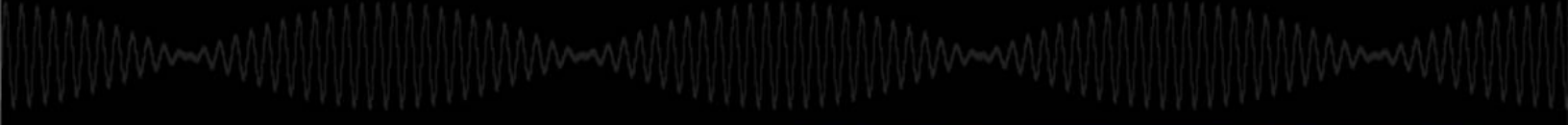


WT1600

THE NEXT GENERATION POWER ANALYZER



Product Tutorial



WT1600 PRODUCT TUTORIAL

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WT1600 POWER ANALYZER DEMONSTRATION GUIDE

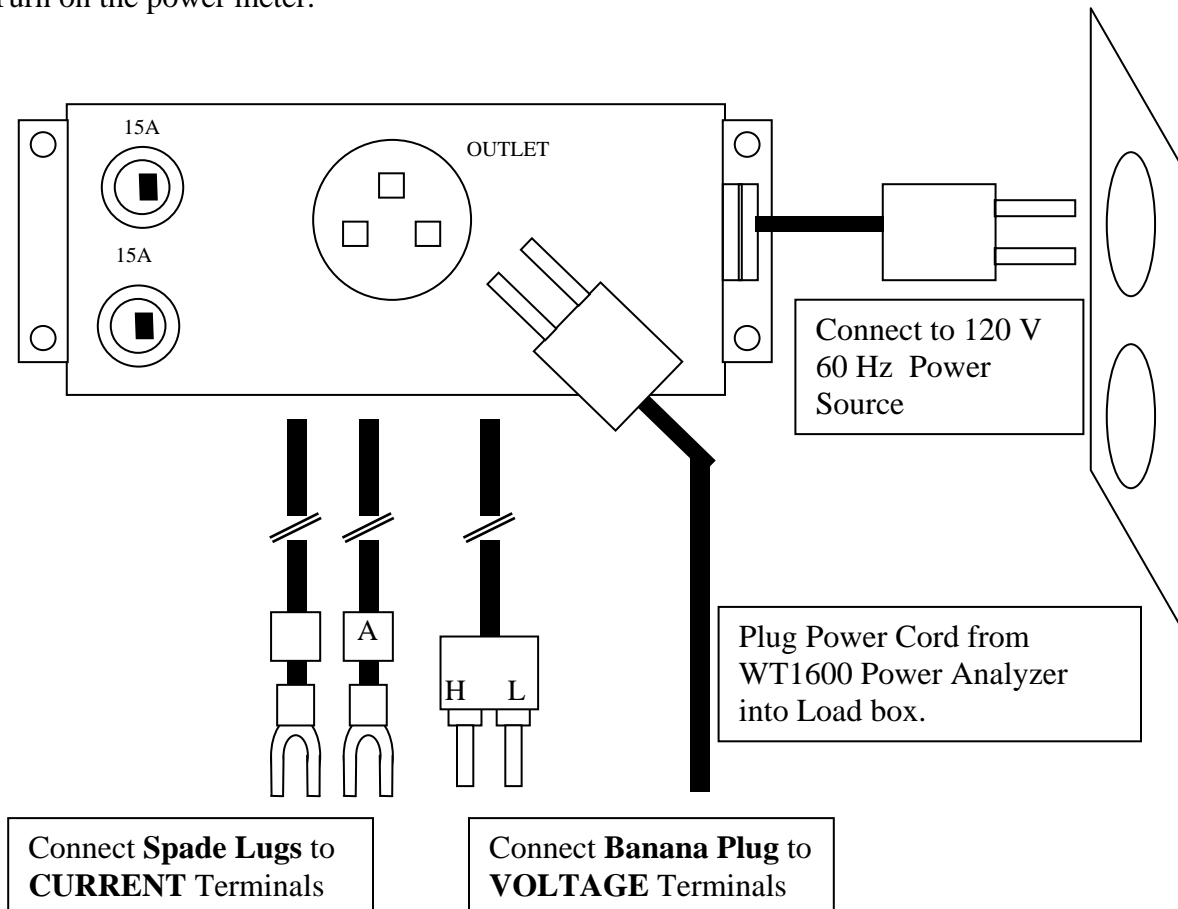
A.) OVERVIEW & OBJECTIVES

The following is a basic demo procedure for the WT1600 Power Analyzer. This demo uses the power meter's own power supply for the load. This demo can easily be done in a conference room or lab without having to hook up to the customer's load.

B.) POWER METER CONNECTION

Measuring consumption power of the WT1600 Power analyzer

1. Connect the Power Meter using the load cord. Plug the **Banana** plugs into the **Voltage** input terminals of Element # 1. Connect the **Spade** lugs to the **Current** terminals of element # 1. Make sure all connections are tight.
2. Plug the power meter power cord into the load cord.
3. Turn on the power meter.



C.) BASIC SETUP FOR POWER MEASUREMENT

SETTING RANGES

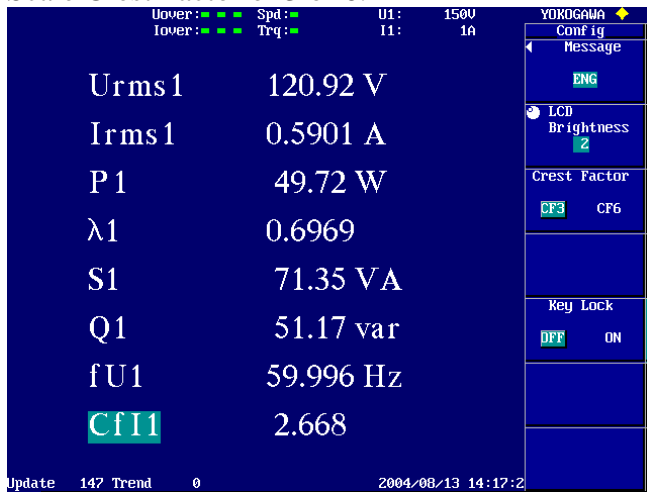


1. Select Element 1 to 6
2. Select Voltage Range
3. Select Current input Terminal
4. Select Current Range
5. Copy Settings to other Like Input Elements

1. Press <RANGE> Button.
2. Press Element Object “Soft Key” and Select Element 1.
3. Press “Soft Key” next to U (Voltage) Range Up OR U (Voltage) Range Down. Voltage range for Element 1, U1, is displayed at the top of the screen. Set to 150 V.
4. Next Select Terminal by pressing the “Soft Key.” This is the Current input Terminal. Direct is for connecting a Current Source to the Large Black Terminals. Sen is the Sensor Input Terminal. This terminal is for a mV signal from a Shunt, or a Voltage signal from a Current Sensor. Select Direct for this demo.
5. Press “Soft Key” next to I (Current) Range Up OR I (Current) Range Down. Current range for Element 1, I1, is displayed at the top of the screen under the voltage range indication. Set to 1 A.
6. If you want to copy the settings you just made for Element 1 to all the other Elements, Press the Range Copy Exec “Soft Key”.
7. If you want different Ranges on the other Elements, Select the Element Number, and set the Voltage and Current ranges.
8. To see the Ranges for each of the Elements, Press <ESC> Button. The setup menu will disappear.

