TR1™ Series VFD
Variable Frequency Drive

LonWorks®

Installation and Operation Manual

LONMARK® 3.3

December, 2003 TR1-SVX01A-EN

175R5562

⚠DANGER

Rotating shafts and electrical equipment can be hazardous. Therefore, it is strongly recommended that all electrical work conform to National Electrical Code (NEC) and all local regulations. Installation, start-up and maintenance should be performed only by qualified personnel.

Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing drives and electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case of an emergency. Disconnect power whenever possible to check controls or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electric control or rotating equipment.

⚠WARNING

Warnings Against Unintended Start

1. While the drive is connected to the AC line, the motor can be brought to a stop by means of external switch closures, serial bus commands or references. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stops are not sufficient.
2. During programming of parameters, the motor may start. Be certain that no one is in the area of the motor or driven equipment when changing parameters.
3. A motor that has been stopped may start unexpectedly if faults occur in the electronics of the drive, or if an overload, a fault in the supply AC line or a fault in the motor connection or other fault clears.
4. If the “Local/Hand” key is activated, the motor can only be brought to a stop by means of the “Stop/Off” key or an external safety interlock.

⚠CAUTION

Electronic components of LonWorks option card are sensitive to electrostatic discharge (ESD). ESD can reduce performance or destroy sensitive electronic components. Follow proper ESD procedures during installation or servicing to prevent damage.

⚠DANGER

Touching electrical parts may be fatal, even after equipment has been disconnected from AC line. To be sure that capacitors have fully discharged, wait 14 minutes for 208 V and 460 V units and 30 minutes for 600 V units over 25 HP after power has been removed before touching any internal component.

Table of Contents

Table of Contents (continued)

Introduction

This manual provides comprehensive instructions on the installation and set up of the LonWorks Option Card for the TR1 Series VFD Variable Frequency Drive to communicate over a LonWorks network.

For specific information on installation and operation of the variable frequency drive, refer to the *TR1 Series VFD Installation and Operation Manual*.

Portions of this manual are printed with the permission of the Echelon Corporation and the National Electrical Contractors Association (NECA) of the USA.

About This Manual

This manual is intended to be used for both instruction and reference. It only briefly touches on the basics of the LonWorks protocol whenever necessary for gaining an understanding of the LonWorks profile for drives and the LonWorks Option Card for the TR1 Series VFD.

This manual is also intended to serve as a guideline when you specify and optimize your communication system. Even if you are an experienced LonWorks programmer, we suggest that you read this manual in its entirety before you start programming, since important information can be found in all sections.

Assumptions

This manual assumes that you have a controller node that supports the interfaces in this document and that all the requirements stipulated in the controller node, as well as the TR1 Series VFD, are strictly observed, along with all limitations therein.

What You Should Already Know

The Trane LonWorks Option Card is designed to communicate with any controller node that supports the interfaces defined in this document. It is assumed that you have full knowledge of the capabilities and limitations of the controller node.

References

TR1™ Series VFD Installation and Operation Manual, document number TR1-SVX10A-EN.

LonWorks Overview

LonWorks is both an existing standard and hardware developed by Echelon Corporation. Echelon's stated goal is to establish a commodity solution to the presently daunting problems of designing and building control networks.

The result is LonMark Interoperability which makes it possible for independent network devices to operate together over a LonWorks network. The LonMark program was developed to address interoperability issues. As a result, the LonMark Interoperability Association Task Groups were developed. The task groups determine that each device on the network has an object definition, create standards and models to be used by particular applications and create a common platform for presenting data. A standard network variable type (SNVT) facilitates interoperability by providing a well defined interface for communication between devices made by different manufacturers. The TR1 Series VFD supports the LonMark functional profile for variable speed motor drives. It also supports node object and controller standard object definitions.

Customers are currently using LonWorks for process control, building automation, motor control, elevator operation, life safety systems, power and HVAC distribution and similar intelligent building applications.

LON Concept

The LonWorks communications structure is similar to that of a local area network (LAN) in that messages are continually exchanged between a number of processors. A LonWorks system is a determined local operating network (LON). LON technology offers a means for integrating various distributed systems that perform sensing, monitoring, control, and other automated functions. A LON allows these intelligent devices to communicate with one another through an assortment of communications media using a standard protocol.

LON technology supports distributed, peer-to-peer communications. That is, individual network devices can communicate directly with one another without need for a central control system. A LON device is designed to move sense and control messages which are typically very short and which contain commands and status information that trigger actions. LON performance is viewed in terms of transactions completed per second and response time. Control systems do not need vast amounts of data, but they do demand that the messages they send and receive are absolutely correct. The critical factor in LON technology is the assurance of correct signal transmission and verification.

Applications

An important LonWorks benefit is the network's ability to communicate across different types of transmission media. The NEURON chip is the heart of the LonWorks system. The NEURON chip's communication port allows for the use of transceivers for other media (such as coax and fiber optic) to meet special needs.

LonWorks control devices are called nodes. Physically, each node consists of a NEURON chip and a transceiver. With proper design, the nodes become building blocks that can be applied to control a variety of tasks, such as lighting or ventilating, integrating a variety of communications media.

The tasks which the nodes perform are determined by how they have been connected and configured. Because hardware design, software design, and network design may be independent in a LonWorks-based system, a node's function can be programmed to accommodate the networks in which it will be used.

TR1 Series VFD Applications

Common applications for the Trane TR1 Series VFD include the following.

- The TR1 is factory mounted or field applied under control of discrete I/O from another controller. It is possible to monitor the TR1 using Tracer Summit's generic LonTalk device (GLD) object.
- The TR1 is field applied using closed loop PID control. It is possible to enable/disable, change setpoints, and monitor the control through Tracer Summit using the GLD object.
- The TR1 can be controlled digitally when used in conjunction with Trane's AH540 and MP580 Comm 5 (LON) controllers.
- The TR1 could be operated in an open loop control method and, under certain circumstances, an override or contact closure can send the drive to a preset value.

TR1 Series VFD LonWorks Option Card

The Trane TR1 Series VFD LonWorks option card is comprised of a control card with a NEURON chip and a memory card. When installed into the TR1 Series variable frequency drive, the unit enables the drive to communicate with other devices on the LON. The TR1 Series drive is designed to provide precision control of standard induction electrical motors for HVAC applications. The drive receives three reference signals along with start/stop and reset commands from the network. The drive also receives a 16-bit control word that provides full operational control of the drive. (See *Network Drive Control Input* for additional details.)

