

# Hi-Tech Techniques



# SYNERGY

Intelligence In Data Acquisition

## SYNERGY IS A...

### ... TRANSIENT RECORDER

Enabling precision capture and analysis. Synergy features individual 16-bit digitizers per channel. Bandwidth up to 25 MHz enables collection of the fastest power transients, engine combustion cycles, pyroshock, ballistics and material test events. Up to 128 MS of transient RAM captures the longest event or thousands of shorter segments.

### ... DATA RECORDER

Offering high speed, scrolling strip chart display, voice and trace annotation and integrated signal conditioning. Store and review literally months of data even at high acquisition rates.

## THE PERFECT COMBINATION OF CAPABILITIES

### SYNERGY KEY FEATURES

- Sample rates to 100 MS/s per channel with 16-bit high resolution A/Ds
- Streaming to disk up to 1 MS/s per channel
- Control and display data in real time from any networked PC
- Mix and match any combination of mainframes and input modules
- Master/slave multiple units for even higher simultaneous channel counts

### THE MOST COMPLETE DATA ACQUISITION SYSTEM EVER BUILT



For 30 years, Hi-Techniques has developed increasingly powerful, high performance Data Acquisition Systems. We started with a clean sheet of paper in developing Synergy. The design goal was simple . . . to leverage emerging technology to design the most capable, most flexible and most complete Data Acquisition System in the world.

Before Synergy, research labs and test facilities were filled with a combination of different types of instruments and signal conditioners all for similar yet distinct measurement requirements. As the name implies, Synergy blends the unique capabilities of multiple instruments in an integrated, easy to use system.



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### ... MULTI-CHANNEL DSO

Featuring multi-channel independent 16-bit digitizing up to 100 MS/s, fast updated YT and XY scope displays and a wide variety of real-time parameter measurements as well as waveform calculations.

### ... DATA ACQUISITION SYSTEM

Featuring high resolution data capture, high speed direct-to-disk long duration recording and signal conditioning for most popular signal types.

### ... REAL-TIME FFT ANALYZER

Including waterfall displays, octave and narrowband analysis, windowing and order analysis. Direct control from ME'scope® modal analysis software enabling setup and analysis for structural testing applications.

## CONTINUOUS STREAMING TO DISK

Synergy's distributed processing hardware captures data directly to a Windows® internal hard drive or external PC via Gigabit Ethernet at speeds of up to 1 MS/s. With virtually unlimited record lengths and reserve bandwidth for streaming video and audio, you never need to worry about running out of disk space. Larger capacity drives and removable RAID or USB Flash can further extend acquisition performance. Synergy can capture weeks of continuous data with annotation and storage. Data is stored directly to Windows disk, eliminating the requirement for lengthy conversion from proprietary hardware post acquisition. Other direct to disk systems can literally take hours to convert acquired data from a proprietary format to usable data.

Hi-Techniques' ClearVU technology tracks max, min and mean values for all channels in real time, so you know in an instant if a channel goes off scale or a lead breaks. This thumbnail statistical information is also stored in the data file to provide instant review of even multi-Gigabyte files. In addition, a summary report for immediate test validation is available at a keystroke.



A full-disk circular-buffer allows for slow background recording until an event is detected at which point sample rate is accelerated to ensure maximum sample resolution only on the points of interest. Quickly mark interesting data with text or voice using the touchscreen interface or integrated microphone input. Playback your recordings to the screen or as a sound channel utilizing the PC sound interface. Scroll through long files with the convenient jog-shuttle knob, or use the Search functions to quickly locate events of interest.

The integrated Gigabit Ethernet switch allows two networks to be supported at the same time. Connect to your corporate network while simultaneously streaming data on the other Ethernet port to an external PC or data storage device.



## HIGH RESOLUTION DSO PERFORMANCE



Synergy features individual 16-bit at up to 100 MS/s digitizers per channel, providing the acquisition power for practically all mechanical or electrical phenomena. Up to 128 MS of transient RAM captures the longest event or thousands of shorter segments with convenient playback and analysis of all past sweeps in memory. Synergy offers multi-channel real-time parameters and cursor measurements. To improve results from noisy signals, averaging is available in both time and frequency domains.

Synergy provides worry-free triggering to ensure you never miss a critical event of interest. Dual level hysteresis triggering provides a stable trigger even in the noisiest of environments. Slope (dV/dT) triggering allows capture of changing repetitive events.

