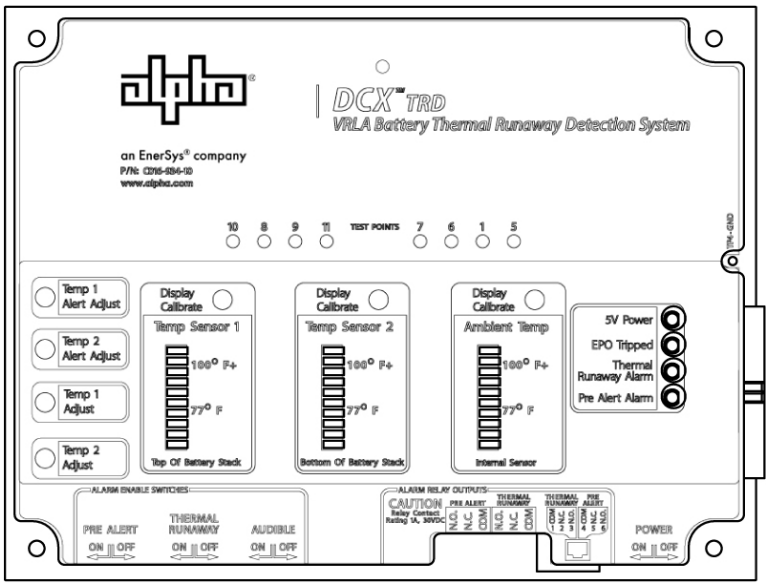
an EnerSys® company

TRD™

VRLA Battery Thermal Runaway Detection System for DCX™ Series Battery Disconnect Systems

Technical Manual

Effective: March 2021



Safety Notes

Alpha Technologies Services, Inc. considers customer safety and satisfaction its most important priority. To reduce the risk of injury or death and to ensure continual safe operation of this product, certain information is presented differently in this manual. Alpha® tries to adhere to ANSI Z535 and encourages special attention and care to information presented in the following manner:

WARNING! GENERAL HAZARD

GENERAL HAZARD WARNING provides safety information to PREVENT INJURY OR DEATH to the technician or user.

WARNING! ELECTRICAL HAZARD

ELECTRICAL HAZARD WARNING provides electrical safety information to PREVENT INJURY OR DEATH to the technician or user.

WARNING! FUMES HAZARD

FUMES HAZARD WARNING provides fumes safety information to PREVENT INJURY OR DEATH to the technician or user.

WARNING! FIRE HAZARD

FIRE HAZARD WARNING provides flammability safety information to PREVENT INJURY OR DEATH to the technician or user.

There may be multiple warnings associated with the call out. Example:

WARNING! ELECTRICAL & FIRE HAZARD

This WARNING provides safety information for both Electrical AND Fire Hazards

CAUTION!

CAUTION provides safety information intended to PREVENT DAMAGE to material or equipment.

***NOTICE**:*

NOTICE provides additional information to help complete a specific task or procedure.

ATTENTION:

ATTENTION provides specific regulatory/code requirements that may affect the placement of equipment and /or installation procedures.

The following sections contain important safety information that must be followed during the installation and maintenance of the equipment. Read all of the instructions before installing or operating the equipment, and save this manual for future reference.

TRD™

VRLA Battery Thermal Runaway Detection System for DCX™ Series Battery Disconnect Systems Technical Manual

C048-702-30 R02, Rev. B

Effective: March 2021

© 2021 by Alpha Technologies Services, Inc.

Disclaimer

Images contained in this manual are for illustrative purposes only. These images may not match your installation. Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies Services, Inc. or your nearest Alpha representative.

Alpha® shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose or is installed or operated in an unapproved manner or improperly maintained.

Contact Information

Sales information and customer service in USA (7AM to 5PM, Pacific Time):	1 800 322 5742
Complete Technical Support in USA (7AM to 5PM, Pacific Time or 24/7 emergency support):	1 800 863 3364
Sales information and Technical Support in Canada:	1 888 462 7487
Website:	www.alpha.com

Table of Contents

1.0 Purpose and Applicability

The purpose of this document is to detail the installation and operation instructions for the Alpha® TRD™ Battery Thermal Runaway Detection System.

1.1 Product Model

This document applies to the TRD Battery Thermal Runaway Detection System. This kit may have been supplied pre-installed on your DCX™ Series battery disconnect system, or was sold separately.

