

WT3000

*SETTING THE STANDARD
for
PRECISION POWER MEASUREMENT*



Product Tutorial

WT3000 PRODUCT TUTORIAL

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WT3000 POWER ANALYZER PRODUCT TUTORIAL

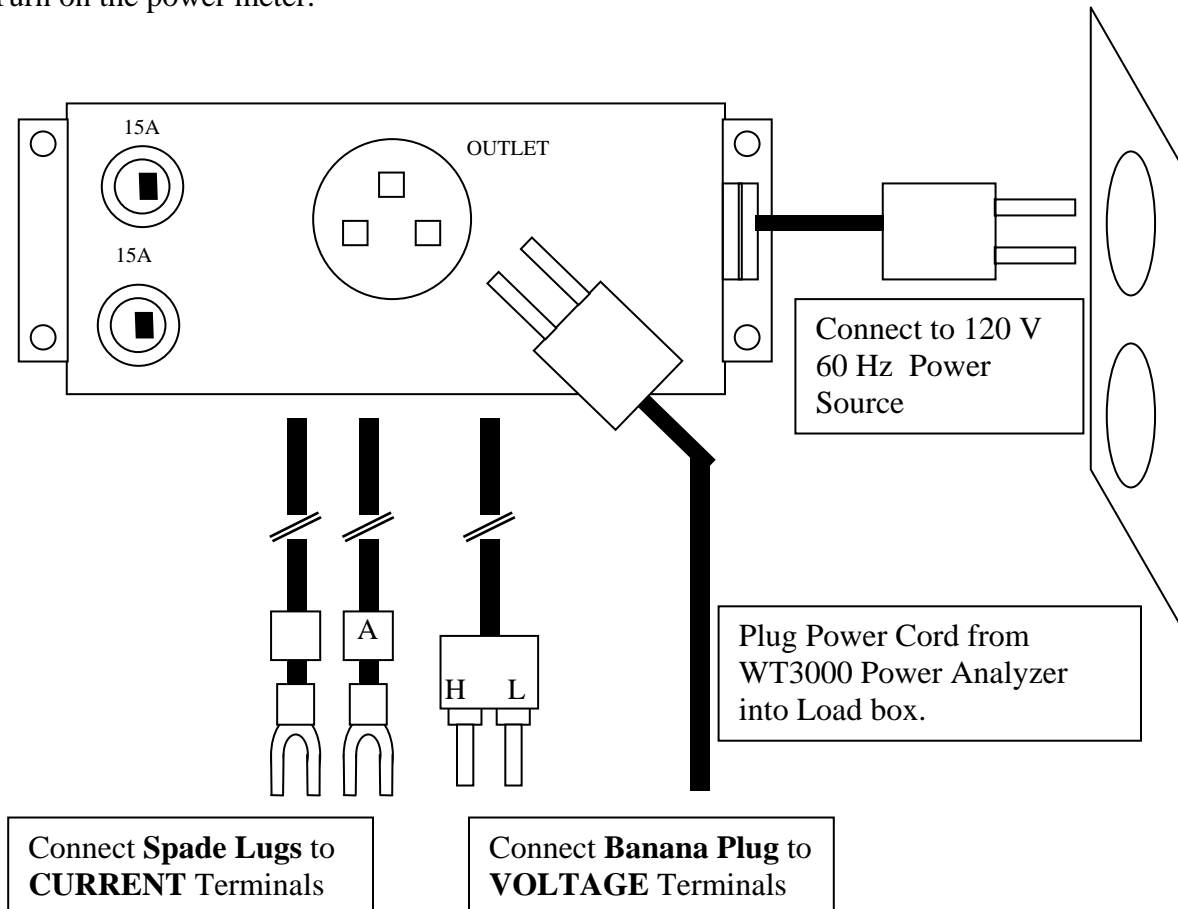
A.) OVERVIEW & OBJECTIVES

The following is a basic demo procedure for the WT3000 Power Analyzer. This demo uses the power meter's own power supply for the load. The 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 WT3000 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

INITIALIZE SETTINGS (Manual Section 3.13)



1. Before you start your demo, you may want to Initialize the settings to make sure it was not left in an unknown mode or some functions left on that may interfere with your demo.
2. Press [MISC] button.
3. Press **Initialize Settings** Soft Key.
4. Press Left Arrow Key to select **OK**.
5. Press [SET] button.

