4301 Power Analyzer User's Manual

Part No. 09-0330

REVISION G

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1. SAFETY

1.1 WARNING: LIVE CIRCUITS

NO INTERNAL ADJUSTMENT OR COMPONENT REPLACEMENT IS ALLOWED BY NON-NH RESEARCH QUALIFIED PERSONNEL. COMPLETE THE FOLLOWING BEFORE ACCESSING THE INSTRUMENT INTERNALS:

- **REMOVE ALL EXTERNAL VOLTAGE SOURCES**
- **DISCONNECT POWER CORD**
- **WAIT A MINIMUM OF 1 MINUTE TO DISCHARGE CIRCUITS**
- **VERIFY CIRCUITS ARE DISCHARGED**

2. DESCRIPTION

The Model 4301 Measurement Module is a Multimeter and Power Analyzer. AC true RMS measurements are Synchronously Sub-sampled for the most accurate results. Two Analog to Digital Converters sampling at 1Meg samples per second are used for metering which allows the display of waveforms similar to a Digital Storage Oscilloscope. Auto-ranging is available for both voltage and current.

2.1 Measurement Features

Voltage ranges	15/30/60/120/250/600VDC 9/17/35/70/150/350VAC Crest Factor 1.7 and 3
Current ranges	0.01/0.05/0.2/1/5/20ADC 0.005/0.01/0.02/0.05/0.1/0.2/0.5/1/2/5/10/20AAC Crest Factor 3 and 6
Voltage waveform	DC - 500khz, isolated, bipolar, AC or DC coupled
Current waveform	DC - 100khz, isolated, bipolar, DC coupled
Peak to Peak Noise	0.25V, 2.5V, Peak to Peak, 10hz-20MHz
Sample rate	1MS/s
Record length	256k points
Trigger	System, DINs, Voltage, Pretrigger
DC measurements	DC average, Power average, Positive and Negative Peak, Rise Fall Settling Turn-On Hold-Up Time, First and Last 10%, Event, Peak to Peak Noise
AC measurements	Power True, Positive and Negative Peak, AC TRMS, AC+DC TRMS, Frequency
AC Derived	Power Apparent and Reactive, Current Crest Factor, THD
Other	Trigger In Time, DIN State and Time

3. SPECIFICATIONS

Accuracies apply when measurements are greater than 10% of the range. At less than 10% of range, error increases. The additional error is (((10% of range) - value) * range error * 10). AC Synchronously Sub-sampled measurement accuracies apply from 45-66Hz with sinusoidal input waveforms, power factor 1, 0VDC, 0ADC, 0V common mode and current crest factor <= 3. All accuracies only apply DC coupled unless noted. Accuracies do not apply for aperture based AC measurements.

3.1 Configuration

One isolated measurement module on one PCA.

16 PCA's may be loaded into a chassis.

One LAN interface communicates with 16 measurement modules.

Control power is supplied by a common DC power supply in the chassis.

3.2 Size

Measurement Module 7.9 inch high, 0.9 inch wide, 18 inch deep.

Chassis 8.75 inch high, 19 inch wide, 22 inch deep.

3.3 Weight

3 lbs.

3.4 Communication

A LAN interface module is in the chassis which communicates with many measurement modules through a parallel 8 bit data bus link.

3.5 Isolation

±1000VDC from AC power input to measurement module or chassis ground.

±600VDC from measurement module to chassis ground.

3.6 Self-test

Power-up self-test is implemented in firmware. This will report comprehensive error messages about the status of the input, output, control and protection mechanism.

3.7 Calibration

Closed cover, all adjustments are done in software and stored in an on-board FLASH.

Equipment Required:

Multimeter, Hewlett Packard Model 3458A or equivalent

Accurate current measurement device or NHR Calibrator

Xitron 2501AH with High Accuracy Option

3.8 Performance Monitoring

Performance monitoring is performed continuously by the measurement module's controller. In case of measurement ambiguities, over/under range conditions, an appropriate error or warning is sent to the controlling device.

3.9 Environmental

Operating from 0 to 35°C.

Noncondensing, humidity < 75% R.H.

Specifications apply at 25°C ±5°C after 10-minute warm-up

3.10 Control power

Operational from 90 to 264VAC, 47-63Hz. DC power supplies in the chassis provides power to the measurement modules and fans.

3.11 Voltage Sense

The voltage sense is fully protected against reverse input and over voltage conditions up to the full isolation rating of ±600VDC from the current measurement input or chassis.

Dedicated peak detect hardware stores positive and negative peak values for a short time. These values are summed and presented to the ADC. The DSP finds the maximum values in the buffer. The results are calibrated and returned as High Frequency Peak to Peak voltage.