In response, the drive provides 16 output network variables containing important drive and motor data. (See *Drive Feedback to Network*.) Output to the network includes drive status, current, voltage, motor and inverter thermal status, and alarms and warnings.

The TR1 Series VFD LonWorks free topology option card, 176F1515, supports four transmission media, which also operates on a link power network (used for Comm 5). A router is required to interface to a LonWorks network when not supported by the option card.

Network Management

Depending on the level of a given application, a LonWorks network may or may not require the use of a network management node. A network management node performs management functions, such as:

- Find unconfigured nodes and download their network addresses.
- Stop, start, and reset node applications.
- Access node communication statistics.
- Configure routers and bridges.
- Download new applications programs.
- Extract the topology of a running network.

Within a Trane BAS system, the Tracer Summit building controller unit (BCU) and/or Rover Service tool act as the network managers.

System Performance

Free topology system specifications and transmission specifications are described below. Both specifications should be met to ensure proper operation.

The transmission specification depends on such factors as resistance, mutual capacitance and the velocity of propagation.

The system designer may choose from a variety of cables, depending on cost, availability, and desired performance. Performance may vary with cable type. Contact Echelon for cable types and the characterization of system performance.

Note

The following specifications are for one network segment. Multiple segments may be combined using repeaters to increase the number of nodes and distance.

System Specifications

- The average temperature of the wire must not exceed 131° F. Individual segments of wire may be as hot as 185° F.
- Up to 64 FTT-10 transceivers are allowed per network segment.

Transmission Specifications

Free Topology nodes run at 78 kbps transmission speeds.

Cable Specifications

Trane recommends the use of shielded LonWorks communication cable, for example 18 guage shielded twisted pair, tinned-copper conductors (Trane "purple" wire).

Free Topology Specifications

	Maximum node-to-node distance	Maximum total wire length
Belden 85102	1650 ft	1650 ft
Belden 8471	1300 ft	1650 ft
Level IV, 22AWG	1300 ft	1650 ft
JY (St) Y 2x2x0.8	1050 ft	1650 ft
*Trane 400-2028	1300 ft	1650 ft

Doubly-Terminated Bus Topology Specifications

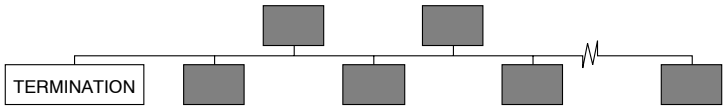
	Maximum bus length for segments with FTT-10 transceivers only	Maximum bus length for segments with both FTT-10 and LPT-10 transceivers
Belden 85102	8850 ft	7200 ft
Belden 8471	8850 ft	7200 ft
Level IV, 22AWG	4500 ft	3800 ft
JY (St) Y 2x2x0.8	2950 ft	2450 ft
*Trane 400-2024	4500 ft	3800 ft

*Recommended

Free Topology Network Configuration

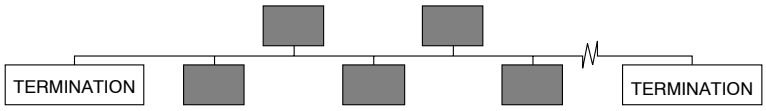
The Free Topology Transceiver (FTT) system is designed to support free topology wiring and accommodates single and doubly terminated bus topologies. The FTT transceiver located on the TR1 Series VFD LonWorks option card provides I/O functions. Flexible wiring capability simplifies system installation and makes it easy to add nodes for system expansion. The figures below represent network topologies.

Singly Terminated Bus Loop



Doubly Terminated Bus Loop

(Recommended)



Network Termination Option

The option of using termination on the LonWorks card is provided. The option card has a 105 ohm termination resistor built in which is activated by the terminator switch. Use of the terminator is optional, depending upon the network configuration. If termination is provided elsewhere in the network, the termination function should be OFF. Terminator switch position functions are provided in the table below. The factory default setting is OFF.