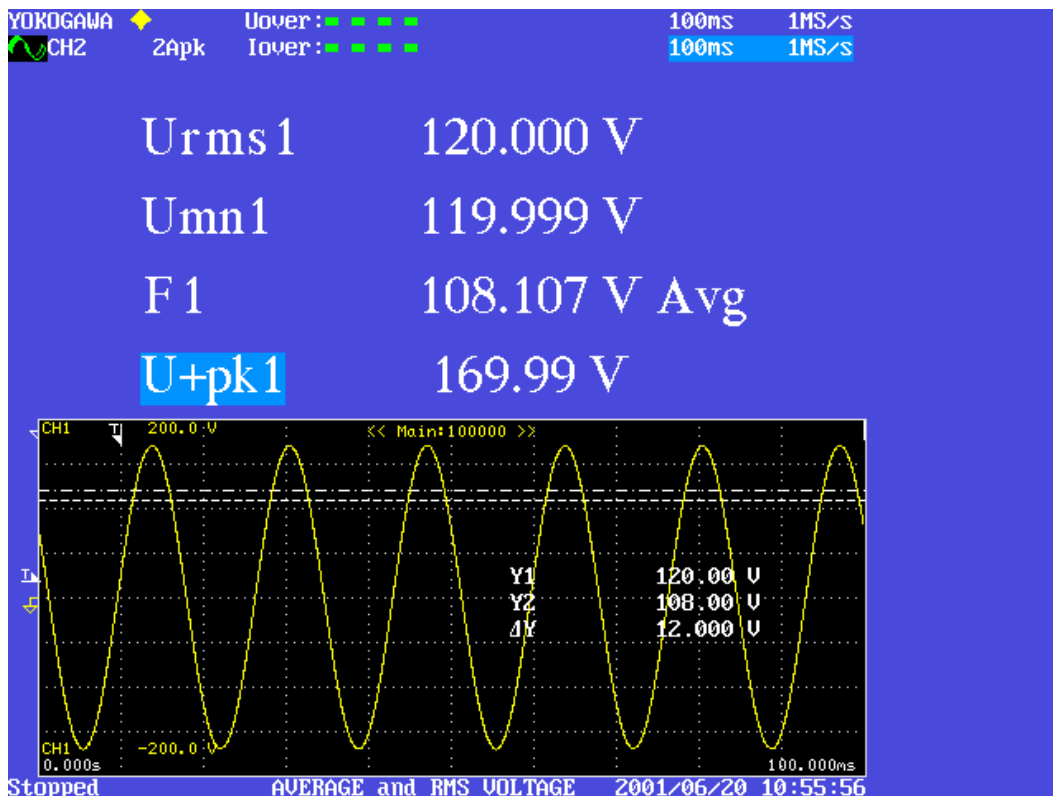
SETTING WIRING (Manual Section 4.1)



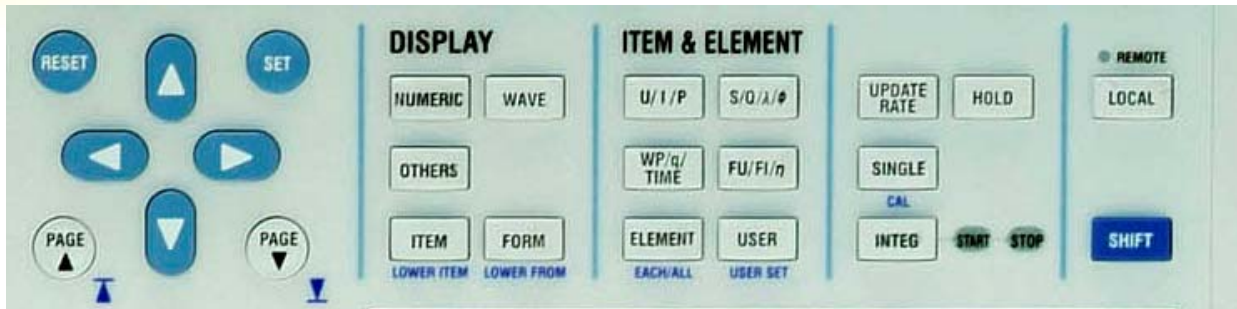
1. Press the [WIRING] button.
2. Press the **Wiring Setting** Soft Key.
3. Press the Blue [SET] button. Press the Blue Down Arrow key to highlight **3P 4W**.
4. Press the Blue [SET] button to select the 3P 4W-wiring configuration. Element lights 1,2 & 3 will turn ON.
5. Press [ESC] button to clear the menu.
6. **NOTE** for this Demo we will use the 3P-4W wiring even though we are only using single phase on Element #1. This will allow you to demo some of the other functions later on in the demo.

