



Installation Manual V1.5

Sapling Converter Box

SCB-100-000-1



The Sapling Company, Inc.
670 Louis Drive
Warminster, PA 18974
USA

P. (+1) 215.322.6063
F. (+1) 215.322.8498
www.sapling-inc.com

2-Wire Converter Box (SCB-100-000-1)

Table of Contents - *Interactive Hyperlinked PDF* – Click on the topic and the document will go to the relevant page. Clicking on the logo will take you back to the table of contents.

Table of Contents	2
Important Safety Instructions	3
System Preparations	4 - 5
Installing the Converter Box--Wall Mount	6 - 8
Installing the Converter Box--Rack Mount	9 - 10
2-Wire Digital Communication and Wiring Information	11 - 14
Status Panel	15
Troubleshooting	16 - 17
Warranty	18

For information on how to install and configure SMA, SAM, or SBD model clocks, please consult the manual for that clock. This manual only covers installation for the converter box.

Please be aware that Sapling distributed a different model of converter box prior to July 2014. Older converter boxes can be identified by their lack of external LEDs and unpainted steel covers. For information on the older converter box, please contact Sapling for an older copy of the manual.

Important Safety Instructions

DANGER

SHOCK HAZARD



- Keep the electricity to this device turned OFF until the clock installation is complete.
- Do not expose the clock movement to water, or install the clock in a location where it may be exposed to water.

NOTICE

- Do not install the device outdoors. Damage to the device if placed outdoors voids the warranty.
- Do not hang objects from the device or device mounting parts. The clocks are not designed to support the weight of other objects.
- After being powered down, the housing may be cleaned with a damp cloth or disinfectant. Test other cleaning products on a small part of the clock housing before attempting to use on the rest of the clock. Avoid bleach and chemicals known to dissolve plastics.

WARNING

FIRE HAZARD



- Always follow your national and regional electrical codes or ordinances.
- The AC power circuit for the device must be attached to a circuit breaker that can be reset by the user.

PHYSICAL INJURY HAZARD



- If you are standing on an object while installing your device, make sure that the object can support your weight, and will not sway or move as you stand on it.
- Take precautions to avoid injury by potential safety hazards near the point of installation including (but not limited to) heavy machinery, sharp objects, hot surfaces, or exposed cables carrying an electric current.
- Follow all mounting instructions exactly as stated in this manual. Failure to do so may result in the device falling off the point of installation.
- Packaging materials and mounting items include plastic bags and small pieces, which pose a suffocation hazard to young children.

System Preparations

Identify an appropriate location to install the converter box. The location should be accessible to the installer, and should have a moving airflow. Ensure that the converter box cooling fan will not be obstructed by walls, or counteracted by surrounding the device with heavy insulation. Keep the converter box away from objects that may melt or warp at 100 degrees Fahrenheit.

The converter box must also be installed to the correct number of clocks, at the correct distance, and with wiring of the correct diameter. Please consult our website for a calculator, which can be found at <http://www.sapling-inc.com/converterboxcalculator/>

For added convenience, some generalized calculations are provided below:

Analog Clock Calculations

		Number of Analog Clocks (0.030A each)						
Feet / Meters		20	30	40	50	60	70	100
Distance (feet / meters)	0-9 ft 0-30 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	100-199 ft 30-60 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	200-299 ft 61-91 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	300-399 ft 91-122 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	400-499 ft 122-152 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AW 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	500-599 ft 152-183 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²
	600-699 ft 183-213 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²
	700-799 ft 213-244 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²
	800-899 ft 244-274 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²
	900-999 ft 274-305 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²

4 Digit 2.5 inch Digital Clock Calculations

		Number of 2.5", 4 Digit Clocks (0.089A each)						
Feet / Meters		10	20	30	40	45	50	55
Distance (feet / meters)	0-99 ft 0-30 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	12AWG 3.31 mm ²
	100-199 ft 30-60 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	
	200-299 ft 61-91 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²		
	300-399 ft 91-122 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²			
	400-499 ft 122-152 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²				
	500-599 ft 152-183 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²				
	600-699 ft 183-213 m	16AWG 1.31 mm ²	12AWG 3.31 mm ²					
	700-799 ft 213-244 m	16AWG 1.31 mm ²	12AWG 3.31 mm ²					
	800-899 ft 244-274 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²					
	900-999 ft 274-305 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²					

System Preparations

6 Digit 2.5 inch Digital Clock Calculations

		Number of 2.5", 6 Digit Clocks (0.121A each)						
Feet / Meters		10	15	20	25	30	35	40
Distance (feet / meters)	0-99 ft 0-30 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²
	100-199 ft 30-60 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²	
	200-299 ft 61-91 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²	
	300-399 ft 91-122 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²		
	400-499 ft 122-152 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²			
	500-599 ft 152-183 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²			
	600-699 ft 183-213 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²				
	700-799 ft 213-244 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²					
	800-899 ft 244-274 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²					
	900-999 ft 274-305 m	12AWG 3.31 mm ²	12AWG 3.31 mm ²					

4 Digit 4.0 inch Digital Clock Calculations

		Number of 4.0", 4 Digit Clocks (0.138A each)					
Feet / Meters		10	15	20	25	30	35
Distance (feet / meters)	0-99 ft 0-30 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²
	100-199 ft 30-60 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²	
	200-299 ft 60-91 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	14AWG 2.08 mm ²	12AWG 3.31mm ²	12AWG 3.31mm ²	
	300-399 ft 91-122 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31mm ²	12AWG 3.31mm ²		
	400-499 ft 122-152 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31mm ²			
	500-599 ft 152-183 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²				
	600-699 ft 183-213 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²				
	700-799 ft 213-244 m	12AWG 3.31 mm ²					
	800-899 ft 244-274 m	12AWG 3.31 mm ²					
900-999 ft 274-305 m	12AWG 3.31 mm ²						

