RX-30, RX-31, RX-33

Xytronic Three-Phase Reference Standard

Operations Manual

RADIAN

Power and Energy Measurement Solutions

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The information contained in this manual remains the property of Radian Research, Inc. It is provided for the operation and servicing of this Radian product.

The operation of this instrument requires training and experience in electric meter testing. The information in this manual is designed to supplement existing knowledge and experience already attained and practiced by journeyman-level meter technicians. Novice meter technicians should not attempt to operate this instrument without first gaining the basic knowledge of meter testing and the application of meter testing instrument from a certified training course.

RX Certifications

At Radian, we are committed to providing the most accurate, reliable, easy-to-use, and safe to use power and energy measurement solutions. To illustrate our commitment to offer our Customers the best in measurement quality and technical competence, our calibration laboratory is accredited under ISO/IEC-17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" while maintaining compliance to ANCI/NCSL Z540-1-1994 and ISO 9001:2008. Calibration of products manufactured and serviced at Radian is traceable to the SI (International System of Units) through NIST (National Institute for Standards and Technology).

This commitment to excellence makes Radian a world leader in power and energy measurement solutions.

www.NIST.gov

www.ISO.org

www.A2LA.org

Contacting Radian Research

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Using this manual

Customer service is the top priority of everything we do at Radian Research, Inc. We listen carefully to your suggestions regarding our operations manuals, services and product.

Listening to our Customers

Tell us how we are doing! Radian Research welcomes your feedback, email radian@radianresearch.com.

Finding what you want

- An improved, clean design makes it easier to scan layout with headings on the left and content on the right just as the layout here.
- A fully interactive linking with text in table of contents, table of figures and tables, and an index.
- A fully searchable electronic PDF version of the operations manual so you can find what you want, when you want it.

Defining the symbols used on RX reference standards

	Caution: Hazardous voltage. Risk of electric shock.
	Caution! Please consult operations manual before using the instrument. Failure to follow or carry out instructions preceded by this symbol may result in personal injury or damage to the device and installation.
	Indicates direct current
	Indicates protective safety ground conductor terminal
	Indicates power button.

Explaining symbols used throughout manual

✓Note	Denotes important information in the manual, please take note.
Warning	Denotes a potentially dangerous situation that can result in death or serious injury.
Caution	Denotes a potentially dangerous situation that can result in an injury or instrument damage.

Contents

Figures and tables

1.0 Using your RX Reference Standard safely

This section addresses using your product safely. It has been divided into three subsections.

1.1 Designing for safety

Connection panel protection	For your safety, connection inputs, when used with Radian supplied accessories, prevent access to HAZARDOUS LIVE voltages.
Encapsulated design	Unit is fully encapsulated to prevent accidental injury to users.

1.2 Labeling for safety information in manual and on product

Caution! HAZARDOUS LIVE voltage. Risk of electric shock.

Caution! Please consult operations manual before using the instrument.

Failure to follow or carry out instructions preceded by this symbol may result in personal injury or damage to the device and installation.

1.3 Safety protocols

- Read all safety information before you use the product.
- Examine product carefully before using.
- Employ personal protective equipment when appropriate.
- Using this product in a manner not specified by the manufacturer, may impair the protection provided by the unit.
- Do not use outside the specified environmental conditions.

- Requires hazardous voltage handling training before using product.
- Misuse of product may cause HAZARDOUS LIVE environment.
- Check for any visible physical damage on connector cables before making any connections.

- Do not use if there is visible physical damage.
- Ensure cooling vents and fan screens are not blocked.
- Do not use if wet.
- Ensure unit is properly grounded before using or making other connections.
- Do not attach any cable except ground to the Protective Earth ground.
- Do not attach potential input cables to current inputs or vice versa.
- Do not apply voltage or current to any input unless all cables are connected.
- Do not attach one current input to Hazardous Voltage and the other to a different Hazardous Voltage or ground.
- Before changing any fuses, turn off the product and remove all cables from the connection panel.
    - Fuses must be replaced with Radian part number 3001016 (500 mA, 1000 VAC/VDC 3AB, 10kA breaking capacity)

- After replacing fuses, clean fuse compartment of any conductive debris.
- Do not use if fuse door is missing.
- Do not apply more than rated voltage or current to instrument inputs.
- Do not use visibly damaged cabling or clamps.
- Deploy only cables with correct voltage ratings.
- Use extreme caution around the terminals. Lethal voltages may be present.
- Only use Radian Current clamps terminated with 7-pin Redel connector on the CT1, CT2, and CT3 input connections.
- Only use the 24V DC power supply (part number 850026) to power the instrument.
- Only use accessories intended to be used with this instrument.
- Check for damage to locking tabs on current cables and instrument panel before using.
- Use caution when attaching voltage and current cables such that the cables do not cause the instrument to move or fall.

2.0 Getting started

You have purchased your product and now it is time to get it ready for work. This section will guide you through the process of getting started.

Thank you for purchasing this quality Radian product. Radian reference standards are recognized throughout the world for their accuracy, precision, and stability in electric energy measurement. Your satisfaction and safety are very important to us and your continued loyalty greatly appreciated.

If for any reason your Radian product does not meet your expectations, please contact our Customer Service staff at radian@radianresearch.com.

2.1 Unpacking and inspecting your product

Every effort is made to ensure that our packing materials and shipping carrier provide the necessary protection for your product. It should reach you in perfect condition.

2.1.1 Contents of box

- Operations Manual
- RX-30, RX-31 & RX-33
- Your optional accessories (if applicable.)
  Note: Some accessories may be shipped separately.

Figure 2.1 Contents of package.

2.1.2 Inspecting contents

1. Remove product carefully.
2. Check for any signs of damage.
3. Call carrier and local sales representative or Radian if the product is damaged.

Figure 2.2 Packed box ready to ship.

2.2 Registering your product

2.2.1 Registration benefits

Figure 2.3 White paper

- Activates instrument two year warranty.
- Guarantees you receive firmware and software updates.
- Assures you receive product application notes and white papers.
- Informs Radian of End user.

2.2.2 Online registration

1. Go to www.radianresearch.com/reg.
2. Complete the online form.
   a. The model number is located on the display panel label.
   b. The serial number can be found on the nameplate on the bottom of the product.

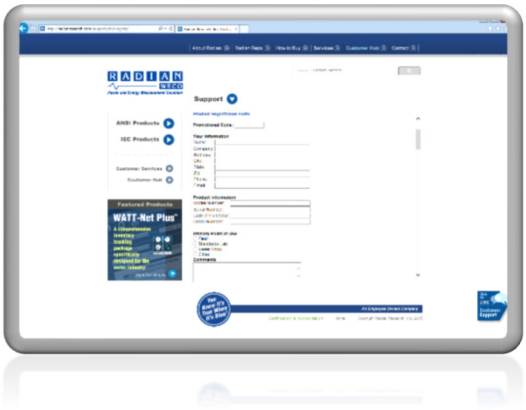


Figure 2.4 Online registration screen

2.2.3 Warranty

- Radian Research, Inc. warrants each product is free from material defects and workmanship.
- Our obligation under this warranty is to repair or replace any instrument or component under normal use that proves to be defective upon examination within two years after shipment.
- Radian will pay local domestic surface freight costs for return shipment of the product back to the Customer.
- Details for receiving service under warranty please contact our Customer Service staff at radian@radianresearch.com .

2.3 Beginning with safety in mind

- Read all safety information before you use the product.
- Examine product carefully before using.
- Employ personal protective equipment when appropriate.
- Using this product in a manner not specified by the manufacturer, may impair the protection provided by the unit.
- Do not use outside the specified environmental conditions.

- Requires hazardous voltage handling training before using product.
- Misuse of product may cause HAZARDOUS LIVE environment.
- Check for any visible physical damage on connector cables before making any connections.
  - Protective safety ground
  - Potential input: Shrouded 4mm connector
  - Current input: Shrouded 6mm connector.
  - 24 V DC Voltage input: Shrouded 12.5mm connector.
- Do not use if there is visible physical damage.
- Ensure cooling vents and fan screens are not blocked.
- Do not use if wet.
- Ensure unit is properly grounded before using or making other connections.

- Do not attach any cable except ground to the Protective Earth ground.
- Do not attach potential input cables to current inputs or vice versa.
- Do not apply voltage or current to any input unless all cables are connected.
- Do not attach one current input to Hazardous Voltage and the other to a different Hazardous Voltage or ground.
- Before changing any fuses, turn off the product and remove all cables from the connection panel.
    - Fuses must be replaced with Radian part number 3001016 (500 mA, 1000 VAC/VDC 3AB, 10kA breaking capacity)
- After replacing fuses, clean fuse compartment of any conductive debris.
- Do not use if fuse door is missing.
- Do not apply more than rated voltage or current to instrument inputs.
- Do not use visibly damaged cabling or clamps.
- Deploy only cables with correct voltage ratings.
- Use extreme caution around the terminals. Lethal voltages may be present.
- Only use Radian Current clamps terminated with 7-pin Redel connector on the CT1, CT2, and CT3 input connections.
- Only use the 24Vpower supply (part number 850026) to power the instrument.
- Only use accessories intended to be used with this instrument.
- Check for damage to locking tabs on current cables and instrument panel before using.
- Use caution when attaching voltage and current cables such that the cables do not cause the instrument to move or fall.

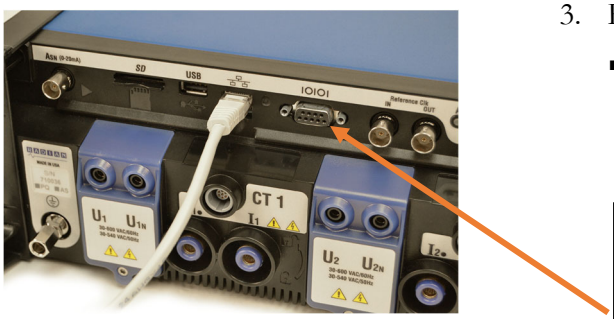
2.4 Connecting your reference standard

Figure 2.5 Protective safety earth connection.

1. Connect protective safety earth connector to ground earth binding post. To maintain the 600V/CAT IV Safety Rating on Potential inputs, a solid Protective Earth connection is required. The ground connection must be maintained by attaching a bare or tinned wire of at least 18 AWG to the ground post through the eyelet and tightening the nut with a 3/8" driver to a minimum of 4 inch-pounds torque to a maximum of 8 inch-pounds. The maximum ground wire length must not exceed 12 ft.

2. Connection panel input sockets:
   - Connect potential input with supplied shrouded 4mm potential connector cable.
   - Connect optional 120 Amp or 200Amp locking current connector cable.
   - Connect 24V DC input with shrouded 5.5mm OD, 2.5mm ID DC Plug.

Figure 2.6 Input connection.



3. For communications:
   - Connect the RJ-45 Ethernet cable into the Ethernet port on the connection panel from its host.

Serial Connection for use with PC Suite

Figure 2.7 Ethernet Communications in place.

2.5 Powering up

Figure 2.8 Powered and ready to work.

4. You are now almost ready to power up the unit.
   - Plug the 24V DC power supply cord into the power port.
   - Turn on the power switch.

3.0 Introducing the Xytronic Reference Standard

Radian is a recognized world leader in the energy reference standards industry beginning with the Metronic line and continuing to advance with the Dytronic line. We continue presenting the cutting edge of technology with our new Xytronic reference standard, RX-30, RX-31 and RX-33. Energy Reference Standards that clearly sets the mark for the future.

3.1 Featuring enhanced design

3.1.1 USB ports	Front and rear USB ports, one on the connection panel and one on the front display panel.
3.1.2 Ethernet port	RJ-45 Ethernet Communication Port on the connection panel.
3.1.3 Serial port	Serial Port on the connection panel.
3.1.4 Standard Commands for Programmable Instruments (SCPI)	Many instrumentation software developers, in a wide variety of settings and industries, are using SCPI because of its self-explanatory and intuitive design that will carry learning and training across multiple applications with greater ease and efficiency. You may find further information on SCPI, including version, command syntax and common commands in Section 5.2.1.4 on SCPI conformance information

You can rest assured this product has gone through the rigorous testing to meet CE Marking EMC and safety compliance. This product meets the requirements for the following Low Voltage Directives: LVD (safety), EMC, RoHS2, WEEE.

3.2 Existing configurations

3.2.1 Summarizing model numbers

There are six models available.

- RX-30, 0.04% (0.02% @ UPF) class
- RX-30-AS, 0.04% plus Analog Sense
- RX-31, 0.02% (0.01% @ UPF) class
- RX-31-AS, 0.02% plus Analog Sense
- RX-33, 0.01 (0.005% @ UPF)
- RX-33-AS, 0.01 plus Analog Sense

3.2.2 Specifying Accessories

There are three configurations available as designated by the last two digits:

- CK — RX-200CK3
- CK — RX-120CK3
- RMK — RX-RMK

You may choose to get your unit with one, two, three or all four of these configurations.

RX-30 Detailed Functions

8030402	RX-30	200Amps 0.04% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters.
8030422	RX-30-AS	200Amps 0.04% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Analog Sense, Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters (100362).

RX-31 Detailed Functions

8031202	RX-31	200Amps 0.02% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters.
8031222	RX-31-AS	200Amps 0.02% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Analog Sense, Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters.

RX-33 Detailed Functions

8033102	RX-33	200Amps 0.01% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters (100362).
8033122	RX-33-AS	200Amps 0.01% Watts/Watthour Accuracy: Whrs, Volts, Amps, VARhrs, VAhrs, Watts, Functions include VARs, VA, Vhr, Ahr, V2hr, A2hr, Phase Angle, PF, Frequency. Analog Sense, Min and Max & AVG Supplied with DC Converter and power cord, Tilt stand, side mount handles, Operators Manual, spare fuses and cable locking adapters.

RX Optional Accessories

100360	RX-RMK	19” Rack Mount Kit assembly (Black)
100359	RX-RMK	19” Rack Mount Kit assembly (Grey)
190270	RX-120CK3	120 Amp Locking Current Cable Kit Assembly (3 pair)
190271	RX-200CK3	200 Amp Locking Current Cable Kit Assembly (3 pair)

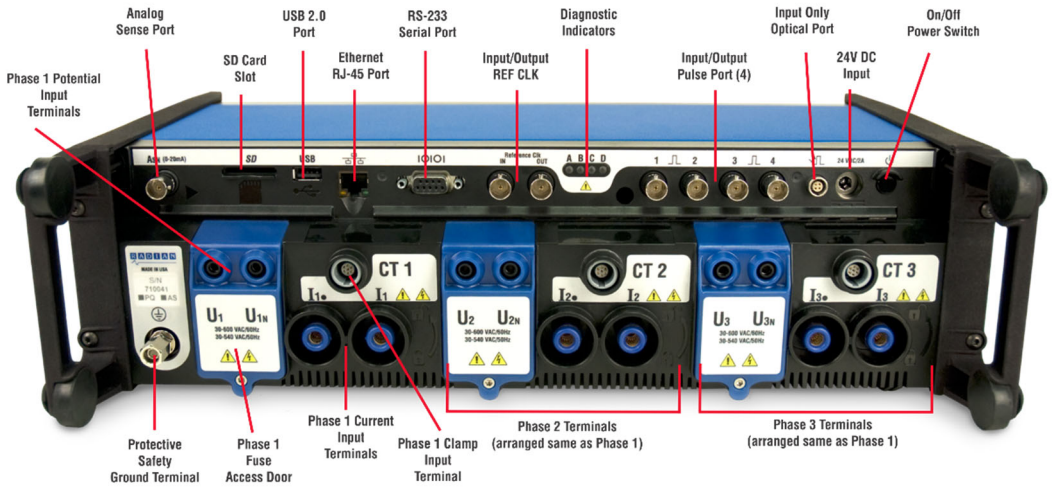


Figure 3.1 Connection Panel

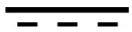
3.3 Reviewing hardware design

3.3.1 Connection panel

Analog Sense Port	You have the option of analog sense functionality to effectively test transducers with a DC output.
SD Card Slot	The RX allows up to 32 GByte of storage of data using removable SD memory card.
USB 2.0 Port	USB port provides access to peripherals (e.g. printers, mouse, monitor touch screen) and USB memory options.
Ethernet RJ-45 Port	Ethernet communications port used for external PC control to remotely control the device, export data, and upgrade software. RX-30, RX 31 & RX-33 enables you to perform these tasks with a standard RJ-45 port Ethernet cable.
RS-232 Port	The serial COM port supports RD legacy command and used for serial communication.
Input/Output BNC Ports	BNC connections are programmable bidirectional ports.

LED Indicators	The RX has four LED indicator used to display self-diagnostic status. The following table defines the status indicators. Error codes are defined in Section 6.1 LED indicator error codes.

Color	Indicator	Flashing	Solid
A. Green	AC Reference /Analog Sense	Error	Fully operational
B. Red	Phase 1	Error	Fully operational
C. Yellow	Phase 2	Error	Fully operational
D. Blue	Phase 3	Error	Fully operational

Optical Pickup (Input only)	This port, a 4-pin Lemo connector, is a sensor port to be used with Radian disk sensors, infrared and visible LED optical pickups to sense disk rotation or pulse revolutions.
 Power Supply Input	Power to your unit is supplied through a +24V DC power supply via a standard 120/60 Hz or 230/50 Hz outlet. As with all connecting cables, check for damage to cables before plugging in.
 On/Off Power Switch	This equipment is on when the power switch is depressed in and the blue LED indicator light display panel is on. Unit power is off when power switch is all the way out.
 Protective safety ground terminal	The main purpose of the protective safety ground is to protect you from the high voltage which may be present in the unit, and must be connected and grounded at all times.

Voltage and current terminals

The voltage and current inputs are auto-ranging, a design feature originally pioneered by Radian. These inputs consist of a toroidal auto-ranging electronically compensated transformer which does not eliminate the need for switching relays that can prove unreliable over time. The specially designed and manufactured Radian toroid transformer provides superior immunity to stray fields while electronic compensation eliminates practically all transformer error. The voltage current inputs are completely autoranging – a design feature that was pioneered by Radian research in their first product offering in 1985. The voltage current inputs of a toroidal autoranging electronically compensated transformer. The Radian toroid transformer provides superior immunity to stray fields and the electronic compensation eliminates practically all of the transformer error.

Fuse access door

The RX has fuses to protect the Potential inputs each fuse pair corresponds with each phase of RX. Fuses must be replaced with Radian part #3001016 (500mA 1000VAC/VDC, 3AB, 10kA Breaking Capacity).

Clamp-on CT Inputs

CT1, CT2 & CT3 must only be used with Radian approved current clamp probes.

The CT input is a seven-pin connector that provides power, serial communications to linearized clamp probes.

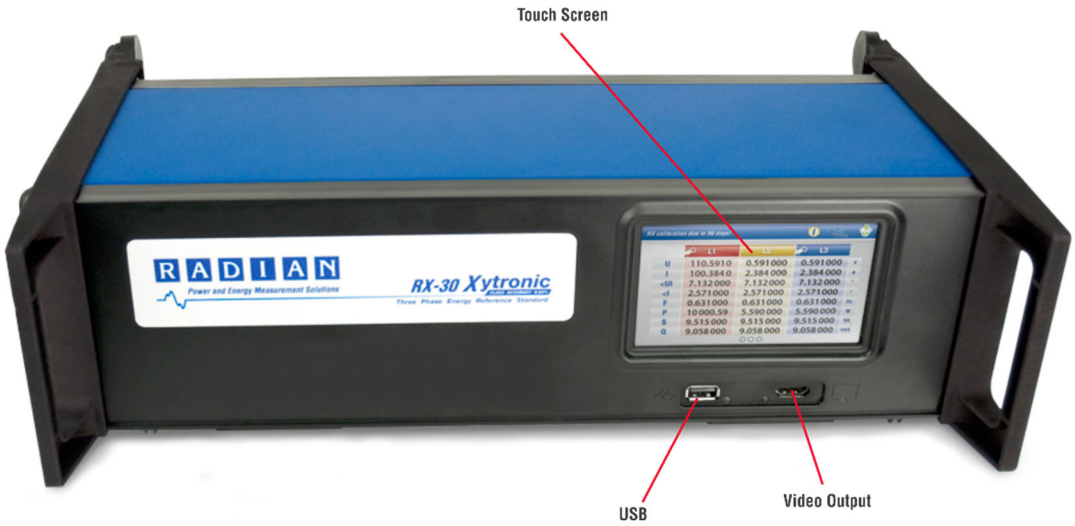


Figure 3.2 Display Panel

3.3.2 Display panel

4-inch x 2.5-inch (101.6mm x 63.5mm) LED Display	Utilize RX-30, RX 31 and RX-33's color touch screen display to access status and measurement information. This touch screen works best using a stylus to input information and select options.
USB 2.0 Port	Including a USB Port on both the connection and display panels increases the flexibility of storage access in various system implementation.
2 LED indicator lights	Indicator lights on the bottom right-hand side of display panel are to show unit is powered up.

3.4 Assuring your satisfaction

3.4.1 Warranty

It is always our desire at Radian, that your products will come to you in perfect condition and last for their maximum life space, but we also understand that accidents do happen, and so we provide a warranty, plus Care Plans, and extended Service and Support Contracts.

- The details of the warranty can be found in section 2.2

Details for receiving service under warranty are found in section 7.2 repairing your RX-30, RX-31 & RX-33.

Additional information on both the service plans and contracts may be found on our website: www.radianresearch.com.

4.0 RX Reference Standard Specifications

4.1 Electrical

4.1.1 Current input

Number of inputs	3 (I_1, I_2 & I_3)
Fundamental frequency	45-70 Hz
Input current range	1 mA to 200 A (Warning; possible overheating may occur if the wrong cable type and connector is used. See Optional Accessories section)
Current Accuracy	20 mA – 120/200 A, RX-30; 0.028% – Harmonic amplitude limited to a 1/N fundamental amplitude. RX-31; 0.014% – Harmonic amplitude limited to a 1/N fundamental amplitude. RX-33; 0.007% – Harmonic amplitude limited to a 1/N fundamental amplitude. 1mA to <20mA de-rated to 2 x Current Accuracy
Maximum harmonic measured	60^{th}
Harmonic accuracy	Base accuracy (0.02% / 0.04%) x N^2
Input impedance	<500 μΩ (Frequency at 45-70 Hz)
Fault current	12t is 4166 A^2-sec, 10,000 A
Max common mode voltage	600 VAC

4.1.2 Potential input

Number of inputs	3 (U_1, U_2 & U_3)
Fundamental frequency	45 to 70 Hz
Input voltage range	30 VAC to 600 VAC at 60 Hz 30 VAC to 525 VAC at 50 Hz (Max. 10.5*line frequency)

Potential Accuracy	Base accuracy (RX-30; 0.020%/RX-31; 0.010%/RX-33; 0.005%) – Harmonic amplitude limited to a 1/N fundamental amplitude.
Maximum harmonic measured	60^{th}
Harmonic accuracy	Base accuracy (0.02% / 0.04%) x N^2
Input impedance	1 MΩ +/- 2% (Frequency at 45 to 70 Hz)
Connectors	4 mm connectors (600 V, 10 kA cartridge fuse)

4.1.3 Clamp Probe input

Number of inputs	3 (CT_1, CT_2 & CT_3)
Fundamental frequency	45 to 70 Hz
Input current range	0.5 mA to 1 A
Maximum common mode voltage	Clamp probe will be at system ground.
Accuracy	RX Class accuracy + Clamp Probe Specification
Maximum harmonic measured	60^{th}
Maximum output for powered devices (e.g. RD-BR1)	+6.0 V +/- 0.3 V at 0.4 A -6.0 V +/-0.3 V at 0.2 A current limited
Clamp power supply ripple	10 mV maximum
Connectors	one 7-pin Redel per input (connector signals +/- 6V, SDA, SCL, GND, I-in, I-rtn)

4.1.4 Analog Sense (Optional RX-AS)

Number of inputs	1

DC current range	-20 mA to +20 mA
Accuracy	+/- 0.02% of reading + 1 µA

4.1.5 Pulse inputs/outputs

Number of ports	4 bidirectional
Input voltage range	-0.3 V to +27 V
Pullups	Switchable 128 Ω / 1KΩ +/- 2%
Maximum pulse rate	4 MHz (input/output) with 128 Ω pullup 1MHz with 1 KΩ
Minimum pulse rate	125 nsec (input/output)
Input logic thresholds	< 1.0 V, > 2.0 V
Connectors	Four 50 Ω BNCs
Output fall time	> 6 nsec (50 Ω)

4.1.6 Reference clock input/output (Optional RX-TX)

2 BNC ports – 1 input and 1 output	0 V to 5 V (TTL compatible)
Frequency	10 MHz / 20 MHz, 50 Ω

4.1.7 Optical pickup port

Connector	Lemo signals: +12 V, GND, DS input 2.15 kOhm pullup to 3.3 V, 3.3 V CMOS levels.

Max Frequency	100 Hz
5 V tolerant (5 mA maximum)	

4.1.8 USB-A 2.0

2 USB 2.0 type A ports supported	100 mA/500 mA maximum

4.1.9 Ethernet

1 external Ethernet port	10/100 Mbit via RJ45 jack connector Gigabit support.

4.1.10 RS-232

RS-232 port	Uses DB9 female connector

4.1.11 Input power

Input voltage	24 Vdc +/- 10%, 35VA max.
Startup surge	2 A: I^2t ~ 0.32 A^2 sec
Maximum source ripple	< 0.25 V peak to peak
Maximum source impedance	< 0.5 Ω

4.1.12 Safety

IP Class	IP30 (per DIN G EN 60529)
Low Voltage Directive	IEC 61010-1, 61010-2-30
Overvoltage Category Voltage Measurement	CAT IV 600V (RX-33; CAT II 600V)
Overvoltage Category Current Measurement	CAT IV 600V (RX-33; CAT II 600V)

Hi-Pot & Surge	IEC 61010-1
Fused Potential Input	500 mA Ultrafast – SIBA 70.172.40.0.500 or Equivalent

4.1.13 Metrics

Watthour Class Accuracy	RX-30 0.04%, RX-31 0.02%, RX-33 0.01%

4.2 Environmental

4.2.1 Operating temperature range	RX-30, RX-31 -20° to 65°C (-4°F to 149°F), RX-33 0° to 40°C (32°F to 104°F)
4.2.2 Storage temperature	-40°C to 80°C (-13°F to 176°F)
4.2.3 Operating humidity	0% to 95% non-condensing
4.2.4 Operating altitude	Up to 2000m (6561.68 ft)
4.2.5 Storage altitude	Up to 15,240m (50,000 ft)

4.3 Mechanical

4.3.1 Product size & weight

	Height	Width	Depth	Weight (no cables)
Overall	116 mm 4.56 in.	420 mm 16.5 in.	200 mm 7.9 in.	6.8 kg 15 lbs.
Without bumpers	106 mm 4.17 in.	410 mm 16.14 in.	195 mm 7.6 in.	6.83 kgs 15 lbs
Shipping (excluding optional current cables)				10.8kgs 24 lbs.

4.3.2 External cabling and connections supplied with product

- Power cable for AC/DC, 24 VDC convertor
- 4mm banana to banana Potential cables, 3 pair
- Legacy Cable locking adapters, 6 pk. (Pt. No. 100862)

4.3.3 Optional External cabling and connections

- Model RX-120CK3 (length 78 in/2 m) 6 x 120 Amp rated unterminated cable
- Model RX-200CK3 (length 78 in/2 m) 6 x 200 Amp rated unterminated cable

4.4 Touch screen Color display

4.4.1 Size and Resolution

101.6 mm x 63.5 mm 4-in. x 2.5-in.	480 x 200 pixels (Resistive touch)

4.5 Specifications

4.5.1 General

RX-30/RX-31/RX-33	
Ambient Temperature Range	Storage; -40 °C to +80 °C Operating; -20 °C to +65 °C Specified Accuracy; -20 °C to +65 °C, RX-33; 0 °C to +40 °C
Humidity	0% to 95% Non-condensing
Max height above sea level	2,000m.
Vibration	All Non-destructive
Supply Voltage	24 VDC ± 10%
Power Consumption	~35 VA max.
AC/DC Power Supply	AC Input 100V to 240V, 50 to 60Hz
Warm-up	<60 Seconds

Recommended calibration interval	1 year
Measurement Functions	Watts, Whr, Volts, Amps, VAR, VARhr, VA, VAhr, Phase, Power Factor, Frequency, Vhr, Ahr, V^2hr, A^2hr, & Min & Max Average Response.

4.5.2 Interface

RX-30, RX-31 & RX-33	
Touch Screen Color Display:	Integrated 4.3", Back Lit LCD Color Screen. Optional External Touch Screen Display.
I/O Ports:	
Communication Interface Port / Protocol	Serial RS-232; Supports Radian Legacy RD Command Ethernet; Standard Commands for Programmable Instrumentation (SCPI)
Memory	Internal (Max. Storage 2,000 Mbytes) External SD (Max. Storage 32 Gbytes) External USB
Front Panel External Monitor Port	Front Panel Video (See Available Monitors)
Front Panel External Touch Screen Port	USB
Optical Sensor Port	4 Pin Lemo (See Available Optical Accessories)
Reference Clock	10/20 MHz selectable, 5V TTL compatible
CT Ports	See Radian Web Site for Available Compensated and Uncompensated Current Clamp Specifications.
Bidirectional Programmable Pulse/Frequency Comparator BNC Ports	
Input Termination	128 Ohm/1 kOhm Pull Up to 5 V, Max External Pullup +27V
Input Gate Rate	125 nS Pulse Width Minimum, Maximum 20 Hz Repetition Rate.
Outputs 1, 2, 3 & 4: (Default = 0.00001 Wh/Pulse)	Short Circuit Tolerant. Programmable Kh Value. Nominal 5 V, Open Collector Compatible, Max. 27V. Max 4.0 MHz (125nS Pulse Width Minimum). Selectable Watt Hours, VAR Hours, VA Hours

4.5.3 Safety

RX-30, RX-31 & RX-33	
IP Class	IP30 (Per DIN EN 60529)
Low Voltage Directive	IEC 61010-1, 61010-2-30
Overvoltage Category Voltage Measurement	CAT IV 600 V (RX-33 CAT II 600V)
Overvoltage Category Current Measurement	CAT IV 600 V (RX-33 CAT II 600V)
Hi-Pot & Surge	IEC 61010-1
Fused Potential Input	500 mA Ultrafast – SIBA 70.172.40.0.500 or Equivalent

4.5.4 RX Specifications

Function	**Reading**	**% Accuracy** *(ppm)* [3,7]			**Stability** *(ppm √ Month)*			**ISO 17025 Cal Uncertainty**[1] *(ppm)*
		RX-30	RX-31	RX-33	RX-30	RX-31	RX-33	
Potential (U)	30V to 600V [(6)]	0.02 % (200)	0.01 % (100)	0.005 % (50)	8	4	2	30
Direct AC Current (I)	20mA to 200A [(2)]	0.028 % (280)	0.014 % (140)	0.007% (70)	12	6	3	50
Power [4,5]	0.03W – 120kW (60Hz)	0.04 % (400)	0.02 % (200)	0.01 % (100)	16	8	4	50
Energy [4,5]	0.03W – 120kW (60Hz)	0.04 % (400)	0.02 % (200)	0.01 % (100)	16	8	4	50
Phase angle	0° to 360°	0.008°	0.005°	0.003°				
Frequency	45 Hz to 70 Hz	1	1	1	0.3	0.3	0.3	0.05

Notes:

[1] At Unity Power Factor, calibration uncertainty <30ppm

[2] 1mA to 20mA De-rated to 2 times accuracy

[3] Includes variables of Stability, Cross Talk, and Traceability Uncertainty.