3.12 Digital Input

2 logic level DIN's are provided for general-purpose input. The state may be measured. Timing measurements may be made from System Trigger to DIN's or any waveform measurement.

DIN's are isolated from the measurement and chassis up to ±600VDC. DIN's are isolated from DOUT's up to ±120VDC.

3.13 Digital Output

2 individually isolated solid state relay DOUT's are provided for general-purpose output. DOUT's are rated for ±100VDC, 300mA.

DOUT's are isolated from the measurement and chassis up to ±600VDC. DOUT's are isolated from DIN's up to ±120VDC.

3.14 4301 Measurements

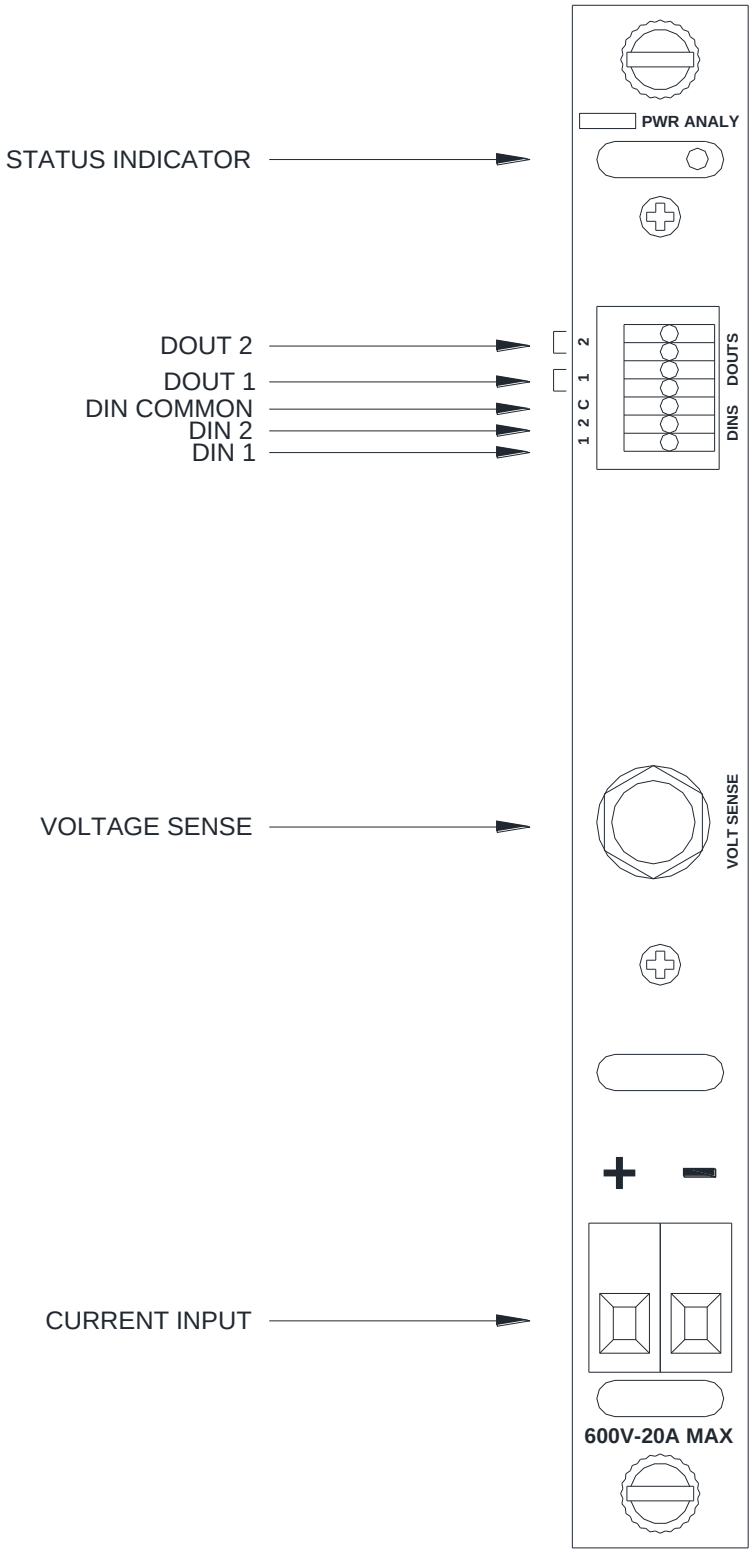
DC Voltage	Range, Resolution	±30/120/600VDC, 15 Bits
		±15/60/250VDC, 14 Bits
	Accuracy	0.1% of reading + 0.1% of range
DC Current	Range, Resolution	±0.01/0.05/0.2/1/5/20ADC, 13 Bits
	Accuracy	0.1% of reading + 0.1% of range
AC Voltage TRMS	Range, Resolution	17/70/350VAC, 16 Bits, CF=1.7
AC+DC TRMS		9/35/150VAC, 15 Bits, CF=3
	Accuracy	0.1% of reading + 0.1% of range
AC Current TRMS	Range, Resolution	0.01/0.05/0.2/1/5/20AAC, 15 Bits, CF=3
AC+DC TRMS		0.005/0.02/0.1/0.5/2/10AAC, 14 Bits, CF=6
	Accuracy	0.1% of reading + 0.1% of range
Power Average,	Range	Current range times Voltage range
True, Apparent,	Accuracy	0.1% of reading + 0.1% of range
Reactive	Resolution	Current range and Voltage range
Power Factor	Range	0 to 1
	Accuracy	0.5% of reading, + 0.5% of range
	Resolution	Current range and Voltage range
Frequency	Range	10 – 1000Hz
	Accuracy	0.5% of reading
Waveform	Voltage Bandwidth	DC to 500khz
Rise Fall Settling	Current Bandwidth	DC to 100khz
Turn-On Hold-Up	Amplitude Accuracy	2% of DC range
Time, Event, THD	Time Accuracy	0.5% of reading + 1/Sample Rate
	Sample rate	Up to 1MS/s
	Record length	256k points
	Trigger	System Trigger, DINs, Voltage
	Range Resolution	same as Voltage or Current
Peak to Peak Noise	Range	2.5V, 0.25V Peak to Peak
	Bandwidth	10hz to 20Mhz
	Accuracy	3% of range, @ 1Mhz
	Resolution	12 Bits
DIN Timing	Range	7 days
	Accuracy	0.05% of reading ±100μSeconds
	Resolution	100nanoSeconds