SETTING RANGES (Manual Section 4.3)

1. **Press** Voltage Up/Down arrow key to select Voltage ranges of 15/30/60/100/150/300/600/1000 Volts. For this demo set Voltage Range to **150 V**.
2. **Press** Current Up/Down arrow key to select Current ranges of 500mA/1/2/5/10/20/30 Amps. For this demo use **500 mA** or **1 A** range.
3. **External Current Sensor Range Setting:** Press **[EXT SENSOR]** button.
4. **Press** Current Up/Down arrow key to select Sensor ranges of 50/100/200/mV 1/2/5/10 Volts.
5. **Sensor Scaling:** Press **[SHIFT] [EXT SENSOR]** button, **Sensor Ratio**.
6. Use the Cursor Arrow keys to set the numeric scaling factor in mV/A.
7. **MODE Setting:** Pressing the **[MODE]** button will change the Measuring Mode for Voltage or Current. The Mode will be changed for each of the active measuring elements. In this case with 3P-4W, Elements 1,2 & 3 will be changed. Element 4 will not be changed.
 - **RMS:** True RMS Measurement
 - **MEAN:** Rectified Mean scaled to RMS. 1.11 multiplier to.
 - **DC:** Simple Average. Blocks AC.
 - **RMEAN:** Rectified Mean value. Half cycle average.
8. For this demo, use **RMS** Mode.



SETTING NUMERIC DISPLAY ITEMS (Manual Section 5.1)



1. Press [NUMERIC] display button. The default is 4 numeric items.
2. Press [FORM] button. This lets you select the number of Numeric Items to be displayed. Press the **Soft Keys** to choose **4 items; 8 items; 16 items or all items**.
3. Selecting **Single List or Dual List** displays the Harmonic Items.
4. When displaying **Single List or Dual List**, use the [PAGE] UP or DOWN buttons to see all the Harmonic data.
5. For this demo set Numeric Form to **8 items**. Press [ESC] to clear Numeric Form menu.
6. There are three ways to select the Numeric Display items.
 - Using the **ITEM & ELEMENT** function keys.
 - Using the User-Defined function key [USER].
 - Select From the [ITEM] menu.
7. Press the **UP Cursor** button to highlight measurement item **Urms1**.
8. Press [U/I/P] button to see how the measurement item is changed. Try the other Item Function keys and the [ELEMENT] key.
9. Press [SHIFT] +[USER] key, **USER SET**. There are four User selectable items. To change the item Press the Soft Key and select an item from the menu list. Use the Cursor Arrow keys to highlight the item then Press [SET] to select.
10. Press [ITEM] button. First Press **Item No.** Soft Key. Use the Cursor Arrow keys to highlight the Item Number to be changed.
11. Press **Function** Soft Key to display the complete Item List. Use the Cursor Arrow keys to highlight the measurement item. Press [SET] to select the item.
12. Press [ESC] to clear menu.

SETTING CREST FACTOR (Manual Section 4.6)

1. Press [MISC] button.
2. Press **Config** Soft Key. Select **CF3** or **CF6** with bottom Soft Key.
3. **NOTE:** When selecting **CF6**, the Voltage and Current Ranges are one-half the standard ranges at **CF3**.