Table 1. GMT 125 Series Fuse Panel Configurations

PART NUMBER	DESCRIPTION
C016-934-10	TRD - VRLA Battery Thermal Runaway Detection System

2.0 Theory of Operation

The DCX Series top terminal mount DC disconnect product family consists of an internal magnetic trip DC rated circuit breaker and control circuit to provide remote status monitoring, remote trip and provides an interface expansion connector to allow optional circuit modules to plug into the DCX Series system. DCX units are available in 400, 600, 800, 1,000 and 1,200 ampere rated versions with a multitude of adapter termination copper bus and mounting kits to support many battery types.

The standard DCX Series disconnect comes with circuit breaker status monitoring via both LED indicators as well as form-c alarm contacts for remote breaker status detection. In addition, a remote EPO (Emergency Power Off) input circuit is provided to allow for use of EPO wall mounted switches, remote trip supervisory controllers or other options to comply with applicable fire or building codes for remote trip function.

A terminal block is provided for remote switch contact or relay contact closure to EPO trip the DC circuit breaker and disconnect the battery string from the load and rectifier system. Manual disconnect is always available via simply turning off the circuit breaker handle.

The TRD option (Thermal Runaway Detector) is a kit that consists of a plug-in circuit card and control panel assembly, two remote temperature sensors, and cable. The TRD can be installed in any DCX Series disconnect unit. The TRD control board assembly simply plugs into the DCX Series circuit board expansion connector and is secured with mounting screws to hold it in position.

The TRD controller circuit monitors temperature in three locations to analyze and determine if the VRLA battery system is approaching or is in thermal runaway condition. Two remote battery terminal sensors are compared against an internal reference temperature sensor and differential is analyzed and if a thermal fault is detected, the system alerts this status.

New NFPA and local state fire codes now specify use of a thermal runaway detection system for VRLA batteries to provide the ability to detect and alert if the battery system has a thermal fault developing or in process. In addition, many local municipalities have added the requirement that if thermal runaway is detected, the battery system must automatically be disconnected from the charging and load circuit without requiring manual intervention.

The DCX Series battery disconnect and TRD system is the only self-contained telecom grade thermal runaway detection and auto-disconnect system that complies with both NFPA and state/local fire codes for VRLA battery installations.

2.1 Features

- Modular, hot-swap circuit card assembly
- Two remote temperature sensor probes
- Pre-alert and Thermal Runaway alarm relay contacts
- Temperature display
- Optional self disconnect feature
- Kit retrofits in any existing DCX Series battery disconnect system

3.0 Unpacking and Inspection

The TRD was carefully packaged at the factory to withstand the normal rigors of shipping. However, you should carefully inspect the box and contents to confirm that no damage has occurred in transit. Most shipping carriers require notification of shipping damage within twenty-four hours of delivery, and it is the responsibility of the recipient to inspect the shipment immediately upon receipt.

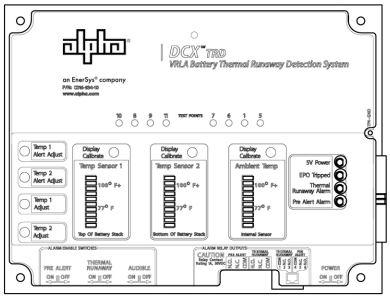


Figure 1. TRD board

3.1 Package Contents

Included with your product are the following items:

- TRD control board
- Two remote temperature sensors with LED status
- Mounting hardware kit
- Temperature sensor cables

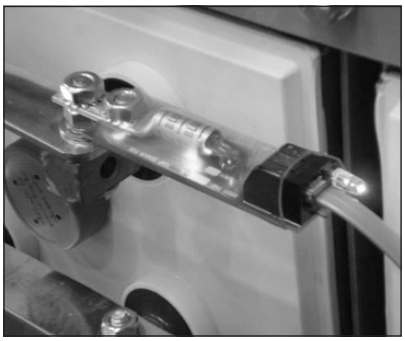


Figure 2. Battery temperature sensor for TRD

4.0 Installation

Installation of the TRD kit is typically performed as a retrofit for existing DCX Series battery disconnect systems in communications battery rooms or similar -48VDC power plants. Orders direct to the factory for new systems where the TRD option is specified on the order are factory installed prior to shipment. This procedure defines the retrofit process to install the TRD kit in an existing DCX Series disconnect system.