CREST FACTOR SETUP

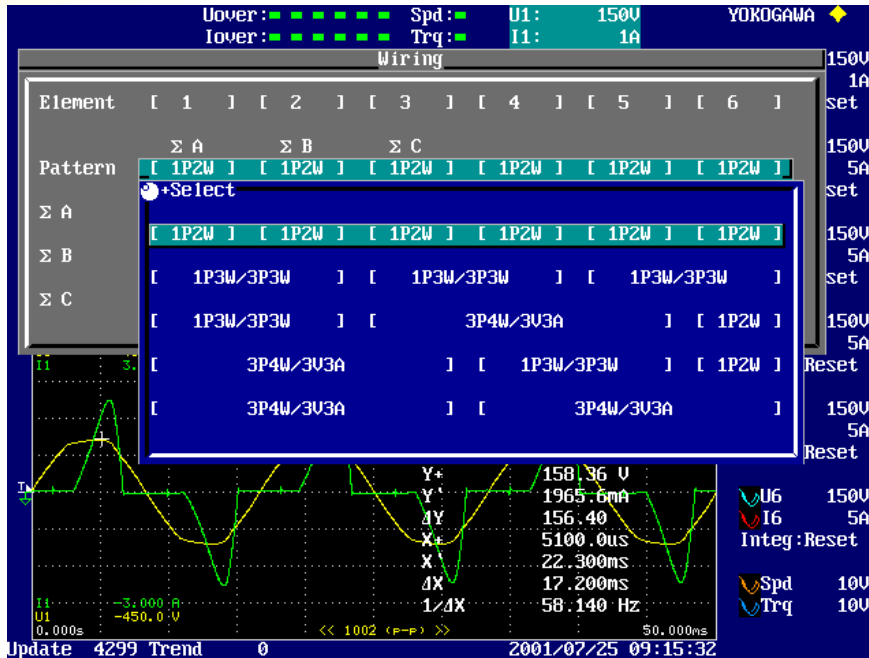
WT1600's with Firmware Version 3.21 or higher have a Setup function for selecting Full Scale Crest Factor of 3 or 6.



1. Press <MISC> key.
 2. Press Config “Soft key.”
 3. Press Crest Factor “Soft Key” to select CF3 or CF6.
- Crest Factor is a ratio of the Peak Value of the waveform to the RMS Value of the waveform. The Crest Factor rating of 3 or 6 is the rating at the Full Scale value of Voltage or Current.

RANGE SELECTION					
CF3 Setting			CF6 Setting		
V Range	I Range	Sen Range	V Range	I Range	Sen Range
5 Amp Input Element					
Auto	Auto	10 V	Auto	Auto	5 V
1000 V	5 Amp	5	500 V	2.5 Amp	2.5
600	2	2.5	300	1	1
300	1	1	150	500 mA	500mV
150	500 mA	500mV	75	250	250
100	200	250	50	100	125
60	100	100	30	50	50
30	50	50	15	25	25
15	20		7.5	10	
10	10		5	5	
6			3		
3			1.5		
1.5			0.75		
50 Amp Input Element					
Auto	Auto	10 V	Auto	Auto	5 V
1000	50 Amp	5	500 V	25 Amp	2.5
600	20	2.5	300	10	1
300	10	1	150	5	500mV
150	5	500mV	75	2.5	250
100	2	250	50	1	125
60	1	100	30	0.5	50
30		50	15		25
15			7.5		
10			5		
6			3		
3			1.5		
1.5			0.75		

WIRING



1. Press <Wiring> Button.
2. Press <SELECT> Button to display the Pattern configurations.
3. Turn the **Rotary Knob** to highlight the wiring configuration desired. Press <SELECT>
4. Set up a **3-Phase 3-Wire Configuration**. How many ways can you do this setup?
 - a. Highlight the **Pattern** line. Press <SELECT> Button.
 - b. Turn the **Rotary Knob** to highlight [1P3W/3P3W] [1P3W/3P3W] [1P3W/3P3W]. Press <SELECT> Button. Note that Element Groups 1 & 2, 3 & 4, and 5 & 6 are used for the 3-wire connection.
 - c. Turn the **Rotary Knob** to highlight ΣA . Press <SELECT> Button to highlight 3P3W. Repeat for ΣB and ΣC . Press <ESC> Button to clear.
 - d. Press <Wiring>, highlight the **Pattern** line. Press <SELECT> Button.
 - e. There are Four (4) different wiring configurations that can be used for 3P3W.
5. Set up a **3-Phase 4-Wire Configuration**.
 - a. Press <Wiring>, highlight the **Pattern** line. Press <SELECT> Button.
 - b. Turn the **Rotary Knob** to highlight [1P3W/3P3W] [3P4W/3V3A] [1P2W]. Press <SELECT> Button.
 - c. Turn the **Rotary Knob** to highlight ΣB .
 - d. Press <SELECT> Button to highlight 3P4W. Press <ESC> Button to clear.
 - e. There are Three (3) different wiring configurations that can be used for 3P4W.
6. For this demo set up a **Single Phase Two Wire Configuration** for Element 1.

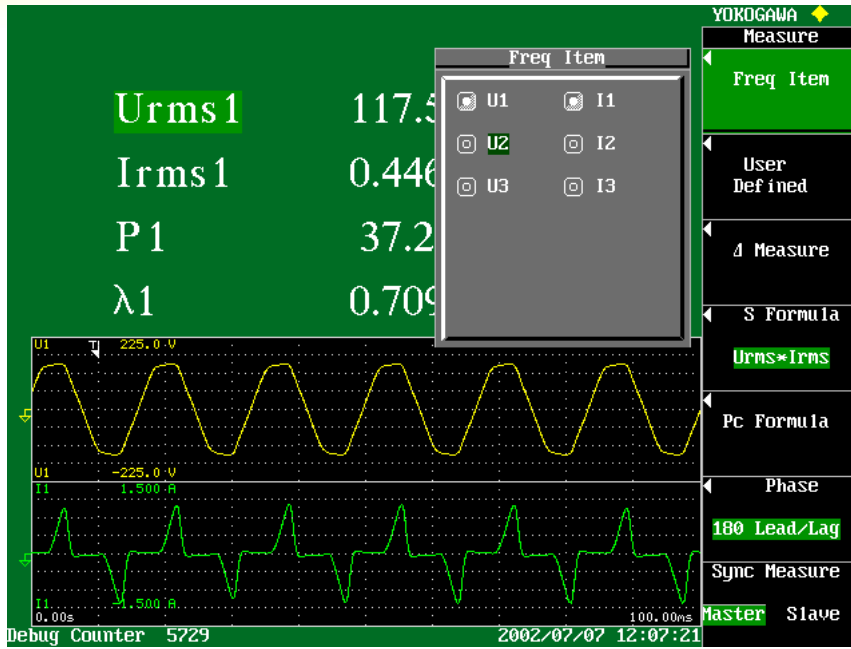
SETTING DISPLAY ITEMS



1. Set Display Format
2. Select number of measurement items to be displayed
3. Menu to Setup the Numeric Items to be Displayed
4. Scrolls Page UP and DOWN for Viewing Additional Numeric Data

1. Press <DISPLAY> Button.
2. First select the **Display Format** style for viewing the measured data. Press the “Soft Key” next to **Format**.
3. Turn the **Rotary Knob** to highlight the desired Display Format. Press <SELECT>.
4. Press **Format** “Soft Key” again and Turn the **Rotary Knob** to **Information** and Press <Select>.
5. Press the “Soft Key” next to **Power Element, Trend, D/A Output** and **Motor Element**. An information overview is displayed for each of the functions selected. Note that you cannot make any changes to the settings from these displays.
6. Press **Format** “Soft Key” and turn the **Rotary Knob** to highlight **Numeric Display Format**. Press <SELECT>.
7. Press **Item Amount** “Soft Key” The Number in () is the amount of Numeric items displayed with a split screen, such as Numeric + Wave. Select 8(4) for this exercise.
8. Press **Numeric Disp Items** “Soft Key”.
9. Press **Norm Item No.** “Soft Key” and turn **Rotary Knob** to display 1.
10. Press **Function** “Soft Key.” Turn **Rotary Knob** to highlight **Urms**. Press <SELECT>.
11. Press **Element** “Soft Key.” Highlight **Element 1** and Press <SELECT>.
12. Repeat this procedure to setup the display as shown above.
13. Press <ESC> Button twice to clear the Display Menus.


SETTING FREQUENCY ITEMS



Set the Frequency Items to be measured.

1. Up to three different Frequency Items, or Sources can be measured with the WT1600.
2. The **Freq Item** in the **MEASURE** Menu must be set to match the Frequency Sources selected in **Numeric Display Items** menu.
3. Press **<MEASURE>** Button.
4. Press **Freq Item** “Soft Key”
5. Turn the **Rotary Knob** to highlight the Frequency Items to be measured. Press **<SELECT>** Button.
6. For this demo, select **U1** and **I1**.
7. Press **<ESC>** Button twice to exit this menu.