[4] For Power Factor < 0.5, ± (0.01% / PF) Maximum, RX-33 ± (0.005% / PF)

[5] For ≥ 1 Second Test Time

[6] Maximum 30V to 525V at 50 Hz

[7] Maximum RX-30 & RX-31; -20°C to +65°C. RX-33; 0°C to +40°C

Direct AC Current (I) Inputs	Range: 1 mA to 200 Amp. <500 μOhm Input Impedance across entire operating range Termination: 6 mm Female Banana ($\leq$ 120 Amp) or Male CONLOC ($\leq$ 200 Amp), See Optional Current Cable Termination and Locking Adapters.
Indirect Current (External CT Input)	Max input: 1 Amp Termination: 7 Pin Female Redel Connector
Potential (U) fused Inputs	Range: 30 V to 600 V (60Hz), 525 V (50Hz). 1M Ohm Input Impedance. Termination: 4 mm Female Banana. Protection: 500mA Fused.
Cable Accessories	AC to 24 DCV Converter (supplied) 3 pair 1m Potential Cables (supplied) Legacy Cable locking adapters, 6 pk (Pt. No.100862) Optional Current Cables; 120A (RX-120CK3) or 200A (RX-200CK3). Unterminated at one end

5.0 Operating your unit

This section will cover the following areas of operating your product.

5.1 Connecting the unit

5.1.1 Connecting Current Input Cables

The Radian RX Xytronic Standard utilizes LOCKING STYLE INPUT CONNECTORS, Radian cable part numbers, RX-200CK3, RX-120CK3 or supporting RD legacy 6mm cables for the current inputs.

✓Note

Locking Adapter (1000362)

These CONNECTORS are very specialized and feature beveled edges and a locking ring. Do NOT use straight ¼" current CONNECTOR studs, they will not fit or work correctly. Radian offers various jumper and adapter cables to fit most applications. Using a legacy RD cable without a locking adapter (100362) will result in an unsecure connection.

Connecting 6mm locking style connectors to current inputs

- Insert 6mm locking style CONNECTOR into current input and turn clockwise until you feel it lock into place.
- Pull CONNECTOR outward to ensure that you are not able to remove it.
- Repeat this process for each of the six connectors and current inputs.

Figure 5.1 Installing locking style connectors.

Unlocking 6mm locking style connectors

Figure 5.2 Unlocking connectors.

- Turn CONNECTOR counterclockwise and pull out of input. You should feel the mechanism unlock.

5.1.2 Implementing your product in a rack system

1. Gather parts and tools. For complete instruction see the Getting Started Guide that is shipped with your RX.
   - Unit
   - Rack mount plate (RX-RMK)
   - Left and right side bracket
   - Left and right handles
   - Tools and screws (8):
     - Max. screw size: 4mm or #8
     - Tools required for screws

Figure 5.3 Unit with side handles

Figure 5.4 Putting together the assembly

2. Disassemble and remove the left and right black side handles by removing rear screws before attaching rack mount assembly.
3. Reassemble and fasten brackets and handles onto unit.

4. Insert assembly into rack, being sure to secure the rack mounting screws tightly into place.

Figure 5.5 Rack mount assembly

5.1.3 Protecting with safety ground connection

➢ Connect protective safety ground connector to ground earth binding post.

Figure 5.6 Protective safety earth connection

5.1.4 Connecting inputs

Figure 5.7 Input connections

➢ Into connection panel input sockets:

- Connect potential input with shrouded 4mm potential connector cable.
- Connect current input with shrouded 6mm current connector cable.
- Connect 24V DC input with shrouded 5.5mm OD, 2.5mm ID DC Plug.

5.1.5 Linking communications ports

- For communications link:
  - Connect the RJ-45 Ethernet cable into the Ethernet port on the connection panel from host computer.

Serial Connection for use with PC Suite

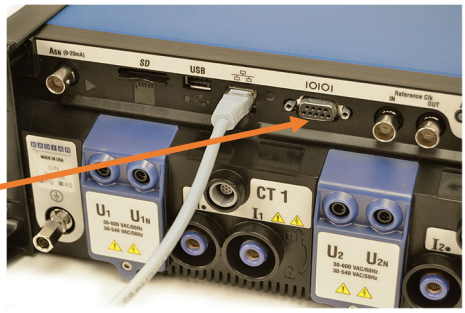


Figure 5.8 Communications cable in place.

5.1.6 Displaying options

Built-in color LCD touch display

Figure 5.9 Built-in display

- An external LCD monitor connected to video port on the Display Panel will override and blank the RX display (See Section 3.3.2, Figure 3.2).
  - Powering on will automatically turn on built-in display.

- If an external monitor is connected to video port on the Display Panel (See Section 3.3.2, Figure 3.2).
  - Power up RX while external display is connected.

External displays

Figure 5.10 External display output

5.2 Powering up the unit

5.2.1 Power connection

➢ You are now almost ready to power up the unit.

- Plug the power supply 'brick' cord into the power port.
- Turn on the power switch.

Figure 5.11 Powered up and ready to work.

5.3 LED Indicators

You will see three modes on LED indicators, auto-calibration, normal, and notification.

Auto-calibration

➢ RX reference standards will automatically power up in auto-calibration mode signaled by the **LED indicators cycling through one light after the other**.

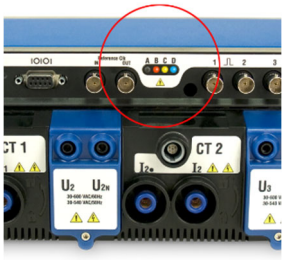


Figure 5.12 Auto-calibrating mode.

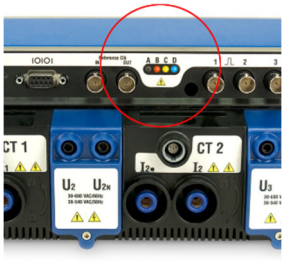


Figure 5.13 Normal mode

Normal

- When unit is in normal mode **all of the LED indicators will be lit**.

Notification

- If one or more LED indicators are **flashing,** you may take either of the actions described below to troubleshoot issue.
  - Check Section 6.1 LED indicator error codes.
  - View diagnostics information on status display.
  - Call Radian office at (765) 449-5576 or your representative.

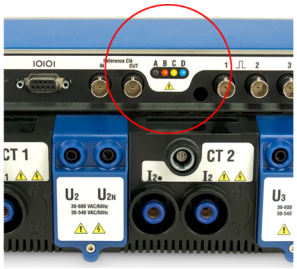


Figure 5.14 Notifying mode

6.0 Running your product software

You may access your product's software to operate the unit and run tests through either the front panel display, or RS-232 port, or Ethernet RJ-45 port. The following topics will be covered in this section.

6.1 LED Indicator Error Codes

When RX reference standard is turned on, it will go through its auto-calibration mode and should end in normal mode with the A rear panel LED indicator on. However, if any of the LED indicators are blinking, it is time to troubleshoot the unit by looking at the error codes produced and stored on the diagnostics screen.

LED A Status – Green with no errors

LED B Status – Flash Red, error reported on L1

LED C Status – Flash Yellow, error reported on L2

LED D Status – Flash Blue, error reported on L3

See section 6.2.4 Error event and Diagnostics display

6.2 RX Status Display Interface

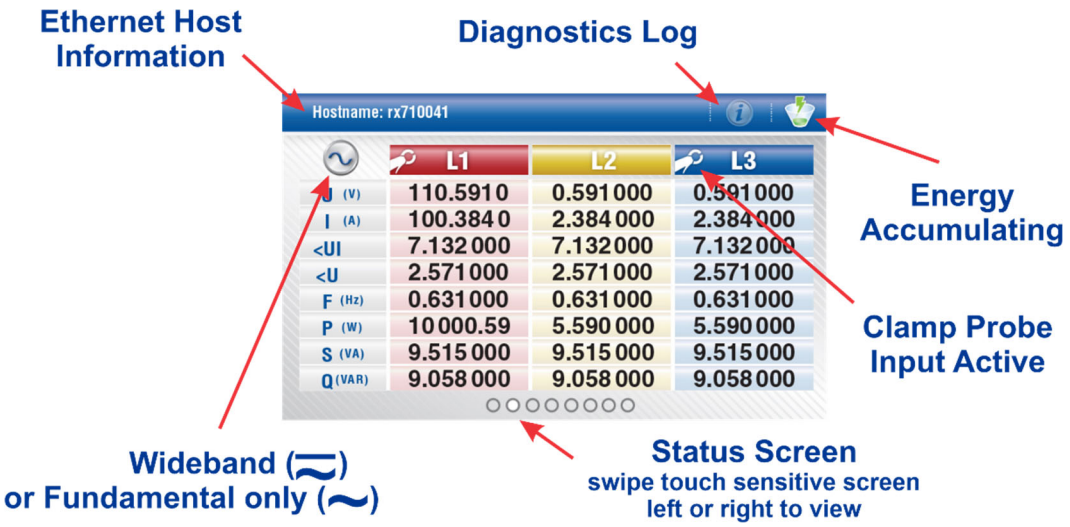
6.2.1. RX-3X Power-up View

During RX-3X power-up, the following loader start-up view will be seen. Three audible beeps will be heard indicating all three phases have sequenced to an active state and the display will default to the last displayed setting at power-down. The power-up sequence takes approximately 30 seconds.

The RX display is touch sensitive and can be swiped with your finger or stylus for other RX status views.

6.2.2 General Information found on each screen view

The display top banner section contains icons and text that is consistent on all other views.



6.2.2.1 Top Screen Banner

The Top screen banner is programmable using an external PC software connected to the Ethernet communication interface. By default, top banner will display Hostname: followed by the serial number of the RX.

6.2.2.2 Diagnostics Log Icon

Diagnostics Log icon will change color depending on severity of the error. While this icon is "greyed out" there are no errors detected. All errors are captured and displayed on the Diagnostics Event Log view. Touching or clicking on this icon immediately takes the user to the System Status screen. See section 6.2.4 for more information on the Diagnostics Event Log view

6.2.2.3 Energy Accumulating Icon

The energy accumulating icon animates during accumulating energy measurements.

6.2.2.4 Clamp Probe Icon

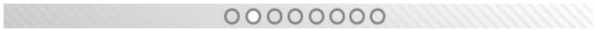
The clamp probe icon will activate upon detection of a CT accessory when connected to one of the rear panel CT ports. If no clamp is detected the RX will default to the direct current input.

6.2.2.5 Measurement Mode

Selecting the Measurement Mode button will toggle between normal 'Wideband' measurement (all frequencies out to the 60th harmonic of the fundamental) and Fundamental Frequency only measurement. The RX determines the fundamental from the measured Frequency at the input for each phase.

6.2.2.6 Screen View Location

Indication of the number of screen views to the left or the right of the current screen view.



6.2.3 Vector View

Vector views indicate the relative phase and amplitude relationships between each Voltage and Current axis.

6.2.3.1 Rotation

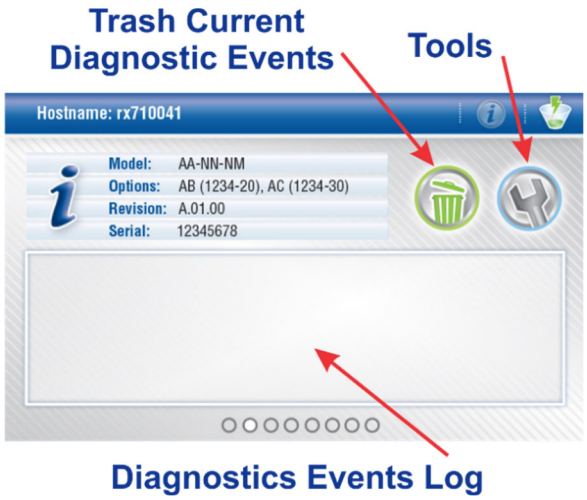
Reverse the polarity of the 90 degree point by selecting the Rotation button.

6.2.3.2 Zero Degree Set Point

Move the Zero degree to the appropriate quadrant by selecting the Zero Degree Set Point button.

6.2.3.3 Select Active Vector

Move the slider up or down for each phase to activate or deactivate L1, L2 or L3 vector.



6.2.4 Diagnostics Event Log

This view displays and retains all RX internally detected error events. The color of the icon represents the most severe message (green if there are only informational messages, yellow if there are any warnings [and no errors], or red if there are any errors. Touching or clicking on this icon immediately takes the user to the System Status screen.

Note: Before contacting Radian Technical support please note the details of each and all error messages.

6.2.4.1 Trash Button

To clear the error event, select the Trash Icon.

6.2.4.2 Tools Button

Selecting the Tools button allows the operator to rest the RX back to factory default condition.

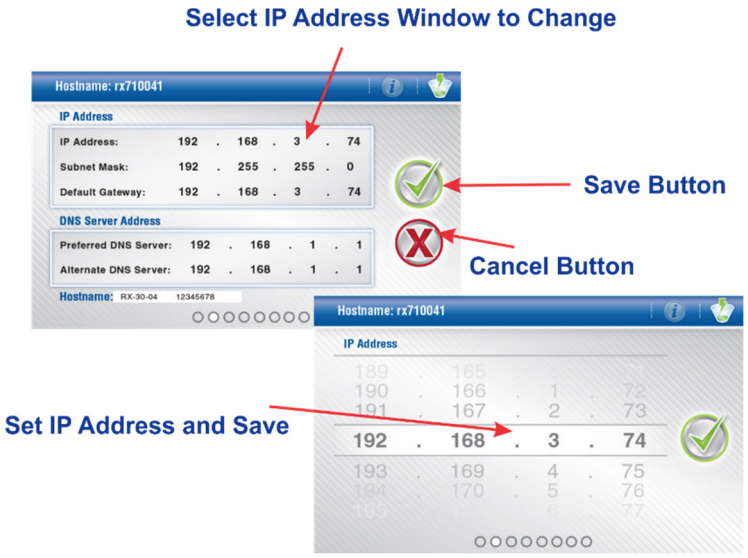
6.2.5 Properties View

The Properties view presents the operator with the ability to change network properties, date/time and localization.

6.2.5.1 IP & DNS Address Configuration

Check the appropriate IP configuration button to obtain IP automatically or define a specific IP address. Selecting "Use the following IP configuration" will enable the EDIT button.

The following IP Configuration screen view will be enabled from the IP Address Edit button.



Use the touch screen to select the IP or DNS address that you would like to change. On selection the Address change screen will activate. Scroll to the correct address and select the Green check button. Once you have set the appropriate address hit The Green check button again to exit this screen.

6.2.5.2 Edit Date and Time

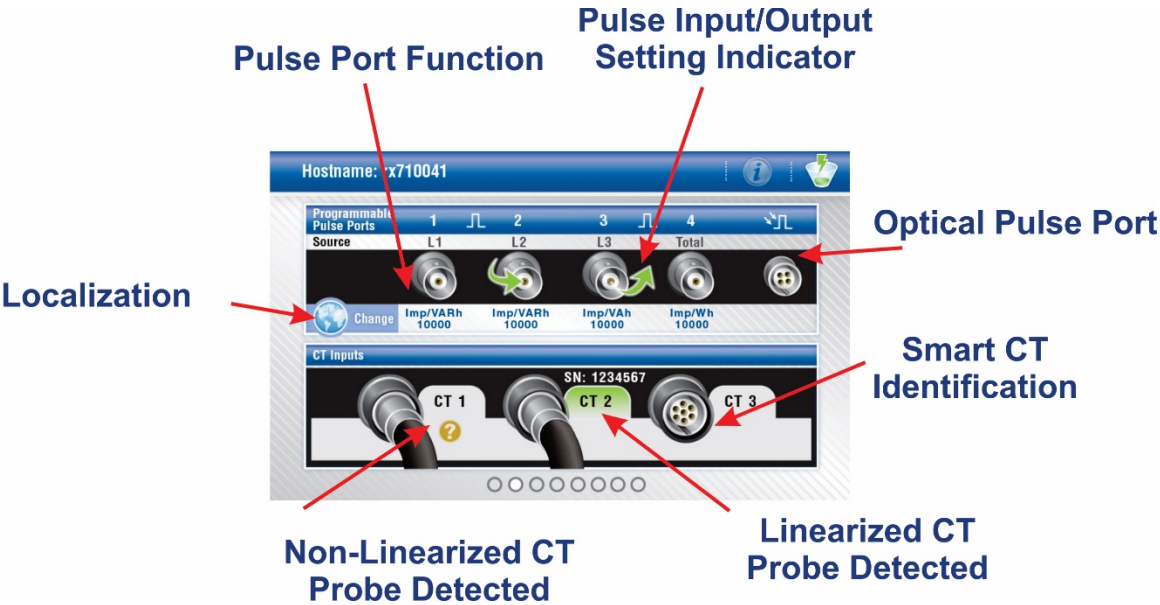
Select the EDIT button to change the internal date and time.

6.2.5.3 Localization

Select the WORLD button to set language preference.

6.2.6 Rear Panel Port Configuration View

The Port Configuration view provides a quick and simple visualization of the rear panel pulse and CT ports



6.2.6.1 Pulse Input/output Setting Indicator

Four programable pulse ports are available on the rear panel each can be programmed from the display or remotely for ke/kh and pulse direction (INPUT or OUTPUT) and Function (Watts, VAR, VA, TOTAL, etc.). An outward facing green arrow denotes Pulse Out, an inward facing green arrow denotes port set to receive pulses.

Factory Default port settings; All BNC ports set to OUTPUT pulse, P1 = Whr, P2=VARhr, P3=VAhr, All ports set to Totalized, All port constants set to 33333.3333 impulses per function, Ports 1-3 set to Wideband, Port 4 set to Fundamental only.

6.2.6.2 Localization

Select the World Button to toggle between impulses per function (e.g. 33333 pulses per Whr or Function per Impulse (e.g. 0.00003 Whr per impulse).

6.2.6.3 Optical Pulse Port

The Optical pulse port is set to receive only and used in conjunction with Radian optical pulse pickup accessories.

6.2.6.4 Clamp Probe Ports

Information relating to the type of clamp connected to one of three clamp input ports is displayed in this view. For a full listing of the many clamps available from Radian see related accessories documentation. There are two basic clamp probe types;

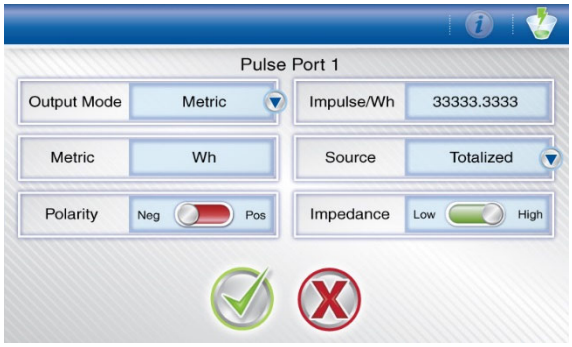
1) Linearized clamp probe – this probe type contains linearization constants that are read by the RX on connection. Once detected the RX disables the primary current input. Linearization constants are maintained within the supplied probe and remove clamp

amplitude and phase non linearities. The serial number of the clamp is also displayed against each CT input.

2) Non-Linearized clamps connected to the CT port will display a question mark.

6.2.7 Pulse Port Setup

Use the touch screen to select the appropriate Pulse Port that you would like to change. On selection the Pulse Port Setup screen will activate. Once the screen is activated, select appropriate setting you wish to change by touching the screen.



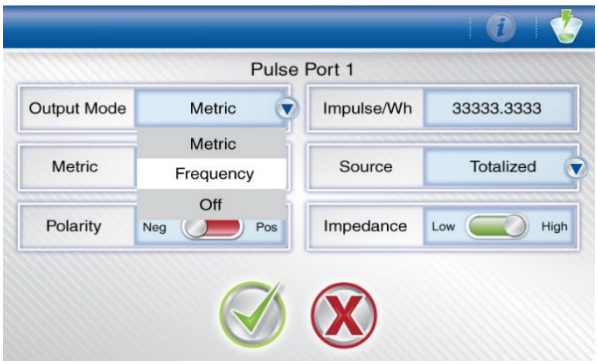
6.2.7.1 Output Mode

There are three selectable Output modes, Metric, Frequency & Off.

Selecting 'Metric' from the drop down menu assigns the port to Output pulses corresponding to the desired Metric (see 6.2.7.2 Metric)

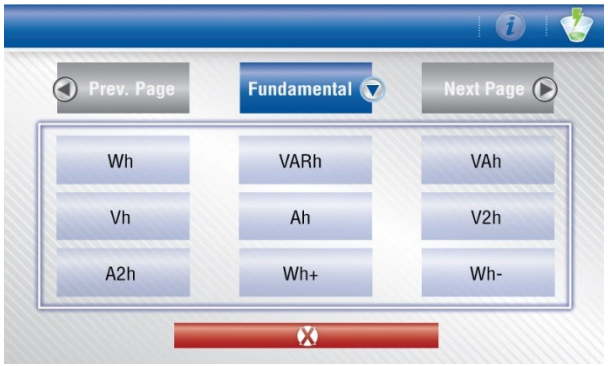
Selecting 'Frequency' from the drop down menu assigns the port to Output a frequency corresponding to the value in Hz typed into the 'Frequency' Field e.g. 100 Hz. This feature allows you to test the Input port configurations by simply connecting the output port to an adjacent defined INPUT port.

Output Mode set to 'Off' transitions the port to receive pulses from an external device (Pulse Input). NOTE: It is not necessary to set Output Mode to "Off" when controlling a test with SCPI commands, the serial interface, or a Radian Research Control application. The software commands will configure the BNC ports as needed.



6.2.7.2 Metric

By selecting Metric opens a displayed window to select the desired Port Metric and Bandwidth. E.g. VARh Fundamental Only. Care should be taken in assigning a port bandwidth different to that of a displayed metric.



The following list of metrics are available for selection and assignment to the pulse parameter (note- 'd' represents Delta, X represents Cross Connected service).

Wh, VARh, VAhr, Vh, Ah, V^2h, A^2h, Wh+, Wh-, VARh+, VARh-, dWh, dVAh, dVARh, dVARhX, VARhX, dWh+, dWh-, dVARh+, dVARh-, dVARhX+, dVARhX-, VARhX+ & VARhX-

6.2.7.3 Polarity

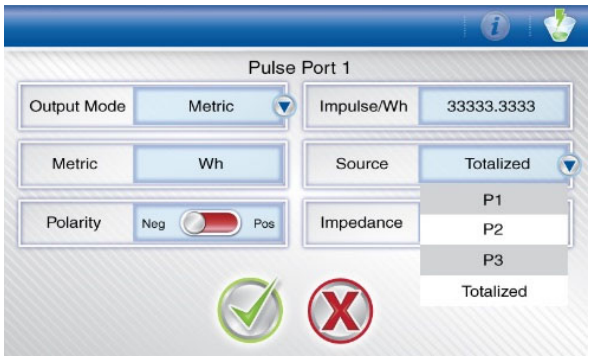
Determines a impulse count relative to a 'Positive' (rising) impulse edge or 'Negative' (falling) pulse edge. All impulse synchronization will be initiated by the selected edge.

6.2.7.4 Impulse/*Metric* or *Metric*/Impulse (see Localization section 6.2.6.2)

Sets the ke value (ke = kWh/impulse) to match that of the external device pulse output/input.

6.2.7.5 Source

Configures the Pulse Port (e.g. Pulse Port 1) to the corresponding RX-3X phase L1, L2, L3, or Totalized and RX-2X, P1 Only.

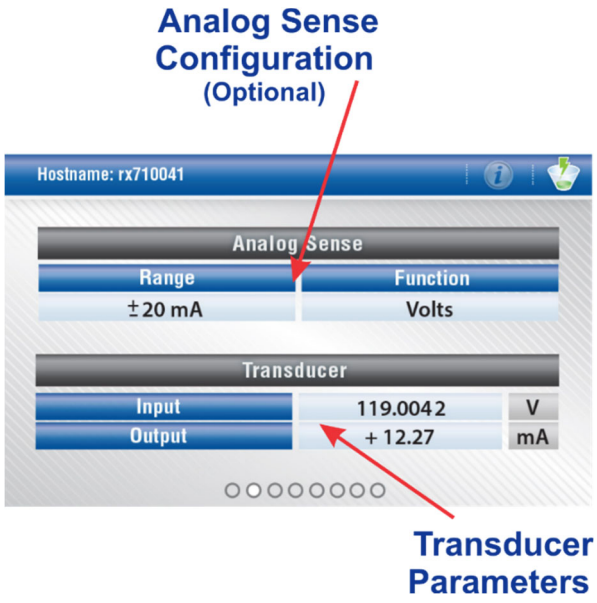


6.2.7.6 Impedance

Impedance defines the resistor pullup value as either 'High' corresponding to a 1kOhm or 'Low' 128Ohm value. Each value is appropriate for the pulse rate expected/output along with the corresponding output/input impedance of the external device. See section 4.1.5 for specification.

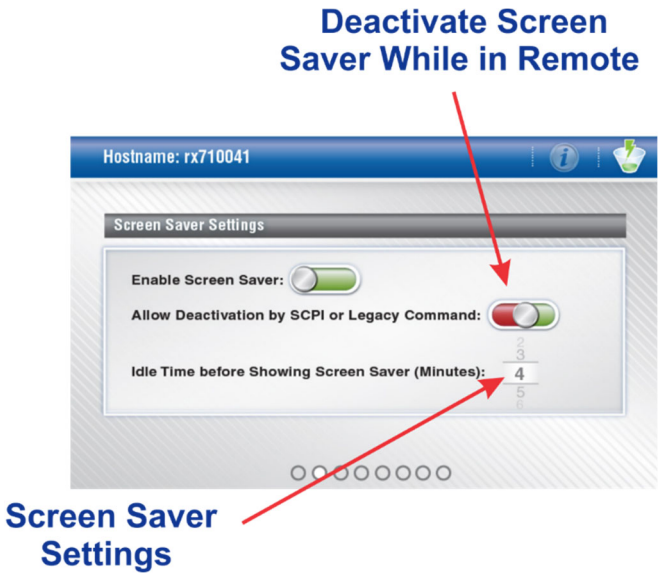
6.2.8 Analog Sense

Analog Sense feature is an option to the base RX configuration. Reference the following sections of this manual for further information; 4.1.4, 6.5.3.2.2, 6.13, Appendix A.1, A,2, A,4 & A.7



6.2.9 Screen Saver Configuration

This view allows the operator to perform the following tasks; Enable Screen Saver, Deactivate Screen Saver using SCPI or legacy remote command and setting the idle time before enabling screen saver. When enabled the screen will shrink and move at random around the display. Touch anywhere on the display to disable screen saver.



6.3 Serial command compatibility with legacy RD-3X via RX-3X RS-232 port

This section describes serial external communications protocol for RX-30, RX31 & RX-33 reference standards, providing a degree of compatibility with RD-3X family of products. It is based on a separate application documents titled, "Serial Commands for Compatibility with the RD-3X," and "External Communications Specifications for the RD-xx Family" version dated February 19, 2013. Only commands supported by the RX are included in this documentation.

6.3.1 Error Handling

- Protocol is inherently based on commands and responses.
- When an error is detected on input (a malformed command), remaining bytes of command are read and discarded before an error response is generated.
- End of malformed command is detected by encountering a timeout in attempting to read next character.

6.3.2 Details on packet type formats

Each packet format contains the following information

- Legend allows you to know which past Radian products use that command, its version, and how it is available across different phases. If a letter is shaded, it is not available for that packet.
  - M – Master
  - A – Phase 1
  - B – Phase 2
  - C – Phase 3
- Communication delay timeout
- Command sent to standard
- Response of standard to operator

6.4 Implementing SCPI through Ethernet RJ-45 port

6.4.1 Introduction

6.4.1.1 SCPI version

RX reference standards use **S**tandard **C**ommand for **P**rogrammable **I**nstruments version 1999.0 with its foundation in IEEE 488.1and 488.2. The basic command syntax is outlined below, and the commands you will use to interface with your unit. Examples of each command are also included.

6.4.1.2 Command syntax.

"//"

- Lines beginning with the double slash are comment or documentation lines so you can better understand what is going on in the coding.

Example:

- // Set IMETrics to "continuous" – the default

Two forms of commands.

- Long form
  - Command string consisting of no more than 12 characters.
    - First four characters are uppercase letters, while remaining are lowercase.
      - Command phrases are separated by colons (:).
- Short form
  - Uppercase letters of long form separated by colons (:).

Examples:

- :CONFigure:IMETrics:CONTinous on
  - Command consists of three commands.
    - Configure
    - IMETrics
    - CONTinous
- :CONF:IMET:CONT on
  - Same command as previous example, but in short form.

6.4.3 Theory of operations

6.4.4 Command reference

You can find a complete listing of SCPI commands with their definitions and responses in Appendix A of this manual.

6.4.5.1 Introduction

The status system used by instrument controllers as implemented in RX reference standards has been defined by IEEE 488.2 and SCPI-99 standards. It was originally defined in 488.2, but SCPI extended it. The system defines a set of data structures and commands that operate on them. Various events that occur within the system will update the data structures which can then be surveyed or cause service requests.

This document, rather than being a comprehensive tutorial on the 488.2 and SCPI standards, seeks to capture crucial details of the data structures as they are defined for RX reference standards. To better understand what the data structures mean and how to use them, we are including an overview of 488.2, section 11 and SCPI volume 1, section 9. This should be enough to understand and use SCPI and its status substation effectively.

6.4.5.1.1 488.2 status data structures

The following image (recreated from Figure 11-4 in 488.2 standard) shown on the next page a summary overview of the status data structures as defined by 488.2. The status byte register is the focal point. It contains summary bits for all of the other status information. If a bit in the Status Byte Register is set and the corresponding bit in the Service Request Enable Register is set, then a Service Request will be generated. The Service Request, in this system, will propagate the contents of the Status Byte Register. There are, of course, commands to read the Status Byte Register and read/set the Service Request Enable Register (along with all of the other associated data structures).

The Status Byte Register contains summary information. For example, the Event Status Bit (ESB) in the Status Byte Register contains a summary of the Event Status Register masked by the Event Status Enable Register. By using this programmable summary approach, it is possible to generate a Service Request when an 'Execution Error' occurs.

6.4.5.1.2 SCPI status reporting extensions

SCPI expands on 488.2 with the additions of QUEStionable Status, OPERation Status, and Error/Event Queue to the status system. Each of these extensions has its own definitions and associated commands in much the same way as commands from 488.2. The tree structure of these commands is illustrated in Figure 6.6 following. Essentially they behave in much the same way as the 488.2 commands before them. They can be surveyed for their status, and/or configure service requests to be generated in various conditions.