SETTING UPDATE RATE (Manual Section 4.10)

1. Press [UPDATE RATE] button.
2. Press Soft Keys to change Update Rate from 50 msec to 20 sec.
3. The highest measurement accuracy is achieved with update rates of 250, 500 msec, 1, and 2 sec. The measurement values are determined by applying an Exponential Average for Measuring Period along with a digital filtering technique. **EAMP** displayed next to update rate time.
4. For update rates of 50, 100 msec, 5, 10 and 20 sec the measurement values are determined by applying an Average for the Synchronous Source Period. **ASSP** displayed next to the update rate time.
5. **NOTE** for Harmonics data to be displayed, the **Update Rate** must be set at **500 ms** or slower. For this demo, set Update Rate to **500 ms**.

PAGE FUNCTION (Manual Section 5.1 Page 5-4)

1. Press [PAGE Down] key to select nine pages of different Display configurations.
2. Note the Default Display for the 3P 4W Wiring Configuration.
3. Use the DISPLAY ITEM & ELEMENT keys to set up the display items for each page if you want something different than the default settings.

SETTING WAVE DISPLAY (Manual Section 6.1)

1. Press [WAVE] display button.
2. Press [ITEM] display button. Press **Wave Display** Soft Key. Use Cursor Arrow keys to select the waveform for display. Highlight the Waveform Number and Press [SET]. The waveform will be displayed when the White Dot appears for the selected item.
3. For this demo select **U1** and **I1** for display.
4. Press [ESC] key to clear menu.
5. Press **V Zoom & Position** Soft Key. This lets you perform a Vertical Zoom or Vertical Positioning of the selected waveform.
6. Press [FORM] display button. This lets you configure various waveform display functions using the menu and Soft Keys.
 - **Format:** Single; Dual; Triad; Quad
 - **Time/div**
 - **Trigger:** Auto/Normal; Source; Slope; Level
 - **Display Settings:** Grid types; Scale Values; Labels. **Note:** Scale Value for both the Wave and Trend displays is turned ON or OFF in this menu.
 - **Wave Mapping:** Auto; Fixed; User
7. Press [ESC] key to clear the menu.

SETTING OTHER TYPE OF DISPLAYS (Manual Section 3.15)

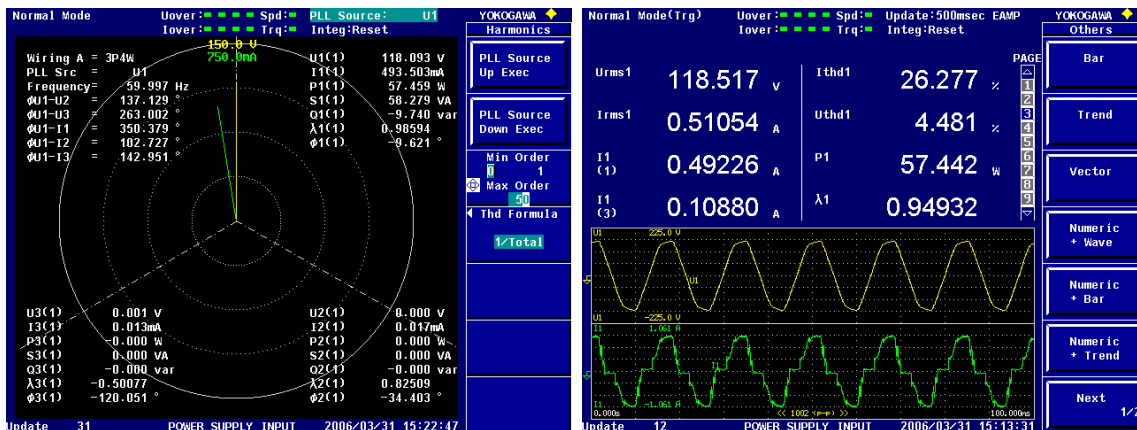
1. Press [OTHER] display button.
2. Using the **Others Menu** and Soft Keys you can select up to nine different display configurations.
3. **BAR DISPLAY: (Expansion Function Manual Section 7.9)**
 - Press Bar Soft Key.
 - Press [FORM] button. Use the Soft Keys to select Form as **Single; Dual; or Triad**. Select Dual or Triad for the demo. Use Soft key to select the Start and End Orders. For the demo select Start Order at 0, and End Order at 100.
 - Press [ITEM] button. By default Bar Item No. 1 should be Volts (U), Bar Item No. 2 Amps (I), and Bar Item No. 3 Watts (P) all for Element No 1. Use the Soft Keys to change the Functions.
4. **TREND DISPLAY: (User's Manual Chapter 7)**
 - Press [OTHER] display button, and **Trend** Soft Key.
 - Press [FORM] button. Use the Soft Keys to select Form as **Single, Dual, Triad, or Quad**. Select Dual or Triad for this demo. Use Soft Key to select Time/Div.
 - Press [ITEM] button. Press **Trend Display** Soft Key. Use UP Arrow Cursor Key to highlight **All OFF**. Press [SET] button to select. Use Down Arrow Cursor Key and Left/Right Cursor Keys to select items **T1, T2, and maybe T3**. Highlight the item and Press [SET] button to select. Press [ESC] to clear menu.
 - Press **Trend Items** Soft key. Press **Trend Object** Soft Key. Use the Up/Down Arrow Cursor Key to display **T1, T2 and T3**. By default T1 should be Volts (U), T2 Amps (I), and T3 Watts (P), all for Element No.1. When **Order** is ---, it is the Total RMS Value for the Function selected. Press **Order** Soft Key. Use Up/Down Arrow Cursor Key to change the order being trended. As an example you could trend the Total RMS current and the Third Order current of a device over time. Press [ESC] to clear menu
 - Press **Trend Scale** Soft Key. Press **Trend Object** Soft Key and Up/Down Arrow Cursor Keys to select desired object number. Press **Scaling** Soft Key. This will toggle between **Auto** and **Manual** scaling. Auto Scaling could be used for this demo.

