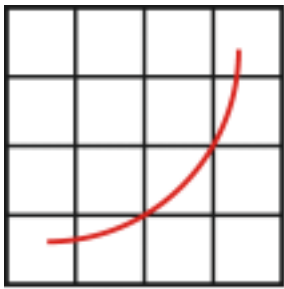


SPEC[®] – Power and Performance



spec[®]

Power and Temperature Measurement Setup Guide

Standard Performance Evaluation Corporation

Table of Contents

1. Introduction	4
2. General Power Analyzer Setup Information	4
2.1 Initial Device Setup	4
2.2 Power Analyzer Connection Types	4
2.2.1 Serial Ports	4
2.2.1.1 USB-Serial adapters	5
2.2.2 USB Ports	5
2.2.3 GPIB Interfaces.....	5
2.2.3.1 GPIB-USB Adapters	5
2.2.3.2 Virtual COM port GPIB adapters	5
2.2.4 Ethernet Interfaces.....	6
2.3 Starting PTDaemon on the Controller System.....	6
2.4 Using Multiple Power Analyzers.....	6
2.5 Configuration for Compliant SPECpower Measurements	7
2.6 Managing Measurement Uncertainty	7
2.7 Restrictions of Currently Accepted Power Analyzers.....	9
2.8 Capability List of Currently Accepted Power Analyzers.....	10
2.9 Calibration Requirements	11
3. Power Analyzer Setup Information for Accepted Devices	12
3.1 Chroma 66202.....	12
3.1.1 Hardware Configuration	12
3.1.2 Range Setting and Uncertainty Calculation	12
3.2 Hioki 3334	12
3.2.1 Hardware Configuration	12
3.2.2 Range Setting and Uncertainty Calculation	12
3.3 Infratek 101A, 107A-1Channel, 107A-3Channel	13
3.3.1 Hardware Configuration	13
3.3.2 Range Setting and Uncertainty Calculation	13
3.3.3 Multi-Channel Measurements.....	13
3.4 Instek GPM-8212	13
3.4.1 Hardware Configuration	13
3.4.2 Range Setting and Uncertainty Calculation	13
3.5 Voltech PM1000+.....	14
3.5.1 Hardware Configuration	14
3.5.2 Range Setting and Uncertainty Calculation	14
3.6 Xitron 2802	14
3.6.1 Hardware Configuration	14
3.6.2 Multi-Channel Measurements.....	15
3.7 Yokogawa WT110 & WT210	15
3.7.1 Hardware Configuration	15
3.8 Yokogawa WT500.....	16
3.8.1 Hardware Configuration	16
3.9 ZES LMG95, LMG450, LMG500	16
3.9.1 Hardware Configuration	16
3.9.2 Range Setting and Uncertainty Calculation	17
3.9.3 Multi-Channel Measurements.....	17
4. Temperature Sensor Setup Information for Accepted Devices	17
4.1 Digi Watchport/H	17
4.1.1 Hardware Connection	18
4.1.2 Windows Software Configuration.....	18
4.1.3 Linux Software Configuration.....	18
4.2 Temperature@Iert	18
4.2.1 Hardware Connection	18

4.2.2	Windows Software Configuration.....	18
4.2.3	Linux/Other Software Configuration.....	18
5.	Troubleshooting.....	18
6.	Appendix A: Configuring the Prologix GPIB-USB-Virtual COM Port Adapter	19
7.	Appendix B: Setup Instructions for Unsupported Devices	20
7.1	Christ Elektronik CLM3000	20
7.1.1	Hardware Configuration	20
7.1.2	Range Setting and Uncertainty Calculation	20
7.1.3	Multi-Channel Measurements.....	20
7.2	Voltech PM100.....	20
7.2.1	Hardware Configuration	20
7.2.2	Range Setting and Uncertainty Calculation	21
7.3	Voltech PM3000.....	21
7.3.1	Hardware Configuration	21
7.3.2	Range Setting and Uncertainty Calculation	21
8.	Disclaimer	21

1. Introduction

This practical guide will explain how to set up and run power analyzers and temperature sensors to communicate with SPEC's Power/Temperature Daemon (PTDaemon) on a controller system. It also describes the configuration requirements to measure conforming results for the various SPECpower benchmarks. This document is a companion to the associated SPECpower User Guides. The underlying principles of SPEC power measurements may be found in the [SPEC Power and Performance Benchmark Methodology](#) document.

Throughout this document "SPECpower" is used as a synonym for the various SPEC benchmarks which provide power measurements, such as SPECpower_ssj2008 and SPECweb2009.

BE SURE to read, understand, and follow all of the safety rules and installation instructions that come with your power analyzer and system under test (SUT).

DO NOT USE PTDaemon WITH DC VOLTAGE SOURCES! SPEC's PTDaemon is designed only to measure AC power, and will initialize power analyzer settings for AC power measurement. Using PTDaemon to attempt to measure DC power will not work correctly and may cause damage to your power analyzer.

