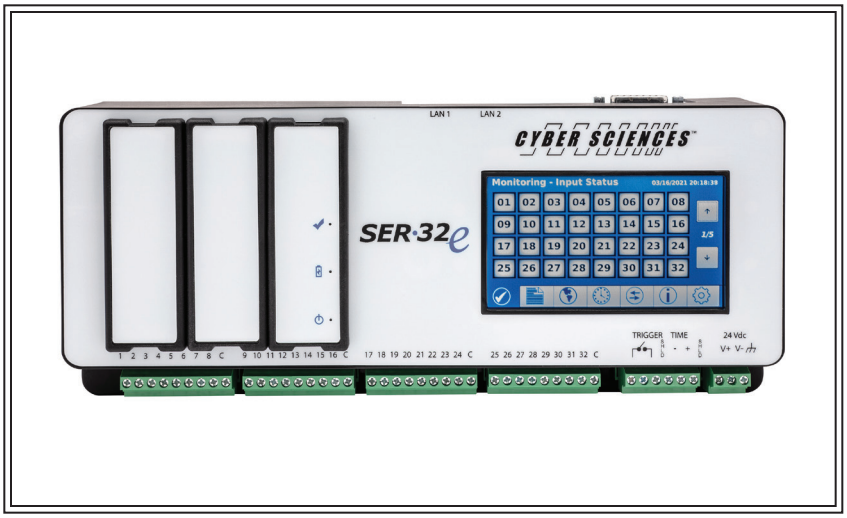
INSTRUCTION BULLETIN

USER'S GUIDE

CyTime™ Sequence of Events Recorder SER-32e



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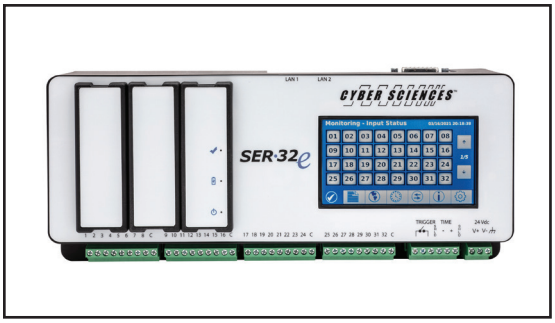


SAFETY PRECAUTIONS

Important safety precautions must be followed before attempting to install, service, or maintain electrical equipment. Carefully read and follow the safety precautions outlined below.

NOTE: *Electrical equipment should be serviced by qualified personnel. No responsibility is assumed by Cyber Sciences, Inc. for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.*

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified workers should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical practices. For example, in the USA, see NFPA 70E.
- Turn off all power supplying the equipment in which the device is to be installed before installing and wiring the device.
- Always use a properly rated voltage sensing device to confirm that power is off.
- Beware of potential hazards, wear personal protective equipment, and carefully inspect the work area for tools and objects that may have been left inside the equipment.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

Failure to follow these instructions can result in death or serious injury.

NOTICE

FCC (Federal Communications Commission)
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. The user is cautioned that any changes or modifications not expressly approved by Cyber Sciences, Inc. may void the user's authority to operate the equipment.

The Class A digital apparatus complies with CISPR 11, Class A, Group 1 (EN 55011) and Canadian ICES-003. (EN 61326-1) L'appareil numérique de classe A est conforme aux normes CISPR 11, classe A, groupe 1 (EN 55011) et à la norme Canadiene ICES-003. (EN 61326-1)

Open source software components
This Cyber Sciences, Inc. device is provided with certain open source software components (collectively, "OSS") developed by third parties. Refer to the section on "Included Software Licenses". (Section 8 of this document)

1—INTRODUCTION

Product Overview

Note: This instruction bulletin describes product features and behaviors for the latest firmware version available at the time of publication. Cyber Sciences recommends updating to the latest firmware whenever feasible, available for free download:

www.cyber-sciences.com/downloads

The CyTime™ Sequence of Events Recorder provides precise time-stamped event reporting for 32 channels to enable root-cause analysis and advanced system diagnostics.

Configurable event recording: Each input is individually configurable with digital filter, debounce and contact chatter functions to ensure reliable operation.

Event log: The CyTime SER records the date and time associated with all state changes to one (1) millisecond and stores up to 8192 events in non-volatile memory. Each event record contains the date/time stamp, event type, channel number and state, time quality, and unique sequence number.

Export events to Comma Separated Variable (CSV): An export button allows the user to save event data to a CSV file for further analysis in Excel® or other software.

EPSS data log groups: Inputs can be assigned to a group for data logging purposes. If any input in a group changes state, then the states of all group members are recorded in its EPSS data log. This enables specialized reporting for mandatory tests of emergency power supply systems (EPSS) to document compliance with standards for healthcare and other critical-power facilities.

Operations counters: Operations counters are maintained for all 32 channels (inputs), with date/time of last reset. Each channel can be reset individually.

Ethernet communications: Network data communications to a host system are supported via 10/100BaseTx Ethernet using Modbus TCP and/or RESTful web service. The device also features an embedded secure web server to simplify setup, operation, firmware updates and file transfers. In addition, PTP (Precision Time Protocol (IEEE 1588) or NTP (Network Time Protocol) can be used for time synchronization over Ethernet.

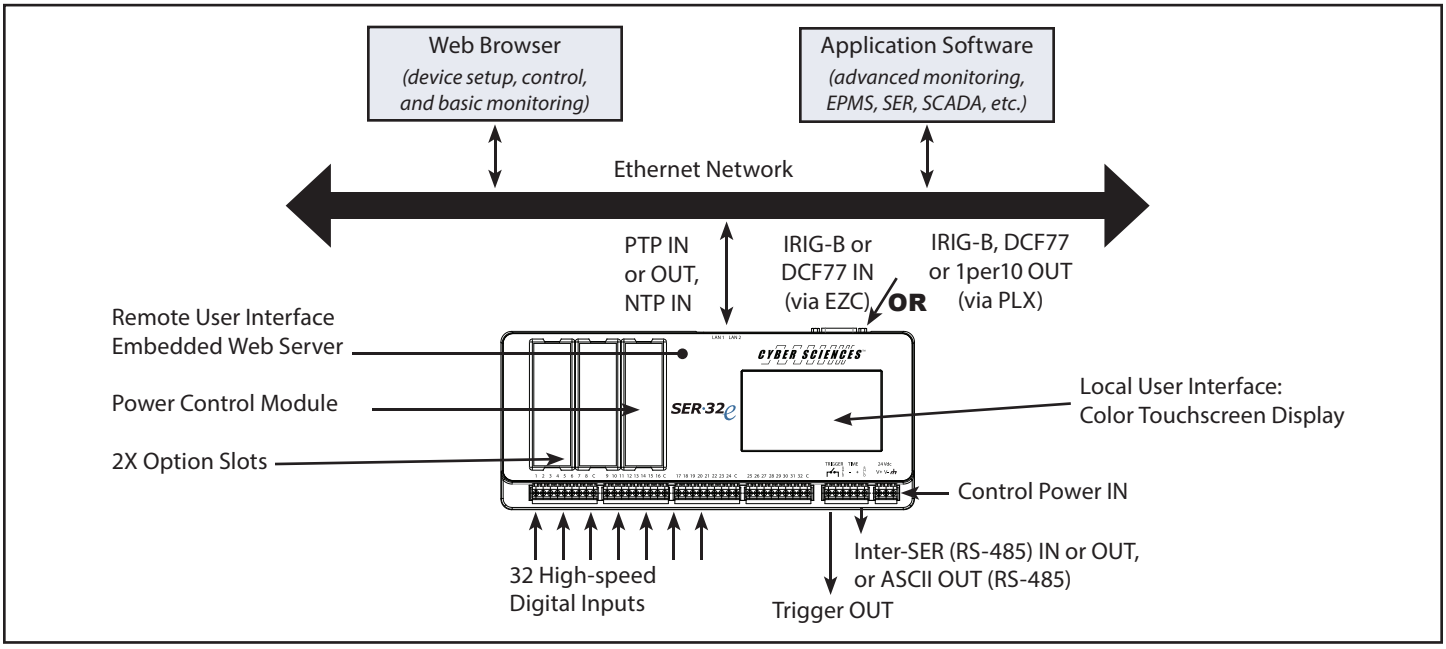


Figure 1-1. CyTime Sequence of Events Recorder SER-32e product overview

Product Overview (cont.)

Status monitoring examples:

- *Breaker status: open/closed/tripped*
- *Breaker control switch: open/close commands*
- *Relay trip signal: normal/trip*
- *Auto-transfer switch (ATS) status: normal/emergency/test*
- *Control scheme status: auto/manual/test*
- *UPS status: normal/bypass*
- *Generator status: stopped/running*
- *Battery status: normal/alarm*

Time synchronization (PTP). High-resolution time sync (100 µs) is supported using PTP (Precision Time Protocol, per IEEE 1588) over the Ethernet network used for data communications. (Timestamps ± 0.5 ms.) The SER-32e can be configured as the PTP master (grandmaster clock for all other SERs and PTP-compatible devices) or a PTP slave, synchronized to a PTP grandmaster (another SER or third-party clock).

Time synchronization (other protocols). Hi-res time sync (100 µs) using legacy protocols such as 'IRIG-B (unmodulated) or DCF77' is also supported. (Timestamps ± 0.5 ms.) NTP or Modbus TCP time-sync are supported, but accuracy depends on network design and is typically ± 100 ms or more.

Time-sync master. One SER can serve as a time-sync master to other devices via PTP or an RS-485 subnet. RS-485 serial protocol is either IRIG-B or DCF77 (per the input time source) or ASCII (selectable). When PTP or NTP is the time source, an SER can output IRIG-B, DCF77 or 1per10 using an optional interface (PLX-5V or PLX-24V).

Trigger output. Any input can be configured to close a high-speed output contact to trigger an associated action, such as a power meter's capture of voltage and current waveforms coincident with an event. The trigger occurs in the same millisecond interval during which the event is detected, with no filtering applied.

Multiple Modbus masters. The SER supports data access from multiple Modbus TCP masters (up to 44 simultaneous Modbus connections). This enables integration of multiple systems and flexibility in how application software manages sockets.

Settings stored in non-volatile memory. All settings are stored in non-volatile flash memory in XML file format. Configuration is accomplished using a standard web browser, or by modifying the setup file directly (by advanced users).

Benefits

Benefits for end users, system integrators and OEMs include:

Time-critical information for root-cause analysis (1 ms)
Time-stamped record of events—up to 8192 events stored in non-volatile memory.

Reliable event recording with "zero blind-time"
Event-recording engine records all events, even those occurring in rapid succession.

Advanced troubleshooting
High-speed trigger output to capture waveforms by a compatible power meter.

Simple setup using a web browser—no proprietary software
Embedded web server hosts user-friendly pages for setup and monitoring.

No maintenance required
Event data and user setup data is stored in non-volatile flash memory.

Easy system integration
Integrate with multiple systems via Ethernet: Modbus TCP, RESTful API and secure web interface.

Flexible time synchronization choices
PTP, IRIG-B, DCF77, NTP, Modbus TCP or SER inter-device (RS-485).

EPSS generator test-compliance reports enabled
16 data logs: when any group member changes state, all members' states are recorded.

Easy replacement
If a unit ever needs to be replaced, settings are transferable via XML setup file.

Regulatory approvals to global standards
UL-Listed (UL/IEC 61010), CSA 22.2, CE, RCM, RoHS-compliant.

Key Features

The CyTime SER-32e Event Recorder is designed to be mounted on a standard DIN rail. The table below gives a description of each key feature.