Manual Scaling could be set as follows for this demo:

- T1 Upper Scale 1.500E+02 Lower Scale 1.000E+02 (100-150)
 - T2 Upper Scale 1.000E+00 Lower Scale 0.000E+00 (0 – 1)
 - T3 Upper Scale 1.000E+02 Lower Scale 0.000E+00 (0 – 100)
- **Scale Value:** Display Scale Values are turned ON or OFF under **WAVE/Display Settings**.
 - Press [ESC] to clear menus.

5. **VECTOR DISPLAY: (Expansion Function Manual Section 7.10)**
 - **TO DISPLAY THE VECTOR DIAGRAM WITH THIS DEMO MAKE SURE WIRING IS SET TO 3P-4W AND UPDATE RATE IS 500ms OR SLOWER.**
 - Press [OTHER] button and Vector Soft Key.
 - Press [FORM] button.
 - Press Mag Soft Key. Press Mag Soft Key twice to highlight both U Mag and I Mag. Press Left Arrow Cursor Key to highlight the most significant digit. Use UP Arrow Cursor Key to increase mag to 2 or 3 for this demo.
 - Press [ESC] to clear menu.

6. **SPLIT DISPLAYS (User Manual Sections 3.15, 5.1 and 6.1)**
 - Press [OTHER] button.
 - Press the Soft Keys to select any of Six different Split Screen Displays.
 - Pressing [ITEM] in Split Screen mode will select the setup menu for top display function, such as Numeric. Pressing [LOWER ITEM]; [SHIFT] + [ITEM], will select the setup menu for the bottom display function such as Wave.
 - Pressing [FORM] button in split Screen mode will select the Form setup menu for the top display. Pressing [LOWER FORM]; [SHIFT] + [FORM], will select the Form setup menu for the bottom display.
 - Press [ESC] to clear menu.



