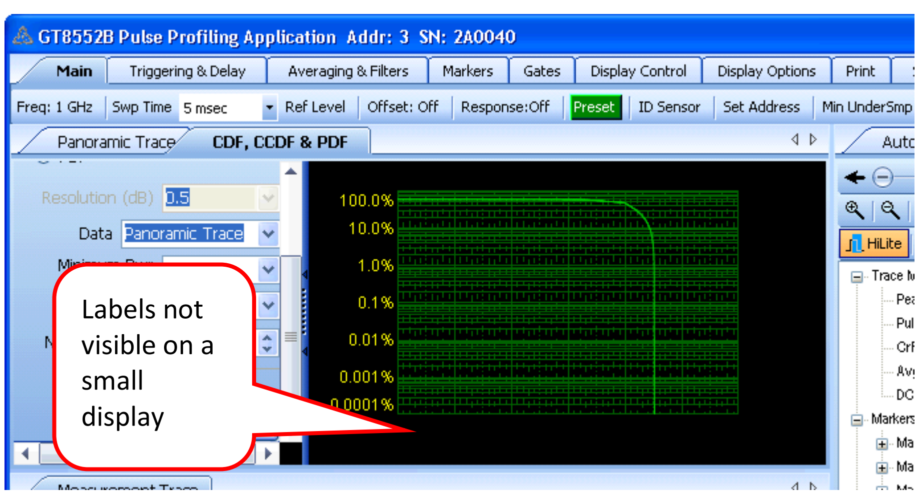
This panel gives you some tools for statistical power analysis. For all these panels, you can enter the resolution; data source (trace or gates); minimum and maximum power; and number of data sets or runs with counter.

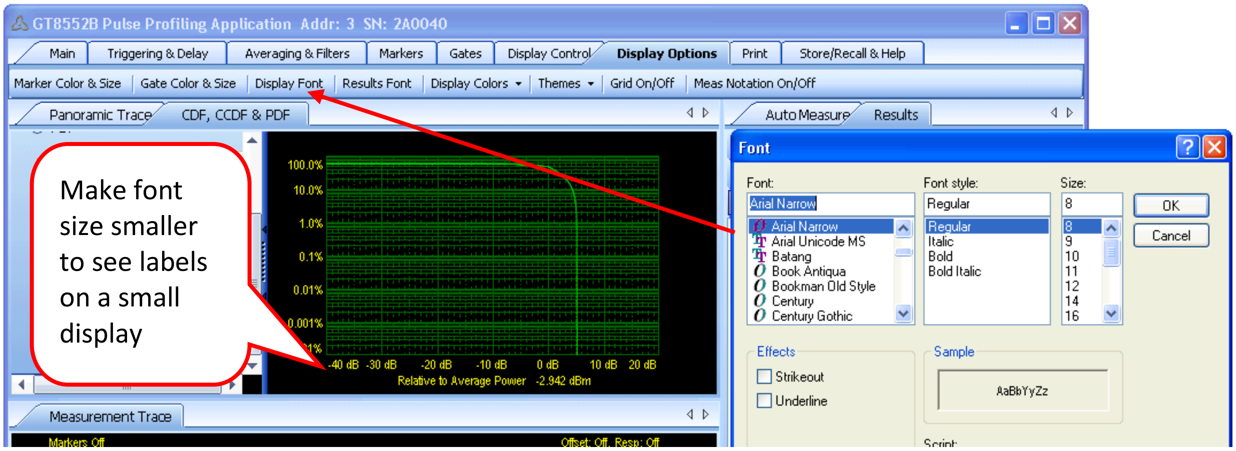


- **CCDF (Complementary Cumulative Distribution Function) display:** shows how much time the signal spends at or above the average power level. The power level is expressed in dB relative to the average power. The percentage of time the signal spends at or above each line defines the probability for that particular power level. A CCDF curve is a plot of relative power levels versus probability.
- **CDF (cumulative Distribution Function) display**: shows the probability that a signal is below the average power level.
- **PDF** (Probability Distribution Function) display: shows the distribution of the average power level.

Missing Labels

If you are displaying this on a small computer display, such as a laptop for example, then you may not see the labels for the axis. You can remedy this by using a larger display, or by changing the font size.





NOTE: Power (**CCDF**) curves provide critical information about the signals encountered in 3G systems. These curves also provide the peak-to-average power (crest factor) data needed by component designers.

4.2.4 Adjusting the Toolbar Tabs and Windows on the Display

The display is composed of five dock able or movable windows that can be rearranged on the display using Microsoft drag and drop tools.

Moving Toolbar menu tabs. You can rearrange the Toolbar menus in the menu panel. Just click on the tab you want to move and then drag it the desired location in the menu panel. When you release the mouse button, the menu tab will be in the new location.

Moving windows. The Panoramic Trace, Measurement Trace, "CDF, CCDF, PDF", Results, and Auto Measure windows can be moved and placed anywhere on the display using the docking popup or by clicking and dragging.

To activate the docking popup and move a window, do the following:
1. Click and hold on one of the windows in the display.
2. Drag the window until you see the docking popup appear.
3. Place the window you are moving over one of the positions (top, bottom,
center, right, left) on the popup. This position represents how the window will be docked on the display and that area of the display will become highlighted.

NOTE. You can also place a window anywhere on the display without using the docking popup. Simply click and drag the window to the desired location and then release the mouse button.

4. Release the mouse button and the move will be completed.

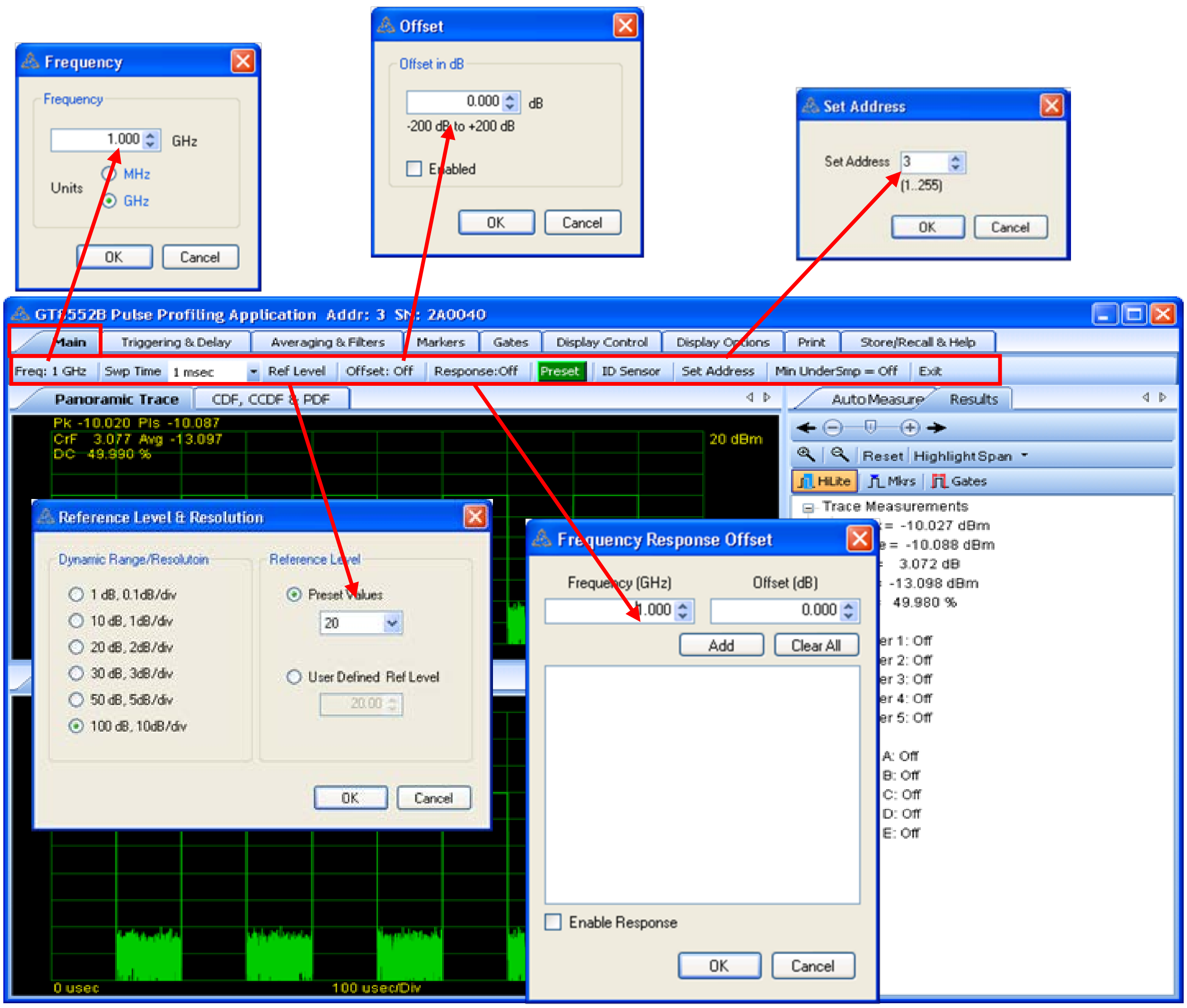
NOTE: These settings cannot be saved and the Preset button will not reset them. To reset the windows to default settings, close and reopen the software.

4.3 Tabbed Toolbar

The toolbar allows you to configure the sensor for any given measurement and provide for housekeeping tasks. The menu is tabbed, as opposed to a drop down type menu. Meaning its subheadings appear as a row below the main heading and not as drop downs.

4.3.1 Main

When the “**Main”** tab is selected on the toolbar, it allows allows setting of the measurement Frequency, Sweep Time, Reference Level and Resolution, Offset and (frequency) Response.



NOTE: The reference level and resolution settings change the formatting of the data that is presented whereas offset and response modifies the measured values.

Frequency:

Setting this value is essential to making accurate measurements. As with all power sensors, Giga-tronics corrects the readings based on a known incoming frequency. In the past this has been referred to as calibration factors or simply cal factors. Large errors can occur without setting the **Frequency** especially at the upper end of operation. Therefore, the **Frequency** setting must correspond to the input to achieve the most accurate measurements.

Sweep Time:

The following table shows the relationship between sweep time, sample rate, and total number of samples. Notice that the resolution of most computer displays is limited to somewhere between 1000 and 2000 points. However, the trace data has much higher resolution. If you want to see more detail on a 10,000 point trace, for example, you can use the zoom icons on the Display Control toolbar.

Table 10 Sweep Time, Time Between Samples, and Length of Trace

Sweep Time	Time Between Samples	Length of Trace
10 usec	0.0208 usec	480 points
20 usec	0.0208 usec	960 points
50 usec	0.0208 usec	2400 points
100 usec	0.0208 usec	4800 points
200 usec	0.0208 usec	9600 points
500 usec	0.05 usec	10000 points
1000 usec	0.1 usec	10000 points
2000 usec	0.2 usec	10000 points
5000 usec	0.5 usec	10000 points
10000 usec	1.0 usec	10000 points
20000 usec	2.0 usec	10000 points
50000 usec	5.0 usec	10000 points

Reference Level

The reference level shifts the viewing area and it does not affect the measured values. When you click the reference level button the dialog box allows you to select a **Resolution** coupled with a viewable dynamic range (due to a fixed number of vertical divisions). The **Panoramic Trace** and **Measurement Trace** panes always display 10 vertical and 10 horizontal divisions. The **Reference Level** can be set using one of the preset values or a user defined value.

The Reference Level selections apply to both the Measurement Trace and the Panoramic Trace views. The **Resolution** setting apply only to the Measurement Trace view. There is provision for offsetting the input over the range shown. Select **Offset** to enter a value and to enable/disable this functionality. The **Offset** and **Response** indicators are visible above and to the right of the measurement grid.

Offset

Offset provides a single valued offset to all measured data. Offset shifts the actual values of the measured data (not the viewing area). Simple offsets can be useful but they are limited in that they are not sensitive to frequency. If there is a frequency sensitive device in the measurement path, offset becomes very cumbersome since every frequency change must be accompanied by a change in offset. To solve this problem use the **Response** tool. **Offset** can be enabled and disabled without changing the data.