4. INSTALLATION

4.1 Hardware Installation

Unpack the Measurement Module and or chassis. Save the packing material if a need arises to return the Measurement Module and or chassis. Measurement Modules may be added or removed from the front of the chassis. The control board only installs in the far right slot.

4.2 Measurement Module Front View


PWR ANALY
STATUS INDICATOR
DOUT 2
DOUT 1
DIN COMMON
DIN 2
DIN 1
1 2 C 1 2
DINS DOUTS
VOLTAGE SENSE
VOLT SENSE
+
−
CURRENT INPUT
600V-20A MAX

4.3 DOUTS Terminal Block in front

Each Measurement Module has 2 individually isolated solid state relay DOUT's are provided for general-purpose output on the front. DOUT's are rated for ±100VDC, 300mA. DOUT 1 is on the two pins labeled 1 and DOUT 2 is on the two pins labeled 2.

DOUT's are isolated from the Measurement Module and chassis up to ±600VDC. DOUT's are isolated from each other and DIN's up to ±120VDC.

4.4 DINS Terminal Block

2 logic level DIN's are provided for general-purpose input. The state may be measured. Timing measurements may be made from System Trigger to DIN's or any waveform measurement. The threshold voltage may be programmed by changing a socketed resistor, contact the factory for more information.

DIN1 input is on 1, DIN2 input is on 2. Both Dins have a common reference pin C. DIN's are isolated from the Measurement Module and chassis up to ±600VDC. DIN's are isolated from DOUT's up to ±120VDC.

4.5 VOLT SENSE

Voltage measurements are made from this input. The voltage sense positive is the center conductor. The voltage sense negative is the shield.

4.6 CURRENT INPUT

Input current positive is applied to the Measurement Module on this large connector pin +. Input current negative is applied to the Measurement Module on this large connector pin -.

5. OPERATION

5.1 Measurement Module Status Indicator

This indicator is located in the front at the top of the Measurement Module. This LED blinks at a one hertz rate during normal operation. If the LED is not blinking, remains off or on, the DSP is not operating. Green indicates normal operation, no errors. Yellow indicates an error has occurred yet the Measurement Module is still operating. Red indicates an error has occurred and the Measurement Module has shut down.

5.2 Ranges

Enter the maximum voltage and current you need and the software will select the proper voltage and current ranges. Do not enter larger than necessary voltage and current because this will cause higher ranges to be selected with less accuracy. Auto-ranging is also available.

5.3 Digital Input

The Measurement Module includes two external logic level DINs. The state may be measured. Timing measurements may be made from Trigger In to Digital In or any DSO measurement.