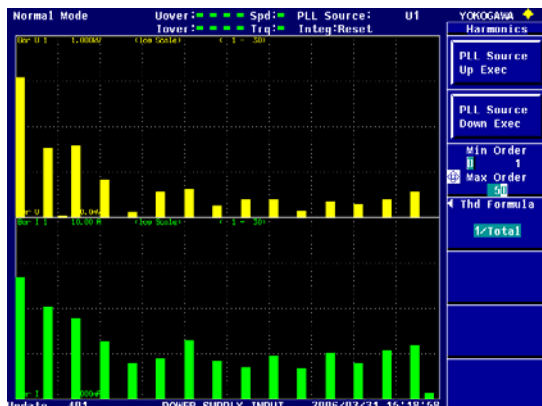
D.) HARMONIC MEASUREMENTS

Expansion Function Manual, Chapter 7 & 8

- **NOTE: UPDATE RATE MUST BE SET TO 500 msec OR SLOWER FOR HARMONIC MEASUREMENT FUNCTION**
- If the Update Rate is set faster than 500 msec, the Harmonic Numeric display will indicate - - - - - .
- Harmonic measurements and Normal measurements are made simultaneously in the WT3000. There is not a Harmonic Mode and Normal Mode selection like in other WT and PZ Series Power Analyzers.

1.) Harmonic Display: Expansion Function Manual, Section 7.1 – 7.4

- **Single List and Dual List Display**
- Press [NUMERIC] button for basic Numeric display.
- Press [FORM] button then select **Single List** or **Dual List** Soft Key. Press [ESC] to clear the Form menu. This is a quick and easy way to show all the harmonic data.
- Press [PAGE Down] to view all the harmonic data.
- Press **Left** Cursor Arrow button to highlight Page Scroll function for the data on left hand side of the display. Now by **Pressing [PAGE Down]** the left hand column of data will scroll through seven pages of data.
- Press **Right** Cursor Arrow button to return to the List Page function.
- **Basic Numeric Display**
- Press [NUMERIC] button for basic Numeric display.
- Press [FORM] button then select **4 Items**, **8 Items**, or **16 Items** Numeric display.
- Press [ESC] to clear form menu.
- Press Up/Down Cursor Arrow button to highlight display position to change.
- Press [ITEM] button. Press **Function** Soft Key. Use Cursor Arrow buttons to highlight a measurement function such as Ithd. Press [SET] button.
- To display an Item like third order current, Press [ITEM] button.
- Press [U/I/P] button to display I.
- Press **Order** Soft Key. Press **Up Arrow** Cursor button to select Order 3.

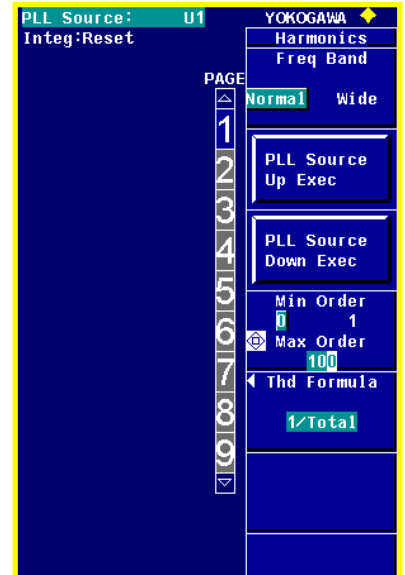


Item	Value	Unit
Urms1	117.714	V
Irms1	0.51425	A
I1(1)	0.49722	A
I1(3)	0.10839	A
Ithd1	25.809	%
Uthd1	4.330	%
P1	57.514	W
λ1	0.95011	