To check for possible updates to this document, please see [http://www.spec.org/power/docs/SPEC-Power Measurement Setup Guide.pdf](http://www.spec.org/power/docs/SPEC-Power_Measurement_Setup_Guide.pdf).

2. General Power Analyzer Setup Information

2.1 Initial Device Setup

The first step in setting up any measurement device is to get the device communications to the controller system functioning using the vendor-supplied software. Follow the manufacturers' instructions for hardware connection, device driver, and software installation.

If the device cannot be controlled using the manufacturer's software, do not proceed to the next step. Instead, contact the manufacturer for technical support.

This document will NOT cover the electrical connections required for proper power measurement. Please refer to the documentation supplied with your device, and contact the manufacturer if additional information is needed.

2.2 Power Analyzer Connection Types

2.2.1 Serial Ports

Standard RS-232 connections are one of the most common analyzer interfaces. Many analyzers have a DB-9 or DB-25 serial connection. The DB-9 connector on many computers may be connected directly to a DB-9 or DB-25 serial connection on the analyzer. Some devices require a cross-over or "null modem" cable. Refer to manufacturers' instructions or the device-specific instructions below.

Serial port naming standards for popular operating systems:

- Windows: COM1, COM2, ... COM9
- Linux: /dev/ttyS0, /dev/ttyS1, ...
- Solaris: /dev/ttya, /dev/ttyb, ...

The default connection type for PTDaemon is serial. No command-line option is used to specify a serial connection, and the serial port name (as listed in the examples above) is used for the "port" argument to PTDaemon.

If you will be using a serial connection on the power analyzer, please see the corresponding power analyzer section below for specifics regarding required serial settings such as baud rate, etc.

2.2.1.1 USB-Serial adapters

Standard RS-232 serial ports are becoming less common on computers due to space constraints. However, there are many inexpensive USB-serial adapters on the market today. Windows drivers available for those devices allow the user to see additional "virtual" serial ports, such as COM7.

Many of these same adapters will also work on Linux. If the Linux distribution includes the "usbserial" driver, it is likely to autodetect and enable the adapter. Typically the device name will be created as /dev/ttyUSB0. Use "dmesg" to find the port your analyzer uses.

Note: USB-Serial converters may not ship with 64-bit Windows drivers. Some users have reported success using the 64-bit drivers found at the following website: <http://www.serialgear.com/USB-Serial-adapter-drivers-windows-mac-linux.cfm>. This website is not affiliated with SPEC, and SPEC will not provide support related to these drivers. Use at your own risk.

2.2.2 USB Ports

Power analyzers available with USB data communications capability typically may be connected to a USB port on the controller system. However, most such analyzers have proprietary drivers and cannot be controlled by SPEC's PTDaemon.

The Yokogawa WT500 can be controlled over a USB connection by PTDaemon using vendor-supplied drivers. See the WT500 setup section for further information.

2.2.3 GPIB Interfaces

Many instruments have a GPIB / IEEE488 interface option available. Several vendors sell adapters that allow PC connections to GPIB, either via USB, PCI, PCIe or other hardware interface. Those adapters fall into two categories: one type that communicates via proprietary drivers and DLLs, and another type that presents a "virtual communications port" interface to the operating system.

2.2.3.1 GPIB-USB Adapters

PTDaemon has been tested with National Instruments' NI488.2 GPIB-USB-HS adapter and NI-488.2 software, and the Agilent 82357A USB/GPIB adapter. If the software and drivers are installed correctly, PTDaemon can access GPIB devices through the "gpib-32.dll" interface for National Instruments, or the "agt-32.dll" interface for the Agilent device. It is likely that PTDaemon will also work with NI adapters other than the USB version, as long as they are supported by NI-488.2 drivers, but no others have been tested.

When starting PTDaemon to communicate with an analyzer using one of these adapters, the "-g" argument must be used to specify GPIB, and the analyzer's GPIB address is used rather than a COM port for the device number.

The SPEC PTDaemon GPIB device support is currently only available with Microsoft Windows operating systems.

2.2.3.2 Virtual COM port GPIB adapters

The Prologix GPIB-USB Controller converts GPIB interfaces to a physical USB connection on the controller system which is viewed by the Windows OS as a virtual COM port. See Appendix A for information on configuring the Prologix device to communicate with your power analyzer.

When starting PTDaemon to communicate with an analyzer using one of these adapters, the virtual COM port should be used as the interface, and the “-g” parameter should NOT be used, since PTDaemon views this as a serial device.

This device is only supported under Microsoft Windows operating systems.

2.2.4 Ethernet Interfaces

Power analyzers available with Ethernet communications capability typically can connect via a network to the host computer. However, many such analyzers have proprietary protocols and cannot be controlled by SPEC’s PTDaemon.

The Yokogawa WT500 can be controlled via its Ethernet port by PTDaemon using vendor-supplied drivers. See the associated analyzer’s setup section for further information.

2.3 Starting PTDaemon on the Controller System

After the analyzer is connected appropriately to the controller system CCS and turned on, the PTDaemon may be started. The following command line options are available:

```
ptd [options] <device-type-#> <device-port>
```

<device-type-#>: With -h option a list of all available power and temperature devices is shown.
 <device-port>: The device-port number, e.g. COM1 for Windows or /dev/sttys0 for Linux.

