TECHNICAL NOTE

Overview of ASCII/RS-485 Time Protocol

Summary

Some power meters use an ASCII character string transmitted over RS-485 for time synchronization.

This document describes the protocol, and gives examples of how Cyber Sciences products are used to synchronize devices requiring this protocol, including PM8000 and ION7550/7650 meters by Schneider Electric and 9410 and 9510/9610 meters by Siemens.

Introduction

ASCII/RS-485 is based on a simple time protocol originally defined by Arbiter Systems called "ASCII + QUAL." An ASCII string is communicated over RS-485 and consists of an on-time mark (OTM) transmitted once per second, followed by an ASCII representation of the date/time and time quality.

This protocol is used by some power meters for time synchronization via a spare RS-485 data communications port. Devices which support ASCII/RS-485 include: PowerLogic™ PM8000, ION9000 and ION7550/7650 meters by Schneider Electric and 9410, 9810 and 9510/9610 meters by Siemens.

CyTime™ Sequence of Events Recorders (SER-32e, SER-3200 and SER-2408) can generate ASCII/RS-485 to synchronize these power meters, greatly simplifying time sync design.

PROTOCOL DESCRIPTION

ASCII Time Code

ASCII/RS-485 is the name for an ASCII-based time protocol distributed over a standard RS-485 2-wire network. The ASCII code (called "ASCII + QUAL") 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<cr><lf>

where:

<soh> = hex 01 (start of header = OTM)

ddd:hh:mm:ss = date/time (day of the year, hour, min, sec)

Q = time quality flag (space = locked, ? = unknown)

<cr> = hex 0d (carriage return code)

<lf> = hex 0a (line feed code)

Note: As shown above, the ASCII code includes an ambiguity of one year, and so the device must first be set to the correct year through other means.

APPLICATIONS OF ASCII/RS-485 IN PRODUCTS BY OTHERS

PM8000 and ION7650 meters by Schneider Electric

ASCII/RS-485 Implementation

The remainder of implementation details for the ASCII/RS-485 are specific to the power meters which support it. As stated previously, these include:

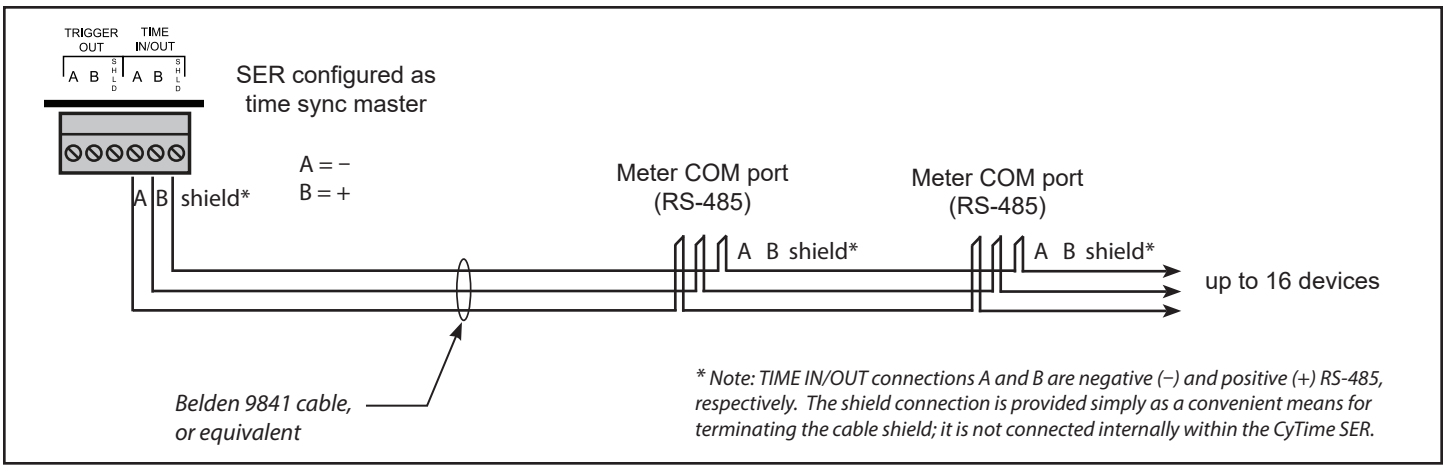
- PowerLogic PM8000, ION9000 and ION7650/7550 meters by Schneider Electric
- 9410, 9810 and 9510/9610 meters by Siemens

Recommended wiring connections and device setup are described below.