5.4 Trigger Input

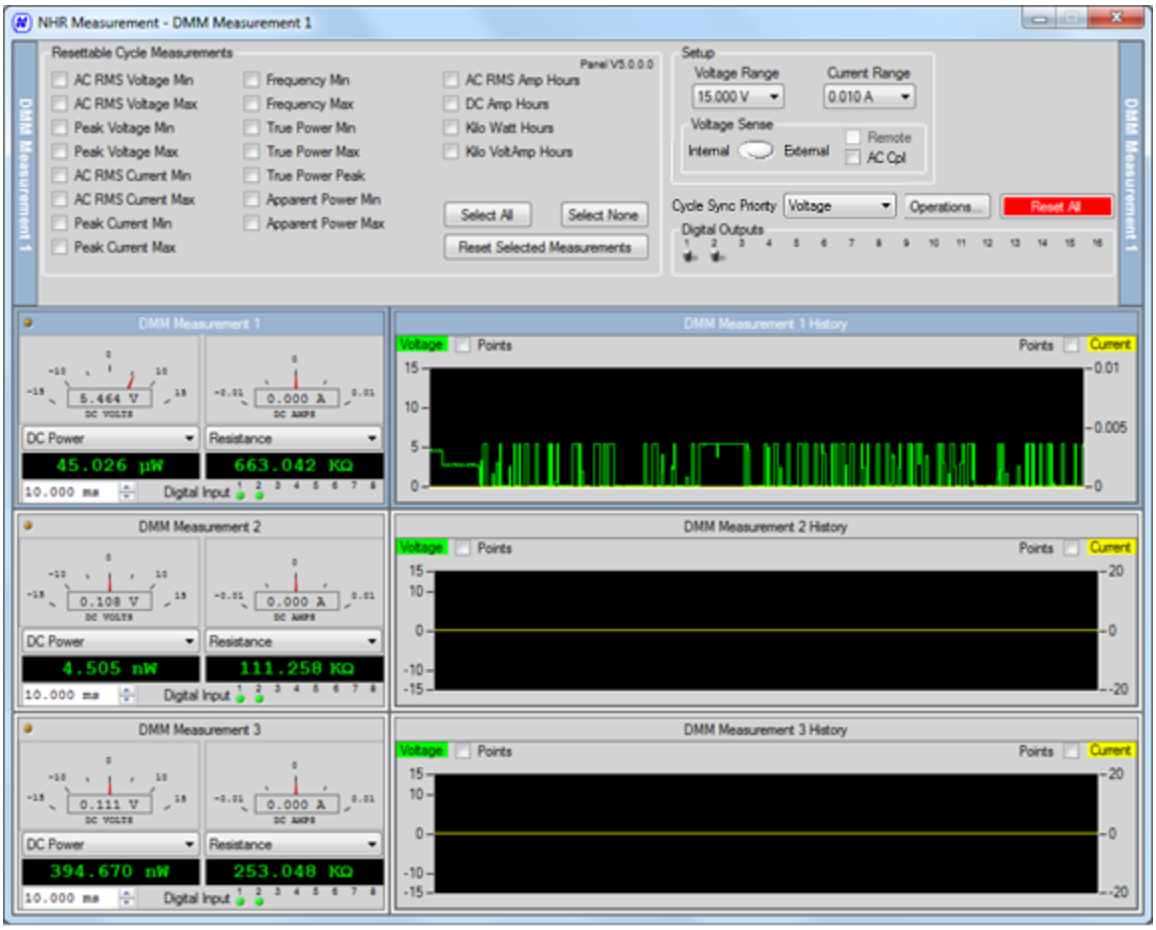
A trigger input is provided to synchronize measurements with external devices. The trigger input is available from the Remote Control Interface and not directly from the Measurement Module. This may be turned on or off under software control.

5.5 NHR IVI Instrument Panel

The NHR IVI Instrument Panel (referred to as the softpanel) can be started from the desktop icon or the start menu in the NH Research program group.