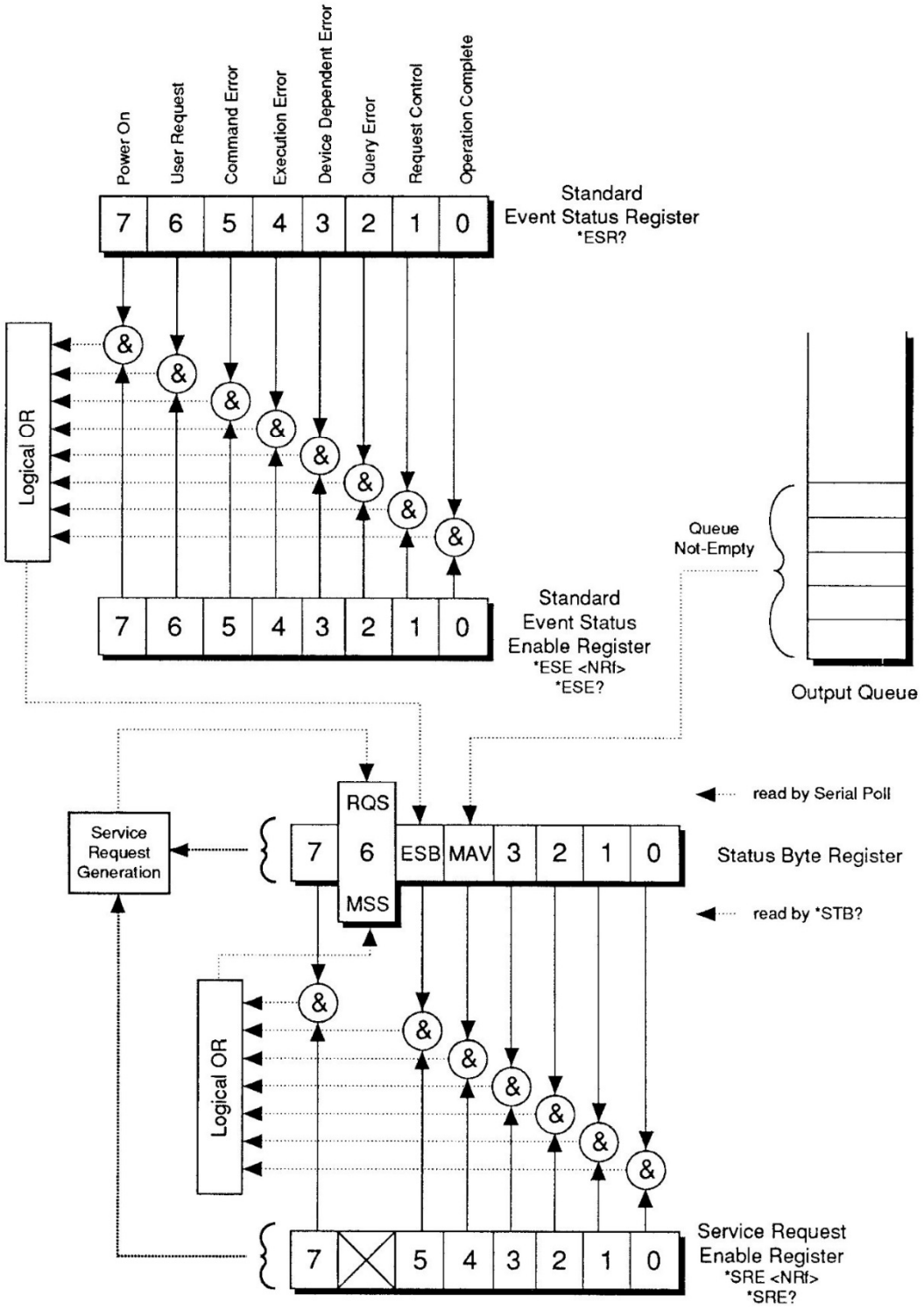
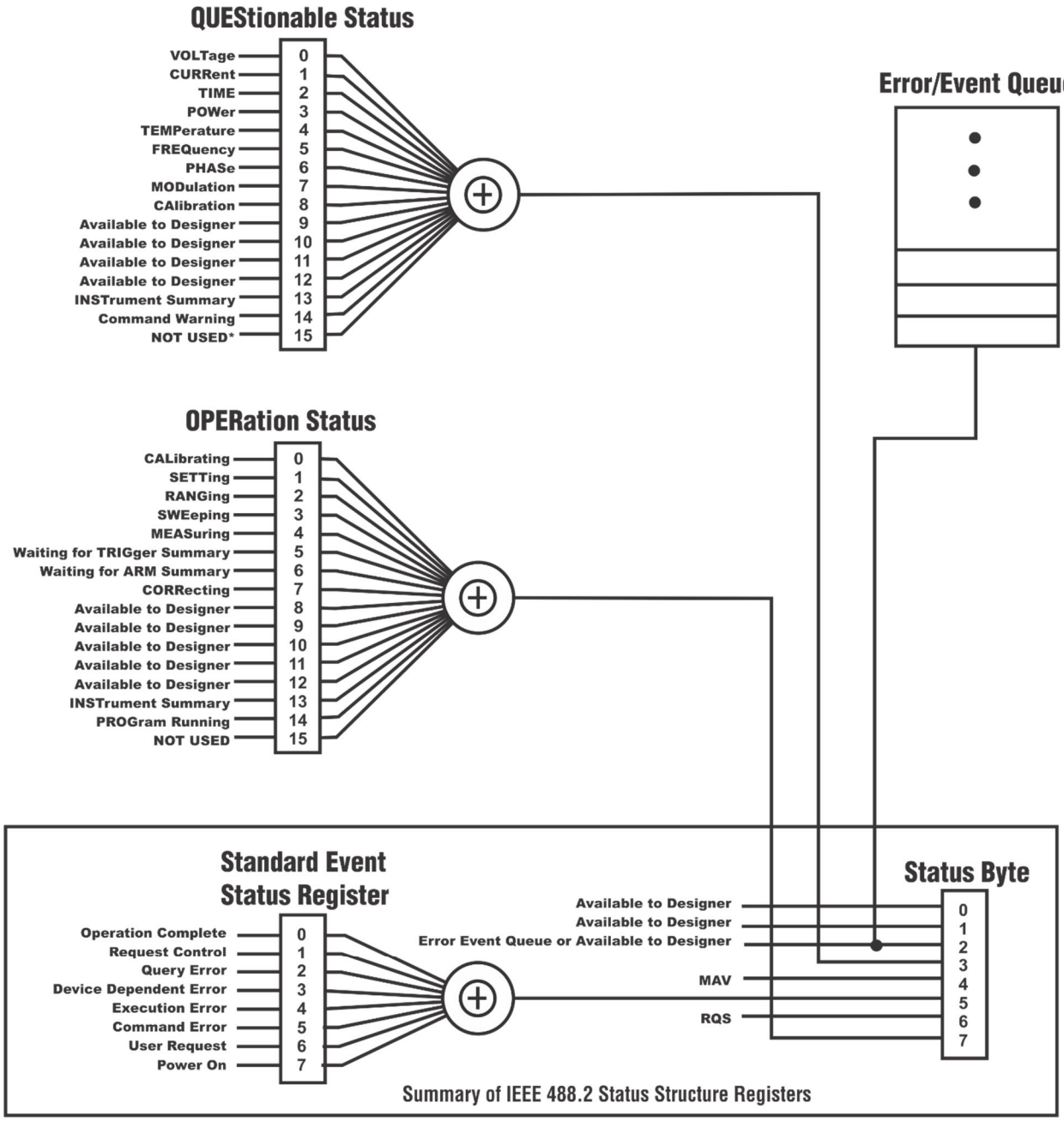


Figure 6.1 Standard Status Data Structures Overview (SCPI-99, IEEE488.2)



*** The use of bit 15 is not allowed since some controllers may have difficulty reading a 16 bit unsigned integer. The value of this bit shall always be 0.**

Figure 6.2 Minimum Status Reporting Structure Required by SCPI.

6.4.5.2 RX standard details

RX standard defines all data structures shown in both Figure 6.5 and 6.6 implements all the associated 488.2 common commands and SCPI commands needed to use them properly. The standard can generate service requests over the socket interface so they can be properly received and acted upon. It may not use all the bits in these structures. For example, the unit will probably never

use the 'Request Control' event or 'User Request' event. As the details are more fully developed before full implementation, they will be further documented for operator usage and understanding.

6.4.5.2.1 Extension to 488.2/SCPI status system

While this product does not use all commands from 488.2 or SCPI, it also expands new commands specific to the needs of the unit, as described in the following sections.

6.4.5.2.1.1 Device event status register

RX standard register adds the Device Event Status Register to provide the ability to detect the following events separately, on any of the three phases:

- Voltage ranging
- Current ranging
- Clamp attach/detach

The bit assignments for these events in the Device Event Status Register are:

- Bit 0: Voltage ranging, phase 1
- Bit 1: Current ranging, phase 1
- Bit 2: Clamp change, phase 1
- Bit 3: Voltage ranging, phase 2
- Bit 4: Current ranging, phase 2
- Bit 5: Clamp change, phase 2
- Bit 6: Voltage ranging, phase 3
- Bit 7: Current ranging, phase 3
- Bit 8: Clamp change, phase 3
- Bits 9-15 are unused

The Device Event Status Register and Enable Register are controlled using the 'SYSTem:EVENt' subsystem.

The Device Event Status Register is summarized in the Status Byte Register in bit 1, so any combination of the above events can be used to generate a Service Request.

6.4.5.2.1.2 SCPI QUEStionable status register extensions

As shown above, the SCPI QUEStionable Status Register includes the concepts of the voltage, current, frequency and/or phase being questionable. The intent of these bits is to signal that some aspect of the stimulus might be adversely affecting the proper operation of the instrument (e.g., voltage is under-range, or frequency is unstable). Since RX has three independent phase channels, it is appropriate to detect and report these conditions independently, then summarize them to allow for reporting into the Status Byte Register.

This is accomplished by having four separate copies of the QUEStionable Status Register and associated Enable Register – one per phase, plus the overall summary register (as defined by SCPI).

These per-phase QUEStionable Status Registers are then summarized into the SCPI-defined QUEStionable Status Register, which is then summarized into the 488.2 Status Byte Register. Using this model and the associated commands, it is possible to selectively generate a Service Request on any combination of QUEStionable conditions from any combination of the phases.

The SCPI-defined commands for accessing the QUEStionable Status Register are in the 'STATus:QUEStionable' subsystem. The RX-specific, per-phase commands are in the 'STATus:QUEStionable:PHASe{1:3}' subsystem.

The commands are more fully described and responses given in Appendix A section A.9.

6.5 Using PCSuite 5 through Serial Interface

6.5.1.1 Overview

The RR-PCSuite 5 software package is a powerful, but yet easy to comprehend and use, set of tools to facilitate the full array of testing and analysis the Radian Research Xytronic Standards are capable of performing. RR-PCSuite 5 allows the user to easily configure the Xytronic Standard, execute meter and standard testing, and perform power analysis routines.

Application areas of the RR-PCSuite 5 software include:

- Device Configuration
- Metrics Measurement
- Harmonics Analysis
- Data Logging
- Vector Analysis
- Meter Testing
- Standards Testing
- CT Testing
- Analog Transducer Testing
- Automated Site Verification

6.5.1.2 Hardware Requirements

The RR-PCSuite 5 software connects to a Radian Research Xytronic Standard through a RS-232 cable or RR-BT Bluetooth Communications Link. Communications must follow the following protocol.

Communications Protocol

- Half duplex RS-232
- 57.6k Baud
- 1 start bit, 1 stop bit, no parity
- DTR line high

- The Computer or other controlling device (host) operates as the master and the Xytronic Standard operates as the slave.

6.5.1.3 Computer Requirements

- **Operating system**

  Microsoft Windows® 7 or Windows 10

6.5.1.5 DB-9 Port Pinout (RX-3x family)

Signal	Description	DB9 Pin	Used by RD-xx
RTS	Request To Send	7	Yes
DTR	Data Terminal Ready	4	Yes
GND	Signal Ground	5	Yes
TX	Data Transmit	3	Yes
RX	Data Receive	2	Yes
DCD	Data Carrier Detect	1	No
DSR	Data Set Ready	6	No
CTS	Clear To Send	8	No
RI	Ring Indicator	9	No

Figure 6.5.1.5.1

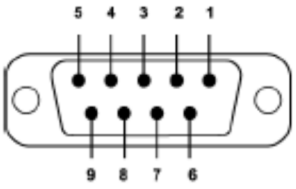


Figure 6.5.1.5.2

6.5.2 Software Configuration

6.5.2.1 Communication Ports

The PCSuite 5 software allows connection and communication to a Xytronic Standard on any one of the 20 comm ports. When the software is launched it will automatically scan the computer's hardware to verify if a Xytronic Standard connected. If a device is detected, the software will automatically initiate communications. If multiple devices are connected, by default, the first communication port available will be initialized for communications. If it is required to communicate to a different device, other than the first available, you must select the 'Setup' and 'Comm Ports' options in the toolbar. From the 'Select Comm Ports' menu screen, you must deselect the undesired communication ports and select the desire communication port, as seen in figure 6.5.2.1.1.

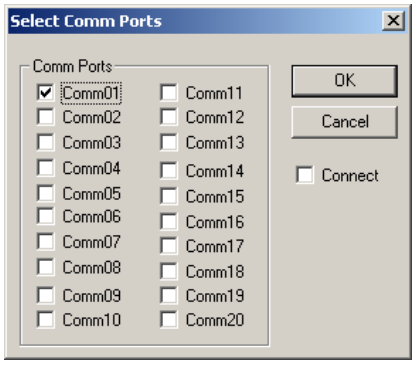


Figure 6.5.2.1.1

6.5.2.2 USB to RS-232 Converters & Bluetooth Adapters

Computers manufactures are increasingly eliminating the DB-9 RS-232 port on newer model computers and laptops. If the control computer does not include a DB-9 connection, a USB to RS-232 Converter is required.

✓Note

Not every USB to RS-232 converter is designed the same. Each has a different communication delay associated with the device. To adjust for each device, you must manually add an entry into the computer's registry, to allow the software to communicate to the standard.

To add the entry, open the computer's registry by selecting 'Run…' in the 'start' menu. From the 'Run' command window, type "regedit" and press 'OK' button. Select the 'HKEY_LOCAL_MACHINE' folder, the 'SOFTWARE' folder, the 'Radian' folder, and the 'RadCommApp' folder. From the Registry Editor window tollbar, select 'Edit', 'New', 'DWORD Value'. See Figure 2.2.1 below, for example.

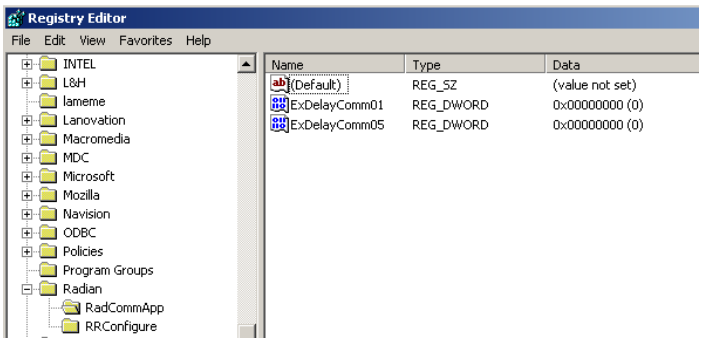


Figure 6.5.2.2.1

The name of the entry needs to follow the format as seen in the example below.

ExDelayComm01	**Example for Communication port 1*
ExDelayComm02	**Example for Communication port 2*

If another communication port is desired, then follow the format and create the DWORD Value to match the examples above.

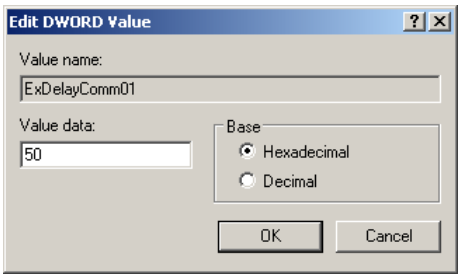


Figure 6.5.2.2.2

The Value data entry can be changed by double clicking on the entry, this will open the 'Edit DWORD Value' screen, as seen in figure 2.2.2 above. The initial 'Value data:' should be set to "50" (hexadecimal), and a higher number may be required, depending on USB to RS-232 converter used.

6.5.3 PCSuite 5 User Guide

6.5.3.1 Initialization

After installation select the following icon to launch the PCSuite 5 application.

Once the Xytronic Standard is powered, launch the PCSuite 5software. The software will automatically connect and initialize, as seen below in figure 6.5.3.1.1.

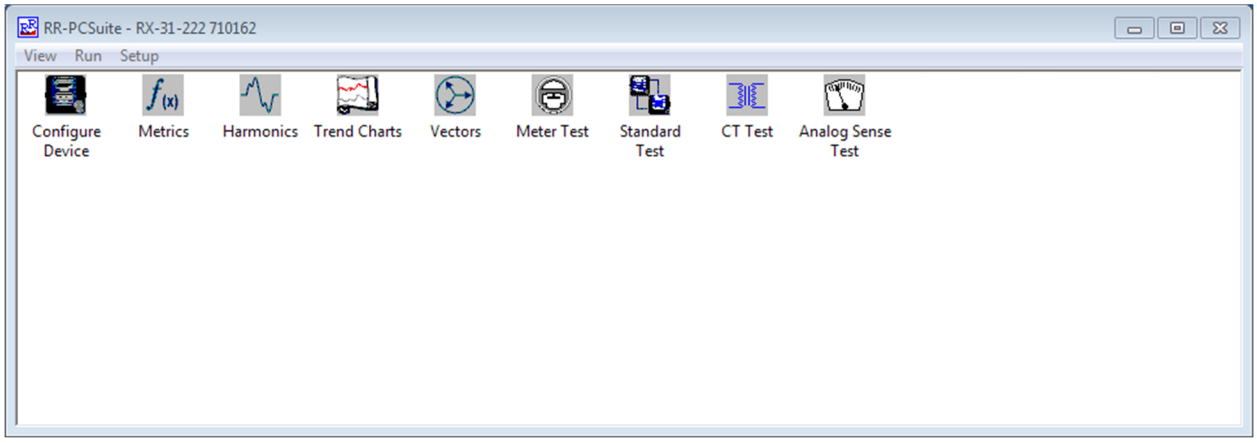


Figure 6.5.3.1.1

Once the PCSuite 5 software is initialized, the full model number and serial number of the Xytronic Standard appears above the toolbar in the top portion of the PCSuite 5 start-up window. A single mouse click on any of the icons automatically launches that specific application, and only one test or measurement application can run at a time.

6.5.3.2 Navigating Menus

In addition to the icons, the various applications can be accessed from the toolbar menu.

6.5.3.2.1 View

The Metrics, Vectors, Harmonics, Trend Chart, Power Quality, Flicker Meter and Site Automation applications can be launched from the 'View' menu. The 'View' menu affords the operator the same functions as if they had

opened the corresponding icon in the PCSuite 5 start-up screen. In addition to the applications, the 'View' menu also includes the 'About' and 'Exit' options.

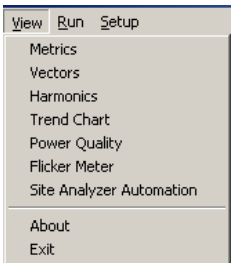


Figure 6.5.3.2.1.1

The 'About' screen provides pertinent information, including the version and Radian Research contact information. See figure 6.5.3.2.1.2 below.

Figure 6.5.3.2.1.2

6.5.3.2.2 Run

The Meter Test, Standard Test, CT Ratio Test, and Analog Sense Test applications can be launched from the 'Run' menu. The 'Run' menu affords the operator the same functions as if they had opened the corresponding icon in the PCSuite 5 start-up screen. In addition to the applications, the 'Run' menu also includes the 'Firmware Initialization', 'Reset', and 'Diagnostics' options.

Figure 6.5.3.2.2.1

The 'Diagnostics' option will display the current status of the standard, including any errors that may be present. If any errors are present, please contact Radian Research's customer support team, who can provide additional commands to be entered in the Diagnostics window that will help further diagnose the problem occurring on the Xytronic. To enter the commands, type the information into the text box, located at the bottom of the Diagnostic window, as seen in Figure 6.5.3.2.2.2below, and select the 'Submit' button.

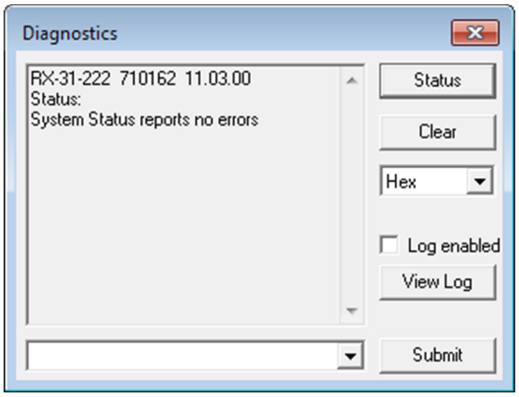


Figure 6.5.3.2.2.2

6.5.3.3 Setup

The Device Configuration application can be launched from the 'Setup' menu. See figure 6.5.3.3.1 below. The 'Setup' menu affords the operator the same functions as if they had opened the corresponding icon in the PCSuite 5 start-up screen. In addition to the Device Configuration application, the 'Setup' menu also includes the 'Comm Ports' and 'Connect' options.

Figure 6.5.3.3.1

If the 'Connect' option has a check next to, the computer is currently connected to a device.

Section 6.5.2 Software Configuration details the communication port setup.

6.5.4 Configure Device

The 'Device Configuration' application facilitates the general configuration of the standard and includes the 'Model', 'BNC Input', 'BNC Output', 'BNC Constant', and 'Service' tabs.

6.5.4.1 Model Information

The 'Model' tab contains information regarding the connected standard. The model number, serial number, firmware version, calibration date, and manufacture date are all displayed in the 'Model' tab, see figure 6.5.4.1.1 below.

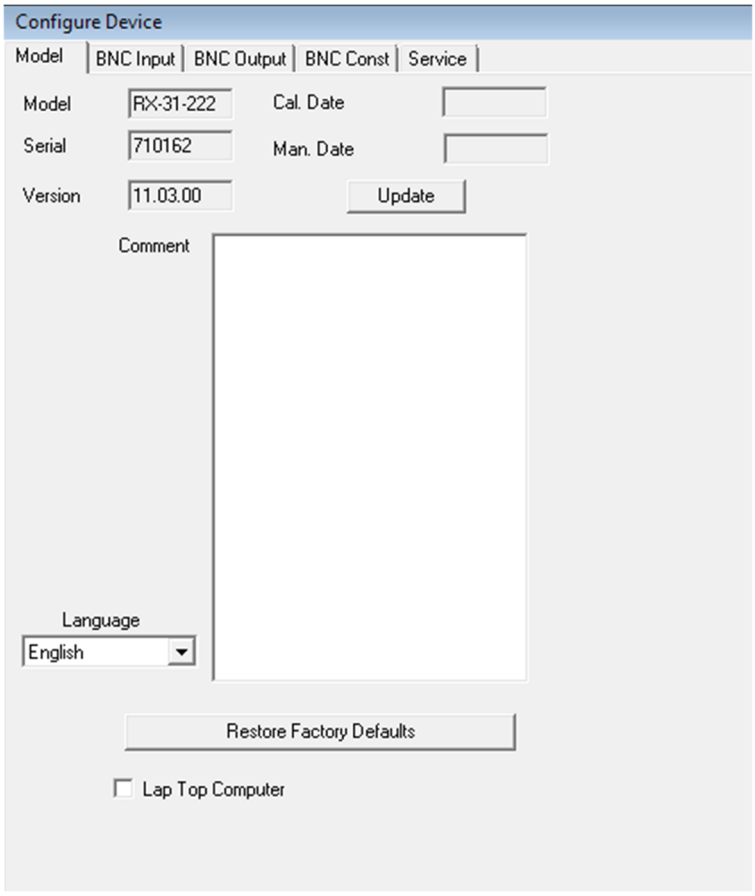


Figure 6.5.4.1.1

In addition to the device information, the 'Model' tab includes the 'Restore factory defaults' button and a field to enter comments. The 'Restore factory

defaults' button resets all configurable fields to their factory default state and does not affect calibration. The 'Comment' field allows the factory or user to enter applicable text. This text can be saved by selecting the 'Update' button.

6.5.4.2 BNC Input Configuration

The 'BNC Input' tab allows the user to configure the device's responses to input signals. The pulse gated accumulators can be configured to respond in either a **Start/Stop/Clear** or a **Clear-Start/Stop** pattern, seen in figure 6.5.4.2.1 below.

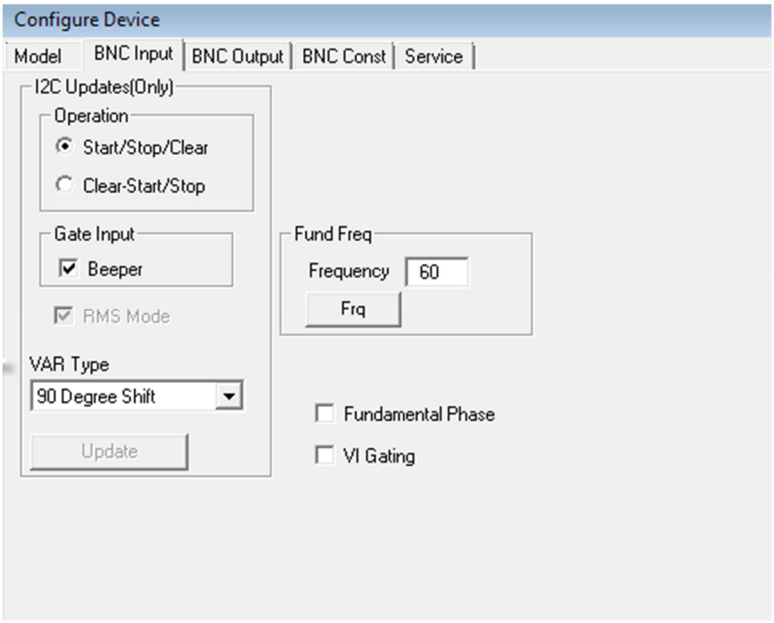


Figure 6.5.4.2.1

The Gate Input Beeper is an indicator that meter sensors have been aligned correctly for a meter test and can be activated/deactivated. The beeper will not actually begin to beep until the test is started.

A VAR measurement type selection can be made from the drop-down box.

The VAR types available are defined as:

VAR 0 = Voltage 90 Degree Shifted

$$VAR_i = \frac{1}{kT}\int_{\tau}^{\tau+kT}\left(I_i V_i\left(t+90°\right)\right)dt \qquad \text{and} \qquad \text{net } VARh = \sum_{i=1}^{3} VARh_i$$

VAR 1 = Integral VAR

$$VAR_i = \frac{\omega}{kT}\int_{\tau}^{\tau+kT} I_i\left[\int V_i dt\right]dt \quad \text{and} \quad \text{net } VARh = \sum_{i=1}^{3} VARh_i$$

VAR 2 = Integral VAR 50 Hz

$$VAR_i = \frac{2\pi 50}{kT}\int_{\tau}^{\tau+kT} I_i\left[\int V_i dt\right]dt \qquad \text{and} \qquad \text{net } VARh = \sum_{i=1}^{3} VARh_i$$

VAR 3 = Integral VAR 60 Hz

$$VAR_i = \frac{2\pi 60}{kT}\int_{\tau}^{\tau+kT} I_i\left[\int V_i dt\right]dt \qquad \text{and} \qquad \text{net } VARh = \sum_{i=1}^{3} VARh_i$$

VAR 4 = RMS VAR

$$\| V_i \| = \sqrt{\frac{1}{kT}\int_{\tau}^{\tau+kT} V_i^2 dt} \qquad \text{and} \qquad \| I_i \| = \sqrt{\frac{1}{kT}\int_{\tau}^{\tau+kT} I_i^2 dt}$$

$$WATT_i = \frac{1}{kT}\int_{\tau}^{\tau+kT} V_i I_i dt \qquad \text{and} \qquad VA_i = \| V_i \| \cdot \| I_i \|$$

$$VAR_i = \sqrt{VA_i^2 - WATT_i^2} \qquad \text{and} \qquad \text{net } VARh = \sum_{i=1}^{3} VARh_i$$

VAR 5 = Fundamental VAR

$$\| \widetilde{V}_i \| = \sqrt{\frac{1}{kT}\int_{\tau}^{\tau+kT} \widetilde{V}_i^{\,2}\, dt} \qquad \text{and} \qquad \| \widetilde{I}_i \| = \sqrt{\frac{1}{kT}\int_{\tau}^{\tau+kT} \widetilde{I}_i^{\,2}\, dt}$$

$$VAR_i = \| \widetilde{V}i \| \cdot \| \widetilde{I}_i \| \sin(\theta_i) \qquad \text{and} \qquad \text{net } VAR = \sum_{i=1}^{3} VAR_i$$

TERMINOLOGY USED

Index "i" represents the i^{th} phase in the poly-phase network.

$\widetilde{V}_i$ = Potential component fundamental (1^{st} harmonic order)

$\widetilde{I}_i$ = Current component fundamental (1^{st} harmonic order)

V_i = Generalized potential waveform (fundamental and all harmonics).

I_i = Generalized current waveform (fundamental and all harmonics).

θ_i = Phase angle between the potential and current.

Δt = VAR-hour and VA-hour integration interval.

T = Fundamental period.

k = Number of fundamental periods.

ω = Fundamental frequency = $2\pi f_0$, where f_0 is the fundamental.

τ = Start time of integration.

|| || = Generally represents the norm of the wave function:
1-norm (Average) or 2-norm RMS

The base frequency is modified within the 'Frequency' field, but will return to the factory default value, once the standard is power-cycled.

6.5.5 BNC Output Configuration

The 'BNC Output' tab allows the user to configure the device's output terminals. The 'BNC Output; tab will look different, depending on the standard's model number. See Figure 6.5.5.1 and Figure 6.5.5.2 below. For three phase Xytronic standards (i.e. RX-30, RX-31, and RX-33) the four output ports may be configured to output pulses for the accumulated energy measured at L1, L2, or L3. The output ports may also be configured to output pulses the total energy, measured at all three inputs. In other words, the standard may be configured to execute a poly-phase test, with each port output corresponding to a single phase energy value, or a single phase test, with each port corresponding to a total energy value.

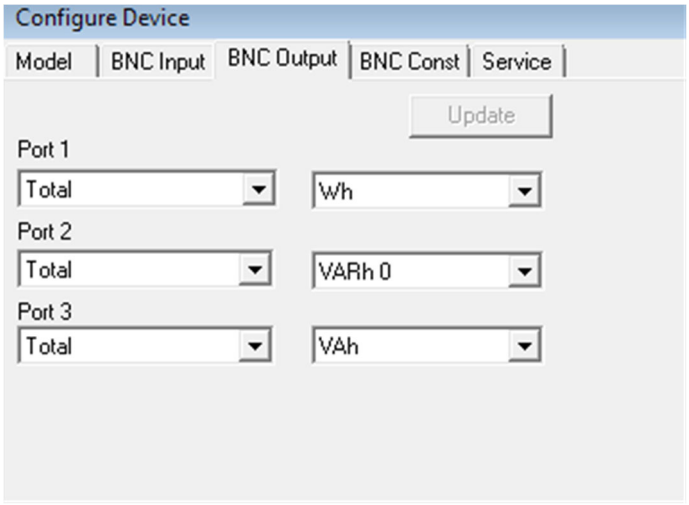


Figure 6.5.5.1, Three Phase Xytronic

6.5.6 BNC Constant

The 'BNC Const' tab allows the user to configure the measurement parameter constants. See Figure 6.5.6.1, below. To change the pulse constant, select and edit the constant and select the 'Update' button.

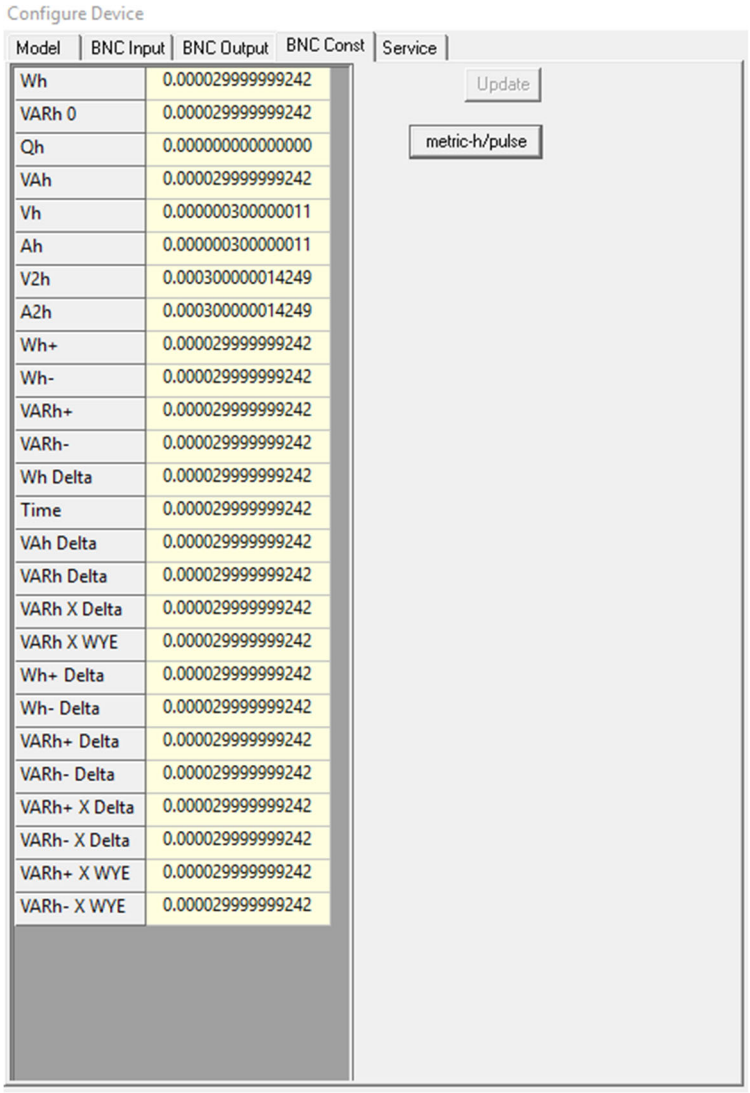


Figure 6.5.6.1

Xytronic standards are loaded with default pulse constants. These default values are listed below. To change how the pulse constant is displayed, select the 'metric-h/pulse' button, and it will invert to 'pulse/metric-h'.