Response

Response is ideal for correcting measurements through devices like directional couplers. The response function allows you to enter a set of amplitude and frequency pairs. As the user changes the frequency of measurement, the application automatically adjusts the offset based on the frequency selected by the user. R**esponse** can be enabled and disabled without changing the data. This allows you to setup a response and enable and disable it without removing the data

Inst Preset

This button returns the unit to the following factory default state:

Frequency = 1 GHz

Sweep Time = 1 msec

Reference Level & Resolution = 20 dBm, 10 db/Div

Offset = 0 dB, disabled

Response = 0 dB, disabled

Trigger Source = Internal Auto

Trigger Level = -35 dBm

Trigger Edge = Positive

Trigger Mode = Continuous

Delay = 0 usec, disabled

Trigger Out = Off, Non-inverted

Averaging = 10, Off

Filter = 10 MHz

Poles = 4

Markers = All Off

Measurement Threshold = -55 dBm, On

Pulse Criteria = 6 dB

Gates = All Off

Display Font = Arial, 8 pts

Theme = Green

Grid = On

Results pane font = Arial, 9 pts

Auto Measure pane (not applicable)

Measurement Trace notation = Arial, 9 pts

Panoramic Trace notation = Arial, 9 pts

Measurement Trace is reset

ID Sensor

The **ID Sensor** button causes the green LED on the back of the sensor to blink. This allows you to quickly associate a particular sensor with a particular window. It is especially useful if you have more than one sensor attached to the computer.

Set Address

This allows you to change the sensor address (1 to 255). Changing the unit address will cause the application to close. You must then re-start the application to initialize the sensor.

Min UnderSmp Off *(Minimize Undersampling set to off)*

For sweep times of 10 ms or less, equivalent-time sampling (undersampling) is used to provide adequate time resolution and fill the trace memory. The Minimize Undersampling function has no effect at these sweep time settings. For sweep times of 20 ms, 50 ms, and 100 ms, undersampling provides more samples than are needed to fill the trace memory. When Minimize Undersampling is turned off, samples are averaged together to fit into the 10,000 point trace. When the Minimize Undersampling function is turned on, equivalent-time samples that do not fit into the trace are not averaged, but are discarded. Activating this function will tend to increase the noise on the trace, but it improves the ability to see peaks. For sweep times of 200 ms or more, real-time sampling provides enough samples to fill the trace memory and to give adequate time resolution. Undersampling is not used and the Minimize Undersampling function has no effect at these sweep settings.

Exit

This button allows you to close the application.

4.3.2 Triggering and Delay

Various triggering methods are provided when this tab is selected

Trg Src (Trigger Source)

You have three options for trigger source settings. All of these options allow you to use positive or negative Edge triggering, as well as Continuous or Single Sweep.

Internal Auto Level:

Internal auto level trigger is determined by sampling the incoming signal. The general algorithm is as follows:

- Sample the incoming signal
- Examine the data for maximums and minimums
- Set the trigger level between the maximum and minimum (favoring the maximum)
- Take a trace using the standard process (same as manual trigger)

The Internal Auto Level is set for each trace so as the input varies the auto trigger level will be adjusted accordingly. Therefore, while the Internal Auto Level is more convenient (and quite reliable) it also can be somewhat less responsive. The Internal Auto Level trigger source is not recommended when peak input levels fall below approximately -50dBm (See Internal Manual Level trigger for inputs below -50 dBm).

The Internal Auto Level trigger mode always returns a trace and triggers off the incoming signal. However, if a signal is not present it will return a noise trace.

Internal Manual Level Trigger

The sensor is capable of triggering on the incoming signal from about -55dBm to +20dBm when Internal Manual Level is selected and a value is entered. This trigger mode requires that you set the trigger level manually. If you set the trigger level too high you will not get a trace. Instead you will get a “Trigger?” message in the middle top of the measurement grid. This message indicates that a trigger was not found. If the trigger is set too low then the system will trigger on noise and you will get a noise trace.

External TTL Trigger

The external TTL trigger mode requires the user to connect an external SMB cable with an incoming TTL signal. Use this capability to trigger on an input that is not level dependent or for very low signal levels approaching the noise floor of the sensor. See the **Averaging & Filters** Toolbar section for more information on measuring low level signals.

NOTE: An incoming pulse must be on at least 0.20 usec followed by at least 1 usec of off time for the sensor to properly trigger.

Edge Trigger

Allows the user to trigger on the positive or negative edge as required for best viewing.

Continuous Sweep

Causes the sensor to continuously deliver new traces.

Single Sweep

Delivers one new sweep each time it is pressed with the exception of the first time. Occasionally the first sweep requires two button clicks.

Delay Trigger

Allows the user to delay the beginning of the trace from the trigger for up to 10 msec. This feature allows the user to acquire high resolution traces long after the trigger has occurred.

Trigger Out

If this feature is enabled it causes a trigger to be passed to the trigger out port on the sensor. The trigger out occurs somewhat differently for internal triggering than for External TTL triggering. When triggering internally (manual or automatic) a trigger is sent out each time a sweep starts. When triggering on an external TTL trigger the trigger is passed through to the trigger out port. The trigger out can also be inverted.

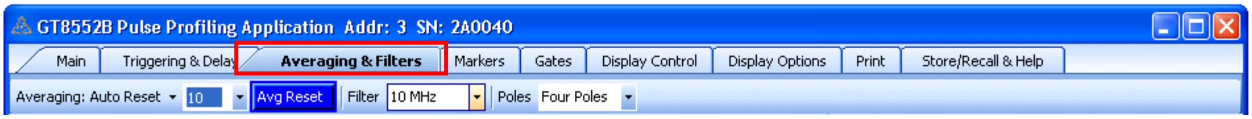
Timeout.

Use this menu function to set a timeout period for an external trigger input (up to 10 seconds). If a trigger event is not detected in the allotted time, the system will time out and the Trigger? indicator will appear at the top center of the Measurement Trace window.

NOTE. *If the trigger timeout is set long, and triggers occur slowly, the meter display will appear sluggish as the instrument waits for triggers.*

4.3.3 Averaging and Filters

When this menu tab is selected, it gives you the ability to set the averaging and filter options. Both averaging and filtering help reduce the noise floor. Below about -53 dBm you may need to use a combination of averaging, filtering, and the standard external triggering capability to get satisfactory measurements.



Averaging

Select to turn averaging on or off. You can select the number of traces to be averaged from the drop down menu. The number of averages can be set from 1 to 100. It takes 0.3 to 1.0 ms to collect each trace. Increasing the number of averages maintains wave shape but decreases responsiveness or how quickly the trace is updated.

Average Reset.

This button is blue when averaging is turned on. Click the button to restart or reset trace averaging.

Filters

The Filter drop down allows you to select an appropriate low-pass video bandwidth depending on your measurement needs. Filter selections: 100 kHz, 200 kHz, 300 kHz, 500 kHz, 1 MHz, 2 MHz, 3 MHz, 5 MHz, and 10 MHz.

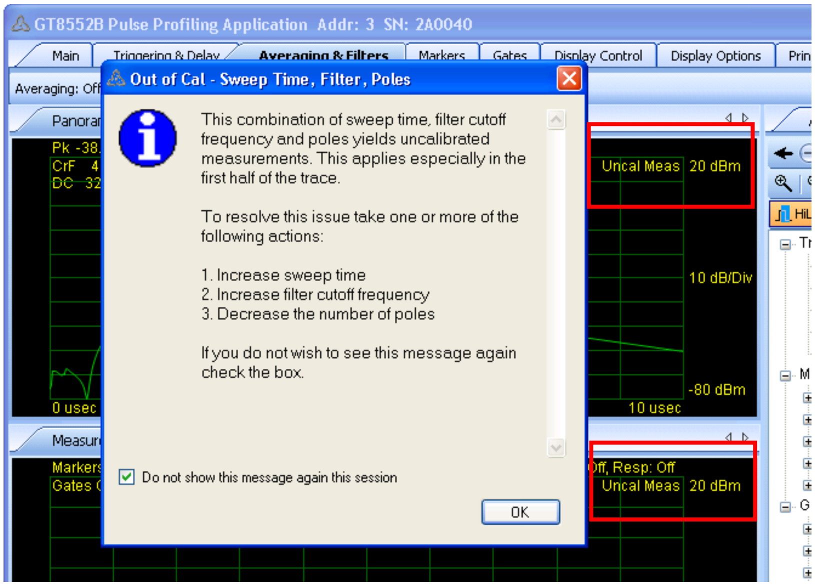
A lower Filter setting will provide faster trace updating but affects the wave shape. This results in a rounded pulse shape because as the filter is narrowed the high frequency component of the signal is decreased.

Poles

The Poles drop down allows selection of one, two or four filter poles. The default value is four poles. The number of Poles has the effect of determining the sharpness of the frequency roll off depending on the filter selection. The greater the number of Poles the steeper the roll off and again, the reduction in the high frequency component of the signal. More Poles then decrease roll off but have the affect of increasing both the rise and fall times of the displayed signal (as time relates inversely to frequency).

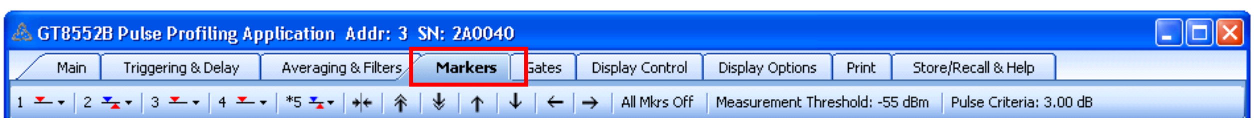
Uncalibrated Measurement Message

You will see a popup message below if the measurement becomes uncalibrated due to the filter, poles or sweep time settings. Also, an “Uncal Meas” label will appear on both the Panorama and Measurement view grids. Adjust the settings accordingly until the error message stops.

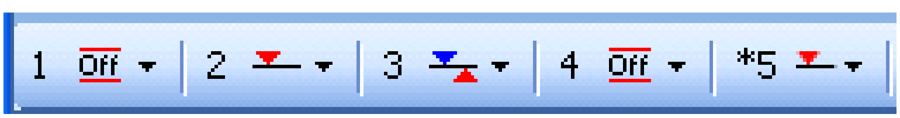


4.3.4 Markers

Markers are used to make measurements at a particular point (Normal Markers) or measure the difference between two points (Delta Markers). Markers are only available in the Measurement Trace window. The value of the active marker is displayed in the upper left portion of the Measurement Trace window unless it is turned off. The value of each marker is displayed in the Results window.



Markers 1 through 5



Select the marker numbers to turn them off (shown above with Markers 1 and 4), on as a Normal marker (shown above with Markers 2 and 5), or on as a Delta marker (shown above with Marker 3).

NOTE. Only one marker can be active at a time, although all five markers can be displayed simultaneously. The active marker will have an asterisk **(*)** next to its number in the toolbar and the marker number will be underlined and appear slightly larger in the trace display.

You can then select Set Position from each marker drop down menu to position the marker. You can also place the marker by clicking in the Panoramic Trace window.

To move or place a particular marker, the Pointer Control mode (found in the Display Control toolbar and in the Results window) must be set to Markers

Once a marker is turned on and the pointer mode is set to Markers, you can click and drag on the Measurement Trace area to position the marker. As you move the marker, the notation in the upper left corner of the Measurement Trace grid will be updated. The x value (time) is determined by the position of the cursor. The y value (magnitude) is determined by the value of the trace closest to that point in time.

A Normal Marker is a single data point and appears above the Measurement trace.

A Delta Marker gives the differential value and appears below the Measurement trace.

NOTE. There is a procedure in this document for making a measurement using delta markers, see that particular section for more details.

Arrow Icons. The arrow icons allow you to position the markers on a peak. The first arrow icon allows you to center the highlight trace on a marker.

All Mrkrs Off. Select to turn off and reset all markers. You will lose marker positioning if you click this button.

Measurement Threshold. Select to view the Threshold window where you can set the threshold value, enable the threshold, or return the threshold to a default value. The measurement threshold sets the minimum value of the peaks considered by the marker and gate search algorithms. It is adjustable across the limits of the dynamic range of the instrument. The default setting is -55 dBm and the function must be enabled/disabled from the dialog box.

NOTE. The Measurement Threshold function is also used to set the lower limit of data used in gated measurements.

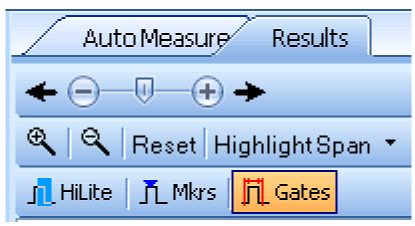
Pulse Criteria. Select to view the Pulse window where you can set the threshold value, enable the threshold, or return the threshold to a default value. This function is used to define that portion of the total trace that is to be considered part of a pulse. The pulse criteria defines the edges of the positive portion of the entire pulse and is relative (or added) to the measurement threshold if threshold is enabled. It is relative to the noise floor if the measurement threshold is disabled.

4.3.5 Gates

The time gates allow you to characterize the incoming signal. Rise time, fall time, and droop measurements are very sensitive to the position of the gates. These measurements use the position of the gates as starting and end points for the measurement.