An external sample rate input (up to a maximum rate of 2 MS/s) is also available for measurements based on rotation, speed or crank angle.

## REAL TIME SPECTRAL ANALYSIS



Synergy's hardware and software were designed for optimum performance in both the frequency and time domains. It includes dozens of spectral calculations and displays including narrowband, octave and spectral maps. The system allows selection of FFT (e.g. 4096) and decimal (e.g. 5000) sample rates and sweep lengths.

Filtering needs for a traditional FFT analyzer and scope are very distinct. The steep rolloff required for maximizing FFT performance caused considerable overshoot in Time Domain step response. In fact, competitive systems using sigma-delta techniques can overstate peak and transient measurements by over 20%! Rather than permanently compromise one mode, Synergy offers software selection of filter and frequency characteristics to best suit your varying tests.



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## Mix and match modules in any configuration.

Synergy offers a wide range of Input Modules for almost any application.

### Basic Input Module

Offers up to 2 MS/s acquisition speeds and direct-to-disk recording at 1 MS/s. High impedance, differential front end supports voltage range from  $\pm 20$  mV to  $\pm 20$  V and direct connection to most oscilloscope probes and connection devices via BNC inputs.

### High Voltage Input Module

Offers 1 MS/s sample rates, up to  $\pm 1000$ V input range and 2000 V peak channel-to-channel isolation for high voltage and high power applications. Wide input range from  $\pm 50$ mV allows direct simultaneous connection to high voltage signals and current shunts via the 4mm safety banana jack connectors.

### Medium Voltage Input Module

Provides a cost effective, 4-channel solution for general purpose voltage applications, offering  $\pm 50$  mV to  $\pm 200$  V ranges and floating isolated capabilities.

### High Density Module

Offers 16 differential voltage and/or thermocouple channels with up to 100 kS/s per channel transient or direct-to-disk acquisition. Optional breakout interface supports screw terminal type connection and contains thermocouple CJC. Optional breakout cable provides BNC connection.

### High Speed Input Module

Provides four channels of 100 MS/s per channel, 16-bit digitizing or two channels of 200 MS/s digitizing using a proprietary interleaving technique. Differential, high impedance, 25 MHz amplifiers support voltage from  $\pm 50$  mV to  $\pm 20$  V full scale.



### Universal Input Module

Provides signal conditioning for virtually all sensor types and can be software configured and re-configured on a channel by channel basis to accommodate changing test requirements. What could be simpler than that?

**DC Bridge** Connect your strain gauges, load cells, force, pressure, torque and piezo-resistive sensors with support for  $\frac{1}{4}$ ,  $\frac{1}{2}$  and full bridge. Auto-balance, Shunt Cal and Auto Cal functions are provided at a touch.



Breakout Interface for Universal Input Module

**Thermocouple** Direct inputs for your thermocouples with cold junction compensation and real-time linearization. Breakout interface simplifies the connection to these sensors, as well as DC Bridges.

**ICP® Type Accel** Constant-current excitation for your accelerometers, microphones and force transducers. Charge-mode sensors are also supported with small in-line charge converters.



Breakout Cable for High Density Module

**Voltage Inputs** Input spans from  $\pm 20$  mV to  $\pm 20$  V direct and up to 40 kV with scope probes. All channels are differential or isolated to prevent ground loop and EMI problems.

**Sensor Power** Up to 16 DC sources of 1 V to 10 V provide flexibility to power bridges, MEMS sensors, DC-LVDTs, transmitters, current loops and other circuitry.

### Enhanced Universal Input Module

Intended for applications requiring long sensor leads. Adds individual channel excitation, remote sense lines, additional RF filtering and input protection to the standard Universal Input Module.

# CHOOSE

the system that best meets your needs



The **Synergy P** mainframe supports up to 4 input modules capable of up to 64 channels in a portable, self-contained chassis. Mix and match input modules in any configuration or choose one of the economical bundled configurations.



The **Synergy Qb** offers the same Synergy input capabilities in a field rugged product offering IP51 environmental resistance against dust and water. This DC-operated system can acquire standalone to its internal low-power PC with solid state drive, or to an external PC via Ethernet.