RX Default Pulse Constants:

Wh	Watthours
VARh	Voltampere Reactive hours
VAh	Voltampere hours
Vh	Volt hours
Ah	Ampere hours
V2h	$Volt_2$ hours
A2h	$Ampere_2$ hours
Wh+	Watthours positive
Wh-	Watthours negative
VARh+	Voltampere Reactive hours positive
VARh-	Voltampere Reactive hours negative
Wh Delta	Watthours Delta
Time	Time (s)
VAh Delta	Voltampere hours Delta
VARh Delta	Voltampere hours Delta
VARh X Delta	Voltampere Reactive hours (Delta, X Connect)
VARh X WYE	Voltampere Reactive hours (WYE, X Connect)
Wh+ Delta	Watthours positive Delta
Wh- Delta	Watthours negative Delta
VARh+ Delta	Voltampere Reactive hours positive Delta
VARh- Delta	Voltampere Reactive hours negative Delta
VARh+ X Delta	Voltampere Reactive hours positive Delta (Delta, X-Connect)
VARh- X Delta	Voltampere Reactive hours negative Delta (Delta, X-Connect)
VARh+ X WYE	Voltampere Reactive hours positive Delta (WYE, X-Connect)
VARh- X WYE	Voltampere Reactive hours negative Delta (WYE, X-Connect)

Note: Pulse constant availability is dependent on the model number.

6.5.7 Service Selection Configuration

The 'Service' tab, which is only available when connected to a three phase Xytronic standard, enables the unit to emulate how a meter would perform the voltage and current calculation. In addition, the 'Service' tab allows the user to enter calibration factors or ratio factors. To create a new service, select 'New Service' from the 'Selection' drop-down menu. This action will cause the 'Service Selection' area of the screen to change to include fields for the new service's title and two lines of descriptive text, see Figure 6.5.6.1 below. This area also includes the 'Diagram:' drop down menu, which allows the user to select a diagram that best fits the new service. All selections are saved by selecting the 'Save' button.

To start the service, select the 'Start-Service' button. Once the service has been started, all metrics will be scaled to the service definitions. To stop the service, select the 'Stop-Emulation' button.

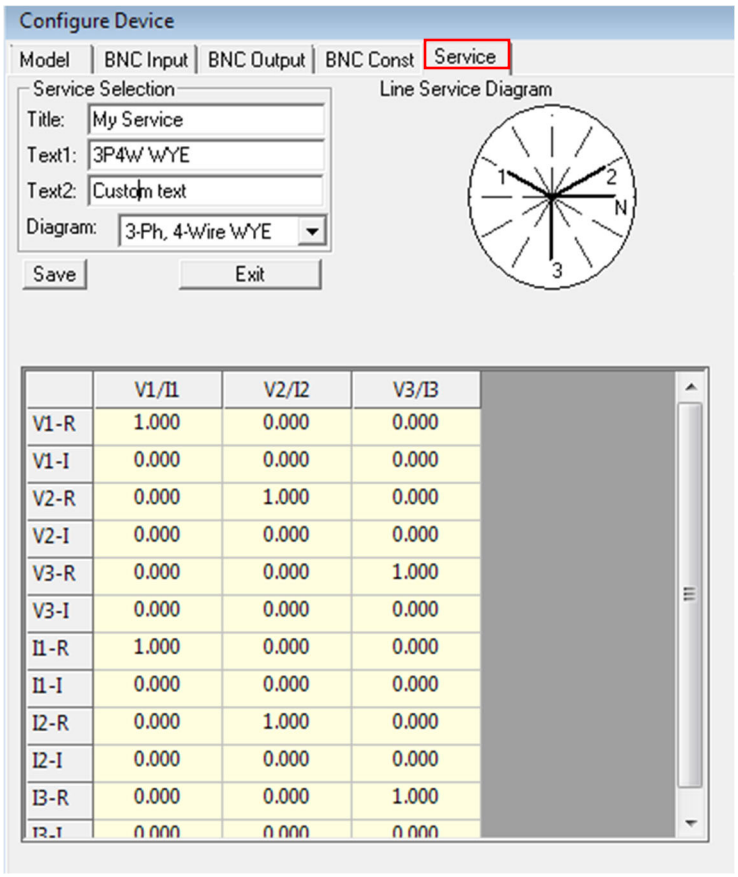


Figure 6.5.6.1

The 'Service' tab allows the user to perform a general complex linear transformation on the three phases of input potential and current.

This complex linear transformation is defined as follows:

$V_1 = C11* V1 + C12*V2 + C13*V3$

$V_2 = C21* V1 + C22*V2 + C23*V3$

$V_3 = C31* V1 + C23*V2 + C33*V3$

$A_1 = K11* A1 + K12*A2 + K13*A3$

$A_2 = K21* A1 + K22*A2 + K23*A3$

$A_3 = K31* A1 + K23*A2 + K33*A3$

Note: There is a real and imaginary input for each potential and current input.

Where "V1", "V2", and "V3" are the standard's complex three phase potentials, "A1", "A2", and "A3" are the standard's complex three phase currents, "C" is the 3x3 complex coefficient matrix for the potential transformation, "K" is the 3x3 complex coefficient matrix for the current transformation, "V_1", "V_2", "V_3" are the transformed complex three phase potentials, and "A_1", "A_2", and "A_3" are the transformed three phase currents.

Example 1: Electricity Meter, Z-Coil, form 6

V1-R = 1, 0, 0 ---- Real
V1-I = 0, 0, 0 ---- Imaginary
V2-R = 1, 0, 1
V2-I = 0, 0, 0
V3-R = 0, 0, 1
V3-I = 0, 0, 0

I1-R = 1, 0, 0 ---- Real
I1-I = 0, 0, 0 ---- Imaginary
I2-R = 0, -1, 0
I2-I = 0, 0, 0
I3-R = 0, 0, 1
I3-I = 0, 0, 0

The real coefficients change the magnitude and the imaginary coefficients change the phase of the waveform. As seen in the example above, the imaginary coefficients have been zeroed. With the "Z-Coil, form 6" service enabled the standard will read power exactly like a meter with a Z-coil. The metrics measurement for voltage on input 2 will be the sum of input 1 and input 3 and the current on input 2 will show negative.

Note: When the service selection is active, the voltage and current readings will not be actual measurements, but will depend on the coefficients entered.

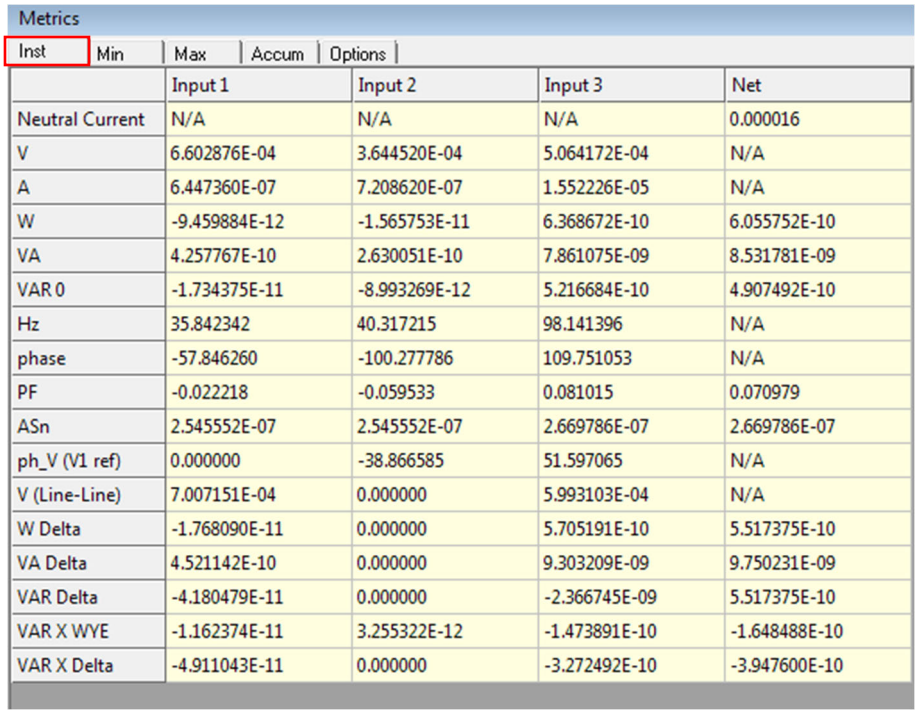
6.6 Metrics

The 'Metrics' application allows the user to view all the instantaneous, minimum, maximum, and accumulated measurement parameters. This application also facilitates the configuration of the metrics display, and includes the 'Inst', 'Min', 'Max', 'Accum', and 'Options' tabs.

Note: Minimum and Maximum measurement availability are model number dependent.

6.6.1 Instantaneous Metrics

Instantaneous metrics are displayed in the 'Inst' tab, see figure 6.6.1.1.



	Input 1	Input 2	Input 3	Net
Neutral Current	N/A	N/A	N/A	0.000016
V	6.602876E-04	3.644520E-04	5.064172E-04	N/A
A	6.447360E-07	7.208620E-07	1.552226E-05	N/A
W	-9.459884E-12	-1.565753E-11	6.368672E-10	6.055752E-10
VA	4.257767E-10	2.630051E-10	7.861075E-09	8.531781E-09
VAR 0	-1.734375E-11	-8.993269E-12	5.216684E-10	4.907492E-10
Hz	35.842342	40.317215	98.141396	N/A
phase	-57.846260	-100.277786	109.751053	N/A
PF	-0.022218	-0.059533	0.081015	0.070979
ASn	2.545552E-07	2.545552E-07	2.669786E-07	2.669786E-07
ph_V (V1 ref)	0.000000	-38.866585	51.597065	N/A
V (Line-Line)	7.007151E-04	0.000000	5.993103E-04	N/A
W Delta	-1.768090E-11	0.000000	5.705191E-10	5.517375E-10
VA Delta	4.521142E-10	0.000000	9.303209E-09	9.750231E-09
VAR Delta	-4.180479E-11	0.000000	-2.366745E-09	5.517375E-10
VAR X WYE	-1.162374E-11	3.255322E-12	-1.473891E-10	-1.648488E-10
VAR X Delta	-4.911043E-11	0.000000	-3.272492E-10	-3.947600E-10

Figure 6.6.1.1

Single phase Xytronic standards only display one input. Entries defined as "**N/A**" suggest that the particular measurement is not supported on the associated phase. The table below includes the definitions of the different measurements.

Metrics Definitions:

V	Volts
A	Amperes
W	Watts
VA	Voltamperes
VAR	Voltamperes Reactive
Hz	Frequency
phase	Degrees Phase (Phase angle between voltage and current)
PF	Power Factor
ASn	Analog Sense
Ph_V (V1 Ref)	Phase
V (Line-Line)	Volts (V1-V3, V1-V2, V2-V3)

W Delta	Watts (Delta)
VA Delta	Voltamperes (Delta)
VAR Delta	Voltamperes Reactive (Delta)
VAR X WYE	Voltamperes Reactive (WYE, X-Connected)
VAR X Delta	Voltamperes Reactive (Delta, X-Connected)

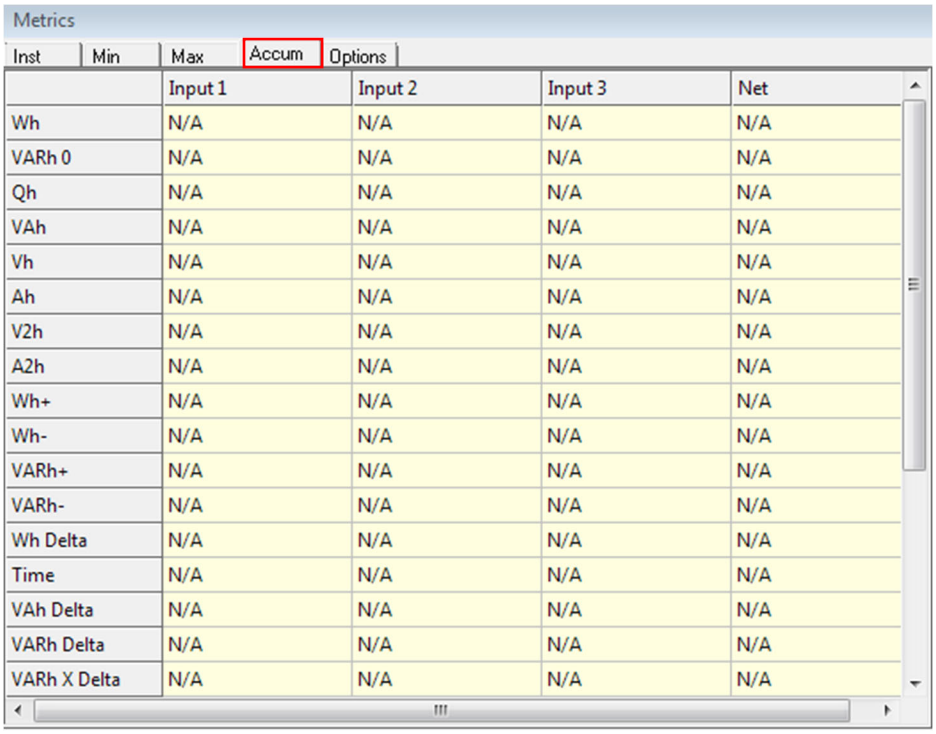
Note: Not all Xytronic standards support ever measurement listed. Metrics availability is model dependent.

6.6.2 Minimum and Maximum Metrics

Minimum and Maximum metrics are displayed in the 'Min' and 'Max' tabs. Within these two tabs, the display will record and hold the max or min measurement values. There is no start or stop for the min or max measurements, because the minimum and maximum metrics start accumulating and updating when the unit is powered on. To reset the minimum and maximum measurements see section 6.6.4 Metric Options.

6.6.3 Metric Accumulator

Accumulated metrics are displayed in the 'Accum' tab. The metric accumulator is supported by all Xytronic Standards, see figure 6.6.3.1. Each model will support different accumulator measurement functions. The accumulator is configured, started, and stopped via the 'Options' tab, see section 6.6.4 Metric Options.



	Input 1	Input 2	Input 3	Net
Wh	N/A	N/A	N/A	N/A
VARh 0	N/A	N/A	N/A	N/A
Qh	N/A	N/A	N/A	N/A
VAh	N/A	N/A	N/A	N/A
Vh	N/A	N/A	N/A	N/A
Ah	N/A	N/A	N/A	N/A
V2h	N/A	N/A	N/A	N/A
A2h	N/A	N/A	N/A	N/A
Wh+	N/A	N/A	N/A	N/A
Wh-	N/A	N/A	N/A	N/A
VARh+	N/A	N/A	N/A	N/A
VARh-	N/A	N/A	N/A	N/A
Wh Delta	N/A	N/A	N/A	N/A
Time	N/A	N/A	N/A	N/A
VAh Delta	N/A	N/A	N/A	N/A
VARh Delta	N/A	N/A	N/A	N/A
VARh X Delta	N/A	N/A	N/A	N/A

Figure 6.6.3.1

6.6.4 Metric Options

The 'Options' tab allows the user to configure the several metric measurement features, see Figure 6.6.4.1. The refresh rate and the integration interval can be changed in the 'Update Interval' field. The interval is in seconds, and once it is modified, the user must select the 'Set' button to save the setting.

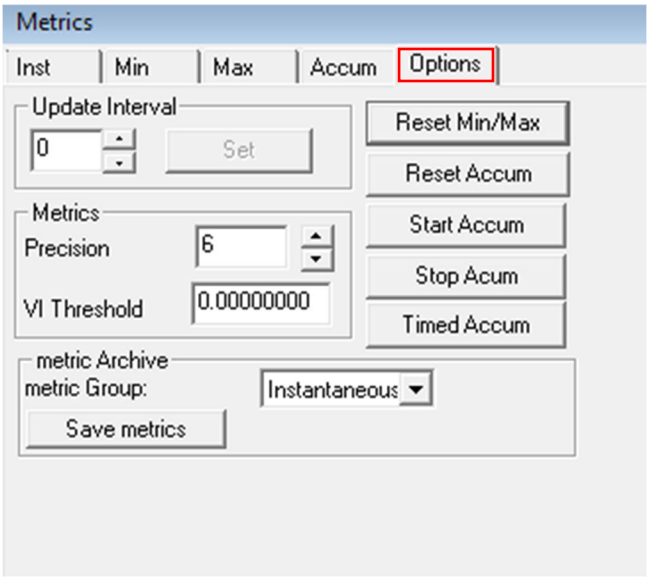


Figure 6.6.4.1

The minimum and maximum metric measurements can be reset by selecting the 'Reset Min/Max' button.

The number of displayed decimal places are adjusted in the 'Precision' field.

The 'V&I Threshold' field may be used to filter out low level measurements. The threshold function allows the user to configure the Xytronic to display only data that is greater than the threshold value, filtering out noise when there is no voltage or current active. When the threshold is in effect, it will also filter measurements that result from the voltage or current measurement.

The accumulators can be manually started, stopped, and reset by selecting the 'Start Accum,' 'Stop Accum,' and 'Reset Accum' buttons, respectively. To run the accumulators for an exact period of time, select the 'Timed Accum' button and enter the required time period.

To save the metric data, select the required metric group and then select the 'Save Metric' button. Once the button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the data.

Note: Three (3) phase Xytronic Standards require that input port 3 is used to start and stop the metric accumulators.

6.7 Harmonic Analysis

The RX family of standards and PCSuite 5 include outstanding harmonic analysis capabilities. Xytronic Standards are capable of analyzing harmonics up to the 58th order at 50Hz and up to the 60th order at 60Hz.

6.7.1 Harmonic Data

The 'Harmonics' application allows the user to view and save the harmonic measurement data. This application also facilitates the configuration of the harmonic measurement, and includes the 'Data', 'Waveform', and 'Bar Chart' tabs.

Harmonics measurement is accessed by selecting the 'Harmonics' icon. The 'Data' tab displays the magnitude and phase of each harmonic, see figure 6.7.1.1, in relation to the fundamental.

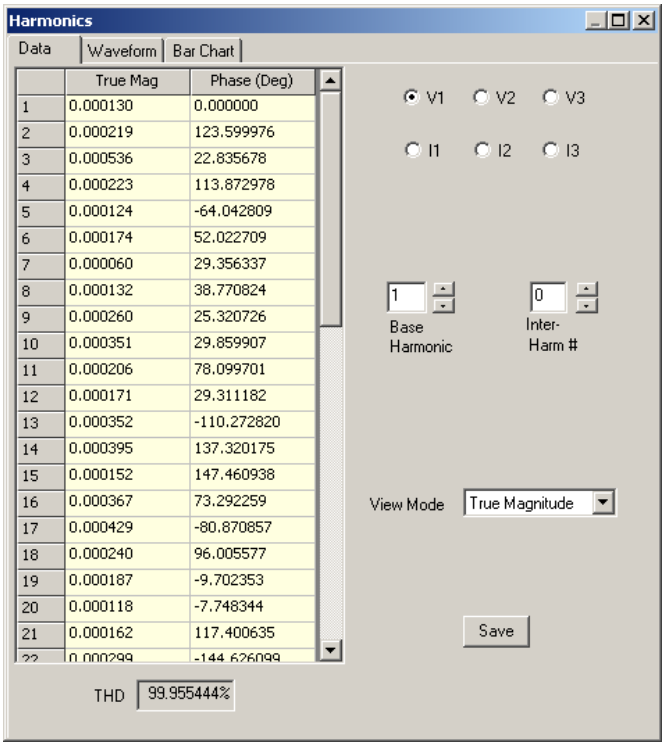


Figure 6.7.1.1

The harmonic data is organized by voltage and current inputs. Each input can be analyzed by selecting the associated input designator, V1, V2, V3 and I1, I2, I3. The 'V' represents the voltage axis and the 'I' represents the current axis. Fifty harmonic orders can be view at one time. To view orders higher than 50, increase the 'Base Harmonic' field.

The 'View Mode' option allows the user to select the harmonic measurement mode. To change the mode, simply select appropriate mode from the drop-down list. The following options are available: 'True Magnitude,' '% of Fundamental,' and '% of RMS.' The '% of Fundamental' mode displays the normalized harmonic amplitude in respect to a percentage of the fundamental amplitude. The '% of RMS' mode displays the normalized harmonic amplitude in respect to a percentage of the RMS amplitude.

The 'Inter-Harm #' option allows the user to display the inter-harmonics between each fundamental. The Xytronic Standards allow up to 9 inter-harmonics.

To save the harmonic data, select the 'Save' button. Once the button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the data.

6.7.2 Total Harmonic Distortion

Total Harmonic Distortion is the ratio of the sum of the powers of all harmonic frequencies above the fundamental frequency to the power of the fundamental frequency. The default formula that the RX uses for %THD is:

$$\%THD = 100\sqrt{\frac{\sum_{k=2}^{K=N} I_k^2}{\sum_{k=1}^{K=N} I_k^2}}$$

6.7.3 Waveform Analysis

The 'Waveform' tab displays a waveform representation of the signal being measured, see Figure 6.7.3.1. The display may look different if connected to a single phase Xytronic standard.

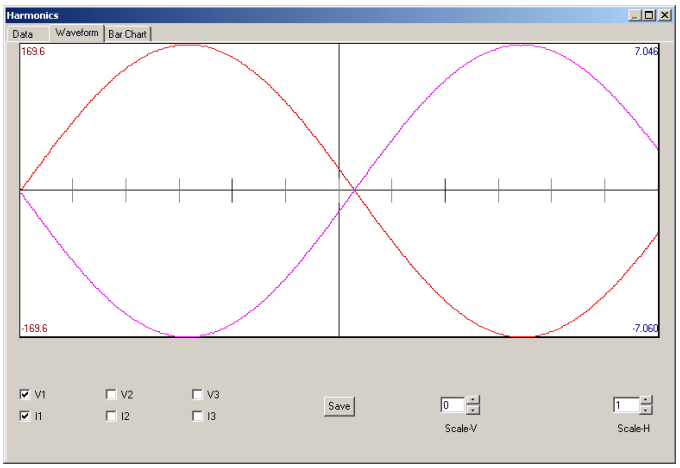


Figure 6.7.3.1

Similar to an oscilloscope, the waveform screen allows the user to adjust the display to increase the number of waveform cycles by increasing the 'Scale-H' value and change the magnitude of the waveform by changing the 'Scale-V' value. The peak voltage is shown at the top and bottom left of the display and the peak current is shown in the top and bottom right of the display.

The data on the waveform plot is color coordinated with the six available inputs of a three phase Xytronic Standard: V1 = Red,
V2 = Yellow, V3 = Blue, I1 = Purple, I2 = Orange, I3 = Green.

To save the harmonic waveform data, select the 'Save' button. Once the button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the data.

6.7.4 Bar Chart Analysis

The 'Bar Chart' tab displays a bar chart representation of the harmonics, see Figure 6.7.4.1. The data is plotted as percent of fundamental.

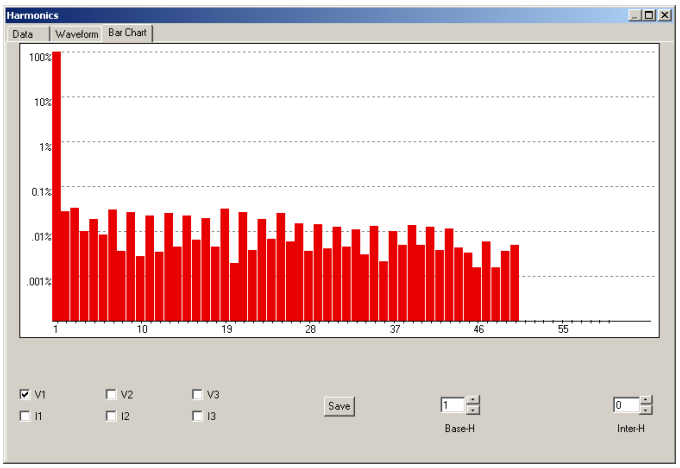


Figure 6.7.4.1

A lot of fifty different harmonic orders can be view at one time. To view orders higher than 50, increase the 'Base-H' number.

The 'Inter-H' number allows the user to show the inter-harmonics between each fundamental. The Xytronic Standards allow up to nine inter-harmonics.

The data on the chart is color coordinated with the six available inputs of a three phase Xytronic Standard: V1 = Red,
V2 = Yellow, V3 = Blue, I1 = Purple, I2 = Orange, I3 = Green.

To save the bar chart data, select the 'Save' button. Once the button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the data.

6.8 Trend Chart

The Trend Chart application, see figure 6.8.1, of the PCSuite 5 software plots measurement recordings over time. This application also facilitates the configuration of the trend charts, and includes the 'Input-1,' 'Input-2,' 'Input-3,' 'Total,' and 'Setup' tabs. A unique feature of the PCSuite 5 Trend Chart is its ability to record all measurement functions for all available phases. It has the ability to automatically adjust its scale to optimize the viewing of the data, and its sample rate can be adjusted to meet various data logging requirements, see section 6.6.4 Metric Options to adjust the update interval.

The trend chart application includes a zoom feature. To zoom on any particular point, single click on the graph over the selected location. It is possible to zoom several times. To return to the original scale, double click on the graph.

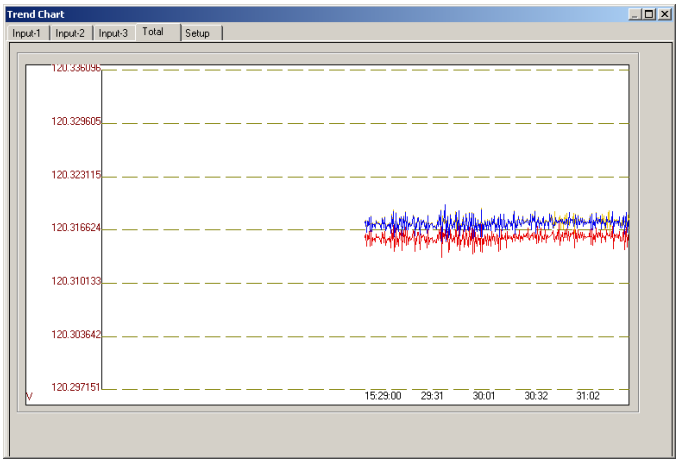


Figure 6.8.1

The data on the chart is color coordinated with the three available inputs of a three phase Xytronic Standard: Input 1= Red, Input 2 = Yellow, and Input 3 = Blue.

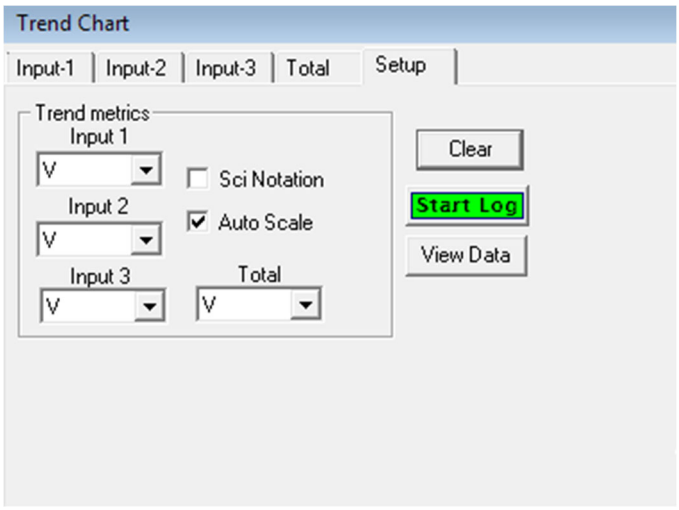


Figure 6.8.2

The 'Setup' tab allows configuration of the trend chart data and display. The 'Auto Scale' option will optimize and scale the trend data, and the 'Scientific Notation' option will display the chart data in scientific notation. The 'L1,' 'L2,' 'L3,' and

'Total' fields allow the user to select which parameter to be displayed on each chart. The default parameter is voltage.

To save the logging of measurements, select the 'Start Logging' button in the 'Setup' tab, see Figure 6.8.4. Once this button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the data.

To view existing logs, select the **'View Data'** button. Once this is selected, the software will display the 'Trend Log Query' screen. This screen includes the 'Query' and 'View' tabs. From the 'View' tab, select the appropriate file in the 'File' field, see Figure 6.8.3. Once the file is selected, use the remaining fields to select the required time period, metric, and phase. The requested data will now be available in the 'View' tab.

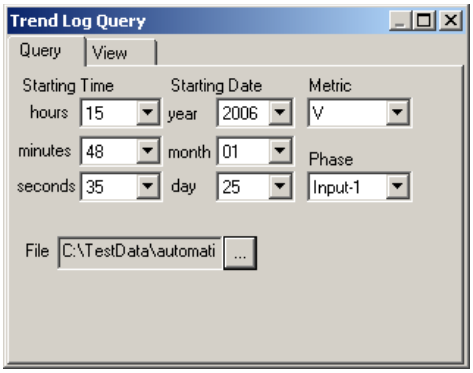


Figure 6.8.3

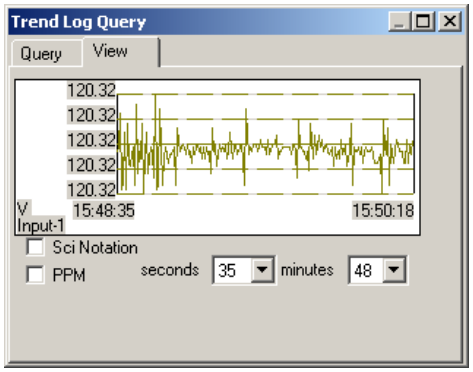


Figure 6.8.4

The 'Sci Notation' and 'PPM' check boxes allow the user to change the display format.

6.9 Vectors

The 'Vectors' application allows the user to view a vector representation, see Figure 6.9.1, of the voltage phase relationships and power factors.

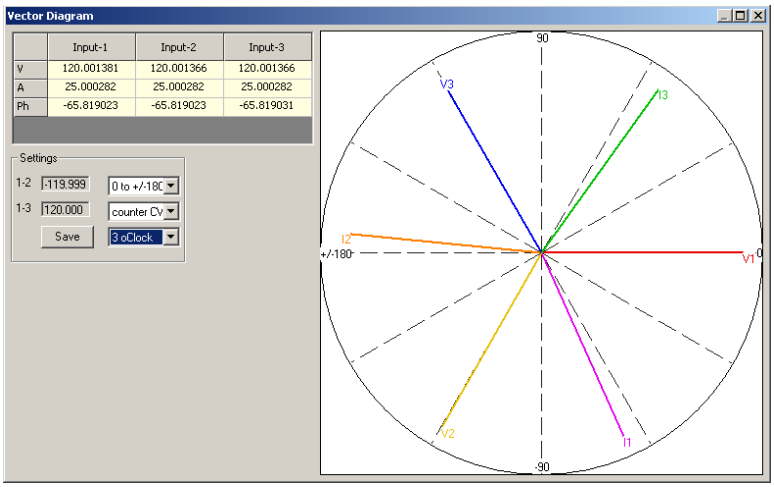


Figure 6.9.1

The data on the chart is color coordinated with the six available inputs of a three phase Xytronic Standard: V1 = Red, V2 = Yellow, V3 = Blue, I1 = Purple, I2 = Orange, I3 = Green. The 'Settings' options allow the user to select a different scale, select the direction of rotation, and move the position of the origin. When any changes are made the graph will automatically change, along with the data being displayed.