4.1 Installation Preparation

When selecting an installation location, ensure that all of the following conditions are met before proceeding.

4.1.1 Elevated Operating Ambient Temperature

If you install the product in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, take care to install the equipment in an environment compatible with the maximum ambient temperature (TMA) specified in Section 6.

4.1.2 Reduced Air Flow

Installation of the equipment in a rack should be such that the amount of air flow required for safe operation of the equipment is not compromised.

4.1.3 Mechanical Loading

Mounting of the equipment in the rack should be such that a hazardous condition is not achieved due to uneven mechanical loading.

4.1.4 Circuit Overloading

Give consideration to the connection of the equipment to the supply circuit and the effect that overloading of the circuits might have on overcurrent protection and supply wiring. Use appropriate consideration for equipment nameplate ratings when addressing this concern.

4.1.5 Reliable Earthing

Maintain reliable earthing of rack-mounted equipment. Pay particular attention to supply connections other than direct connections to the branch circuit (e.g., use of power strips).

4.1.6 Disconnect Device

A readily accessible disconnect device must be incorporated in the building installation wiring.

4.2 Installation Procedure

NOTICE:

THIS PRODUCT MUST BE INSTALLED WITHIN A RESTRICTED ACCESS LOCATION WHERE ACCESS IS THROUGH THE USE OF A TOOL, LOCK AND KEY, OR OTHER MEANS OF SECURITY, AND IS CONTROLLED BY THE AUTHORITY RESPONSIBLE FOR THE LOCATION. THIS PRODUCT MUST BE INSTALLED AND MAINTAINED ONLY BY QUALIFIED TECHNICIANS.

WARNING! ELECTRICAL HAZARD

VRLA BATTERY STACKS CAN PROVIDE THOUSANDS OF AMPERES OF DISCHARGE CURRENT INTO A SHORT CIRCUIT, IN ADDITION, PARALLELED BATTERY STACKS AND LARGE RECTIFIER SYSTEMS CAN ALSO DISCHARGE EXTREMELY HIGH CURRENTS INTO A SHORT CIRCUIT FAULT. THERE IS AN EXTREME SAFETY HAZARD WHEN WORKING ON LARGE SYSTEMS WITH THIS DISCHARGE AMPACITY POTENTIAL. EYE PROTECTION, SAFETY GLOVES AND PROTECTIVE SHIELDS ARE REQUIRED ENTIRELY DURING THE TRD INSTALLATION PROCESS.

Step 1. Unpack and inspect contents of TRD kit. See "3.1 Package Contents" on page 6 for more information. Confirm all parts are present and no shipping damage has occurred.

Step 2. Installation into the DCX unit technically can be performed with the battery disconnect circuit breaker on and connected to the rectifier and load system in extreme cases but is not recommended for safety reasons and due to the fact that battery bus bar connections must be loosened as part of the temperature sensor installation process. It is recommended that the battery disconnect circuit breaker be turned off for the installation process.

Step 3. Locate the DCX unit to be retrofitted with the TRD kit. Turn off the DCX circuit breaker and tape in the off position as a reminder during the work process and as a notification to co-workers that may be present. Ensure that eye protection, safety gloves, long sleeve shirts are used as a precaution.

Step 4. Open the flip-up DCX unit lid/door and confirm that it latches in the secure upright position.

Step 5. Install the TRD circuit board and control assembly from the left of the DCX unit and move toward the right to plug into the expansion connector on the existing circuit board assembly inside of the DCX unit. Ensure that there is a secure connection with full alignment and seating of the connectors. Align the mounting holes of the TRD board assembly with the existing threaded metal stand-offs inside of the DCX unit. Install the screws provided in the kit to secure the TRD board module assembly to the DCX metal housing.

Step 6. Locate the temperature sensor kit which consists of two remote terminal temperature sensors and cable assemblies. Note that one cable may be shorter than the other. One temperature sensor and cable is intended to mount on a battery terminal near the top of the battery stack which requires a shorter cable, while the other sensor is intended to be installed on the lower section of the battery stack, requiring the longer cable to route to this location.