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# FLEXIBILITY BY DESIGN

	Basic Input Module	Medium Voltage Module	High Voltage Module	High Density Module	High Speed Module	Universal & Enhanced Universal Module
Number of Input Channels	4	4 Isolated	4 Isolated	16	4	4 with Signal Conditioning
Types of Inputs	Differential, Single Ended Voltage	Single Ended Voltage	Single Ended Voltage, Current via Shunt	Differential, Single Ended Voltage, Thermocouple	Differential, Single Ended Voltage	Voltage, Bridge, Accelerometer, Thermocouple
Sample Rate	Up to 2 MS/s transient, 1 MS/s streaming	Up to 1 MS/s transient, 1 MS/s streaming	Up to 1 MS/s transient, 1 MS/s streaming	Up to 100 kS/s per channel	Up to 100 MS/s (4-ch mode), Up to 200 MS/s (2-ch mode)	Up to 2 MS/s transient, 1 MS/s streaming
Input Range	$\pm 20$ mV to $\pm 20$ V	$\pm 50$ mV to $\pm 200$ V	$\pm 50$ mV to $\pm 1000$ V	$\pm 100$ mV to $\pm 10$ V	$\pm 50$ mV to $\pm 20$ V	$\pm 20$ mV to $\pm 20$ V
Connector Type	BNC	BNC	4mm Safety Banana	78-pin connector, optional Breakouts	BNC	BNC or multipin, optional Breakouts

## Multiple Instrument Synchronization

For higher channel counts, connect multiple systems together utilizing Synergy's master/slave architecture. All systems are synchronized within nanoseconds and start/stop simultaneously. Data can be consolidated on a single display for comparison and analysis. System clocks can be synchronized to GPS or IRIG time using the optional time stamp interface.



**USB Thermocouple Module** provides a cost effective means of adding Thermocouple and RTD channels. Supports J, K, R, S, T, N, E and B type Thermocouples and 2, 3 or 4 wire RTD with internal cold junction compensation. Thermocouple data is synchronized with high speed acquisition and waveforms displayed in real-time using Synergy software. Use up to 4 modules per Synergy mainframe for a total of 32 additional thermocouple channels.



The **Synergy 8** supports up to eight input modules in a compact, card modular form factor capable of 32 high-speed channels or 128 using the 16-channel high density module. System can be configured with a flexible carrying handle for either field or factory use.

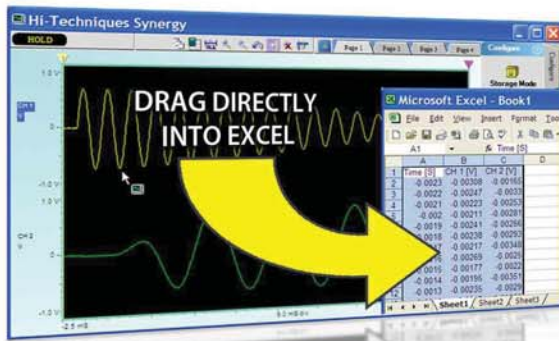


The **Synergy CS** mainframe further extends the available channel count supporting up to 16 input modules in a benchtop or rackmount configuration. The Synergy CS can be configured with or without internal display.



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### Interactive Analysis

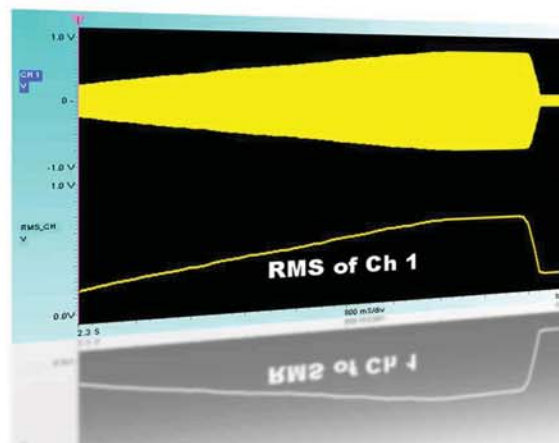
The most common and useful measurements don't even require a trip to the Analysis screen. At a single keystroke, the maximum and minimum points of your waveforms are located and measured. At the touch of an icon, a Waveform Calculator instantly pops up statistics for all channels on screen such as Max, Min, RMS and Frequency. The waveforms and numeric measurements can be copied or dragged into Excel or any other Windows program.



