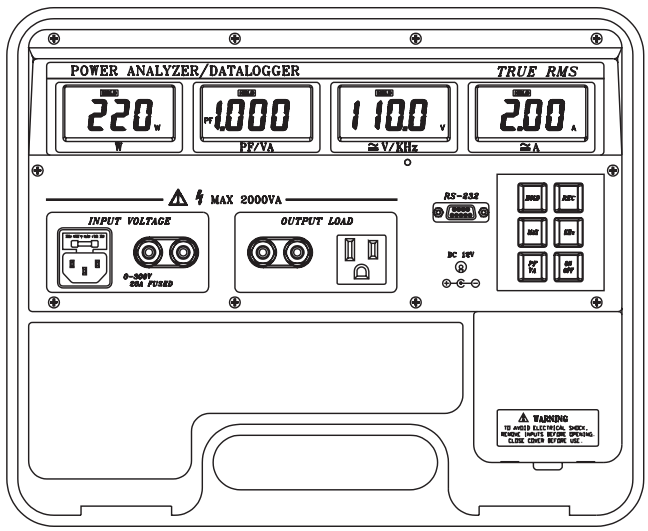
User's Guide

EXTECH INSTRUMENTS

Power Analyzer Model 380801

Power Analyzer Datalogger Model 380803



Introduction

Congratulations on your purchase of the Extech 380801 or 380803 Power Analyzer Datalogger. This device offers the following features:

- Convenient front panel plug-in and testing
- Four displays for Watts, PF/VA, V/KHz, Amperes
- True power, true RMS for AC Voltage (V) and Current (A)
- Datalogger stores over 1000 readings (Model 380803)
- Auto Range for Watts and Volts
- RS-232 PC Interface
- Windows™ Application Software

Careful use of this meter will provide years of reliable service.

Warranty

EXTECH INSTRUMENTS CORPORATION warrants this instrument to be free of defects in parts and workmanship for one year from date of shipment (a six month limited warranty applies on sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period, contact the Customer Service Department at (781) 890-7440 ext. 210 for authorization or visit our website at www.extech.com (click on 'Contact Extech' and go to 'Service Department' to request an RA number). A Return Authorization (RA) number must be issued before any product is returned to Extech. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Extech specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. Extech's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

Specifications

WATT (Auto Range, AC+DC, Crest Factor < 5)

Range	Resolution	Accuracy	Input
200W	0.1W	±(0.9% reading + 5digts) (50/60Hz)	0-300V, 0-20A,
2000W	1W	±(2% reading + 9digts) (40 to 400Hz)	PF=0.5 to 1

VOLTAGE (True RMS, Auto Range, AC+DC, Crest Factor < 5)

Range	Resolution	Accuracy	Overload Protection
200V	0.1V	±(0.5% reading + 5digts) (40 to 400Hz)	1000VDC/750VAC
750V	1V		

CURRENT (True RMS, AC+DC, Crest Factor < 5)

Range	Resolution	Accuracy (40 to 400Hz)	Overload Protection
2	0.001A	±(0.5% reading + 5digts)	20A, fused
20	0.01A		

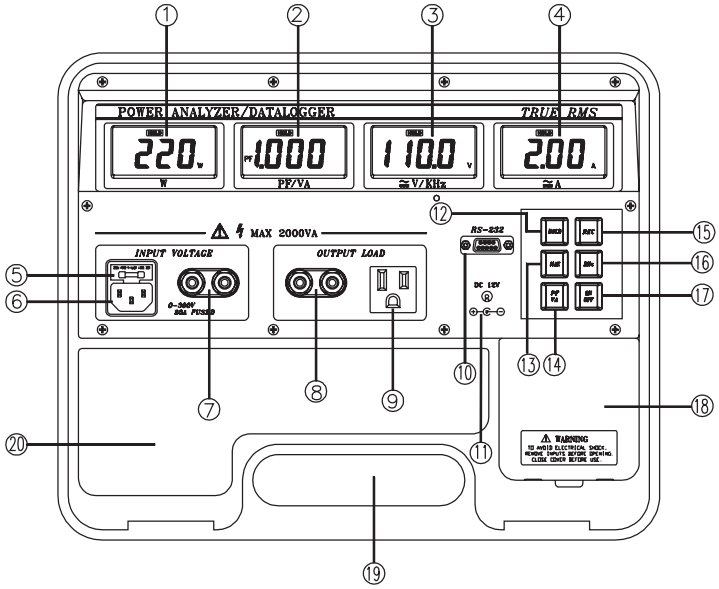
PF (Direct Calculation from W, V, A): PF = Watt / (V * A)