6 Digit 4.0

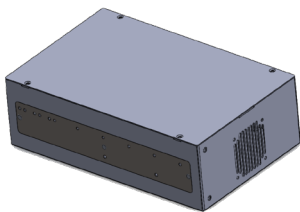
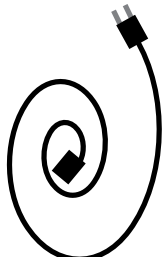
	Feet / Meters
Distance (ft/m)	0-99 ft 0-30 m
	100-199 ft 30-60 m
	200-299 ft 60-91 m
	300-399 ft 91-122 m

6 Digit 4.0 inch Digital Clock Calculations

		Number of 4.0", 6 Digit Clocks (0.183A each)			
Feet / Meters		10	15	20	25
Distance (ft/m)	0-99 ft 0-30 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²
	100-199 ft 30-60 m	16AWG 1.31 mm ²	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²
	200-299 ft 60-91 m	16AWG 1.31 mm ²	14AWG 2.08 mm ²	12AWG 3.31 mm ²	
	300-399 ft 91-122 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²	12AWG 3.31 mm ²	
	400-499 ft 122-152 m	14AWG 2.08 mm ²	12AWG 3.31 mm ²		
	500-599 ft 152-183 m	12AWG 3.31 mm ²			
	600-699 ft 183-213 m	12AWG 3.31 mm ²			
	700-799 ft 213-244 m	12AWG 3.31 mm ²			

Installing a Converter Box—Wall Mount

Included in Package

<u>Description</u>	<u>Quantity</u>	<u>Picture</u>
1) Converter Box	1	
2) Mounting kit (M-SURF-MNT-KIT-1)	1	(See Below)
3) Power Cable	1	

Included in Wiring and Mounting Kit

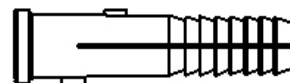
2a) #10-1.5 Sheet Metal Screw

4



2b) #10 Wall Anchors

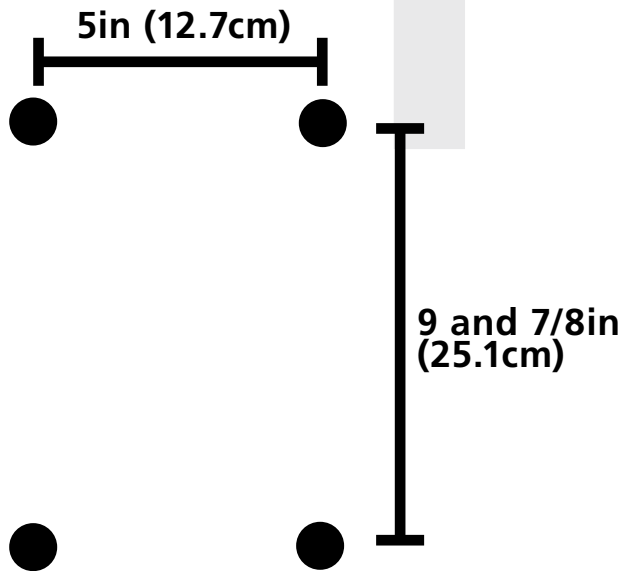
4



****A user will also have to provide a Phillips-head screwdriver, a ruler, a level, and a drill capable of creating #10 sized holes in your wall.***

Installing a Converter Box—Wall Mount

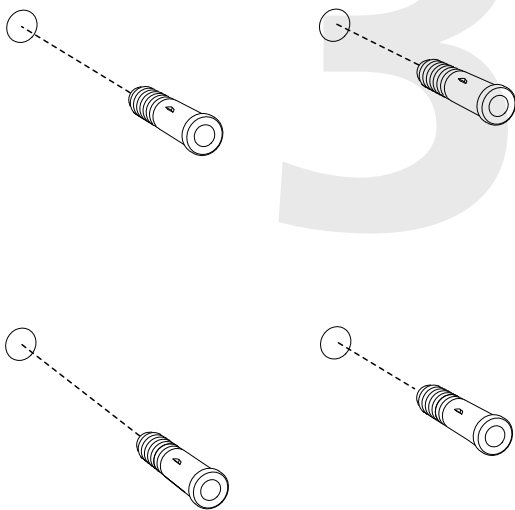
1) Use a ruler and a level to mark four points on the wall. The screws should have a horizontal separation of 5 inches (12.7cm), and a vertical separation of 9 and 7/8 inches (25.1cm).



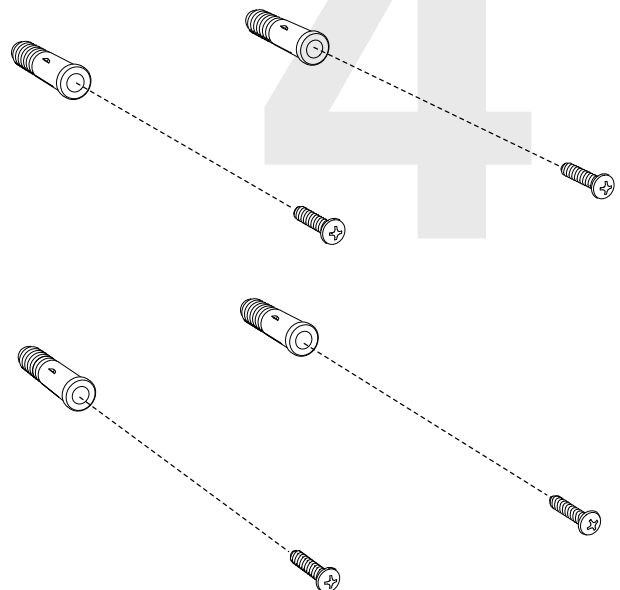
2) Use a drill to drill holes into the wall at the marked locations.



3) Insert wall anchors into the holes.