Step 7. Installation of the temperature sensor modules requires that the bolt connecting the copper bus strap that will be used to mount the sensor be removed and replaced with a longer bolt to mount the TRD sensor module. This requires access to the battery terminals and is a safety hazard area. Ensure that insulated tools, safety gloves, and eye protection are used.

Step 8. To install the temperature sensor modules, two mounting locations must be confirmed: one at the top of the battery stack to monitor the upper section of the stack and one near the lower third of the stack to monitor lower stack temperature.

These two temperature sensing points are compared to an ambient temperature sensor in the TRD unit to determine the temperature rise of the battery sensors compared to ambient and compared to each other. The temperature sensor module has a copper lug with a clearance hole for a 1⁄4-20 bolt which is the typical size bolt used in the strapping kit from the battery manufacturer. Confirm that the DCX circuit breaker is in the OFF position, then remove the appropriate clear cover from the battery stack that is covering the bolt location desired for installation. Ensure that insulated tools, safety gloves, and eye protection are used. Carefully loosen and remove the bolt while being extremely careful to not contact adjacent battery terminal posts or strap locations. Remove this bolt and washers and nut and set aside.

Step 9. **Top sensor:** select a bolt location in the top battery string shelf or second shelf from the top. Locate the temperature sensor module and lengthened bolt kit. Locate the sensor module lug clearance hole on the battery terminal post and slide the new bolt in from the bottom up through the battery post and strap assembly and new nut. The hardware order from bottom up should be bolt, flat washer, battery terminal post and strap then flat washer, split lock washer, second nut, temperature sensor lug and final nut. Finger tighten this assembly and check to ensure that the sensor lug and PCB assembly are not pinched or pressed against adjacent terminals, bus bars etc.

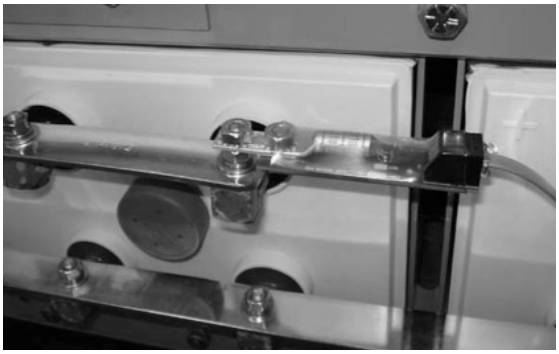


Figure 3. Temperature sensor cable connected to battery terminal

The sensor module is designed to sit above the first nut so that the sensor lug is not in compression with the bolt assembly required for correct tight torque for current carrying capacity of the battery strap system. Tighten the hardware on the battery post and strap to the battery manufacturers correct torque setting. Typically this is about 100 inch pounds. Use a torque wrench with insulated feature to avoid potential for short circuit. Locate the temperature sensor lug and tighten top nut carefully on top of lug to hold the sensor to the bolt. This connection does not need to be over tightened. Take caution as to not rotate or stress the sensor circuit board while tightening. This is intended as a temperature measurement connection and not a high current connection requiring extreme torque to hold the sensor module in place.

Step 10. **Bottom sensor:** Select a bolt location in the second or third battery shelf from the bottom of the stack and repeat the installation procedure from Step 9 for this sensor. Confirm all connections are tight.

Step 11. Locate temperature sensor cables and confirm that they are different lengths: the shorter cable is for the top sensor and the longer cable is for the bottom sensor. Plug the sensor cable into the jack of the sensor module securely and ensure that it latches. Route the sensor cable up the face of the battery stack carefully around the battery posts and straps. It is not recommended that this cable be allowed to chafe on these bus bars or be cable-tied to the bus bars. Use double-sided tape cable tie anchors or route cable directly up to the top of the stack in such a manner that it is not contacting battery straps or terminal posts to avoid a potential short circuit. Plug in both cables at the sensor ends and confirm correct routing of the cables safely up the stack to the DCX unit mounted on the top of the battery stack.

Step 12. Replace all of the battery terminal plastic cover shields removed for access for the sensor installation. Confirm all are mounted correctly.

Step 13. Route the two sensor cables up to the bottom of the DCX housing through the black plastic grommet hole and into the control panel assembly and plug in the cables into the jacks provided on the DCX control circuit board. The sensor on the top of the stack is TEMP 1 and the sensor on the bottom of the stack is TEMP 2. Confirm this by reading the label on the DCX PCB next to the jacks. These are clearly marked and it is important to ensure that the correct sensor cable is plugged into it's correct jack. Store any excess sensor cable by carefully coiling and secure with a cable tie. This concludes the TRD control and temperature sensor installation procedure.