The panel should look similar to this after loading…

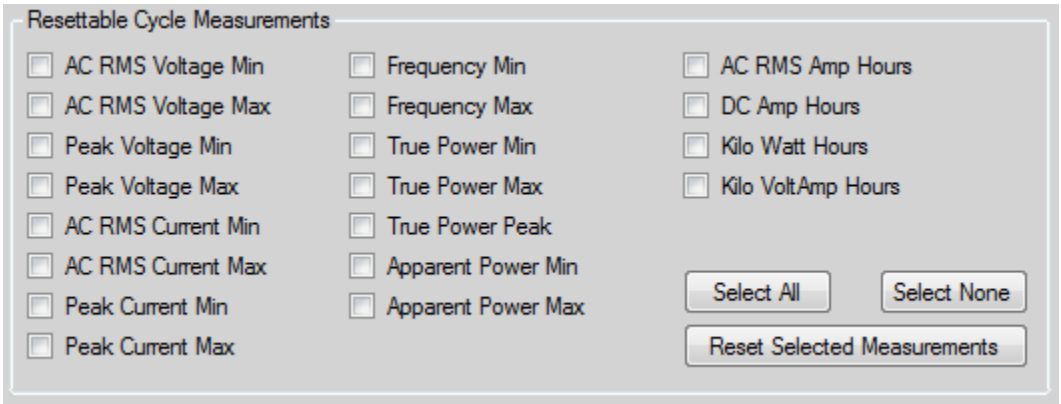
If there is more than one analyzer in your configuration, the softpanel will adjust itself to maximize the number of analyzers visible at one time. Depending on your configuration and computer monitor, your softpanel may appear slightly different, but the operations remain the same.



The title bar and side bars contain the logical name of the Power Analyzer you are currently controlling. This softpanel can control any number of physical analyzers. Use the Control section to set the various features of the selected analyzer. To switch analyzers simply click anywhere within the measurement or history window of the desired analyzer. Switching from one analyzer to another does NOT affect the settings. The Control section is automatically updated to reflect the state of the selected analyzer.

The panel allows full control of the Power Analyzer. The panel is divided into 6 sections.

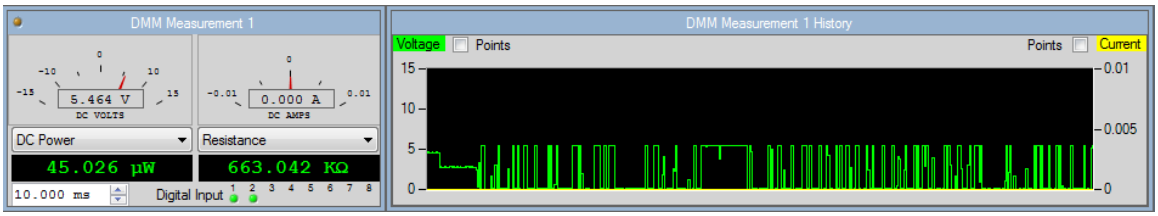
5.5.1 Resettable Cycle Measurements Section



Some measurements collect their value over time. For example, a peak voltage measurement will return the highest voltage value it has encountered; the Kilo Watt Hour measurement reports the power metered over a period of time. But for these measurements to have meaning, you must be able to reset the values. To perform the reset, select the measurements you wish to restart and press the "Reset Selected Measurements" button. Only the selected measurements will be restarted – unselected measurements will retain their current values.

Press "Select All" to check every measurement, then press "Reset Selected Measurements" to perform the reset. Press "Select None" to clear all the selections.

5.5.2 Measurement Section



If enabled, the analyzer will make measurements over a period defined by the aperture. To reduce the effect of noise, increase the aperture; to make faster, less accurate measurements, reduce the aperture. The aperture window is located in the lower-left corner of the measurement section. Each analyzer can define its own aperture size.

Each time a measurement is taken, the analyzer will display the active voltage and current in the analog gauges. You can toggle the analog gauges between AC and DC modes by clicking on the measurement title inside the gauge face. Two additional measurements are available in the digital gauges. Use the dropdown lists above each digital gauge controls to select the desired additional measurements.

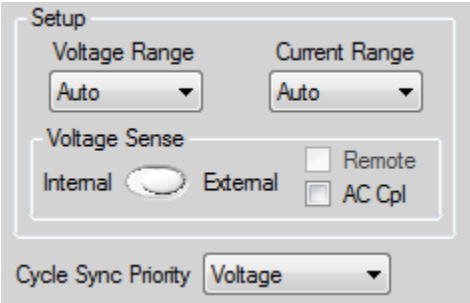
The amber LED in the upper-left corner flashes whenever a measurement is active. You can click this light to disable the measurements. Click again to re-enable.

The measurement history chart displays the past voltage and current measurements. It is ONLY updated when measurements are active. Depending on the number of analyzers in your configuration, there may not be enough screen space to display the history chart all the time. In this situation, the history chart shares screen space with the measurement window and a "+" sign will be visible in the upper-right corner. Pressing the "+" button will toggle between the measurement window and the history chart.

Enabling the "points" options will display a dot on the history chart where each measurement occurred. When you hover the mouse pointer on a point, the value and time of measurement are displayed.

If the analyzer supports Digital Inputs (DINs), the state of each input is displayed via an LED. When the LED is lit, the DIN is high; when off, the DIN is low.

5.5.3 Setup Section



This section sets up the analyzer's measurement ranges and controls the state of the voltage sense input.