FREQUENCY (Sensitivity 5V)

Range	Resolution	Accuracy
40Hz to 20kHz	1Hz-10Hz	±(0.5% of rdg ±2digts

Memory Size (380803)	1012 x 4 readings (non-volatile)
Memory Life (380803)	100,000 memory writes
Display	2000 count LCD displays
Over Range Indication	'OL' displayed on LCD
Sampling Rate	2.5 times per second
Power Source	Eight 1.5V 'AA' batteries or AC adaptor
Power Consumption	22 mA approx.
Operating conditions	32 to 122°F (0 to 40°C); Less than 80%
Dimension	13.9"(L) x 11.8"(W) x 3.9" (H)
	352(L) x 300(W) x 100(H)mm
Weight	3.6 lbs (1.637 Kg) approx.

Meter Description



1. Watts display
2. PF or VA display
3. V or KHz display
4. A display
5. 20A fuse
6. Input Receptacle
7. Input Terminal
8. Output Terminal
9. Output Receptacle
10. RS-232 Terminal
11. DC 12V Adaptor Input
12. Hold
13. MAX button
14. PF/VA Select Button
15. REC button (380803)
16. KHz (frequency)
17. On/Off Button
18. Battery Compartment Cover
19. Carrying Handle
20. Storage Space for Accessories.

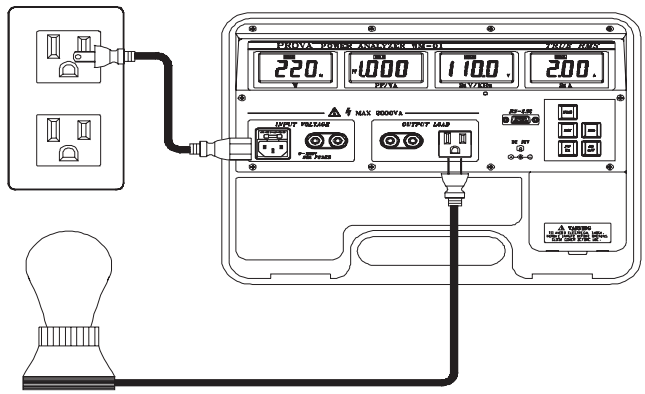
Basic Operation

Warning: If a power source of 220V is connected to the input voltage terminal/receptacle, do not connect a110V device to the output load terminal/receptacle.

Using Receptacles

1. Plug one end of the power cord into the input receptacle and plug the other end into the wall outlet.
2. Plug the device to be tested into the output load receptacle. The display will show the W, PF, V, and A for the device under test.

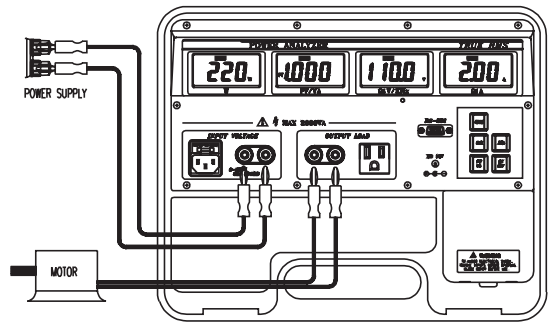
Note 2: W= VA, 1KW = 1KVA = 1000W = 1000VA, when PF = 1.



Warning: The input receptacle and terminal are connected in parallel (as are the outputs). To avoid electrical shock, do not touch any metal part of the receptacle or terminal.

Using Terminals

1. Plug one end of the power leads into the input voltage terminal (left) and connect the other end of the test leads to the power source.
2. Plug the device power leads into the output load terminals. W, PF, V, and A will display for the device under test.