Gates A through E.

There are five time gate pairs (A-E). The drop down menu for each gate allows you to set measurement type and gate position. You can then select Set Position from the gate drop down menu to access the Set Position window to place the gate. You can also place the gate by clicking in the Panoramic Trace window. To move or place a particular gate, the Pointer Control mode (found in the Display Control toolbar and in the Results window) must be set to Gates.



NOTE. Only one gate can be active at a time, though all five gates can be displayed simultaneously. The active gate will have an asterisk (*) next to its letter in the toolbar and the gate letter will be underlined and appear slightly larger in the trace display.

The time gates allow characterization of the pulse signal to include the following parameters, selectable in the Gates toolbar from the Gate drop down menus. You can also make all of the following measurements automatically by clicking the Start Measurement button in the Auto Measure window.

A brief description of every measurement follows. After the list of measurements, there is a Gate Positioning digram to help illustrate further.

Rise Time (RT).

Returns the time required for the signal to increase in amplitude from 10% to 90% of the amplitude defined by the placement if the right-most gate. RT is measured on the first complete pulse: the left gate determines the start of data and the right gate marks the highest point to be considered. from 90% to 10% of the amplitude as defined by the placement of the left-most gate. The right gate defines the end of data for this measurement.

Pulse Width (PW)

Returns the pulse width in µs. The width of the pulse is the time for a signal to rise to within 3 dB of the top of the pulse, and then fall 3 dB below the top of the pulse. The left-most gate defines the start of data and must precede a positive going edge. The right-most gate defines the end of data and must follow one or more subsequent falling edges.

Pulse Repetition Time (PRT).
Returns the PRT in µs. The PRT is the time between the first rising edge and the second rising edge. The gates for this measurement must include at least one complete, uninterrupted cycle. The left-most gate must follow a positive going edge and the right-most gate must precede one or more subsequent falling edges and at least one rising edge.

Pulse Repetition Frequency (PRF).
Returns the PRF in Hz or kHz. The PRF is the inverse of the time (1/PRT) between the rising edges of two successive pulses. The pulse edges are defined by the pulse peak criteria. This measurement can be limited by the threshold value. The gates for this type of measurement must be positioned with the same restrictions as the PRT measurement.

Duty Cycle (DC).
Returns the percentage of on time during a selected cycle. The gates for a duty cycle measurement must be positioned with the same restrictions as the PRT and PRF measurements. The measurement then proceeds to sort all samples into one of two bins. One bin is the “ON” bin and the other bin is the“OFF” bin. All points within 3 dB of the pulse top are placed in the “ON” bin. All other samples are placed in the “OFF” bin. Then a simple calculation is done: DC (Duty Cycle) = #ON samples / (#ON samples + #OFF samples)

Pulse Power (Pls).
Returns the average power between the rising and falling edges of the first complete pulses in dBm. The gate must be positioned exactly like PW measurements. The average of all samples between the rising and falling edges is reported. The pulse edges are defined by the pulse peak criteria. This measurement can be limited by the threshold value.

Peak Power (Pk).
Returns the highest power level between two gates. There is no requirement for a rising or falling edge anywhere within the measurement window as defined by the gates.

Average Power (Avg).
Returns the average power between two gates. There is no requirement for a rising or falling edge anywhere within the measurement window as defined by the gates.

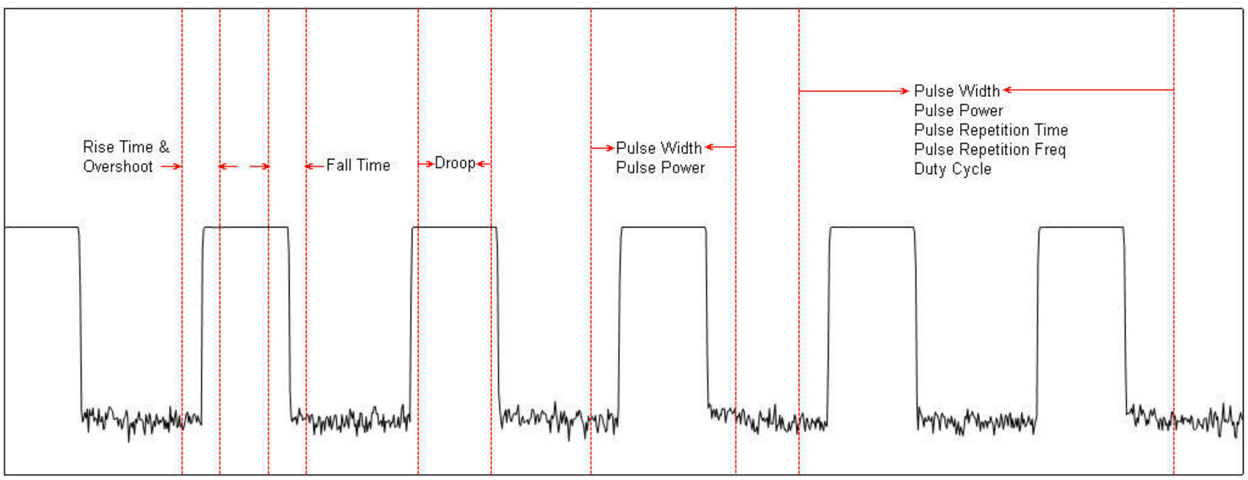
Crest Factor (CF or CrF).
Returns the difference between the peak power and average power in dB. There is no requirement for a rising or falling edge anywhere within the measurement window as defined by the gates.

Overshoot (OvSh)
Returns the difference in dB between the highest point after a rising edge and the average power of the pulse. The gates for this type of measurement must be positioned with the same restrictions as the rise time measurement.

Droop (Droop)
Returns in dB a decrease in pulse power measured between the first 5% after the left gate and the last 5% before the right gate.
The gates also provide the following three groups of measurements:

- Power Set : peak power, pulse power and crest factor
- Time & Frequency Set: pulse width, pulse repetition time, pulse repetition frequency
- Mixed Set: peak power, crest factor, pulse width, pulse repetition frequency

Below is a general **Gate Positioning Diagram** that shows where to place the gates for the various measurement types.



At the end of the Pulse Profiling section, there is a simple measurement example using gates.

4.3.6 Display Control

This toolbar allows you to adjust the trace display views and switch control of the mouse pointer function between Markers, Highlight, or Gates.

Zoom In and Out.

Click the zoom icons to increase or decrease the trace display resolution. These icons are also available at the top of the Results window.

Reset. This button returns the Measurement trace to full view. This option is also available at the top of the Results window.

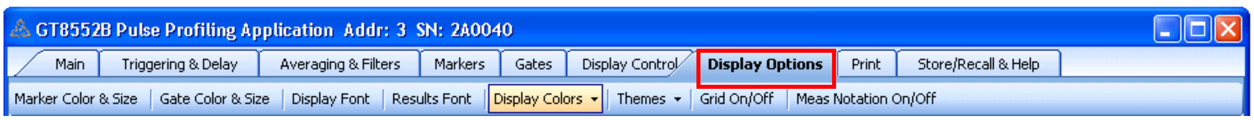
Pointer Control. The Pointer Control mode can be set to Highlight, Markers, or Gates.

The settings control which of these the mouse can manipulate when clicking and dragging in a trace display.

These icons are also available at the top of the Results window.

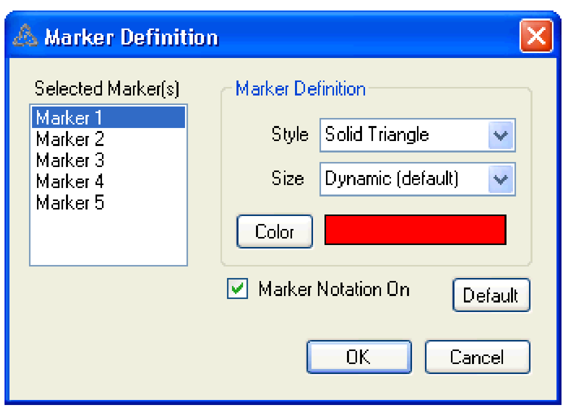
4.3.7 Display Options

This toolbar allows you to adjust how the trace windows and other windows are viewed. For example, you can adjust the size and color of markers and gates in the Measurement Trace window or the appearance of text in the Results window.



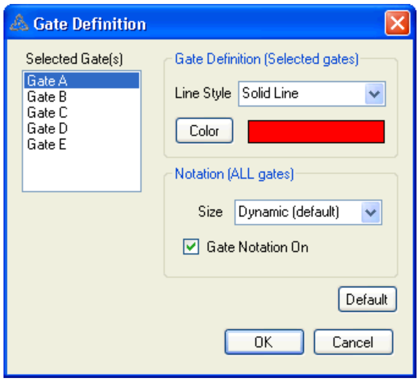
Marker Color and Size.

This button allows you to change the style (shape), color, and size of the markers. Click to button to view the Marker Definition window and make your selections.



Gate Color and Size

This button allows you to change the line style, color, and size of the gates. Click to button to view the Gate Definition window and make your selections.



Display Font

This button allows you to change the font type, style, size, and language (script) of the trace display text.

Display Colors

This button allows you to select the background, trace, grid, text and notation, and highlight colors from a drop down menu. You can also select the degree of highlight opacity.

Themes

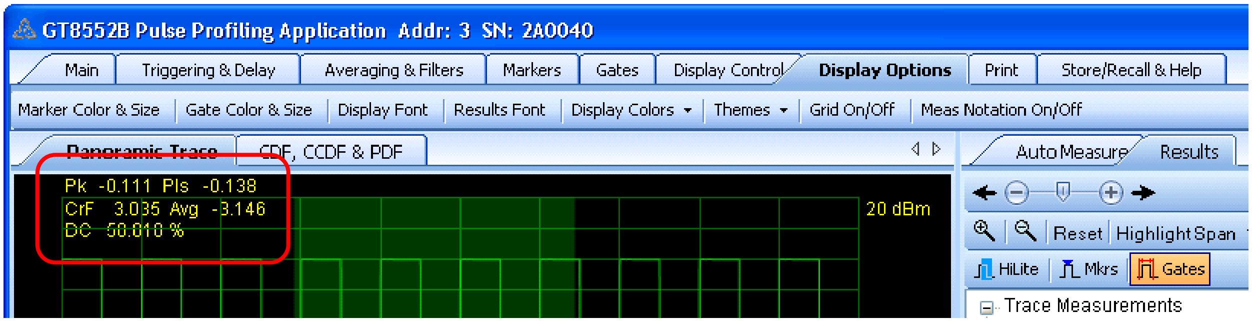
This button allows you to select color themes for the display from a drop down menu.

Grid On/Off

This button allows you to turn the Panoramic and Measurement Trace window grids on and off.

Meas Notation On/Off

This button allows you to turn the measurement notation in the Panoramic and Measurement Trace windows on and off.



4.3.8 Print

When this tab is selected, it enables you to select to print the Panoramic trace and the Measurement trace. You can also select to print CDF (Cumulative Distribution Function), CCDF (Complementary Cumulative Distribution Function), or PDF (Probability Density Function) displays. All displays are printable in black and white or color (depending on the capabilities of your printer).

4.3.9 Store/Recall & Help

This menu enables you to store and recall measurement states and get user documentation.

Store Register

This button allows you to store a register. A register holds an entire state.

Recall Register. This button allows you to recall a stored register. A register holds an entire state

Store as Name. This button allows you to store the current setup state.

Recall as Name. This button allows you to recall a stored named register or file.

Copy Trace Data. This button allows you to paste the trace data as time and amplitude pairs into other applications, like Excel, for further analysis.