WIRING

RS-485 Connections to Power Meter(s)

Wiring of the ASCII/RS-485 signal from the time source (SER) to one or more meters is shown below. Though not shown, the shield conductor should be grounded at one end only, and the data pair terminated with a suitable impedance (e.g., 120-ohm, 1/4-watt resistor), per the RS-485 standard.



DEVICE SETUP

The Clock module controls the meter's internal clock, and so the meter must be set to use the RS-485 communications port for time sync, then the COM port settings specified to ensure compatibility with the ASCII/RS-485 time source.

ION Clock Setup	Setting
Clock Source	COMM
Time Sync Source	COM1 or COM2
ION COM Setup	**Setting**
Protocol	GPS: Arbiter
Baud Rate	9600 bps
RTS (Transmit) Delay	0 (or 0.01s)
Unit ID	1
Serial Port Settings	8N1
RS-485 Bias	OFF

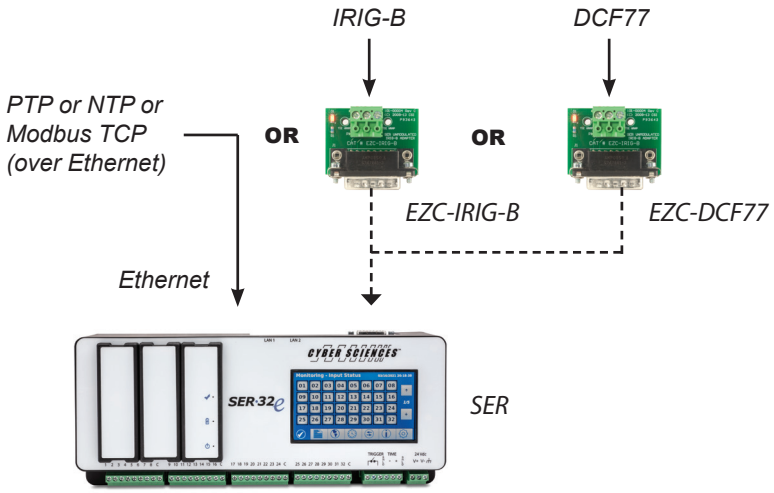
APPLICATIONS OF ASCII/RS-485 IN CYBER SCIENCES PRODUCTS

CyTime SER-32e (or SER-3200/2408-PTP)

CyTime Sequence of Event Recorders accept a variety of time source options and then sync with each other using PTP (Precision Time Protocol). A PTP slave can also output a legacy protocol to devices that do not support PTP, such as ASCII/RS-485. Other time-sync input and output options are also supported for additional flexibility and interoperability with other devices.

SER Time Source Options (Time-Sync IN)

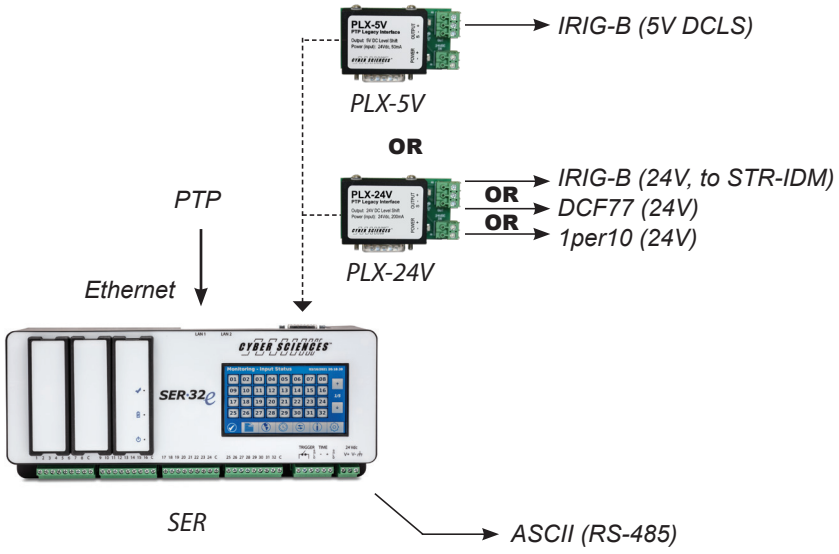
Time source options via PTP, NTP or Modbus TCP use the SER's built-in Ethernet interface (RJ-45). IRIG-B or DCF77 inputs require an adapter (EZC-IRIG-B or EZC-DCF77) as shown.