Figure 4. Temperature sensor cable routing through DCX chassis via grommet hole and up to DCX control PCB jack locations

5.0 Operation

5.1 Configuration and Alarm Wiring

The TRD system is configurable in several ways to provide remote alarm monitoring and either local or remote battery breaker trip disconnection if either terminal runaway is detected or a ventilation system fails etc.

The TRD PCB assembly includes the control circuit to monitor, analyze and detect thermal faults via three sensor systems. The alarm output of this circuit assembly includes LED indicators as well as two alarm contact relays that can provide remote alarm detection.

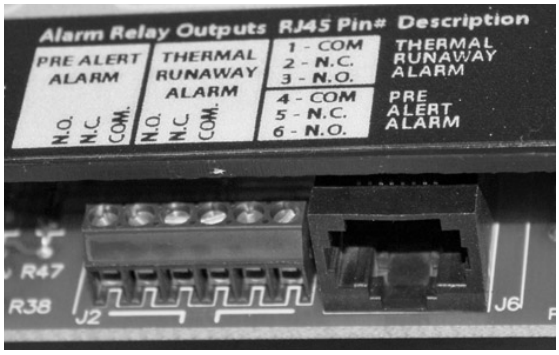


Figure 5. Alarm connections

5.1.1 Alarm Connections

The alarm connections are provided on a 6-position terminal block and on an 8p8c (RJ-45) jack (see Figure 5).

Pre-alert

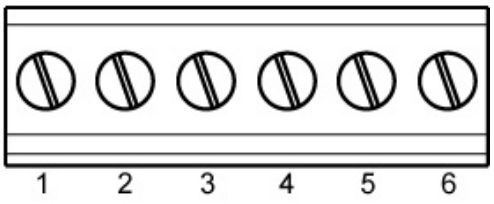
Form-C. NO (normally open), NC (normally closed), C (common). Max 1 ampere, 30VDC.

- Actuates first if a thermal fault is initially detected. Can be wired to a remote strobe, lamp, horn etc. to notify alert condition locally. Can be wired to remote monitoring or fire suppression control panel.

Thermal Runaway Detect

Form-C. NO (normally open), NC (normally closed), C (common). Max 1 ampere, 30VDC.

- Actuates second if a thermal runaway is detected. Can be wired to a remote strobe, lamp, horn etc. to notify alert condition locally. Can be wired to remote monitoring or fire suppression control panel. This signal is typically used for a remote monitoring and control system to detect thermal runaway and then to send a DCX battery breaker disconnect signal.



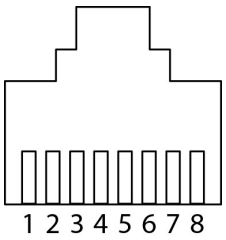


Table 2. P-Terminal Alarm Outputs

PIN #	DESCRIPTION	
1	N.O.	PRE-ALERT ALARM
2	N.C.	
3	COM	
4	N.O.	THERMAL RUNAWAY ALARM
5	N.C.	
6	COM	

Table 3. RJ-45 Alarm Outputs

PIN #	DESCRIPTION	
1	COM	PRE-ALERT ALARM
2	N.C.	
3	N.O.	
4	COM	THERMAL RUNAWAY ALARM
5	N.C.	
6	N.O.	
7	RESERVED	N/A
8	RESERVED	

5.2 Control Options

Option A: Internal TRD detect and self-disconnect

This option does not require an external monitoring or control system such as a fire suppression controller and simply uses the thermal runaway detect relay output of the TRD module to connect into the EPO switch input of the DCX control PCB. Essentially the TRD alarm relay closes and sends an EPO signal to the DCX which trips the battery circuit breaker and isolates the batteries from the charging system. This approach is viable for small systems with a single battery stack, remote sites such as cell sites, cabinets or equipment rooms where a fire suppression system may not be present or where there may not be sufficient supervisory control functions in the fire suppression or monitoring controller.