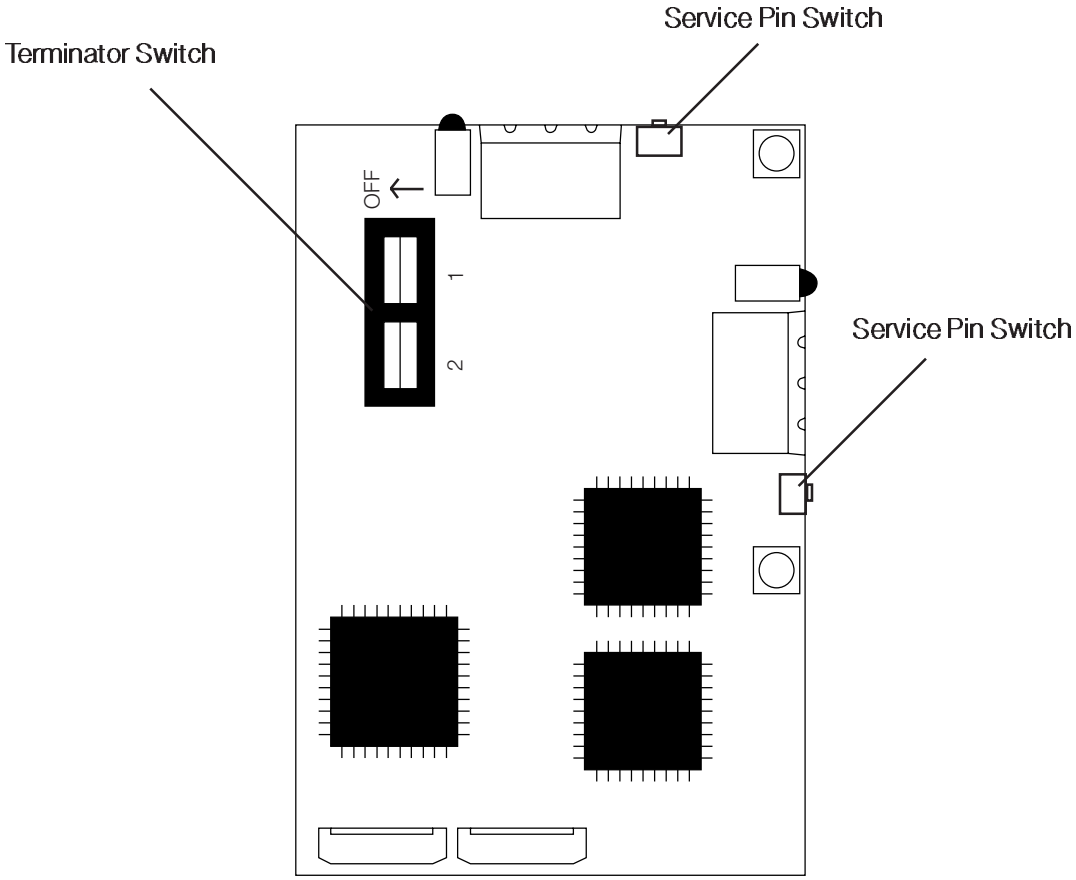
NOTE

Termination resistor selection should be made prior to installing option card. It is recommended to use an external termination resistor because switches will not be viable after assembly.

Switch Position Functions

Termination	Position 1	Position 2
No termination	Net Term OFF	Net Term OFF
Single termination	Net Term ON	Net Term OFF
Double termination	Net Term ON	Net Term ON

Terminator and Service Switch Locations



Free Topology LonWorks Control Card

Wiring Installation

Wiring

The variable frequency drive generates a carrier frequency with a pulse frequency between 3 kHz and 14 kHz. This results in radiated frequency noise from the motor cables. It is very important that the LonWorks cable be isolated as much as possible from the drive output cabling to the motor. Use the recommended Trane Comm 5 twisted-shielded pair when connecting to the TR1 VFD (refer to BAS-SVN01A-EN). Do not run LonWorks cabling and motor cables in parallel or in close proximity to one another. Ensure that the drive is properly grounded.

Card Installation

The following section describes the installation procedures for the LonWorks option card (see following illustration). For additional information on installation and operation of the TR1 Series VFD, refer to the *TR1 Series VFD Installation and Operation Manual*.

⚠DANGER

TR1 Series variable frequency drive contains dangerous voltages when connected to line power. After disconnecting from line, wait at least 14 minutes before touching any electrical components.

⚠WARNING

Only a competent electrician should carry out electrical installation. Improper installation of motor or TR1 drive can cause equipment failure, serious injury or death. Follow this manual, National Electrical Code and local safety codes.

⚠CAUTION

Electronic components of TR1 variable frequency drives are sensitive to electrostatic discharge (ESD). ESD can reduce performance or destroy sensitive electronic components. Follow proper ESD procedures during installation or servicing to prevent damage.

⚠CAUTION

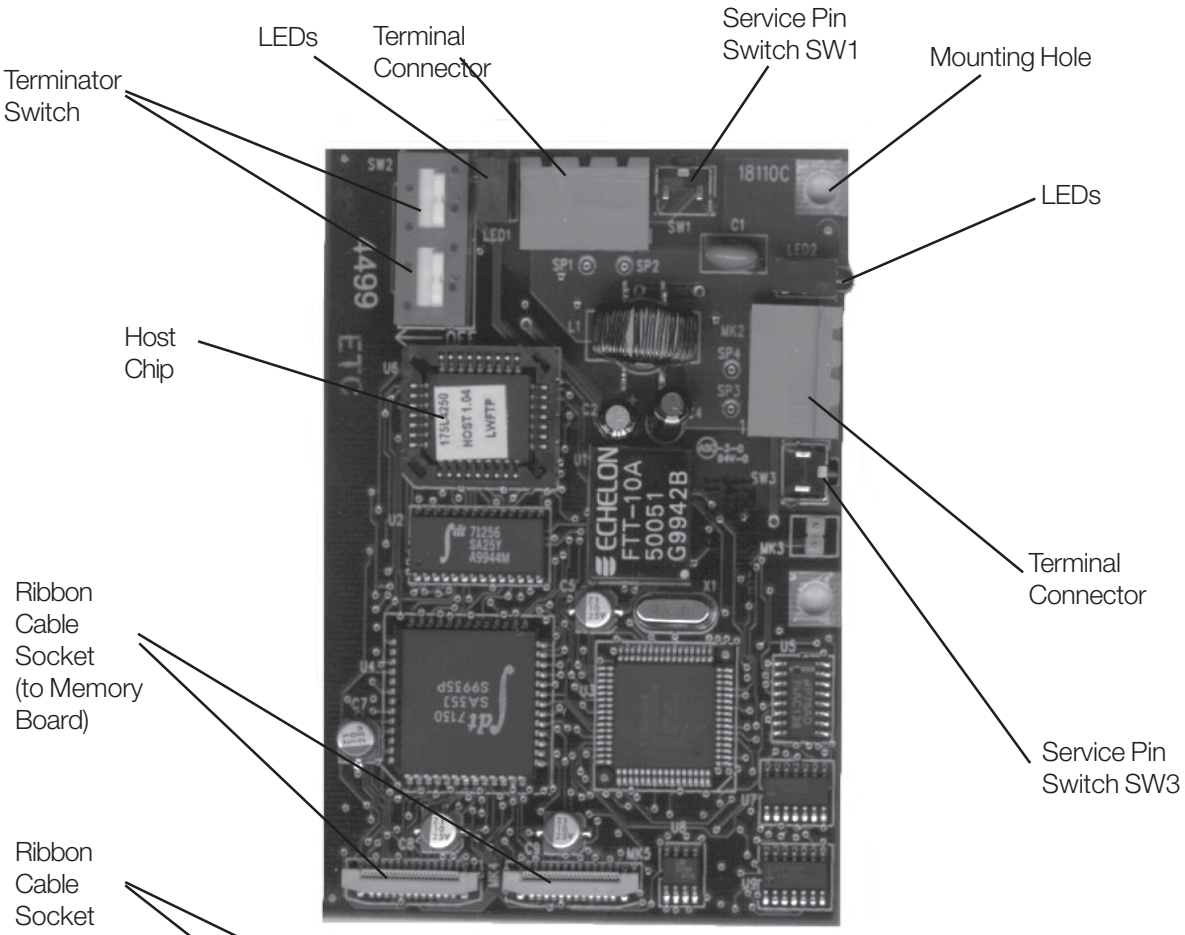
It is responsibility of user or installer of TR1 Series variable frequency drive to provide proper grounding and motor overload and branch protection according to National Electrical Code and local codes.