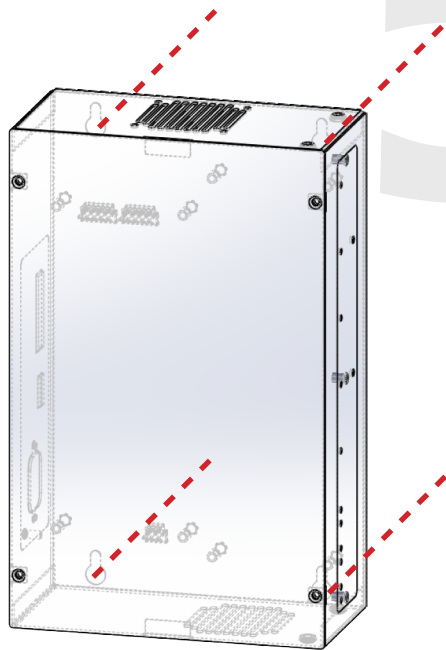


4) Insert the sheet metal screws into the wall anchors.

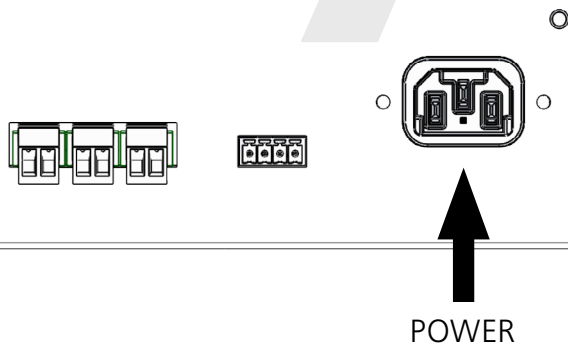


Installing a Converter Box—Wall Mount

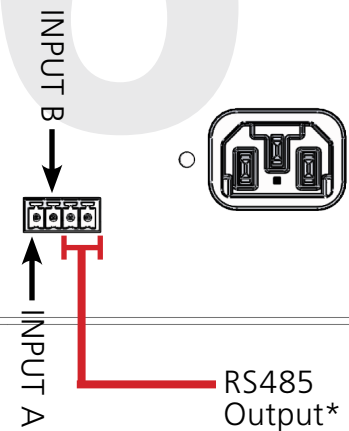
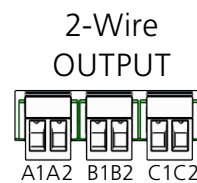
5) Hang the converter box on the wall screws. Do this by lining the screws up with the keyhole slots on the bottom of the box, and slipping the slots atop the screws.



7) Plug the power cord into the socket on the converter box.



6) Attach the signal wiring to the input ports and at least one pair of output ports.

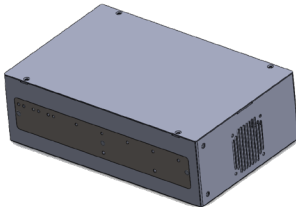
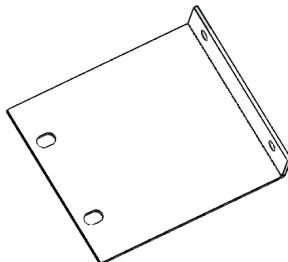
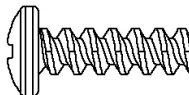



**The RS485 Output extends the RS485 signal to other converter boxes. It DOES NOT provide 2-wire power to clocks. Output A goes to Input A on the next box, and Output B goes to Input B.*

8) If the Master clock has been connected, powered, and configured, and the converter box is powered and operating normally, the colored LEDs on the front panel should be lit or not lit depending on their function. See the Status Panel section of this manual for more information.

Installing a Converter Box—Rack Mount

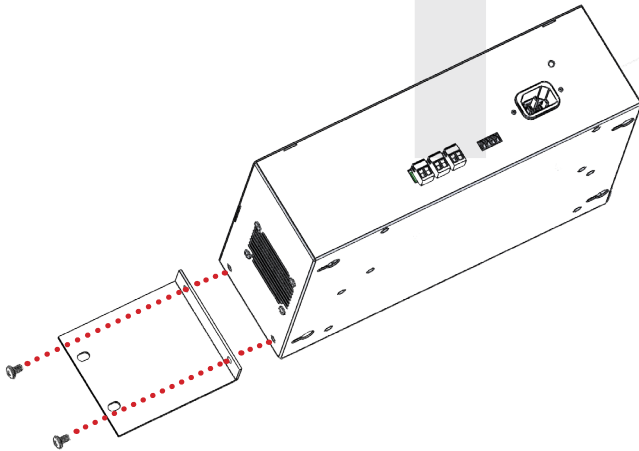
Included in Package

<u>Description</u>	<u>Quantity</u>	<u>Picture</u>
1) Converter Box	1	
2) Rack Mount Flaps	2	
3) #10-32x3/8 Truss Head Phillips Black Screw	4	
4) Power Cable	1	

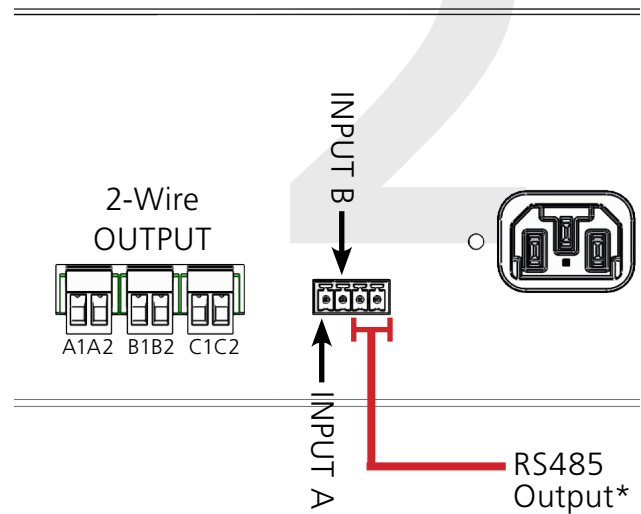
A user will also have to provide a Phillips-head screwdriver, a mounting rack, and the screws and bolts needed to attach the converter box to the rack.

Installing a Converter Box—Rack Mount

1) Use a screwdriver and the #10-32x3/8 Truss Head Phillips Black screws to attach the converter box rack panels to both sides of the converter box.