The following options are available:

-p port	Network port, default 8888
-q	Quiet mode, minimal output to console
-v	Increase general debug output (may be repeated)
-m	Increase meter-specific debug output (may be repeated)
-l logfile	Log standard output to logfile
-e	Use extended logfile format
-d debugfile	Log debug output to file
-t	Temperature mode, default is power mode
-V <value>	Set analyzer voltage range to lowest needed for value or autorange if value = 'a\n"
-A <value>	Set analyzer ampere range to lowest needed for value or autorange if value = 'a\n"
-u	List unsupported devices that may work
-c <channel>	Select channel number for multichannel analyzers operating in single channel mode

Options only available on Windows:

-g Use GPIB-USB interface (default is RS232)

2.4 Using Multiple Power Analyzers

When utilizing multiple power analyzers to measure one or more SUTs, the procedure for connecting each power analyzer is similar to connecting a single SUT/single power analyzer configuration.

For each connected power analyzer a unique PTDaemon instance must be started with the appropriate parameters. If multiple PTDaemon instances are run on the same controller, they must each be assigned a unique TCP/IP port number using the “-p” command-line switch.

2.5 Configuration for Compliant SPECpower Measurements

Please be aware to always check http://www.spec.org/power/docs/SPECpower-Device_List.html for the latest information!

On the above website you find a list of power measuring devices that have been tested by SPEC and that are accepted for use in the measurement of “compliant results” as they passed the SPECpower Analyzer Acceptance Test. Additionally also the minimum PTDaemon version required for publishable results for the various benchmarks using PTDaemon, changes over time and is specified in the SPEC Power Temperature Daemon (PTDaemon) Update Process. This update process is also documented on the website above.

Compliant results are those that meet all the requirements specified in the Run and Reporting Rules of the various SPECpower benchmarks.

Additionally restrictions for some individual analyzer types for conforming SPECpower measurements, e.g. to the PTDaemon version or allowed range settings, are listed in chapter 2.6.

There are also analyzer types which may operate successfully with the PTDaemon but are not accepted for compliant SPECpower benchmark runs. They are available for research purposes only. A complete list of all tested analyzers including all accepted analyzers is displayed using the “-u” (unsupported) flag, PTDaemon -u. Support is not available from SPEC for use of any unsupported analyzer types.

2.6 Managing Measurement Uncertainty

Another very important issue of measuring compliant power data is the configuration of the correct volt and ampere ranges appropriate to the measurement environment to avoid inaccurate or even invalid values.

For compliant SPECpower benchmark runs, specific uncertainty requirements have to be guaranteed according to the SPECpower Run and Reporting Rules. The uncertainty of a measured power value depends on how well the configured volt and ampere ranges fit to this value. The formulas to calculate the uncertainty often directly include the configured volt and ampere ranges.

Selecting the volt range is quite easy as the voltage depends only on the power source and does not change during the test. Selecting the ampere range is more complex, because it differs with the SUT’s power consumption during the benchmark run. A large difference between different load levels may even require individual ampere range settings for each level.

PTDaemon has the ability to select the closest range appropriate for a requested value. The information is maintained on a per-analyzer basis. For example, if you specify a range of 2.2A and the analyzer in use has ranges of 0.5, 1.0, 2.0 and 5.0A, PTDaemon will set the analyzer to the 5.0A range.

There are three ways to set the volt and ampere ranges of the analyzer:

- **manual range setting:** For instructions read the manufacturer’s manual. PTDaemon cannot read range settings for some power analyzers such as the Instek GPM-8212; compliant runs cannot be produced using manual range settings for these analyzers.
- **fixed range setting via PTDaemon command line input parameters:** When starting the PTDaemon the volt and ampere ranges can be set by selecting the command line flags -A and -V. For example, using the parameter “-A 1.6” will cause PTDaemon to set the current

range to the next highest range that can legally measure 1.6A for the analyzer model in use.

- **dynamic range setting via benchmark command interface:** Most SPECpower benchmarks provide the ability to set ranges dynamically through configuration parameters. For instructions read the user guide for the associated benchmark. This is the recommended technique since it gives the ability to set different ranges for different load levels.

Selecting auto-range mode does not provide compliant measurement results for any currently accepted analyzer types. There are two main reasons:

- Changing the range in auto-range mode often needs so much time that several samples of the active measurement may be missed during the setting.
- In auto-range mode the current ranges have to be read by the analyzer to compute the current uncertainty value. Not all analyzers provide this capability, and even those that do are not able to guarantee that the range readings were those used for the measurement values at that point of time.

The capabilities in range setting, uncertainty calculation and auto-range compliance are listed in section 2.7.

To configure the benchmark to minimize uncertainty, a few simple steps should be followed:

- First, run the benchmark with the power analyzer voltage range set to the voltage in use, and the current range set to either “auto” or the highest range expected.
- Next, examine the output files to determine the average current used during each benchmark load level
- Finally, set the benchmark-specific power analyzer range configurations to values appropriate for the current of each load level. A small amount of margin should be maintained so that the measurement does not end up “over-ranging”. For example, if the average current during a measurement is 0.95A, it may be necessary to set the range to a value larger than 1.0A.

