PowerLogic™ Satellite Time Synchronization System (STS3000)

Installation Guide

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INTRODUCTION

The Satellite Time Synchronization System (STS3000) provides the ability to synchronize the date and time of Schneider Electric products (PM800 series power meters, Sepam™ digital protection relays, and PowerLogic CM3000/CM4000 series circuit monitors) to UTC (Coordinated Universal Time) with an accuracy better than +/-1 millisecond. By synchronizing the date and time of all devices across a facility or campus, you can determine the actual sequence in which events occurred.

The STS3000 package contains a Cyber Sciences™ STR-100 Satellite Time Reference Module, a GPS antenna/receiver, and associated cables (see Table 1). The STR-100 provides two time synchronization outputs, one DCF77, and one configurable for either DCF77 or 1per10 (1 pulse every 10 seconds) time protocols. Each output provides a time synchronization signal to 16 devices, in a daisy-chain format, with a maximum cable length of 300 meters (985 feet) when using 18-AWG, shielded, twisted-pair cable.

The STR-100 accepts GPS-based time synchronization reference signals from either a Trimble® Acutime™ antenna (included), or from a modulated IRIG-B source. The antenna and an IRIG-B source can be concurrently connected to the unit to provide redundant time reference inputs. The STR-100 will first synchronize to the antenna input, since it is the preferred source. It will automatically change to the IRIG-B source if the antenna input is lost.

While the STS3000 system was designed to provide time synchronization signals to Schneider Electric CM3000/CM4000 series circuit monitors and Quantum ERT cards, it can also be used with any slave device that can accept a 24Vdc pulse stream and decode the DCF77 or 1per10 protocols. For example, the STR-100 can provide a time synchronization output to programmable controllers and other distributed processing units that perform control tasks based on date and time.
NOTE: The STR-100 requires a control power source of 24Vdc, +/-10%, with the ability to provide 36 watts of power. This power supply is not included in the STS3000 package. For additional information see Connecting 24 Vdc Control Power to the STR-100 on page 5.

SAFETY PRECAUTIONS

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- To avoid personal shock or damage to the electronic components of the satellite time reference, do not connect the power supply to the unit until you have made all connections as described in this bulletin.

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

CONNECTING THE SYSTEM

Connecting the STS3000 system requires five main steps. Details for completing these steps are provided in the sections that follow.

1. Determine the GPS time reference source to be used — either a Trimble Acutime antenna or an IRIG-B source.

2. If the Trimble Acutime antenna is selected as the time reference source, it must be installed outside with a clear view of the sky. The antenna cable must then be connected between the antenna and the STR-100. If an IRIG-B source is used, connect a 75-ohm coaxial cable, with a BNC connector on each end, between the IRIG-B generator and the STR-100.

3. Connect the DCF77 output from the STR-100, in a daisy-chain format, to a discrete digital input on each device to be synchronized. Using the display on each device, configure the selected input’s mode to be “Time Sync”.

4. Connect the 24Vdc (36 Watt minimum) power supply to the STR-100.

5. Configure the STR-100 and antenna (if used).
Figure 1 illustrates a typical system layout.

DETERMINING THE GPS TIME REFERENCE SOURCE

The Trimble Acutime antenna is the preferred time reference input. If the STR-100 is being installed in an area that has an existing, modulated IRIG-B time reference signal, then the IRIG-B source may be used to avoid having to install the antenna.

NOTE: Both inputs can be connected for redundant operation.

INSTALLING THE ANTENNA

The Trimble Acutime Gold antenna is a pole-mounted GPS receiver and antenna in a single, environmentally-sealed enclosure. After power is applied (through the antenna cable), the antenna automatically tracks satellites and surveys its position to within meters. It then switches to overdetermined time mode and generates a PPS (pulse-per-second) output synchronized, within 50 nanoseconds, to UTC (Coordinated Universal Time). The communications connection between the antenna and the STR-100 is RS-422, simplifying cable design compared to traditional RF antenna connections.
Mount the antenna outside with a clear, unobstructed view of the sky. Mount the antenna to a 1” (25.4 mm) outside diameter, 14 threads-per-inch conduit, or to a standard 0.75” (19.05 mm) inside diameter NTP/tapered-thread pipe. Connect the weather proof DIN connector on the antenna cable to the antenna. Connect the screw terminal connector on the other end of the antenna cable to the “GPS Interface” port on the STR-100. The antenna cable can be routed through the mounting conduit/pipe, but a moisture-proof entrance will be required since the antenna cable connector is located to one side of the antenna mount. Always adhere to local codes when routing exterior wiring.