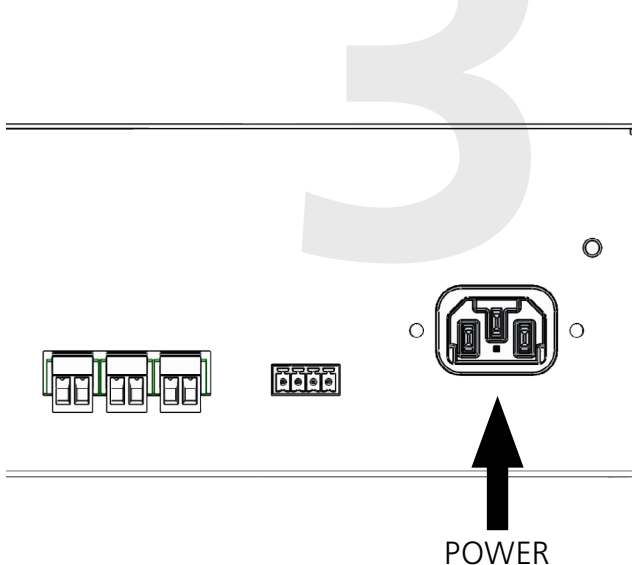


2) Attach the signal wiring to the input ports and at least one pair of output ports.

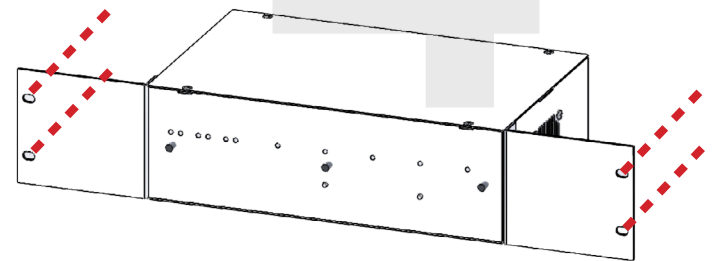


**The RS485 Output extends the RS485 signal to other converter boxes. It DOES NOT provide 2-wire power to clocks. Output A goes to Input A on the next box, and Output B goes to Input B.*

3) Plug the power cord into the socket on the converter box.

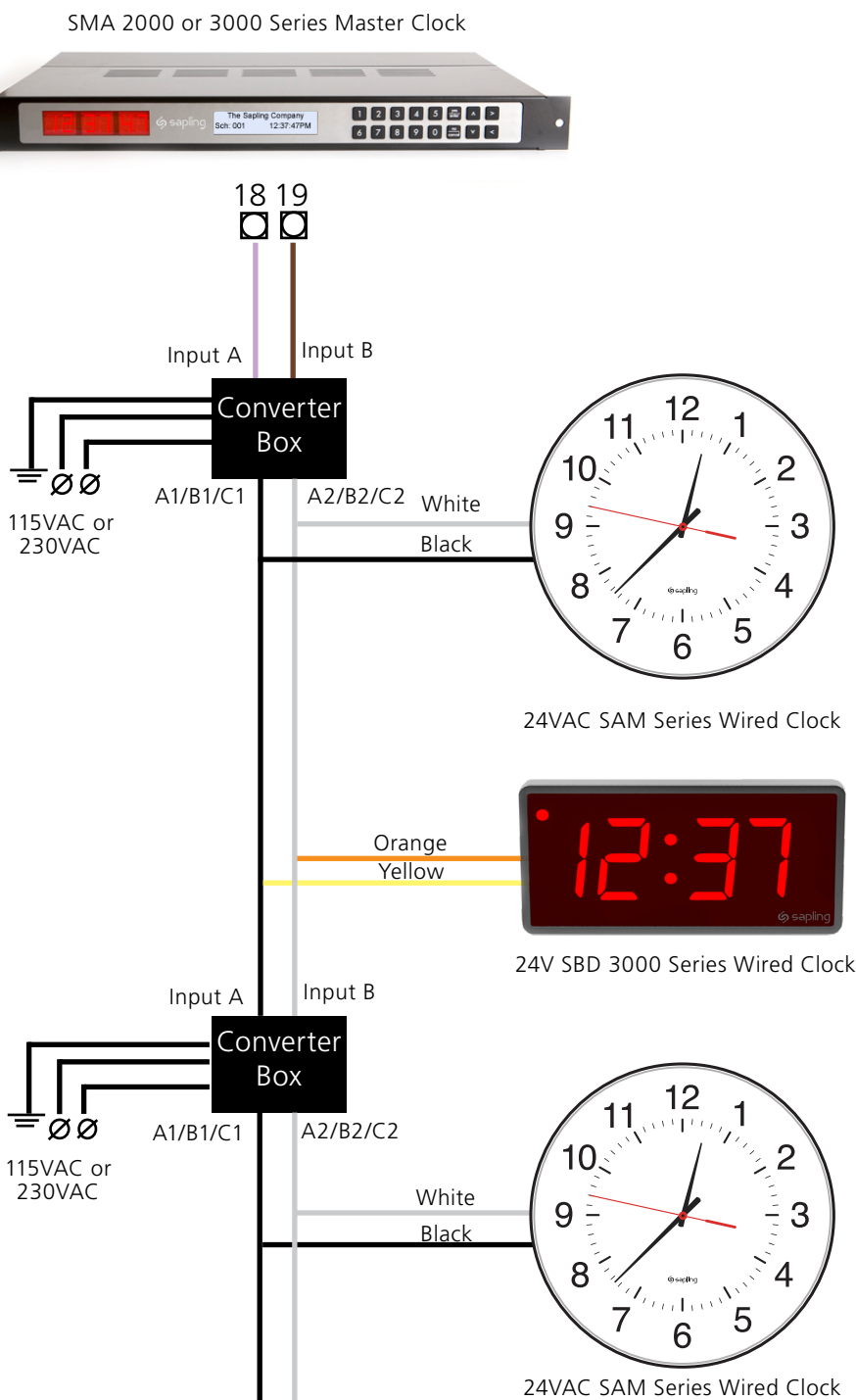


4) Use the rack screws and nuts to attach the converter box to the rack.