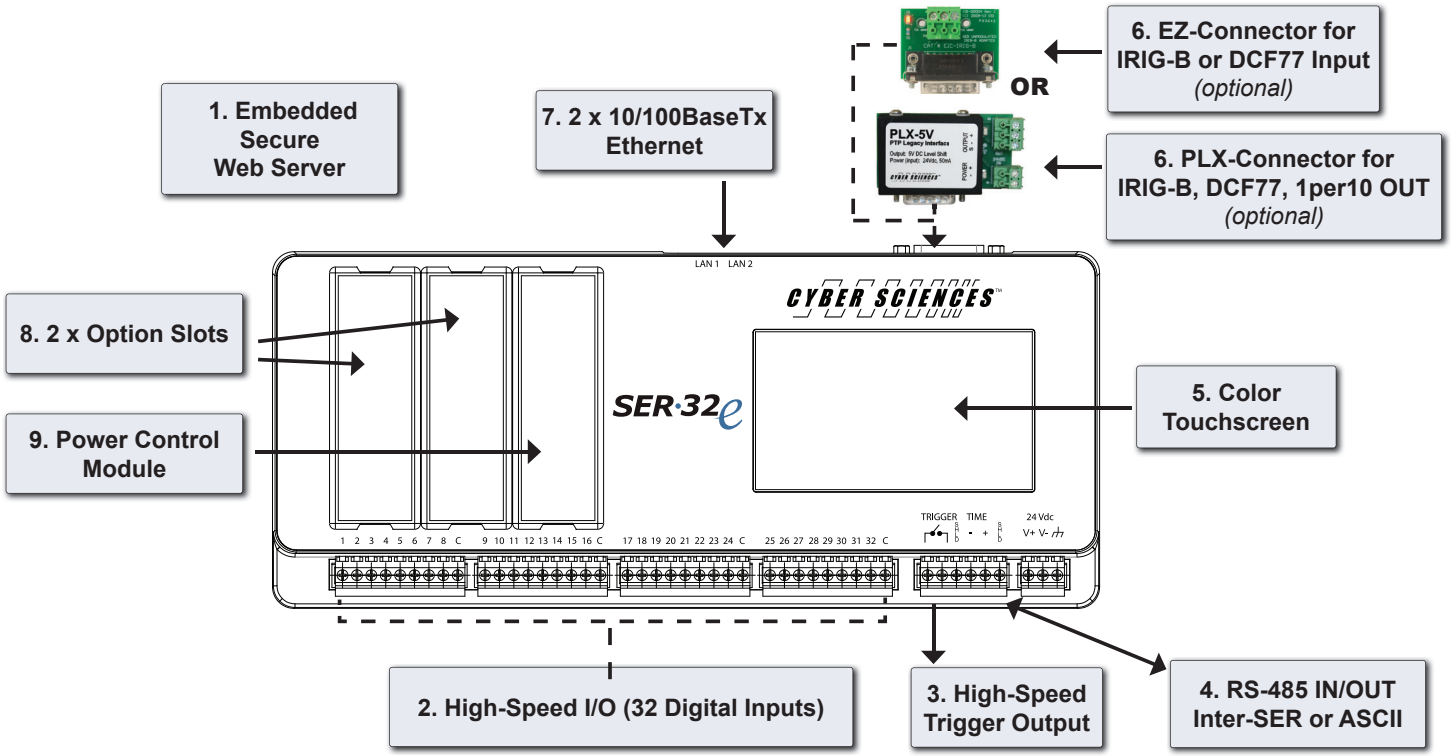


Figure 1-2. CyTime Event Recorder key features

Table 1-1—Key Features

Feature		Description
①	Embedded Secure Web Server	Set up the device, monitor status, counters, diagnostics, and view event log records. Use web browser for firmware updates, manage security certificates, and upload/download configuration files.
②	High-Speed I/O	32 digital inputs in four (4) groups of eight (8) inputs.
③	High-Speed Trigger Output	Digital output contact which can be configured to close momentarily on state change of one or more inputs to trigger an action, such as a waveform capture (WFC) by a compatible power meter.
④	Time Sync IN/OUT (RS-485)	Time sync OUT (when serving as a time-sync master to other devices) or time sync IN (when synchronized to another SER time-sync master) over RS-485 (2-wire plus shield). ASCII / RS-485 output is selectable.
⑤	Color Touchscreen	Color resistive touchscreen display (4.3" TFT, 480 x 272 pixels) for local access to status, events and setup parameters. User configurable brightness and screen saver.
⑥	EZC-IRIG-B/DCF77 (IN) or PLX-5V/PLX-24V (OUT)	DB-15-to-screw-terminal connector: EZ Connector (EZC) to accept IRIG-B or DCF77 time source (IN), or PLX (PLX-5V or PLX-24V) to output IRIG-B, DCF77 or 1per10 (OUT).
⑦	Ethernet Interface (10/100BaseTx)	Two Standard Ethernet RJ-45 network interface, with indicator LEDs for speed (10 or 100 Mbps) and link/activity. The SER auto-detects Ethernet wiring polarity and network speed.
⑧	Expansion Slots	Two expansion slots for future I/O expansion modules.
⑨	Power Control Module	Provides over 10 seconds of control power ride-through to ensure power system events are recorded. Includes replaceable battery for RTC (Real-Time Clock) backup.

Ordering Information

The following models and accessories are available for the CyTime SER-32e:

Table 1-2— CyTime SER and accessories catalog numbers

	Catalog no.	Description
Sequence of Events Recorder (SER)	SER-32e	CyTime Event Recorder, 32-input, PTP, secure web, 2x option slots, control power ride-thru
Accessories	EZC-IRIG-B	EZ connector for SER (input: IRIG-B time source)
	EZC-DCF77	EZ connector for SER (input: DCF77 time source)
	PLX-5V	PTP Legacy Interface (5V DCLS, for unmodulated IRIG-B output)
	PLX-24V	PTP Legacy Interface (24V DCLS, for DCF77, 1per10 or 24V IRIG-B output to STR-IDM)
	PLXe-5V	PTP Legacy Interface Self Powered (5V DCLS, for unmodulated IRIG-B output)

2—INSTALLATION

Dimensions

The dimensions for the CyTime SER-32e Event Recorder are illustrated below.

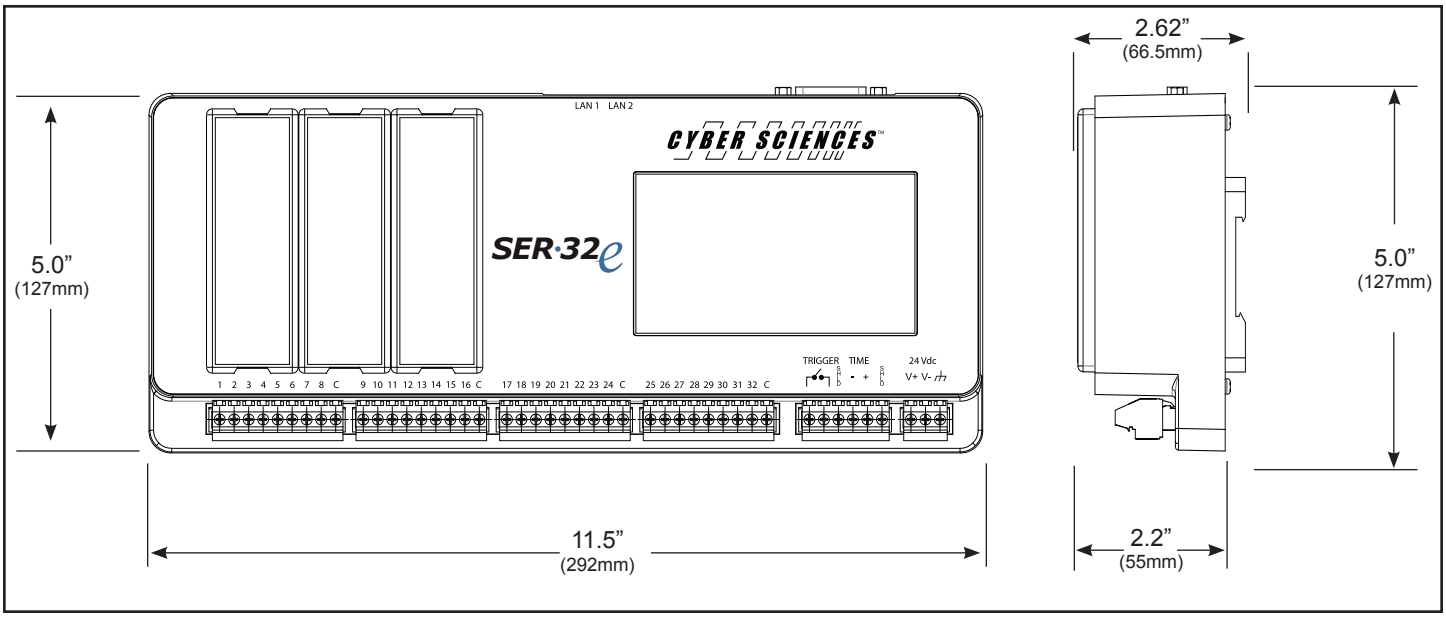


Figure 2-1. Front and side views, with dimensions—SER-32e

Mounting Considerations

The CyTime Event Recorder is designed to be mounted on a standard DIN rail in the orientation shown below. When choosing a mounting location, consider the following:

- Allow for easy access.
- Allow space for all wires to be neatly routed away from the device.
- Allow sufficient ventilation to stay within the operating temperature limits of the device (see section 7—Specifications).

Typical locations for mounting the SER include the following:

- Power equipment cell or compartment.
- Office or raised-floor environment.
- Auxiliary control panel or cabinet.

DIN-rail Mounting

The SER-32e is mounted to a standard (35mm) DIN rail by engaging the bottom edge first, then rotated into place as shown below:

① Start by engaging the lower edge of both DIN-mounting brackets with the bottom of the DIN rail as shown.

② Then raise the device to compress the spring-loaded jaws in the bottom clips to allow clearance for the edge of the top clips.

③ Rotate the top of the device to vertical...

④ ...and then lower the device into place onto the DIN rail.

To uninstall, simply reverse this process: raise the device (to compress the bottom springs) and then rotate the top outward.

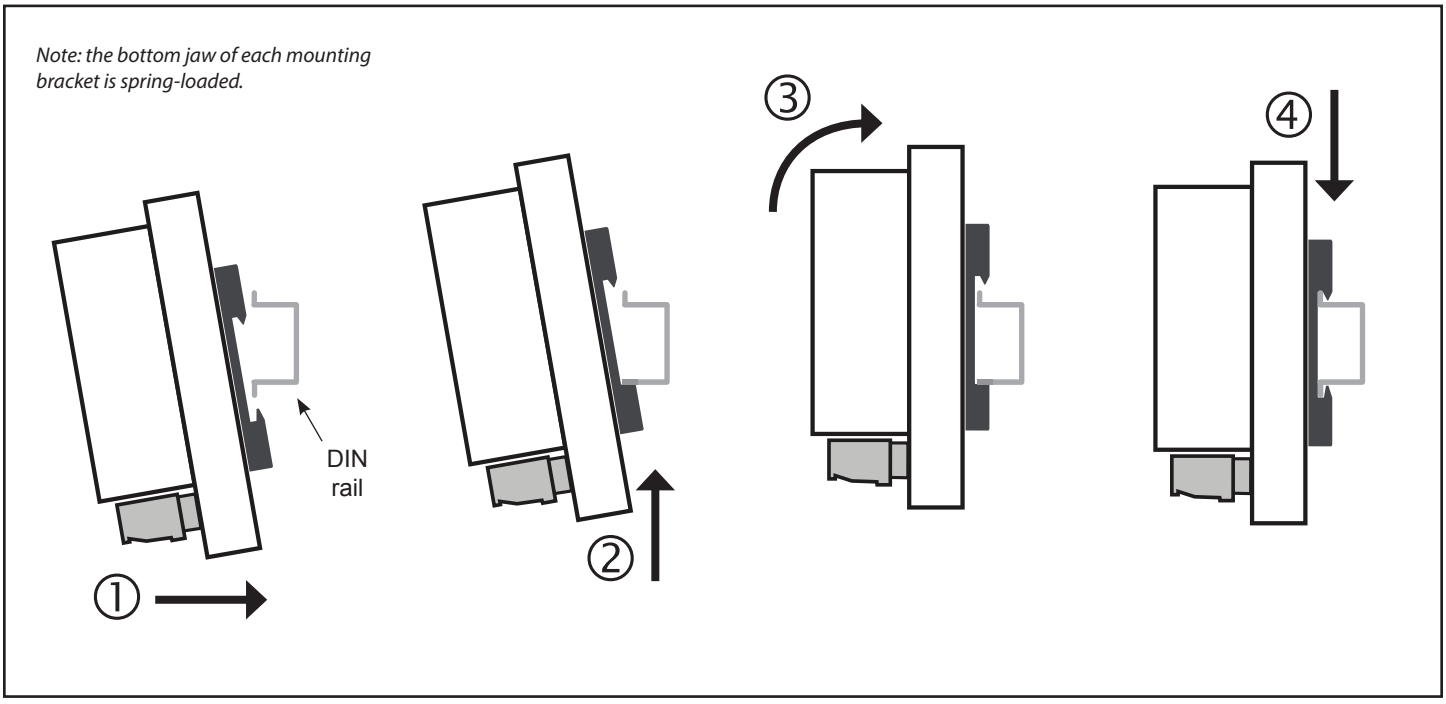


Figure 2-2. DIN-rail mounting (side views)

3—WIRING

Wiring Connections for SER-32e

Note: With PTP or IRIG-B time source, the CyTime SER typically requires 30 seconds to lock onto the precision time reference (Time Quality = Good). DCF77 may require up to 10 minutes.

An overview of wiring connections for the CyTime SER-32e is shown below. Wiring connections include two (2) Ethernet network interface RJ-45 connectors *(either Ethernet interface port can be used, but not at the same time),* time source input, digital inputs, control power input, optional trigger output, and optional time-sync IN or OUT (via RS-485 and/or PLX-5V or PLX-24V).

Removable plug-in, screw-terminal connectors are provided for connections at bottom. Optional adapters convert the DB-15 options connector to a screw-terminal connector to support input or output of legacy protocols, such as IRIG-B or DCF77.

32 digital inputs (numbered 1-32) are divided into four (4) groups of eight (8), each sharing a common return (marked "C").