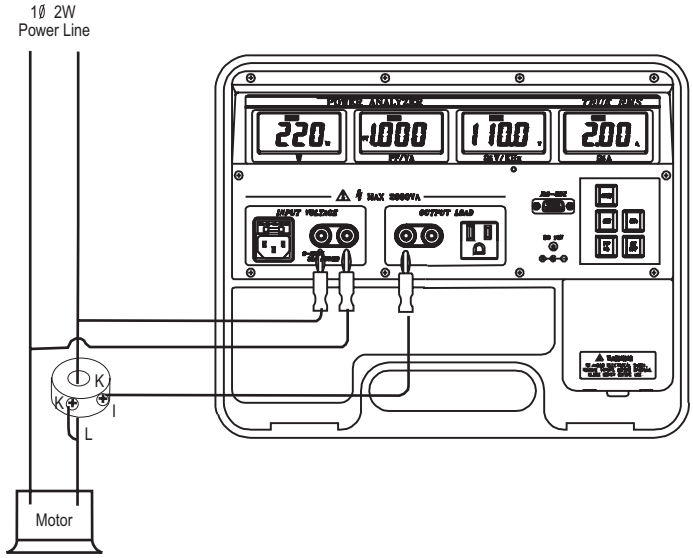


Note 2: W=VA, 1KW = 1KVA = 1000W = 1000VA, when PF =1 at DC

Warning: The input and output receptacle and terminal are connected in parallel Do not touch any metal part of the receptacle or terminal to avoid electrical shock.

Using a Current Transformer

Warning: Only personnel well trained in the principles of Current Transformers (CT) should attempt this test connection. When connecting a CT, follow the wiring diagrams and instructions below.



1. Connect the CT's ***k*** terminal (entering the CT) to the power line that passes through the CT, and connect this ***k*** terminal to the **input voltage black terminal** (ground).
2. Connect the other power line to the input voltage red terminal.
3. Connect the CT's ***l*** terminal (leaving the CT) to the output load black terminal (ground).
4. The Watt reading and Amp reading should be multiplied by the CT ratio. The V and PF readings do not need to be multiplied by the CT ratio.

Warning: The input receptacles and terminals are connected in parallel (as are the outputs). Do not touch any metal part of the receptacle or terminal.

Datalogging with the PC Interface

Basic Operation

a. Connect the power analyzer to a PC using the supplied communications cable and run the supplied Windows™ application program.

b. Set the sampling rate (interval at which readings are stored) by selecting SAMPLING TIME from the OPTION menu in the main software window or by double-clicking SAMPLE in the main window and typing the desired sampling time.

c. Enter a file name (where data will be stored) by first selecting the FILE menu in the main window and then typing the file name.

d. Select START RECORDING under the FILE menu in the main window. Once selected, a small window, with the caption RECORDING, will appear.

e. To stop recording, select STOP RECORDING from the FILE menu in the main window.

Manual Mode (Recording one measurement

When the REC button is momentarily pressed, one data set (W, PF, V, A) will be stored in internal memory (note that the record number will be displayed and a total of 1,012 records can be stored). The records are remembered even when the power source is removed. If the memory is full, the LCD will display 'FUL' when the REC button is pressed. To retrieve records, refer to the 'Datalogging' section later in this manual.

Automatic Mode (Continuous Recording

To start recording continuously, first set the Sampling Time as described above in the Basic Operation section and then press and hold the REC button for 2 seconds. The PF or VA symbol on the LCD will blink to indicate the power analyzer/datalogger is recording. When the memory is full, the power analyzer/datalogger automatically stops recording and the PF or VA symbol will stop blinking. To retrieve data records, refer to the section entitled 'Reviewing the Data file' below.

Clearing the Datalogger Memory

There are two ways to erase the datalogger memory:

1. Press and hold the REC button while turning the datalogger on. The PF LCD will display 'EPE' while the datalogger is erasing the memory.
2. Send an 'EEE' command to the datalogger through the RS-232 port. Refer to the section entitled XXX for details.

Downloading and Reviewing the Data File

Details on downloading, reviewing, and plotting stored data are provided in the 'Windows™ Application Program' section later in this manual.

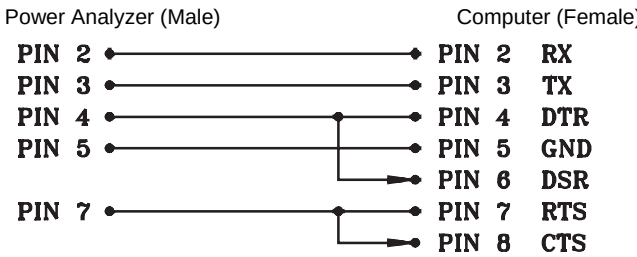
Hardware setup for the PC Interface

Connecting the Power Analyzer to the PC

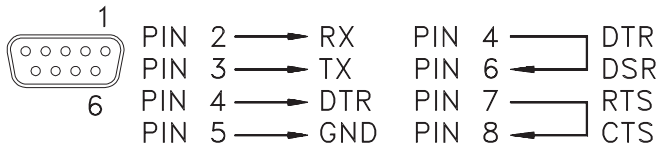
Use the supplied 9-pin RS-232 communications cable to connect the power analyzer to the PC COM port. Use the supplied 25-pin adaptor if necessary.