8. SETTING UPDATE RATE

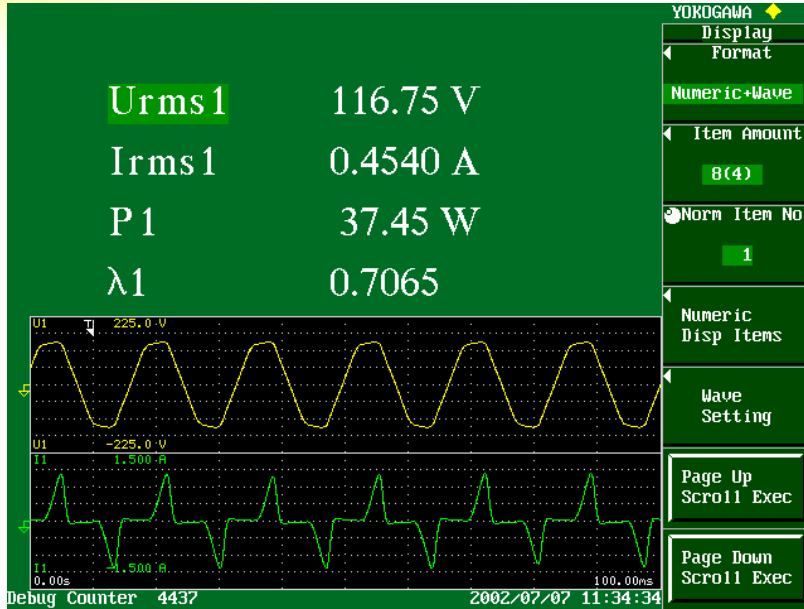


The screenshot shows a green background with white text. At the top right, it says 'Rate: 50msec'. Below this, there is a list of measurements: Urms1 (123.22 V), Irms1 (0.4396 A), P1 (38.61 W), λ1 (0.7137), fU1 (60.007 Hz), I+pk1 (1.2296 A), Q1 (37.89 var), and S1 (54.10 VA). On the right side of the screen, there are two buttons: 'Update Rate Up Exec' and 'Update Rate Down Exec'. The 'Update Rate' label is at the top right of the screen.

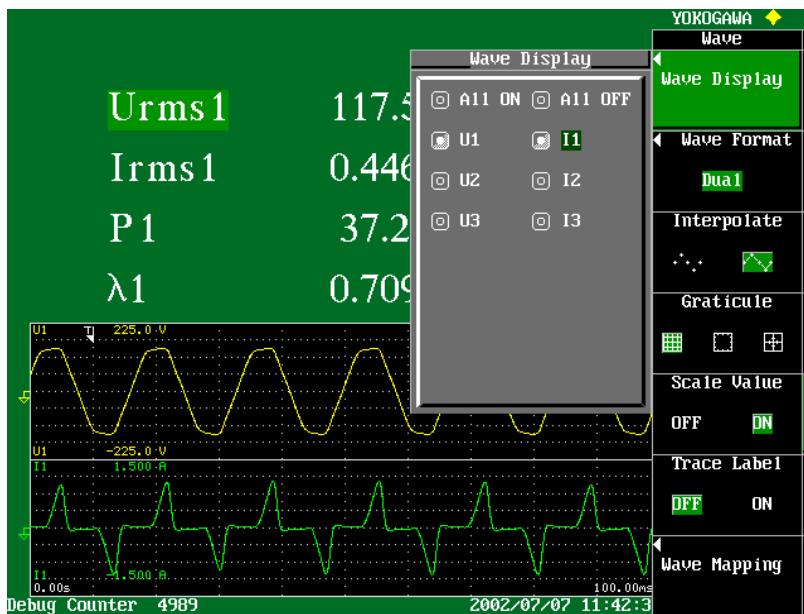
Update Rate is displayed at Top Right of screen.
Increases the Data Update Rate.
Decreases the Data Update Rate

1. Press <UPDATE RATE> Button
2. This function is the **Data Update Rate**, *NOT ALWAYS* the **Display Update Rate**.
3. Press the **Update Rate Up Exec** “Soft Key” to **Increase** the Data Update Rate
4. The fastest Data Update Rate is 50msec, 20 readings per second.
5. Press the **Update Rate Down Exec** “Soft Key” to **Decrease** the Data Update Rate
6. The slowest Data Update Rate is 5 sec.
7. Note 1: The fastest Display Update rate is 100 msec, even when the Data Update Rate is set to 50 msec.
8. Note 2: When the WAVE Sampling is turned ON, the fastest Display Update rate is 500 msec, regardless of the Data Update setting.
9. Note 3: The Data Update Rate **CANNOT** be changed when in the Harmonic Measurement Mode. This update rate is set automatically, and is determined by the fundamental frequency of the PLL source and the Window Width.

DISPLAYING WAVEFORMS

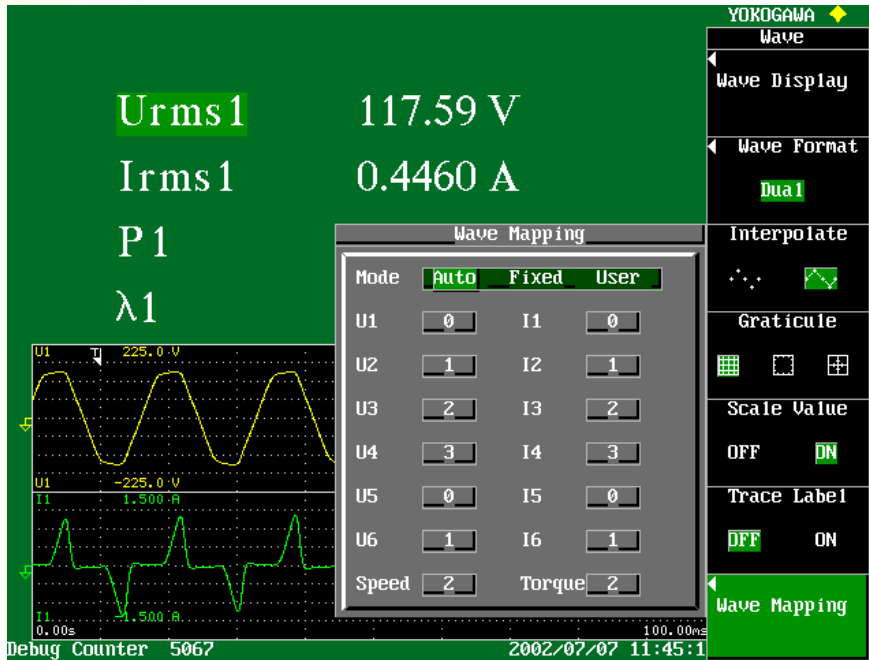


1. Press <DISPLAY> Button. Select **Numeric+Wave**.
2. Press Wave Setting “Soft Key”
3. Press Wave Format “Soft Key”
4. Press Dual “Soft Key” for this demo.
5. Press Wave Display “Soft Key”
6. In the **Wave Display** Window, turn the **Rotary Knob** to highlight the Waveform to be displayed. Press <SELECT> Key to turn on the desired waveform.
7. Press <ESC> Button to exit this menu.



9. Press <WAVE> Button.
10. Press Wave Sampling “Soft Key” to select **ON**.
11. Turn **Rotary Knob** to adjust **Time/div**. Set to 10ms for this demo.
12. Press **Trigger** “Soft Key.” Setup the following Trigger conditions:
13. **Mode:** Auto **Source:** U1 **Slope:** ↑ **Level:** 10%
14. Press <UPDATE RATE> Key. Change the Update Rate and observe the display. Also note the maximum Time/Div as the Update Rate is changed.