Tools Required

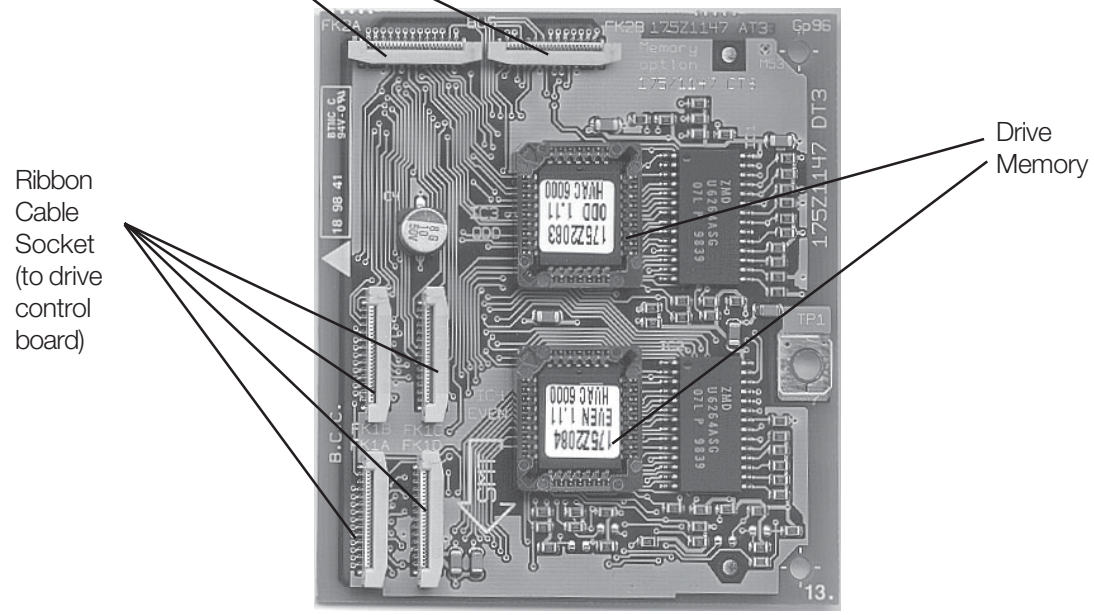
Flat-head screw driver
Torx T-10 screw driver
Torx T-20 screw driver

Packing List

LonWorks control board
Memory board
(3) T-10 screws
Grounding strip (left)
Grounding strip (right)
Hardware kit 175L5900



LonWorks Control Board



Memory Board

TR1 Series VFD LonWorks Option Card
(Free Topology Model FTT 10A)

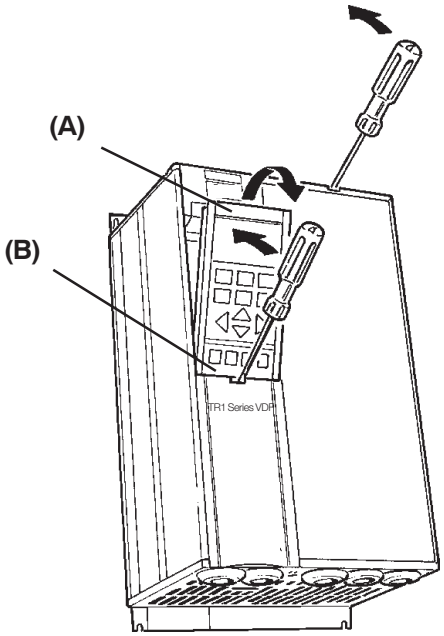
1. Access to Control Card Cassette

NEMA 1

- Remove Local Control Panel (LCP) by pulling out from top of display (A) by hand. LCP connector on panel back will disconnect.
- Remove protective cover by gently prying with a screw driver at notch (B) and lift cover out of guide pin fittings.

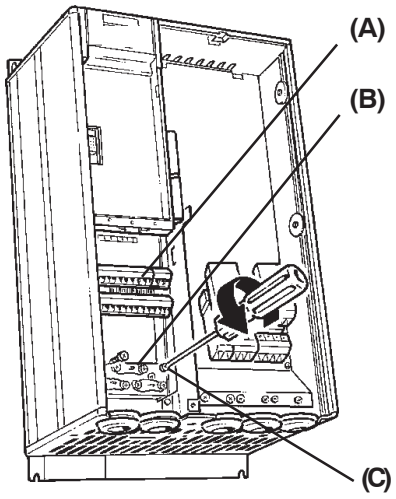
NEMA 12

- Open front panel of drive by loosening captive screws and swing open.
- Disconnect Local Control Panel (LCP) cable from drive control card.



2. Disconnect Control Card Cassette

- Remove control wiring by unplugging connector terminals (A).
- Remove grounding clamps (B) by removing two screws holding each in place. Save screws for reassembly.
- Loosen two captive screws (C) securing cassette to chassis.

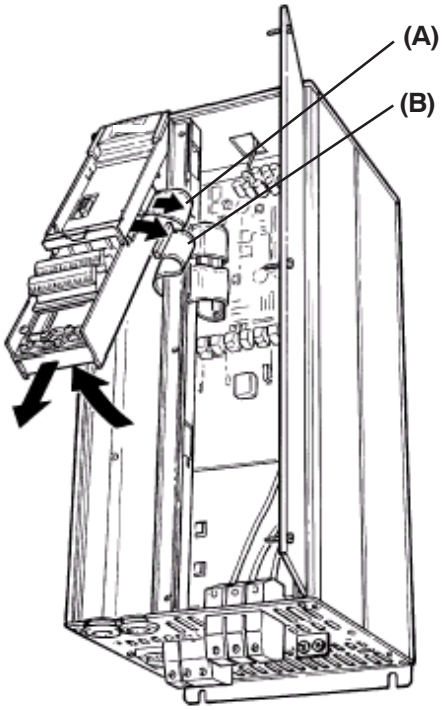


3. Remove Cassette and Ribbon Cables

- Lift control card cassette from bottom.
- Unplug two ribbon cables (A) and (B) from control board.
- Unhinge cassette at top to remove.