When your analysis needs become more complicated, choose from over 100 built-in math functions including arithmetic, statistics, trigonometry, calculus, spectral and timing. Select the waveforms of interest, your measurement and the region to analyze, and a new trace or numeric result appears. Synergy even remembers each operation for repeat at a keystroke. All post-process math routines are coded in tightly optimized C+ for lightning-fast operations even on multi-megasample arrays. With a click of the Auto-Repeat button, any sequence you perform once will be automatically updated every time you acquire new data.

### Real-Time Analysis

All Synergy modules include a DSP in the data stream to provide virtual Math Channels, intelligent triggering and selectable digital filtering in real-time during recording. Not only can you record traces of True-RMS and Frequency of every channel, you can set a Trigger or Alarm output if any reading goes too high or too low, all with no need for cumbersome external dongles or expensive signal conditioners.



### Test Cell Integration

An automated test cell typically includes a variety of instrumentation and signal generation. Synergy is equally at home as a DAQ resource in a cell environment, accepting remote commands and data transfers from a test controller over Ethernet. The controller might be a Windows PC running LabVIEW, a Mac or a Linux machine; the only requirement is an Ethernet port.

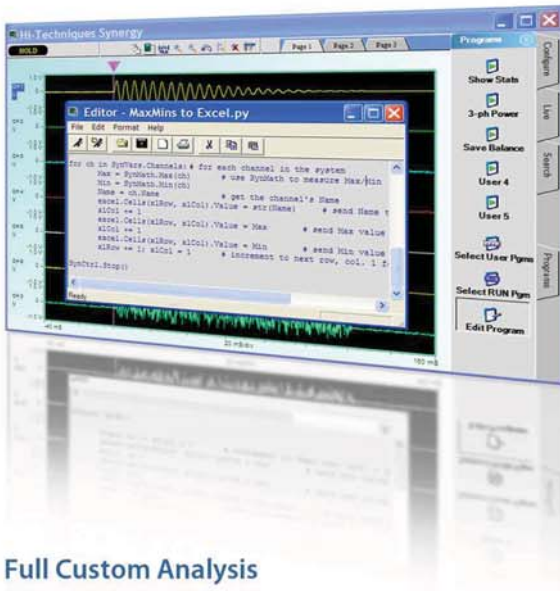


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# Unparalleled Analysis Capability

Your productivity depends on getting the results you need, so Synergy includes a wide range of analysis and data reduction tools. Unlike lower performance PC solutions which rely solely on the PC to perform block-oriented calculations after an acquisition, we put a powerful array of DSPs directly in the data stream to enable real-time cycle-by-cycle measurements and on-the-fly data reduction. High-speed streaming data is analyzed at the full sample rate with results stored as new virtual channels or reduced to just the statistics of interest.

No matter your application, Synergy excels at delivering the *answers*, not just the data.

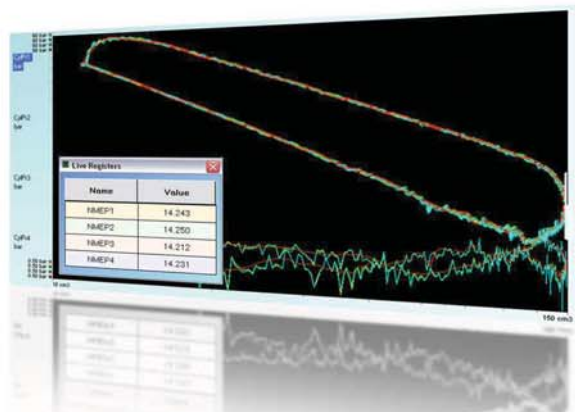
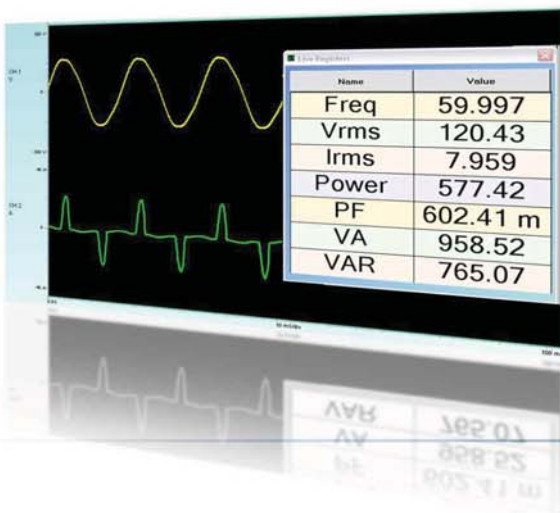


For even more demanding applications, Synergy includes a full macro editor based on the open-source Python language. In addition to full control of Synergy setup, acquisition and analysis functions, Python can communicate with any other Windows applications and hardware. For example, the results of a specialized and complex calculation may be sent directly to an Excel spreadsheet, a NotePad log file, or even an analog output. Up to five user programs can be attached to buttons in the Synergy control panel for instant keystroke access.