The voltage and current ranges select the measurement ranges of the hardware. When set to "auto" range, the analyzer will automatically increase or decrease the measurement range in order to make an optimum measurement.

Important note: The auto-ranging feature of the Power Analyzer is not active during aperture measurements. If you program a long aperture and your input signal does not remain within the currently active range, you may possibly over-range the measurement.

The Power Analyzer uses external voltage sense exclusively, making all voltage measurements using the signal present on the sense connector. **If the voltage sense is disconnected, you will measure 0V.**

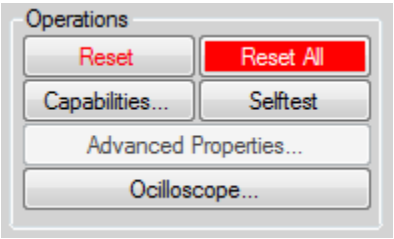
When AC coupling is enabled, a capacitor is placed in series with the voltage sense, which blocks the DC component of the signal from reaching the measurement circuitry.

The Cycle Sync Priority selection controls how AC measurements are synched. When "Voltage" is selected, the analyzer attempts to synchronize to the signal on the voltage sense connector to determine cycle boundaries, even when taking current measurements. When "Current" is selected, the analyzer uses the current signal. When set to "Off," the analyzer makes an unsynchronized measurement.

The sync selection is a priority; if the analyzer is unable to synchronize to the selected signal, it attempts to sync to the other signal before resorting to an unsynchronized measurement.

Note: The "remote" feature is not applicable to the Power Analyzer.

5.5.4 Operations Section



5.5.4.1 Reset

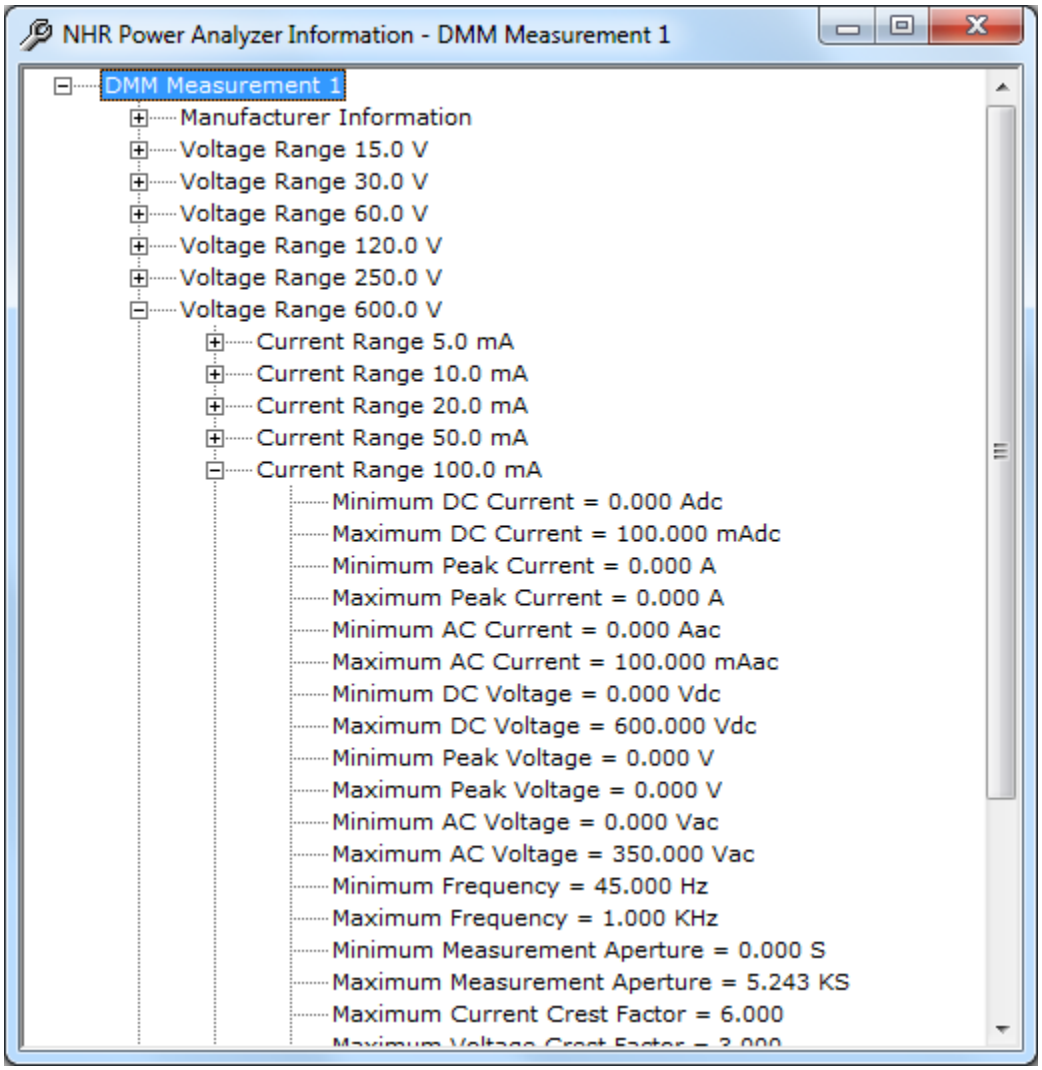
Pressing reset will reset the selected analyzer and set all settings back to default.