- **Bar Graph & Vector Display**
 - Press [OTHERS] button and **Select** type of Display such as **Bar, Vector**, or one of the combination displays.
 - **Select Bar.** Press [FORM] button. From the menu select type of display such as Single, Dual or Triad. Select number of Harmonic Orders to display by using the Start Order and End Order. Use this as a “Zoom” function for the Bar Display.
 - Press [ITEM] button. From the menu select Function (U, I, P, etc) to display as a Bar Graph. Use the Bar Item No. to select where to display a selected Function.
 - Press [OTHERS] button and **Select Vector.**
 - Press [FORM] button. In this demo example the Object should be set to “Sigma A”, Numeric ON.
 - Use the Mag function to expand the Vector display
 - **IEC Harmonic Display: Expansion Function Manual Chapter 9**
 - Press [OTHERS] button.
 - Press **Next**, display menu 2/3 and **Select IEC Harmonics.** The WT3000 is now set to comply with the IEC Harmonic Measurement functions.
- 2.) **Harmonic Set: Expansion Function Manual, Sections 7.5 - 7.8**
- **Selecting PLL Source**
 - Press [HRM SET] button. Press **PLL Source Down Exec** Soft Key. The PLL source is displayed on the upper right corner of the screen.
 - Select a PLL source that has an input signal with little distortion.
 - For this demo it is best to select U1 as the PLL source.
 - For Power Supply applications, select a Voltage input for the PLL Source
 - For a PWM Motor drive applications, select a Current input for the PLL Source.
 - **Selecting Harmonic Orders**
 - Press [HRM SET] button.
 - Press **Min Order** Soft Key. Pressing this key toggles between 0 (DC), and 1 (Fundamental).
 - Press the Up/Down Cursor Arrow buttons to change the **Max Order.**
 - The **Max Order** sets the number of Harmonic Orders over which to calculate the THD. As an example a specification may call for calculating THD over 50 Orders.
 - **Selecting THD Formula**
 - Press [HRM SET] button.
 - Press **THD Formula** Soft Key.
 - **UL & CSA** applications typically use **1/Total** as the mathematical formula. This is using the Total RMS value of the harmonic item such as Voltage, or Current, or others.
 - **IEC** applications use **1/Fundamental** as the mathematical formula. This is the Fundamental value of the harmonic item. This calculation can result in a higher THD calculated number, and can even exceed 100% on highly distorted waveforms.

• **Selecting Frequency Band**

- Press [HRM SET] button
- Select Freq Band **Normal** or **Wide**.
- **Normal** Band covers 10 Hz to 440 Hz Fundamentals and simultaneous True RMS measurements.
- **Wide** Band covers 0.1 Hz to 2600 Hz Fundamentals
- Display **Irms1** in **Normal** Band then switch to **Wide** Band and observe readings.
- **Wide** Band is the sum of the Integer Harmonic Orders up to 100 Orders Max.



G.) CYCLE-BY-CYCLE MEASUREMENT

Expansion Function Manual Chapter 13

- Press [OTHERS] button. Press **Next** and go to page 2/3. Press **Cycle-by-Cycle**
- Press [FORM] button. For this demo set up as follows:
 - **Sync Source** U1
 - **Sync Slope** Rising
 - **Trigger** Auto; Source U1; Slope Rising; Level 1%
 - **Cycle Count** Some value 20-60 for example
 - **Time Out** Some value like 10 sec
- Press **Start Soft Key**. Data will be acquired and displayed. Press **Page Down** to display data in 20 cycle groups.
- To make another acquisition, Press **Reset Soft Key**, **Left Arrow OK**, **SET**. Then Press **Start Soft Key** again.
- To change the Measured Items, Press [ITEM] button. There are 10 different functions available for Cycle-by-Cycle measurement. Five Items can be displayed.

E.) INTEGRATOR FUNCTIONS

User's Manual Section 5.11

INTEGRATOR MODES & MEASUREMENT FUNCTIONS

- Set Numeric Display as shown below.

WP = Watt Hours

q = Ampere Hours

WS = Volt-Amp Hours

WQ = VAR Hours

Time = Integration Run Time



The screenshot shows the following data on the display:

Measurement	Value	Unit
Urms1	120.402	V
Irms1	0.50391	A
P1	57.073	W
WP1	7.79381	Wh
q1	69.4330	mAh
WS1	8.34409	VAh
WQ1	2.96885	varh
Time1	0:08:14	

Additional display information includes: Normal Mode, Uover, Iover, Spd, Trq, U1-3 : 150Vrms, Integ: Stop, 0:08:14, and YOKOGAWA logo.