## Synergy Application Packs

Hi-Techniques has already created several software extensions for specialized applications. Our **Power Analyzer** package provides single-phase and three-phase power analysis, with true power, apparent power, harmonic analysis and other common measurements. With isolated input modules up to 1000 Vdc and 600 Vac, Synergy replaces a data recorder, an oscilloscope and a multi-phase power analyzer in one portable system.

Our **REvelation** internal combustion analyzer (ICA) package offers Pressure-Volume analysis for any type of piston engine from weed whackers to cargo ships. In the drive for fuel efficiency and optimal power, REvelation's ability to measure the power contribution of each cylinder in real time is indispensable.



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	Synergy P	Synergy CS	Synergy Qb	Synergy 8
<b>Mainframe</b>				
<b>Number of Input Slots</b>	Accepts 4 modules (64 channels max)	Accepts 16 modules (256 channels max)	Accepts 4 modules (64 channels max)	Accepts 8 modules (128 channels max)
<b>Input Power</b>	90-240 Vac, 47-63 Hz, 150 W max	90-240 Vac, 350 W max	9-18 VDC, 90 W Max External AC/DC Adaptor Provided (100 - 240 V AC, 47-63 Hz)	90-240 Vac, 47-63 Hz, 200 W max, 9-18 VDC optional
<b>Size W x H x D</b>	42 cm x 33 cm x 16 cm (17" x 13" x 6.4")	45 cm x 36 cm x 46 cm (17.6" x 14" x 18") 8 rack units	27 cm x 24 cm x 25 cm (10.5" x 9.5" x 10")	44 cm x 22 cm x 30 cm (17.4" x 8.6" x 11.7") 5 rack units
<b>Weight</b>	Approx. 15 kg (32 lb.)	Approx. 32 kg (70 lb.) min, 41 kg (90 lb.) max	Approx. 9 kg (20 lb.) max	Approx. 16 kg (35 lb.) max
<b>Operating Temperature</b>	10 to 40 °C	10 to 40 °C	0 to 45 °C	5 to 45 °C
<b>Humidity</b>	10% - 90%, non condensing	10% - 90%, non condensing	10% - 90%, non condensing	10% - 90%, non condensing
<b>Shock</b>	20g 11 ms half-sine, Mil-Std-810F, Procedure 1	10g 11 ms half-sine, Mil-Std-810F, Procedure 1	50g 11 ms half-sine, Mil-Std-810F, Procedure 1	30g 11 ms half-sine, Mil-Std-810F, Procedure 1
<b>Vibration</b>	2g, 35-500 Hz, Mil-Std-810F, Procedure 1	2g, 35-500 Hz, Mil-810-F	5g, 35-500 Hz, Mil-810-F	5g, 35-500 Hz, Mil-810-F
<b>Altitude</b>	< 20,000 feet (6100 m)			
<b>Interface</b>	15.1" Touchscreen		Front Panel Start/Stop buttons, LED indicators for acquisition and network status	
<b>PC I/O</b>	6 USB, 1 eSATA, 1 IEEE 1394a, 1 ext. VGA, Audio In/Out & Mic, 2 RJ-45 Ethernet Ports		4 USB, 1 VGA, PS2 Mouse/Keyboard, Audio In/Out & Mic* 2 RJ-45 Ethernet Ports	