6.10 Run Meter Test

The 'Meter Test' application, see Figure 6.10.1, allows the user to configure and perform a test on a watthour meter. This application also facilitates the configuration of the test results. When connected to a three phase Xytronic standard, this application will include the 'DUT 1,' 'DUT 2,' 'DUT 3,' 'Run,' and 'View Results' tabs. When connected to a single phase Xytronic standard, this application will include the 'DUT 1,' 'Run,' and 'View Results' tabs.

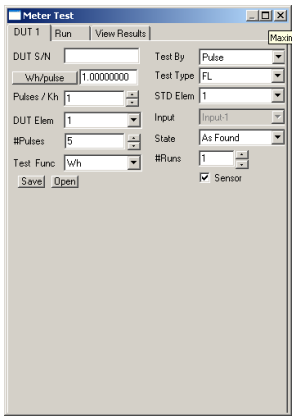


Figure 6.10.1

The user can configure and perform a new test or select a pre-saved test. To select a pre-saved test, select the 'Open' button. Once the button is selected, the standard will automatically open an 'Open' pop-up screen. From this screen, browse to the appropriate directory and select the required test.

To configure and run a meter test, enter the necessary information into the appropriate 'DUT' tab. The 'DUT 1,' 'DUT 2,' and 'DUT 3' tabs are associated to the BNC, potential, and current input ports, respectively. For example, the 'DUT1' tab sensor pulses must be counted on BNC input port 1.

In the DUT tab, the user defines the type of meter test to run.

- The **DUT S/N** is the meter under test's serial number.
- The **Whr / Pulse** value is the amount of energy each pulse represents. The metric function changes as the test function changes.
- The **Pulses / Kh** is the number of pulses for an equivalent revolution.
- The **DUT Elem** is the number of elements that are being tested. This is only valid if performing a series-parallel test.
- The **# Pulses** is the number of pulses required for completion of the test.
- The **Test Func** is the measurement function to be tested.
- The **Test By** selects how the meter will be tested, either by pulses, time length, or demand.
- The **Test Type** is a label for the test data. Options include: FL –Full Load, PF – Power Factor, PF – Power Factor +, PF – Power Factor -, LL – Light Load, In Service, Customer Load and Other.
- The **STD Elem** is the number of elements used, and it is valid with single phase Xytronic Standards. It is used when performing series parallel testing.
- The **Input** defines the test as either three-phase or single-phase.
- The **State** is a label for the test data. Options include "As Found" and "As Left."
- The **# Runs** sets the number of repetitions of the test.
- The **Sensor** check box configures the standard for either a manual test or sensor based test.

To save the test setup, select the 'Save' button. Once this button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the test.

Once a new test is configured or a saved test is opened, a test can be executed in the 'Run' tab. To run a test, select the DUT by checking the associated check box at the bottom of the screen, see figure 6.10.2, and then select the 'Run' button.

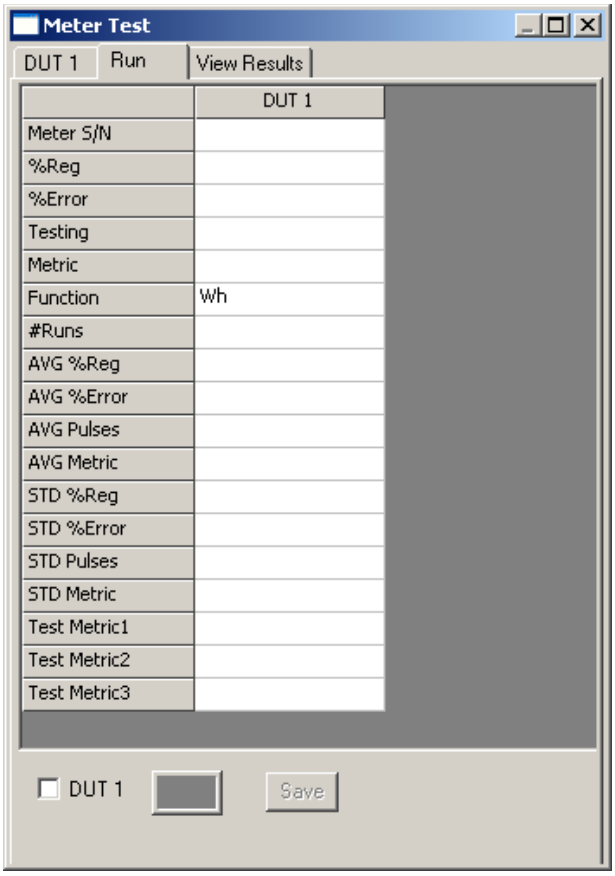


Figure 6.10.2

The various fields in the 'Run' tab allows the user to verify the meter serial number and the function to be tested, before the test is started. At the conclusion of the test, the window is compiled with the following data:

- Meter S/N
- Percent Registration
- Percent Error
- Test Status
- Metric Value
- Function Tested
- Number of Runs
- Average Percent Registration
- Average Percent Error

- Average Pulses
- Average Metric
- Standard Deviation of Percent Registration
- Standard Deviation of Percent Error
- Standard Deviation of Number Pulses
- Standard Deviation of the Metrics
- Test Metric 1 is the metric for phase 1
- Test Metric 2 is the metric for phase 2
- Test Metric 3 is the metric for phase 3

The Average and Standard Deviation values are only populated when the test has multiple runs. When multiple runs are defined, the test results will automatically save. If multiple runs are not defined, the test results must be manually saved.

To view meter test results, select the 'View Results' tab and select the 'View Results' button. Enter the serial number range of the meters of interest and select the 'View' button, see figure 6.10.3. If no serial number or date range is entered, then all the results will be displayed.

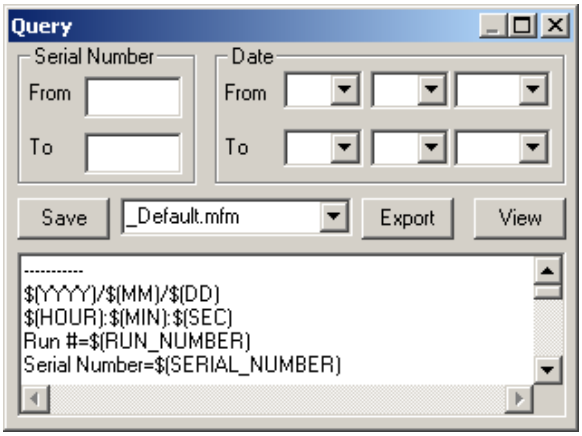


Figure 6.10.3

To change how the results are displayed, select a new option from the drop-down menu. The menu includes the following options: _Default.mfm, CSV_No_Quotes.mfm, and CSV_Quotes.mfm. The two CSV formats are commonly used when exporting information to a third party software.

To create a new file format. enter the new file name in the file name box and select the 'Save' button. The file name must have a *.mfm file extension. The following is a list of variables available:

Year	$(YYYY)
Month	$(MM)
Day	$(DD)
Hour	$(HOUR)
Minute	$(MIN)
Second	$(SEC)
Run Number	$(RUN_NUMBER)
DUT Serial Number	$(SERIAL_NUMBER)
DUT Kh Constant	$(DUT_KH)
DUT Pluses per Revolution	$(DUT_PULSES_PER)
DUT Elements	$(DUT_ELEMENTS)
Num of Standard Cur Inputs	$(STD_CURRENT_INPUTS)
Sensor Uses	$(STD_SENSOR_USED)
Standard Phase used for Test	$(STD_PHASE)
Test Function	$(TEST_FUNCTION)
Test	$(TEST)
Test Type	$(TEST_TYPE)
Test Revolutions	$(TEST_REVS)
Demand Minutes	$(DEMAND_MINUTES)
Test Volts	$(TEST_VOLTS)
Test Amps	$(TEST_AMPS)
Meter Demand Test	$(METER_DEMAND)
Metrics Accumulated	$(STANDARD_READING)
Percent Registration	$(PERCENT_REG)
Percent Error	$(PERCENT_ERROR)
Minimum Accumulated Metrics	$(MN_STANDARD_METRIC)
Minimum Standard pulses	$(MN_STANDARD_PULSES)
Minimum Percent Registration	$(MN_PERCENT_REG)
Minimum Percent Error	$(MN_PERCENT_ERROR)
Standard Deviation Accum Metrics	$(SD_STANDARD_METRIC)
Standard Deviation Standard pulses	$(SD_STANDARD_PULSES)
Standard Deviation Percent Reg	$(SD_PERCENT_REG)
Standard Deviation Percent Error	$(SD_PERCENT_ERROR)

Phase1 Metric	$(TEST_METRIC1)
Phase2 Metric	$(TEST_METRIC2)
Phase3 Metric	$(TEST_METRIC3)

The results viewer has common characters for indicating a header. The header text must be inside brackets ("[" and "]"). Below is a sample header:

[Meter Testing Results]

[]

[]

[Year, Month, Day, Hour, Min, Sec, # Runs, S/N, DUT kh]

To export the results to a flat file, select the format and select the 'Export' button. The saved data can be limited by using the search conditions. Once this button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the test. It is recommended that the data is saved as a *.txt file. If the file is saved as a *.txt file, the data can be viewed in a text editor.

6.11 Standards Test

The 'Standards Test' application, see Figure 6.11.1, allows the user to configure and perform a test on a watthour standard. This application also facilitates the configuration of the test results. When connected to a three phase Xytronic standard, this application will include the 'DUT 1,' 'DUT 2,' 'DUT 3,' 'Run,' and 'View Results' tabs. When connected to a single phase Xytronic standard, this application will include the 'DUT 1,' 'Run,' and 'View Results' tabs.

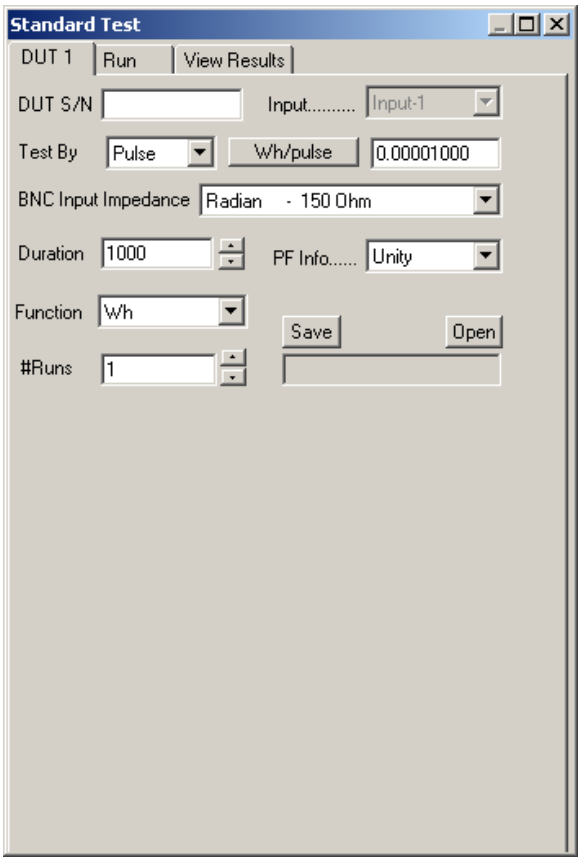


Figure 6.11.1

The user can configure and perform a new test or select a pre-saved test. To select a pre-saved test, select the 'Open' button. Once the button is selected, the standard will automatically open an 'Open' pop-up screen. From this screen, browse to the appropriate directory and select the required test.

To configure and run a standards test, enter the necessary information into the appropriate 'DUT' tab. The 'DUT 1,' 'DUT 2,' and 'DUT 3' tabs are associated to the BNC, potential, and current input ports, respectively. For example, the 'DUT1' tab sensor pulses must be counted on BNC input port 1.

In the DUT tab, the user defines the type of standards test to run.

- The **DUT S/N** is the standard under test's serial number.
- The **Test By** selects how the meter will be tested, either by pulses or time length.
- The **Duration** is the number of pulses or amount of time to test the standard

- The **Function** is the measurement function to be tested.
- The **# Runs** sets the number of repetitions of the test.
- The **Whr/pulse** value is the amount of energy each pulse represents. This is also a button that can be selected to change to **pulses/Whr** if needed. The name will change with the test function.
- The **Input** defines if the test is a three phase or a single phase test.
- The **BNC Input Impedance** is needed to determine the proper pullup resistor that should be used. If **Radian** is selected, then an internal 150 ohm pull-up resistor is used. If **Non-Radian** is selected, then an internal 1000 ohm pull-up resistor is used.
- The **PF Info** is a label to indicate the type of test being performed

To save the test set, select the 'Save' button. Once this button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the test.

Once a new test is configured or a saved test is opened, a test can be executed in the 'Run' tab. To run a test, select the DUT by checking the associated check box at the bottom of the screen, see figure 6.11.2, and then select the 'Run' button.

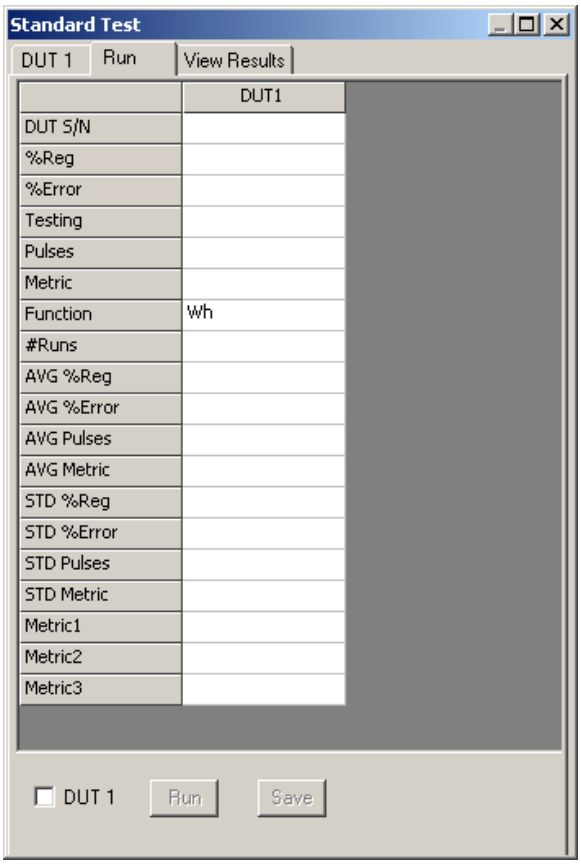


Figure 6.11.2

The various fields in the 'Run' tab allows the user to verify the standard's serial number and the function to be tested, before the test is started. At the conclusion of the test, the window is populated with the following data:

- DUT's Serial Number
- Percent Registration
- Percent Error
- Test Status
- Number of Pulses
- Metric Value
- Function Tested
- Average Percent Registration
- Average Percent Error
- Average Percent Pulses
- Average Percent Metric
- Standard Deviation of Percent Registration
- Standard Deviation of Percent Error
- Standard Deviation of Number Pulses
- Standard Deviation of the Metrics
- Test Metric 1 is the metric for phase 1
- Test Metric 2 is the metric for phase 2
- Test Metric 3 is the metric for phase 3

The Average and Standard Deviation values are only populated when the test has multiple runs. When multiple runs are defined, the test results will automatically save. If multiple runs are not defined, the test results must be manually saved.

To view standard test results, select the 'View Results' tab and select the 'View Results' button. Enter the serial number range of the standards of interest and select the 'View' button, see figure 6.11.3. If no serial number or date range is entered, then all the results will be displayed.

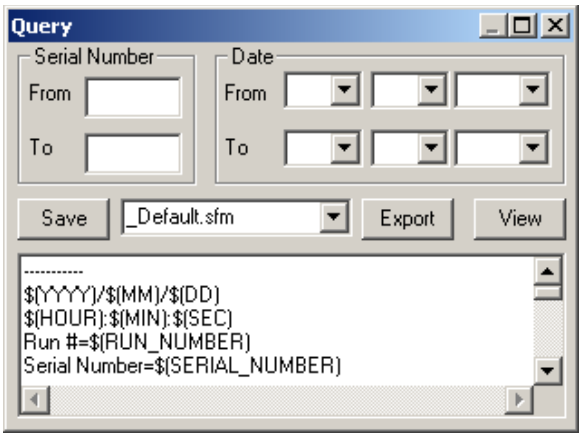


Figure 6.11.3

To change how the results are displayed, select a new option from the drop-down menu. The menu includes the following options: _Default.mfm, CSV_No_Quotes.mfm, and CSV_Quotes.mfm. The two CSV formats are commonly used when exporting information to a third party software.

To create a new file format. enter the new file name in the file name box and select the 'Save' button. The file name must have a *.mfm file extension. The following is a list of variables available:

Year	$(YYYY)
Month	$(MM)
Day	$(DD)
Hour	$(HOUR)
Minute	$(MIN)
Second	$(SEC)
Run Number	$(RUN_NUMBER)
Serial Number	$(SERIAL_NUMBER)
DUT Kh	$(DUT_KH)
DUT Device Type	$(DUT_DEVICE_TYPE)
Standard phase Input	$(STD_PHASE)
Test Function	$(TEST_FUNCTION)
Test By	$(TEST_BY)
Test Duration	$(TEST_DURATION)
Test Volts	$(TEST_VOLTS)
Test Amps	$(TEST_AMPS)

Total Accumulated Metric	$(STANDARD_METRIC)
Standard Pulses	$(STANDARD_PULSES)
Percent Registration	$(PERCENT_REG)
Percent Error	$(PERCENT_ERROR)
AVG Standard Metric	$(MN_STANDARD_METRIC)
AVG Standard Pulses	$(MN_STANDARD_PULSES)
AVG Percent Registration	$(MN_PERCENT_REG)
AVG Percent Error	$(MN_PERCENT_ERROR)
Standard Deviation Standard Metric	$(SD_STANDARD_METRIC)
Standard Deviation Standard Pulses	$(SD_STANDARD_PULSES)
Standard Deviation %Reg	$(SD_PERCENT_REG)
Standard Deviation %Error	$(SD_PERCENT_ERROR)
Phase1 Metric	$(TEST_METRIC1)
Phase2 Metric	$(TEST_METRIC2)
Phase3 Metric	$(TEST_METRIC3)

The results viewer has common characters for indicating a header. The header text must be inside brackets ("[" and "]"). Below is a sample header:

[Standard Testing Results]

[]

[]

[Year, Month, Day, Hour, Min, Sec, # Runs, S/N, DUT kh]

To export the results to a flat file, select the format and select the 'Export' button. The saved data can be limited by using the search conditions. Once this button is selected, the standard will automatically open a 'Save As' pop-up screen. From this screen, select an appropriate location and file name to save the test. It is recommended that the data is saved as a *.txt file. If the file is saved as a *.txt file, the data can be viewed in a text editor.

6.12 CT Burden and Ratio Testing

With the use of clamp on Current Transformers, BR1 Burden Analyzer Module and the internal measurement capability of the Xytronic Standard PCSuite 5 allows a **CT Burden and Ratio Test**, see figure 6.12.1.

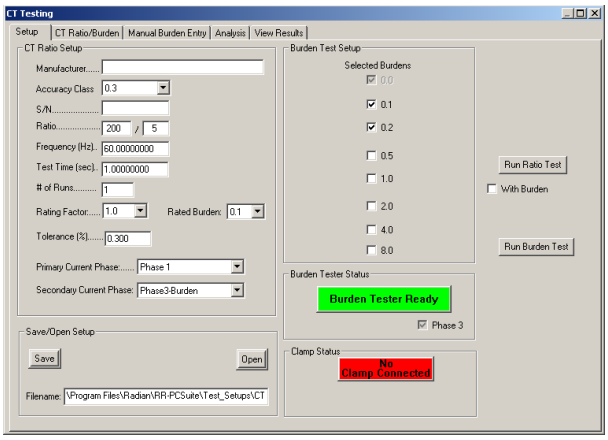


Figure 6.12.1

The CT Burden and Ratio Test will allow the Xytronic Standard to fully test the Current Transformer for VA output capabilities along with the primary to secondary ratio. For the burden test it will synchronize the zero crossings of the current signal with the insertion of the selected burden resistor(s) and compares the measurements. For the ratio test it compares the current sensed on a selected primary input verse the current sensed on the selected secondary input for the test time duration. For the CT Setup enter the following information.

Manufacture The manufactures name of the CT under test.

Accuracy Class The accuracy of the CT.

S/N The Serial number of the CT under test.

Ratio This defines the Ratio of the CT under test.

Frequency (Hz) This defines the Frequency in which the test is performed.

Test Time (Sec) This defines how long to test the CT. The Xytronic will average the measurements over this period.

# of Runs This defines how many times to repeat the test.

Rating Factor This defines the current rating factor of the CT under test

Rated Burden This defines the amount of burden that the CT should accurately drive and still meet the accuracy specification.

Tolerance (%) This defines the error allowed for the test. If the tolerance is exceeded, then the test will indicate failed.

Primary Current This defines the input to use as a primary **Phase** current measurement

Secondary Current This defines the input to use as a secondary **Phase** current measurement

The test setup can be saved for future use by selecting the **Save** button. After the button is selected it will prompt to enter in the name and location to save the test. If a test setup has already been completed it can be loaded prior to the test by selecting the **Load** button and choosing the setup file.

After the information has been entered select the user has multiple Run options. To only run a ratio test select **Run Ratio Test** or to run a Burden test select the **Run Burden Test** and as a final option to run a Ration with Burden Check the **With Burden** box and select **Run Ratio Test**. When the Test proceeds the screen will automatically change to the CT Ratio/Burden Tab, see figure 6.12.2

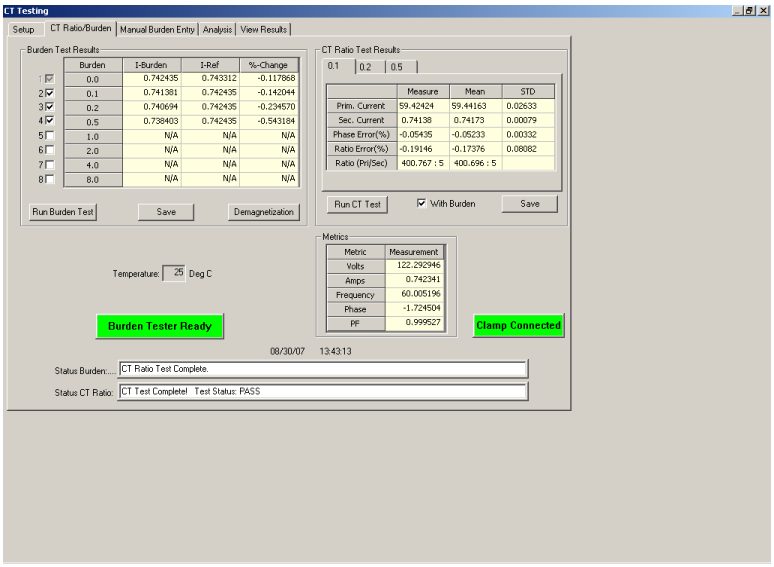


Figure 6.12.2

When the test is complete the screen will show the measured primary current, measured secondary current, error sensed for phase, Ratio error and CT Ratio. The mean average along with the standard deviation is given for each measurement. If a burden and ratio test was performed select the tab above the CT Ratio Test box to select the appropriate burden result to view.

If a burden test was selected, then the screen will show the current reading with and without the burden inserted and then provide a percent change comparing the two measurements.

To save any of the results, select the **Save Report**. After the button is selected it will prompt to enter in the name and location to save the test.

A graphic representation of the data is available in the Analysis tab. An Accuracy parallelogram, figure 6.12.3, Amplitude accuracy graph, figure 6.12.4, Phase accuracy graph, figure 6.12.5, Burden Accuracy, figure 6.12.6, and Burden Amplitude graph, figure 6.12.7 are available. The Graphs can be saved by selecting the **Save** button. After the button is selected it will prompt to enter in the name and location to save the test. The data along with a screen capture will be saved.

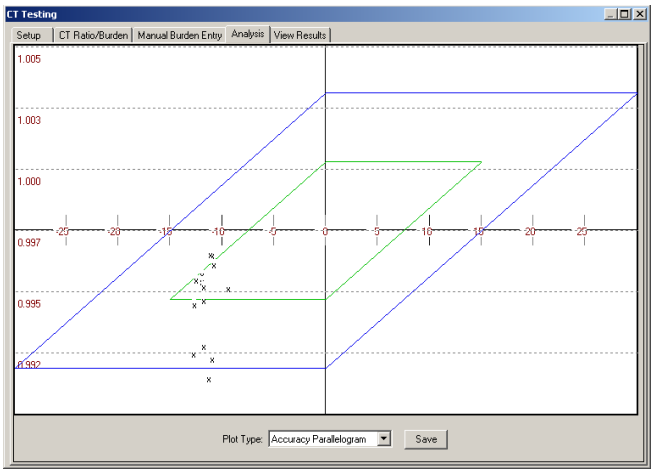


Figure 6.12.3

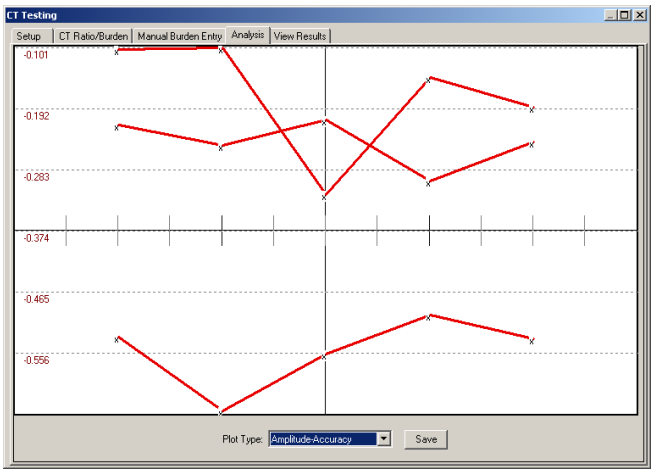


Figure 6.12.4

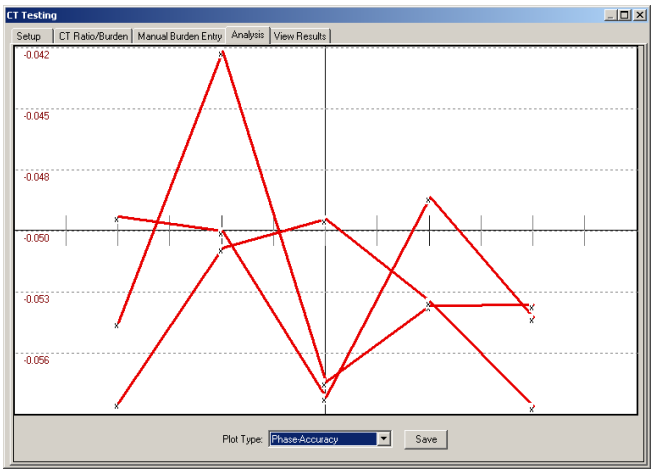


Figure 6.12.5

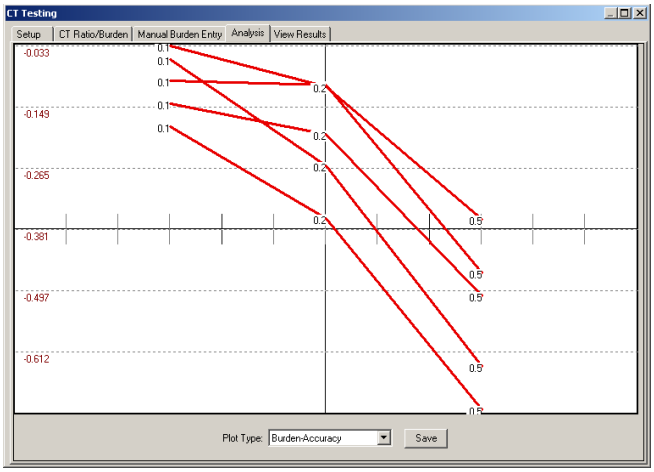


Figure 6.12.6

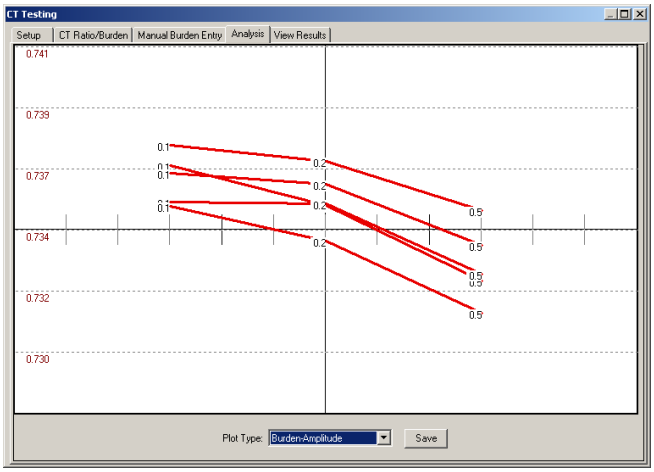


Figure 6.12.7

To view Test results, select the **View Results** tab and select the **View Results** button. Enter the serial number range of interest and select **View**, see figure 6.12.8. If no serial number or Date range is entered, then all the results will be displayed.

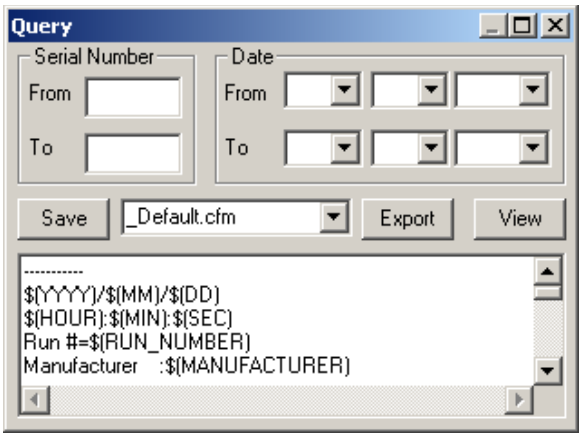


Figure 6.12.8

To change how the results are displayed use the dropdown menu. The options of _Default, CSV_No_Quotes or CSV_Quotes are available. CSV is defined as Comma Separated Variable. These two formats are commonly used when information is exported to third party software. To create and save a new file format enter the new file name in the file name box and select the save button. The file name must have .cfm as the file extension or PCSuite 5 will not recognize the new file. The following is a list of variable available if you wish to create a custom file.

Year	$(YYYY)
Month	$(MM)
Day	$(DD)
Hour	$(HOUR)
Minute	$(MIN)
Second	$(SEC)
Run #	$(RUN_NUMBER)
Manufacturer	$(MANUFACTURER)
Accuracy Class	$(ACCURACY_CLASS)
Serial Number	$(SERIAL_NUMBER)
Ratio	$(RATIO)
Test Frequency	$(FREQUENCY)
Error Tolerance	$(TOLERANCE)
Test Duration	$(TEST_TIME)

Primary Current	$(PRI_CURRENT)
Mean Primary Current	$(MEAN_PRI_CURRENT)
Standard Dev Primary Current	$(STD_PRI_CURRENT)
Secondary Current	$(SEC_CURRENT)
Mean Secondary Current	$(MEAN_SEC_CURRENT)
Standard Dev Secondary Current	$(STD_SEC_CURRENT)
Phase Error	$(PHASE_ERROR)
Mean Phase Error	$(MEAN_PHASE_ERROR)
Standard Deviation Phase Error	$(STD_PHASE_ERROR)
Ratio Error	$(RATIO_ERROR)
Mean Ratio Error	$(MEAN_RATIO_ERROR)
STD Ratio Error	$(STD_RATIO_ERROR)
Measured Ratio	$(MEAS_RATIO)
Measured Ratio Mean	$(MEAS_RATIO_MEAN)
Burden Value (0-9)	$(BURDEN_VALUE0)
I_None (0-9)	$(I_NO_BURDEN0)
I_With Burden (0-9)	$(I_WITH_BURDEN0)
Percent Change (0-9)	$(PERCENT_CHANGE0)

To enter a header the Results Viewer has common characters for indicating a header. The header text must be inside brackets "[" and "]". Below is a sample header.