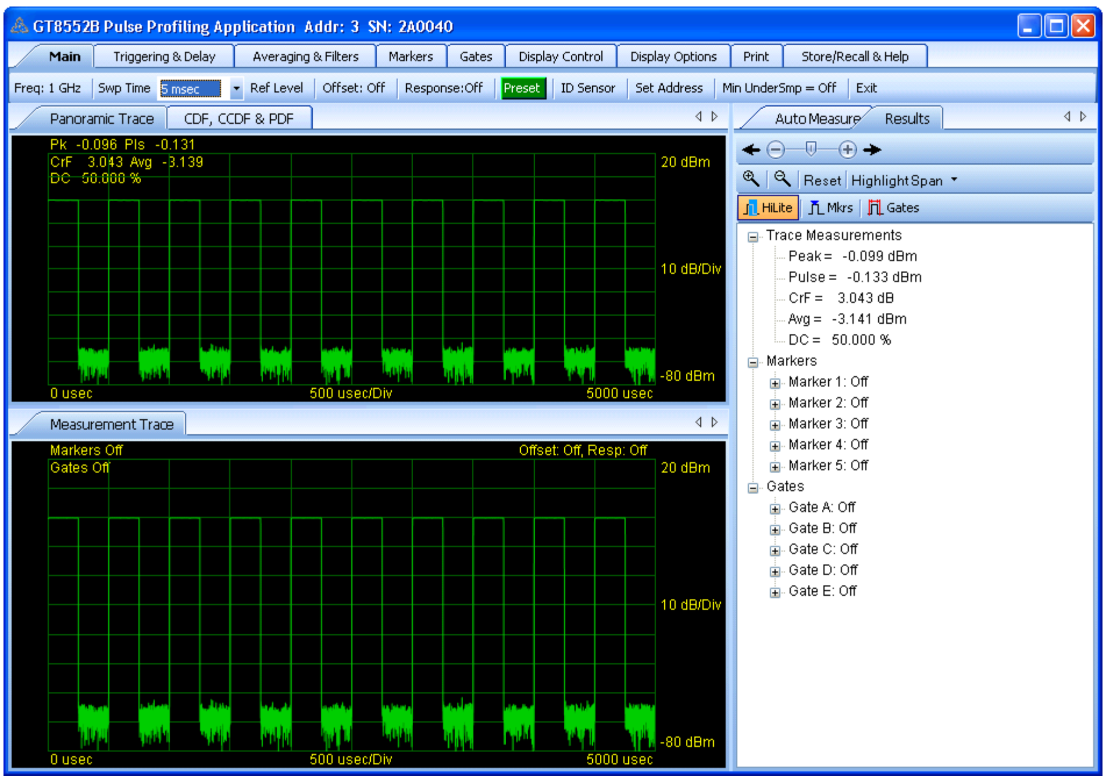
1.1.1 Make a Measurement Using Markers

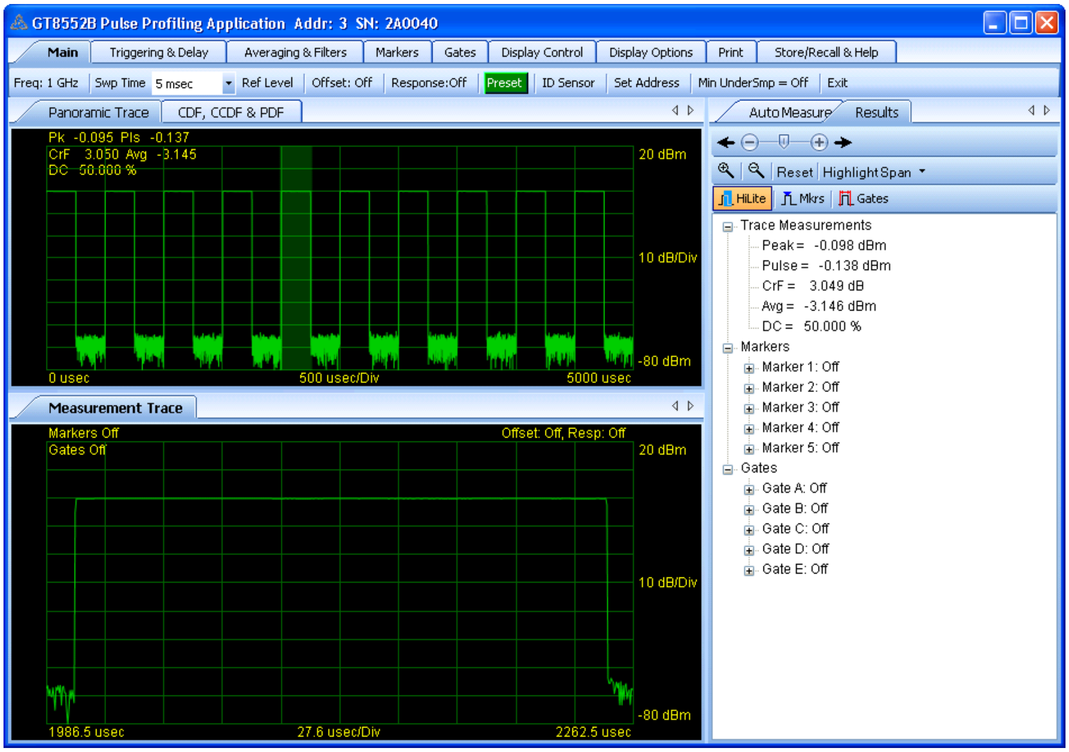
This simple example illustrates using markers to make a simple measurement. In this example, we will be measuring pulse width.

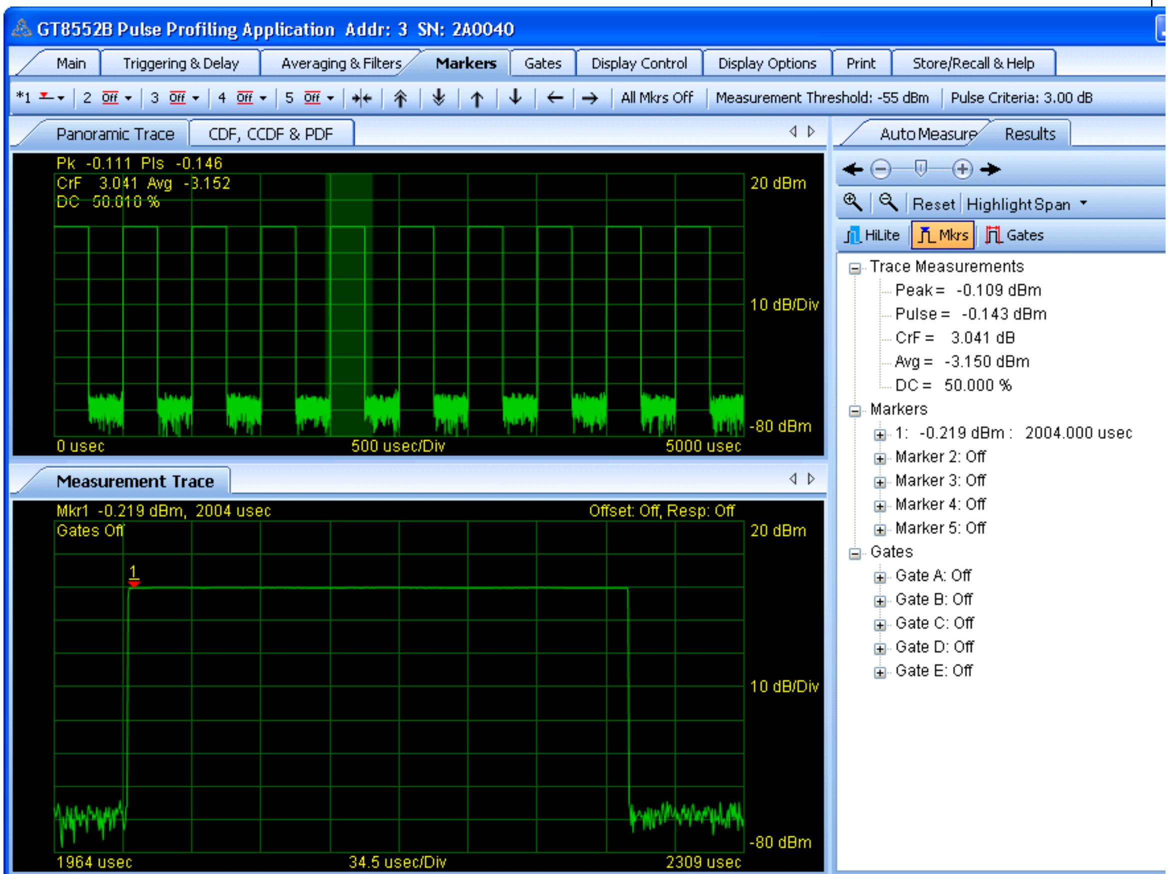
Pulse width measurements are normally defined as the time between the 3 dB points on the rising and falling edge of a pulse. When using markers for a measurement like this, the results are highly dependent on the placement of the markers. Placing markers at the precise 3 dB down points can be problematic for pulses with very fast rise and fall times.

Table 11 Make a Measurement Using Markers

Make a Measurement Using Markers	
Step	**Action**

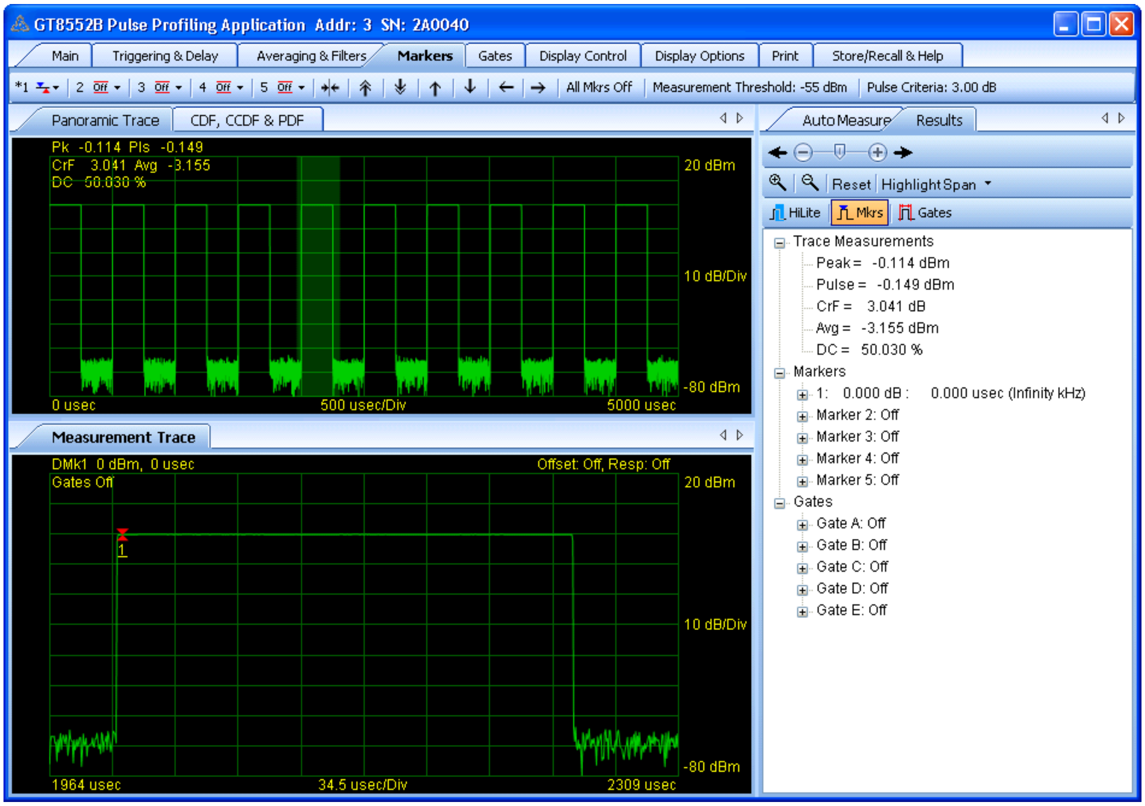
Make a Measurement Using Markers	
Step	**Action**
1.	Start the Pulse Profiling Application Software
2.	Before connecting the RF signal to the GT-8550B Power Sensor, de-energize (turn OFF) the RF signal.
3.	Connect the GT-8550B Power Sensor to the RF source.
4.	Energize the RF signal. Configure the source for a pulse waveform.
5.	Figure shows the GUI:  Figure 15. Sensor Window with Pulse Parameters Set the Frequency and Sweep Time to the appropriate values.

Make a Measurement Using Markers	
Step	**Action**
6.	Highlight a single pulse in the Measurement Trace window and zoom in on the pulse to position the marker for a Pulse Width measurement. 

Make a Measurement Using Markers	
Step	**Action**
7.	Select Markers from the Toolbar and click on the Marker 1 down arrow and select the Normal Marker type. Notice that Marker 1 appears in the Measurement window at the center graticule and the mode in the Results window toolbar will switch from Highlight to Markers in the Results Window. Move the marker to the left edge of the pulse. The delta will be measured relative to this value.  Note: Alternatively you can right click on the individual marker in the Results window to select the marker type.