5.5.4.2 Reset All

This button will reset all the modules in the panel to their default settings.

5.5.4.3 Capabilities

Pressing capabilities will display a dialog that allows you to see the minimum and maximum settings for all values of the selected analyzer for any range you choose.



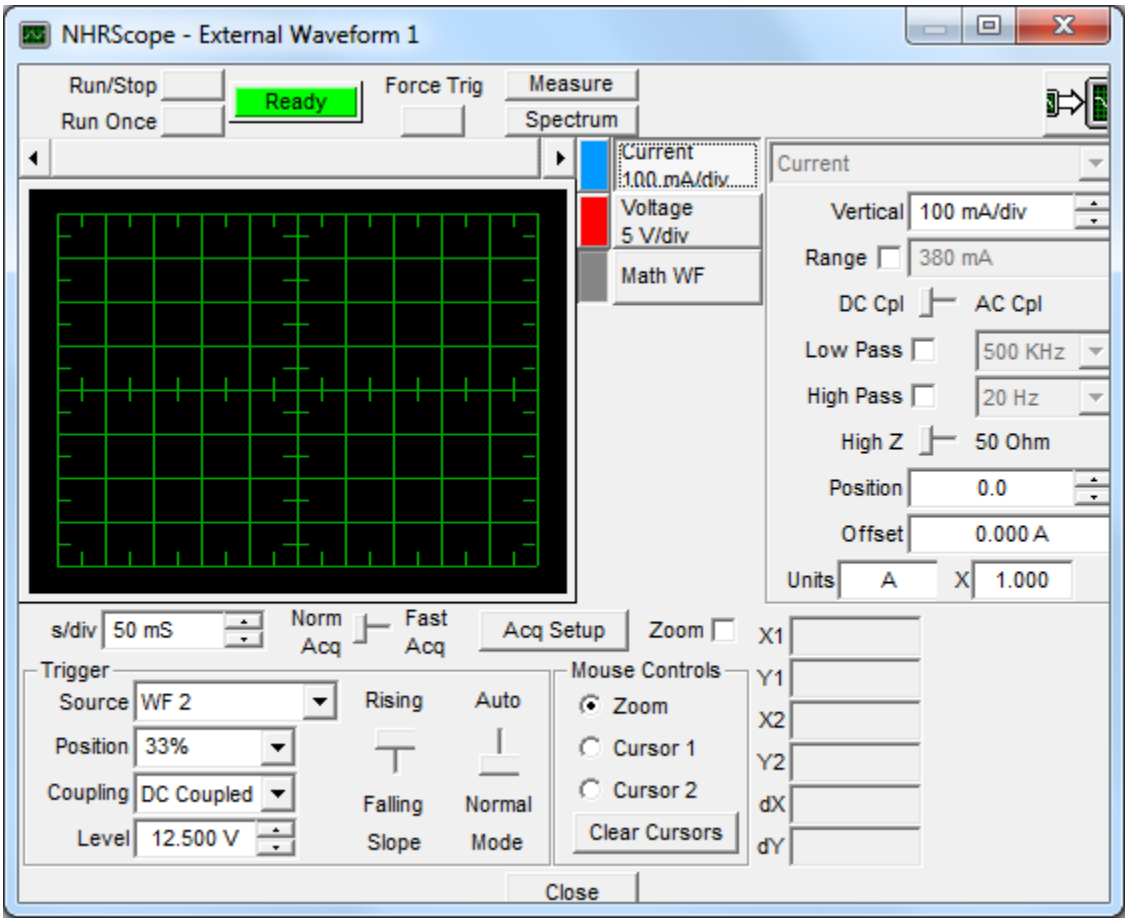
The Manufacturer Information section contains useful data such as the analyzer's serial number, hardware and firmware revision numbers, and date of last calibration.

5.5.4.4 Selftest

Pressing self-test will reset the selected analyzer then perform a built-in test. After the test is complete, a pop-up dialog appears informing the results of the test.