5) If the Master clock has been connected, powered, and configured, and the converter box is powered and operating normally, the colored LEDs on the front panel should be lit or not lit depending on their function. See the Status Panel section of this manual for more information.

2-Wire Digital Communication Wiring Information



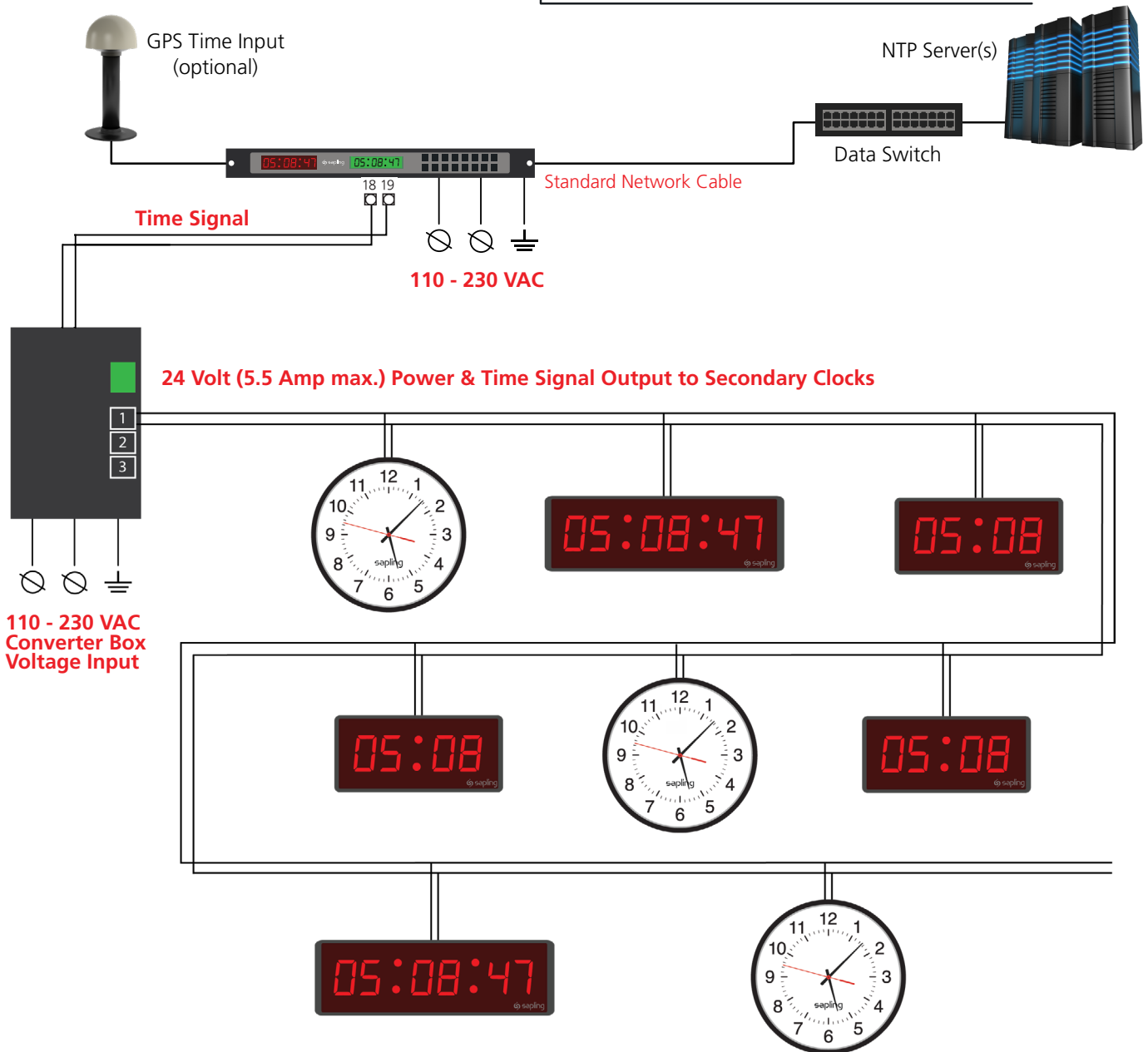
When translating systems from older converter boxes and wiring guides, the following values are equivalent:



2-Wire Digital Communication Wiring Information

Single Converter Box

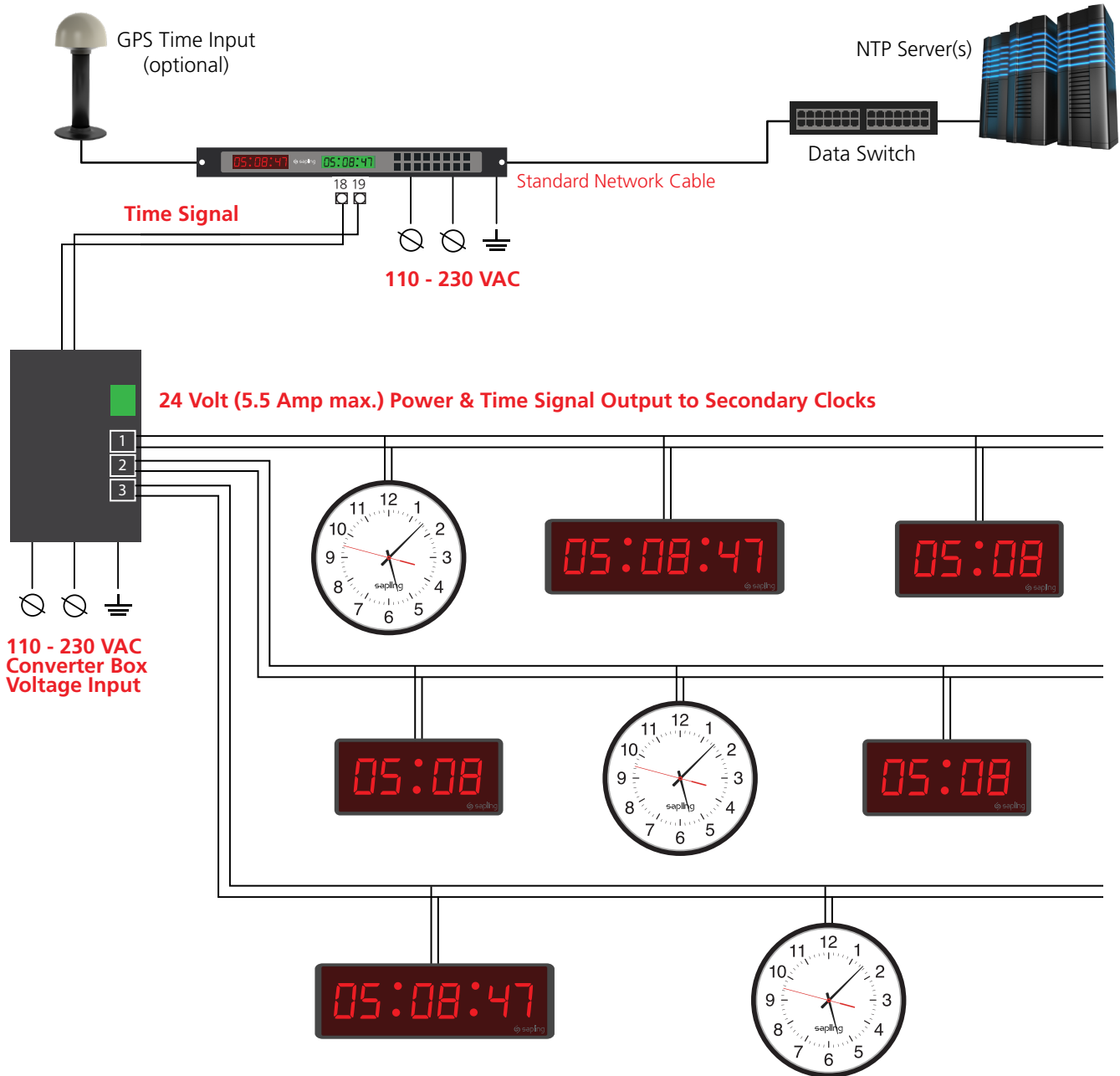
Configuration A - Small 2-Wire Clock System using one converter box on a single clock run.



2-Wire Digital Communication Wiring Information

Single Converter Box

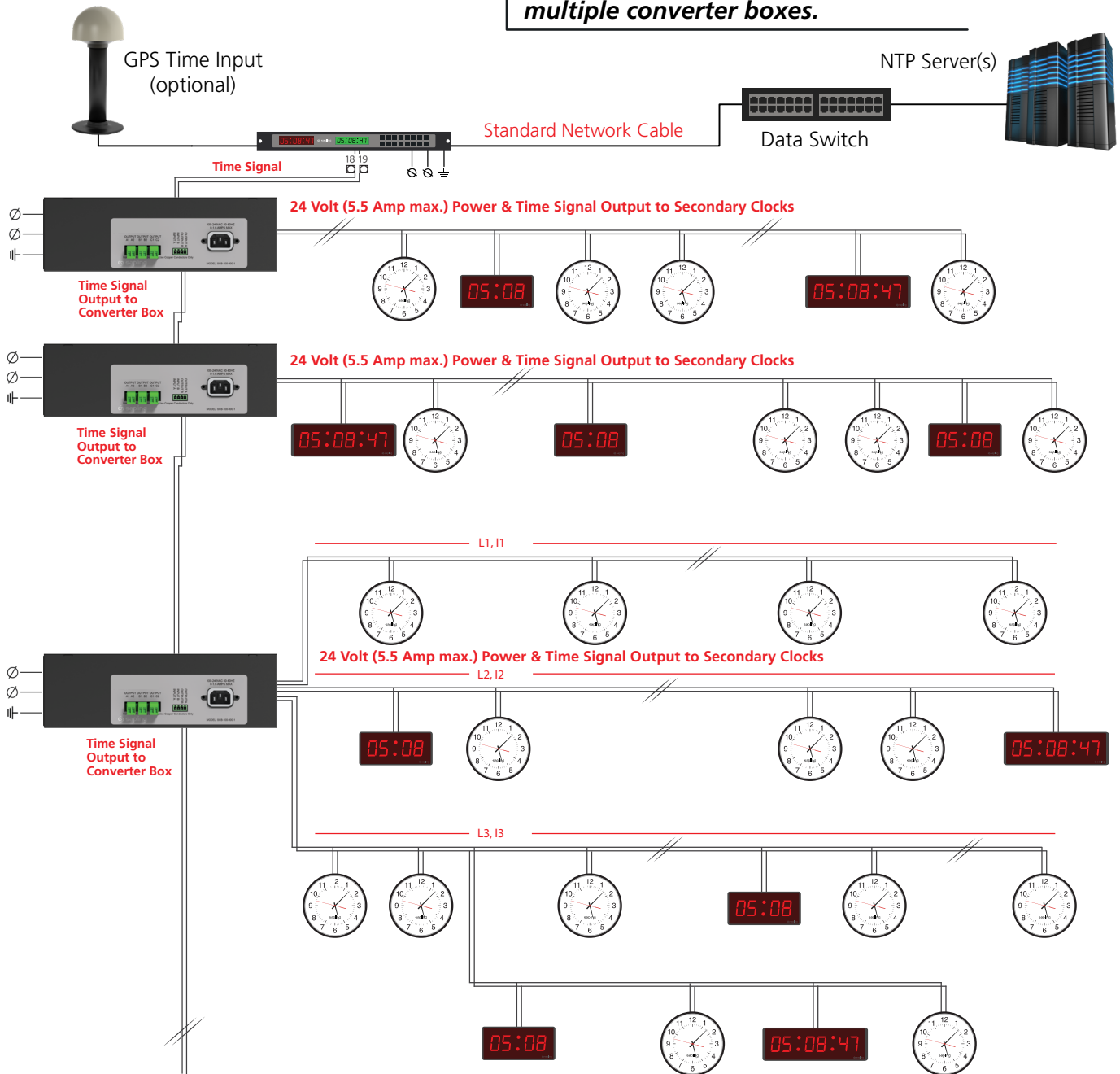
Configuration B - Small 2-Wire Clock System using one converter box on a triple clock run.