SER as Time-sync Hub (Time-Sync OUT)

When PTP is selected as time source, the SER also serves as a "PTP time-sync hub" for non-PTP devices, generating the time-sync protocol needed: IRIG-B, DCF77, 1per10 (via PLX adapter) or ASCII (via built-in RS-485 port), as shown below.

Note: Only one protocol can be selected for output via the PLX connector (IRIG-B, DCF77 or 1per10). However, for maximum flexibility, the ASCII / RS-485 output is enabled by default any time an SER is set to use PTP for time source (IN) or time-sync (OUT).



PRECISION TIME PROTOCOL (PTP) per IEEE 1588

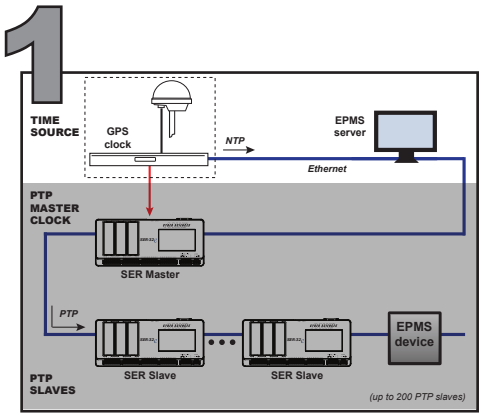
For More Info on PTP:

Tech Note: Hi-res Time Sync using PTP/1588 (TN-100)

Time Synchronization as Easy as 1-2-3

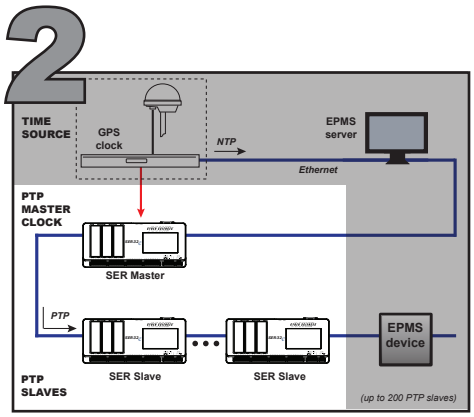
PTP (Precision Time Protocol defined in IEEE 1588) takes advantage of hardware-assisted timestamping to achieve sub-millisecond time synchronization over an Ethernet network. Cyber Sciences offers simple, scalable system architectures using PTP as the means to distribute a precise time reference to all devices that support PTP. CyTime Sequence of Event Recorders accept a variety of time-source options, and sync with each other automatically over Ethernet, using PTP. In addition, an SER can serve as a "PTP time sync hub" for devices that do not yet support PTP.

Simple, building-block options are shown below. The first CyTime SER accepts a time reference signal (such as IRIG-B or DCF77), then serves as PTP master clock for all other SERs as well as other devices which support PTP. For a device that does not support PTP, a nearby SER outputs the protocol needed (e.g., ASCII/RS-485) effectively making this device "PTP-enabled" as well.



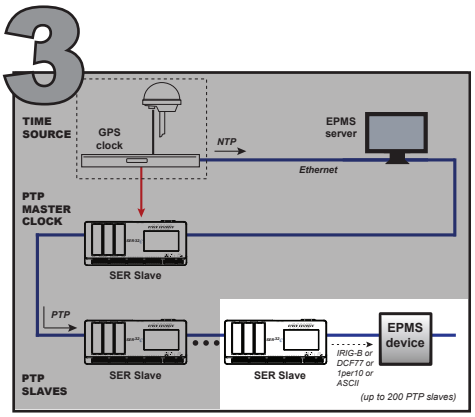
Choose a Time Source

Set the first SER's time from a web browser, EPMS software or NTP server. Optionally, add a GPS antenna/receiver to provide an external time reference traceable to UTC (Coordinated Universal Time), to compare data from other sites or organizations (e.g., electric utilities).