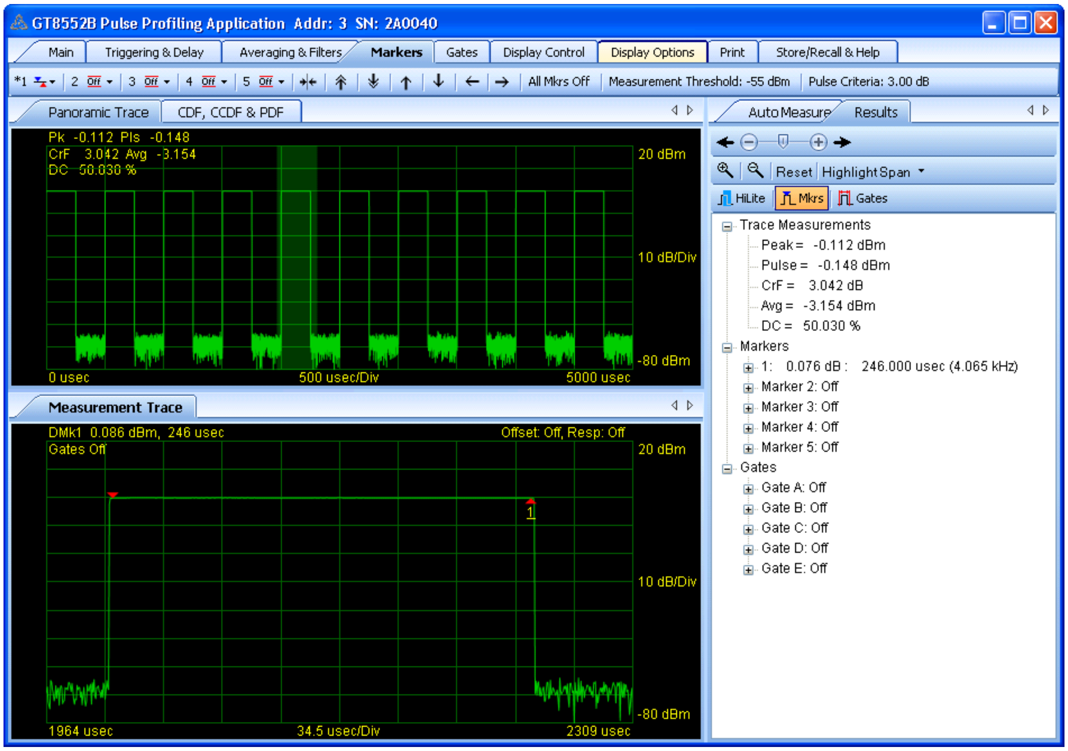
Make a Measurement Using Markers

Step	Action
8.	Now change Marker 1 to a delta Marker. This can be done from the Toolbar by selecting Marker 1 and selecting delta Marker.



Notice that the number is now below the triangle, this indicates that this is a delta Marker.

<table>
<tr><th colspan="2">Make a Measurement Using Markers</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>9.</td><td>
Click on the Marker 1 delta to move the delta to the right edge of the pulse.



Notice that the Delta Marker 1 (DMk1) value located above the left edge of the Measurement grid is the approximate pulse width of the signal. The relative and absolute Delta marker values are shown in the Results window.
</td></tr>
<tr><td>10.</td><td>Click All Mkrs Off to turn off the markers when you are finished.</td></tr>
<tr><td colspan="2">End of Procedure</td></tr>
</table>

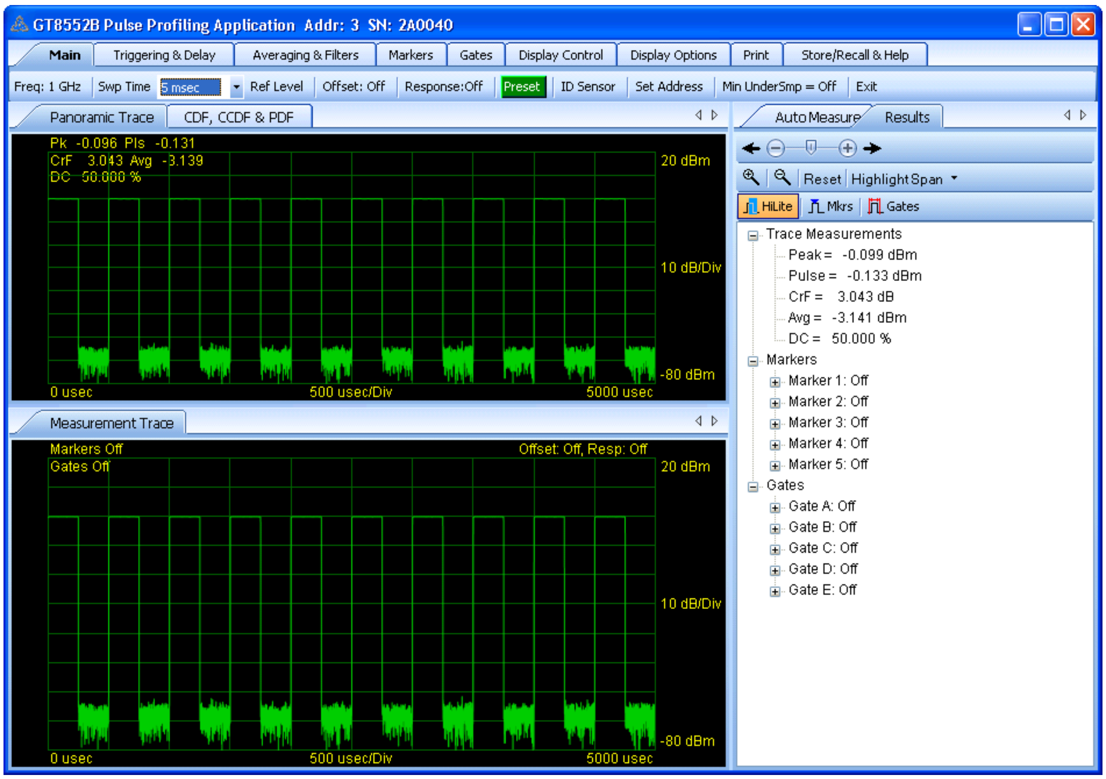
4.3.10 Make a Gated Measurement

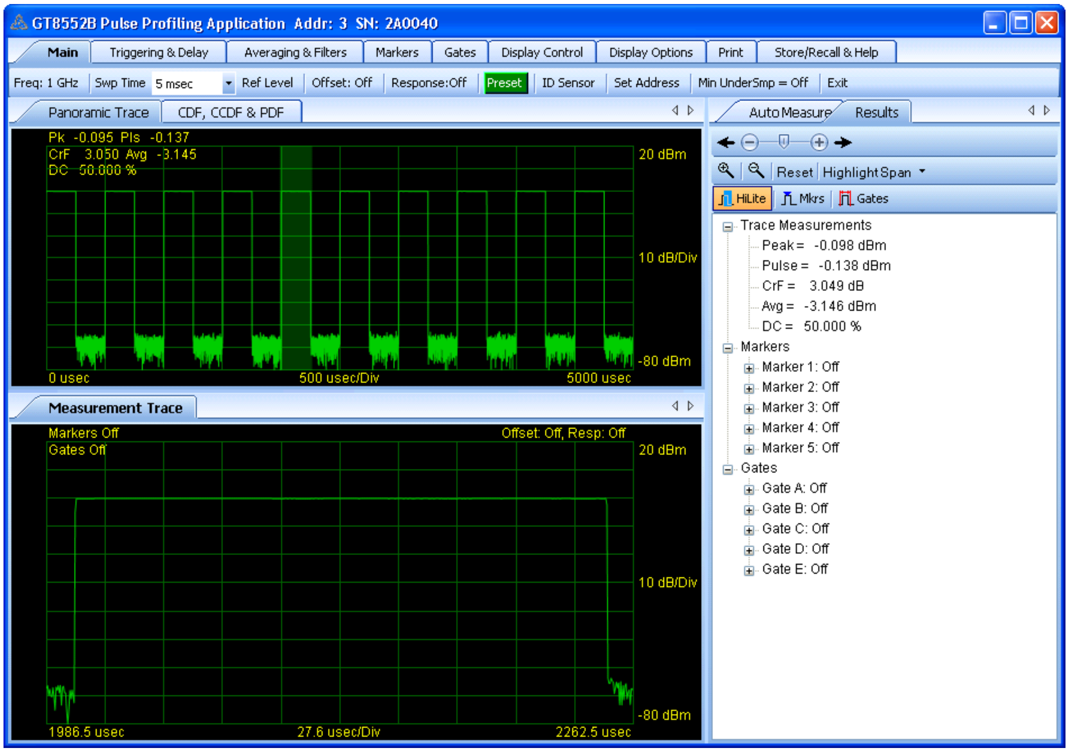
This simple example illustrates using a gate to make a simple measurement. In this example, we will be measuring pulse width.

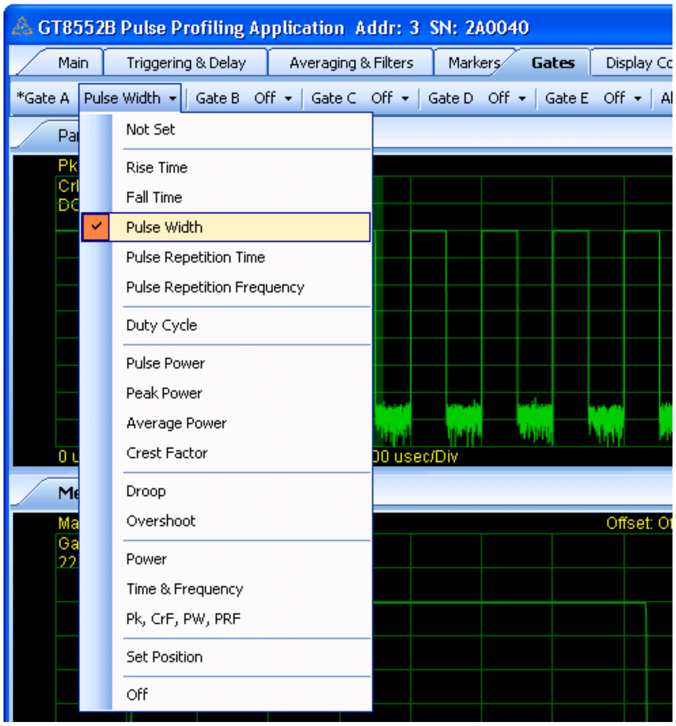
Pulse width measurements are normally defined as the time between the 3 dB points on the rising and falling edge of a pulse. The gate can be placed anywhere, as long as the pulse is contained within it and the software will automaticaly calculate the 3 dB points.