- Press [INTG] button.
- Press **Start** Soft Key to start Integration function. Once Integration is started, you cannot change any of the settings. Try changing Range or any of the other functions
- Press **Stop** to stop Integration function. Note Timer stops as Integration functions. Press **Start** again and note the Timer starts again as well as Integration functions. This is more like a **Pause** condition. Settings Cannot be changed.
- To **Quit or End** Integration function, Press **Stop then Press Reset**. This stops the Timer, and now settings can be changed. **Quit Integration before continuing.**

F.) USER DEFINED FUNCTIONS

User's Manual Section 5.4

- The WT3000 includes a powerful **User Defined Math Function** as standard. Twenty Math Functions can be assigned for special analysis and computation.
- Press [MEASURE] button. Select **User Defined Function**.
- Select **User Defined F1 – F5**. Use the Up/Down Arrow buttons to highlight the Expression line for Function 1. Press **SET** to display the keyboard and the available Math functions.
- The Default **UMN(E1)** is a very common function for Transformer Testing and Motor Drive Testing.
- Transformer Testing requires the Simultaneous display of True RMS Voltage and MEAN Voltage. If the values are different, it will give an indication of distortion.
- The Mean Voltage function is used on Variable Speed Motor Drives as a way to measure the Fundamental Voltage of the drive voltage.

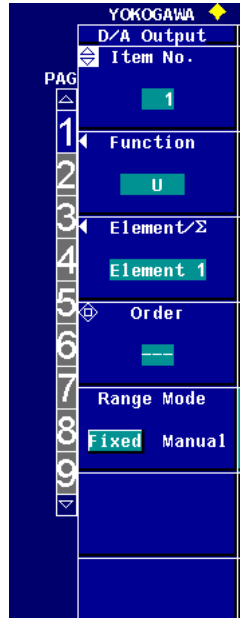
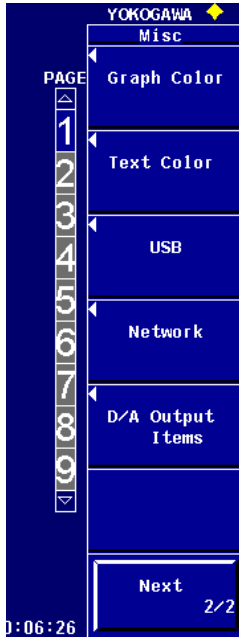
G.) STORE FUNCTION

User's Manual Chapter 8

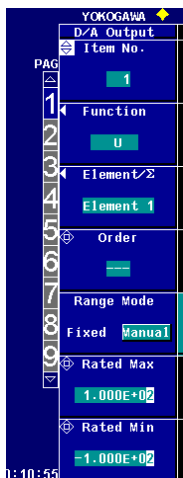
- Press [SHIFT] [STORE] (**Store Set**).
- Set **Mode** to Store; **Store** to Memory.
- Press **Store Setting** Soft Key and set as follows:
 - **Mode** Manual for the demo exercise
 - **Count** Some number you like for amount to be stored
 - **Interval Setting** With All Zeros, the store Interval will be at the selected Update Rate. You can select some other time interval
 - **Store Item** Numeric for this demo
 - **List Item** Select a few items like U, I, P, PF, FREQ for Element 1.
- Press **ESC** to clear all Menus.
- Press [STORE] button to start. Initialize memory if so prompted. Press [STORE] button again to start storing data.
- Press [SHIFT] [STORE] buttons and select **Mode Recall**.
- Scroll Recall No. to view stored data. Make sure Display matches the Stored Items selected.
- Stored data can be saved to Memory Card, USB Memory, or transferred to PC in CSV file format.
- **Store** function provides a means for Data Acquisition for fast short time periods to long term unattended operation.

G.) D/A OUTPUT FUNCTION

Expansion Function User's Manual Chapter 3



- Press [MISC] button. Press **Next 1/2** to display second menu page.
- Press **D/A Output Items** Soft Key.
- From the D/A Output Menu, set up the following
 - Item No.: D/A Output Channel, 1 to 20
 - Function: Measurement function, Volts, Amps, Watts, etc.
 - Element: Element from which the measurement function is being made, 1 to 4, plus Sigma A, and Sigma B.
 - Order: Harmonic Order. --- is Total. 0 is DC. 1, 2, 3, etc is the Harmonic Order.



Setting the D/A Zoom Function

- Press the **Range Mode** Soft Key to select **Manual**.
- Set the **Rated Max** value to that of the measured signal.
- Set the **Rated Min** value to that of the measured signal.