**CONNECTING THE STR-100 TIME SYNC OUTPUTS**

The DCF77 output from the STR-100 is a 24Vdc, 500ma (max), pulse-width-modulated signal that provides a complete date and time string once each minute. The 1per10 output provides a single 24Vdc pulse every 10 seconds. Output 1 is always a DCF77 signal while Output 2 can be configured to be either a DCF77 or a 1per10 signal. Each output can be connected to a discrete input on a slave device. Multiple slave devices can be connected to a single output in a daisy-chain format using Belden 8760 cable (18AWG, shielded, twisted pair cable) or equivalent. The maximum length of the daisy chain depends on the number of devices and the cable type. For additional information, see Time Sync Output Wiring Limitations on page 7.

The STS3000 system can be used with any slave device that can accept a 24Vdc pulse stream and decode either the DCF77 or 1per10 protocols.

Figure 2 illustrates wiring connections to the STR-100 connector. To connect the STR-100’s outputs to a slave device, do the following:

1. Select an input on each device to accept the DCF77 or 1per10 signal. (For the CM3000/C4M000 series circuit monitor, any of the inputs on the IOC44 I/O card or the 32Vdc input modules on the CM4000 I/O Extender can be configured to accept the DCF77 time sync input.)

2. Connect the twisted-pair cable between devices in a daisy-chain format. Ensure that the 24Vdc positive lead is connected to the device’s positive input terminal and the 24Vdc common lead is connected to the negative input terminal. (Table 2 on page 7 describes cable length limitations based on the cable type and number of devices.)

3. Configure the mode feature for the selected input on each device to be “Time Sync.” Refer to the procedures on pages 5 through 7 for configuring the inputs of the PM800 series power meters, the Sepam protection relays, and the CM3000/C4M000 circuit monitors.

4. Connect the twisted-pair cable to the appropriate output at the rear of the STR-100, maintaining the cable color code for the positive and negative terminals. For 1per10 signaling, use Output 2 and program that output for the 1per10 option. For DCF77 signaling, use Output 1 (and Output 2 if 1per10 signaling is not required). The STR-100 instruction bulletin, included with the STR-100 module, provides detailed instructions on connecting to the appropriate outputs.

![Figure 2: STR-100 Output Connections](image-url)
CONNECTING 24 VDC CONTROL POWER TO THE STR-100

The STR-100 requires a control power source of 24Vdc, +/-10%, with the ability to provide 36 watts of power. The power supply (not included in the STS3000 package) should be Class 2 rated with a minimum of 1500 volts of isolation. Use 18AWG wire (minimum) for control power connections, and limit the control power cable length to less than 10 meters (32.8 feet).

To connect the STR-100 to the power supply, do the following:

1. Connect the positive (+) terminal on the STR-100 to the 24 Vdc positive on the power supply (see Figure 3).
2. Connect the negative (–) terminal on the STR-100 to the common on the power supply.
3. Connect the ground terminal on the STR-100 to a true earth ground. Do not connect the common from the 24Vdc power supply to true earth ground unless specified by local electrical codes.

FIGURE 3: CONTROL POWER CONNECTIONS

CONFIGURING THE STR-100 AND ACUTIME ANTENNA

The STR-100 and the Acutime Gold antenna do not require any setup to provide a UTC time synchronization signal. However, if Sepam relays are used, the STR-100 channel 2 output must be configured for 1per10. In addition, if you prefer that devices be synchronized to local time rather than UTC time, some configuration is required. Refer to the Cyber Sciences “Model STR-100 Satellite Time Reference” instruction bulletin provided with the STR-100 module for complete details.