WAVE MAPPING

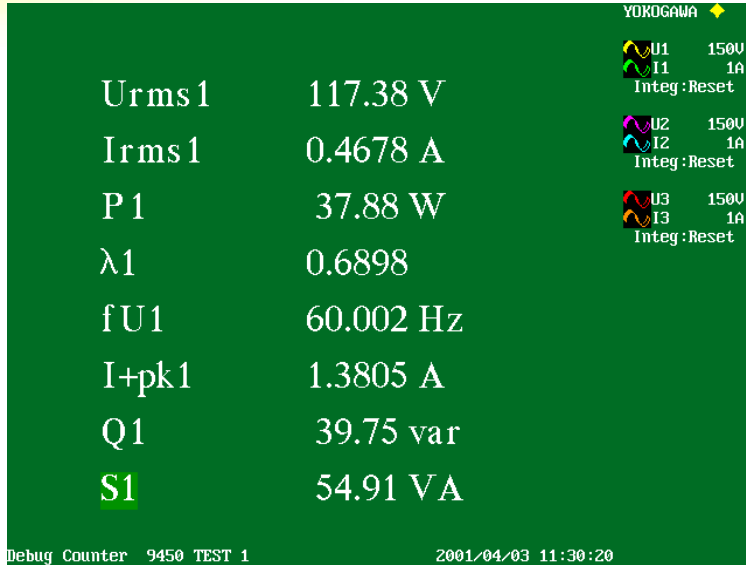


1. Press <DISPLAY> Button.
2. Press Wave Setting “Soft Key.”

3. Press Wave Mapping “Soft Key.”

4. **Auto:** The waveforms that are turned ON for display are assigned a graph position in order from the top graph down. The waveforms are assigned in sequence **U1, I1, U2, I2, U3, I3, ...** if a waveform is turned Off, the next waveforms will move up in sequence.
5. **Fixed:** This fixes the waveforms to their assigned graph location in the sequence **U1, I1, U2, I2, ...** if a waveform is turned Off, the display sequence of the other waveforms does not change.
6. **User:** The waveforms can be assigned arbitrarily by using the **Wave Mapping** programming table. Note that the **Wave Mapping** program applies only when **User** is selected.
7. Press <DISPLAY> Button then Press **Wave Setting** “Soft Key.” Press **Wave Mapping** “Soft Key” to display the menu.
8. Turn **Rotary Knob** to highlight **Mode**. Press <SELECT> to change Mode from **Auto** to **Fixed** to **User**.
9. To change the **User Wave Mapping** program, turn the **Rotary Knob** to highlight a function such as **U1**. Press <SELECT>. Turn the **Rotary Knob** to select graph **0, 1, 2,** or **3**.
10. Wave Format **Single** displays graph **0** only.
Wave Format **Dual** displays graphs **0** and **1**.
Wave Format **Triad** displays graphs **0, 1,** and **2**.
Wave Format **Quad** displays graphs **0, 1, 2,** and **3**.

PRINTING MEASUREMENT DATA



A. SCREEN COPY:

1. The <COPY> Button provides a Screen Copy to a File on the Standard Floppy Disk, or to the Built-In Printer or a Network Printer via Ethernet if these options are installed.
2. Setup the Display in the format you want to copy.
3. Press <SHIFT> <MENU> Buttons. Press Copy To “Soft Key” and then Press Printer
4. You can add a Comment to the Screen that will also be printed. Press Comment “Soft Key” and enter text from the keyboard.
5. When you are ready to Print, Press <ESC> Button. This will clear the set up menu and display the Range Setting information on the screen like example above. Press <COPY>
6. To make a screen copy to the Floppy, Press Copy To “Soft Key” and then Press File “Soft Key.” Press Format “Soft Key” and select format style using “Soft Keys.”
7. Press File Name “Soft Key.” Turn the Rotary Knob to highlight File Name. Press <SELCT> Button. Use the keyboard to enter a file name. Press <ESC> to clear menu.
8. Press <COPY> Button to copy the screen image to a floppy disk.

B. NUMERIC DATA LIST:

1. Press <SHIFT> MENU> Buttons. Press Copy to “Soft Key” and select Printer.
2. Press List Item “Soft Key.” Turn Rotary Knob to highlight All OFF. Press <SELECT>. Turn Rotary Knob to highlight Element 1, Press <SELECT>.
3. Turn Rotary Knob to highlight the measurement functions to print. As an example, highlight Urms, Press <SELECT>. Select other Measurement items such as Irms, P, S, Q, λ , FreqU. Press <ESC> Button to clear this menu.
4. Press Print Data List Exec “Soft Key.”

D.) HARMONIC MEASUREMENTS
HARMONIC SETUP



Mode turns **Harmonics OFF & ON**

Object is the Element Group as set in the **Wiring** menu

Sets the **Phase Lock Loop Source** to any one of the Voltage or Current Inputs or to External Clock source.

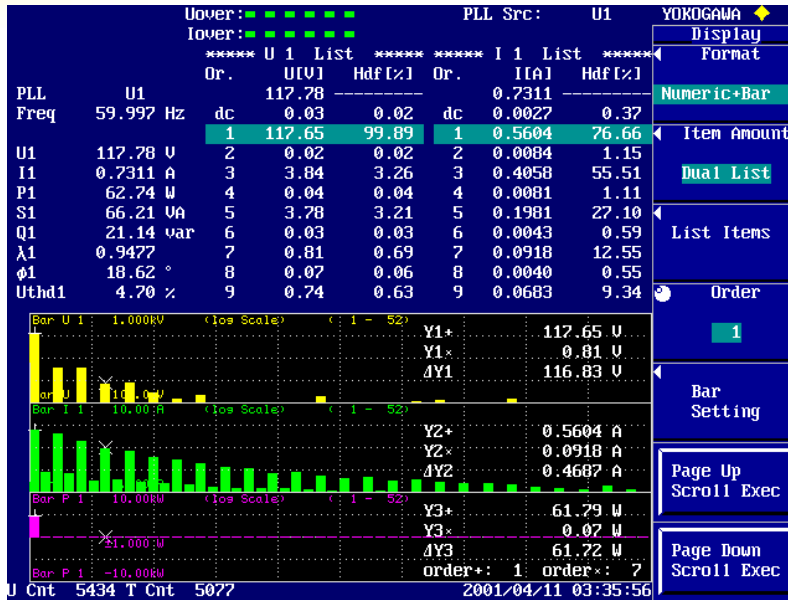
Sets the Maximum Harmonic Order for use in THD Calculation

Sets one of two methods for calculating THD.

Sets one of three Window Widths for FFT Calculation

1. Press <HARMONICS> Button.
2. Press **Mode** “Soft Key.” Turns Harmonic Measurement mode ON.
3. Press **Object** “Soft Key.” Turn **Rotary Knob** to select the Element Group as set in the **Wiring** menu. Set to ΣA for this demo.
4. The PLL Source needs to be a relatively clean waveform. For this demo select Voltage on Element 1. Press the “Soft Keys” to display **PLL Src: U1** at the top of the screen.
5. Harmonic Order, THD Formula, and Window Width can be left at the default settings or changed to your preference. Use the “Soft Keys” to change settings.
6. Press <DISPLAY> Button. Press **Format** “Soft Key” and select **Numeric+Bar**.
7. Press **Item Amount** “Soft Key.” Select **16(8)** with the “Soft Key.”
8. Press **Numeric Disp Items** “Soft Key.” Set display items similar to the example.
9. Press <DISPLAY> Button again to return to Display Menu. Press **Bar Setting** “Soft Key.” Press **Bar Format** “Soft Key.” Select **Dual** or **Triad** for this demo.
10. Press **Bar Item No.** “Soft Key.” Turn **Rotary Knob** and set to **1**.
11. Now Press **Function** “Soft Key.” This selects the Harmonic Spectrum function to be displayed. Turn **Rotary Knob**, highlight **U** (Voltage), and Press <SELECT>.
12. Press **Element** “Soft Key.” Turn **Rotary Knob**, highlight **Element 1**, Press <SELECT>.
13. Repeat Steps 11 & 12 to set up the functions for Bar Display 2 and 3.
14. Press **Order** “Soft Key.” This sets the **Start** and **End Order** to be displayed. This works as a “Zoom” function for the Bar Graph Display.
15. Press <SHIFT> then <CURSOR>. Press **Bar Cursor** “Soft Key” to ON.
16. Use the **Rotary Knob** to move Cursor 1, **Bar C1 +**, and Cursor 2, **Bar C2 X**.

PRINTING HARMONIC DATA



Set Harmonic Display Format

Dual List Display selected with lists for Voltage & Current.

Selects which functions are displayed in the List.

A. SCREEN COPY:

1. The <COPY> Button provides a Screen Copy to a File on the Standard Floppy Disk, or to the Built-In Printer or a Network Printer via Ethernet if these options are installed.
2. Setup the Display in the format you want to copy.
3. Press <SHIFT> <MENU> Buttons. Press Copy to “Soft Key” and then Press Printer.
4. When you are ready to Print, Press <ESC> Button. This will clear the set up menu and display the Range Setting information on the screen. Press <COPY>.