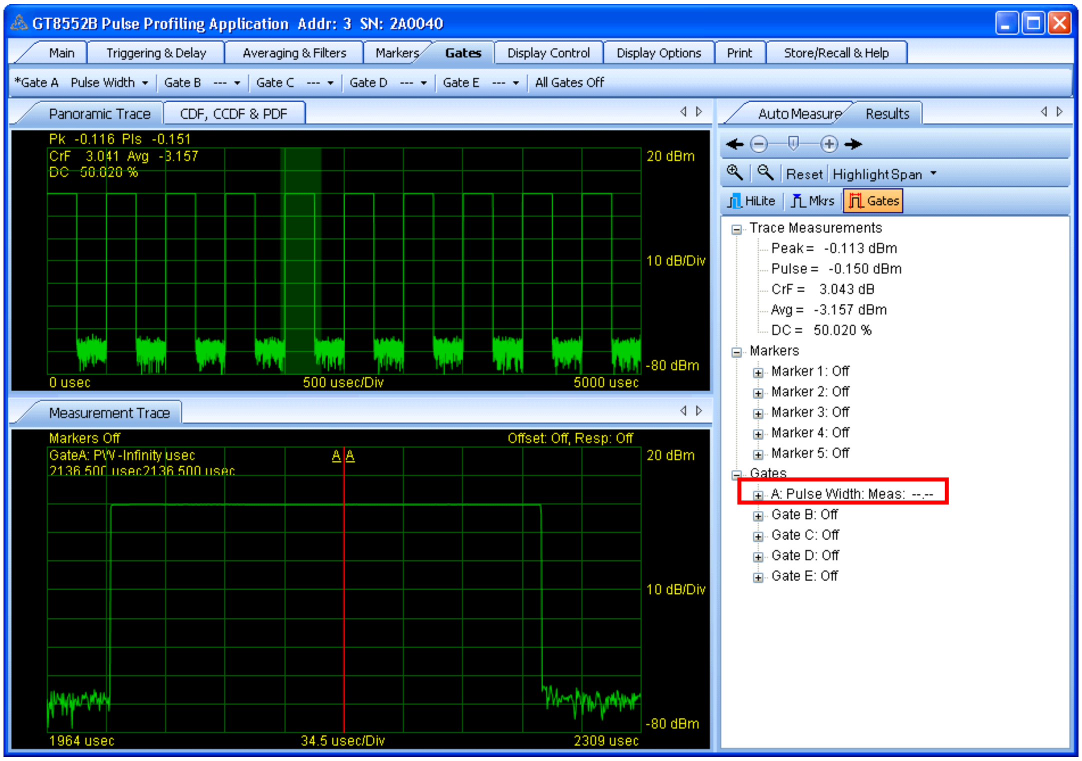
Table 12 Make a Gated Measurement

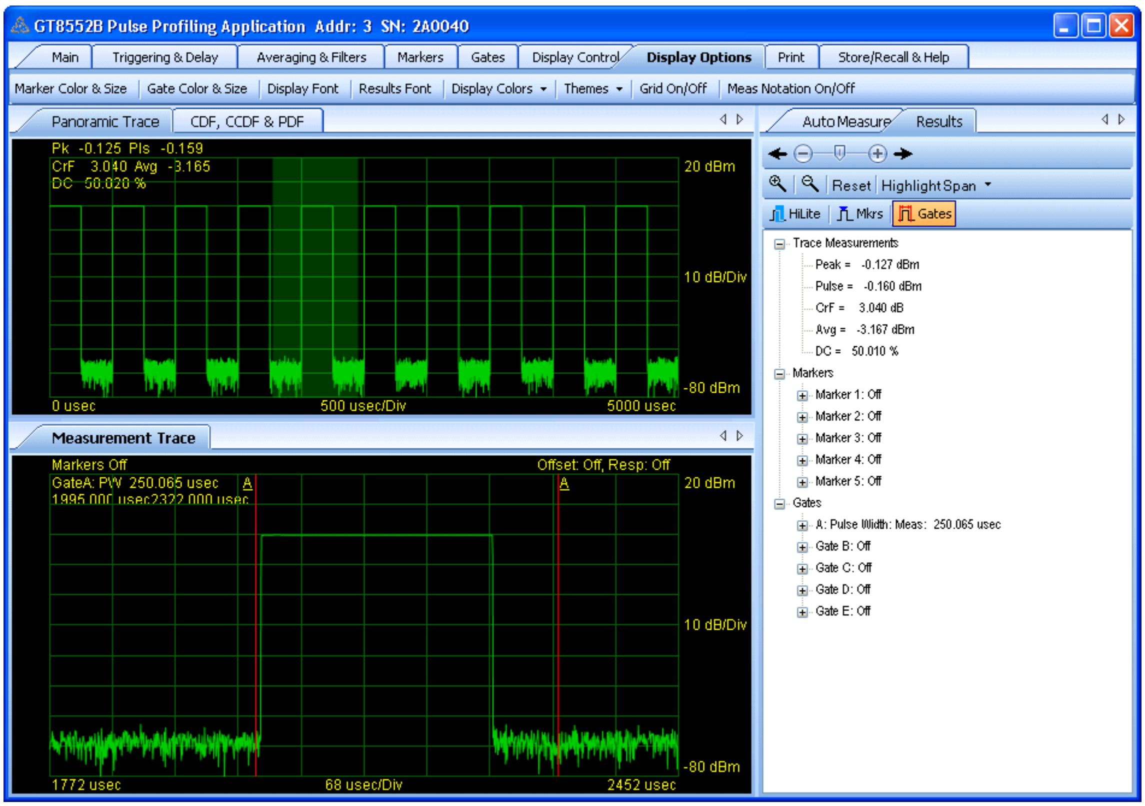
Make a Measurement Using Time Gates	
Step	**Action**
1.	Start the Pulse Profiling Application Software
2.	Before connecting the RF signal to the GT-8550B Power Sensor, de-energize (turn OFF) the RF signal.
3.	Connect the GT-8550B Power Sensor to the RF source.
4.	Energize the RF signal. Configure the source for a pulse waveform.

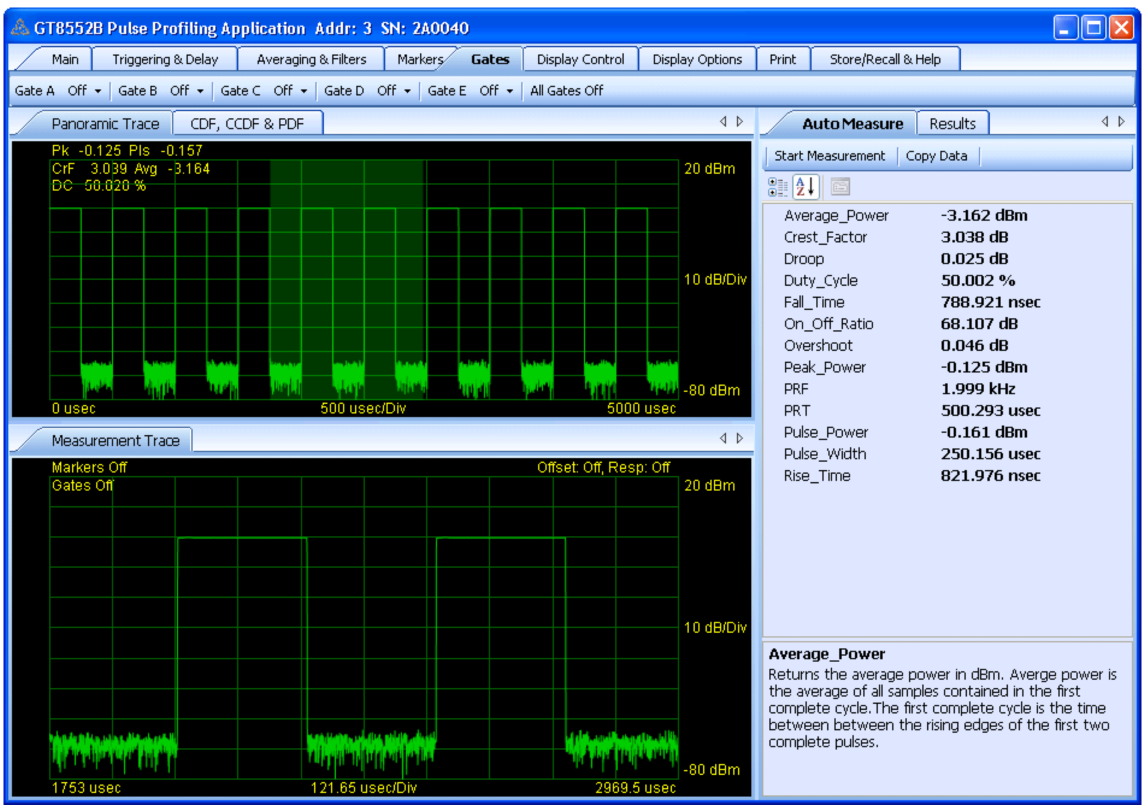
Make a Measurement Using Time Gates	
Step	**Action**
5.	Figure shows the GUI:  Figure 14. Sensor Window with Pulse Parameters Set the Frequency and Sweep Time to the appropriate values.

Make a Measurement Using Time Gates	
Step	**Action**
6.	Highlight a single pulse in the Measurement Trace window and zoom in on the pulse. 

Make a Measurement Using Time Gates	
Step	**Action**
7.	Select the Gates Toolbar. Click on the Gate A and select Pulse Width. 

Make a Measurement Using Time Gates	
Step	**Action**
8.	Observe that the gate pair appears at the center graticule in the Measurement window. The active gate will have an asterisk (*) next to it in the Toolbar and the **A** will be underlined and will appear slightly larger in the Measurement Trace window. Observe that the measured value will appear in the Results window under the active gate and above the grid in the Measurement window.  Note: Alternatively you can right click on the individual gate in the Results window to select the gate type.

Make a Measurement Using Time Gates	
Step	**Action**
9.	Pulse width measurements require a rising and falling transition through the 3 dB points. Do the following to adjust the gates: **a.** Click on the left gate in the Measurement window and move it to the left until the rising edge of the pulse is positioned to the right of the left gate. **b.** Click on the right gate in the Measurement window and move it to the right until the falling edge of the pulse is positioned to the left of the right gate.  ***NOTE.*** *A complete cycle of the incoming signal must be gated for periodic measurements such as duty cycle and frequency.* Notice that the gate doesn't have to be symmetrical and at specific points to measure the pulse width of the signal that is within it. If you move the left gate closer to the left edge of the display or the right gate, the measurement result remains unchanged as long as the entire pulse is selected. As long as the gate is set to measure Pulse Width, the measurement algorithm will automatically compute the 3 dB points.

Make a Measurement Using Time Gates	
Step	**Action**
10.	Observe that the drop down menu on each gate shows the selection of measurements that can be made. You can also right-click on the gate in the Results window. A dashed line (–.–) will appear if the gate cannot take a measurement or is not set. Now turn off the gates.
11.	You can compare a manual measurement like the one just explained with an automatic measurement by doing the following: **1.** Check that there are at least two pulse cycles in the Measurement window. **2.** Click on the Auto Measure tab to view the Auto Measure window. **3.** Click Start Measurement. 
12.	Compare results
End of Procedure	

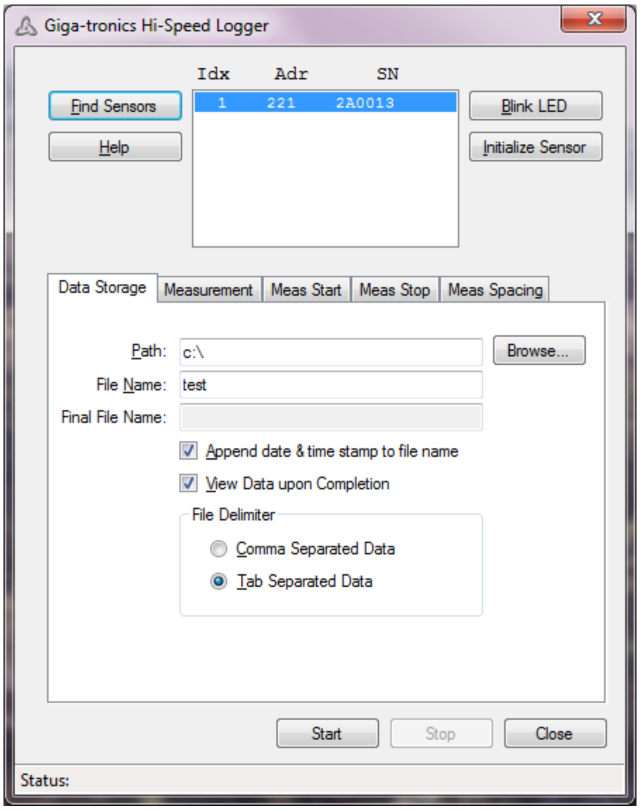
5 High Speed Logger Application

This section describes the High Speed Logger application. There is a Logger Application contained within the Power Meter application, but is more limited than this application.

NOTE. *This application is available for all instrument models.*

NOTE. *Using more than one type of application at a time can result in errors. It is recommended that you use only one type of application at a time.*

When you first open the High Speed Logger Application, a window will appear asking if you would like to initialize the instrument. Select **Yes**. If you have multiple instruments connected, select an instrument by clicking on the instrument name, and then click **Initialize Sensor**. The default view will look similar to the following image.



There are several buttons at the top of the GUI, which are described below:

5.2 Graphical User Interface Description

5.2.1 Buttons

Find Sensors Click this button to tell the software to search for all connected instruments. The results will appear in the window with the instrument serial number and address.

Sensor ID Click this button to activate the green LED on the selected instrument. This is useful when you have multiple instruments connected and you want to identify a particular one.

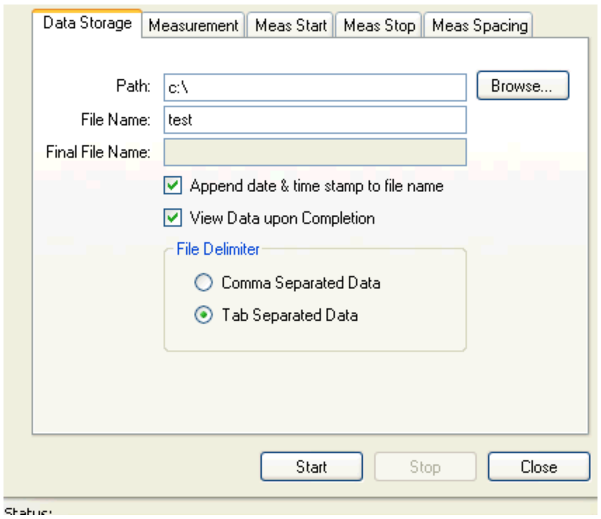
Initialize Sensor Click this button to initialize the instrument. When initialization is complete, a dialog box will appear stating so.

Help Click this button to open the online help file for this application. It is in a PDF format.

At the bottom of the GUI, there is a window with 5 tabs consisting of: Data Storage, Measurement, Meas Start, Meas Stop, Meas Spacing.