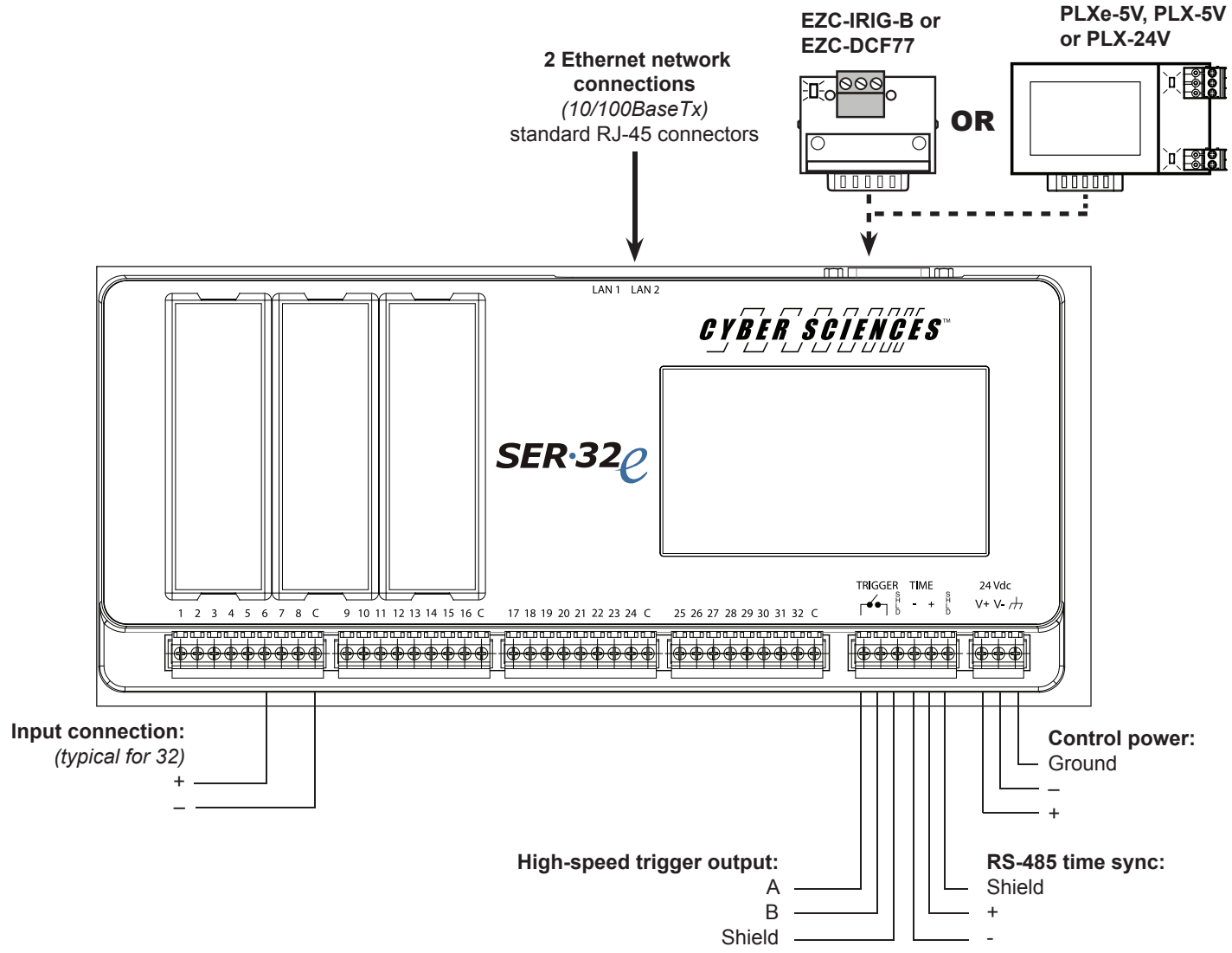


Figure 3-1. SER-32e wiring connections

Digital Inputs (SER-32e)

The SER-32e has 32 isolated digital inputs arranged in four (4) groups of eight (8), each sharing a common return, wired as shown.

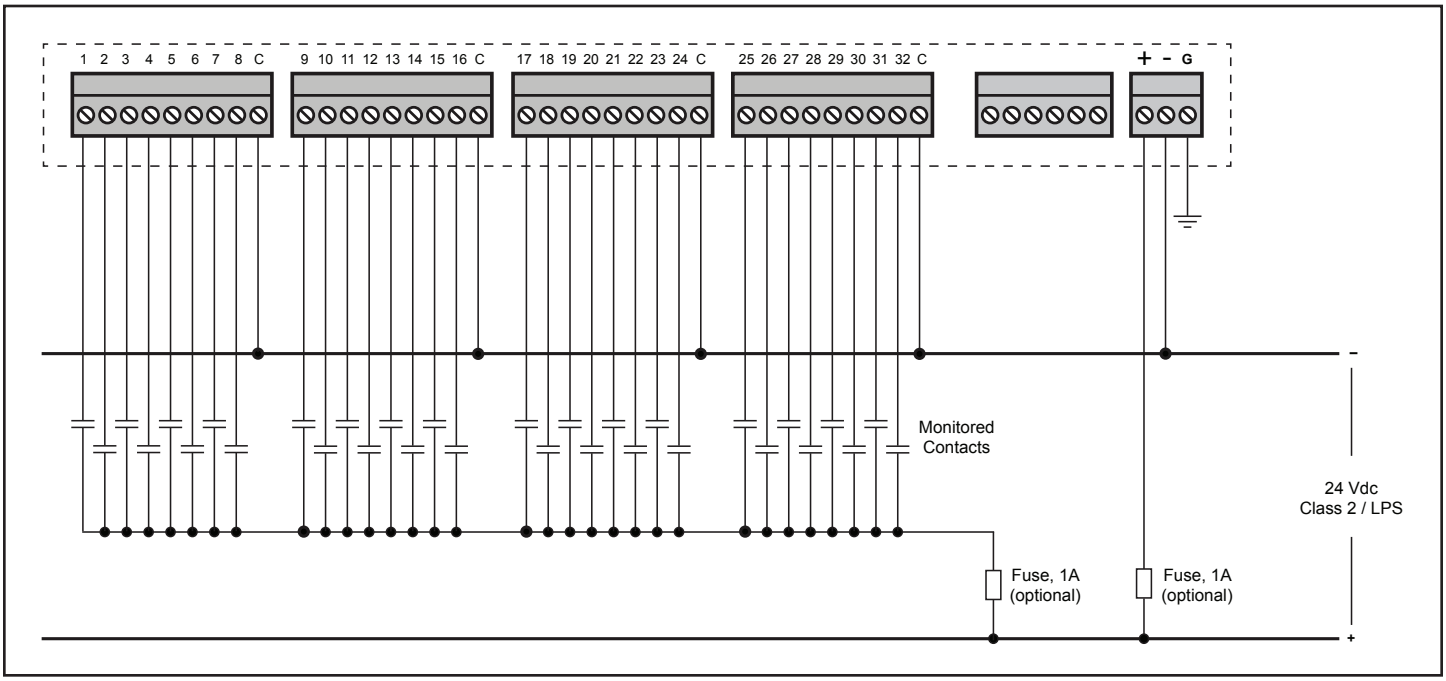


Figure 3-2. Digital input wiring connections (SER-32e)

Control Power

The CyTime SER-32e requires a control power source with nominal voltage of 24 Vdc. The control power connector has three terminals: 24 Vdc positive and common connections and a chassis ground connection (green-wire ground).

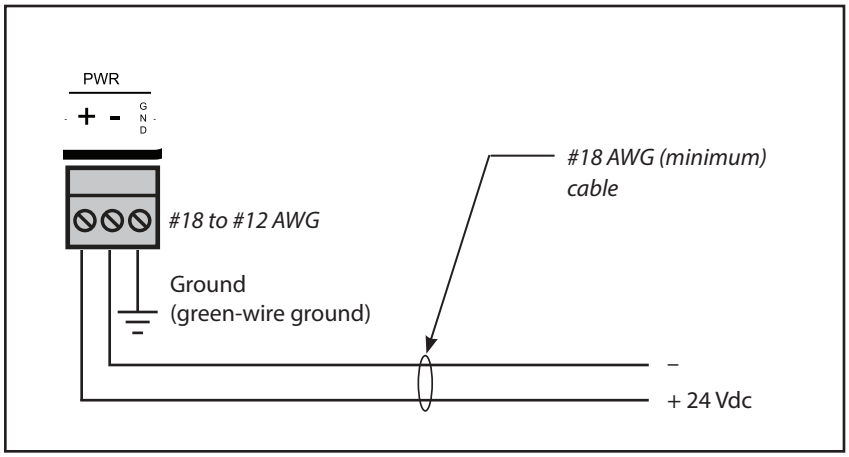


Figure 3-3. Control power connections

Time Sync (PTP Master or Slave)

The CyTime SER-32e Event Recorder supports PTP (per IEEE 1588). User setup determines whether the device functions as a PTP master or PTP slave (or neither). The SER-32e offers several time-sync input and time-sync output options, as well as trigger output for waveform capture. PTP can be used in conjunction with these capabilities to form a flexible system that is compatible with third-party clocks and can "PTP-enable" meters and relays that currently support only legacy protocols.

In the example shown in Figure 3-6, one or more CyTime Event Recorders are configured as PTP slaves and sync automatically with a GPS clock (by others) which serves as PTP master (grandmaster).

PTP time sync is accomplished over the same Ethernet network used for data communications using a standard Ethernet cable (e.g. Cat 5e).

Alternatively, a CyTime SER-32e can be the PTP master. In the example shown in Figure 3-7, the first CyTime Event Recorder serves as PTP grandmaster; all other SERs sync automatically using PTP over the Ethernet network. The SER serving as grandmaster may use any convenient time source: IRIG-B, DCF77, NTP or even periodic updates from an EPMS server using Modbus TCP or RESTful API over Ethernet.

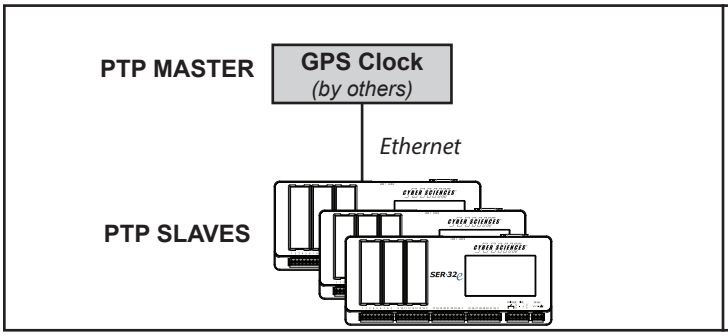


Figure 3-4. SER-32e as PTP slave(s) using PTP over Ethernet to sync with PTP master clock by others

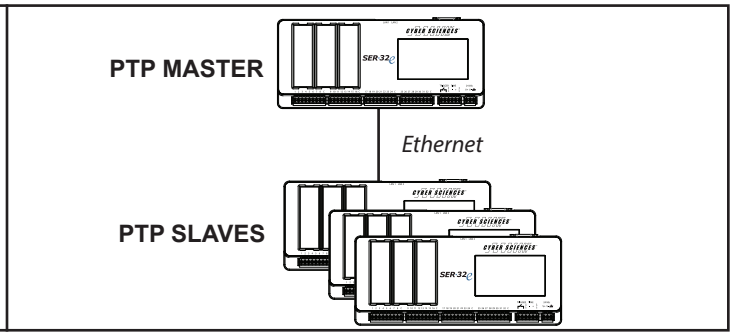


Figure 3-5. One SER-32e is PTP master and syncs all other SERs (PTP slaves) over Ethernet

Time Sync IN (IRIG-B or DCF77)

The CyTime SER accepts IRIG-B or DCF77 time reference via its DB-15 options connector at the top of the device. An optional wiring accessory (EZC-IRIG-B or EZC-DCF77) facilitates wiring as shown in the figure below.

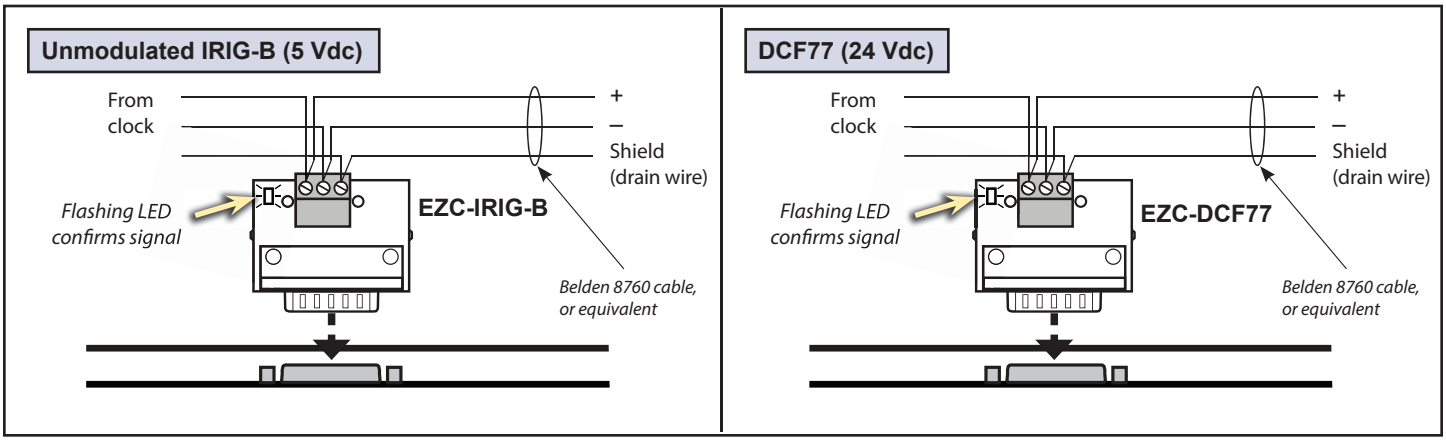


Figure 3-6. CyTime SER uses optional EZC-IRIG-B or EZC-DCF77 to accept time source of IRIG-B or DCF77, respectively

Time Sync OUT (IRIG-B, DCF77 or 1per10)

When the time source is PTP or NTP, the CyTime SER can be configured to output a legacy protocol (IRIG-B, DCF77 or 1per10) via its DB-15 connector using a PLX, type PLXe-5V, PLX-5V or PLX-24V, as shown below.