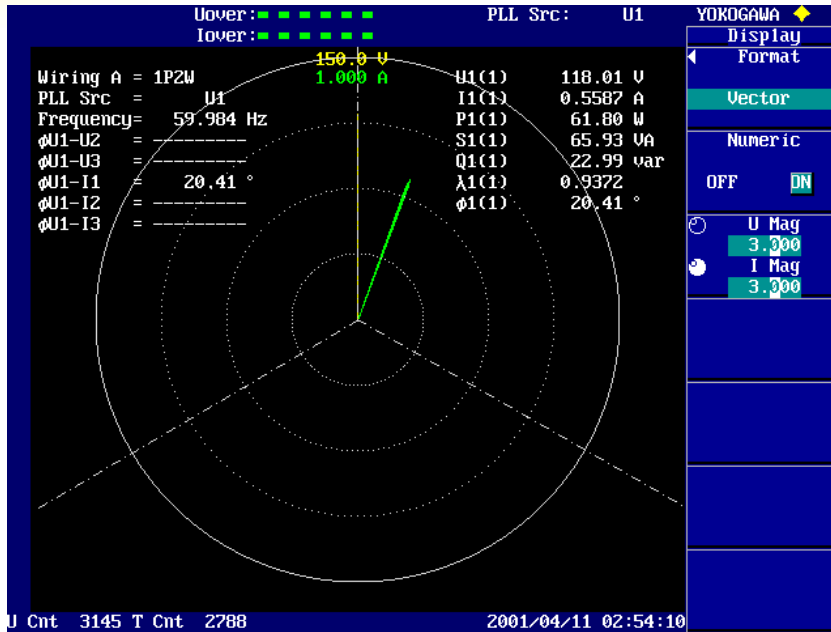
B. NUMERIC DATA LIST: Prints a complete list of all the Harmonic Data

1. Press <SHIFT> <MENU> Buttons. Press Copy to “Soft Key”, and select Printer.
2. Press List Item “Soft Key.” Turn Rotary Knob to highlight Numeric/Bar menu. Press <SELECT> Button to highlight Numeric.
3. Turn Rotary Knob to highlight Element 1. Press <SELECT> to highlight selection.
4. Turn Rotary Knob to highlight the measurement function to print. Highlight I, and Press <SELECT>. Make sure the other functions are turned OFF. Press <ESC> Button to clear this menu.
5. Set the Maximum Harmonic Order before you print the Data List. Press <HARMONICS> Button. Turn Rotary Knob to set Max Order. The order can be set to any value from 1 to 100. Set to 50 for this demo
6. Press <SHIFT> <MENU> Buttons. Press Print Data List Exec “Soft Key.”

C. BAR GRAPH:

1. Press List Item “Soft Key.” Turn Rotary Knob to highlight Numeric/Bar menu. Press <SELECT> Button to highlight Bar.
2. Follow the above instructions to setup and print the Bar Graph Harmonic spectrum.

VECTOR DISPLAY



Set Display Format to Vector

Turns Numeric Items ON & Off in Vector Display

Magnification or ZOOM function for Voltage, U, and Current, I, vectors.

1. Press <DISPLAY> Button. Press Format “Soft Key.” Turn Rotary Knob to highlight Vector. Press <SELECT>.
2. Press Numeric “Soft Key” to ON position.
3. The Vector Display shows the Phase Angle between the Fundamental Voltage and Current waveforms.
4. $\Phi U1 - I1$ is the Phase Angle between the Fundamental Voltage of Element 1 and the Fundamental Current of Element 1.
5. $\lambda 1(1)$ is the Fundamental or Displacement Power Factor. This value is the Cosine $\Phi (U1 - I1)$. Another way to calculate Displacement Power Factor $\lambda 1(1) = P1(1) / S1(1)$
6. To magnify the Vectors, Press Mag “Soft Key.” Turn the Rotary Knob to magnify the Voltage, U, and Current, I, vector display.

OTHER HARMONIC DISPLAY FORMATS

1. Press <DISPLAY> Button. Press Format “Soft Key.”
2. The following Display Formats are available in the Harmonics Mode:

Numeric	Wave
Bar	Vector
Trend	
Numeric+Wave	Numeric+Bar
Numeric+Trend	Wave+Bar
Wave+Trend	Bar+Trend
3. Turn Harmonics Mode OFF. Press <HARMONICS> Button. Press Mode “Soft Key” to OFF Position.

E.) INTEGRATOR FUNCTIONS

INTEGRATOR MODES & MEASUREMENT FUNCTIONS

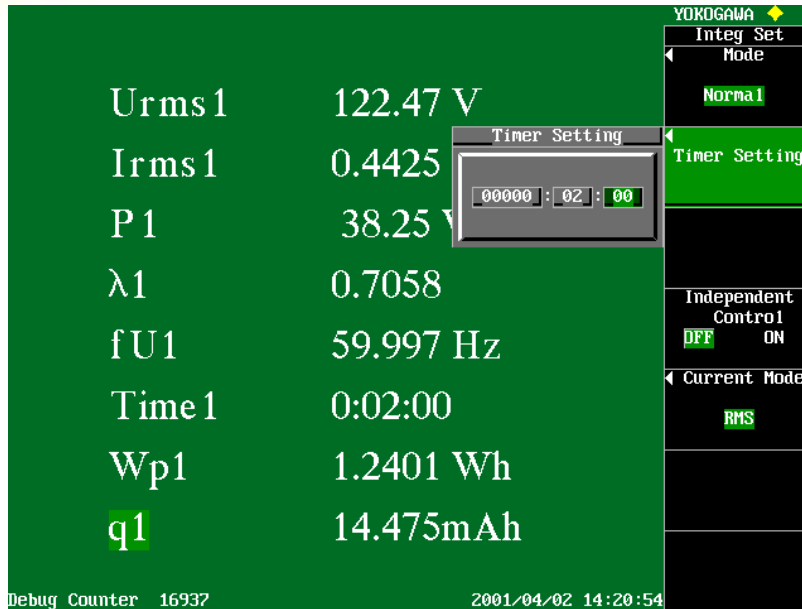


Four Integration Modes

Select by Pressing "Soft Keys" next to desired function.

1. Press <SHIFT> then <INTEG> Buttons. Press Mode "Soft Key."
2. The WT1600 has four Integrator Operation Modes like the other WT Series Power Analyzers.
 - **Normal:** This is the Default Mode and the simplest and easiest to demonstrate. In this mode Integration starts when the **START** button is pressed, and continues until the integration time reaches the maximum, or when the **STOP** button is pressed. If the Timer is set, the integration will stop at the preset time.
 - **Continuous:** Integration starts when the **START** button is pressed. When the timer-preset time is reached, the integrated value and integration time are reset automatically and restarted immediately.
 - **R-Normal:** This is the same as the **Normal** Mode with the addition of a **Real Time** Start/Stop Timer.
 - **R-Continuous:** This is the same as the **Continuous** Mode with the addition of a **Real Time** Start/Stop Timer.
3. The following is a definition of the Integrator Measurement Functions:
 - **Wp(_):** Total Watt-Hours for the Element or Group of Elements set inside (_).
 - **q(_):** Total Amp-Hours for the Element or Group of Elements set inside (_).
 - **Wp+(_):** Positive Watt-Hours.
 - **Wp-(_):** Negative Watt-Hours. In an AC Circuit, this is the Reactive Power component. In a DC Circuit this is the Reverse Power Flow.
 - **q+(_):** Positive Amp-Hours. This is the Positive Flow of Current, AC or DC.
 - **q-(_):** Negative Amp-Hours. This is the Total Negative Flow of Current, AC or DC
 - **Wp(1) = Wp+(1) + Wp-(1)**
 - **q(1) = q+(1) + q-(1)**

Normal Mode Integration



Select one of four Integration Modes

Timer Setting

Sets control of each Element independently

1. The following is a simple demo of the Integration Function using the **Normal** Integration Mode.
2. Press <DISPLAY> Button. Press **Numeric Disp Items** “Soft Key.”
3. Add Integrator Measurement items to your display as shown in the example.
4. Press <SHIFT> and <INTEG> Buttons. Select **Normal** Mode with the “Soft Keys.”
5. Press Integrator <START> Button. The Integrator will run until you Press Integrator <STOP> Button.
6. The **STOP** Function is like a Pause. You can Press <START> again and the integrator will continue.
7. Press <SHIFT> and <RESET>. This operation Resets the Integrator Timer to Zero and is **REQUIRED** to fully **STOP** the Integration function.
8. Press **Timer Setting** “Soft Key.” This sets a time in **Hours: Minutes: Seconds** for the Integrator to run then automatically stop and hold the final values.
9. Set a short Integration time. Turn the **Rotary Knob** to highlight “Minutes.” Press <SELECT> Button. Turn the **Rotary Knob** to set “Minutes” and Press <SELECT>. To set “Seconds” turn **Rotary Knob** to highlight “Seconds” Press <SELECT> and set value. Press <ESC> Button to clear menu.
10. Press Integrator <START>. When finished, Press <SHIFT> and <RESET>.
11. Press **Independent Control** “Soft Key” to ON Position.
12. This function allows setting separate Integration Timers for each Element.