RS-232 Cable Wiring Diagram

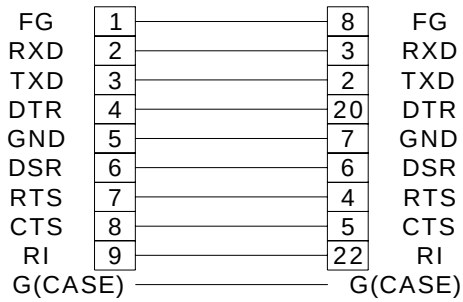
Note that in order to ignore hardware handshake, the RS-232 wiring should be configured as shown in the following diagram. The RTS must be pulled low (between -10 and -12V).



The supplied RS-232 9-pin cable is wired as in the diagram below:



The supplied 25-pin adaptor wiring is shown in the diagram below:



Default RS-232 Communications Settings

Baud Rate: 9600; Stop bit: 1; Data bits: 8; Parity: None

NOTE: Software developers must ensure that DTR provides 10V (or higher) and RTS provides -10V (or lower). Voltage (10V, -10V) from DTR and RTS is used to generate the RS-232 signal. DTR is usually enabled (10V) but RTS must be disabled in order to provide -10V. To accomplish this in BASIC, add RS in the OPEN command:

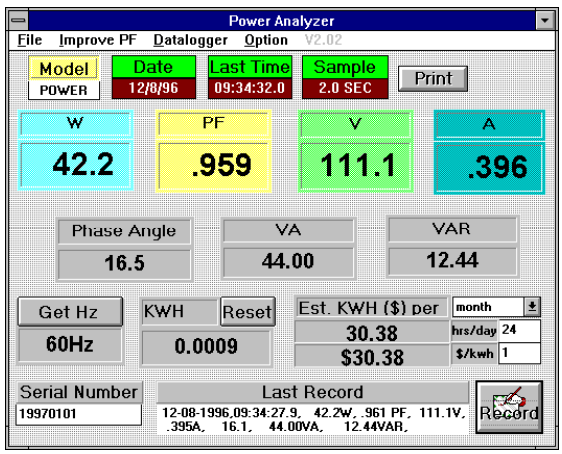
OPEN "COM1: 9600, N, 8, 1, CS, DS, CD, RS" as #1

Windows™ Application Program

1. Start **Windows™**
2. Insert the supplied program disk in the appropriate drive
3. Press the **START** button and select **Run**
4. Type SETUP and press the **Enter** key
5. Follow the on-screen instructions

Main Software Window

When the program icon 'Power Analyzer' is selected and executed, the program automatically searches for a connected power analyzer on an available serial port. If no serial port is available a 'No Communication' message will display and the program halts. Once the PC communication port is setup correctly, the main software window will be displayed as shown below:



FILE: Under FILE, the options detailed below are available.

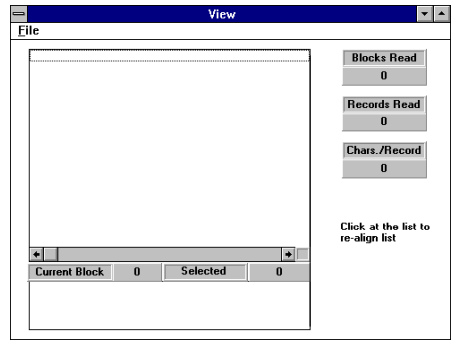
Name: Enter a file name where data will be stored.

Start Recording: There are two sub-options under the START pull down menu:

- Now: Starts automatic continuous recording when selected
- Manually: A RECORD button will appear at the bottom right corner of the screen. Press once to record one data point.

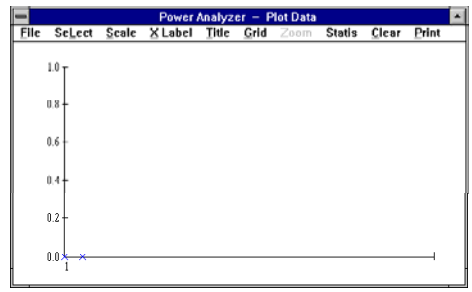
End Recording: Stop recording data into the opened file.

View: Display the ASCII data in the view window shown below.