CONFIGURING PM800 SERIES POWER METER INPUTS FOR TIME SYNC

Input 5 I on a PM800 series power meter (connections S1 and C1 of the I/O terminal on the unit) accepts an external DCF77 time synchronization signal from the STS3000. To monitor this input, the mode setting for Input 5 I must be configured for “Time Sync.” To configure the PM800 series 5 I input, do the following:

1. Using the display keys, press - - - - until MAINT (maintenance) is visible.
2. Press MAINT, then press SETUP.
3. Use † and ‡ to enter the password (default = 0000) and press OK.
4. Press - - - - until I/O is displayed, then press I/O.
5. Press IN to display the 5 I screen.
6. Press EXIT and use † to select TIME SYNC mode, then press OK.
7. Press † until the SAVE CHANGES? screen is displayed, and press YES.
CONFIGURING SEPAM INPUTS FOR TIME SYNC

All three Sepam relay models can be configured to accept an external 1per10 time synchronization signal.

For the Series 80 Sepam relay, signal connection is made at Input I103 (pins 7 and 8) on the rear of the unit. The mode settings for the Series 80 Sepam unit must be configured by using the SFT2841 software. To monitor this input, the mode setting for Input I103 must be configured for “External Network Sync.”

For the Series 20 and 40 Sepam relays, signal connection is made at Input I21 (pins 1 and 2) on the rear of the unit. The Series 20 and 40 Sepam units can be configured from the front panel. To monitor this input, the mode setting for Input I21 must be configured for “Synchronization.”

To configure the I21 input on the Series 20 and 40 Sepam units for Synchronization mode, do the following:

**Sepam Series 20**

1. On the Sepam display, press .
2. Use and along with to enter your four-digit password (default = 0000), then press until Apply is selected. Press .
3. Press until the Control Logic screen is displayed.
4. Press until input I21 is selected.
5. Press until I21: Synchronization is displayed.
6. Press until Apply is selected.
7. Press to complete the procedure.

**Sepam Series 40**

1. On the Sepam display, press .
2. Use and along with to enter your four-digit password (default = 0000), then press until Apply is selected. Press .
3. Press .
4. Press until Control Logic is selected. Press .
5. Press until the Assignment screen is displayed.
6. Press until input I21 is selected.
7. Press until I21: Synchronization is displayed.
8. Press until Apply is selected.
9. Press to complete the procedure.
CONFIGURING CM3000/CM4000 INPUTS FOR TIME SYNC

The CM3000/CM4000 circuit monitors accept the DCF77 time synchronization signal. The circuit monitor must have one digital input available on either an IOC44 module (CM3000 and CM4000) or an I/O Extender (CM4000 only), and that input’s mode must be configured for “Time Sync.”

To connect to an IOC44 module, use either S1, S2, S3, or S4, and C (common). For an I/O Extender, use the plus and minus connections for one of the inputs, C1 through C8.

To configure a circuit monitor input for Time Sync mode, start at the Main Menu and do the following:

1. On the circuit monitor display, press ▼ to select SETUP, then press .
2. Use ▲ and ▼ to enter your password (default = 0), then press .
3. Press ▼ to select I/O, then press .
4. Press ▼ to select the input module (IOC44 or I/O Extender), then press .
   NOTE: One or both of these modules may be present, depending on the application of the circuit monitor.
5. If using the I/O Extender, press ▼ to select Configure Modules, then press .
   Press ▼ to select the appropriate digital input in the menu (1 through 8), then press .
   If using the IOC44 module, select the desired “Digital In xxx” from the menu, then press .
   NOTE: “xxx” represents the designation of the input being used – for example the S1 input on an IOC44 module in Slot A would be AS1.
6. Press ▼ until Mode is selected, then press .
7. Press ▼ until Time Synch is selected, then press .
8. Press the Menu key until the display shows “Save Changes?”
9. Use ▲ or ▼ to select YES, then press  to complete the process.

TIME SYNC OUTPUT WIRING LIMITATIONS

Table 2 provides recommendations for selecting a cable that will adequately provide connection between the STR-100 time synchronization outputs and the input on a number of slave devices. Based on data in Table 2, it is recommended that Belden 8760 cable be used to connect the STR-100 outputs to each device’s Time Sync input.