2.7 Restrictions of Currently Accepted Power Analyzers

Restriction List of Accepted Power Analyzers			
Analyzer	1st Supported in PTDaemon Version	Minimum Firmware version	Minimum Restrictions on Use with SPECpower
Chroma 66202	v.1.3.9	v1.20	Valid only for low shunt ranges (0.01, 0.1, 0.4, 2.0 ARMS) and the 20 ARMS high shunt range
Hioki 3334	v1.3.10	v1.10	Maximum valid load currents less than 14.167A, with PTD version >= v1.4.0 and firmware version > v1.10 maximum valid load currents less than 17.334A
Infratek 107A-1	v1.2	none	Valid only for load currents less than half the selected current range in order to satisfy the required minimum crest factor value of 3
Instek GPM-8212	v1.2	none	Valid only for load currents less than 10A
Voltech PM1000+	v1.4.1	v4.22	-
Xitron 2802	v1.3	none	May only use one of the channels at a time. Auto-ranging cannot be used for the current or voltage range settings. Current and voltage settings must be manually selected.
Yokogawa WT210	v1.0	none	-
Yokogawa WT500	V1.3.9	none	May only use one of the channels at a time
ZES Zimmer LMG95	v1.2	none	-
ZES Zimmer LMG450 1-Channel 4-Channel 3-Phase	v1.0 v1.4.0 v1.4.0	none	Can be used in 1-Channel, 4-Channel or 3-Phase mode. Please check, if your benchmark harness supports the multichannel-modes yet
ZES Zimmer LMG500	v1.2	none	Can be used in 1-Channel, 4-Channel or 3-Phase mode. Please check, if your benchmark harness supports the multichannel-modes yet

Capability List of Currently Accepted Power Analyzers

Characteristics of power analyzers vary widely. The following table shows the PTDaemon's range setting capabilities of all currently accepted devices. Normally these range setting capabilities are the same as described in the manufacturer's documents, but it may happen that there are differences because of newer analyzer revisions. Range settings which are requested by the user and not listed in this table for a specified analyzer type, are always adapted by the PTDaemon to the optimal available range in this list.

Power Analyzer Range Setting Capabilities via SPECpower PTDaemon				
Analyzer	PTD-ID	Ampere Range Settings	Fixed Range Setting via PTDaemon parameters (static setting for complete benchmark run)	Dynamic Range Setting by PTDaemon commands (individual setting for each target load)
Chroma 6620x	31	0.01, 0.1, 0.4, 2.0, 8, 20	yes	yes
Hioki 3334	33	0.1, 0.3, 1.0, 3.0, 10.0, 30.0	yes	yes
Infratek 107A-1	25	1, 3, 10	yes	no
Instek GPM-8212	14	0.16, 0.32, 0.64, 1.28, 2.56, 5.12, 10.24, 20.48	yes	yes
Xitron 280X: 1-Channel	28	0.01, 0.03, 0.1, 0.3, 0.65, 2.0, 6.5, 20, 65	yes	yes
Voltech PM1000+	23	0.07, 0.3, 1.1, 4.4, 17.7, 70.7	yes	yes
Yokogawa WT210	8	0.005, 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0	yes	yes
Yokogawa WT500	35	0.5, 1.0, 2.0, 5.0, 10.0, 20.0, 40.0	yes	yes
ZES LMG95	22	0.15, 0.3, 0.6, 1.2, 2.5, 5, 10, 20, 120, 240, 480, 960	yes	yes
ZES LMG450: 1-Channel 4-Channel 3-Phase	16 17 37	0.6, 1.2, 2.5, 5, 10, 16	yes	yes

The following table shows the uncertainty calculation capabilities and auto-range compliance of currently accepted analyzers:

Power Analyzer Uncertainty Calculation Capabilities via SPECpower PTDaemon and Autorange Compliance				
Analyzer	PTD-ID	Range Reading by PTDaemon commands	Uncertainty Calculation by PTDaemon commands	Auto-range Compliance for SPECpower
Chroma 6620x	31	yes	formulas, only if not auto-range mode	no
Hioki 3334	33	yes	formulas	no
Infratek 107A-1	25	only if not auto-range mode	formulas, only if not auto-range mode	no
Instek GPM-8212	14	only if range was set via PTDDaemon	formulas, only if not autorange mode	no
Xitron 280X: 1-Channel	28	only if range was set via PTDDaemon	estimation of worst case	no
Voltech PM1000+	23	yes	formulas	no
Yokogawa WT210	8	yes	formulas	no
Yokogawa WT500	35	yes	formulas	no
ZES LMG95	22	yes	formulas	no
ZES LMG450: 1-Channel 4-Channel 3-Phase	16 17 37	yes	formulas	no

2.8 Calibration Requirements

The analyzer must have been calibrated by a standard traceable to NIST in the USA (<http://nist.gov>) or a counterpart national metrology institute in other countries, such as PTB in Germany or NML in Taiwan. The calibration certificate must be dated within one year of the test date.