NOTE

Ribbon cables will need to be reconnected to same connec-tions from which removed.

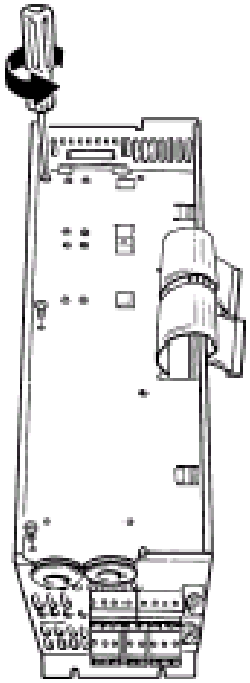


4. Chassis Ground Connections

NOTE

Ground strips are used on 208 V drives of 30 HP (22 kW) or less and on 460 V drives of 60 HP (45 kW) or less. For all other drives, go to step 6.

- Location of holes to mount grounding strips can vary with drive configuration. When applicable, remove mounting screws located in chassis using Torx T-20 screw driver and save for reassembly. Otherwise, grounding strips attach with screws provided as, shown in step 5.

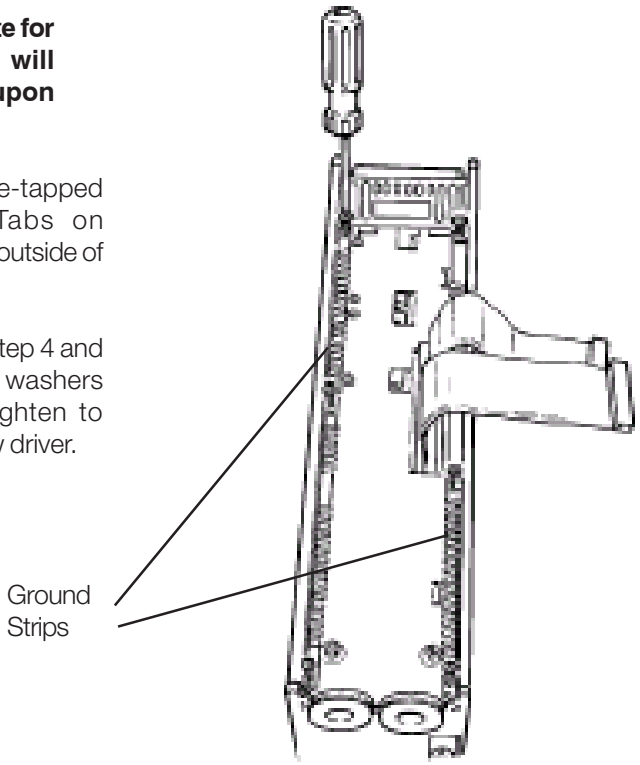


5. Install Chassis Ground Connections

NOTE

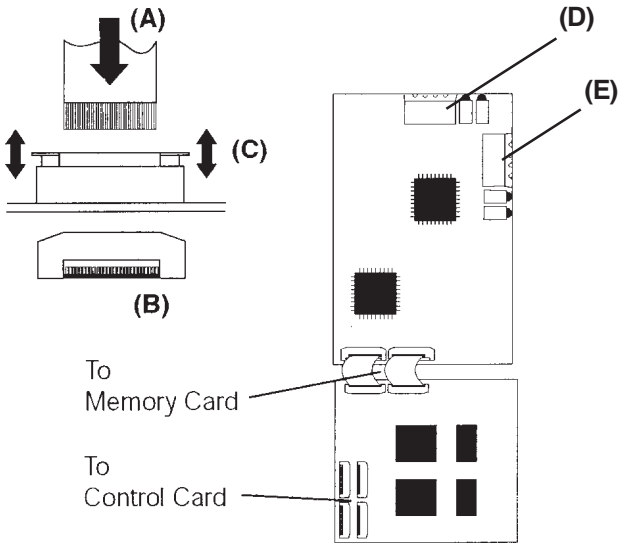
Layout of control card cassette for attaching grounding strips will vary somewhat depending upon unit size.

- Align ground strips over pre-tapped screw holes provided. Tabs on grounding strips point toward outside of chassis.
- Replace screws removed in step 4 and add additional screws and washers provided, as necessary. Tighten to 8 in-lbs using Torx T-20 screw driver.



6. Install Ribbon Cables between Option Cards

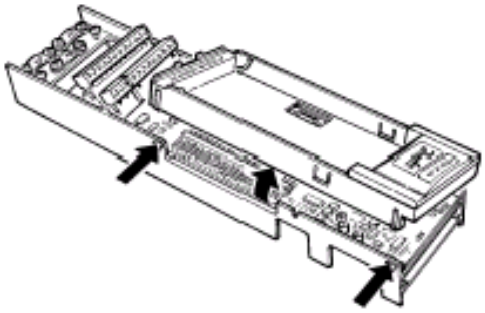
- Attach ribbon cables between LonWorks control card and memory card.
- Be sure exposed wire portion of ribbon cable (A) is facing front of socket (B). Do not remove blue insulation covering end of ribbon cable.
- Pull up collar (C) of ribbon cable socket, insert cable and push collar closed.
- Repeat procedure for all ribbon cables.
- Remove terminal connector from terminal block (D) and connect to terminal block (E) at this time for ease of access.



7. Remove LCP Cradle

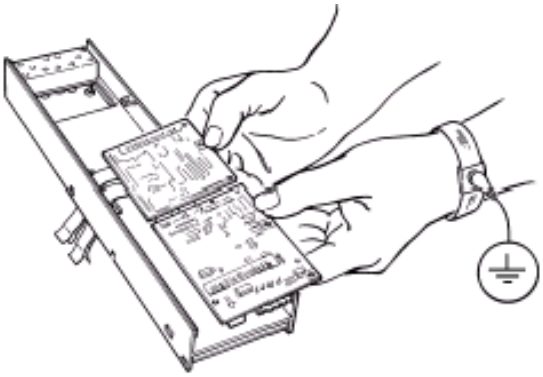
NEMA 1

- Carefully push in tabs at corners of LCP cradle to release clips. Pull out to disengage clips and lift cradle free.