File: Enter a file name when prompted. The program will bring up one block of data.
Blocks Read: Number of data blocks read.
Records Read: Indicate how many records have been read.
Chars/Record: Indicate how many characters in one record.
Current Block: The current block number.
Selected: The current record number selected.

Plot Data from File: Opens an x-y graph of the currently selected file as shown below.



File: Open the data file to plot.
Select: Select one of the parameters W, V, A, PF, VA, etc. to plot
Scale: Set the Y-axis scaling.
X Label: Select sequence number (1, 2, 3, 4) or time (12:00:01, 12:00:05) as the X-axis label.
Title: Enter the title for X-axis, Y-axis, or Graph.
Grid: Draw Horizontal and/or Vertical grids.
Zoom: The zoom size is limited to 3600 points.
Statis (Statistics): Plot average value, standard deviation, and best fit over the curve. This function is valid only when there are less than 3600 data points.
Clear: Clear the graphic screen.
Print: Prints the graph to connected printer.

OPTION: The Option menu on the main software screen provides the following three options:

- **Sample Rate:** Sample rate is the interval of time between readings. Select the desired interval time here or click on SAMPLE on the main software screen.
- **Baud Rate**: Select the baud rate (9600, 4800, 2400 or 1200).
- **Language**: Select Windows™ in English or Chinese.

Get Hz: Obtain a frequency reading in Hz.

KWH: Kilo-Watt Hours (Sum of 'W' * Sampling time / 1000 / 3600)

Est. KWH per month (usage 24 hrs/day): Estimated KWH. Select per month, year, or day, and enter the daily usage (0-24 per day).

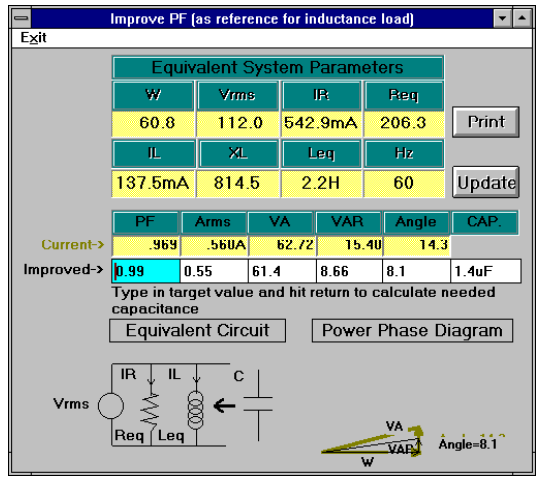
Serial Number: Enter a serial number; the program will increment the serial number for each record.

Last Record: Contents of the last data record.

Record Button: Appears only when Manual recording is selected. Press once to store one record.

Power Factory Improvements (IMPROVE PF Menu item on main software screen**)**

Calculate the required capacitance to improve power factor by entering the desired PF, A, VA, VAR, or Phase Angle. Press the ENTER key and the program will calculate the required capacitance. This function can only be used for AC. If the power analyzer senses that the frequency of voltage is '0' an error message will display.
Press the UPDATE button each time changes are made to obtain a new capacitance value. Click PRINT to obtain a hard copy of the software window.

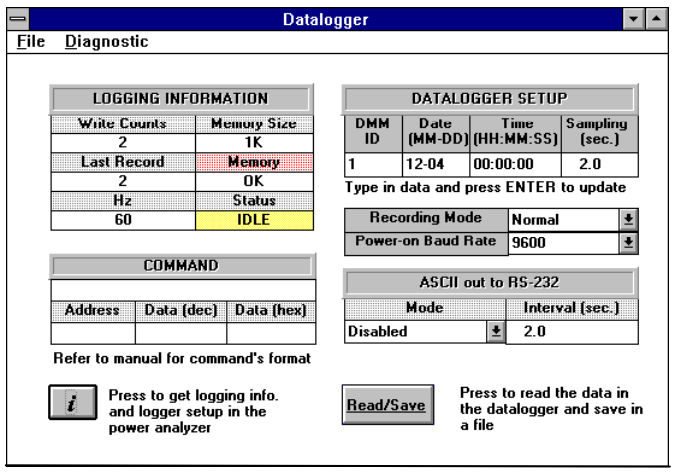


Warning: This function is valid only when circuit is equivalent to a voltage source, resistance, and inductance in parallel as drawn above.