2-Wire Digital Communication Wiring Information

Multiple Converter Boxes

Configuration C - Large 2-Wire Clock System using multiple converter boxes.



Status Panel



A colored circle indicates that the LED in question is steadily on.

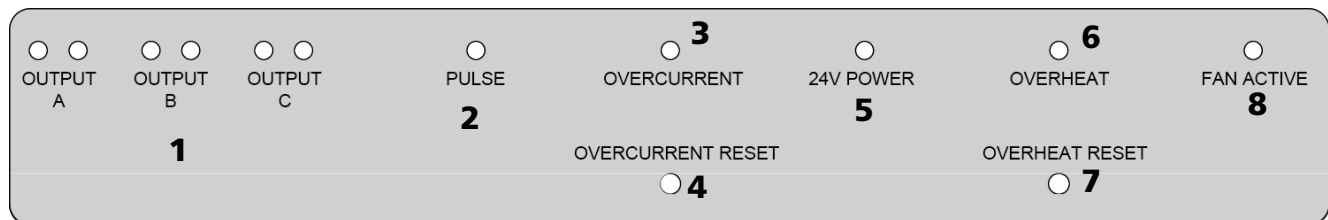


A black circle with a dashed halo indicates that the LED in question is blinking on and off.



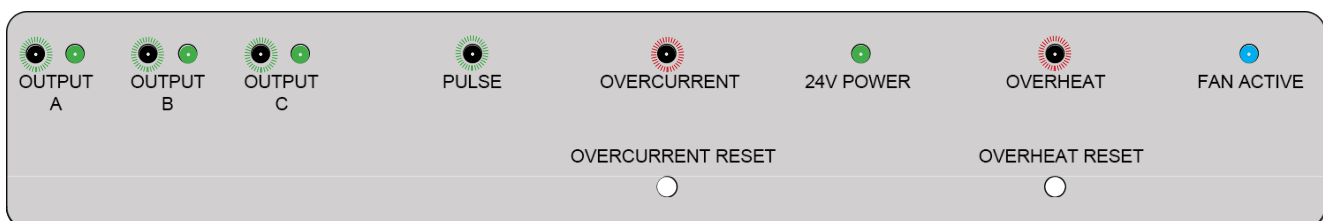
A black circle alone indicates that the LED in question is off.

Every potential concern relating to the converter box can be identified by examining the LEDs on the converter box front panel. The panel is arranged as follows:



- 1) **OUTPUT LED PAIRS**— The converter box has three Output LED pairs: A, B, and C. Each pair of output LEDs acts as an activity indicator for a pair of output ports on the back of the converter box.
- 2) **PULSE LED**—The pulse LED indicates that the converter box processor is active.
- 3) **OVERCURRENT LED**—Indicates the Overcurrent Status. During normal operation, the Overcurrent LED will blink once for each Amp being distributed (for example, two blinks means that two amps are being distributed). The converter box can distribute up to 5.5 Amps.
- 4) **OVERCURRENT RESET BUTTON**—Resets the Overcurrent Sensor (See Troubleshooting)
- 5) **24V POWER LED**—Indicates that the converter box is distributing 24V power.
- 6) **OVERHEAT LED**—Indicates the temperature status of the converter box. The Overheat LED displays the temperature inside the box by blinking once for each additional 10°C (for example, four blinks means that it is 40°C inside the converter box).
- 7) **OVERHEAT RESET BUTTON**—Resets the Overheat Sensors (See Troubleshooting)
- 8) **FAN ACTIVE LED**—Indicates whether or not the cooling fan is active.

If the converter box is functioning normally, the Pulse LED will flicker, the 24V LED will remain on, and in each pair of Output LEDs the LED nearest to the "P" in "OUTPUT" will remain on, while the LED nearest to the "O" shall occasionally flicker. The Overcurrent LED will blink once for each Amp being distributed. The Overheat LED displays the temperature inside the box by blinking once for each additional 10°C. The Fan LED may be on or off, depending on the internal temperature of the converter box.



Troubleshooting



A colored circle indicates that the LED in question is steadily on.

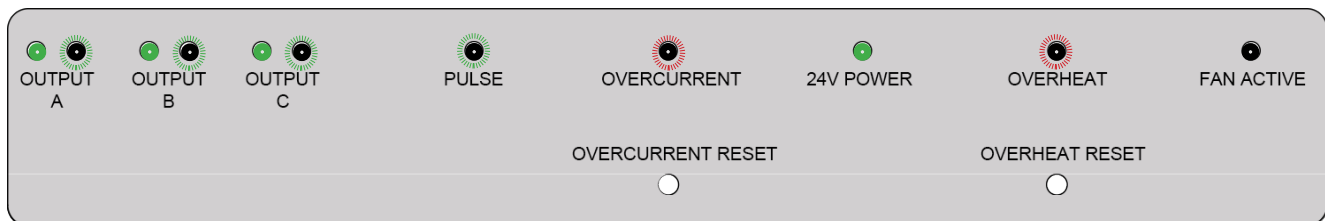


A black circle with a dashed halo indicates that the LED in question is blinking on and off.