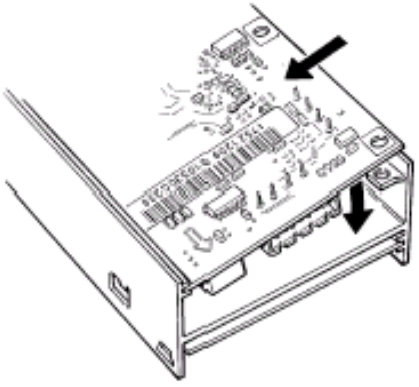
8. Ribbon Cable Routing

- Route ribbon cables from LonWorks memory card through slot at side of control board cassette.



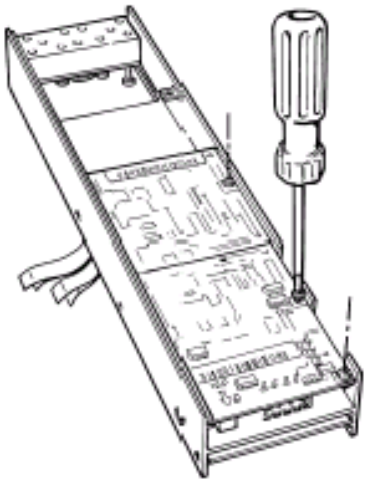
9. Insert LonWorks Card

- Insert edge of LonWorks cards into slot in side of cassette and align screw holes.



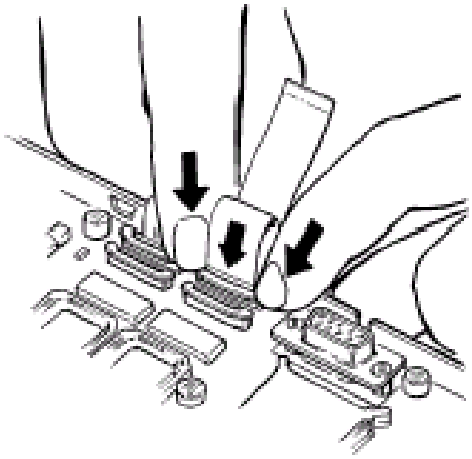
10. Secure LonWorks Card

- Secure LonWorks card with 3 self-tapping screws and washers provided using Torx T-10 screw driver. Tighten to 8 in-lbs.



11. Install Ribbon Cable on TR1 Control Board

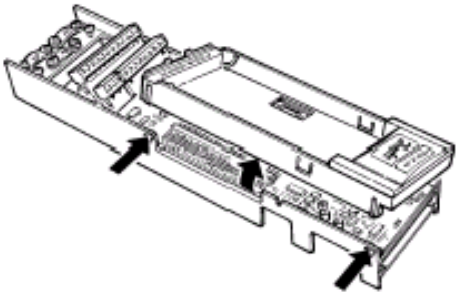
- Be sure not to twist or crimp ribbon cables.
- Insert cables into corresponding sockets and fasten in accordance with directions in step 5.



12. Install LCP Cradle

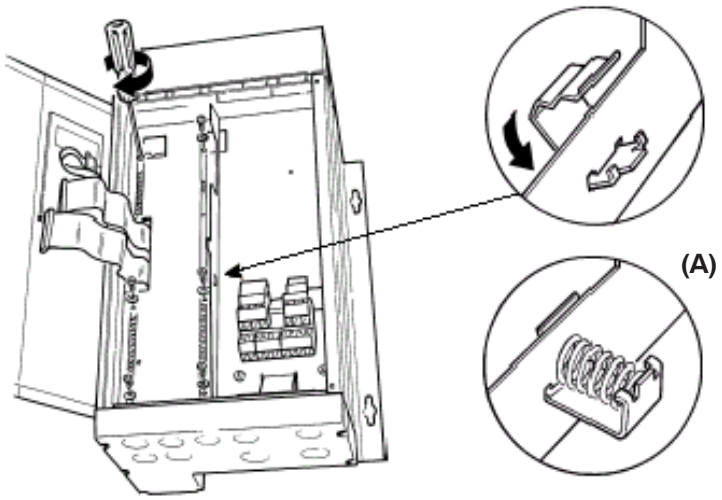
NEMA 1

- Insert cradle clips into holes in cassette.
- Push down on cradle to snap it into place.



13. Install Spring Tension Clip

- Spring tension clip (A) is used as a cable strain relief.
- Insert clip through inner wall of chassis at slot provided.
- Compress spring into clip at outer wall of chassis.

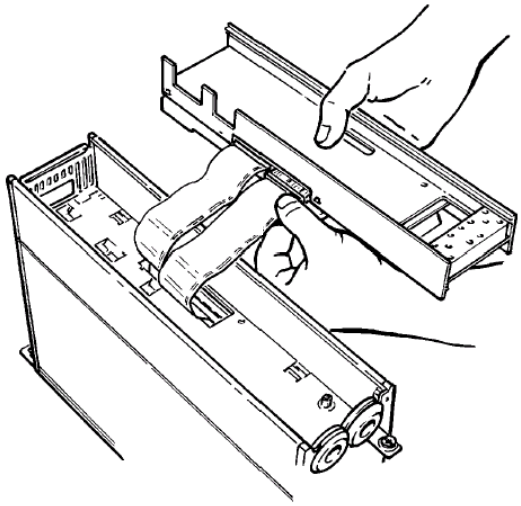


14. Install Ribbon Cables

- Connect ribbon cables.
- Connect control card cassette to hinge at top of drive and fit into chassis.

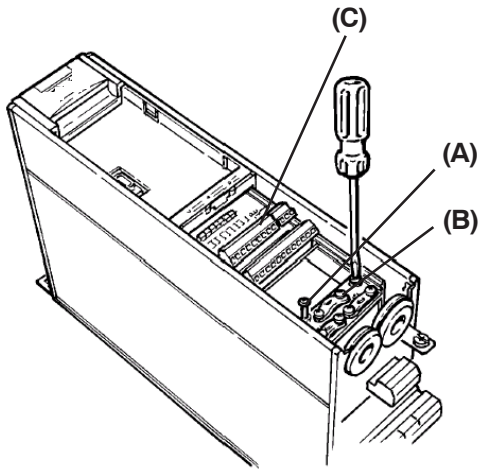
NOTE

Ribbon cables must be reconnected to same connections from which removed.