F.) USER DEFINED FUNCTIONS

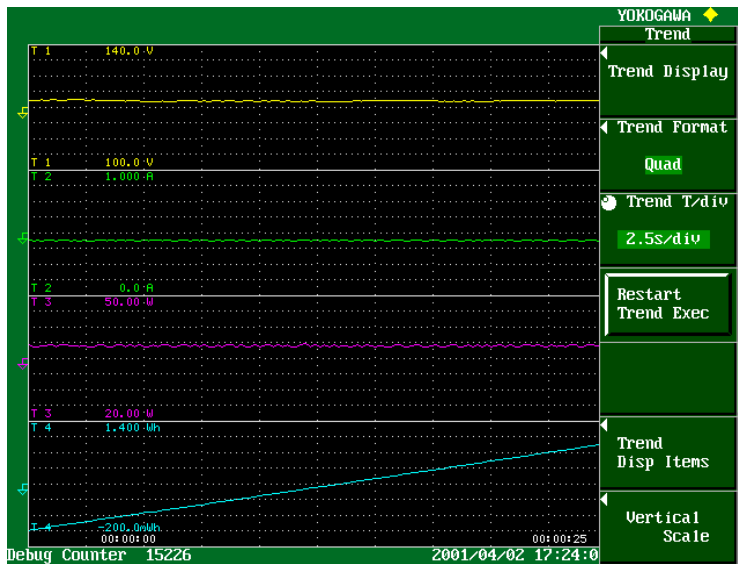


User Defined function permits writing up to four Math functions for advanced analysis.

1. Press <MEASURE> Button. Press User Defined “Soft Key.”
2. Turn Rotary Knob to highlight OFF ON. Press <SELECT> to ON position.
3. Turn Rotary Knob to highlight Unit, and Press <SELECT>.
4. Use Rotary Knob to highlight keyboard character then Press <SELECT>. When done, highlight ENT and Press <SELECT>.
5. Press <DISPLAY> Button, and Numeric Disp Items.
6. Press Function “Soft Key.” Select Display Item F1 to display the results for Function 1 Expression. F2 for Function 2 Expression, and so on.
7. Three applications are displayed:
 - **F1:** This is an expression for **% Voltage Regulation**. This measures the RMS Voltage on Element 1, and makes calculations based on 120V Nominal Line. Applications include **Power Supplies, Generators, and UPS Systems**.
 - **F2:** This is an expression for **Power Loss**. This measures the Single Phase Input Power on Element 1 and the Output Power on Element 2. Applications include **Lighting Ballast’s, Power Supplies, and Motor Inverters**. A variation of this expression can be made for Single Phase Input – Three Phase Output, and Three-Phase Input – Three-Phase Output.
 - **F3:** This is an expression for **% Frequency Regulation**. This measures the Frequency of the Voltage on Element 1, and makes calculations based on 60 Hz Nominal Line frequency. This could be applied to 400 Hz systems, or any other reference frequency. Applications include **Generators, UPS Systems**.
 - **F4:** This is an expression for **Volts per Hertz**. This is an application for **Variable Speed Motor Drives**. It measures the **MEAN** or **Fundamental** Voltage of a PWM Drive divided by the drive frequency. The result can be displayed as a Numeric Value or displayed as a **Trend** function.

G.) TREND FUNCTIONS

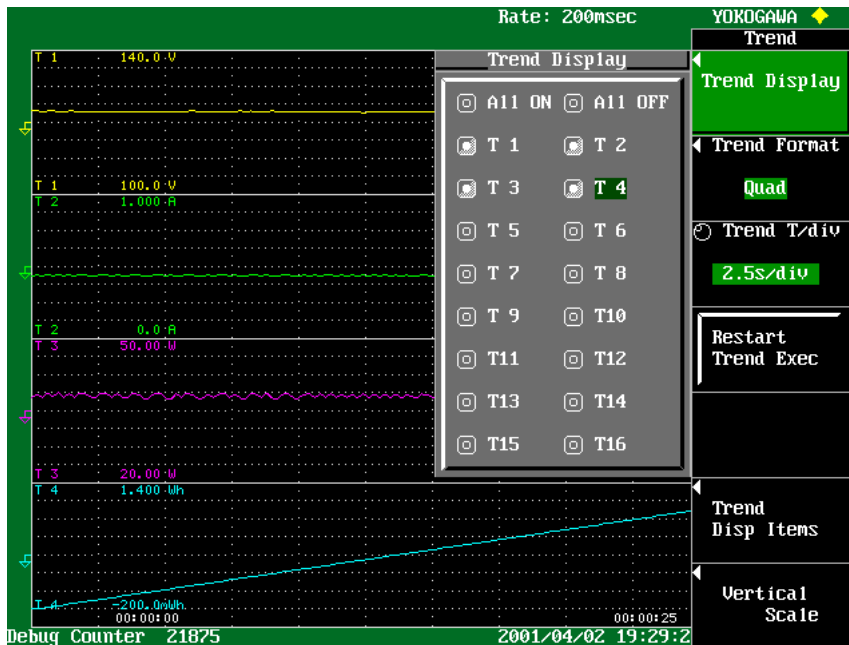
TREND DISPLAY OVERVIEW



Trend Display is a new feature to the WT1600 Power Analyzer.

Trend times can be set from 25 Seconds to 10 Days.

In the above example **T1** is RMS Voltage Trend; **T2** is RMS Current Trend; **T3** is Power Trend; and **T4** is Watt-Hour Trend.



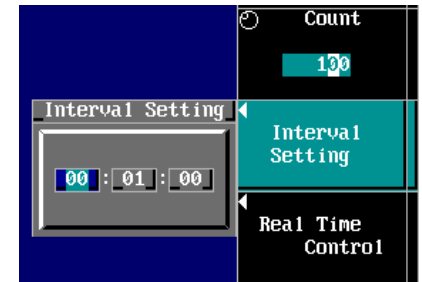
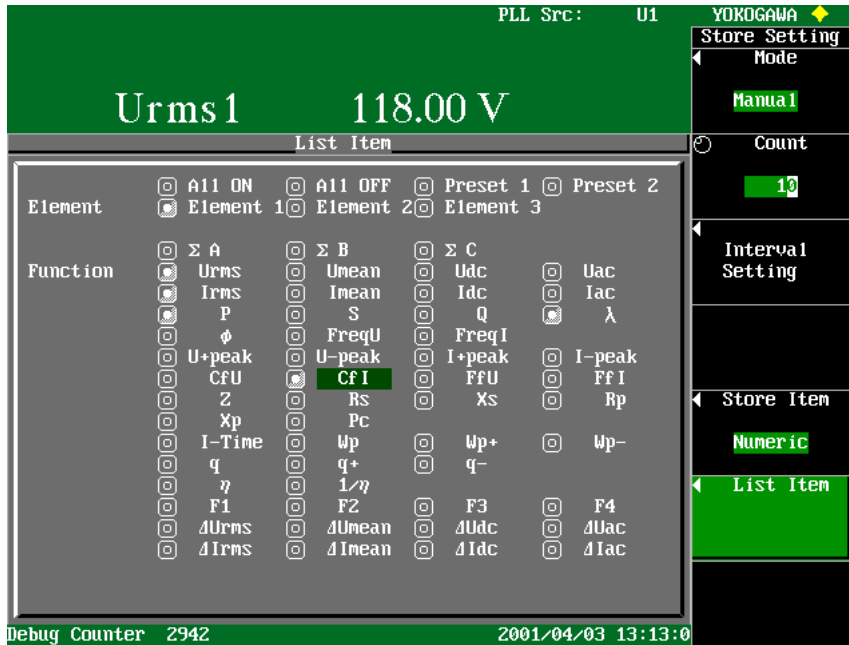
- Trend Display sets Number of Trend Items. Up to 16 Items can be trended.**
- Trend Format can be set from a Single Trend Graph to a Quad Graph.**
- Time/Div can be set from 2.5s/div to 1day/div.**
- Selects measurement items to be trended.**
- Sets Vertical Scaling. Can be set to Auto or Manual Scaling.**