The manufacturer's test certificate received with the analyzer meets the SPECpower calibration requirements if the certificate is entitled "Certificate of Calibration" or "Certificate of Traceable Calibration" and includes a unique calibration number or sticker, lab accreditation to ISO or other standards, and test equipment certification with traceability to a national standards institute.

Note: The calibration certificate issued is valid only for the specific device (one serial number) calibrated.

3. Power Analyzer Setup Information for Accepted Devices

The following instructions provide information specific to use of SPEC's PTDaemon with each device. The manufacturer's documentation should be the primary reference for all subsections (hardware configuration and input connection) for which specific information is not provided.

Interfaces documented below are those that have been tested by SPEC. Other interfaces may be available from the associated vendor but have not been tested by SPEC.

An up to date list of power analyzers and temperature sensors which are accepted for SPECpower submissions can be found at the following URL:

http://www.spec.org/power/docs/SPECpower-Device_List.html

3.1 Chroma 66202

3.1.1 Hardware Configuration

- GPIB – Set GPIB device address per Chroma User's Manual
- Input Connection – Direct input only
- Firmware Version - Analyzer firmware version must be v1.20 or higher.

3.1.2 Range Setting and Uncertainty Calculation

For SPECpower, measurement results from the Chroma 66202 are valid only if the following requirements have been satisfied:

- Low shunt ranges must be one of the following: 0.01, 0.1, 0.4, 2.0 ARMS. All other low shunt ranges will result in invalid benchmark runs.
- The only high shunt range that can be used is the 20ARMS range.

3.2 Hioki 3334

3.2.1 Hardware Configuration

Connect the analyzer according to the manufacturer's manual (chapter 2 and 3).

Note: The HIOKI's display is locked when the PTDaemon is started. After stopping the PTDaemon you have to press the "local" button to reuse it.

- RS232 - No manual configuration of the RS232 interface is needed.
- GPIB - Available.
- Firmware Version - Analyzer firmware version must be V1.10 or higher.

3.2.2 Range Setting and Uncertainty Calculation

For SPECpower, measurement results from the HIOKI 3334 are valid only for load currents less than 14.167A to ensure that a crest factor of at least 3 can be supported. This limit is increased to 17.334A with firmware versions > v1.10.

3.3 Infratek 101A, 107A-1Channel, 107A-3Channel

3.3.1 Hardware Configuration

Connect the analyzer according to the manufacturer's manual.

Note: The 107A's display is locked when the PTDaemon is started. After stopping the PTDaemon you have to turn the analyzer off and on to reuse it.

- RS232 - The Infratek's RS232 interface is configured to the correct parameters by default (Baud:9600, Parity:None, Terminator:CR, Handshake:None, IEEE_address:n/a). Only the interface parameters of the Infratek 107A can be changed by the user. Instructions are described in the manufacturer's manual (chapter 6.4 Setting Interface Parameters).
- Input Connection - For Infratek 107A there are two input channels available. For instructions how to select and configure the input channel that fits best to your environment, read the manufacturer's manual (chapter 4.6). To measure valid power data the connected physical input channel has also to be selected manually on the display.
- Firmware Version - There are no restrictions to any firmware versions.

3.3.2 Range Setting and Uncertainty Calculation

Instructions on how to configure the range setting are given in the manufacturer's manual (chapter 5.2.1 for Infratek 101A or chapter 5.2.2 for Infratek 107A: Range Selection, Auto Range Selection).

The 101A supports range setting via PTDaemon command interface and PTDaemon input parameters.

The 107A only supports range setting via PTDaemon input parameters, as after being started it is no longer configurable. So there is no possibility to configure the range setting for every individual load level of the SPECpower benchmark. If the electrical power differs between every load level in a larger range, this may cause problems to get valid measurement data.

For SPECpower, measurement results from the Infratek 107A are only valid for load currents less than half the selected current range in order to satisfy the required minimum crest factor value of 3.

Both analyzers provide uncertainty checking by the PTDaemon.

3.3.3 Multi-Channel Measurements

The 107A-3Channel analyzer can only be used as a single-channel analyzer with PTDaemon. Only channel 1 is evaluated.

3.4 Instek GPM-8212

3.4.1 Hardware Configuration

- RS232 – Use default settings
- Input Connection – Direct input only
- Firmware Version

3.4.2 Range Setting and Uncertainty Calculation

For SPECpower, measurement results from the Instek GPM-8212 are only valid for load currents less than 10A in order to satisfy accuracy requirements.

Since the Instek software interface does not allow reading of voltage and current ranges, manual setting of ranges via the device's front panel will not produce valid results.

3.5 Voltech PM1000+

3.5.1 Hardware Configuration

The PM1000+ should be preconfigured using their keypad buttons prior to use with the PTDaemon software. First, reset the analyzer to factory default.