[CT Testing Results]

[]

[]

[Year, Month, Day, Hour, Min, Sec, # Runs, S/N]

To export the results to a flat file, select the format and then select the **Export** button. The user can limit the saved data by using the search conditions. When selecting the Export button PCSuite 5 prompts the user to provide a name to save the data. It is recommended to save the data as a .txt file. If the file is saved as a .txt file then the Windows system can view it using a text editor.

6.13 Analog Sense Test

Xytronic Models that support Analog Sense Test can utilize the PCSuite 5 Analog Sense Test feature, see figure 6.13.1. The **Analog Sense Test** allows Xytronic Standard to test Transducer and Analog sense enabled meters. It does this by comparing the current sensed on the analog sense input to the metric on L3 over a period of time.

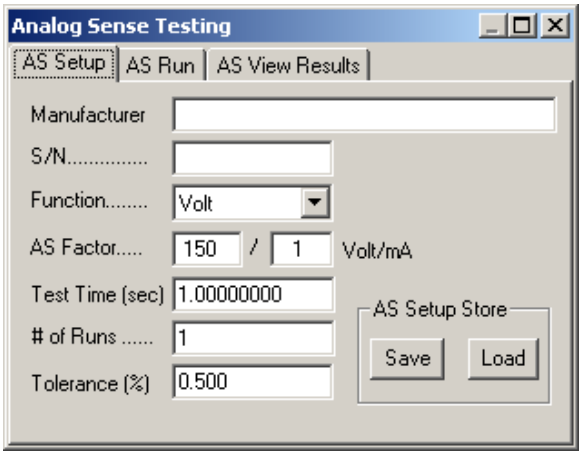


Figure 6.13.1

For the AS Setup enter the following information.

Manufacture	The manufacture's name of the Meter/Transducer under test.
S/N	The serial number of the Meter/Transducer under test.
Function	This defines which metric the Analog Sense is tested against.
AS Factor	This defines the Ratio of the Metric to Analog Sense Current.
Test Time (Sec)	This defines how long to test the Meter/Transducer. The Xytronic will average the measurements over this period.
# of Runs	This defines how many times to repeat the test.
Tolerance (%)	This defines the error allowed for the test. If the tolerance is exceeded, then the test will indicate failed.

The test setup can be saved for future use by selecting the **Save** button. After the button is selected it will prompt to enter in the name and location to save the test. If a test setup has already been completed it can be loaded prior to the test by selecting the **Load** button and choosing the setup file.

After the information has been entered select the AS Run tab and select Run Test to perform the test, see figure 6.13.2.

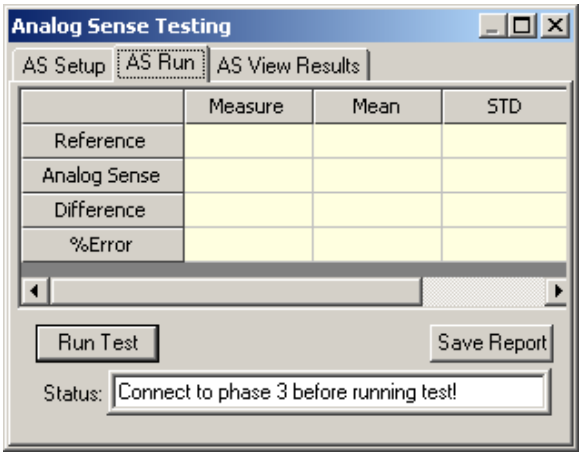


Figure 6.13.2

When the test is complete the test will show the measured Reference, measured Analog sense Current, Difference and the error. The mean average along with the standard deviation is given for each measurement. Select the save button to save the test results.

To view the Analog Sense Test results, select the **AS View Results** tab and select the **View Results** button. Enter the serial number range of interest and select **View**, see figure 6.13.3. If no serial number or Date range is entered, then all the results will be displayed.

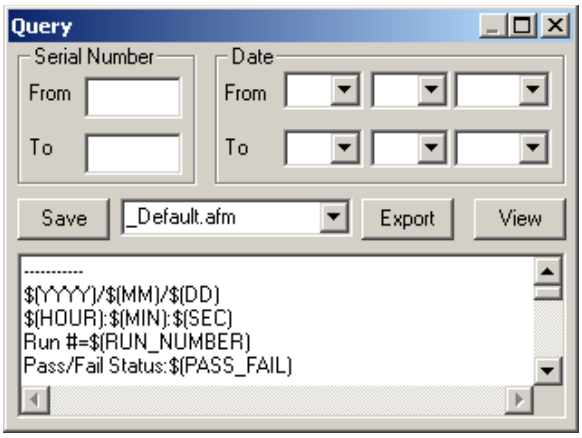


Figure 6.13.3

To change how the results are displayed use the dropdown menu. The options of _Default, CSV_No_Quotes or CSV_Quotes are available. CSV is defined as Comma Separated Variable. These two formats are commonly used when information is exported to third party software. To create and save a new file format enter the new file name in the file name box and select the save button. The file name must have .afm as the file extension or PCSuite 5 will not recognize the new file. The following is a list of variables available if you wish to create a custom file.

Year	$(YYYY)
Month	$(MM)
Day	$(DD)
Hour	$(HOUR)
Minute	$(MIN)
Second	$(SEC)
Run #	$(RUN_NUMBER)
Pass/Fail Status	$(PASS_FAIL)
Manufacturer	$(MANUFACTURER)
Serial Number	$(SERIAL_NUMBER)
Function	$(FUNCTION)
Factor	$(FACTOR)
Error Tolerance	$(TOLERANCE)
Test Duration	$(TEST_TIME)

Reference	$(REFERENCE)
Mean Reference	$(MEAN_REFERENCE)
STD Reference	$(STD_REFERENCE)
DUT	$(DUT)
Mean DUT	$(MEAN_DUT)
Standard Deviation DUT	$(STD_DUT)
Difference	$(DIFF)
Mean Difference	$(MEAN_DIFF)
Standard Deviation Difference	$(STD_DIFF)
Error	$(ERROR)
Mean Error	$(MEAN_ERROR)
Standard Deviation Error	$(STD_ERROR)

To enter a header the Results Viewer has common characters for indicating a header. The header text must be inside brackets "[" and "]". Below is a sample header.

[Analog Sense Testing Results]

[]

[]

[Year, Month, Day, Hour, Min, Sec, # Runs, S/N]

To export the results to a flat file, select the format for the export data and then select the **Export** button the user can save the data, using the search conditions. When selecting the Export button PCSuite 5 prompts the user to provide a name to save the data. It is recommended to save the data as a .txt file. If the file is saved as a .txt file then the Windows system can view it using a text editor.

6.16 Site Automation

6.16.1 Automation Setup

The Site Automation, figure 6.16.1.1, is an advanced feature that provides the ability to automate all the testing functions available in the PCSuite 5 Software.

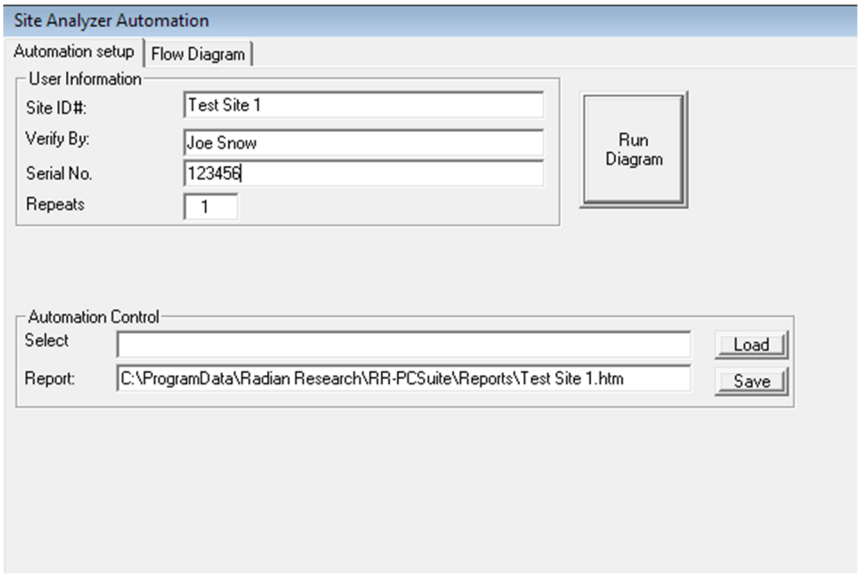


Figure 6.16.1.1

At the end of the automation sequence a report will be generated and saved. In addition to the automated test data, the report also has detailed site information including the Site ID, Verifier Name and Serial Number. The report name is defined by the serial number entered. The report location can be selected using the **Path**. To load a saved Automation Diagram select the **Load** button and select the diagram file.

3.16.2 Automation Flow Diagram

The Flow Diagram defines the automation sequence. To create a new flow diagram select the Flow Diagram tab, figure 6.16.2.1.

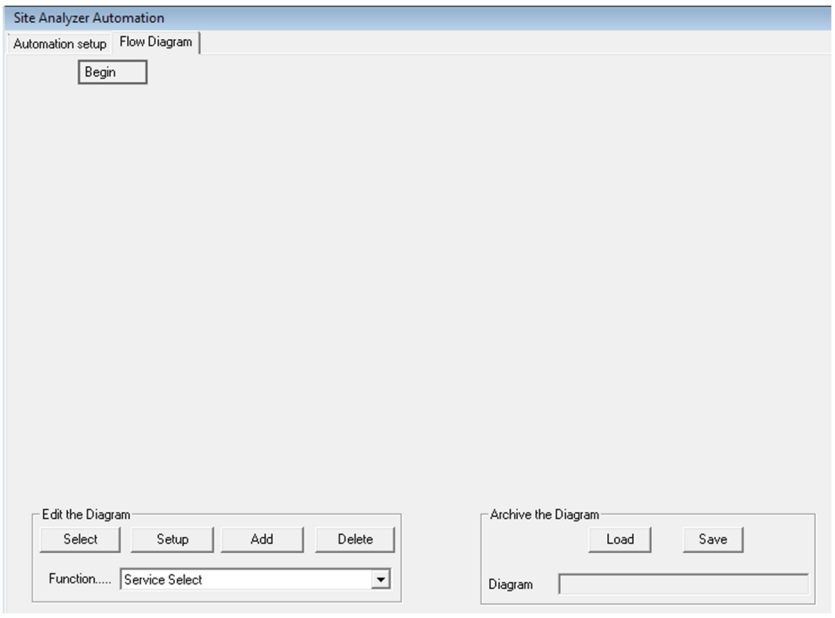


Figure 6.16.2.1

Each Automation Sequence must be saved before you can run the automation. To save the sequence select the **Save** button and select a file name and location.

There are 15 different functions that you can choose to add onto the flow diagram. To add a function, select the function from the list and select the **Add** button.

To edit the function setups, use the **Select** button to toggle to the function you wish to edit and select the **Setup** button.

To insert a function in-between two functions, use the **Select** button to choose the function, click **Add** and the added function will go above your selected function.

To delete a function from the automation sequence, use the Select button to toggle to the correct function and select the **Delete** button.

Several functions require setup:

1. Service Selection Setup, figure 6.16.2.2

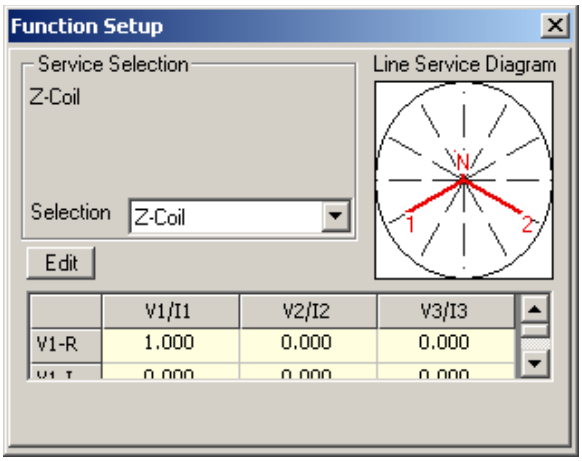


Figure 6.16.2.2

For three (3) phase Xytronic Standards, PCSuite 5 allows the unit to be configured similar to how a meter would perform the voltage and current calculation see section 6.5.7 Service Selection Configuration. When the Automation is started the service selection will automatically be configured and started based on the Automation Service Selection Setup.

2. Metrics Setup, figure 6.16.2.3.

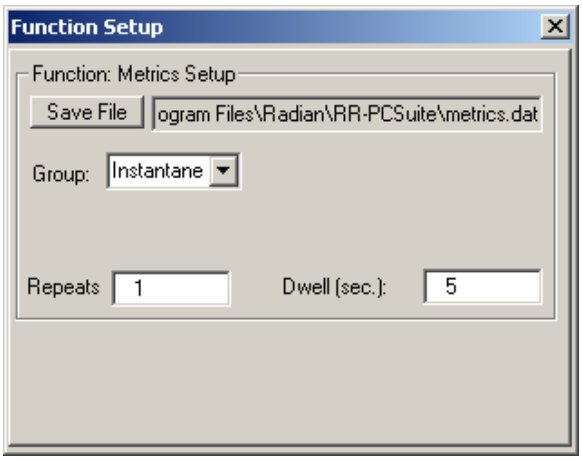


Figure 6.16.2.3 – Metrics Setup

In the Automation Metrics Setup, the user can select a Metrics **Group (Instantaneous, Min, Max, Accumulators)** see section 6.6 Metrics, a **Dwell** time length to keep the metrics data open and a **Save File** name and location for the data. To save the data multiple times, increase the **Repeats** number.

3. Harmonic Setup, figure 6.16.2.4

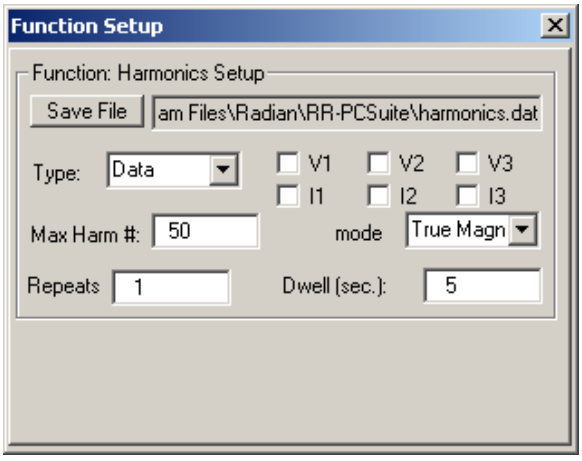


Figure 6.16.2.4

In the Automation Harmonics Setup, the user can select the **Type** of data to be captured. **(Data, Waveform, Bar Chart)** see section 6.7 Harmonic Analysis, a **Dwell** time length to keep the harmonic data

open and a **Save File** name and location for the data. To save the data multiple times, increase the **Repeats** number. The **Max Harm #**, the **phase check boxes** and the **Mode** allow the automation to capture the harmonic data according to the setup.

4. Trend Setup, figure 6.16.2.5

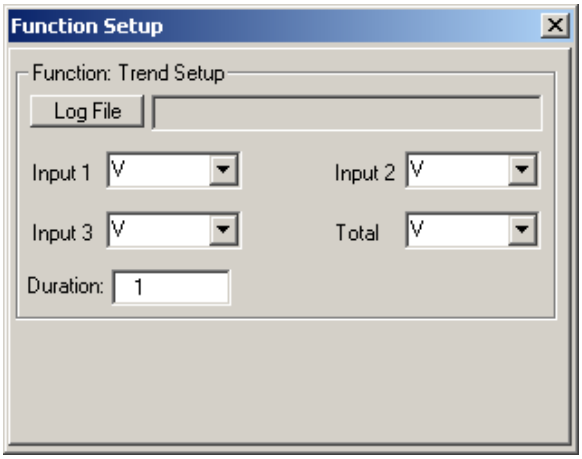


Figure 6.16.2.5

The Trend Chart takes recordings of measurements using the Xytronic Standard, see section 6.8 Trend Chart. The Automation Trend Setup defines the **Log File** name, which **metrics** are shown on each phase as the trend is started and the time **Duration** for the automated trend sequence.

5. Vector Setup, figure 6.16.2.6

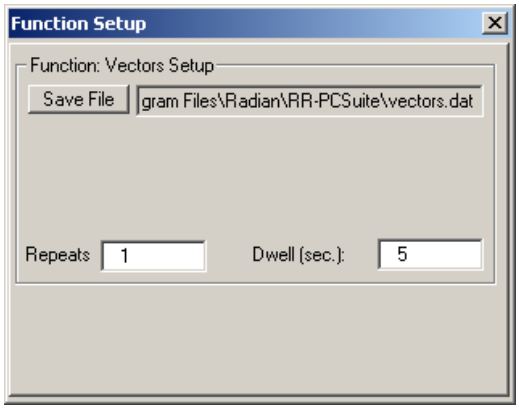


Figure 6.16.2.6

A vector representation of the voltage phase relationships and power factors are readily available in the Vectors screen, see section 6.9 Vectors. The Automation Vectors Setup allows the user to setup a **Dwell** time length to keep the Vectors data open and a **Save File** name and location for the data. To save the data multiple times, increase the **Repeats** number.

6. Meter Test Setup, figure 6.16.2.7

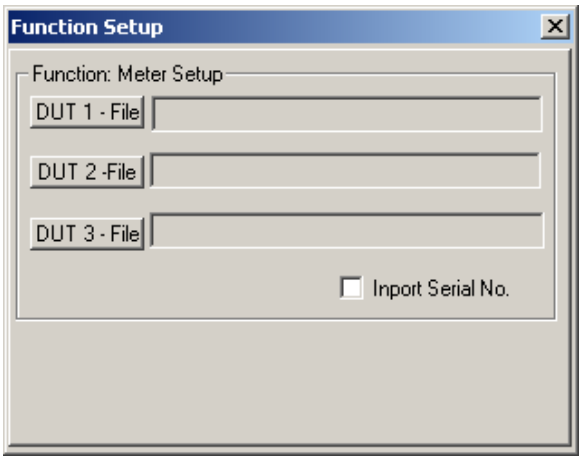


Figure 6.16.2.7

The Automation Meter Test Setup allows the user to preload a Meter Test Setup file for any DUT, see section 6.10 Run Meter Test. The **Import Serial No**. check box allows the Serial number from the Automation Information to be set as the meter serial number for the test.

7. Standard Test Setup, figure 6.16.2.8

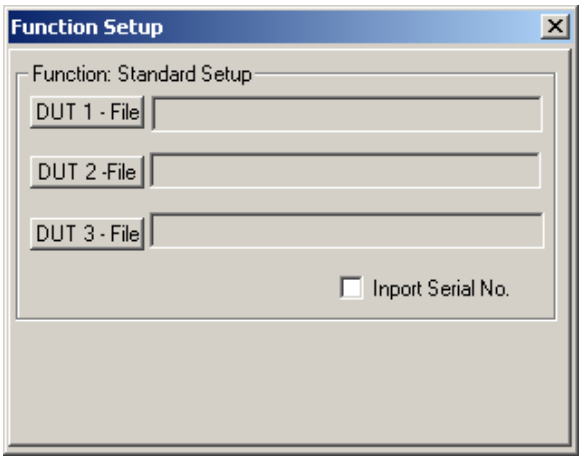


Figure 6.16.2.8

The Automation Standard Test Setup allows the user to preload a Standard Test Setup file for any DUT, see section 6.11 Standards Test. The **Import Serial No**. check box allows the Serial number from the Automation Information to be set as the Standard serial number for the test.

8. CT Ratio Test Setup, figure 6.16.2.9

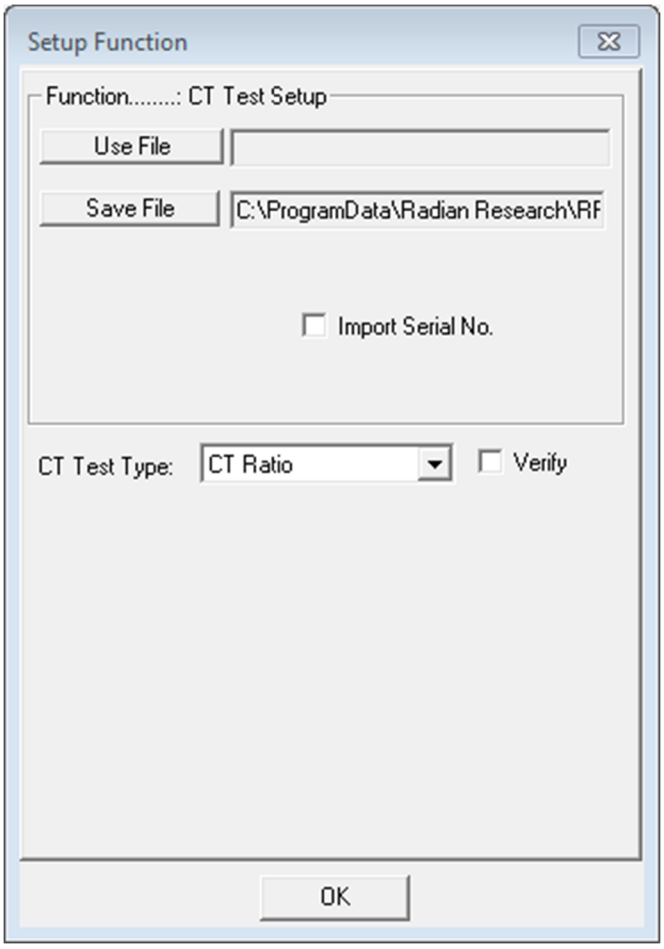


Figure 6.16.2.9

The Automation CT Ratio Test Setup allows the user to preload a CT Ratio Test Setup file, see section 6.12 CT Ratio Testing. The CT Ratio Testing Data can also be stored to another file by selecting the **Save File** button**,** selection a name and location for the data. The **Import Serial No**. check box allows the Serial number from the Automation Information to be set as the CT serial number for the test.

9. Analog Sense Setup, figure 6.16.2.10

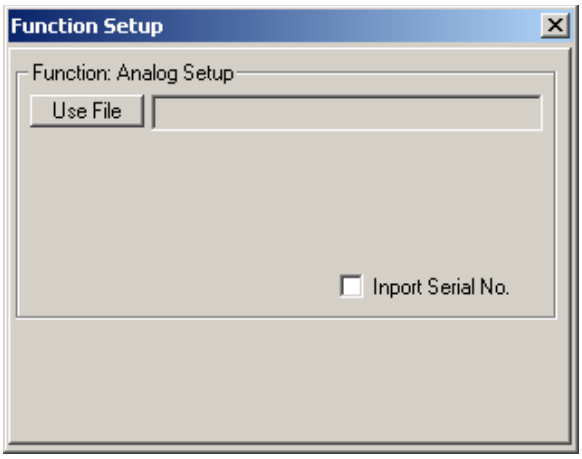


Figure 6.16.2.10

The Automation Analog Sense Test Setup allows the user to preload an Analog Sense Test Setup file, see section 6.13 Analog Sense Test. The **Import Serial No**. check box allows the Serial number from the Automation Information to be set as the device serial number for the test.

13. Pause Setup, figure 6.16.2.15

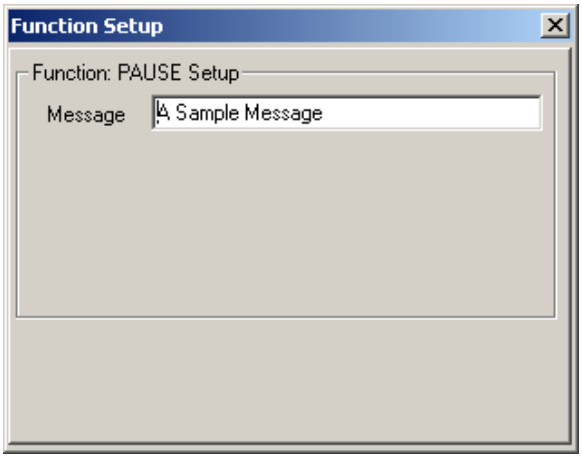


Figure 6.16.2.12

The Automated Pause setup provides a pause, which can show a custom **Message**. The Pause feature is crucial for testing of different

Meter Elements, multiple CT's or if any hardware configuration needs to change before the automation continues. When the Pause is ran a prompt will open, figure 6.16.2.13, displaying your custom message. To continue the **OK** must be selected.

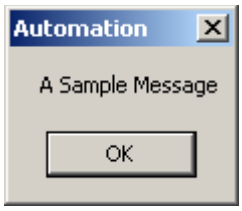
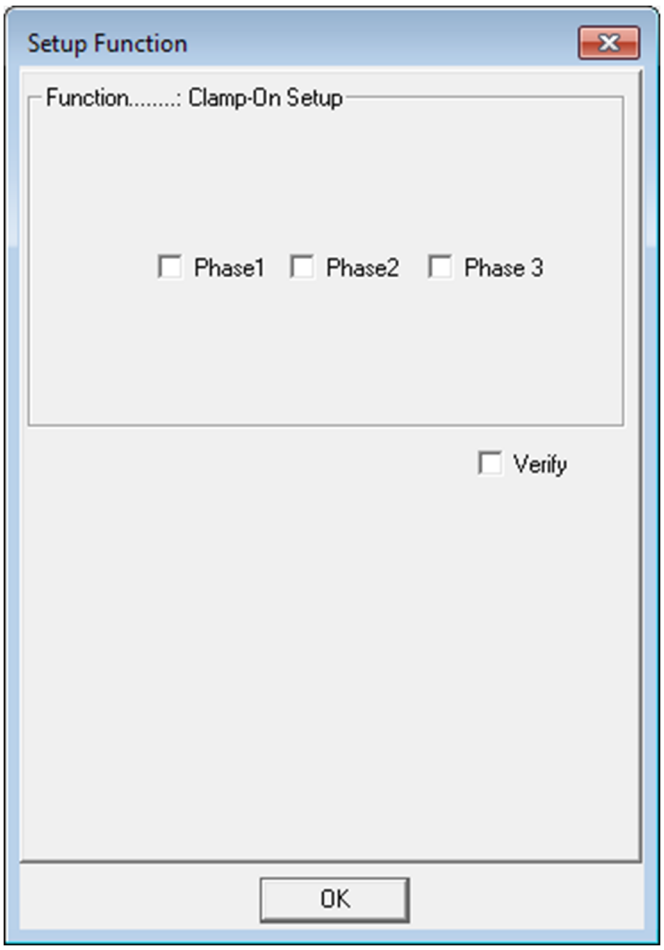


Figure 6.16.2.13

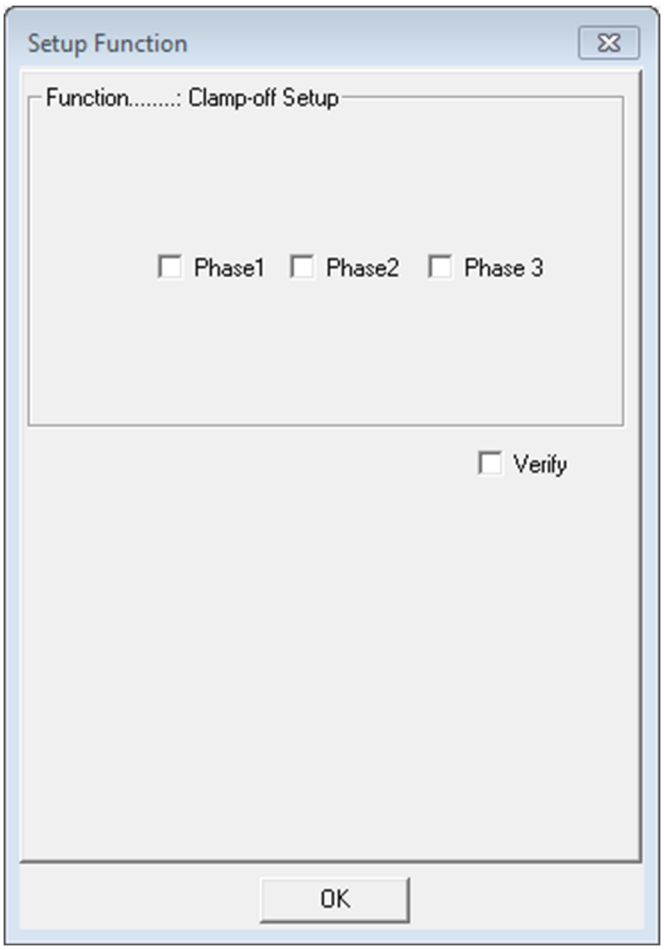
14. End Block

Every Automation Sequence requires an End Block to complete the sequence. The End Block will terminate the automation process, in addition, if opened it will stop the power quality function and the flicker function.

15. Clamp On


Setup Function
Function.....: Clamp-On Setup
Phase1
Phase2
Phase 3
Verify
OK

16. Clamp Off



17. End Function

Terminates a Test Sequence

7.0 Maintaining your RX Reference Standard

Your product is virtually maintenance free, other than cleaning the outside surface and yearly calibration. No routine maintenance is required. You will find information on the following topics in this section.

7.1 Cleaning your unit

Figure 7.1 Cleaning essentials

1. Use a clean, lint-free, slightly dampened cloth and a mild, non-abrasive cleaner.
2. Wipe down the outside case of the unit.
3. Buff dry around the tops of the terminals with a different clean, dry cloth.

7.2 Repairing your RX-30, RX-31 or RX-33

To process warranty service:

1. Contact Radian (765-449-5500) or your Radian representative.
2. Provide the model number and serial number to the representative
3. Give them a complete detailed description of the problem. Ex.:
4. Request a Return Material Authorization (RMA) number. Ex.:

Figure 7.2 Model and serial number locations

7.3 Recalibrating your product

Anyone who owns a car knows the importance of getting oil changes done on the recommended manufacturer's schedule to keep your car running at optimal performance, and your Radian products are no different.

There are two qualities that recalibration aids in maintaining your product. First, accuracy, the extent to which a given measurement agrees with the defined value, is achieved through rigorous research, and development into the best and most efficient methods for reaching a high degree of accuracy. These high levels are maintained through routine calibrations and testing to ensure your product remains at its manufacturing level of accuracy throughout its lifespan.

The second quality is stability, the ability of a device to maintain its performance characteristics. The device's stability is more easily seen in repeatability, the accuracy of a measurement given the exact same value multiple times in a row and how well they [the measurement] agrees, combined with reproducibility, how well a measurement agrees from day-to-day, or week-to-week. The final contributor to stability is minimizing possible drift, the long term trend of a device measurement to move up or down. It is therefore the recommendation of Radian that you schedule recalibrations for your units on a **yearly** basis.

7.4 Replacing the fuses

Figure 7.3 Fuse units

1. Turn off unit and remove the input cables.
2. Determine which of the sets of fuses need replacing.
3. Loosen and remove the 2.5mm hex head screw at the bottom of fuse unit.
4. Open the door of fuse unit.

1. Remove and replace the two fuses with Radian part number: 3001016 (500 mA, 1000 VAC/VDC 3AB, 10kA breaking capacity).
2. Close the door, replace and tighten the screw.
3. Insert input cables, and turn unit back on.

Note: There are a total of six fuses in your unit, arranged in sets of two per Potential phase.

Figure 7.4 Fuse placement

8.0 Accessorizing your unit

This section covers all accessories available for your product that will aid you in accomplishing the tasks necessary for your job.