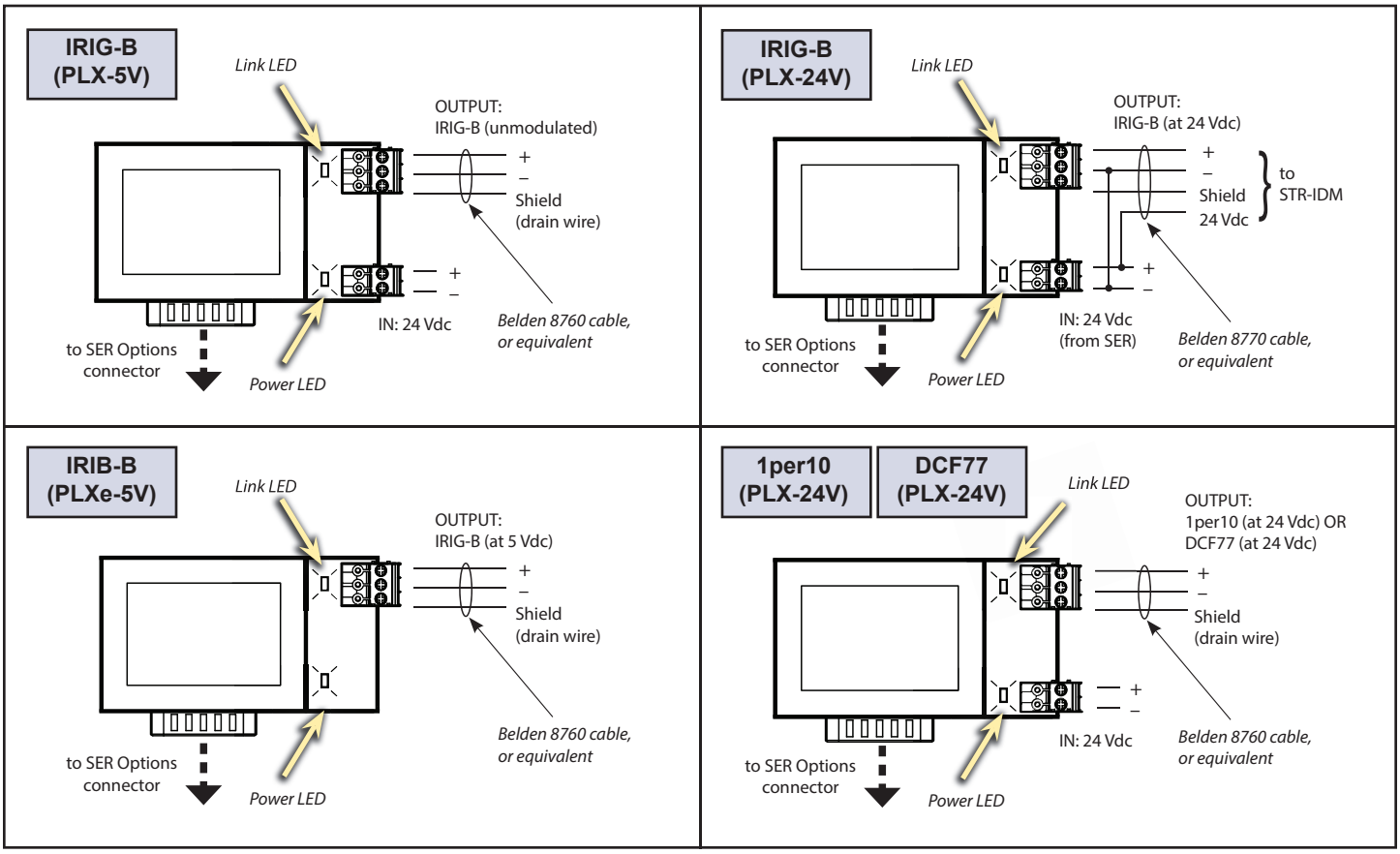


Figure 3-7. CyTime SER uses PLXe-5V, PLX-5V or PLX-24V to output legacy protocols (IRIG-B, DCF77 or 1per10) at 5V or 24V, respectively

RS-485 Time Sync IN/OUT (Inter-SER or ASCII OUT)

The CyTime SER inter-device time-sync (RS-485) can be wired to one device or daisy-chained to multiple devices. This is also used to output ASCII/RS-485: an ASCII string originally defined by Arbiter Systems called "ASCII + QUAL" (9600 bps). This consists of an on-time mark (OTM) once per second followed by ASCII representation of the date/time and time-quality as follows:

```
<soh>ddd:hh:mm:ssQ      where: soh = Hex 01 (start bit = OTM) and
Q = time quality (space = locked, ? = unknown)
```

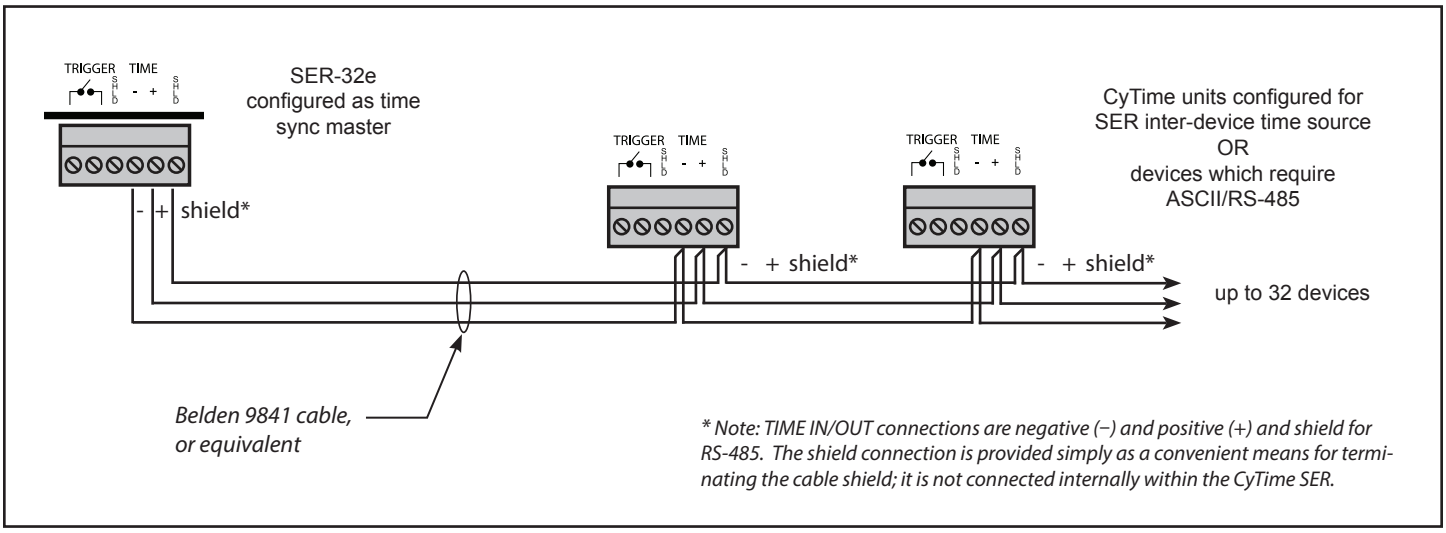


Figure 3-8 SER inter-device (RS-485) time sync input/output or ASCII/RS-485 time-sync output

Trigger Output (to One or More Devices)

The Trigger Output can be wired to a single device or in parallel to multiple devices as shown in the figure below. (Note: trigger output is available with all models.)

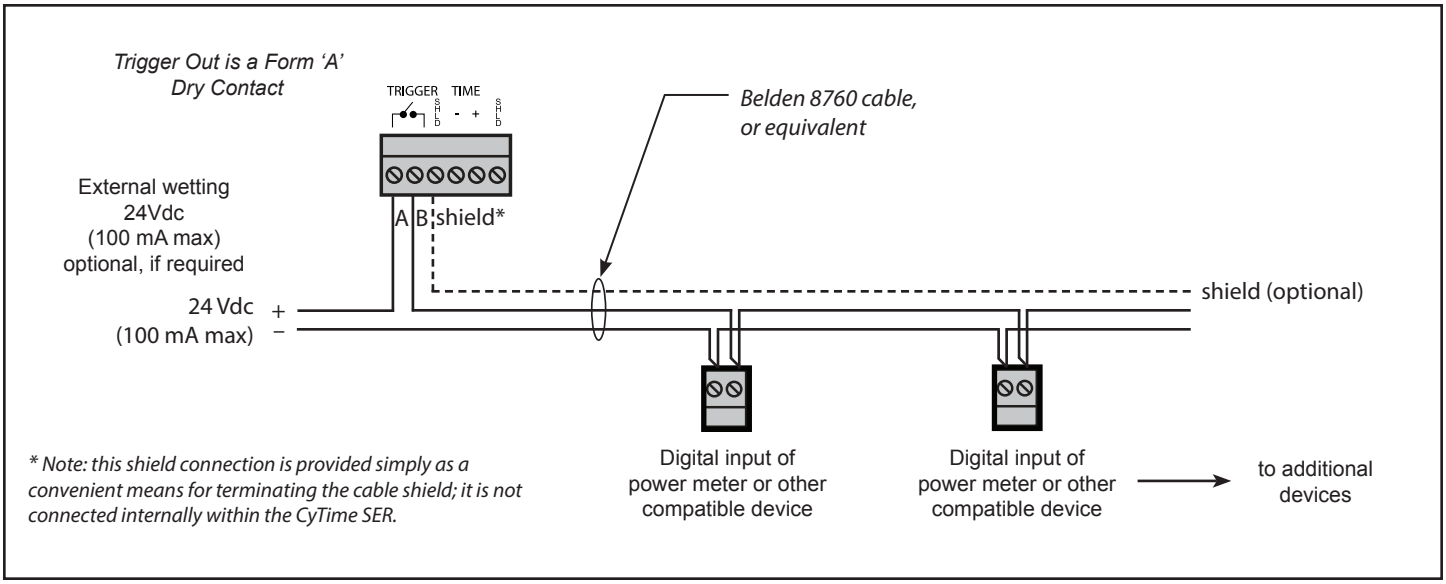


Figure 3-9. Trigger output connection to multiple devices

4—OPERATION

Local Display and Keypad

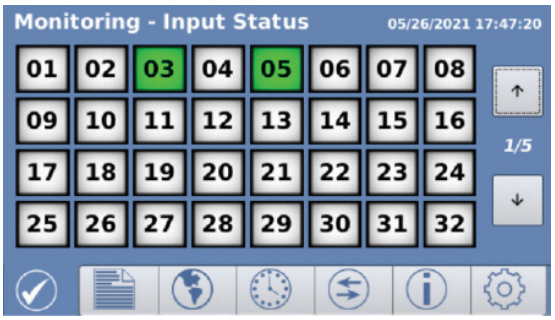


Figure 4-1. Color Touchscreen

The CyTime SER-32e features a 4.3" color TFT (480 x 272 pixels) touchscreen display to provide local access to status, events and setup parameters.

The SER screen displays viewing options to verify correct operation, including current date/time, time quality and time zone offset. In addition, communications parameters (DHCP, IP address, subnet mask, and default gateway) can be set or modified via "Setup-Communications".

Menu structure and reference icons are shown below.

LEGEND

- Monitoring
- Events
- Communications
- Time
- Input
- Diagnostic
- Setup

Touchscreen Menu Structure

Monitoring
- **Input Status** — Input - ON/OFF
- **Input Counters (1-8)** — Operation Counters
- **Input Counters (9-16)** — Operation Counters
- **Input Counters (17-24)** — Operation Counters
- **Input Counters (25-32)** — Operation Counters

Events
- **Event Log** — Up to 8192 Events

Communications
- **Communication Information**
  - Eternet Port
  - DHCP Status
  - IP Address
  - Subnet Mask
  - Default Gateway
  - Modbus Server
  - Modbus Clients

Time
- **Time Information**
  - Source Setup
  - Source Actual
  - Time Quality
  - Time Sync Master
  - Output Type
  - Output TZ Offset (PLX)
  - Output TZ Offset (ASCII)
- **Time PTP**
  - Port State
  - Clock Class
  - Clock Accuracy
  - Clock Source
  - GM Clock ID
  - Domain Number
- **Time - Zone Info**
  - Time Zone Offset
  - DST Enable
  - DST Start
  - DST End
  - Last NTP Sync Time
  - Last NTP Sync Server

Input
- **Input Status**
  - Name
  - Event Recording
  - Inverted
  - Trigger Enabled
  - Filter (ms)
  - Debounce (ms)
  - Chatter
  - ON Text
  - OFF Text

  (1 page per input)

Diagnostic
- **Diagnostic Info**
  - Device ID
  - Device Name
  - Catalog Number
  - Date of Manufacture
  - Serial Number
  - Firmware Version
  - Hardware Version
  - Temperature
- Overall Status
  - Event Processor
  - Time Processor
  - System Module
  - DHCP Status
  - NTP Server
  - Storage
  - XML Setup File
  - RTC Battery
  - SVM Status

Setup
- **Communications**
  - DHCP
  - IP Address
  - Subnet Mask
  - Default Gateway
- **Admin**
  - Login Credentials - Reset
  - Device - Restart
- **Display**
  - LCD ON Intensity
  - LCD Idle Intensity
  - LCD ON Timeout (minutes)

Figure 4-2. LCD display menu structure (model SER-32e example shown)

Initial Setup via Display

To change communications settings from the SER front panel, select the GEAR icon (⚙) and press the EDIT button (page 1/3):

Use the ARROW keys (▼▲) to scroll to the desired screen.