Sync all SERs with Each Other (PTP)

Configure the first SER to output PTP (PTP grandmaster clock); all other SERs on the same Ethernet network sync with each other automatically (within 100 µsec). No special Ethernet switches. No additional setup. Simple, affordable, scalable.



Sync Other EPMS Devices

Sync SERs with other EPMS devices using PTP over Ethernet, all within 100 µsec. No PTP? No problem! For devices that do not yet support PTP, a CyTime SER (PTP slave) can serve as a "time-sync hub" to output the legacy protocol needed (IRIG-B, DCF77, ASCII, or 1per10).

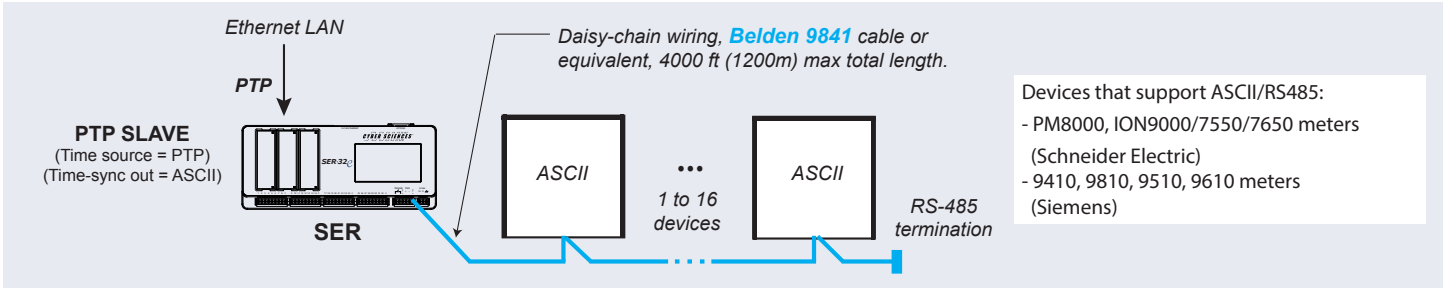
SYNCHRONIZING NON-PTP DEVICES (via ASCII/RS-485)

Time-sync Output (ASCII / RS-485)

Sequence of Events Recorders have a built-in RS-485 communications port that can be used to output the ASCII serial code supported by PM8000, ION9000 and ION 7550/7650 meters from Schneider Electric and 9410, 9810 and 9510/9610 meters from Siemens.

The ASCII protocol ("ASCII + Quality") is distributed over a 2-wire RS-485 network at 9600 bps as described earlier. The SER is configured as time-sync master to generate the ASCII/RS-485 output to one or more devices. If desired, up to 16 devices can be synchronized over RS-485 from a single SER.

For greater flexibility, a CyTime SER configured as PTP master (outputs PTP to other devices) also outputs ASCII/RS-485 by default. (See note below.)



SYNCHRONIZING NON-PTP DEVICES (ASCII hybrid systems)