5.5.4.5 Oscilloscope

To display the oscilloscope panel for the selected analyzer, press the Oscilloscope button. When you do, this panel is displayed.



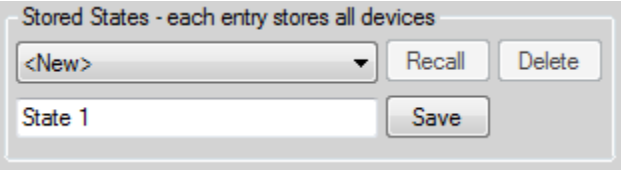
Operation of the oscilloscope panel is similar to a traditional scope. It is, however, limited to the capabilities of the analyzer hardware.

5.5.5 Digital Output Section

The NHR Power Analyzer provides general-purpose Digital Outputs, useful for fixture control. The state of the digital output matches that of the corresponding toggle switch. To set the digital high, simply move the switch to its up position (as shown in #2 above); move the switch to its down position for a digital low.

5.5.6 Stored States Section

(Note: depending on your monitor resolution, this section may be part of the Operations pop-up dialog.)



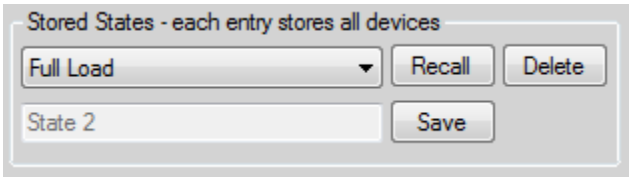
As a convenience, all device settings can be saved to the hard disk for later recall. You can save as many different states as you have room on your hard drive (for all intents and purposes unlimited). All analyzer settings are saved including the selected "measurement reset" options. Each state stores the settings for all devices being controlled by the softpanel (one state saves all).

To save the current settings to a new state description

1. Set up all analyzer settings as desired.
2. Select <New> in the "Stored States" selection box.
3. Modify the description if desired (the default will be "State #" which will be a unique name).
4. Press the "Save" button.

To recall a saved state

1. Select the desired state to restore in the "Stored States" selection box. In this example, "Full Load" was chosen.



2. Press the "Recall" button. ***WARNING!*** The saved state will be restored and become active immediately!

6. PROGRAMMING

6.1 General

NH Research provides an IVI-compliant instrument driver with the softpanel, along with support files for various popular development environments. The driver contains functions for selecting, configuring, taking measurements from and controlling the instrument.

Complete, context-sensitive help is provided for every method and property via a compiled HTML help file, `NHRPowerAnalyzer.chm`, which is located in `C:\Program Files\IVI\Drivers\NHRPowerAnalyzer`.

Samples are located in the `C:\NHR\NHR Power Analyzer\Samples` folder.

6.2 Microsoft .NET Languages

You use the IVI-COM instrument driver to control the analyzer in a .NET program. Interop assemblies are used in .NET environments, such as C# and VB.NET, to access COM components. The necessary interop assembly is deployed and registered on the system during software installation. The "Samples" folder contains a C# program that illustrates the use of the analyzer driver in the .NET environment.

6.3 Microsoft Visual Basic 6.0

You use the IVI-COM instrument driver to control the analyzer in a VB6 program. References to COM drivers are used in VB6 to gain access to the analyzer hardware. The necessary driver is deployed and registered on the system during software installation. The "Samples" folder contains a VB6 program that illustrates the use of the analyzer driver in this environment.

6.4 National Instruments LabVIEW

A palette set providing direct access to each of the instrument driver functions is included with the software installation. NOTE: for LabVIEW to see the palette, you must copy or move the `NHRPowerAnalyzer` folder located in `C:\NHR\NHR Power Analyzer\Samples\LabVIEW\instr.lib` into the LabVIEW instrument sub-folder, which is usually located in `C:\Program Files\National Instruments\LabVIEW X.X\instr.lib`.

From a LabVIEW block diagram, traverse the Instrument I/O and Instrument Driver menus to find the NHR Power Analyzer palette. The "Samples" folder contains a LabVIEW program that illustrates the use of the analyzer driver in this environment.

Alternately, a LabVIEW programmer can access the IVI-COM driver directly using LabVIEW's support for ActiveX drivers.

6.5 National Instruments LabWindows/CVI

A function panel providing access to the driver is included with the software installation. The “Samples” folder contains a LabWindows program that illustrates the use of the analyzer driver in this environment. NOTE: depending upon where you install the files, you may have to browse for the instrument function panel (`NHRPowerAnalyzer.fp`, usually located in `C:\Program Files\IVI\Drivers\NHRPowerAnalyzer`) before the sample will compile.