For each screen:

- Press the ARROW keys (▼▲) to select the desired value or enter the desired value using the provided keypad.
- For each screen press EDIT / RESET / RESTART, modify values then press NEXT / APPLY.
- Touch any icon to exit setup for that screen.

The SER allows you to configure the touchscreen display for maximum viewing or to conserve energy. The SER's display has 8 intensity settings (0 - 7) and an ON timer to reduce the display intensity or turn the display OFF until touched. Default settings are ON intensity = 6, IDLE Intensity = 0, Timeout = 5 (minutes)

The SER provides administrative functions to reset login credentials (in case they are lost) and to restart the device.

To reset login credentials, press the GEAR icon to access the Setup - Administration menu.

- Press the down arrow to access Page 2/3.
- Press the 'Reset' button next to 'Login Credentials'.
- Press the 'Confirm' button to reset login credentials to factory default or 'Cancel' to return to the previous menu.

This action will reset the SER login credentials to factory defaults for 5-minutes. (user name = 'admin', password = 'csi_serial number'). Log into the SER using a web browse to set the desired user name and password. If the action is not completed within 5 minutes, the SER login credentials will be restored to the pervious values.

To Restart the SER, press the GEAR icon to access the Setup - Administration menu.

- Press the down arrow to access Page 2/3.
- Press the 'Restart' button next to 'Device'.
- Press 'RESTART' button in 'Confirmation' screen to restart the SER.

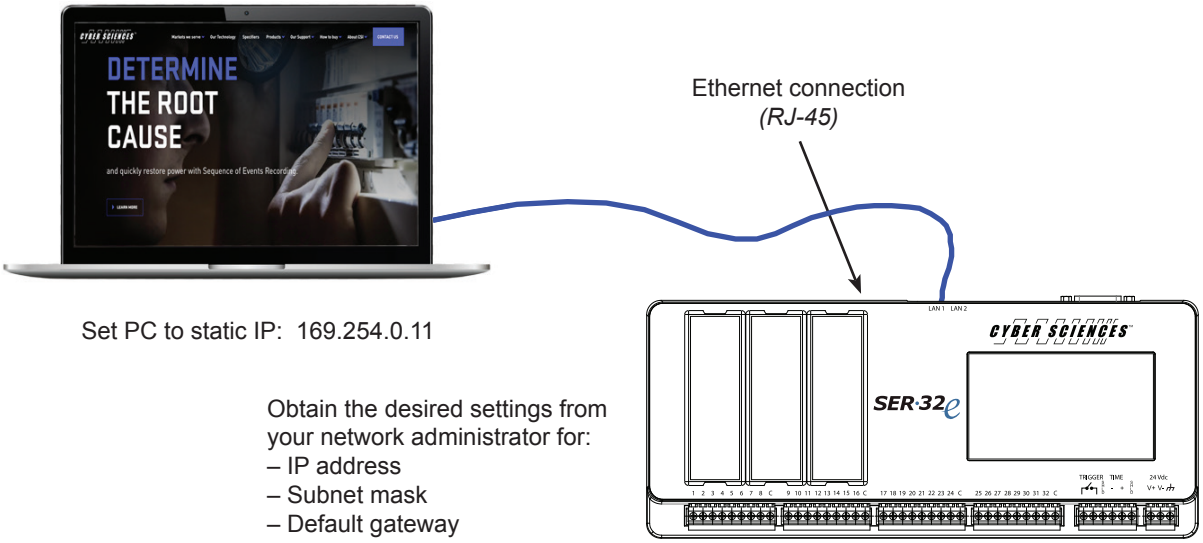
Figure 4-3. Initial setup via LCD/keypad

Table 4-1— Initial communications settings

Option	Description	Available values	Default
DHCP enabled	When enabled, the SER automatically obtains an IP address from a DHCP server at startup.	enabled or disabled	disabled
IP address	The network (IP) address of the SER.	0.0.0.0 to 255.255.255.255	169.254.0.10
Subnet mask	The Ethernet IP subnet mask of your network.	0.0.0.0 to 255.255.255.255	255.255.0.0
Default gateway	The IP address of the gateway (router) serving the SER.	0.0.0.0 to 255.255.255.255	0.0.0.0

5—SETUP (WEB SERVER)

Initial Setup via Web Page (Direct-connect)



The SER has two (2) Ethernet ports (LAN1 / LAN2). Either port can be used, but only one can be connected at a time. If two ports are connected, only LAN 1 will be active.

Figure 5-1. Initial setup connection

Note: Initial setup of communications parameters can also be done via the front touchscreen. See previous page.

Direct connection to PC.

1. Connect the SER to your PC using a standard Ethernet patch cable. (The SER auto-detects wiring polarity— a special crossover cable is not required.)
2. Set PC to use static IP address of 169.254.0.11.
3. Apply power to the SER.
4. Open a standard web browser (Edge, Chrome and Firefox are recommended).
5. Type the default IP address 169.254.0.10 into your web browser.
6. Enter the default user name (admin) and password (csi_serial number) and click "Login" to access the home page.
7. Click the Setup tab, then change the network settings to those provided by your network administrator and click "Update" to save.
8. Disconnect the Ethernet patch cable and connect the SER to your local area network. Continue to the next section for additional setup.
9. Restore your PC to its previous network settings. (e.g., "Obtain IP address automatically.")

Setup via Web Page (Over a Network)

Setup can be accomplished over an Ethernet network using a standard web browser.

At the login screen, enter user name (default = admin) and password (default = csi_ device serial number).

Figure 5-2. Setup via standard web browser: login screen

As shown below, the monitoring screen appears. Clicking the setup tab provides access to setup parameters.

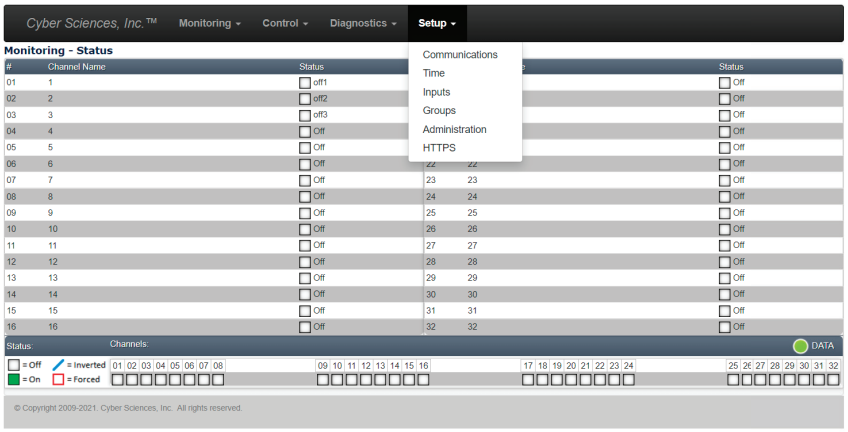


Figure 5-3. SER home web page (Monitoring screen)

Communications Setup

The SER features a standard Ethernet interface (10/100BaseTx) for connection to a local area network (LAN). The device auto-detects LAN used, wiring polarity and network speed (10 or 100 Mbps). To configure communication parameters, click "Communications" under the Setup tab to bring up the communications setup web page.

Note: The "Defaults" button loads default settings for the displayed page only, and changes are not saved until the user hits "Apply" and confirms. To set all setup values to default settings, visit all setup pages and click "Defaults" (followed by "Apply" to save changes.)

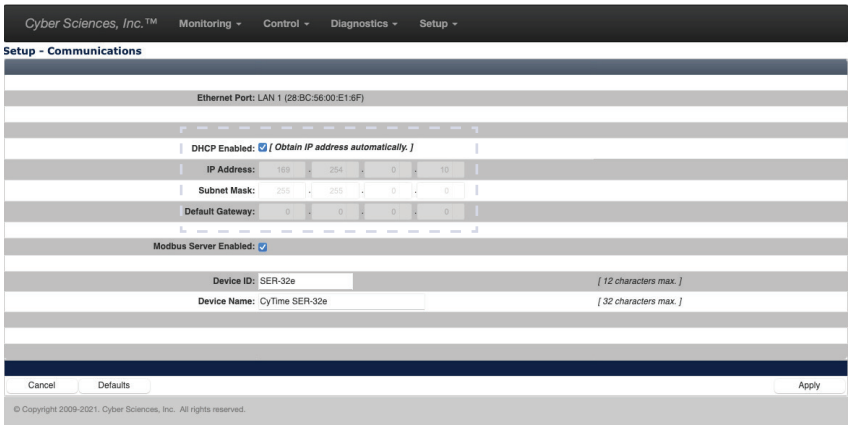


Figure 5-4. Communications setup web page

Table 5-1— Communications settings

Option	Description	Available values	Default
MAC Address	The physical address of the SER Ethernet port (unique value assigned at factory per port).	hh-hh-hh-hh-hh-hh (read-only)	assigned at factory
DHCP Enabled	When enabled, the SER automatically obtains an IP address from a DHCP server at startup.	enabled or disabled	disabled
IP Address	The network (IP) address of the SER.	0.0.0.0 to 255.255.255.255	169.254.0.10
Subnet Mask	The Ethernet IP subnet mask of your network.	0.0.0.0 to 255.255.255.255	255.255.0.0
Default Gateway	The IP address of the gateway (router) serving the SER.	0.0.0.0 to 255.255.255.255	0.0.0.0
Device ID	ID assigned to the SER (used by some PLCs and application software).	UTF-8 text string, ① 12 characters max	CyTime SER
Device Name	Descriptive name assigned to the SER (used by SER web pages and some application software).	UTF-8 text string, ① 32 characters max	CyTime Event Recorder
Disable Modbus TCP	When security is of utmost importance, the Modbus TCP interface can be disabled and data can be accessed using a RESTful API over secure connection (HTTPS).		Modbus TCP - ON

① *Only the following special characters are available:* ! @ # $ & * ( ) _ - + = { } [ ] ; . ~ ` '

Time Setup

Clicking "Time" under the setup tab brings up the time setup web page:

Note: Only one protocol can be selected for output via the PLX connector (IRIG-B, DCF77 or 1per10).

Note: The accuracy of NTP time sync depends on external factors; therefore, when the SER time source is NTP, the SER uses only two states for Time Quality as follows: Time Quality = "2:OK (NTP)" if locked to a server, or "3: Bad (no sync)" if no NTP server is found.

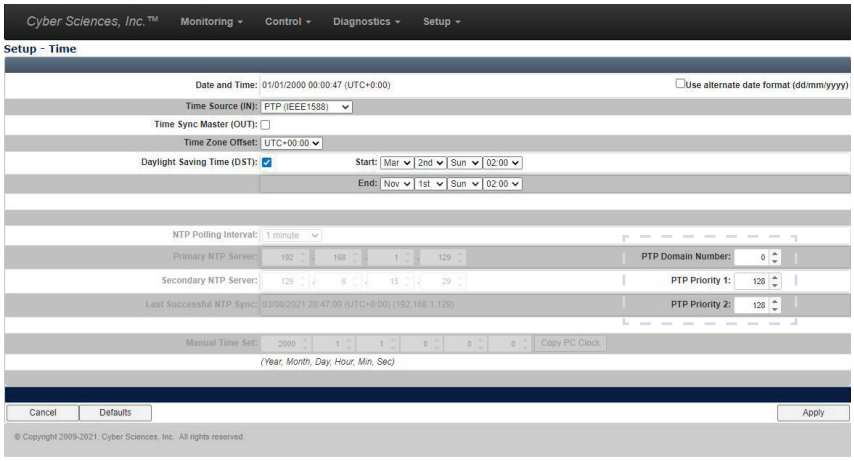


Figure 5-5. Time setup web page (with PTP time source setting shown)

Table 5-2— Time settings

Option	Description	Available values	Default
Time Source (IN)	Specifies the time source input: – IRIG-B (unmodulated, 5V DCLS) – DCF77 – SER inter-device (IRIG-B or DCF77 over RS-485) – PTP (per IEEE 1588) – NTP (network time server) – Manual time set (external time-sync)	IRIG-B, DCF77, Inter-SER (IRIG-B), Inter-SER (DCF77), PTP (IEEE 1588), NTP, or Manual (external)	PTP (IEEE 1588)
Time Sync Master (OUT)	Indicates if this SER also serves as the master time source for other devices. (Not applicable if time source is RS-485).	enabled or disabled	disabled
Time-sync Output	Specifies the output protocol (if time-sync master enabled): – PTP master (over Ethernet); – IRIG-B or DCF77 or 1per10 (via PLX adapter); – IRIG-B or DCF77 or ASCII (over RS-485)	PTP, IRIG-B, DCF77, 1per10, IRIG-B (RS-485), DCF77 (RS-485), or ASCII (RS-485)	none
Time Zone Offset	Offset in hours and minutes from Coordinated Universal Time (UTC) to adjust time for local time zone.	-12:00 to +13:00	0 (UTC+00:00)
Apply Offset to: PLX	Apply time zone offset to IRIG-B or DCF77 output via PLX	enabled or disabled	disabled
Apply Offset to: ASCII	Apply time zone offset to ASCII output (RS-485)	enabled or disabled	disabled
Alternate Date Format	The default date format for all display is mm/dd/yyyy When alternate date format is enabled, dd/mm/yyyy is used	enabled or disabled	disabled

Time Setup (cont.)