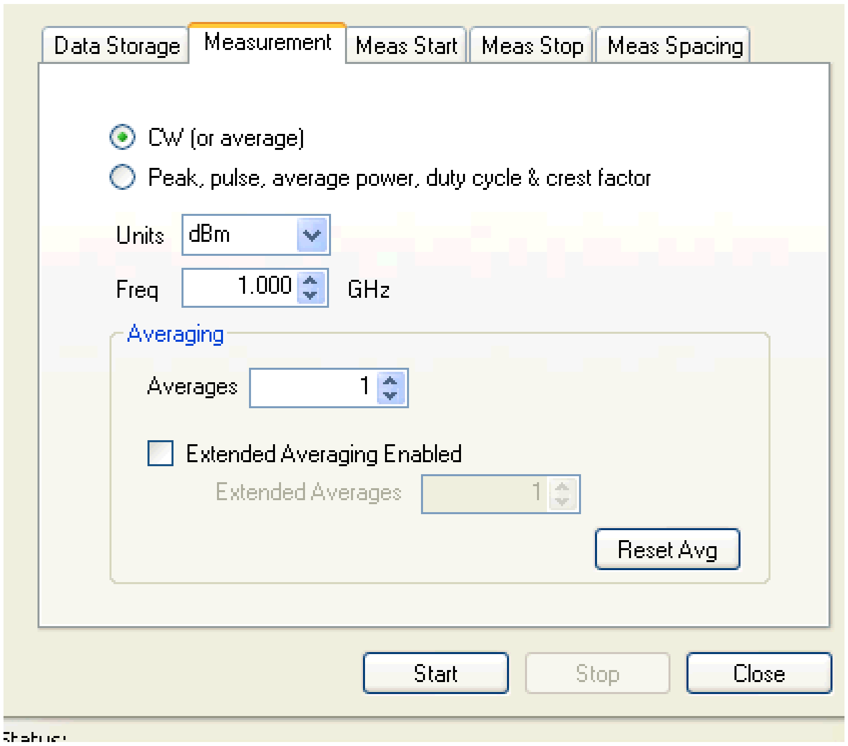
5.2.2 Tabbed Menu:

Data Storage Use the Data Storage window to specify where files will be stored and to select to add a date and time stamp to the file name. If you check Append date and time to file name, the date and time is appended to the specified file name and modified each time a new set of data is taken. This allows you to take several sets of data without having to specify a new name. It also groups the files together in the file browser. You can also choose to view a NotePad (by default) version of the data when the measurements are completed.



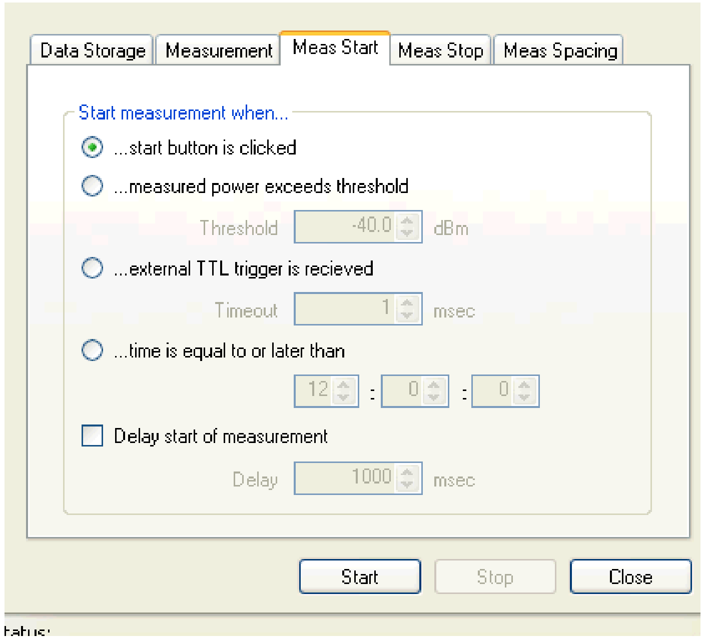
The application also allows you to select the format of the files you save (tab or comma delimited). Tab delimited works well with spreadsheet applications like Microsoft Excel.

Measurement Use the Measurement window to select measurement type, units, and frequency.



In order to get accurate measurements you will need to set the frequency. If CW is selected, only the average or continuous wave power is recorded. If Peak, pulse… is selected, then all of the indicated parameters are recorded.

Meas Start This window allows you to select when to start a measurement.



The measurement process proceeds as follows:

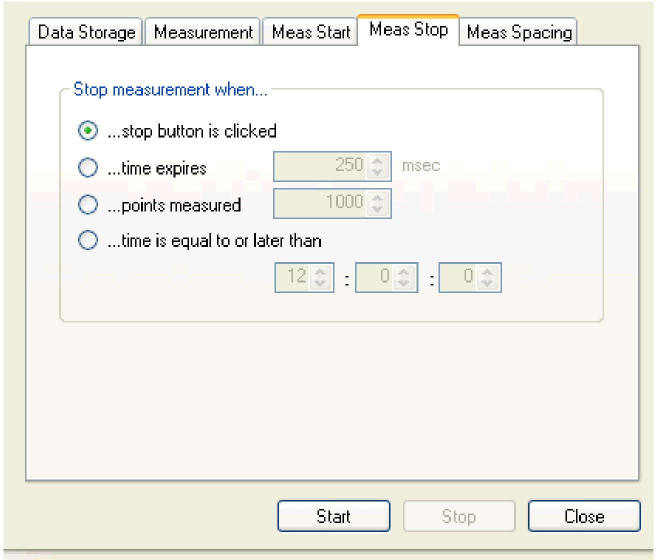
1. Select the start criteria with one of the following settings:
   - Threshold: Clicking start causes the application to monitor the incoming measurements (average power if CW has been selected and peak power if peak has been selected). As soon as the appropriate measurement exceeds the specified threshold, the measurement proceeds. The threshold is specified in dBm.
   - External TTL Trigger: Clicking start causes the application to monitor the external TTL trigger input. When a trigger occurs, measurement will begin. Only the first measurement requires a trigger. You can set the trigger timeout. If the timeout occurs before the measurement begins, no measurements will be made.
   - Time of Day: Set the time of day when you want measurements to begin.
   - Click the start button to begin the measurement process.
2. Execute a delay if desired. The delay begins immediately after the start criteria has been satisfied and precedes the start of measurements.

Meas Stop Set the criteria for stopping a measurement to this window with one of the following options:

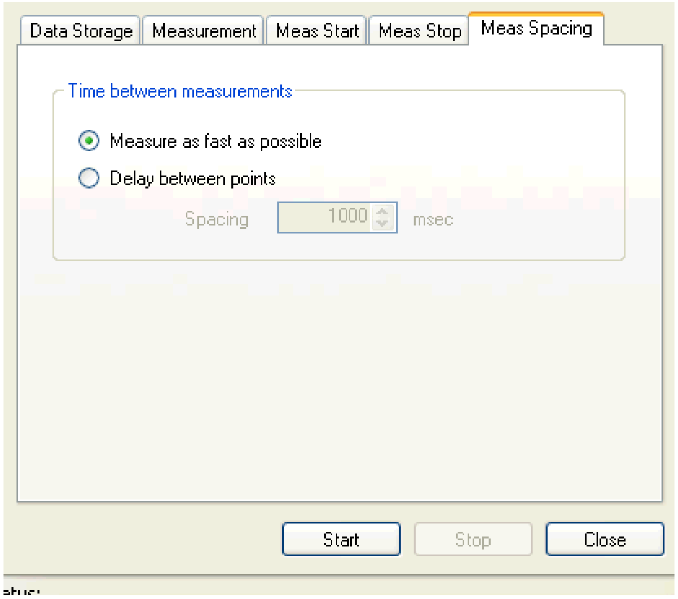
Stop button: Click the stop button to stop the measurement.

Time expires: Specify the time, in milliseconds, when the measurement will stop.

Points measured: Specify the number of measurements to be taken.



Meas Spacing The measurement spacing window allow you to define the time between measurements



Fast as possible: Measures at about 350 µs per point on most computers. Some computers will be faster, some slower. However, many other factors may affect this rate. Virtually any loading on the computer may reduce the rate of measurement. The magnitude of the effect is a function of the power of the computer and the demands of the competing applications.

Delay between points (in milliseconds): Set this value to that a delay in the prescribed number of points causes a stop in measurement. As stated above, many factors can negatively impact this rate. Again, these affects tend to be modest in most cases and pose little concern. In addition, the resolution and accuracy of the computer clock will have some effect.

5.3 Make a Simple Measurement

The following information outlines how to make some simple measurements using this application. These procedures assume that a single instrument is connected and that you have installed the appropriate applications.

Table 13 Use the Hi Speed Logger (Strip Chart) software

<table>
<tr><th colspan="2">Use Hi Speed Logger to Make a Simple Measurement</th></tr>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1.</td><td>Start the High Speed Logger Application, selecting Yes to initialize the instrument.

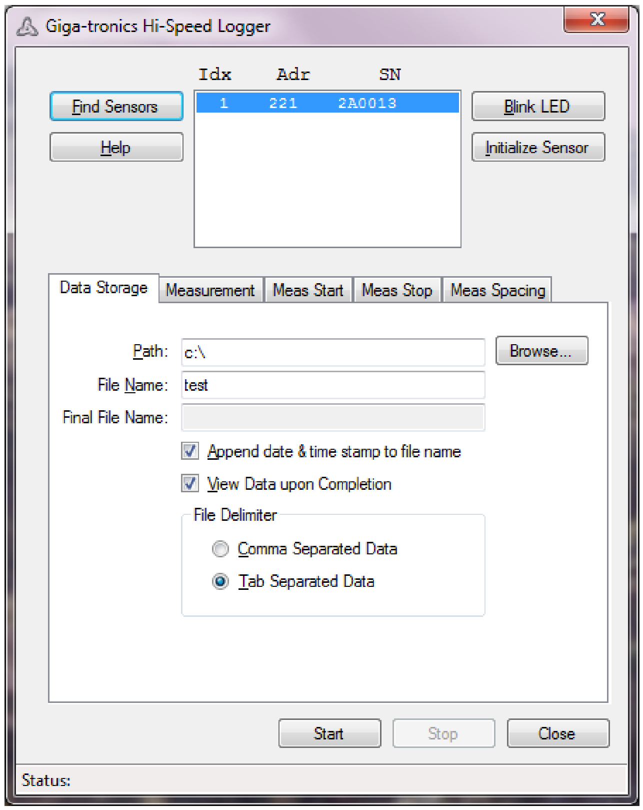


Figure 17. High Speed Logger application window</td></tr>
<tr><td>2.</td><td>Select the Data Storage tab and click the Browse... button. Select Desktop (your desktop) and then click OK.</td></tr>
<tr><td>3.</td><td>Enter TestFile into the File Name text box.</td></tr>
<tr><td>4.</td><td>Check the Append and View Data boxes if they are not already checked.</td></tr>
<tr><td>5.</td><td>Select Tab Separated Data for the file delimiter.</td></tr>
<tr><td>6.</td><td>Click the Measurement tab and select CW.</td></tr>
<tr><td>7.</td><td>Set the units to dBm and the frequency to 1.000 GHz.</td></tr>
<tr><td>8.</td><td>Click the Meas Start tab and select start button is clicked.</td></tr>
</table>

Use Hi Speed Logger to Make a Simple Measurement	
Step	**Action**
9.	Click the **Meas Stop** tab and select **stop button is clicked**.
10.	Click the **Meas Spacing** tab and select **as fast as possible**.
11.	Click the **Start** button, wait one to two seconds, then click **Stop**.
12.	A Notepad or text file should appear with the data. Depending on the time between clicking Start and Stop, you may have several thousand lines. If you used tab delimited text, you should be able to copy and paste portions of this file directly into a Microsoft Excel spreadsheet. You should see the icon for the file on your desktop and the name of the file should include the date and time.
End of Procedure	

5.4 Troubleshooting Memory Errors

This application can generate a large amount of data and can consume significant amounts of memory and disk space. This can cause two problems. This will probably be because the text file written during measurements is too large for the application trying to display the file (probably NotePad) if you are running as fast as possible. You can assume that text will be generated at 100 kB/s for CW measurements, and 250 kB/s for pulse measurements. If your computer runs out of RAM or disk space, this may also cause a problem. Each measured point requires (roughly) 54 bytes. If there is not sufficient memory (RAM) and you do not reduce memory usage, you could run out of RAM. To address either problem, reduce the reading rate using the **Meas Spacing** settings. For text files, you can also reduce the duration of the test run by adjusting the **Meas Start** and **Meas Stop** setting, or deselect the **View Data upon Completion** check box.