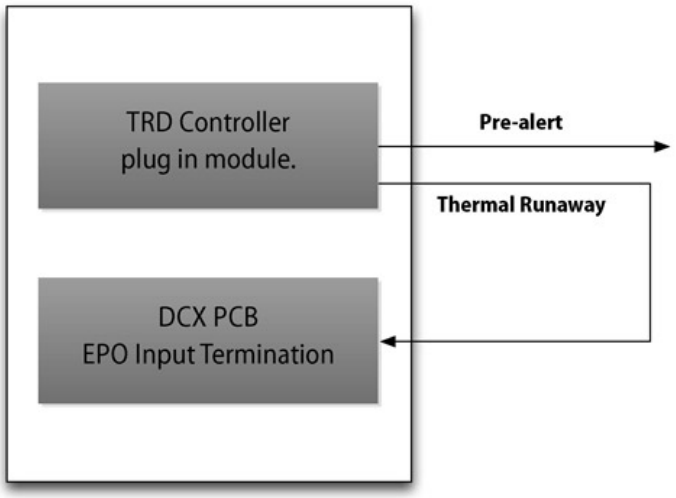


Figure 6. Internal TRD detect and self-disconnect

Option B: Internal TRD detect and remote disconnect control

This option requires use of a remote controller device of some kind such as a fire control panel or supervisory controller or PLC etc. This device can monitor both the pre-alert and TRD relays of the TRD module and provide remote monitoring, send an alarm to a call center, send a fire department alarm and/or provide an EPO trip signal back to the DCX unit after a programmable time delay after waiting for manual intervention first etc.

The remote controller device provides the control monitoring and trip control. The advantage of this approach is that the controller device can also monitor other site conditions to determine if the DCX breaker should be EPO tripped off. Examples include EPO wall switches pushed, remote hydrogen sensors detecting out gassing, ventilation – cooling system failure etc. Any one of these conditions can be programmed to send an EPO trip signal to the DCX including the thermal runaway detection from the TRD module.

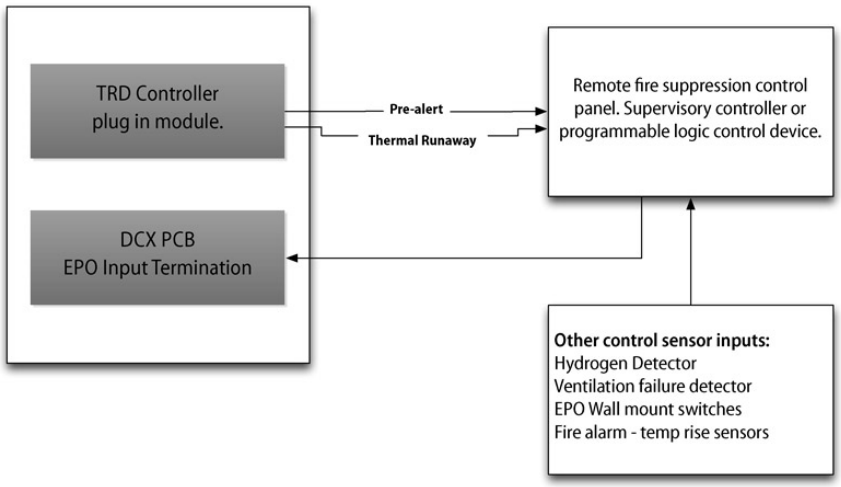


Figure 7. Internal TRD detect and remote disconnect control

6.0 Product Specifications

Table 4. Specifications

Input Voltage	-48V DC (supplied by DCX unit term board)
Width	7.25 in.
Height	5.5 in.
Operating Temperature	0 to 50°C
Elevation	-500m to 2800m

7.0 Ordering Information

Table 5. Kit Configuration

DESCRIPTION	PART NUMBER
TRD - VRLA Battery Thermal Runaway Detection System	C016-934-10

an EnerSys® company

Alpha Technologies Services, Inc. | 3767 Alpha Way, Bellingham, WA 98226, USA
Tel.: Toll Free North America: +1 800 322 5742 | Outside US: +1 360 647 2360 | Technical Support: +1 800 863 3364
For more information visit our website at: www.alpha.com

© 2021 Alpha Technologies Services, Inc. All Rights Reserved. Trademarks and logos are the property of Alpha Technologies Services, Inc. and its affiliates unless otherwise noted. Subject to revisions without prior notice. E.&O.E.

C048-702-30 R02, Rev. B (03/2021)

an EnerSys® company