Note: The ASCII (RS-485) time-sync output option generates a proprietary code defined by Arbiter Systems called "ASCII + QUAL." Typically, this is used to synchronize PowerLogic ION7550/7650 meters from Schneider Electric or 9510/9610 meters from Siemens. Set the meter's time-sync protocol to "GPS:ARBITER" and COM port baud rate to 9600 bps.

Clicking "Time" under the setup tab brings up the time setup web page:

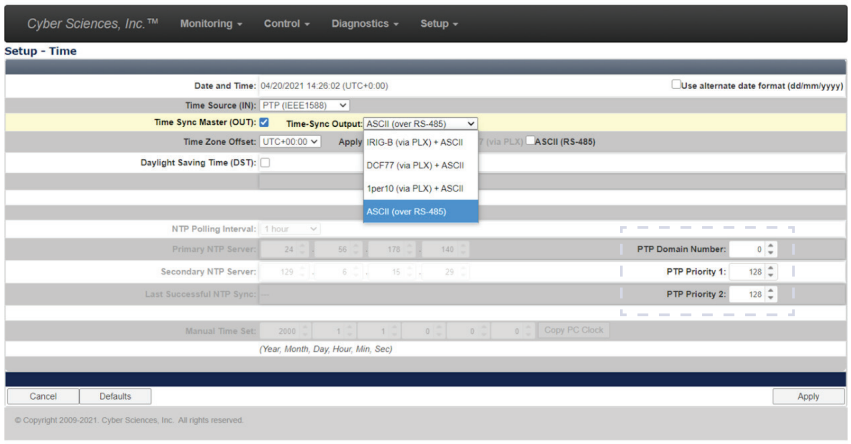


Figure 5-6. Time setup web page

Table 5-2— Time settings (cont.)

Option	Description	Available values	Default
Daylight Saving Time (DST)	Apply DST adjustment (+1 hour) during specified period	enabled or disabled	disabled
DST Start and End ②	Starting and Ending Date/Time to apply DST if enabled	Month: Jan - Dec Week: 1st - 5th (last) Day: Sun - Sat Time: 00:00 - 23:00	US defaults (shown above)
NTP Polling Interval	Interval used to update device clock from a network time server via NTP protocol	1, 2, 5, 10, 15, 30 min, 1, 2, 4, 8, 12 hours, 1 day, or 1 week	1 hour (60 minutes)
NTP Time Server IP (Primary and Secondary)	IP addresses of NTP time servers. (If sync via primary time server fails, device tries secondary time server IP address)	0.0.0.0 to 255.255.255.255	25.56.178.140 (www.nist.gov) 129.6.15.30 (time-c.nist.gov)
Last NTP Sync	Date/time of last successful NTP time sync, as well as the IP address of the NTP time server used	Jan 01, 2000 through Dec 31, 2120	(read-only)
PTP Domain Number	PTP slaves must use same domain number as PTP master	0 to 127	0
PTP Priority 1	For multiple PTP masters, best master clock algorithm uses this value as first "tie-breaker" to select grandmaster	0 to 255	128
PTP Priority 2	For multiple PTP masters, best master clock algorithm uses this value as second "tie-breaker" to select grandmaster	0 to 255	128
Manual Time Set	Allows the date/time to be set manually (external or copy from the PC clock's current date and time)	Jan 01, 2000 through Dec 31, 2120	Jan 01, 2000 00:00:00

Inputs Setup

Clicking "Inputs" brings up the inputs setup web page:

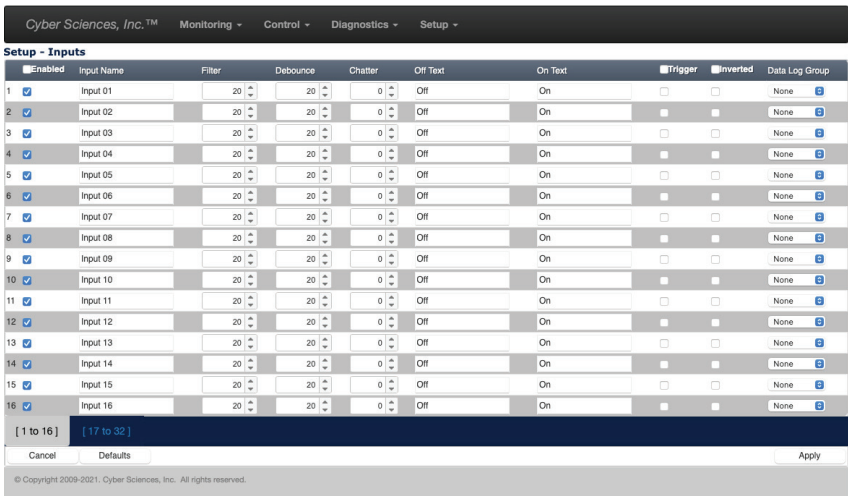


Figure 5-7. Inputs setup web page

Table 5-3— Inputs settings

Option	Description	Available values	Default
Input	Each input can be enabled for event recording. This does not affect status monitoring—only recording of state changes.	enabled or disabled	enabled
Input Name	Text string (UTF-8) to describe a given input.	32 characters max ①	Input nn
Filter	Filter time is the minimum time that an input must remain in its new state before it is recorded as an event. This helps eliminate false events due to noise, transients, etc.	0 to 65535 ms ②	20ms
Debounce	Debounce time is the period that event processing is suspended for a given input after an event has been recorded. This prevents recording multiple events for a single state change.	0 to 65535 ms ②	20ms
Chatter	Chatter count is the maximum number of events recorded for a given input per minute. If the number of events per minute exceeds the setpoint, the input will be disabled for further event processing until the number of events per minute drops below the setpoint. This prevents recording an excessive number of events due to a faulty input. Events are also generated to indicate the time event processing was suspended / resumed.	0 to 255 (0 = disabled)	0 (disabled)
Off Text and On Text	Customized label to describe an input's "off" state and "on" state	UTF-8, 16-char. ①	On / Off
High-speed Trigger Output	Any input can be configured to close the "Trigger Out" contact on status change. This is typically used to trigger a compatible power meter to capture current and voltage waveforms coincident with an event to aid analysis and troubleshooting.	enabled or disabled	disabled
Inverted	Any input can be designated as "inverted" and status reported opposite of its sensed state	normal or inverted	normal
Group Assignment (for Data Logs)	Each input can be assigned to a data log group for reporting purposes	None, or Group 01 to Group 16	None

① *Only the following special characters are available:* ! @ # $ & * ( ) _ - + = { } [ ] ; . ~ ` '

② *Setting this time too low (e.g., < 5 ms) can cause unwanted events to be recorded; setting too high (e.g., > 100 ms) can result in missed events.*

Groups Setup

Clicking "Groups" brings up the Groups setup web page:

Note: To activate EPSS data logging, a group must be enabled, at least one group member defined (via Inputs Setup page) and sufficient space (records) allocated.

Note: Click the "Auto-Allocate" check box to have the system calculate the optimal number of records (equal allocation across all enabled groups). To return to previously saved values, click "Cancel."

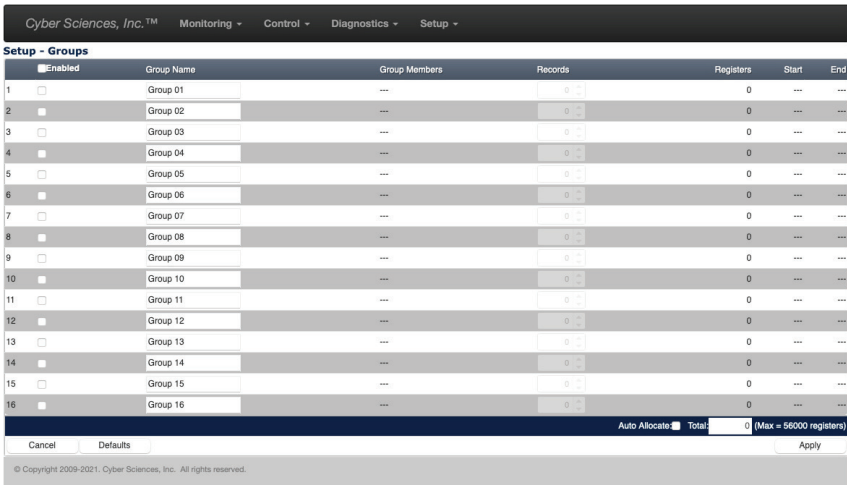


Figure 5-8. Group setup web page

Group assignments are used to establish an association among two or more inputs. For example, three inputs may be assigned to the group representing the normal, emergency and test states of an ATS. Enabling groups, assigning members, and allocating records causes the SER to log the status of all group members in a contiguous memory block accessible using Modbus TCP or RESTful API. This is used by some report modules, such as EPSS test reports, to confirm regulatory compliance. If logging has begun and a group is disabled, data logging for this group is suspended. However, changes to any group's members or allocated records causes all data logs to be cleared and restarted.

Table 5-5— Groups settings

Option	Description	Available values	Default
Group	Each group can be enabled for data logging in the expanded Modbus register area. This does not affect status monitoring—only recording of state changes in the expanded memory area.	enabled or disabled	disabled
Group Name	Text string (UTF-8) to describe a given data log group.	32 characters max ①	Group nn
Group Members	Inputs assigned to this group (from previous setup pages)	Inputs 01 to 32	- - - -
No. of Records (Log File Depth)	Number of records to be allocated to each group's data log, (up to 56000 registers maximum for all records).	0 to 16000	0
No. of Registers	This is calculated as the product of "1 + number of records" times the record length (4 + the number of group members)	0 to 56000 (read-only)	- - - -
Starting Register	Starting register designated for a given group's data log, based on the number of registers allocated.	409501 to 465500 (read-only)	- - - -
Ending Register	Ending register designated for a given group's data log, based on the number of registers allocated.	409501 to 465500 (read-only)	- - - -

① *Only the following special characters are available:* ! @ # $ & * ( ) _ - + = { } [ ] ; . ~ ` '

Administration Setup

Clicking "Administration" brings up the administration setup web page:

Note: It is recommended the user change the user name and password upon setup of the SER-32e for security purposes.

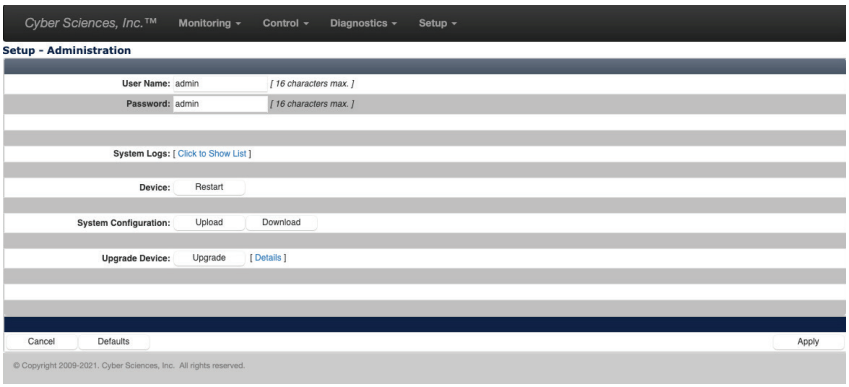


Figure 5-9. Administration setup web page

Table 5-6— Administration settings

Option	Description	Available values	Default
User Name	User name used to log in to the CyTime SER.	UTF-8 text string, ① 16 characters max	admin
Password	Password used to log in to the CyTime SER.	UTF-8 text string, ① 16 characters max	csi_*Serial Number* ②
Restart	Restarts unit. (Note: event recording is suspended momentarily while the device restarts)		
System Configuration			
Upgrade Device			

① *Only the following special characters are available:* ! @ # $ & * ( ) _ - + = { } [ ] ; . ~ ` '

② *Product passwords are unique to each device and include product serial numbers. Example: SER with serial number '12345' would have a password of: csi_12345. Product serial numbers are located on product and packaging labels, and can be found on the SER's diagnostic menu.*

Alternate Setup: Editing XML File

Note: the XML setup file should only be modified by advanced users who are familiar with XML syntax, since errors may cause the unit to malfunction. Please refer to the CyTime SER Reference Guide (IB-SER-05) for additional details.

Setup data is stored in non-volatile memory in an XML file format. Setup changes can therefore be made simply by editing this file using a text editor, such as Windows® Notepad. Standard setup templates can be created and replicated quickly across multiple units.

The setup file can be accessed over a network via the device's web interface through the Administration tab.

To preserve a backup copy of the setup file, go to the Setup / Administration page, download the "_SETUP.XML" to a local directory on a PC. To restore these settings, simply upload the file back to the device (overwrites existing _SETUP.XML file).