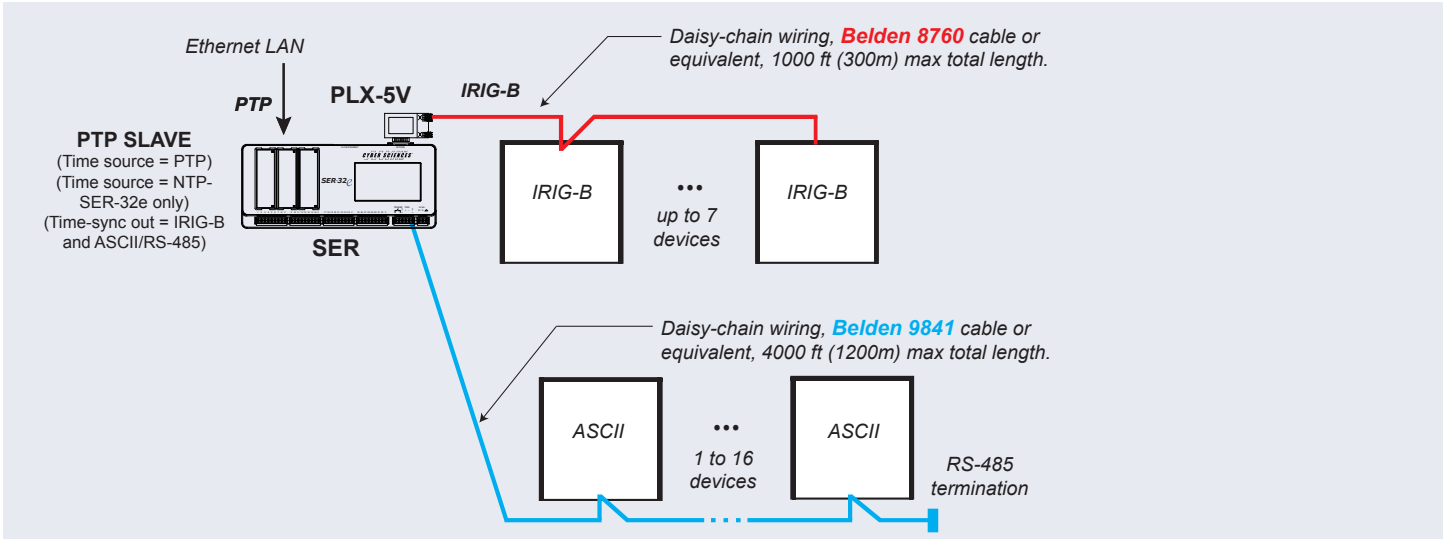
Note: Only one protocol can be selected for output via the PLX connector (IRIG-B, DCF77 or 1per10). However, for maximum flexibility, the ASCII / RS-485 output is enabled by default any time an SER is set to use PTP or NTP for time source (IN) or time-sync (OUT).

Time-sync Output (ASCII / RS-485) + IRIG-B

Because the RS-485 comm port is built into the SER, it is possible to output both ASCII/RS-485 and another protocol (e.g. IRIG-B) out its top DB-15 connector using a PLX interface.

Note: Only one protocol can be selected for output via the PLX connector (IRIG-B, DCF77 or 1per10). However, for maximum flexibility, the ASCII / RS-485 output is enabled by default any time an SER is configured with time source = PTP. Thus, an SER can output one of these protocols (via the PLX connector) and output the ASCII/ RS-485 signal as well, without additional configuration for the ASCII output.

The example shown below illustrates such a case, with conventional (5V) IRIG-B signal via PLX-5V and ASCII via the RS-485 time-sync output connection.



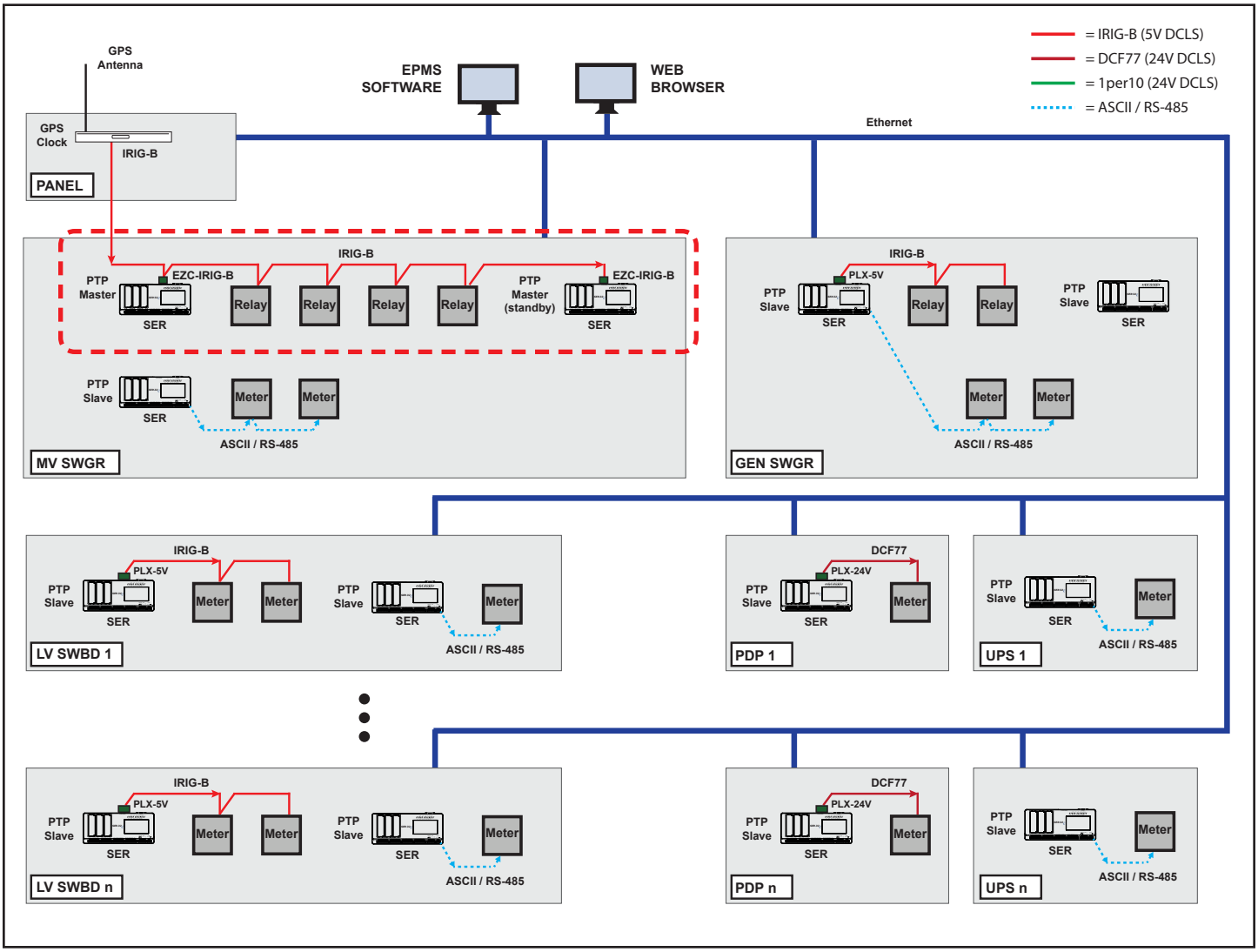
EPMS SYSTEM EXAMPLE (Sync 2 or more SERs via IRIG-B: PTP Master and PTP Standby Master)