TREND DISPLAY SETUP

1. Press **<DISPLAY>** Button. Press **Format** “Soft Key” and select **Trend**.
2. Press **Trend Setting** “Soft Key.”
3. Press **Trend Display** “Soft Key.” Use the **Rotary Knob** to highlight **All OFF**, and Press **<SELECT>**. Turn **Rotary Knob** to highlight **T1**, Press **<SELCT>**. Repeat the process to turn on items **T2**, **T3** and **T4**. Press **<ESC>** Button to exit menu.
4. Press **Trend Format** and select **Quad** with the “Soft Key.”
5. Set **Trend T/div** using the **Rotary Knob**.
6. Press **Trend Disp Item** “Soft Key.”
7. Set **Trend Object** to **T1** by using the **Rotary Knob**. Set **Function** to **Urms**, and **Element 1**. You can set the **Function** to any item you want.
8. Set **Function** for each of the other **Trend Objects**, **T2**, **T3** and **T4**. Press **<ESC>** Button to exit menu and return to **Trend** menu.
9. Press **Restart Trend Exec** “Soft Key” to start Trending.
10. At the end of the Trend Cycle (example 25 sec) Press **<HOLD>** Button to Stop trending.
11. Press **Scale** “Soft Key” to adjust scaling for best resolution.
12. Press **Trend Object** “Soft Key” and select **T1** using the **Rotary Knob**.
13. Press **Scaling** “Soft Key” and set to **Manual**.
14. Press **Upper Scale** “Soft Key” and use the **Rotary Knob** to set Upper Scale. Set **Lower Scale** in the same way. Set scaling for each **Trend Object**, **T2**, **T3** and **T4**. Press **<ESC>** Button to exit menu and return to **Trend** menu.
15. For the above example, **Manual** Scaling was set for **Trend Items T1**, **T2** and **T3**. **Auto** Scaling was set for **Trend Item T4**.
16. You can change the **DISPLAY Format** while the Trend is on **HOLD**.

H.) SAVING DATA

SAVING DATA TO MEMORY – MANUAL METHOD

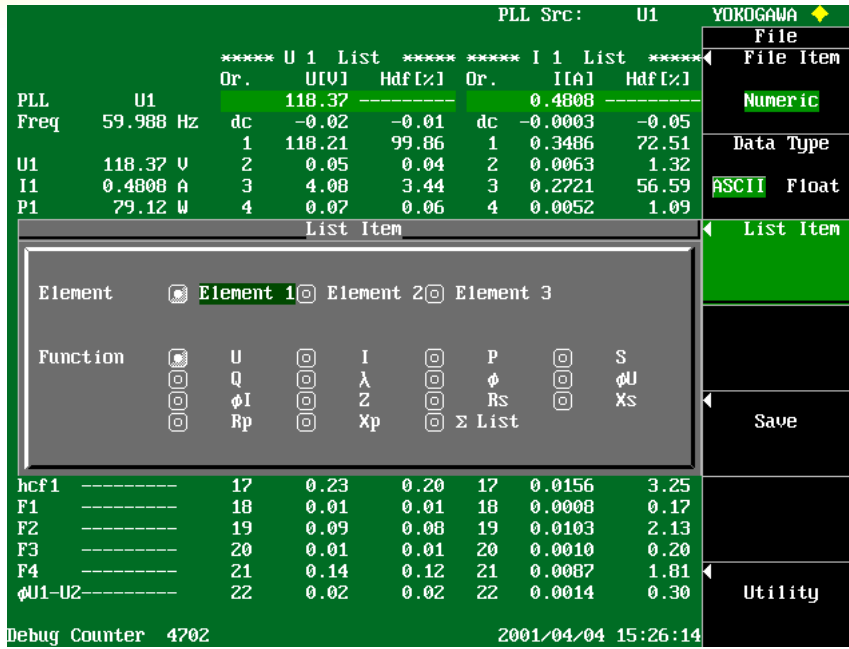


MANUAL CONTROL:

- Set the number of Counts, and Press **STORE** to start.
- Storage stops automatically when Count Number is reached.
- Set the Interval Setting **H:M:S**. With Interval Setting at 00:00:00, the interval will be at the Update Rate of the WT1600. Maximum Update Rate is 20 Readings Per Second.

1. Press <SHIFT> then <STORE SET>.
2. Press Mode “Soft Key” and select **Store**. Press Store to “Soft Key” and select **Memory**. Press **Initialize Memory Exec** “Soft Key” to clear memory.
3. Press **Store Setting** “Soft Key.”
4. Press Mode “Soft Key” and select **Manual** with the “Soft Keys.” Turn the **Rotary Knob** to set the Memory **Count**.
5. Press **Store Item** “Soft Key” and select type of items to be saved with “Soft Keys.”
6. Press **List Item** “Soft Key.” This menu sets the Numeric Items, which you want to Save. Turn the **Rotary Knob** to highlight an Item, and Press <SELECT>.
7. If you selected a **Wave** or **Numeric+Wave** Store Item, Press the **Wave Trace** “Soft Key” and select the waveforms to be saved using the **Rotary Knob**. Highlight the waveform symbol and Press <SELECT>.
8. Press <STORE> Button to start saving. **Store: Stop** will appear in the Upper Left-hand corner of the screen when the store function is complete.
9. To view saved data, Press <SHIFT> then <STORE SET>. Press Mode “Soft Key” and select **Recall**.
10. Turn the **Rotary Knob** to view the saved data files.

SAVING HARMONIC DATA TO A FILE



The screenshot shows the WT1600 harmonic analysis interface. At the top, it displays 'PLL Src: U1'. Below this, there are two data tables. The first table is for the fundamental component (U1) and the second is for the 11th harmonic (I1). The 'List Item' menu is open, showing 'Element 1' selected. The 'Function' menu is also open, showing 'U' selected. The 'Save' button is highlighted.

***** U 1 List *****		***** I 1 List *****					
Or.	U[V]	Hdf [%]	Or.	I[A]	Hdf [%]		
PLL	U1	118.37	0.4808				
Freq	59.988 Hz	dc	-0.02	-0.01	dc	-0.0003	-0.05
		1	118.21	99.86	1	0.3486	72.51
		2	0.05	0.04	2	0.0063	1.32
		3	4.08	3.44	3	0.2721	56.59
		4	0.07	0.06	4	0.0052	1.09

Element	Function
Element 1	U
Element 2	I
Element 3	P
	S
	Q
	λ
	ϕ
	ϕI
	Z
	Rs
	Xs
	Rp
	Xp
	Σ List

Item	Order	Amplitude	Phase	Order	Amplitude	Phase
hcf1	17	0.23	0.20	17	0.0156	3.25
F1	18	0.01	0.01	18	0.0008	0.17
F2	19	0.09	0.08	19	0.0103	2.13
F3	20	0.01	0.01	20	0.0010	0.20
F4	21	0.14	0.12	21	0.0087	1.81
$\phi U1-U2$	22	0.02	0.02	22	0.0014	0.30

Debug Counter 4702 2001/04/04 15:26:14

Selects File Item to Save: Setup; Wave or Numeric

Sets Data Type

Sets the Measurement Items to be Saved to the File

Save Menu for Setting File Name and Save Execute function.

1. Setup WT1600 in the Harmonics Mode.
2. Insert a Floppy Disk in the disk drive.
3. Press <SHIFT> then <STORE SET>.
4. Press Mode “Soft Key” and select Store. Press Store to “Soft Key” and select File.
5. Press <FILE> Button. Press File Item “Soft Key” and select Numeric.
6. Press Data Type and select ASCII. This will save the data in a .csv file, which will go directly into Excel.
7. Press List Item “Soft Key.” Turn the Rotary Knob to highlight the Element you want to save data from. Press <SELECT>. Now turn the Rotary Knob to highlight the Function to be saved, such as U. Press <SELECT>. Select additional functions to be saved as desired. Press <ESC> to clear this menu.
8. Press Save “Soft Key.” Press File Name “Soft Key” and enter the file name.
9. Press File List “Soft Key.” Turn the Rotary Knob to select the save destination medium. Press <ESC> to clear this menu.
10. Storage media File Names:
 [FD0]: Floppy Disk
 [SC4]: Built-in Hard Disk
 [ND0]: Network Drive
 Select Floppy Disk for this demo.
11. Press Save Exec “Soft Key” to start saving the data to the Floppy Disk.