15. Install Control Card Cassette

- Fasten control card cassette by alternately tightening two captive screws (A). Tighten to 8 in-lbs.
- Route control wires through clamp fasteners (B) and secure clamps with two screws.
- Connect control terminals (C) by firmly pressing them into connector receptacles.

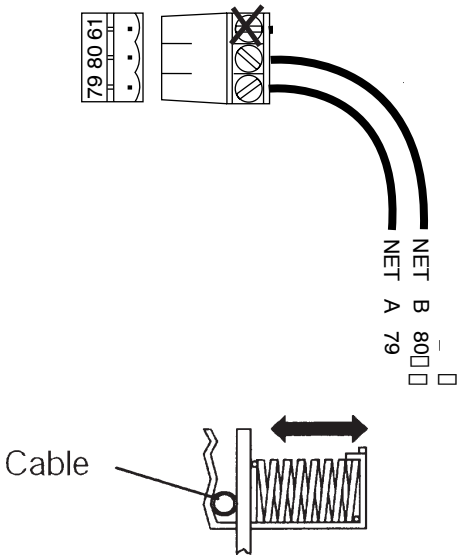


16. Plug in Terminal Connector

- Connect signal wire NET A to terminal 79 and NET B to 80 of terminal connector. (In free topology model, connections can be reversed.)
- Plug network connector into terminal block at side of control card cassette.
- Insert LonWorks cable between inner wall of chassis and spring tension clip.

NOTE

Shielded cable is recommended. Ground shielded cable at spring tension clip location or ground at cable clamp by removing cable insulation at contact point. Do not use connector terminal 61.



Network Initialization of LonWorks Option Card

The LonWorks option card contains a NEURON chip with a unique address. After hardware installation, initialize the LonWorks option card by using a Tracer Summit BCU or Rover running in active mode. Addressing nodes on the LonWorks network is performed at installation time by an installation tool or network management tool. Addressing requires the retrieval of a node's NEURON ID. The NEURON ID is a 48 bit number that identifies every manufactured NEURON chip. There are several methods by which the network software will initialize the drive automatically. The network can recognize the drive without action beyond proper installation. The card is then ready to be programmed for network operation. The TR1 LonWorks option supports three additional methods of addressing a node:

1. *Service Pin* - There are two momentary-contact service switches that send the NEURON ID over the network. If the network software prompts the action, press either service pin (SW1 or SW3) to transmit the NEURON ID over the network. The service pin locations are shown in the illustration in *Terminator and Service Switch Locations* in this manual.

2. *Query and Wink* - The LonWorks option card is shipped with a domain of "0" and subnet of "1." Upon receiving the wink command, the on-board green status LED flashes so that the installer can locate the node. The chip sends out its Neuron ID over the network in response to the query command.

3. *NEURON ID Label* - The TR1 LonWorks option card has a NEURON ID label that displays the NEURON ID as a 12 digit hexadecimal number. The installer can manually enter the NEURON ID during installation.

LonMark Drive Profile

A LonMark external interface file (.XIF extension) provides the host processor with device information. With this, it is possible to design a LonWorks network without the drive being physically present. The resource file is available for downloading from the Trane website at **www.trane.cso.tr1vfd.com/index.html**, or contact Trane GCC Product Support.

The drive may also be added to the network upon initialization.

The TR1 LonWorks network interface consists only of SNVTs. The SNVTs support the LonMark Controller Profile along with TR1 configuration, control and monitoring capabilities. Any combination of SNVTs can be used to operate the TR1.

Also supported is the functional profile for variable speed drives from the LonMark Interoperability Association at **www.lonmark.org/products/fprofile.htm#industrial**. This profile defines a set of network variables (SNVTs) and configuration properties (SCPTs).

LonWorks Card Diagnostic LEDs

The LonWorks board includes two LEDs to display the communication status of the board, display the state of the NEURON chip, and respond to the network management wink command. The onboard LEDs are the Service LED (LED 1, red) and the Status LED (LED 2, green).

Status LED

The Status LED patterns are:

ON

There is power on the board but there has not been any communication to an input network variable in the last 2 seconds.

Flashing 10 times per second

There is regular network communication to the TR1's input network variables.

Flashing intermittently

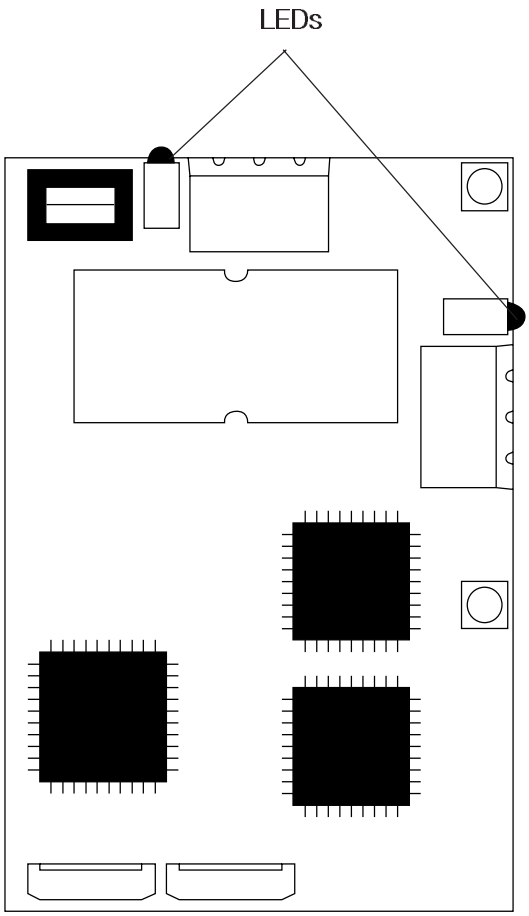
There is network communication to the TR1's input network variables but input network variables are received at a period greater than 2 seconds.

Flashing 5 times per second

The response to the network management “Wink” command. The TR1 LonWorks node must be reset to leave the wink state.

OFF

No power on board or hardware fault.



Service LED

The Service LED displays the state of the NEURON chip. The following table shows the Service LED patterns for various states and defines their meaning.