HTTPS

Clicking "HTTPS" brings up the HTTPS setup web page:

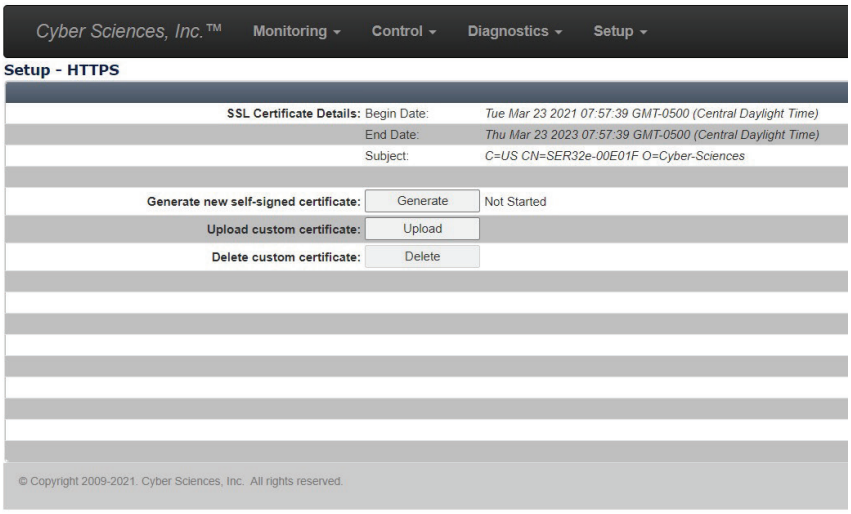


Figure 5-10. HTTPS setup web page

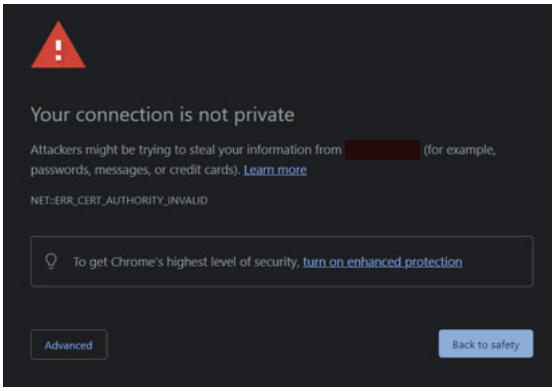


Figure 5-11. HTTPS certificate unrecognized

The SER-32e uses HTTPS to enhance security for all web (port 443) communications. HTTPS (HyperText Transport Protocol Secure) uses TLS (Transport Layer Security) encryption to secure communications and protect data exchanges between a web browser and the SER's web server. The SER ships with a self-signed SSL (Secure Socket Layer) certificate installed. This self-signed certificate will not be recognized as a trusted web server and the web browser will prompt you with a security warning. (Figure 5-11)

To continue to the SER's web interface, click "Advanced" and "Proceed to IP_Address (unsafe)". The SER provides administration tools for security certificates by supporting the ability to generate new self-signed certificates, upload a custom certificate and delete a custom certificate (SETUP > HTTPS). A trusted custom certificate, provided by your IT department, can be installed on the SER resulting in it being a trusted web server.

Table 5-7— HTTPS Settings

Option	Description	Default
SSL Certificate Details		
Begin Date:	Date certificate was created	
End Date:	Expiration date for certificate	Expiration is 2 years for self-signed certificate
Subject:	Certificate name	C=US CN=SER32e-00E023 O=Cyber-Sciences
Generate new self-signed certificate:	Control to generate a new self-signed certificate	
Upload custom certificate:	Control to upload a custom certificate	
Delete custom certificate:	Control to delete the certificate	

6—MONITORING (WEB SERVER)

Monitoring: Status

The CyTime SER-32e Event Recorder monitors the status of 32 high-speed input channels. Data is available via the Ethernet communications interface using Modbus TCP protocol, RESTful API or its embedded web server using a standard web browser.

To view status using a standard web browser, open the browser and type the IP address of the SER and press Enter. The unit's home page is the "Monitoring" web page called "Status." Sample channel status details are shown:

All of these fields can be customized:

- **Channel name ("Main CB")**
- **OFF/ON text ("OPEN"/"CLOSED")**

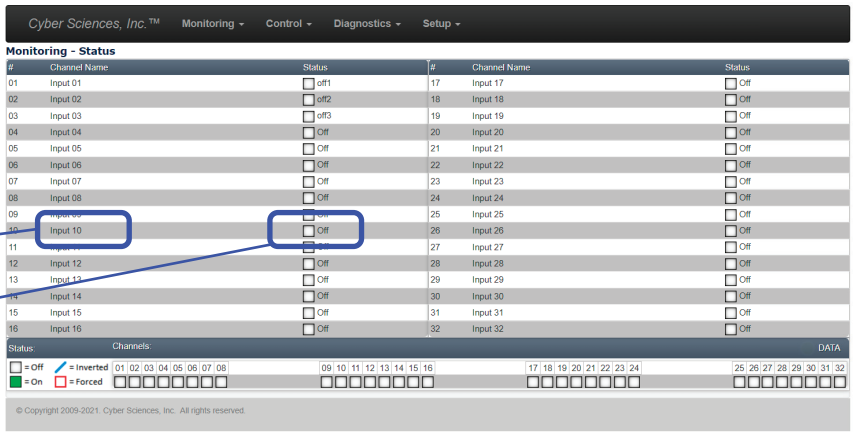


Figure 6-1. Monitoring: status web page

Note: The "Forced OFF" and "Forced ON" TEST functions refer to an override of the external monitored signals connected to each channel, and "forcing" these OFF or ON for reporting or logging by the SER. This simulation allows testing of host software without the need to physically open/close the connected equipment.

The Status page provides real-time status of all 32 channels, refreshed about once per second. The green "DATA" light flashes with each set of new data to confirm ongoing connection with the SER. Default values for channel names and OFF/ON states are shown in the example above. In an actual application, user-configured labels can greatly enhance the readability of the information. For example, Input 01 could be labeled "Main breaker" and OFF/ON states labeled "Open/Closed."

In addition to normal status reporting, the following are supported:

Inverted. Any input can be configured with inversion "enabled." This inverts the state of a monitored input for reporting or logging purposes. For example, a normally-closed contact can be set to "inverted" and its status reported OFF when in normal mode.

Forced OFF or ON. The SER supports a simulation TEST mode (via the Control web page or via Modbus command register), and all channels are initialized to OFF. Auto-test mode simulates closing all external contacts sequentially ("Forced ON") and then back off again ("Forced OFF"). Manual-test mode starts with all channels Forced OFF, and the user can simulate the closing of each channel individually or in groups ("Forced ON"). If an input is also set to inverted, then its reported state will be opposite to the forced (simulated) condition.

Data Page (Counters)

The Data page displays operations counters and the last reset date and time. If a channel is enabled for event recording, each status change (transition from Off-to-On or On-to-Off) increments its counter value.

Clicking "Data" under the monitoring tab brings up the following web page:

Note: Counters are subject to filter, debounce and chatter functions used for event recording. Therefore, counter values only increment when a corresponding status-change event is recorded for a given channel (input).

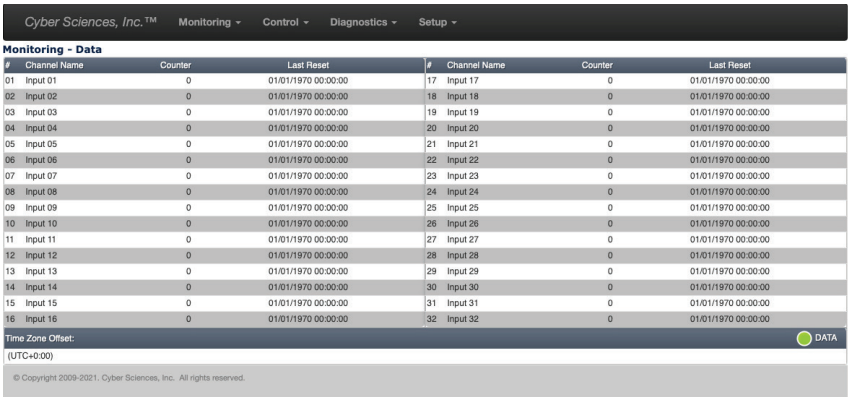


Figure 6-2. Data web page

Resets Page

The Resets page allows reset of operations counters, either individually or all at once. From the Control tab, clicking "Resets" brings up the following web page:

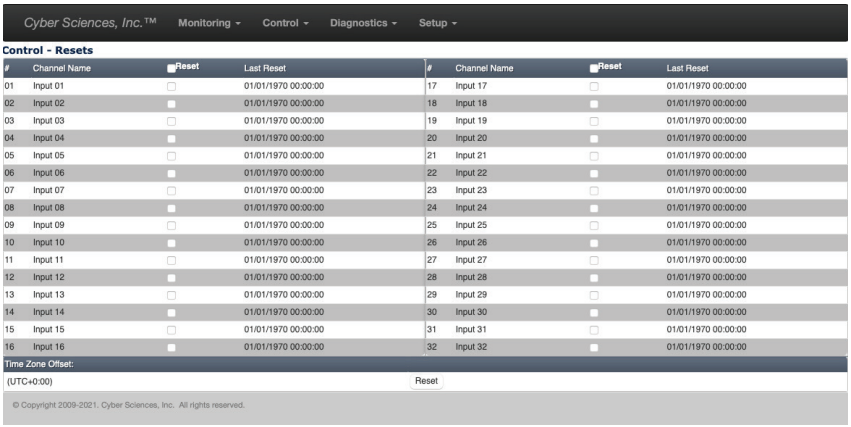


Figure 6-3. Resets web page

A Counter Reset event will be recorded in the Event Log with date and time.

Events Page

The SER records the date and time of all events, such as the change of state of an input channel. Event data is accessible via Modbus TCP, RESTful API, local display (or touchscreen display) or may be viewed by clicking the link for the "Events" web page:

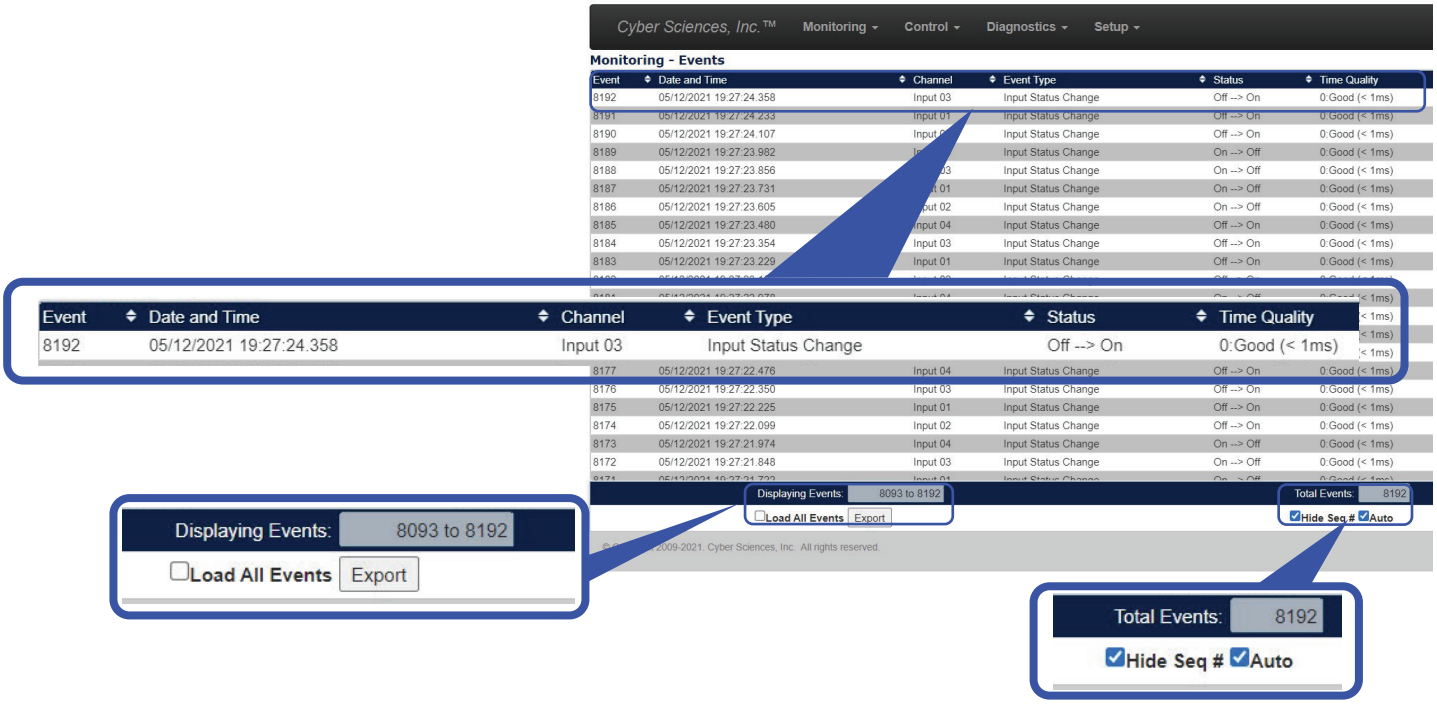


Figure 6-4. Monitoring: events web page

The SER stores up to 8192 events, after which only the latest 8192 events are stored. Each event record contains:

- date and time of the event (adjusted for local time, if applicable)
- channel (input name)
- event type
- channel status
- time quality at time of the event
- sequence number (unique serial number, column hidden by default)

When the page is first accessed, the last 100 events are loaded and the 20 most recent are displayed, starting with the most recent event at the top.