SAMPLE EXCEL DATA FILE

Model	WT1600			7	0.0748	15.5610
Comment				8	0.0027	0.5594
Version	0.0100			9	0.0565	11.7454
Date	36985.0000			10	0.0021	0.4442
Time	0.6725			11	0.0396	8.2314
Mode	Harmonics			12	0.0012	0.2502
Wiring	1P2W- 1P2W-1P2W			13	0.0242	5.0400
PLL Source	U1			14	0.0015	0.3030
Harmonics	Sigma A			15	0.0209	4.3459
Object						
Order	0 To 50			16	0.0012	0.2485
THD Formula	Total			17	0.0156	3.2462
Harmonics	16.0000			18	0.0008	0.1732
Window Width						
Average	Off			19	0.0103	2.1334
Frequency Item	U1	I1	U2	20	0.0010	0.2003
F1	U(E1,OR1)	Unit	V	21	0.0087	1.8075
F2	I(E1,OR1)	Unit	A	22	0.0014	0.2956
F3	P(E1,OR1)	Unit	W	23	0.0068	1.4045
F4	Off			24	0.0013	0.2654
S Formula	Urms X Irms			25	0.0049	1.0209
Phase Angle	180 degree			26	0.0010	0.2017
Max Hold	Off			27	0.0050	1.0307
Null	Off			28	0.0007	0.1380
Element	Element1	Element2	Element3	29	0.0042	0.8715
Module				30	0.0009	0.1774
Voltage Range	150V	150V	150V	31	0.0033	0.6772
Terminal	5A	5A	5A	32	0.0008	0.1660
Current Range	100mA	100mA	100mA	33	0.0035	0.7281
Sensor Ratio	10.0000	10.0000	10.0000	34	0.0006	0.1260
Line Filter	OFF	OFF	OFF	35	0.0028	0.5910
Zero Cross Filter	500Hz	OFF	500Hz	36	0.0007	0.1486
Scaling	Off	Off	Off	37	0.0030	0.6312
Pt Ratio	1.0000	1.0000	1.0000	38	0.0005	0.1027
Ct Ratio	1.0000	1.0000	1.0000	39	0.0024	0.4931
Scaling Factor	1.0000	1.0000	1.0000	40	0.0006	0.1325
				41	0.0018	0.3776
Order	I[E1]	lhdf[E1]		42	0.0003	0.0612
TOTAL	0.4808	nan		43	0.0018	0.3774
DC	-0.0003	-0.0528		44	0.0011	0.2237
1	0.3486	72.5086		45	0.0019	0.4019
2	0.0063	1.3163		46	0.0003	0.0726
3	0.2721	56.5911		47	0.0022	0.4530
4	0.0052	1.0917		48	0.0010	0.2073
5	0.1534	31.9013		49	0.0008	0.1750
6	0.0013	0.2785		50	0.0005	0.1101

DATA LOGGING FUNCTION



REAL TIME CONTROL

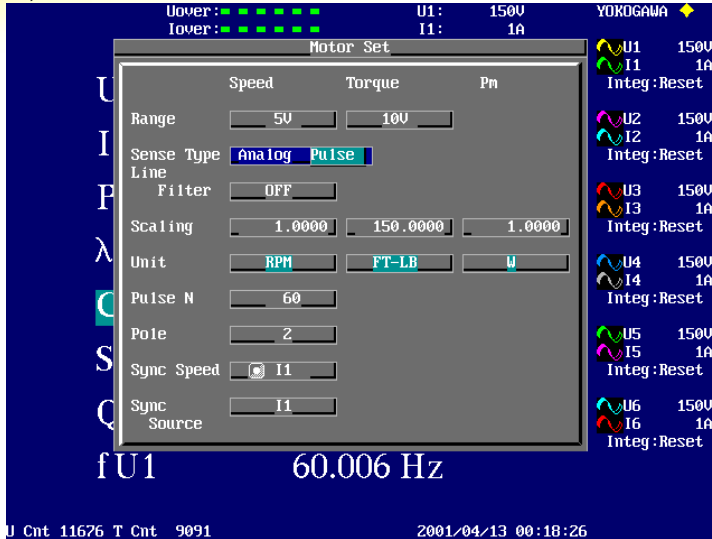
Set the START Date YEAR:MONTH:DAY and Start Time HOUR:MIN:SEC and the END Date and Time

Set the Interval Setting HOUR:MIN:SEC.

With Interval Setting at 00:00:00, the interval will be at the Update Rate of the WT1600. The Maximum rate is 20 Readings Per Second.

1. Press <SHIFT> then <STORE SET>.
2. Press Mode “Soft Key” and select **Store**. Press **Store** to “Soft Key” and select **File**. Press **Initialize Memory Exec** “Soft Key” to clear memory.
3. Press **Store Setting** “Soft Key.”
4. Press Mode “Soft Key” and select **Real Time** with the “Soft Keys.” Set the Memory **Count** equal to or greater than Interval times Time. $C = I \times T$
5. Press **Interval Setting** “Soft Key.” Set Interval time in HOUR:MIN:SEC.
6. Press **Real Time Control**. Turn Rotary Knob to highlight Store Start Year. Press <SELECT>. Use Rotary Knob to set Year. Press <SELECT> to end. Set the Store Start date as Year:Month:Day, and Time as Hour:Min:Sec. Set the Store Stop in the same manor. Press <ESC> to clear menu.
7. Press **Store Item** “Soft Key” and select **Numeric** as the type of items to be saved.
8. Press **List Item** “Soft Key.” This menu sets the Numeric Items, which you want to Save. Turn the **Rotary Knob** to highlight an Item, and Press <SELECT>.
9. Press <ESC> again to return to Store Set Menu. Press **File Setting** “Soft Key.”
10. Press **File List** “Soft Key,” highlight [**FD0**], and Press <SELECT>. This sets the Save Destination to the Floppy Disk. Press <ESC> to clear the menu.
11. Press **File Name** “Soft Key” and enter a File Name.
12. Press **Data Type** “Soft Key” and select ASCII by pressing the “Soft Key.”
13. Install a Floppy Disk. Press <STORE> Button. Storage will start at the preset Date and Time, and stop automatically at the preset end Date and Time. Data will then be transferred to the

I.) MOTOR FUNCTION SETUP



U Cnt 11676 T Cnt 9091

2001/04/13 00:18:26

A. SPEED SETUP

1. Press <SHIFT> <MOTOR SET> Buttons.
2. Turn **Rotary Knob** to highlight **Speed Sense Type**, either **Analog** or **Pulse**
3. **SETUP for ANALOG SPEED SENSOR:**
 - a. Highlight **Analog** and Press <SELECT>.
 - b. Turn **Rotary Knob** to highlight **Speed Range**, Press <SELECT>. Turn **Rotary Knob** to highlight desired Voltage Range of the tachometer and Press <SELECT>.
 - c. Turn **Rotary Knob** to highlight **Speed Scaling**, Press <SELECT>. Use the **Rotary Knob** to set the Numeric Scale factor. As an example, a Tachometer might have an output of 20 Volts at 4000 RPM. Set Scaling to **4000.0000**, Press <SELECT>.
4. **SETUP for PULSE SPEED SENSOR:**
 - a. Highlight **Pulse** and Press <SELECT>. Set **Scaling** value to **1.0000**
 - b. Turn **Rotary Knob** to highlight **Pulse N** and Press <SELECT>. Set the **Pulse Per Revolution** to match the Speed Sensor. Typical values are 60 and 1024.
 - c. Turn **Rotary Knob** to highlight **Pole**, and Press <SELECT>. Set the value to match the number of poles of the motor being tested.
 - d. Set **Sync Speed** and **Sync Source**. These are typically one of the current channels, and would be **I1** or **I4**, depending on connection to the WT1600.
5. **SETUP for TORQUE SENSOR:**
 - a. Turn **Rotary Knob** to highlight **Torque Range**, Press <SELECT>. Turn **Rotary Knob** to highlight desired Voltage Range of Torque Sensor and Press <SELECT>
 - b. Turn **Rotary Knob** to highlight **Torque Scaling**, Press <SELECT>. Use the **Rotary Knob** to set the Numeric Scale factor. As an example, a Torque meter might have an output of 10 Volts at 150 Ft-Lb. Set Scaling to **150.0000**, Press <SELECT>
 - c. Turn **Rotary Knob** to highlight **Torque Unit**, Press <SELECT>. Use keyboard to enter the Torque Unit.
 - d. **Pm**, Mechanical Power, Scaling is typically left at **1.0**, with Units as **Watts**.