Note: Once PTDaemon 'connects' to the PM1000+, the front panel is 'locked' to avoid inadvertent changes during a SPECpower benchmark run. To re-enable the front panel, exit PTDaemon and the front panel should be enabled again.

- RS232 - For RS-232 connections, a cable with DB9 Female and DB25 Male connectors and null modem capability are required. The analyzer's serial communications settings should be configured for 9600 baud before use with PTDaemon
- GPIB - The GPIB address of the analyzer can be viewed and changed via the front-panel command buttons. That address is used as the "port" number for use with the "-g" command-line argument with true GPIB adapters. For GPIB connections with a virtual COM port driver, see Appendix A. Connect the converter to the GPIB interface of the analyzer, and connect the controller.

3.5.2 Range Setting and Uncertainty Calculation

To avoid bad samples due to auto ranging, set up the analyzer for the voltage and current ranges expected during the test.

3.6 Xitron 2802

3.6.1 Hardware Configuration

The Xitron 2802 should be preconfigured using the keypad buttons before using the device for benchmark testing. The analyzer should also be configured to use the correct port (GPIB or RS232) depending on which option is available.

- RS232 - For RS-232 connections, a serial cable with DB9 Female and DB25 Male connectors and null modem capability are required. The analyzer's serial communications settings should be configured as follows:
 - Press the "menu" key
 - in display window use the Up/down arrow keys to select "Setup System"; Press enter
 - In display window use the Up/down arrow keys to select "RS232 Baud Rate"; Press enter
 - In display window use the Up/Down arrow keys to select the baud rate which matches the serial port on your CCS system, ("9600" is a suitable speed); Press enter.
 - Press the "menu" key twice to return to the main display
- GPIB - For GPIB (IEEE488) connections, the analyzer's serial communications settings should be configured as follows:
 - Press the "menu" key.
 - In display window use the Up/Down arrow keys to select "Setup System"; Press enter.
 - In display window use the Up/Down arrow keys to select "IEEE488 Address"; Press enter.

- In display window use the Up/Down arrow keys to select a unique numeric address for the analyzer; Press enter.
- Press the “menu” key twice to return to the main display.
- Input Connection – Direct input only. Configure the device to match your electrical wiring configuration as follows:
 - Press the “menu” key.
 - In display window use the Up/Down arrow keys to select “Channel Configuration”; Press enter.
 - In display window use the Up/Down arrow keys to select the option that matches your wiring configuration. Options are 1, 2, or 3 phases, 3 wire, or Independent Channels. Press enter.
 - Press the “menu” key twice to return to the main display.
- Firmware Version - You can examine the firmware version installed in the meter as follows:
 - Press the “menu” key.
 - In display window use the Up/Down arrow keys to select “About...”; Press enter.
 - The firmware version will be printed on the screen. For information on upgrading the firmware, consult the manufacturer.
 - Press the “menu” key twice to return to the main display

3.6.2 Multi-Channel Measurements

Only one of the Xitron 2802 channels may be used at a time with PTDaemon.

3.7 Yokogawa WT110 & WT210

3.7.1 Hardware Configuration

The WT110 & WT210 should be preconfigured using their keypad buttons prior to use with the PTDaemon software. First, reset the analyzer to factory default.

Note: Once PTDaemon 'connects' to the WT210, the front panel is 'locked' to avoid inadvertent changes during a SPECpower benchmark run. To re-enable the front panel, exit PTDaemon and on the WT210 front panel, press the Stop (integrate) button then the Reset button. Front panel operations should be enabled again.

- RS232 - For RS-232 connections, a cable with DB9 Female and DB25 Male connectors and null modem capability are required. The analyzer's serial communications settings should be configured as follows:
 1. Press the “local” key
 2. in display window “C” use the Up/down arrow keys to select 488.2; Press enter
 3. In display window “A” use the Up/down arrow keys to select “hand 0”; Press enter
 4. In display window “B” use the Up/down arrow keys to select “For 0”; Press enter
 5. In display window “C” use the Up/down arrow keys to select “b 9600”; Press enter
 6. In display window “C” use the Up/down arrow keys to select “CR”. Press enter

Note that the Yokogawa provided software requires the line terminator character to be “LF” (in #6 above).

- GPIB - The GPIB address of the analyzer can be viewed and changed via the front-panel command buttons. That address is used as the “port” number for use with the “-g” command-line argument with true GPIB adapters. For GPIB connections with a virtual COM port driver, see Appendix A. Connect the converter to the GPIB interface of the analyzer, and connect the controller.

- Input Connection – Only the direct input terminals of the WT210 are supported by PTDaemon.

3.8 Yokogawa WT500

3.8.1 Hardware Configuration

- GPIB – The GPIB address of the analyzer may be set from the front panel configuration menus. For GPIB connections with a virtual COM port driver, see Appendix A.
- Ethernet - PTDaemon supports Ethernet communication with the WT500 on Windows operating systems via use of Yokogawa's TMCTL DLL, which can be requested from Yokogawa support channels. With TMCTL installed on the controller system, use the "-y" command-line parameter with the IP address as the "port" parameter. For example, "ptd-windows-x86 -y 35 192.168.0.3". The WT500's IP configuration can be set from the front panel controls.
- USB - PTDaemon supports USB communication with the WT500 on Windows operating systems via use of Yokogawa's TMCTL DLL, which can be requested from Yokogawa support channels. With TMCTL installed on the controller system, use the "-y" command-line parameter with the WT500's serial number as the "port" parameter. For example, "ptd-windows-x86 -y 35 WX503020".