Click any column heading to sort events. Click the "Load all events" check box to display all stored events.

By default, the page checks for new events in the background and automatically adds them to the display. To prevent automatic update, deselect the "Auto" check box. The page will still check for new events but they will not be shown until "Auto" is checked again. Any recent events added can be identified in the "Events" and "Date and Time" columns.

Finally an Export button allows the user to export (save) all displayed event data to a CSV file for further analysis in Microsoft Excel® or other software. Please see Cyber Sciences Tech Note TN-201 for more details on exporting SER data to CSV, as well as how to format the date/time cells in Excel for proper display with millisecond resolution.

Control: Test

The test function simulates status changes to facilitate testing of application software. Each status change is reflected in Modbus TCP status registers and recorded as a test event in the event log. Test events are also recorded to mark the start and end of test mode.

Clicking the "Control" tab brings up the following web page:

Note: While operating in test mode, the SER suspends normal event recording. In addition, counters are not affected by test events.

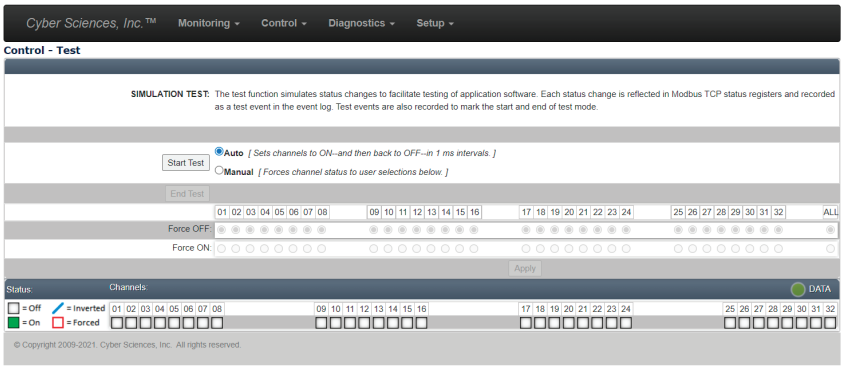


Figure 6-5. Control: Simulation test page (Manual mode shown)

Choose one of two test modes, then click the "Start Test" button to begin:

- **Auto**— Sets channels to ON and then back to OFF, automatically.
- **Manual**— Forces channel status to user selections.

Auto test mode simulates automatic sequencing of inputs off-to-on and back to off in 1 millisecond intervals. Each status change is recorded as an event in the event log, along with events designating the start and end of test mode.

In **Manual test mode**, channels can be "forced" OFF or ON (overriding normal status). Click the desired check box(es) and then click the "Apply" button to simulate the selected states. Status registers (Modbus TCP) and test event records in the event log can be used to verify proper operation with application software. Finally, click the "End Test" button to return to normal operation. After 10 minutes of inactivity, the SER will revert automatically back to normal operation.

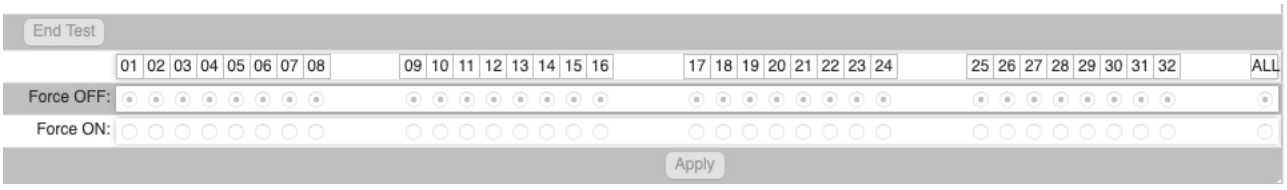


Figure 6-6. Control test web page—Manual test mode (close-up)

Diagnostics Page

Use the Diagnostics page to verify device data such as MAC address, serial number, hardware and firmware versions, available memory, time-sync values (including PTP attributes if applicable), available Modbus sockets, and self-diagnostics.

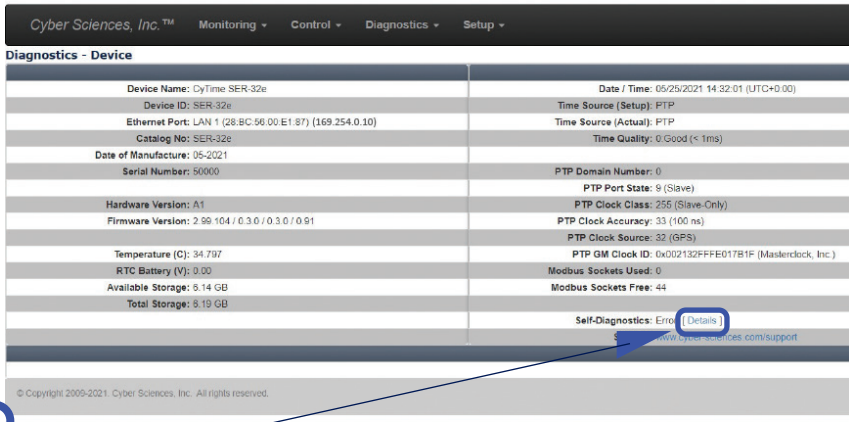


Figure 6-7. Diagnostics web page

Figure 6-8. Self-diagnostics details

Click the "Details" link to view an expanded list of diagnostics values, as shown.

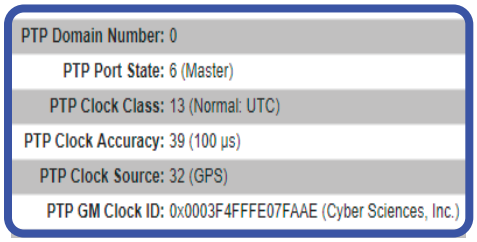


Figure 6-9. Typical PTP values (PTP master)

PTP Attributes—PTP Master

Shown at left are typical PTP diagnostics values under normal operating conditions for an SER configured as a PTP master.

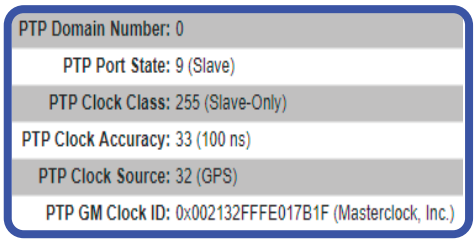


Figure 6-10. Typical PTP values (PTP slave)

PTP Attributes—PTP Slave

Shown at left are typical PTP diagnostics values under normal operating conditions for an SER configured as a PTP slave.

Power Control / Ride-through Module:

The SER-32e includes a Power Control module providing over 10 seconds of control power ride-through. The Power Control module is located in option slot 3 which is dedicated to this module.

Diagnostic status information is provided for the Power Control module through LED status indicators as well as the Diagnostics menus on the SER's display and web interface. No maintenance is required for this module during the service life of the SER under typical installation conditions.

Real-time Clock Battery Status

The SER-32e is equipped with a real-time clock (RTC) with battery backup to maintain relative time in the event of a power loss. The backup battery is expected to remain viable for the life of the SER, but may need to be replaced under some service conditions. Status of the RTC backup battery can be observed through the LED status indicators on the Power Control module as well as the Diagnostics menus on the SER's front panel display and web interface.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified workers should service this equipment.
- Before performing visual inspections, tests, or maintenance on this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical practices. For example, in the USA, see NFPA 70E.
- Turn off all power supplying the equipment in which the device is to be installed before installing and wiring the device.
- Always use a properly rated voltage sensing device to confirm that power is off.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

Failure to follow these instructions can result in death or serious injury.

In the event the real-time clock battery requires replacement, follow these steps:

1) Remove control power from the SER.
2) Monitor the LED indicators on the Power Control module until they are all OFF.
3) Remove the Power Control module by pressing the two latches on the top and bottom of the module and pull out.
4) Remove the module front cover by gently lifting the clips to release the printed circuit board.
5) Remove the coin cell battery from the battery holder and replace it with an industrially rated CR2032 or BR2032 battery from Panasonic.
6) Re-attach the module's front panel by pressing it onto the board until the latches click into place.
7) Insert the module into slot 3 using the card guides until the latches engage with a click.
8) Reapply control power to the SER and confirm the status of the clock battery is good.

7—PRODUCT SPECIFICATIONS

Electrical		
Digital inputs	Number of inputs	32
	Voltage, operating	24 Vdc (-15% to +10%)
	Input impedance / current draw (max.)	10K ohms resistive / 1 mA
	Must turn on/off voltage	turn on: 20 Vdc / turn off: 9 Vdc
	Turn on time / turn off time (max.)	0.5 ms
	Isolation	Each input is optically isolated
High-speed Trigger Output	Relay type	Form A relay
	Maximum current	100 mA at 24 Vdc nominal
	Contact closure characteristics	Momentary contact closure, duration of 100 ms
Control Power	Voltage, operating	24 Vdc (± 10%)
	Burden, steady state (max.)	7 VA
	Burden, momentary (max.)	Inrush current: 0.8 A for 5-8 ms
	Ride-through	> 10 seconds
Front Panel Display	4.3″TFT color touchscreen, adjustable brightness, screen saver	
Time Synchronization		
Time Source (IN) Protocols Supported	PTP slave	IEEE 1588-2019 (v2.1), E2E Default Profile, per Annex I.
	IRIG-B (via optional EZC-IRIG-B connector)	Unmodulated IRIG-B (5V DCLS) types B004, B007 (with year) ①
	DCF77 (via optional EZC-DCF77)	DCF77 (24 Vdc)
	SER inter-device time sync (legacy)	RS-485 (IRIG-B or DCF77 time code)
	NTP (SNTP) client	User-configurable NTP primary/secondary servers and update interval
Time-sync Output Protocols Supported	PTP master	IEEE 1588-2019 (v2.1), E2E Default Profile, per Annex I.
	IRIG-B (via optional PLX-5V connector)	Unmodulated IRIG-B (5V DCLS) type B007
	IRIG-B (via optional PLX-24V)	IRIG-B (24V DCLS) type B007, compatible with STR-IDM
	DCF77 or 1per10 (via optional PLX-24V)	DCF77 (24 Vdc) or 1 pulse per 10 seconds (24 Vdc)
	RS-485	ASCII / RS-485 (ASCII + Quality) or Inter-SER time sync (legacy)
Clock	Accuracy	< 100 µs (with time source = PTP, IRIG-B or DCF77)
	Holdover (after initial time sync lock)	5 min. (remains within 100 µs even after loss of sync for up to 5 min.)
Clock Battery	Battery life (expected)	10 Years
	Replacement battery	Panasonic CR2032 or BR2032

PRODUCT SPECIFICATIONS (CONT.)

Communications	
Ethernet ports	2x, 10/100Base-TX, RJ45 connector, CAT5/5e/6/6a shielded cable
Ethernet protocols (10/100 Mbps)	Modbus TCP, PTP, NTP, HTTPS, RESTful API
Serial port (time-sync IN/OUT)	RS-485 (2-wire plus shield)
Secure web server (for setup and monitoring)	HTTPS, TLS v1.2/v1.3, 256 bit encryption
Simultaneous TCP connections	44 simultaneous Modbus connections
Mechanical	
Mounting	Standard DIN rail (EN 50022, 35 mm x 15 mm)
Wire sizes supported	#24 to #12 AWG (#26 to #14 AWG for 3-position EZC connectors)
Dimensions (W x H x D)	11.5 x 5.0 x 2.62 inches (292 x 127 x 66.5 mm)
Dimensions (W x H x D), in carton	12.5 x 6.5 x 4.5 inches (318 x 165 x 114 mm)
Weight (product alone / in carton)	2.4 lbs. (1.1 kg) / 3.5 lbs. (1.6 kg)
Environmental	
Operating temperature	-25 to +70 C
Storage temperature	-40 to +85 C
Humidity rating	5% to 95% relative humidity (non-condensing) at 40 C
Altitude rating	0 to 3000 meters (10,000 feet)
Sustainability	RoHS-compliant, lead-free
Regulatory	
Safety, USA	UL Listed (NRAQ-cULus, UL 61010-1, UL 61010-2-201)
Safety, Canada	CAN/CSA-C22.2 (61010-1-12, 61010-2-201)
Safety, Europe	CE mark (EN 61010-1:2010, EN 61010-2-201:2017)
Emissions / Immunity	EN 61326-1 (IEC 61326-1 : 2012)
Radiated emissions	CISPR 11, Class A, Group 1 (EN 55011) / FCC Part 15B, Class A
Electrostatic discharge	EN 61000-4-2
Radiated immunity	EN 61000-4-3
Electrical fast transient / burst immunity	EN 61000-4-4
Surge immunity	EN 61000-4-5
Conducted radio frequency immunity	EN 61000-4-6
W3C web standards	W3C-validated (standards-compliant for browser-independence)

① *The Unmodulated IRIG-B signal must include the year (B004, B007), also known as enabling "IEEE-1344 extensions." For more information on IRIG-B, please refer to Cyber Sciences Tech Note TN-102, "Overview of IRIG-B Time Codes."*

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TinyXML

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JAM STAPL

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Link: https://github.com/bblanchon/ArduinoJson/blob/6.x/LICENSE.md

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Version: 2.29.2
License: MIT
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Link: https://github.com/moment/moment

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Version: 9-Jun-14
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Link: https://github.com/christianbach/tablesorter

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