<table>
<thead>
<tr>
<th>Cable Length (meters)</th>
<th>Slave Devices per</th>
<th>Max Current per Output (mA)</th>
<th>Voltage Drop at GPS (&lt;4.0V)</th>
<th>Recommended Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>16</td>
<td>0.400</td>
<td>3.513</td>
<td>Belden 8760, 18 awg</td>
</tr>
<tr>
<td>500</td>
<td>8</td>
<td>0.240</td>
<td>3.513</td>
<td>Belden 8760, 18 awg</td>
</tr>
</tbody>
</table>

NOTE: This table is only a guide. The number of slave devices that can be connected in a daisy-chained configuration is dependent on the wire gauge and length, and the total burden placed on the network by the specific devices. Refer to the digital input specifications of the slave devices for input voltage range requirements.

NOTE: For surge protection, we recommend connecting the shield wire directly to an external earth ground.

OPERATION

After all system connections are made and the STR-100 is configured, the STR-100 will continuously provide the time synchronization signal output without user interaction.
**APPENDIX A – ACUTIME GOLD ANTENNA SPECIFICATIONS**

Table 3: Trimble Acutime Gold Antenna Specifications

<table>
<thead>
<tr>
<th>Physical Characteristics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>3.74&quot; D x 2.85&quot; H (95 mm x 72.5 mm)</td>
</tr>
<tr>
<td>Weight</td>
<td>5.4 oz (154 g)</td>
</tr>
<tr>
<td>Connector</td>
<td>12-pin round, waterproof</td>
</tr>
<tr>
<td>Mounting</td>
<td>1&quot; (25.4 mm) — 14 straight thread or 3/4” (19.05 mm) pipe thread</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>–40° to +185° F (–40° to +85° C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>–67° to +221° F (–55° to +105° C)</td>
</tr>
<tr>
<td>Vibration</td>
<td>0.008 g^2/Hz at 5–20 Hz</td>
</tr>
<tr>
<td></td>
<td>0.05 g^2/Hz at 20–100 Hz</td>
</tr>
<tr>
<td></td>
<td>~3 db/octave at 100–900 Hz</td>
</tr>
<tr>
<td>Operating humidity</td>
<td>95% RH, non-condensing at 140° F (60° C)</td>
</tr>
<tr>
<td>EM C</td>
<td>CE, FCC Class B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>L1 frequency, C/A code (SPS) continuous tracking receiver, static overdetermined clock mode (default)</td>
</tr>
<tr>
<td>Update Rate</td>
<td>1 Hz</td>
</tr>
<tr>
<td>Time to first fix (no stored position)</td>
<td>Typical cold start: &lt;46 seconds (50%), &lt;50 seconds (90%)</td>
</tr>
<tr>
<td>Time to first PPS (stationary with stored position, e.g., after power outage)</td>
<td>&lt;14 seconds (50%), &lt;18 seconds (90%)</td>
</tr>
<tr>
<td>Re-acquisition after 60-second signal loss</td>
<td>&lt;2 seconds (90%)</td>
</tr>
<tr>
<td>PPS Output</td>
<td></td>
</tr>
<tr>
<td>Physical interface</td>
<td>RS-422</td>
</tr>
<tr>
<td>Width</td>
<td>10 microseconds (default); user programmable from 10 microseconds to 500 milliseconds</td>
</tr>
<tr>
<td>On-time Edge</td>
<td>Rising edge on-time (default); user-programmable rising or falling</td>
</tr>
<tr>
<td>Resolution</td>
<td>80 nanoseconds</td>
</tr>
<tr>
<td>Accuracy</td>
<td>UTC 15 nanoseconds (static); UTC 90 nanoseconds (dynamic, TDOP ≤ 3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antenna Cable Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>200 feet (61 meters)</td>
</tr>
<tr>
<td>Weight</td>
<td>Approximately 12 lbs (5.4 kg)</td>
</tr>
<tr>
<td>Description</td>
<td>6 twisted pairs, 22 AWG, overall foil shield with drainwire, pvc jacket, 300 volt</td>
</tr>
</tbody>
</table>