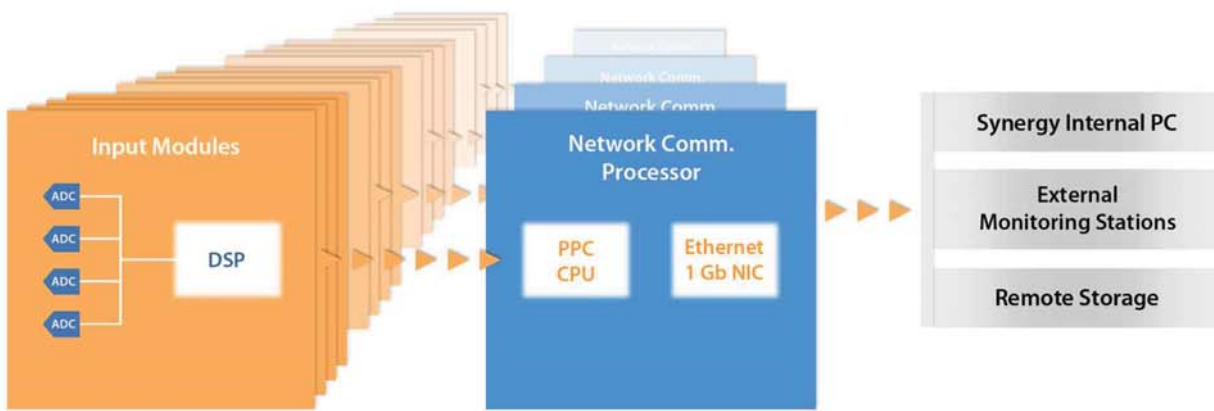


## Connectivity and Control

Synergy includes a full-featured Windows PC with Gigabit Ethernet and high speed USB 2.0. Save your files to its built-in DVD-RW, to a USB "thumb drive", to your network or any other medium. When you're in the office, connect any USB keyboard and mouse for convenient navigation. When you're on the plant floor, add a Wi-Fi adapter to stay in touch with your company network. With integrated PCI card slots, USB 2.0 and our open software, system expansion possibilities (e.g., high speed video, digital data buses, ...) are unlimited. Synergy's dual video support enables independent display of multiple data sets. View live data on the large 15" touchscreen display and perform simultaneous analysis on a separate external display.

## Remote Control, Display and Storage from Any Network PC

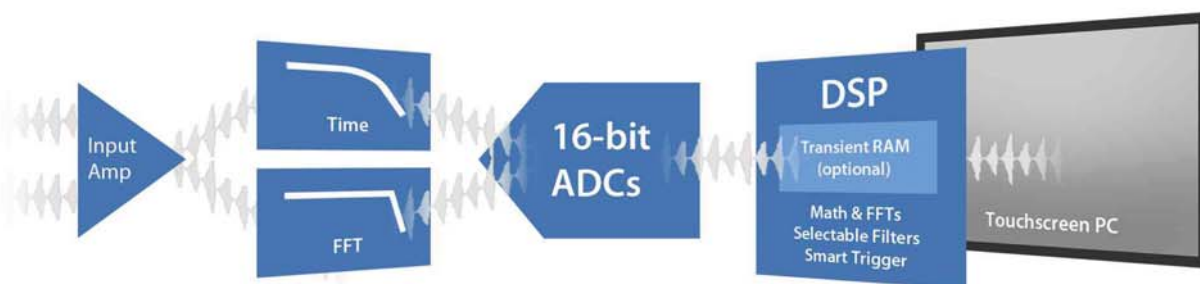
Synergy's Ethernet architecture offers the advantage to stream high-speed data to an integrated PC or to a remote, networked PC or file server. Dual integrated Ethernet switch allows data to be streamed through one port creating a virtual Intranet while allowing the second port to be connected to your corporate network. Whether connected to the internal PC or any remote PC, the software operates the same. Control, analyze and stream directly to the host PC or to the remote PC over Gigabit Ethernet. Data stored directly to Windows based media saves time and frustration of post-test file copying. All Synergy systems include an additional software license for remote real-time control or analysis or offline analysis on a separate PC. Multiple user or site licenses are available. No software dongles or keys required.



## Distributed Processing and Acquisition

The unique Synergy architecture is designed to maximize processing functions including real-time streaming and real-time math calculations. Each individual Synergy input module features its own Digital Signal Processor (DSP) directly in the data stream to perform real-time individual channel or channel-to-channel calculations as well as to perform real-time anti-alias filtering. Create up to 28 mathematically derived virtual channels per module including complex functions such as cycle-by-cycle RMS and Frequency. Real-time virtual channels can even be used as a trigger source.