6 Specifications

6.2 General Specifications for all GT-8550B Series Power Sensors

Table 14: General Sensor Specifications

General Sensor Specifications		
Parameter	**Specification**	
USB voltage	+4.5 V to +5.5 V	
USB power	450 mA typical, 500 mA maximum	
Operating temperature	0 °C to 50 °C	
Storage temperature	-20 °C to +75 °C	
USB cable length	15 ft. (5 m) maximum	
Dimensions (GT-8551B, GT-8552B)	2" H x 2.5" W x 3" D (50 mm H x 65 mm W x 75 mm D)	
Dimensions (GT-8553B, GT-8554B, GT-8555B)	2" H x 2.5" W x 3.5" D (50 mm H x 65 mm W x 90 mm D)	
Weight	< 1 lbs (< 0.5 kg)	
Environmental	MIL-PRF-28800F, Class 3 WEEE compliant, RoHS compliant	
Safety	EN 61010 and CE compliant	
Emissions	EN 61326 and FCC compliant	
Video bandwidth	GT-8551B, GT-8552B and GT-8555B: 10 MHz minimum	GT-8553B and GT-8554B: 100 Hz typical
Measurement speed	2000 Reading/second typical	
Maximum peak-to-average ratio	GT-8551B, GT-8552B, GT-8553B and GT-8554B: 70 dB typical GT-8555B: 55 dB typical	
RF Input Connector	GT-8551B, GT-8552B and GT-8553B: Low VSWR, Type-N (m) GT-8554B, GT-8555B: Low VSWR, SMA (m)	
USB Port	Rugged 4-Pin USB	
Frequency range		
GT-8551B and GT-8552B	100 MHz to 8 GHz, operational to 10 GHz	
GT-8553B	10 MHz to 18 GHz	
GT-8554B	10 MHz to 26.5 GHz	
GT-8555B	100 MHz to 20 GHz	
Continued on next Page		
Dynamic range		

General Sensor Specifications			
Parameter	**Specification**		
GT-8551B and GT-8552B	100 MHz to 6 GHz: -60 dBm to +20 dBm	6 GHz to 8 GHz: -50 dBm to +20 dBm	
GT-8553B and GT-8554B	-50 dBm to +20 dBm		
GT-8555B	-40 dBm to +20 dBm		
Maximum peak input power (damage level)	+23 dBm (200 mW) Maximum input voltage: 25 VDC		
VSWR			
GT-8551B	100 MHz to 250 MHz: 1.18:1	250 MHz to 8 GHz: 1.15:1	8 GHz to 10 GHz: 1.18:1 typical
GT-8552B	100 MHz to 250 MHz: 1.18:1	250 MHz to 8 GHz: 1.15:1	8 GHz to 10 GHz: 1.18:1 typical
GT-8553B	10 MHz to 10 GHz: 1.20:1	10 GHz to 18 GHz: 1.30:1	
GT-8554B	10 MHz to 10 GHz: 1.20:1	10 GHz to 26.5 GHz: 1.30:1	
GT-8555B	100 MHz to 10 GHz: 1.20:1	10 GHz to 20 GHz: 1.29:1	
Trigger Input function (applies only to GT-8551B, GT-8552B, and GT-8555B sensors)			
Rate	1 Hz to 750 kHz		
Resolution	20.8 ns		
Modes	Single or Continuous		
Trigger Source	Internal or External		
Internal Trigger Level Range	-20 dBm to +20 dBm (Manual or Auto)		
External Trigger Input	TTL compatible, rising or falling edge		
Operating Input Levels	0.0 V to 0.8 V (low), 2.0 V to 5.0 V (high), +/- 10 µA		
Maximum Input Levels	-0.5 V (low) to 5.5 V (high)		
Trigger Off Time	1 µs minimum for reliable triggering		

Table 15: General Sensor Measurement Capabilities

General Sensor Measurement Capabilities	
Parameter	**Measurement Capability**
Data Logger (Strip Chart) Mode	Data Logging Output File (CSV)
Statistical Chart Mode	PDF, CDF and CCDF
Other Capabilities	Selectable Power Units, Relative Function, Offset Function, Adjustable Averaging, Upper and Lower Alarm Limits, and Min and Max Hold

6.3 Sensor Measurement Uncertainty Factors

6.3.1 Accuracy

Measurement uncertainty is computed from the individual cal factor, mismatch, linearity, noise and temperature error factors, and can be computed as either worst case (sum of the applicable error terms) or RSS, representing the most probable error, where RSS is the square root of the sum of the squares of the error terms.

Accuracy is typically < 2 % (RSS) mid-band with source VSWR 1.2:1 (or better) at 25 °C +/- 5 °C.

This section presents correction factors for various aspects of sensor measurements.

Table 16: GT-8551B Measurement Uncertainty Factors

GT-8551B Measurement Uncertainty Factors					
Parameter	**Specification**				
Calibration Factor	100 MHz to 0.5 GHz		0.5 GHz to 8 GHz		
-60 to +20 dBm	4 %		1.7 %		
Linearity	100 MHz to 2 GHz		2 GHz to 8 GHz		
+15 to +20 dBm	7 %		5 %		
+10 to +15 dBm	5 %		3 %		
-60 to +10 dBm	3 %		2 %		
Noise [1]	100 MHz to 6 GHz		6 GHz to 8 GHz		
-30 to +20 dBm	0.02 %		0.04 %		
-50 to -30 dBm	0.04 %		0.15 %		
-60 to -50 dBm	0.11 %		N/A		
Temperature	0 °C to 10 °C	10 °C to 20 °C	20 °C to 30 °C	30 °C to 40 °C	40 °C to 50 °C
-60 to 0 dBm	1 %	0.75 %	0 %	0.75 %	1 %
0 to +10 dBm	2 %	1.75 %	0 %	1.75 %	2 %
+10 to +20 dBm	4 %	3.75 %	0 %	3.75 %	4 %
Zero Offset	100 MHz to 8 GHz				
-60 to +20 dBm	0.35 nW typical at 25 °C, 1.7 nW typical at 0 °C to 50 °C				

[1] Noise measured with a 5 second integration time.

Table 17: GT-8552B Measurement Uncertainty Factors

GT-8552B Measurement Uncertainty Factors					
Parameter	**Specification**				
Calibration Factor	100 MHz to 0.5 GHz		0.5 GHz to 8 GHz		
-60 to +20 dBm	4 %		1.7 %		
Linearity	100 MHz to 2 GHz		2 GHz to 8 GHz		
+15 to +20 dBm	7 %		5 %		
+10 to +15 dBm	5 %		3 %		
-60 to +10 dBm	3 %		2 %		
Noise [1]	100 MHz to 6 GHz		6 GHz to 8 GHz		
-30 to +20 dBm	0.02 %		0.04 %		
-50 to -30 dBm	0.04 %		0.15 %		
-60 to -50 dBm	0.11 %		N/A		
Temperature	0 °C to 10 °C	10 °C to 20 °C	20 °C to 30 °C	30 °C to 40 °C	40 °C to 50 °C
-60 to 0 dBm	1 %	0.75 %	0 %	0.75 %	1 %
0 to +10 dBm	2 %	1.75 %	0 %	1.75 %	2 %
+10 to +20 dBm	4 %	3.75 %	0 %	3.75 %	4 %
Zero Offset	100 MHz to 8 GHz				
-60 to +20 dBm	0.35 nW typical at 25 °C, 1.7 nW typical at 0 °C to 50 °C				

[1] Noise measured with a 5 second integration time.

Table 18: GT-8553B Measurement Uncertainty Factors

GT-8553B Measurement Uncertainty Factors					
Parameter	**Specification**				
Calibration Factor	10 MHz to 1.0 GHz	1 GHz to 10 GHz		10 GHz to 18 GHz	
-50 to +20 dBm	1.8 %	1.7 %		1.9 %	
Linearity	10 MHz to 18 GHz				
+15 to +20 dBm	3 %				
-15 to +15 dBm	2.5 %				
-50 to -15 dBm	2 %				
Noise [1]	10 MHz to 18 GHz				
-30 to +20 dBm	0.1 %				
-40 to -30 dBm	0.25 %				
-50 to -40 dBm	0.5 %				
Temperature	0 °C to 10 °C	10 °C to 20 °C	20 °C to 30 °C	30 °C to 40 °C	40 °C to 50 °C
-50 to +20 dBm	2 %	0.75 %	0 %	0.75 %	2 %
Zero Offset	10 MHz to 18 GHz				
-50 to +20 dBm	1 nW typical at 25 °C, 5 nW typical at 0 °C to 50 °C				

[1] Noise measured with a 5 second integration time.

Table 19: GT-8554B Measurement Uncertainty Factors

GT-8554B Measurement Uncertainty Factors					
Parameter	**Specification**				
Calibration Factor	10 MHz to 10 GHz	10 GHz to 18 GHz	18 GHz to 26.5 GHz		
-50 to +20 dBm	2.5 %	2.7 %	3.7 %		
Linearity	10 MHz to 26.5 GHz				
+15 to +20 dBm	3 %				
-15 to +15 dBm	2.5 %				
-50 to -15 dBm	2 %				
Noise [1]	10 MHz to 26.5 GHz				
-30 to +20 dBm	0.1 %				
-40 to -30 dBm	0.25 %				
-50 to -40 dBm	0.5 %				
Temperature	0 °C to 10 °C	10 °C to 20 °C	20 °C to 30 °C	30 °C to 40 °C	40 °C to 50 °C
-50 to +20 dBm	2 %	0.75 %	0 %	0.75 %	2 %
Zero Offset	10 MHz to 26.5 GHz				
-50 to +20 dBm	1 nW typical at 25 °C, 5 nW typical at 0 °C to 50 °C				

[1] Noise measured with a 5 second integration time.

Table 20: GT-8555B Measurement Uncertainty Factors

GT-8555B Measurement Uncertainty Factors					
Parameter	**Specification**				
Calibration Factor	100 MHz to 0.5 GHz	0.5 GHz to 12.5 GHz	12.5 GHz to 18 GHz	18 GHz to 20 GHz	
-40 to +20 dBm	4 %	2.6 %	3.2 %	3.5 %	
Linearity	100 MHz to 2 GHz	2 GHz to 20 GHz			
+15 to +20 dBm	7 %	6 %			
+5 to +15 dBm	5 %	4 %			
-40 to +5 dBm	3 %	2 %			
Noise [1]	100 MHz to 20 GHz				
-30 to +20 dBm	0.25 %				
-40 to -30 dBm	0.50 %				
Temperature	0 °C to 10 °C	10 °C to 20 °C	20 °C to 30 °C	30 °C to 40 °C	40 °C to 50 °C
-40 to +20 dBm	2.5 %	1.25 %	0 %	1.25 %	2.5 %
Zero Offset	100 MHz to 20 GHz				
-40 to +20 dBm	0.25 nW typical at 25 °C, 0.75 nW typical at 0 °C to 50 °C				

[1] Noise measured with a 5 second integration time.

6.4 Additional Technical Specifications

Table 21: GT-8551B Additional Measurement Capabilities

GT-8551B Additional Measurement Capabilities	
Parameter	**Measurement Capability**
Peak Power Mode	Pulse Power, Peak Power, Average Power, Duty Cycle and Crest Factor
Pulse Power Mode	Peak Power, Average Power, Duty Cycle and Crest Factor
Duty Cycle	Duty Cycle Corrected Power, Peak Power, Average Power and Crest Factor

Table 22: GT-8552B and GT-8555B Additional Technical Specifications

GT-8552B and GT-8555B Additional Technical Specifications	
Parameter	**Specification**
Sample Rate	48 MS/s
Rise/Fall Time	< 55 ns (10% to 90%) at 4 GHz
Minimum Pulse Width [1]	100 nS typical
Minimum Duty Cycle [2]	0.01%

[1] The minimum pulse width is the recommended minimum pulse width viewable on the power meter, where power measurements are meaningful and accurate, but not warranted.

[2] The minimum duty cycle is the recommended minimum duty cycle viewable on the power meter, where power measurements are meaningful and accurate, but not warranted.

Table 23: GT-8552B and GT-8555B Additional Measurement Capabilities

GT-8552B and GT-8555B Additional Measurement Capabilities	
Parameter	**Measurement Capability**
Pulse Profiling Gated Measurements	Peak Power, Average Power, Crest Factor, Droop, Overshoot, Rise Time and Fall Time, Duty Cycle, Pulse Repetition Frequency, Pulse Repetition Interval and Pulse Width
Pulse Profiling Marker Measurements	Peak Power and Delta Markers
Peak Power Mode	Pulse Power, Peak Power, Average Power, Duty Cycle and Crest Factor
Pulse Power Mode	Peak Power, Average Power, Duty Cycle and Crest Factor
Duty Cycle	Duty Cycle Corrected Power, Peak Power, Average Power and Crest Factor

End of Document