3.9 ZES LMG95, LMG450, LMG500

There are three types of ZES LMG power analyzers supported by the SPECpower PTDaemon. The LMG95 provides one-channel measurements, while LMG450 and LMG500 can be used for 1-channel, 4-channel or 3-Phase measurements.

3.9.1 Hardware Configuration

After connecting and turning on the ZES LMG according to the manufacturer's manual the analyzer has to be configured correctly.

Note:

First of all always reset the LMG's settings to the default parameters by pressing the both lower softkeys when switching on the analyzer. In general the analyzer stores the actual settings, so this has always to be done after using the analyzer in an environment other than SPECpower.

Note: During the measurement the analyzer buttons are locked by PTDaemon. If PTDaemon is not stopped via "X" command, the analyzer has to be turned "off" and "on" for reuse.

- RS232 - The ZES LMG's RS232 interface has to be configured for "57600 Baud, <lf>, Echo off" before use with PTDaemon. Instructions how to configure the interface are described in the manufacturer's manual (chapter 4.4.2 IF/IO).
- GPIB - Available and supported by PTDaemon, but not yet tested on ZES LMGs.
- Input Connection - The ZES LMGs have for each available channel one input connection. For compliant measurements on LMG450 and LMG500 channel 1 has to be selected. Multi-channel measurements are not yet accepted for compliant SPECpower benchmark results. For physical connection read the manufacturer's manual (chapter 1-3).
- Firmware Version - There are no restrictions to any firmware versions.

3.9.2 Range Setting and Uncertainty Calculation

Be careful in selecting the correct ranges which fit best to your measurement environment to avoid inaccurate or even invalid values. Uncertainty calculation for ZES LMGs by PTDaemon is only available if the measured values during the benchmark lie in between 10% and 110% of the configured range, so these limits have to be kept for conforming measurements.

Instructions how to configure the range setting manually are described in the manufacturer's manual (chapter 5.2 Measuring ranges(Range)).

All accepted ZES LMG power analyzers support range setting via PTDaemon command interface or PTDaemon input parameters.

Additional all accepted ZES LMG power analyzers provide uncertainty checking by the PTDaemon.

3.9.3 Multi-Channel Measurements

The ZES LMG450 and ZES LMG500 can also be used as 4-channel and 3-phase analyzers by PTDaemon, providing the measurement data of the individual channels and the sum channel. Using the 3-Phase mode all calculated sum values of watts, volts, amps etc. are valid. Using the 4-channel-mode only the sum value of power is calculated and provides a valid result. Other sum values, e.g. volts and amps are marked as invalid, because the formulas for those calculations may provide incorrect results.

Note: The multichannel features are not yet integrated into all SPECpower benchmarks, e.g. SPECpower_ssj2008 only supports the 3-Phase mode with the restriction that for all channels the range settings have to be identical. In this case only the data of the sum channel calculated by the analyzer from the individual channels are reported. The calculation formulas are explained in the [SPEC Power and Performance Benchmark Methodology](#) document. The appropriate range settings of the individual channels can be estimated by the following formula:

Estimated ampere range: Expected maximum volt * $\sqrt{3}$
 Estimated volt range: Expected maximum ampere * $\sqrt{3}$

4. Temperature Sensor Setup Information for Accepted Devices

All temperature measuring devices that have been tested by SPEC and that are accepted for use in the measurement of compliant results are listed in the table below.

List of Accepted Temperature Sensors		
Manufacturer	1st Supported in PTDaemon Version	Restrictions on use with SPECpower
Digi Watchport	v1.0	-
Temperature@Iert	v1.0	-

Please be aware to always check http://www.spec.org/power/docs/SPECpower-Device_List.html for the latest information!

4.1 Digi Watchport/H

4.1.1 Hardware Connection

The Watchport/H is only available as a USB device. Plug the USB connector into an available USB port. Make sure to locate the temperature sensor in front of the SUT air intake as specified in Run and Reporting Rules.

4.1.2 Windows Software Configuration

The “find new hardware wizard” should detect the Watchport/H device, and find the drivers if the driver CD is installed. The drivers allow applications to access the Watchport device on a virtual serial port. Use Windows device manager to locate the virtual serial port in the “COM and LPT ports” section, and use that serial port number as the port argument to PTDaemon.

The Watchport Manager application can be also used to test and communicate with the device.

The available Windows drivers are for 32-bit Windows only.

4.1.3 Linux Software Configuration

Linux kernels with the io_ti and usbserial drivers will autodetect the Watchport device. The name of the virtual serial port can usually be found by looking at the system log output, for example using the “dmesg” command.