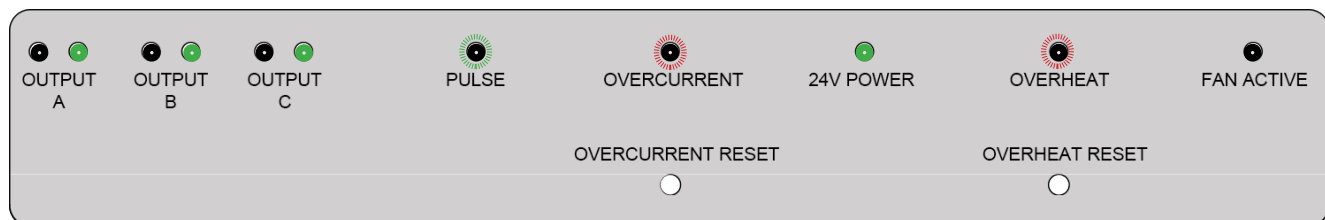


A black circle alone indicates that the LED in question is off.

For each pair of Output LEDs, if the Output LED nearest to the “O” in “OUTPUT” remains on, while the Output LED nearest to the “P” flickers, then the input wires were installed backwards and must be switched.



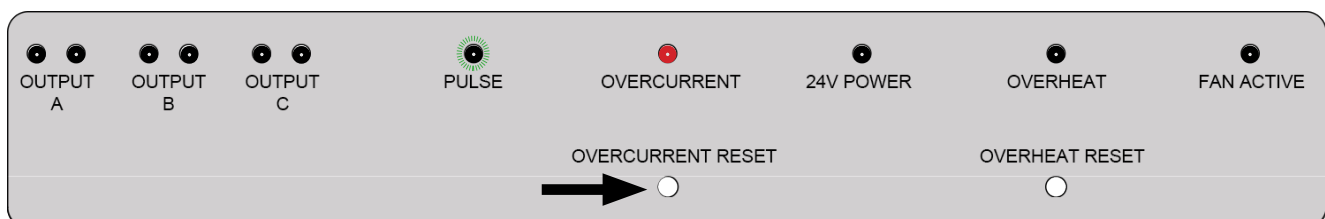
If the Output LED nearest to the “P” in “OUTPUT” remains on, and the Output LED nearest to the “O” remains off, then no data is being received by the converter box. If the Master Clock was configured correctly and there are no electrical shorts, contact Tech Support.



If the Overcurrent LED turns on and the 24V LED turns off, then either too many devices are drawing current from the converter box (5.5 Amps has been exceeded), or the wiring has been shorted. Remove a few clocks and press the reset switch to determine if the first case is the cause of the problem.

If the solid red light reappears, check the wiring for an electrical short.

If the reset button refuses to function, unplug the converter box from the power source, and plug it back in again.



Troubleshooting (continued)



A colored circle indicates that the LED in question is steadily on.



A black circle with a dashed halo indicates that the LED in question is blinking on and off.



A black circle alone indicates that the LED in question is off.

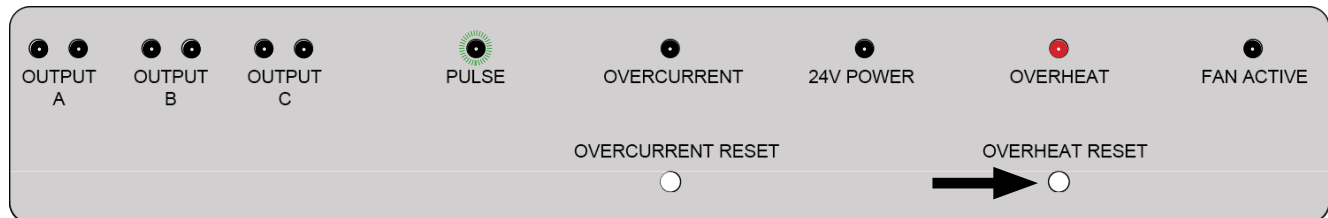
If the Overheat LED turns on and remains steadily on for a period longer than five seconds, then the interior of the converter box has exceeded the temperature threshold. When this happens, Pulse and Overheat will remain active/on, but all other LEDs on the front panel should turn off. Give the converter box five minutes to cool down, then press the reset switch.

If the solid red light reappears, check to confirm that the air vent is not blocked, and that the converter box has been installed in a room-temperature environment.

If both conditions have been proven true, and the red Overheat LED turns on and remains on a third time, contact Tech Support.

If, at any point, you reset the device by disconnecting and reconnecting the converter box from its power source, and the red Overheat LED remains on, contact Tech Support.

If the FAN ACTIVE LED never turns on **before** the Overheat LED activates and remains on, your converter box fan may be having a mechanical problem. Contact Tech Support.



If the converter box is powered, the Overcurrent and Overheat LEDs are off, and either the 24V LED or the Pulse LED remains completely dark, contact Tech Support.

If all of the LEDs are functioning normally, but a time signal is not reaching your clocks, check the wiring between the converter box and the clocks. If the wiring is sound, compare the number and position of the clocks you installed to the "Converter Box Table" at the beginning of this manual.

Warranty

Sapling Limited Warranty and Disclaimer

The Sapling Company, Inc. warrants only that at the time of delivery and for a period of 24 calendar months after delivery or the period stated in this invoice, if different, the Goods shall be free of defects in workmanship and materials, PROVIDED that this warranty shall not apply:

To damage caused by Buyer's or any third party's act, default or misuse of the Goods or by failure to follow any instructions supplied with the Goods.

Where the Goods have been used in connection with or incorporated into equipment or materials the specification of which has not been approved in writing by The Sapling Company, Inc.;

To Goods which are altered, modified or repaired in any place other than a Sapling Company, Inc. factory or by persons not expressly authorized or approved in writing by The Sapling Company, Inc.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WITH RESPECT TO GOODS DELIVERED UNDER THIS CONTRACT, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The foregoing warranty runs only to Buyer. There are no oral or written promises, representations or warranties collateral to or affecting this contract. Representatives of The Sapling Company, Inc. may have made oral statements about products described in this contract. Such statements do not constitute warranties, shall not be relied on by Buyer and are not part of the contract.

Note: An extended 5 year (60 month) warranty is also available at the time of the system purchase with a surcharge.