8.1 Accessories

8.1.1 RX current connecting locking cables

Figure 8.1 RX current connecting locking cables

- Use for current inputs
- 5.1.1, describes using Radian RX 6mm locking current connectors.

8.2 Test accessories

8.2.1 RR-DS meter disk sensor

- Comes with two different mounting options.
  - RR-DS/f is the field mount options with a Velcro strap that fits around the meter cover, allowing the sensor to read disk rotation from the meter's side.
- RR-DS/sm is the suction mount option, featuring an L-bracket with three suction cups that attach to the front of the meter, allowing the sensor to read disk rotation from the front rather than the side.

Figure 8.2 RR-DS meter disk sensors

8.2.2 RM-OA optical adapter

Figure 8.4 RM-OA optical adapter

- Operates with solid-state meters whose infrared calibration pulses are emitted from the optical communications port (RJ-45), by magnetically coupling to the communication port of the meter.
- Attaches to the clear cover of the RM-OA by the suction cover of the RD-1H.
- Incorporates a rare earth permanent magnet for exceptional holding power over the product's lifespan.

8.2.3 RR-KYZ pulse input adapter

- Senses the KYZ output pulses of induction or solid-state meters.
- Receives pulse data, and conditions and feeds data into the pickup port of product.
- Tests KYZ equipped meters automatically with built-in computer.

Figure 8.5 RR-KYZ pulse input adapter

8.2.4 RM-1S remote reset switch

Figure 8.6 RM-1S remote reset switch

- Connects to BNC port, and has a hermetically sealed snap switch.
- Feels positively tactile to provide instantaneous feedback of the switch action.

8.2.5 RM-Metronic sensors

- Use your product with older RM-sensors, by connecting to BNC port. This includes
  - RM-DS Disk Sensor
  - RM-1H Infrared Optical Pickup
  - RM-1H/v Visible Optical Pickup
  - RM-KYZ Pulse Input Adapter

Figure 8.7 RM-Metronic sensors

8.2.6 RX-RMK (Black), RX-RMK (Light Grey) Rack Mount Kit

- RX-RMK (Black) part number 100360 and RX-RMK (Light Grey) part number 100359 are available for rack mounting the RX Standard.

Figure 8.8 RX-RMK Rack Mount Kit

8.2.7 RX-120CK3 (120 Amp Current Cable Kit) and RX-200CK3 (200 Amp Current Cable Kit)

- Current cable kits are available for both 120 and 200 amp. Both cables come in three sets of two. RX-120CK3 (120 Amp Current Cable Kit) and RX-200CK3 (200 Amp Current Cable Kit).

9.0 Meeting compliances

This section lists specific compliances held by RX-30, RX-31.

9.1 EMC compliance

9.1.1 USA: FCC	47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103.
9.1.2 International: EMC Directive 2014/30/EU	IEC 61326-1:2012 and IEC 61326-2-1:2012. Class A Emissions/Basic Electromagnetic Environment. ➢ CISPR 11:2003. Radiated and conducted emissions. ➢ IEC 61000-4-2:2001. Electrostatic discharge immunity. ➢ IEC 61000-4-3:2002. RF (radio frequency) electromagnetic field immunity. ➢ IEC 61000-4-4:2004. Electrical fast transient/burst immunity. ➢ IEC 61000-4-5:2001. Power line surge immunity. ➢ IEC 61000-4-6:2003. Conducted RF immunity. ➢ IEC 61000-4-11:2004. Voltage dips and interruptions immunity. Group 1, Class A: Class A instrument is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances. Emissions that exceed the levels required by CISPR 11 can occur when the instrument is connected to a test object. Only use accessories that show the CE mark. Industrial Electromagnetic Environment: Environment existing at locations characterized by a separate power network, in most cases supplied from a high- or medium-voltage transformer, dedicated for the supply of installations feeding manufacturing or similar plants with one or more of the following conditions: – frequent switching of heavy inductive or capacitive loads; – high currents and associated magnetic fields; – presence of Industrial, Scientific and Medical (ISM) instrument (for example, welding machines) ➢ Compliance ensured only when accessory cables <3m are used. ➢ System compliance when used with non-Radian products is the responsibility of the end user.
9.1.3 European contact	<TBD>

9.2 Safety compliance

9.2.1 U.S. Nationally Recognized Testing Laboratory (NRTL) Listing	➢ UL 61010-1:2012, 3rd Edition. Safety Requirements for Electrical Instrument for Measurement, Control, and Laboratory Use - Part 1: General Requirements ➢ UL 61010-2-030:2012, 1st Edition. Safety requirements for electrical instrument for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits ▪
9.2.2 International: Low Voltage Directive 2014/35/EU	▪ IEC 61010-1: 2010 (Safety requirements for electrical instrument for measurement, control, and laboratory use - Part 1: General requirements) ▪ IEC 61010-2-030: 2010 (Safety requirements for electrical instrument for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits) ➢
9.2.3 Canadian Certification	➢ CAN/CSA-C22.2 No. 61010-1-12 Safety requirements for electrical instrument for measurement, control, and laboratory use. Part 1. ➢ CAN/CSA-C22.2 No. 61010-2-030-12 Safety requirements for electrical instrument for measurement, control, and laboratory use - Part 2-030: Particular requirements for testing and measuring circuits
9.2.4 Pollution degree ✓Note	Pollution Degree 2 (as defined in IEC 61010-1): Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service. Rated for indoor use only.
9.2.5 Installation (Overvoltage) Category	Terminals on this product may be different installation (overvoltage) category designations. Only use cables and accessories with appropriate ratings. ➢ Current Inputs (non-clamp) 600V/CAT IV ➢ Voltage Inputs 600V/CAT IV with PE Ground Attached ➢ Voltage Inputs 600V/CAT II without PE Ground Attached ➢ All other ports have no category rating

9.3 Environmental Consideration

9.3.1 Product end-of-life handling	Observe the following guidelines when recycling an instrument or component:
9.3.2 Energy recycling	Production of this instrument required the extraction and use of natural resources. The instrument many contain substances that could be harmful to the environment or human health if improperly handled at the product's end-of-life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.
9.3.2 Energy recycling (continued)	 This symbol indicates that this product complies with the applicable European Union requirements according to RoHS 2 Directive 2011/65/EU and 2002/19/EU on waste electrical and electronic instrument (WEEE) and batteries. For information about recycling options, check the Support/Service section of <TBD>.

Appendix A SCPI Commands

The following table is a complete list of SCPI syntax for the RX. Further information on use of SCPI can be found in 'RX Series SCPI Status System' document and 'SCPI Console Overview' application note an the Radian Research website.

Reference SCPI-99 standard is available from the IVI Foundation. It can be found at the following link: http://www.ivifoundation.org/SCPI/Default.aspx

*CLS	488.2 10.3, SCPI - 99 4.1.3.2.Clear Status Command. Clears all status data structures in a device.
*ESE <value>	488.2 10.10. Standard Event Status Enable Command. Clears the Standard Event Status Register as a side-effect.
*ESE?	488.2 10.11. Standard Event Status Enable Query.
*ESR?	488.2 10.12. Standard Event Status Register Query. Reading the Standard Event Status Register clears it. The response is NR1.
*IDN?	488.2 10.14. Identification Query. The response is Arbitrary ASCII Response Data.
*OPC?	488.2 10.19. Operation Complete Query. Places an ASCII character '1' into the device's Output Queue when all pending selected device operations have been finished.
*OPT?	488.2 10.20. Option Identification Query. Reports available device options.
*RST	488.2 10.32., Reset Command.
*SRE <value>	488.2 10.34. Service Request Enable Command. Sets the Service Request Enable Register bits.
*SRE?	488.2 10.35. Service Request Enable Query. Response is NR1.

*STB?	488.2 10.36. Read Status Byte Query. Read the Status Byte Register and Master Summary Status bits. Response is NR1.
*TRG	488.2 10.37 Device-specific analog of the IEEE 488.1 defined Group Execute Trigger (GET) interface message, and has exactly the same effect as a GET when received, parsed, and executed by the device.
*TST?	488.2 10.38. Self-Test Query. Causes an internal self-test and places a response into the Output Queue indicating whether or not the device completed the self - test without any detected errors. Response is NR1.
*WAI	488.2 10.39. Wait-to-Continue Command. Prevent the device from executing any further commands or queries until the no-operation-pending flag is TRUE.
CONFigure:AMETrics:CONTinuous {OFF|ON}	Configure the accumulative metrics to run continuously or in single-shot mode.
CONFigure:AMETrics:CONTinuous?	Query the continuous state of accumulative metrics. The response is NR1.
CONFigure:AMETrics:DURation:PULSes {<numeric>|MINimum|MAXimum}	Sets the duration in pulses of the accumulative metric test. Only used in meter gate accumulative metric tests.
CONFigure:AMETrics:DURation:PULSes? [MINimum|MAXimum]	Queries the duration in pulses of the accumulative metric test. Response is NR3.
CONFigure:AMETrics:DURation[:TIME] {<numeric>|MINimum|MAXimum}	Sets the duration in seconds of the accumulative metric test. Only used in timed accumulative metric tests.
CONFigure:AMETrics:DURation[:TIME]? [MINimum|MAXimum]	Queries the duration in seconds of the accumulative metric test. Response is NR3.
CONFigure:AMETrics:GMODe {SSCLear|CSSTop}	Sets the gating mode to be used for manual mode pulse-gated accumulative metric tests. The parameter specifies either Start/Stop/Clear mode or Clear-Start/Stop mode.

CONFigure:AMETrics:GMODe?	Queries the gating mode to be used for manual mode pulse-gated accumulative metric tests. The response is Character Data.
CONFigure:AMETrics:MLISt (m1	m2,...),Sets the list of accumulative metrics returned by the FETCh? query. The allowable choices for metric are as returned by the CONFigure:AMETrics:MLISt:ALL? query.
CONFigure:AMETrics:MLISt:ALL?	Returns the list of all available accumulative metrics. The response is an Expression containing a list of character data items.
CONFigure:AMETrics:MLISt?	Returns the list of accumulative metrics returned by the FETCh? query. The response is an Expression containing a list of character data items.
CONFigure:AMETrics:MODE {NORMal|METer|MANual|TIMed}	Sets the current mode of operation of the accumulative metric test.
CONFigure:AMETrics:MODE?	Queries the current mode of operation of the accumulative metric test. The response is a character data item.
CONFigure:AMETrics:PORT <numeric>	Sets the pulse port to be used for the accumulative metric test, if relevant for the current test mode.
CONFigure:AMETrics:PORT? [MINimum|MAXimum]	Queries the pulse port to be used for the accumulative metric test. The response is NR1.
CONFigure:AMETrics:TIMeout {<numeric>|MINimum|MAXimum}	Sets the timeout time (seconds) for the accumulative metric test.
CONFigure:AMETrics:TIMeout? [MINimum|MAXimum]	Queries the timeout time (seconds) or the minimum/maximum timeout time (seconds) for the accumulative metric test. Response is NR3.
CONFigure:ASENse:CONTinuous {OFF|ON}	Configure the analog sense test to run continuously or in single-shot mode.
CONFigure:ASENse:CONTinuous?	Query the continuous state of analog sense test. The response is NR1.

CONFigure:ASENse:DURation[:TIME] {<numeric>|MINimum|MAXimum}	Configure the duration in seconds of the test.
CONFigure:ASENse:DURation[:TIME]? [MINimum|MAXimum]	Query the duration in seconds of the test. The response is NR3.
CONFigure:ASENse:METRic {m1|m2|...}	Configure the metric to be tested. The allowable choices for metric are as returned by the CONFigure:ASENse:METRic:ALL? query.
CONFigure:ASENse:METRic:ALL?	Query the possible choices of metric to be tested. The response is an Expression of Character Data.
CONFigure:ASENse:METRic?	Query the metric to be tested. The response is Character Data.
CONFigure:ASENse:OFFSet {<numeric>|MINimum|MAXimum}	Configure the offset (in units of the metric in use) to be applied to the measured value when calculating the measured value of the metric.
CONFigure:ASENse:OFFSet? [MINimum|MAXimum]	Query the offset (in units of the metric in use) to be applied to the measured value when calculating the measured value of the metric. The response is NR3.
CONFigure:ASENse:PHASe {P1|P2|P3|TOTalized}	Configure the source phase of the metric to be tested.
CONFigure:ASENse:PHASe?	Query the source phase of the metric to be tested. The response is Character Data.
CONFigure:ASENse:SCALe {<numeric>|MINimum|MAXimum}	Configure the scale factor (metric units / analog sense measurement) to be applied to the analog sense measured value when calculating the measured value of the metric.
CONFigure:ASENse:SCALe? [MINimum|MAXimum]	Query the scale factor (metric units / analog sense measurement) to be applied to the analog sense measured value when calculating the measured value of the metric. The response is NR3.

CONFigure:ASENse:TRANsducer {ma0	ma4,ma12},Configure the type of transducer being used, from the list returned by the CONFigure:ASENse:TRANsducer:ALL? query.
CONFigure:ASENse:TRANsducer?	Query the type of transducer being used. The response is Character Data.
CONFigure:BTESt:BURDens:ALL?	Queries the list of all available burdens. The response is an Expression containing a list of Character Data items.
CONFigure:BTESt{1:3}:BURDens (b1	b2,b3,...),Configure the burdens to be used for the burden test. The list will automatically be sorted and duplicates ignored.The allowable choices for each burden are as returned by the CONFigure:BTESt:BURDens:ALL? query.
CONFigure:BTESt{1:3}:BURDens?	Queries the burdens to be used for the burden test. The response is an Expression containing a list of Character Data items.
CONFigure:BTESt{1:3}:REPetitions {<numeric>|MINimum|MAXimum}	Sets the number of repetitions for the burden test. The sequence of burdens will be repeated this many times and the mean values reported.
CONFigure:BTESt{1:3}:REPetitions? [MINimum|MAXimum]	Queries the number of repetitions for the burden test. Response is NR1.
CONFigure:BTESt{1:3}:SCHannel {P1|P2|P3}	Configure the channel to which the secondary current is connected. The default is the channel to which the BR-1 is connected. This is used to limit the burdens tested if the secondary current is too high.
CONFigure:BTESt{1:3}:SCHannel?	Query the channel to which the secondary current is connected. The response is Character Data.
CONFigure:BTESt{1:3}:STATus?	Query the specified burden test for any abnormal status. The response is an Expression of String Response Data.
CONFigure:BTESt{1:3}:TIMeout {<numeric>|MINimum|MAXimum}	Sets the timeout time (seconds) for the burden test.

CONFigure:BTESt{1:3}:TIMeout? [MINimum|MAXimum]	Queries the timeout time (seconds) or the minimum/maximum timeout time (seconds) for the burden test. Response is NR3.
CONFigure:HARMonics:CONTinuous {OFF|ON}	Configure the harmonics measurement to run continuously or in single-shot mode.
CONFigure:HARMonics:CONTinuous?	Query the continuous state of harmonics measurement. Response is NR1.
CONFigure:HARMonics:ITIMe {<numeric>|MINimum|MAXimum}	Configure the integration time for the harmonics measurement. Results from each line cycle during the integration time will be averaged to produce the final result.
CONFigure:HARMonics:ITIMe? [MINimum|MAXimum]	Query the integration time for the harmonics measurement. The response is NR3.
CONFigure:IMETrics:CEXTrema	Clear the minimum and maximum value history of all instantaneous metrics.
CONFigure:IMETrics:CONTinuous {OFF|ON}	Configure the instantaneous metrics measurement to run continuously or in single-shot mode.
CONFigure:IMETrics:CONTinuous?	Query the continuous state of instantaneous metrics. The response is NR1.
CONFigure:IMETrics:ITIMe {<numeric>|MINimum|MAXimum}	Sets the integration time (seconds) for Instantaneous Metrics.
CONFigure:IMETrics:ITIMe? [MINimum|MAXimum]	Queries the integration time (seconds) or the minimum/maximum integration time (seconds) for Instantaneous Metrics. Response is NR3.
CONFigure:IMETrics:MLISt (m1	m2,...),Sets the list of instantaneous metrics returned by the FETCh? query. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.
CONFigure:IMETrics:MLISt:ALL?	Returns the list of all available instantaneous metrics. The response is an Expression containing a list of character data items.

CONFigure:IMETrics:MLISt?	Returns the list of instantaneous metrics returned by the FETCh? query. The response is an Expression containing a list of character data items.
CONFigure:INTerharmonics:CONTinuous {OFF|ON}	Configure the interharmonics measurement to run continuously or in single-shot mode.
CONFigure:INTerharmonics:CONTinuous?	Query the continuous state of the interharmonics measurement. The response is NR1
CONFigure:INTerharmonics:WINDow (start	end),Set the first and last index of the result list to be reported. The end index must be equal to or greater than the start index.
CONFigure:INTerharmonics:WINDow?	Get the first and last index of the result list to be reported. Result is an expression of NR1.
CONFigure:MEASurement:CLAMp{1:3}:ENABle [_ON_|OFF]	Configure the unit to use the clamp as the current input, rather than the primary current input. ON implies that the clamp current input is used, regardless of whether a clamp is connected.OFF implies that the primary current input is used, regardless of whether a clamp is connected.
CONFigure:MEASurement:CLAMp{1:3}:ENABle:AUTO [_ON_|OFF]	Configure the unit to automatically ENABle the clamp current input when a clamp is connected and to disable the clamp current input when a clamp is disconnected.If AUTO is OFF, then connecting and disconnecting a clamp does not change the current input in use.
CONFigure:MEASurement:CLAMp{1:3}:ENABle:AUTO?	Query the AUTO state of the clamp input. The response is NR1.
CONFigure:MEASurement:CLAMp{1:3}:ENABle?	Query the enabled state of the clamp input. The response is NR1.
CONFigure:MEASurement:CLAMp{1:3}:IDN?	Query the identification information for the clamp. The response is String Response Data in the format 'serial,version'.
CONFigure:MEASurement:CLAMp{1:3}:MULTiplier:ACTual?	Query the actual clamp multiplier in use for the specified phase of the unit. If AUTO is on and no clamp is attached, the value is NaN. The response is NR3.

CONFigure:MEASurement:CLAMp{1:3}:MULTiplier:AUTO [_ON_|OFF]	Configure the clamp multiplier value to use the data detected on the connected clamp. If AUTO is OFF, then the multiplier set by the CONFigure:MEASurement:CLAMp{1:3}:MULTiplier command will be used.
CONFigure:MEASurement:CLAMp{1:3}:MULTiplier:AUTO?	Query the AUTO state of the clamp multiplier. The response is NR1.
CONFigure:MEASurement:CLAMp{1:3}:MULTiplier[:REQuested] <numeric>	Configure the value of the clamp multiplier to use when 'AUTO' is off. Setting this value has the side effect of turning 'AUTO' off.
CONFigure:MEASurement:CLAMp{1:3}:MULTiplier[:REQuested]?	Query the last requested clamp multiplier value. The response is NR3.
CONFigure:MEASurement:CLAMp{1:3}:STATus?	Query the status of the clamp. The response is String Response Data. The string 'OK' indicates the clamp is functional. Any other response indicates an error condition.
CONFigure:MEASurement:CLAMp{1:3}[:CONNected]?	Query the status of the clamp. The response is NR1 - '1' if there is a clamp attached, '0' if there is not.
CONFigure:MEASurement:VARMethod {m1|m2|...}	Configure the method used to measure VAR. The allowable choices are as returned by the CONFigure:MEASurement:VARMethod:ALL? query.
CONFigure:MEASurement:VARMethod:ALL?	Query the possible choices of methods used to measure VAR. The response is an Expression of Character Data.
CONFigure:MEASurement:VARMethod?	Query the method used to measure VAR. The response is Character Data.
CONFigure:MEASurement:VIGate {ON|OFF}	Configure metrics calculations to use VI Gating. When VI Gating is enabled, very low input signals (e.g. noise) will be suppressed to zero.
CONFigure:MEASurement:VIGate?	Query whether metrics calculations are configured to use VI Gating.

CONFigure:MTESt:ELEMents:ALL?	Queries the list of all available meter elements for the meter test. The response is an Expression containing a list of character data items.
CONFigure:MTESt:METRic:ALL?	Query the possible choices of metric to be tested. The response is an Expression of Character Data.
CONFigure:MTESt:PHASe:ALL?	Queries the list of all available source phases for use in a meter test. The response is an Expression containing a list of character data items.
CONFigure:MTESt{1:5}:CONTinuous {OFF|ON}	Configure the meter test to run continuously or in single-shot mode.
CONFigure:MTESt{1:5}:CONTinuous?	Query the continuous state of meter test. Response is NR1
CONFigure:MTESt{1:5}:DEMand {<numeric>|MINimum|MAXimum}	Set the DUT demand value. This value must be entered after the demand test time is finished and will be used to calculate error. The error is then retrieved with a FETCh.
CONFigure:MTESt{1:5}:DEMand? [MINimum|MAXimum]	Queries the DUT demand value.
CONFigure:MTESt{1:5}:DURation:REVolutions {<numeric>|MINimum|MAXimum}	Sets the duration in revolutions of the meter test. Only used in pulse-duration meter tests.
CONFigure:MTESt{1:5}:DURation:REVolutions? [MINimum|MAXimum]	Queries the duration in revolutions of the meter test. Response is NR3.
CONFigure:MTESt{1:5}:DURation[:TIME] {<numeric>|MINimum|MAXimum}	Sets the duration in seconds of the meter test. Only used in timed meter tests.
CONFigure:MTESt{1:5}:DURation[:TIME]? [MINimum|MAXimum]	Queries the duration in seconds of the meter test. Response is NR3.
CONFigure:MTESt{1:5}:ELEMents {e1|e2|...}	Configure the number of meter elements for the meter test. The allowable choices are as returned by the CONFigure:MTESt:ELEMents:ALL? query.

CONFigure:MTESt{1:5}:ELEMents?	Queries the number of meter elements for the meter test. The response is a character data item as returned by the CONFigure:MTESt:ELEMents:ALL?.
CONFigure:MTESt{1:5}:KH {<numeric>|MINimum|MAXimum}	Sets the pulse constant of the meter test.
CONFigure:MTESt{1:5}:KH? [MINimum|MAXimum]	Queries the pulse constant of the meter test. Response is NR3.
CONFigure:MTESt{1:5}:METRic {m1|m2|...}	Configure the metric to be tested. The allowable choices for metric are as returned by the CONFigure:MTESt:METRic:ALL? query.
CONFigure:MTESt{1:5}:METRic?	Query the metric to be tested. The response is Character Data.
CONFigure:MTESt{1:5}:MODE {PSENsor|PMANual|DEMand|TIMed}	Sets the current mode of operation of the meter test.
CONFigure:MTESt{1:5}:MODE?	Queries the current mode of operation of the meter test. The response is a character data item.
CONFigure:MTESt{1:5}:PHASe {P1|P2|P3|TOTalized}	Configure the source phase to be used for the meter test. The numeric suffix indicates the pulse port used for the meter test.
CONFigure:MTESt{1:5}:PHASe?	Query the source phase used for the meter test. The numeric suffix indicates the pulse port used for the meter test. The response is Character Data.
CONFigure:MTESt{1:5}:PREVolution {<numeric>|MINimum|MAXimum}	Sets the pulses per revolution of the meter test.
CONFigure:MTESt{1:5}:PREVolution? [MINimum|MAXimum]	Queries the pulses per revolution of the meter test. Response is NR3.

CONFigure:MTESt{1:5}:TIMeout {<numeric>|MINimum|MAXimum}	Sets the timeout time (seconds) for the meter test.
CONFigure:MTESt{1:5}:TIMeout? [MINimum|MAXimum]	Queries the timeout time (seconds) or the minimum/maximum timeout time (seconds) for the meter test. Response is NR3.
CONFigure:STESt:METRic:ALL?	Query the possible choices of metric to be tested. The response is an Expression of Character Data.
CONFigure:STESt:PHASe:ALL?	Queries the list of all available source phases for use in a standard compare test. The response is an Expression containing a list of character data items.
CONFigure:STESt{1:4}:CONTinuous {OFF|ON}	Configure the test to run continuously or in single-shot mode.
CONFigure:STESt{1:4}:CONTinuous?	Query the continuous state of test. The response is NR1.
CONFigure:STESt{1:4}:DURation:PULSes {<numeric>|MINimum|MAXimum}	Sets the duration in pulses of the standard compare test. Only used in pulse-duration standard compare tests.
CONFigure:STESt{1:4}:DURation:PULSes? [MINimum|MAXimum]	Queries the duration in pulses of the standard compare test. Response is NR3.
CONFigure:STESt{1:4}:DURation[:TIME] {<numeric>|MINimum|MAXimum}	Sets the duration in seconds of the standard compare test. Only used in timed standard compare tests.
CONFigure:STESt{1:4}:DURation[:TIME]? [MINimum|MAXimum]	Queries the duration in seconds of the standard compare test. Response is NR3.
CONFigure:STESt{1:4}:KH {<numeric>|MINimum|MAXimum}	Sets the pulse constant of the standard compare test.
CONFigure:STESt{1:4}:KH? [MINimum|MAXimum]	Queries the pulse constant of the standard compare test. Response is NR3.

CONFigure:STESt{1:4}:METRic {m1|m2|...}	Configure the metric to be tested. The allowable choices for metric are as returned by the CONFigure:STESt:METRic:ALL? query.
CONFigure:STESt{1:4}:METRic?	Query the metric to be tested. The response is Character Data.
CONFigure:STESt{1:4}:MODE {PULSe|TIME}	Configure the current mode of operation of the standard compare test.
CONFigure:STESt{1:4}:MODE?	Queries the current mode of operation of the standard compare test. The response is a character data item.
CONFigure:STESt{1:4}:PHASe {P1|P2|P3|TOTalized}	Configure the source phase to be used for the standard compare test. The numeric suffix indicates the pulse port used for the standard compare test.
CONFigure:STESt{1:4}:PHASe?	Query the source phase used for the standard compare test. The numeric suffix indicates the pulse port used for the standard compare test. The response is Character Data.
CONFigure:STESt{1:4}:TIMeout {<numeric>|MINimum|MAXimum}	Sets the timeout time (seconds) for the standard compare test.
CONFigure:STESt{1:4}:TIMeout? [MINimum|MAXimum]	Queries the timeout time (seconds) or the minimum/maximum timeout time (seconds) for the standard compare test. Response is NR3.
CONFigure:WAVeform:CONTinuous {OFF|ON}	Configure the waveform measurement to run continuously or in single-shot mode.
CONFigure:WAVeform:CONTinuous?	Query the continuous state of waveform measurement. The response is NR1.
CONFigure:WAVeform:DECimation {<numeric>|MINimum|MAXimum}	Sets the decimation rate for waveform measurement.
CONFigure:WAVeform:DECimation? [MINimum|MAXimum]	Queries the decimation rate or the minimum/maximum decimation rate for waveform measurement. Response is a unitless NR1.

CONFigure:WAVeform:SFRequency?	Query the sampling frequency. Response is NR3.
DISPlay:ENABled {ON|OFF}	Enable or disable the integrated LCD display. Only effective if no external display is attached.
DISPlay:ENABled?	Query the status of the integrated LCD display. Response is NR1.
DISPlay:PHASe:CURRent:LEADs {ON|OFF}	Set whether a positive phase angle between current and voltage is shown on the GUI as current leading voltage (on) or current lagging voltage (off).
DISPlay:PHASe:CURRent:LEADs?	Query whether a positive phase angle between current and voltage is shown on the GUI as current leading voltage (on) or current lagging voltage (off).
FETCh:AMETrics:TOTalized:INTegrity?	Fetch only the totalized accumulative metric integrity value. The response is the integrity represented as Character Data.
FETCh:AMETrics:TOTalized:MLISt? (m1	m2,...),Fetch only the totalized accumulative metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:AMETrics:MLISt:ALL? query.
FETCh:AMETrics:TOTalized[:ALL]?	Fetch the totalized accumulative metrics integrity value and the metrics set by the CONFigure:AMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:AMETrics{1:3}:INTegrity?	Fetch only the accumulative metrics integrity value. The response is Character Data.
FETCh:AMETrics{1:3}:MLISt? (m1	m2,...),Fetch only the accumulative metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:AMETrics:MLISt:ALL? query.
FETCh:AMETrics{1:3}[:ALL]?	Fetch the accumulative metrics integrity value and the metrics set by the CONFigure:AMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.

FETCh:ASENse:INTegrity?	Fetch only the analog sense test integrity value. The response is Character Data.
FETCh:ASENse[:ALL]?	Fetch the analog sense test integrity value, the measured value of the analog sense (milliamps), the measured value of the metric (metric units), the expected value of the metric (metric units) and the error (percent). The measured value of the metric is computed from the measured value of the analog sense using the OFFSet and SCALe specified. The expected value of the metric is calculated by the reference standard based on the stimulus seen on the specified PHASe. The error is 100 * (measured - expected)/(expected). The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:BTESt{1:3}:FUNDamental[:ALL]?	Fetch the burden test integrity value, followed by the measured (fundamental-only) currents for each channel for each possible burden and the measured current phases for each channel for each possible burden. The phase measurements are all relative to the phase of the voltage signal on the channel where the secondary current is measured (as indicated by the CONFigure:BTESt{1:3}:SCHANnel command). The current and phase data points will be listed by burden value in the same order as the burdens returned by the 'BURDens:ALL?' query. The response is the integrity represented as Character Data followed by an Expression containing nested Expressions for each channel, each of which contains an Expression for the (fundamental-only) currents and the phases. The nested Expressions contain comma-separated NR3 values indicating the measured value at each burden point. For example, the Expression containing the results will be formatted as: (((c_1_1,c_1_2,...),(p_1_1,p_1_2,...)),((c_2_1,c_2_2,...),(p_2_1,p_2_2,...)),((c_3_1,c_3_2,...),(p_3_1,p_3_2,...))) where 'c_1_2' is current for channel 1, burden 2, p_3_1 is the phase for channel 3, burden 1, and so on. Note: Values for burdens that were not tested will be NaNs.
FETCh:BTESt{1:3}:INTegrity?	Fetch the burden test integrity value. The response is Character Data.
FETCh:BTESt{1:3}[:ALL]?	Fetch the burden test integrity value, followed by the measured (wideband) currents for each channel for each possible burden and the measured current phases for each channel for each possible burden. The phase measurements are all relative to the phase of the

	voltage signal on the channel where the secondary current is measured (as indicated by the CONFigure:BTESt{1:3}:SCHANnel command). The current and phase data points will be listed by burden value in the same order as the burdens returned by the 'BURDens:ALL?' query. The response is the integrity represented as Character Data followed by an Expression containing nested Expressions for each channel, each of which contains an Expression for the (wideband) currents and the phases. The nested Expressions contain comma-separated NR3 values indicating the measured value at each burden point. For example, the Expression containing the results will be formatted as: (((c_1_1,c_1_2,...),(p_1_1,p_1_2,...)),((c_2_1,c_2_2,...),(p_2_1,p_2_2,...)),((c_3_1,c_3_2,...),(p_3_1,p_3_2,...))) where 'c_1_2' is current for channel 1, burden 2, p_3_1 is the phase for channel 3, burden 1, and so on. Note: Values for burdens that were not tested will be NaNs.
FETCh:HARMonics:AMPS{1:3}:THD?	Fetch the total harmonic distortion for the specified measurement channel. Response is NR3.
FETCh:HARMonics:AMPS{1:3}?	Fetch the results of the harmonic analysis on the current axis of the specified channel. The result is an Expression of pairs of NR3 values in the format (amplitude,phase).
FETCh:HARMonics:INTegrity?	Fetch only the harmonic analysis integrity value. The response is Character Data.
FETCh:HARMonics:VOLTs{1:3}:THD?	Fetch the total harmonic distortion for the specified measurement channel. Response is NR3.
FETCh:HARMonics:VOLTs{1:3}?	Fetch the results of the harmonic analysis on the voltage axis of the specified channel. The result is an Expression of pairs of NR3 values in the format (amplitude,phase).
FETCh:IMETrics:EXTRema:TOTalized:INTegrity?	Fetch only the integrity value for the totalized instantaneous metrics maximums and minimums. The response is Character Data.
FETCh:IMETrics:MAXimum:TOTalized:MLISt? (m1	m2,...),Fetch only the totalized maximum instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.