Datalogger Software Window

Select 'Datalogger' from the OPTION menu and the datalogger window will appear as shown below. To retrieve data from the datalogger, select the Read/Save button. Enter a file name when prompted and the program will retrieve and store data in the named file.

Click the 'i' button to view details on the datalogger. To configure the datalogger: Make the desired changes and **press ENTER to update**.



LOGGING INFORMATION Window

- Write Counts: For every download, the Write Counts field is incremented by one.
- Memory Size: Size of the data block in the datalogger's memory
- Memory: Indicates if there was a 'write failure' during recording. 0: None. If 'FAIL' appears, run a diagnostic test to check the memory (see the 'Diagnostic' section later in this manual).
- Last Record: Details on last data record in a data block.
- Status: Status of datalogger ('idle' or 'recording').

DATA LOGGER SETUP Window

ID: Used to identify individual dataloggers; enter a number from 0 to 65535.

Date and Time: The datalogger does not have a real-time clock, therefore the user must enter a date and time for the 1st reading (make note of the time and date at the time of recording). The program will then distribute a date and time for all other readings based on the date/time entered by the user and the sample rate selected. The date and time formats are MM-DD and HH:MM:SS. Press ENTER after setting the time and date.

Sampling: Set the datalogger sample rate (interval of time between recorded readings). Range is 0.4 seconds to 13106.8 seconds.

Recording Mode: The menu items under Recording Mode are as follows:

- **Normal mode**: Datalogger records data at the programmed sample interval.
- **Max mode**: Datalogger records the maximum value during each interval.
- **Min mode**: Datalogger records the minimum value during each interval.

Baud Rate: Select 9600, 4800, 2400, or 1200.

COMMAND: It is recommended that this function be used only by those very familiar with the commands of the power analyzer and datalogger. Request a copy of the 380803 Protocol Manual from Extech that includes the commands format.

FILE: The File menu heading includes the following selections:

- CONVERT: Convert coded data file into an ASCII data file. A coded data file RAW_DATA.DMM is generated when the Read/Save button is selected.
- DATA DUMP: Select DATA DUMP to retrieve all of the data stored in the datalogger. The data will be converted to ASCII format and saved in a file.

ASCII Output to RS-232: The Datalogger can be configured to output data in ASCII format rather than coded format in order to accommodate a serial printer for example. Ensure that the RS-232 configuration is setup as specified in the 'Hardware Setup' section earlier in this manual. In the Datalogger window, the MODE selection under 'ASCII out to RS-232' has three options as follows:

- **Disable**: Disable ASCII format data output.
- **One Shot Mode** (Manual): When the REC button is pressed once, one data record (W, A, V, PF + CR + LF) will output to the RS-232 port in ASCII format.
- **Continuous Mode** (Auto): With this option selected, the user must specify an output interval. Once configured, the user must turn datalogger power off and on to enable this function. In this mode, the datalogger outputs data (W, A, V, PF + CR + LF) in ASCII format at the specified interval continuously.

Stopping the ASCII Output Stream

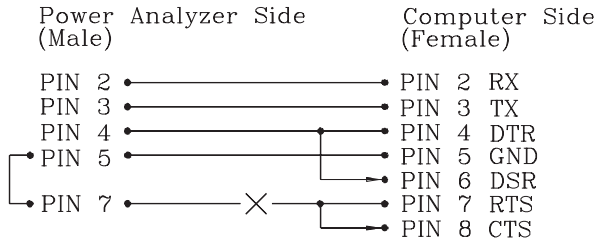
If the datalogger receives any character from the RS-232 port, or if the user presses and holds the REC button for 2 seconds to enable datalogging in AUTO MODE, the ASCII output stream will stop. To restart it, turn power off and on again.

RS-232C Setup for ASCII output

To enable the ASCII output, the communications configuration must follow the conditions defined in “Hardware Setup’ section earlier in this manual.

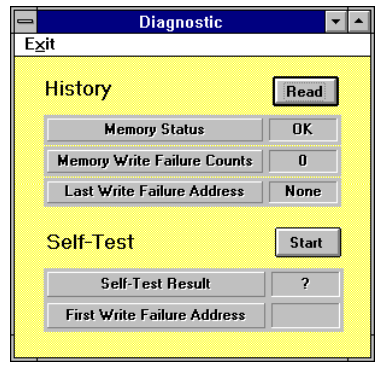
Using TERMINAL or TELIX programs for ASCII output

Windows TERMINAL and TELIX communication programs do not allow users to disable the RTS line as explained earlier in the ‘Hardware Setup’ section. However, users can rewire the RS-232 connection as drawn below:



Diagnostic of Datalogger Memory

Select DIAGNOSTIC from the DATALOGGER window, a diagnostic window will display as shown:



Press the READ button to view failures that may have occurred while writing to the datalogger memory. For no errors, the memory status will show ‘OK’, Memory Write Failure Counts will show ‘0’, and Last Write Failure Address will show ‘none’. If any WRITE failure occurred, the Memory Status will display ‘FAIL’, the Memory Write Failure Counts will show the number of failures, and the Last Write Failure Address will show the memory address for the failure.