Synergy's distributed processing approach also applies to streaming capabilities. Competitive systems often specify an aggregate sampling rate to disk often limited by a data processing bottleneck. Every four Input modules are connected to a Synergy Controller which pre-processes the data for the Gigabit Ethernet. Multiple Controller modules in the 16-slot Synergy CS and 8-slot Synergy 8 share the processing task to support maximum streaming to disk regardless of aggregate channel count.



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## Acquisition Specifications

Sample Rates	Decimal rates up to 100 MS/s to 0.5 S/s in 1, 2, 5 steps Binary rates up to 1.024 MS/s to 0.512 S/s Ext. clock up to 2 MS/s (>33K RPM at 3600 ppr)
Clock Accuracy	<50 ppm
Abs Time Accuracy	With IRIG/GPS option <1 us, PC time accuracy without
Transient Memory	64 or 128 MS per input module
Sweep length	64 samples to max transient memory in Scope mode, unlimited length in Recorder mode
Pre-Trigger	1 sample to 100% sweep length in scope mode, up to full disk in Recorder mode
Post-Trigger Delay	1 - 1E9 samples, 1 - 64K trigger events
Triggering	Any input channel, +/-dual slope with variable hysteresis; DSP-computed measurements from any channel, or External
Logical Trigger	OR of all channels, plus separate Gate input
Trigger Sequences	Up to 65,536 segments with time stamps
Signal Averaging	Up to 65,536 sweeps, selectable artifact rejection
ClearVU	Max/Min saved in real time for accurate live displays and fast review

## Acquisition Modes

Recorder	80 kHz bandwidth, streaming to disk at up to 204.8 kS/s per channel with all channels recording. To 1 MS/s and 200 kHz bandwidth with reduced channels. In continuous mode, data can be saved to <i>Windows HD at full rate</i> or USB flash, RAID, server or other storage medium at media-dependent rates.
Scope/Transient	1 MHz bandwidth, up to 100 MS/s 16-bit digitizer per channel. Single-shot or repetitive mode. High-speed transient RAM storage.
Frequency Analyzer	Real-time FFT analysis including Third Octave analysis up to 1 MHz with or without simultaneous time-domain displays.
Signal Averager	Both time-domain and frequency-domain averaging are provided to reduce noise and increase resolution.

## Software Specifications

Operating System	Microsoft Windows 7 Professional®
Control	Software runs on Synergy internal CPU or any networked PC
Channel Setup	Individual channel controls or spreadsheet setup
Auto Setup	Scans inputs for active signals to set range and timebase
Display Modes	Scope, stripchart, XY, FFT, Third-Octave, waterfall, zoom
Data Formats	SYN (Synergy Native Binary), Hi-Techniques DAT, several styles of single- and multi-channel ASCII, CSV, MAT, RPC III, WFT Drag-and-drop of text or graphic data into any Windows application such as Microsoft Excel, Word, etc...

## PC Options

All Synergys are equipped with a full-featured dual-core PC. Optional additions can tailor the PC functionality to your needs.

- Larger Hard Drive
- Removable Hard Drive/Flash Drive
- Solid State Drive
- Additional Memory
- Microsoft Office pre-installed
- Miniature keyboard for field use

## Data Acquisition Options

Synergy's powerful data acquisition features can be enhanced with optional accessories.

- Transient Capture up to 100 MS/s
- Extended Transient Memory
- USB Temperature Channels
- IRIG or GPS Timecode Input
- IRIG Output
- Alarm Output
- Master/Slave Cabling
- Breakout Cards and Cables
- Software Site Licenses
- Macro Programming
- REvelation Combustion Analysis
- Power Analysis



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## Accessories To Complement Your System

### Cases



Hard Shipping Case for Synergy P, Qb, and 8



Shock Mounted Shipping Case for Synergy CS



Soft Carrying Case for Synergy P

### Carts and Mounting Devices



Mobile Cart for Synergy CS with keyboard tray and storage



VESA 100mm Mounting Connectors allow a variety of mounting solutions



Mobile Cart for Synergy P

### Breakout Connectors



Breakout Cable for High Density Module



Breakout Modules for High Density Module



Breakout Module for Universal Module Supports Bridge Devices and Thermocouples

### Probes



AC Current Probes



x1000 High Voltage Probes



Passive x1, x10, and x100 Probes



High Voltage Cables, Clips, and Adapters



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