FETCh:IMETrics:MAXimum:TOTalized[:ALL]?	Fetch the totalized maximum instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:IMETrics:MINimum:TOTalized:MLISt? (m1	m2,...),Fetch only the totalized minimum instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.
FETCh:IMETrics:MINimum:TOTalized[:ALL]?	Fetch the totalized minimum instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:IMETrics:TOTalized:INTegrity?	Fetch only the totalized instantaneous metrics integrity value. The response is Character Data.
FETCh:IMETrics:TOTalized:MLISt? (m1	m2,...),Fetch only the totalized instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.
FETCh:IMETrics:TOTalized[:ALL]?	Fetch the totalized instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:IMETrics{1:3}:EXTRema:INTegrity?	Fetch only the integrity value for the instantaneous metrics maximums and minimums. The response is Character Data.
FETCh:IMETrics{1:3}:INTegrity?	Fetch only the instantaneous metrics integrity value. The response is Character Data.
FETCh:IMETrics{1:3}:MAXimum:MLISt? (m1	m2,...),Fetch only the maximum instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.

FETCh:IMETrics{1:3}:MAXimum[:ALL]?	Fetch the maximum instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:IMETrics{1:3}:MINimum:MLISt? (m1	m2,...),Fetch only the minimum instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.
FETCh:IMETrics{1:3}:MINimum[:ALL]?	Fetch the minimum instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:IMETrics{1:3}:MLISt? (m1	m2,...),Fetch only the instantaneous metrics specified. The response is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:IMETrics:MLISt:ALL? query.
FETCh:IMETrics{1:3}[:ALL]?	Fetch the instantaneous metrics integrity value and the metrics set by the CONFigure:IMETrics:MLISt command. The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:INTerharmonics:AMPS{1:3}?	Fetch the results of the interharmonics analysis on the current axis of the specified channel. The data points fetched are defined by the CONFigure:INTerharmonics:WINDow command.The response is an Expression of pairs of NR3 values in the format (amplitude,phase).
FETCh:INTerharmonics:BSIZe?	Fetch the calculated width of the frequency bins in Hz of the interharmonic analysis. The response is NR3
FETCh:INTerharmonics:INTegrity?	Fetch only the harmonic analysis integrity value. The response is Character Data.
FETCh:INTerharmonics:VOLTs{1:3}?	Fetch the results of the interharmonics analysis on the voltage axis of the specified channel. The data points fetched are defined by the CONFigure:INTerharmonics:WINDow command.The response is an Expression of pairs of NR3 values in the format (amplitude,phase).

FETCh:MTESt{1:5}:INTegrity?	Fetch only the meter test integrity value. The response is Character Data.
FETCh:MTESt{1:5}[:ALL]?	Fetch the meter test integrity value, the meter's measured value of the metric (metric units), the reference standard's measured value of the metric (metric units), the registration (percent), and the error (percent). The error is 100 * (meter measured - reference measured)/(reference measured). The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:STESt{1:4}:INTegrity?	Fetch only the standard compare test integrity value. The response is Character Data.
FETCh:STESt{1:4}[:ALL]?	Fetch the standard compare test integrity value, the DUT's measured value of the metric (metric units), the reference standard's measured value of the metric (metric units), the registration (percent), and the error (percent). The error is 100 * (DUT measured - reference measured)/(reference measured). The response is the integrity represented as Character Data followed by an Expression containing the NR3 values, in order.
FETCh:WAVeform:SEQuence?	Fetch only the waveform measurement sequence number. The sequence number counts the number of measurements triggered since system startup. The response is NR1.
FETCh:WAVeform:SNUMber?	Fetch only the waveform measurement starting sample number. The starting sample number uniquely identifies the sample that begins the waveform data since system startup. The response is NR1.
FETCh:WAVeform{1:3}:CURRent[:ALL]?	Fetch the waveform measurement integrity value and the current samples (amps). The response is the integrity formatted as Character Data followed by an Expression containing the samples as NR3 values.
FETCh:WAVeform{1:3}:INTegrity?	Fetch only the waveform measurement integrity value. The response is Character Data.
FETCh:WAVeform{1:3}:VOLTage[:ALL]?	Fetch the waveform measurement integrity value and the voltage samples (volts). The response is the integrity formatted as Character Data followed by an Expression containing the samples as NR3 values.

INITiate:AMETrics [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:AMETrics:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:AMETrics:STOP	Stops an on-going NORMal mode measurement, if any, causing it to finish immediately.
INITiate:ASENse [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:ASENse:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:ASENse:ZERO	Perform an auto-zero adjustment on the analog sense hardware to improve the measurement accuracy for low-level inputs.
INITiate:ASENse:ZERO?	Query whether or not an auto-zero adjustment on the analog sense hardware is in process. Response is NR1.
INITiate:BTESt{1:3} [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:BTESt{1:3}:DEMag	Initiate a demagnetization.
INITiate:BTESt{1:3}:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:HARMonics [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.

INITiate:HARMonics:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:IMETrics [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:IMETrics:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:INTerharmonics [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:INTerharmonics:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:MTESt{1:5} [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:MTESt{1:5}:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
INITiate:STESt{1:4} [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:STESt{1:4}:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).

INITiate:WAVeform [_ON_|OFF]	If 'On': A new measurement cycle is started. If the measurement is currently in a measurement cycle, it is aborted. If a timeout is specified, the timeout period begins when a measurement is initiated. If 'Off': Deactivates the measurement.
INITiate:WAVeform:STATe?	Queries the state of the measurement. Response is Character Data: one of OFF, ON, MEASuring, RAVailable (Result AVailable).
IRESult:AMETrics:TOTalized:MLISt? (m1	m2,...),Query the intermediate result of the accumulative metric test, returning the integrity value and the totalized accumulative metrics specified. The response is a boolean (NR1) indicating whether the test is complete, followed by the integrity represented as Character Data, followed is an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:AMETrics:MLISt:ALL? query.
IRESult:AMETrics:TOTalized[:ALL]?	Query the intermediate result of the accumulative metric test, returning the integrity value and the metrics set by the CONFigure:AMETrics:MLISt command. The response is a boolean (NR1) indicating whether the test is complete, followed the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order.
IRESult:AMETrics{1:3}:MLISt? (m1	m2,...),Query the intermediate result of the accumulative metric test, returning the integrity value and the accumulative metrics specified. The response is a boolean (NR1) indicating whether the test is complete, followed by the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order. The allowable choices for metric are as returned by the CONFigure:AMETrics:MLISt:ALL? query.
IRESult:AMETrics{1:3}[:ALL]?	Query the intermediate result of the accumulative metric test, returning the integrity value and the metrics set by the CONFigure:AMETrics:MLISt command. The response is a boolean (NR1) indicating whether the test is complete, followed by the remaining duration (seconds for timed tests, pulses for meter tests, NaN otherwise) as NR3, followed by the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order.
IRESult:ASENse[:ALL]?	Query the intermediate result of the analog sense test, returning the measured value of the analog sense (milliamps), the measured value of the metric (metric units), the expected value of the metric (metric units) and the error (percent). The measured value of the metric

	is computed from the measured value of the analog sense using the OFFSet and SCALe specified. The expected value of the metric is calculated by the reference standard based on the stimulus seen on the specified PHASe. The error is 100 * (measured - expected)/(expected). The response is a boolean (NR1) indicating whether the test is complete, followed by the time remaining in the test in seconds as NR3, followed by the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order.
IRESult:BTESt{1:3}:FUNDamental[:ALL]?	Query the intermediate result of the burden test, returning the completion status and the result data as described for the FETCh:BTESt:FUNDamental:ALL? command. The response is a boolean (NR1) indicating whether the test is complete, followed by the integrity represented as Character Data, followed by an Expression containing the available test results as described in the FETCh command. If no repetitions have been completed, the result Expression described in the FETCh command will be NaNs.
IRESult:BTESt{1:3}:RCOMplete?	Query the number of repetitions completed. The result is an NR1.
IRESult:BTESt{1:3}:RREMaining?	Query the number of repetitions remaining in the measurement. The result is an NR1.
IRESult:BTESt{1:3}[:ALL]?	Query the intermediate result of the burden test, returning the completion status and the result data as described for the FETCh:BTESt:ALL? command. The response is a boolean (NR1) indicating whether the test is complete, followed by the remaining repetitions as NR1, followed by the integrity represented as Character Data, followed by an Expression containing the available test results as described in the FETCh command. If no repetitions have been completed, the result Expression described in the FETCh command will be NaNs.
IRESult:MTESt{1:5}[:ALL]?	Query the intermediate result of the meter test, returning the meter's measured value of the metric (metric units), the reference standard's measured value of the metric (metric units), the registration (percent), the error (percent), the pulse count detected and the elapsed time (seconds).The error is 100 * (meter measured - reference measured)/(reference measured). The response is a boolean (NR1) indicating whether the test is complete, followed by the duration remaining (seconds for timed tests, pulses for meter tests, NaN otherwise) as

	NR3, followed by the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order.
IRESult:STESt{1:4}[:ALL]?	Query the intermediate result of the standard compare test, returning the DUT's measured value of the metric (metric units), the reference standard's measured value of the metric (metric units), the registration (percent), the error (percent), the pulse count detected and the elapsed time (seconds).The error is 100 * (DUT measured - reference measured)/(reference measured). The response is a boolean (NR1) indicating whether the test is complete, followed by the duration remaining (seconds for timed tests, pulses for pulse tests) as NR3, followed by the integrity represented as Character Data, followed by an Expression containing the NR3 values, in order.
READ:AMETrics:TOTalized?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:AMETrics:TOTalized:ALL?
READ:AMETrics{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:AMETrics{1:3}:ALL?
READ:ASENse?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:ASENse:ALL?
READ:BTESt{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:BTESt{1:3}:ALL?
READ:HARMonics:AMPS{1:3}:THD?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:HARMonics:AMPS{1:3}:THD?
READ:HARMonics:AMPS{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:HARMonics:AMPS{1:3}?
READ:HARMonics:VOLTs{1:3}:THD?	Perform an 'INITiate' operation, followed by the equivalent of HARMonics:VOLTs{1:3}:THD?
READ:HARMonics:VOLTs{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:HARMonics:VOLTs{1:3}?

READ:IMETrics:TOTalized?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:IMETrics:TOTalized:ALL?
READ:IMETrics{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:IMETrics{1:3}:ALL?
READ:INTerharmonics:AMPS{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:INTerharmonics:AMPS{1:3}?
READ:INTerharmonics:VOLTs{1:3}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:INTerharmonics:VOLTs{1:3}?
READ:MTESt{1:5}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:MTESt{1:5}:ALL?
READ:STESt{1:4}?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:STESt{1:4}:ALL?
READ:WAVeform{1:3}:CURRent?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:WAVeform{1:3}:CURRent:ALL?
READ:WAVeform{1:3}:VOLTage?	Perform an 'INITiate' operation, followed by the equivalent of FETCh:WAVeform{1:3}:VOLTage:ALL?
STATus:OPERation:CONDition?	SCPI-99 20.1.2. Returns the contents of the Operation status register. The response is NR1.
STATus:OPERation:ENABle <value>	SCPI-99 20.1.3. Sets the enable mask which allows true conditions in the event register to be reported in the summary bit. Clears the event register as a side-effect.
STATus:OPERation:ENABle?	SCPI-99 20.1.3. Returns the enable mask for the Operation status event register. The response is NR1.

STATus:OPERation[:EVENt]?	SCPI-99 20.1.4. Returns the contents of the Operation status event register. The response is NR1.
STATus:PRESet	SCPI-99 20.2. Sets the SCPI OPERation and QUEStionable enable registers to zero.
STATus:QUEStionable:CONDition?	SCPI-99 20.3.2. Returns the contents of the Questionable status register. Always zero for this device. The response is NR1.
STATus:QUEStionable:ENABle <value>	SCPI-99 20.3.3. Sets the enable mask which allows true conditions in the event register to be reported in the summary bit. Clears the event register as a side-effect.
STATus:QUEStionable:ENABle?	SCPI-99 20.3.3. Returns the enable mask for the Questionable status event register. The response is NR1.
STATus:QUEStionable:PHASe{1:3}:ENABle <value>	Sets the enable mask which allows true conditions in the event register to be reported in the summary bit. Clears the event register as a side-effect.
STATus:QUEStionable:PHASe{1:3}:ENABle?	Returns the enable mask for the Questionable status event register. The response is NR1.
STATus:QUEStionable:PHASe{1:3}[:EVENt]?	Returns the contents of the Questionable status event register for the specified phase. The response is NR1.
STATus:QUEStionable[:EVENt]?	SCPI - 99 20.3.4. Returns the contents of the Questionable status event register. The response is NR1.
SYSTem:BEEPer:ENABle {OFF|ON}	Configure whether the beeper will make sound or not.
SYSTem:BEEPer:ENABle?	Query whether the beeper will make sound or not. The response is NR1.
SYSTem:CALibration:DATetime (<year>	<month>,<day>,<hour>,<minute>,<second>),Sets the calibration date and time (24-hour format). Requires elevated privileges. The single parameter is an expression with 6 numerical fields and is in local time.

SYSTem:CALibration:DATetime?	Queries the calibration date and time (24-hour format). The timestamp reported is in local time (adjusted for the current timezone). The response is an expression of NR1, with the following fields, in order: year, month, day, hour, minute, second.
SYSTem:COMMunicate:LAN:APPLy	Apply the network configuration to the network interface.
SYSTem:COMMunicate:LAN:DHCP [_ON_|OFF]	Configure the LAN interface to use DHCP.
SYSTem:COMMunicate:LAN:DHCP:RELease	Immediately releases any DHCP address lease.
SYSTem:COMMunicate:LAN:DHCP:RENew	Immediately renews any DHCP address lease.
SYSTem:COMMunicate:LAN:DHCP?	Query the state of the DHCP configuration. The response is NR1.
SYSTem:COMMunicate:LAN:FTRansfer:ENABle {<numeric>|MINimum|MAXimum}	Starts file transfer server on the given port.
SYSTem:COMMunicate:LAN:FTRansfer:ENABle? [MINimum|MAXimum]	Queries the port that the file transfer server is currently running on. The value 0 means 'not running'. The response is NR1.
SYSTem:COMMunicate:LAN:HOSTname <string>	Configure the hostname for the LAN interface.
SYSTem:COMMunicate:LAN:HOSTname?	Query the hostname for the LAN interface. The response is String Response Data.
SYSTem:COMMunicate:LAN:MAC?	Read the MAC address of the Ethernet interface. Response is a string in the form of '00:00:00:00:00:00'.
SYSTem:COMMunicate:LAN:STATic:BROadcast <string>	Configure the broadcast address for the lan interface. The String parameter is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:BROadcast?	Query the broadcast address for the lan interface. The response is String Response Data and is a dotted-quad IPv4 address.

SYSTem:COMMunicate:LAN:STATic:DGATeway <string>	Configure the default gateway address for the lan interface. The String parameter is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:DGATeway?	Query the default gateway address for the lan interface. The response is String Response Data and is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:DNSServer{1:2} <string>	Configure the DNS server address for the lan interface. The String parameter is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:DNSServer{1:2}?	Query the DNS server address for the lan interface. The response is String Response Data and is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:IPADdress <string>	Configure the static IPv4 address of the lan interface. The String parameter is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:IPADdress?	Query the static IPv4 address of the lan interface. The response is String Response Data and is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:SUBNet <string>	Configure the IPv4 subnet mask of the lan interface. The String parameter is a dotted-quad IPv4 address.
SYSTem:COMMunicate:LAN:STATic:SUBNet?	Query the IPv4 subnet mask of the lan interface. The response is String Response Data and is a dotted-quad IPv4 address.
SYSTem:COMMunicate:TCPip:CONTrol?	Query the raw-mode TCP/IP port used for DCL and SRQ. The response is NR1.
SYSTem:COMMunicate:TCPip:CRResponse [_ON_|OFF]	For raw-mode TCP/IP responses, configures the unit to send a carriage return in addition to the normal line feed. Useful when using a terminal emulator.
SYSTem:COMMunicate:TCPip:CRResponse?	Queries whether responses append a carriage return. Response is NR1.
SYSTem:COMMunicate:UDPip:LISTen [_ON_|OFF]	Configure the unit to listen for and respond to particular UDP broadcast messages. These UDP broadcast messages are designed to allow a client computer to find reference standards on the network.

SYSTem:COMMunicate:UDPip:LISTen?	Query whether the unit to listens for UDP broadcast messages. Response is NR1.
SYSTem:DATetime (<year>	<month>,<day>,<hour>,<minute>,<second>),Sets the system date and time (24-hour format). The single parameter is an expression with 6 numerical fields and is in local time.
SYSTem:DATetime?	Queries the system date and time (24-hour format). The timestamp reported is in local time (adjusted for the current timezone). The response is an expression of NR1, with the following fields, in order: year, month, day, hour, minute, second.
SYSTem:DIAGnostic:LOG:ARCHive:DONE?	Automatically set to false when the SYSTem:DIAGnostic:LOG:ARCHive command is executed. Changes to true when the archive file is finished being zipped. Response is NR1.
SYSTem:DIAGnostic:LOG:ARCHive:FILename <string>	Set the filename used for archiving log files. Do not include a path.
SYSTem:DIAGnostic:LOG:ARCHive:FILename?	Query the filename used for archiving log files. The response is String Response Data.
SYSTem:DIAGnostic:LOG:ARCHive:STARt	Begins the operation of archiving the log files into a file with the name specified by SYSTem:DIAGnostic:LOG:ARCHive:FILename.
SYSTem:DIAGnostic:LOG:COMMands [_ON_|OFF]	Configures the instrument to log SCPI and Legacy Serial commands in the log file.
SYSTem:DIAGnostic:LOG:COMMands?	Queries whether or not SCPI and Legacy Serial commands are being logged in the log file. Response is NR1.
SYSTem:DIAGnostic:SLINe <string>	Sets the status line message on the GUI.
SYSTem:DIAGnostic:SLINe?	Query the current status line message on the GUI.
SYSTem:ERRor:ALL?	Queries the error/event queue for all the unread items and removes them from the queue. See SCPI-99 21.8.8.4. The response is a comma separated list of code, message pairs.

SYSTem:ERRor:CODE:ALL?	Queries the error/event queue for all the unread items and removes them from the queue. See SCPI-99 21.8.5.1. The response is a comma separated list of error/event codes.
SYSTem:ERRor:CODE[:NEXT]?	Queries the error/event queue for the next item and removes it from the queue. See SCPI-99 21.8.5.2. The response is the error/event code.
SYSTem:ERRor:COUNt?	Queries the error/event queue for the number of unread items. See SCPI-99 21.8.6
SYSTem:ERRor:ENABle:ADD <numeric list>	The events included in the numeric list are added to the previous ENABle list. See SCPI-99 21.8.8.7.1
SYSTem:ERRor:ENABle:DELete <numeric list>	The events included in the numeric list are deleted from the previous ENABle. See SCPI-99 21.8.7.2
SYSTem:ERRor:ENABle[:LIST] <numeric list>	The list indicates which errors/events are allowed to enter the queue. See SCPI-99 21.8.7.3. Omitting the <numeric list> enables all errors/events.
SYSTem:ERRor:ENABle[:LIST]?	Query the error/event enable list. See SCPI-99 21.8.7.3. The response is a numeric list formatted as 488.2 <Expression Response Data>.
SYSTem:ERRor[:NEXT]?	Queries the event/error queue for the next item and removes it from the queue. See SCPI-99 21.8.8. The response consists of a code, string pair.
SYSTem:EVENt:DESE <value>	Set the Device Event Status Enable Register. Clears the Device Event Status Register as a side-effect. This command is a device-dependent analog to *ESE.
SYSTem:EVENt:DESE?	Query the Device Event Status Enable Register. This command is a device-dependent analog to *ESE?.
SYSTem:EVENt:DESR?	Query the Device Event Status Register. Reading the Device Event Status Register clears it. The response is NR1.This command is a device-dependent analog to *ESR?.
SYSTem:FIRMware:UPDate:FILename <string>	Sets the name of the file that the update process will look for.

SYSTem:FIRMware:UPDate:FILename?	Queries the name of the file that the update process will look for. The response is String Response Data.
SYSTem:FIRMware:UPDate:LOAD	Load a firmware update file from a USB drive or SD card. Will look in the root of the attached device for the filename specifiedby the SYSTem:FIRMware:UPDate:FILename command. If no filename was specified, it will attempt to search based on the standard update naming pattern.
SYSTem:FIRMware:UPDate:MESSage?	Queries a message that represents the current state of the update. The response is String Response Data.
SYSTem:FIRMware:UPDate:PROGress?	Query this to get a value between 0 and 100 (inclusive) which represents the progress of the update. Response is NR3.
SYSTem:FIRMware:UPDate:STARt	Begins the firmware update process. The update file must already be loaded onto the system with the filename specified by SYSTem:FIRMware:UPDate:FILename.
SYSTem:HELP:HEADers?	Returns a list of all available commands and queries. See SCPI-99 21.9.1. The response is Definite Length Arbitrary Block Response Data.
SYSTem:HELP:LANGuage?	Produce a listing of all SCPI mnemonics and associated help text in 'CSV'-style format. The response is Definite Length Arbitrary Block Response Data.
SYSTem:HELP:SYNTax:HELP? <command_header>	Returns help text for the command. The response is String Response Data.
SYSTem:HELP:SYNTax? <command_header>	Returns a string containing the syntax specification of the provided command_header. See SCPI-99 21.9.2. The response is String Response Data.
SYSTem:IDENtify:LEGend?	Returns an Expression of strings consisting of field names for the SYSTem:IDENtify? command.
SYSTem:IDENtify?	Returns an Expression of strings with identifying information about the device.

SYSTem:MEMulation {OFF|ON}	Configure the meter emulation state of the unit.
SYSTem:MEMulation:CURRent{1:3} (c1	c2,c3),Configure the meter emulation for the specified current phase to be determined by the coefficients in the parameter expression. The parameter is an Expression containing three ordered numeric elements.The order of the values is such that the first value is applied to the current measured on phase 1, the second to phase 2, and the third to phase 3. Thus, assuming 'CURRent1' as an example, the resulting transformation is A1 = C1*A1 + C2*A2 + C3*A3, where C1 is the first coefficient and so on.
SYSTem:MEMulation:CURRent{1:3}?	Query the meter emulation coefficients for the specified current phase. The response is an Expression of NR3 elements, in a format corresponding exactly to the SYSTem:MEMulation:CURRent command.
SYSTem:MEMulation:RESet	Configure the meter emulation coefficients such that meter emulation is off and is an identity transformation (i.e., effectively the same as meter emulation being off).
SYSTem:MEMulation:VOLTage{1:3} (c1	c2,c3),Configure the meter emulation for the specified voltage phase to be determined by the coefficients in the parameter expression. The parameter is an Expression containing three ordered numeric elements.The order of the values is such that the first value is applied to the voltage measured on phase 1, the second to phase 2, and the third to phase 3. Thus, assuming 'VOLTage1' as an example, the resulting transformation is V1 = C1*V1 + C2*V2 + C3*V3, where C1 is the first coefficient and so on.
SYSTem:MEMulation:VOLTage{1:3}?	Query the meter emulation coefficients for the specified voltage phase. The response is an Expression of NR3 elements, in a format corresponding exactly to the SYSTem:MEMulation:VOLTage command.
SYSTem:MEMulation?	Query the meter emulation state of the unit. The response is NR1.
SYSTem:PASSword:CDISable	SCPI-99 21.15.1. Disables protected commands.
SYSTem:PASSword:NEW <new password>	SCPI-99 21.15.2.1. Sets a new password. The password is Unquoted String data. Protected commands must already be unlocked.

SYSTem:PASSword:STATe?	SCPI-99 21.15.2.1. Queries the protected state of enabled commands. The response is NR1.
SYSTem:PASSword[:CENable] <password>	SCPI-99 21.15.2. Enables protected commands. The password is Unquoted String data.
SYSTem:PORT:AMETrics:ALL?	Returns the list of all available accumulative metrics. The response is an Expression containing a list of Character Data items.
SYSTem:PORT:KH:DEFault [m1|m2|...]	{<numeric>|MINimum|MAXimum|DEFault},Configure the default pulse output constant for the specified accumulative metric. The possible values for the accumulative metric are available from the SYSTem:PORT:AMETrics:ALL? query.
SYSTem:PORT:KH:DEFault:ALL {<numeric>|MINimum|MAXimum}	Configure the default pulse output constant for all accumulative metrics.
SYSTem:PORT:KH:DEFault? {m1|m2|...}	Query the default pulse output constant for the specified accumulative metric. The possible values for the accumulative metric are available from the SYSTem:PORT:AMETrics:ALL? query. The response is NR3.
SYSTem:PORT:RESet	Reset the pulse port states to factory-default values.
SYSTem:PORT{1:4}:FREQuency {<numeric>|MINimum|MAXimum}	Configure the output frequency in Hertz of the specified port, for use when it is configured to output a particular frequency.
SYSTem:PORT{1:4}:FREQuency? [MINimum|MAXimum]	Query the output frequency in Hertz of the specified port. The response is NR3.
SYSTem:PORT{1:4}:KH {<numeric>|MINimum|MAXimum|DEFault}	Configure the pulse output constant for the specified port. If set to DEFault, the default constant for the currently configured accumulative metric will be used.

SYSTem:PORT{1:4}:KH? [MINimum|MAXimum]	Query the pulse output constant for the specified port. If NaN is returned, the default constant for the currently configured accumulative metric is being used.The response is NR3.
SYSTem:PORT{1:4}:METRic {m1|m2|...}	Configure the specified port to pulse out the specified accumulative metric.
SYSTem:PORT{1:4}:METRic?	Query the accumulative metric to be pulsed out of the specified port. The response is Character Data.
SYSTem:PORT{1:4}:OUTPut {OFF|METRic|FREQuency}	Configure the specified port to pulse out the configured accumulated metric, a fixed frequency, or nothing.
SYSTem:PORT{1:4}:OUTPut?	Query the output state of the specified port. The response is Character Data.
SYSTem:PORT{1:4}:PULLup:IMPedance {LOW|HIGH}	Configure the pullup resistor value for the specified port, for use when it is an input. The parameter is one of 'LOW' for a pullup value of 128 ohms or 'HIGH' for a pullup value of 1K ohms.
SYSTem:PORT{1:4}:PULLup:IMPedance?	Query the pullup resistor value for the specified port. The response is Character Data.
SYSTem:PORT{1:4}:SOURce {P1|P2|P3|TOTalized}	Configure the specified port to pulse out the configured accumulative metric from the specified source phase.
SYSTem:PORT{1:4}:SOURce?	Query the source phase for the accumulative metric to be pulsed out of the specified port. The response is Character Data.
SYSTem:PORT{1:5}:POLarity {POSitive|NEGative}	Configure the pulse polarity for the specified port, for use when it is an input or output. The parameter is a Character Data element: POSitive going or NEGative going.
SYSTem:PORT{1:5}:POLarity?	Query the pulse polarity for the specified port. The response is Character Data.
SYSTem:PRESet	SCPI-99 21.16. Sets the device to the same state as the *RST, except for optimizing for manual control rather than programmatic control. For example, 'CONFigure:IMETrics:CONTinuous' is set to 'ON'.

SYSTem:RANGe:AUTO [OFF|_ON_]	Configure the autoranging state of the unit as a whole.
SYSTem:RANGe:AUTO?	Query the autoranging state of the unit as a whole. Returns MIXed if not all axes and phases are the same. The response is Character Data.
SYSTem:RANGe:CURRent{1:3}:ACTual?	Query the actual current range in use for the specified phase of the unit. The value returned is an instantaneous value reported by underlying hardware. There is some inherent lag in the reporting. The response is NR3 (amps).
SYSTem:RANGe:CURRent{1:3}:AUTO [OFF|_ON_]	Configure the current range of the specified phase of the unit to autorange.
SYSTem:RANGe:CURRent{1:3}:AUTO?	Query the state of the current autoranging of the specified phase of the unit. The response is NR1.
SYSTem:RANGe:CURRent{1:3}:CLAMp:ACTual?	Query the actual clamp current range in use for the specified phase of the unit. The value returned is an instantaneous value reported by underlying hardware. There is some inherent lag in the reporting. The response is NR3 (amps).
SYSTem:RANGe:CURRent{1:3}:CLAMp:AUTO [OFF|_ON_]	Configure the clamp current range of the specified phase of the unit to autorange.
SYSTem:RANGe:CURRent{1:3}:CLAMp:AUTO?	Query the state of the clamp current autoranging of the specified phase of the unit. The response is NR1.
SYSTem:RANGe:CURRent{1:3}:CLAMp:RANGes?	Query the clamp current range breakpoints for autoranging. The response an Expression of NR3 (amps).
SYSTem:RANGe:CURRent{1:3}:CLAMp[:REQuested] {<numeric>|MINimum|MAXimum}	Configure the clamp current range of the specified phase of the unit so that it will properly accomodate an input current of up to the specified value in amps. Setting a particular current range has the side effect of turning 'AUTO' off.

SYSTem:RANGe:CURRent{1:3}:CLAMp[:REQuested]? <MINimum|MAXimum>	Query the last requested clamp current range of the specified phase of the unit. The response is NR3 (amps).
SYSTem:RANGe:CURRent{1:3}:RANGes?	Query the current range breakpoints for autoranging. The response an Expression of NR2 (amps).
SYSTem:RANGe:CURRent{1:3}[:REQuested] {<numeric>|MINimum|MAXimum}	Configure the current range of the specified phase of the unit so that it will properly accomodate an input current of up to the specified value in amps. Setting a particular current range has the side effect of turning 'AUTO' off.
SYSTem:RANGe:CURRent{1:3}[:REQuested]? [MINimum|MAXimum]	Query the last requested current range of the specified phase of the unit. The response is NR3 (amps).
SYSTem:RANGe:VOLTage{1:3}:ACTual?	Query the actual voltage range in use for the specified phase of the unit. The value returned is an instantaneous value reported by underlying hardware. There is some inherent lag in the reporting. The response is NR3 (volts).
SYSTem:RANGe:VOLTage{1:3}:AUTO [OFF|_ON_]	Configure the voltage range of the specified phase of the unit to autorange.
SYSTem:RANGe:VOLTage{1:3}:AUTO?	Query the state of the voltage autoranging of the specified phase of the unit. The response is NR1.
SYSTem:RANGe:VOLTage{1:3}:RANGes?	Query the voltage range breakpoints for autoranging. The response an Expression of NR1 (volts).
SYSTem:RANGe:VOLTage{1:3}[:REQuested] {<numeric>|MINimum|MAXimum}	Configure the voltage range of the specified phase of the unit so that it will properly accomodate an input voltage of up to the specified value in volts. Setting a particular voltage range has the side effect of turning 'AUTO' off.
SYSTem:RANGe:VOLTage{1:3}[:REQuested]? [MINimum|MAXimum]	Query the last requested voltage range of the specified phase of the unit. The response is NR3 (volts).
SYSTem:TOUChscreen:CALibrate	Causes the touchscreen calibration to execute on the next power-up.

SYSTem:TZONe <string>	Sets the timezone. Valid timezone strings can be obtained with the SYSTem:TZONe:LIST? command.
SYSTem:TZONe:LIST?	Returns an expression containing a list of character data items. The items on the list alternate between a timezone name and the offset from UTC for that timezone.
SYSTem:TZONe?	Queries the current timezone.
SYSTem:VERSion?	SCPI-99 21.21. Returns an <NR2> formatted numeric value corresponding to the SCPI version number for which the instrument complies.