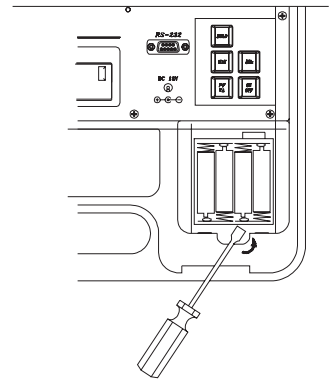
Test the non-volatile memory of the datalogger by pressing the start button and following the on-screen instructions (power must be on during test). The PF LCD will display ‘EPS’ indicating that the datalogger is testing. While testing, the W, V, and A functions continue to operate while the PF does not. Also, the power analyzer will not send any data to its RS-232 port. When the test is complete the ‘EPS’ display will switch off and the power analyzer/datalogger will return to normal operation.

Replacement of Batteries and 20A Fuse

Battery Replacement

When the low battery symbol is displayed on any of the LCDs, replace the eight (8) 1.5V 'AA' batteries.

1. Turn off the power analyzer.
2. Open the battery compartment by using a screw driver (see diagram).
3. Replace the batteries.
4. Replace the battery compartment.



20A Fuse Replacement

To replace the 20A fuse, remove the fuse cover as indicated in item (5) in the Meter Description section earlier in this manual and replace the fuse if necessary.

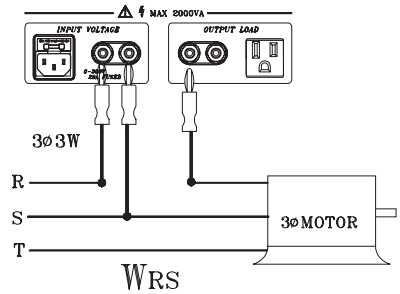
Warning: Do not replace the blown fuse with a fuse rating greater than 20A.

Measurement of 3-Phase 3-Wire Power

Using One Power Analyzer

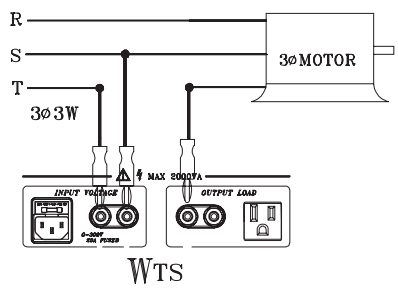
Measure W_{RS} first (RST phases must be correctly identified)

1. Connect the R-phase of the power source to the black terminal of the input voltage
2. Connect the S-phase of the power source to the red terminal of the input voltage
3. Plug the R-phase of the device to be tested to the black terminal of the output load. Do not short the R-phase of the device to be tested to the R-phase of the input power source.
4. Record the reading of W_{RS} displayed on the 'W' LCD.



Measure W_{TS} secondly (RST phases must be correctly identified)

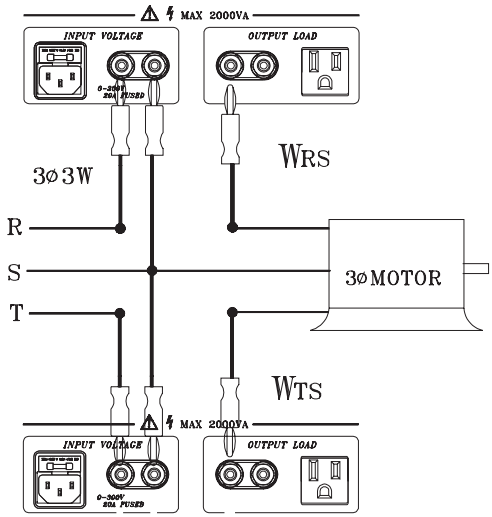
1. Connect the T-phase of the power source to the black terminal of the input voltage
2. Connect S-phase of the power source to the red terminal of the input voltage
3. Plug the T-phase of the device to be tested to the black terminal of the output load. Do not short the T-phase of the device to be tested to the T-phase of the input power source.
4. Record the reading of W_{TS} displayed on the 'W' LCD.