An EPMS (Electrical Power Management System) example is shown below that uses PTP for time synchronization over Ethernet, with IRIG-B from the time source (GPS clock) and SERs as PTP time-sync hubs to output legacy protocols (e.g., IRIG-B, DCF77, ASCII/RS-485) to devices that do not support PTP directly.

Time Source. In addition to the first SER, a second CyTime SER accepts IRIG-B as its time source from the GPS clock. In this design, both SERs are configured as a PTP master using the same PTP domain number. Using the IEEE 1588 "Best Master Clock" algorithm, one SER automatically acts as the PTP grandmaster clock, and the other waits in standby mode in case it is ever needed as a backup.

Time Distribution. The first SER (or the backup SER) serves as PTP grandmaster for all other CyTime SERs (PTP slaves), synchronized within 100 µsec of each other. If the first clock fails or goes offline, the backup PTP master becomes the grandmaster clock automatically and remains in service until the other is restored. This ensures reliable, uninterrupted time service to all devices.

Time Conversion. The devices located in other power distribution equipment enclosures are synchronized from a nearby SER, using the protocol needed (e.g., IRIG-B or ASCII/RS-485)).



EPMS SYSTEM EXAMPLE—High-def time-sync over Ethernet using PTP; two SERs accept IRIG-B from GPS clock, one is PTP master, other is standby

REFERENCES

References

[1] "Technical Note: ION Time Synchronization & Timekeeping," publication number 70072-0111-14, 06/2009, Schneider Electric.

[2] Kennedy, Robert A., P.E., "GPS Time Synchronization: How precision timing and sequence of events recording will make the Smart Grid even smarter," *Electrical Construction & Maintenance (EC&M)* magazine, August 19, 2011, pp. 18-20.

http://ecmweb.com/computers-amp-software/gps-time-synchronization

[3] Brown, PE, Bill, and Mark Kozlowski, "Power System Event Reconstruction Technologies for Modern Data Centers," Square D Critical Power Competency Center. Aug. 2006.

[4] Product instruction manuals from Arbiter Systems, Schneider Electric and Siemens.

Cyber Sciences, Inc. (CSI)
229 Castlewood Drive, Suite E
Murfreesboro, TN 37129 USA
Tel: +1 615-890-6709
Fax: +1 615-439-1651

Doc. no: TN-108 May-2022
(supersedes doc. dated Sep-2017)