4.2 Temperature@Iert

4.2.1 Hardware Connection

The Temperature@Iert is only available as a USB device. A USB extension cable will probably be necessary to situate the sensor in the appropriate location in front of the SUT as specified in the Run and Reporting Rules. Plug the USB connector into an available USB port.

4.2.2 Windows Software Configuration

“Virtual Serial Port” drivers for most Windows versions may be downloaded from <http://ftdichip.com/Drivers/VCP.htm>. Once the driver is installed, a virtual serial port will be found in Windows’ Device Manager. The COM port number found in Device Manager should be used as the port argument to PTDaemon.

4.2.3 Linux/Other Software Configuration

Linux kernels 2.6.9 and beyond already include “Virtual Serial Port” drivers that support the Temperature@Iert. Drivers for other Linux versions, as well as for MacOS, are available at <http://ftdichip.com/Drivers/VCP.htm>. Once the driver is installed, the name of the virtual serial port can usually be found by looking at the system log output, for example using the “dmesg” command.

5. Troubleshooting

For further help with troubleshooting specific issues, please refer to the FAQs of the various SPECpower benchmarks.

6. Appendix A: Configuring the Prologix GPIB-USB-Virtual COM Port Adapter

When using the Prologix device, the GPIB address used by the device to communicate with the power analyzer must be set manually using the following steps:

1. Connect the converter to the GPIB interface of the analyzer, and connect the controller system to the converter with a standard USB cable.
2. Download the driver at this URL, <http://www.ftdichip.com/Drivers/VCP.htm>, and install it onto the controller system. This driver will map the Prologix device to a virtual com port in windows. (for example, com3).
3. Open a Windows Hyperterm session with the Prologix device (com3) with settings of 9600,8,no,1,no.
4. Send the command "++addr" to see what GPIB address the Prologix device is currently set to control. For the purpose of these instructions, a returned value of 5 (which is usually the case) will be used.
5. Determine the GPIB address of your power analyzer. For example, on the Yokogawa WT210, press Local, scroll to 488.2 with the up and down arrows, and press Enter. It should now show what GPIB address the WT210 is currently set to listen on. For the purposes of these instructions, a returned value of 10 will be used.
6. Now, make sure the GPIB addresses of both the power analyzer and the Prologix device are the same. You can use either of the following:
 - a. Change the address of the Prologix device to match that of the analyzer by sending the command "++addr 10" or
 - b. Change the address of the analyzer to 5 – in the WT210 case by using the arrow keys on the front display, and then press Enter.
7. Close the hyperterm session.

7. Appendix B: Setup Instructions for Unsupported Devices

7.1 Christ Elektronik CLM3000

With CLM3000 up to three phases can be measured. Use the device #20 (Christelektronik CLM3000:1-Ch) for measurements of one phase and device #21 (Christelektronik CLM3000:3-Ch) for measurements of three phases. Both types are not accepted for conforming SPECpower measurements.

7.1.1 Hardware Configuration

After connecting and turning on the CLM3000 according to the manufacturer's manual you have to do the following manual configuration on the analyzer's display:

1. Press the "door" on the touch screen
2. Press "Menu"
3. You may change the language to English by pressing "language" and selecting "En" and return
4. Press "Setup"
 - a. Configure the serial interface to "block mode", this means the analyzer itself sends measurement data. Press "save" and return. Notice that this configuration setting is permanent over Power ON/OFF.
5. Press "User power values and measurement time"
 - a. Press delete and return
6. Press the "door"

Now the analyzer is correctly configured and you should see reasonable power values on the display.

When starting the PTDaemon you may have problems with connecting to the CLM3000 because of missing synchronization in rare cases. It may help to just restart the PTDaemon for several times. If it still doesn't work, try to turn the analyzer off and on and to disable and enable the Com port via the device manager.

- RS232 - The analyzer's RS232 interface is not configurable.
- Input Connection - The CLM300s don't have several input channels to be selected. For physical connection read the manufacturer's manual.
- Firmware Version - There are no restrictions to any firmware versions.

7.1.2 Range Setting and Uncertainty Calculation

The CLM3000s don't support individual range setting neither manually nor via PTDaemon. Also uncertainty calculation is not provided by PTDaemon. The maximum current range per phase is 16A.

7.1.3 Multi-Channel Measurements

Read the manufacturer's manual on how to connect the analyzer to 3 phases and use PTDaemon-ID 21 for measurements.

7.2 Voltech PM100

7.2.1 Hardware Configuration

- RS232 - The PM100's RS232 interface should be configured for 9600 baud before use with PTDaemon.

7.2.2 Range Setting and Uncertainty Calculation

To avoid bad samples due to auto ranging, set up the analyzer for the voltage and current ranges expected during the test.

7.3 Voltech PM3000

7.3.1 Hardware Configuration

- RS232 - The PM3000's RS232 interface should be configured for 9600 baud before use with PTDaemon.

7.3.2 Range Setting and Uncertainty Calculation

To avoid bad samples due to auto ranging, set up the analyzer for the voltage and current ranges expected during the test.

8. Disclaimer

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