Using Two Power Analyzers

Measure W_{RS} and W_{TS} (RST phases must be correctly identified)

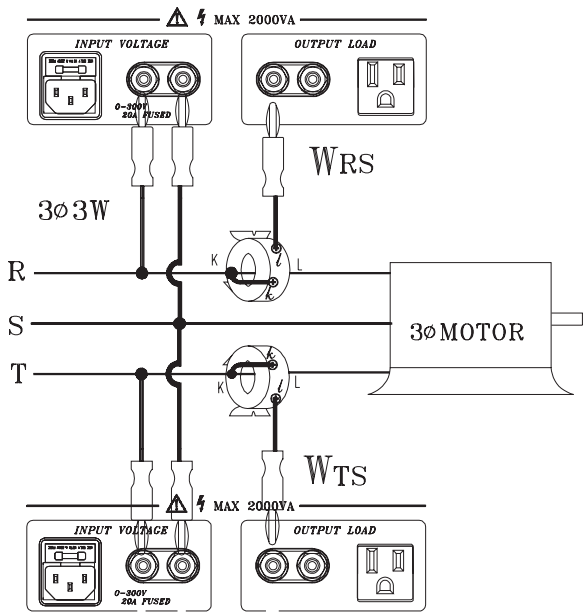
1. Connect the R-phase of the power source to the black terminal of the input voltage of power analyzer 1.
2. Connect the S-phase of the power source to the red terminal of the input voltage of power analyzer 1.
3. Plug the R-phase of the device to be tested to the black terminal of the output load of power analyzer 1. Do not short the R-phase of the load to the R-phase of the input power source.
4. Record the reading of W_{RS} displayed on the 'W' LCD of power analyzer 1.
5. Connect the T-phase of the power source to the black terminal of the input voltage of power analyzer 2.
6. Connect the S-phase of the power source to the red terminal of the input voltage of power analyzer 2.
7. Plug the T-phase of the device to be tested to the black terminal of the output load. Do not short the T-phase of the device to be tested to the T-phase of the input power source.
8. Record the reading of W_{TS} displayed on the Watt LCD of power analyzer 2.



Using Current Transformers (CT) with 2 Power Analyzers

Measure W_{RS} and W_{TS} (RST phases must be correctly identified)

1. Connect the R-Phase to the black terminal of the input voltage of power analyzer 1.
2. Connect the S-phase to the red terminal of the input voltage of power analyzer 1.
3. Connect the *k* terminal of CT1 to the R-phase.
4. Connect the *l* terminal of CT1 to the black terminal of the output load of power analyzer 1.
5. The Watt reading of the power analyzer 1 is W_{RS}
6. Connect the T-phase to the black terminal of the input voltage of power analyzer 2.
7. Connect the S-phase to the red terminal of the input voltage of power analyzer 2.
8. Connect the *k* terminal of CT2 to the R-phase.
9. Connect the *l* terminal of CT2 with the black terminal of the output load of power analyzer 1.
10. The Watt reading of the power analyzer 2 is W_{TS}



Glossary of Terms

W	True Watt
PF	Power Factor
V	True RMS Voltage
A	True RMS Ampere
Phase angle	Time difference between V and A calculated by $\cos^{-1}$ (Power Factor)
VA	Apparent Power (V * A)
VAR	Reactive Power (SQRT [$VA^2 - W^2$])
IR	Equivalent current (through equivalent resistance)
Req	Equivalent resistance
IL	Equivalent current (through equivalent inductance)
XL	Equivalent impedance of equivalent inductance
Leq	Equivalent inductance
CAP	Required capacitance
CR	Carriage Return
LF	Line Feed
EPS	Datalogger Memory Self-test
EPE	Erasing Datalogger Memory
$W_{3\phi}$	True Power (3ϕ 3W)
W_{RS}	Power of R phase with respect to S phase
W_{TS}	Power of R phase with respect to S phase
$VA_{3\phi}$	Apparent Power (3ϕ 3W and Balanced Load)
$VAR_{3\phi}$	Reactive Power (3ϕ 3W and Balanced Load)
$PF_{3\phi}$	Power Factor (3ϕ 3W and Balanced Load)
Mean	Mean Value
Std Dev	Standard Deviation
Best Fit	A line drawn to fit a curve with minimum error

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