Service LED Patterns and Descriptions

LED Pattern	Operation	Description
Continuously ON	Power-up of Neuron 3120xx chip-based node or Neuron 3150 chip-based node with any PROM	Use EEBLANK and follow reinitialization procedure.
Continuously OFF	Power-up of Neuron 3120xx chip-based node or Neuron 3150 chip-based node with any PROM	Indicates bad node hardware.
ON for one second at power-up followed by approximately 2 seconds OFF, then stays ON	Power-up/Reset	May be caused by Neuron chip firmware when mismatch occurs in application checksum.
Short flash every 3 seconds	Anytime	Indicates watchdog timer resets occurring. Possible corrupt EEPROM. For Neuron 3150 chip-based node, use EEBLANK and follow reinitialization procedure.
Flashing at 1 second intervals	Anytime	Indicates node is unconfigured but has an application. Proceed with loading node.
Brief flash at power-up. OFF duration approximately 10 seconds after which stays ON	Using EEBLANK or Neuron 3150 chip-based node	Indicate completion of blanking process.
Brief flash at power-up. OFF duration approximately 1 to 15 seconds, depending on application size and system clock. LED then begins flashing at 1 second intervals.	First power-up with new PROM on Neuron 3150 chip-based custom node. Unconfigured firmware state exported.	Indicates unconfigured state.
Brief flash at power-up followed by OFF		Node is configuring and running normally.

Service LED Pattern Descriptions

Network Configuration Properties (Nci)

The TR1 Series VFD LonWorks option card supports LonMark network design to improve interoperability.

The configuration parameters are network variable inputs to the drive. Configuration of parameters needs setting only one time, usually at installation. See the table below for definitions.

⚠CAUTION

Data written to configuration parameters is stored in non-volatile memory. Continuous writing may impair non-volatile memory.

Network Configuration Definitions

Function	SNVT Type	Variable Name	Units	Parameter
Nom. motor frequency	SNVT_freq_hz	nciNmlFreq	1 Hz	104
Nom. motor rpm	SNVT_rpm	nciNmlSpeed	1 rpm	106
Min. frequency	SNVT_lev_percent	nciMinSpeed	0.005%	201
Max. frequency	SNVT_lev_percent	nciMaxSpeed	0.005%	202
Ramp up time	SNVT_time_sec	nciRampUpTime	1 sec	207
Ramp down time	SNVT_time_sec	nciRampDownTime	1 sec	208
Heart beat time	SNVT_time_sec	nciSndHrtBt	0.1 sec	---

Functions listed in the table are part of the LonMark Functional Profile for Variable Speed Drive 6010 starting with version 1.1

Network Drive Control Input

The most common functions for controlling the TR1 Series Variable Frequency Drive from the LonWorks network are made readily available. Those functions and their descriptions are presented in the table below. The control word function accesses additional drive capabilities for network control. The installer must verify that parameter 500, *Protocol*, is set for FC protocol.

The choice of open loop or closed loop operation of the drive is selected in parameter 100, *Configuration*.

For open loop control, it is recommended to set the following parameters:
201 = 0 Hz
202 = 60 Hz
203 = LINKED TO HAND/AUTO
204 = 0.0
205 = 60.0

Network Variable Inputs to TR1 Series VFD

Function	SNVT Type	Variable Name	Units	Parameter
Start/Stop	SNVT_lev_disc	nviStartStop	Boolean	104
*Reset fault	SNVT_lev_disc	nviResetFault	Boolean	---
Reference 1	SNVT_lev_percent	nviRefPcnt	0.005%	---
Reference 3	SNVT_freq_hz	nviRefHz	0.1 Hz	---
Control word	SNVT_state	nviControlWord	16 Boolean	---
**Drive speed setpoint	SNVT_switch	nviDrvSpeedStpt	(see below)	Ctrw + Ref.
Setpoint 1	SNVT_lev_percent	nviSetpoint1	0.01%	418
Setpoint 2	SNVT_lev_percent	nviSetpoint2	0.01%	419
Bus feedback 1	SNVT_lev_percent	nviFeedback1	0.01%	535
Bus feedback 2	SNVT_lev_percent	nviFeedback1	0.01%	536

* Reset on a transition from 0 to 1. A "0" must be sent after reset to enable the next reset.

**Part of the LonMark Functional Profile for Variable Speed Drive 6010 starting with version 1.1

Network variable nviDrvSpeedStpt is comprised of a stop/start command (state) and a separate speed command (value). 0 is a stop command and 1 is a run command. Drive speed is a function of the reference signal between 0 and 100%.

Network Drive Control Input (continued)

Using nviRefPcnt, the drive's reference is expressed as a percentage of the reference range. The range is set using parameters 204, *Min. Reference,* and 205, *Max. Reference*. In open loop operation, reference represents the drive's desired output speed. In this case, set *Min. Reference* to 0 Hz and *Max. Reference* equal to *Max. Frequency* in parameter 202.

In closed loop operation, reference represents the desired setpoint. It is recommended that parameters 204 and 205 be set equal to parameters 201, *Min. Frequency,* and 202, *Max. Frequency*, respectively.

For closed loop operation, either nviDriveSpeedSetpoint (state position of SNVT_switch) or nviStartStop can be used to enable/disable the drive.

All references provided to the drive are added to the total reference value. If reference is to be controlled by the LonWorks bus only, ensure that all other reference inputs are zero. This means that digital input terminals and analog input terminals should not be used for reference signals. The default setting (0%) should be maintained for preset references in parameters 211 through 214. Also, in closed loop operation, the default setting (0.0) should be maintained for drive setpoints in parameters 418 and 419.

NOTE

To optimize network performance and for proper drive operation, use only one of following input reference commands.

Reference 1
Network variable nviRefPcnt is a signed value. It represents the desired percentage of the TR1 drive's reference range.
Range: -163.840 - 163.835

Reference 3
Network variable nviRefHz is an unsigned value. It represents the output frequency of the drive in Hz in open loop. It is rarely used in closed loop mode.
Range: 0 - 6553.5

Start/Stop and *Reset fault*
SNVT_lev_disc, ST_OFF and ST_NUL are interpreted as low or "0." ST_LOW, ST_MED, ST_HIGH, and ST_ON are interpreted as high or "1."

The equivalent control word bit settings to start and stop the drive (nviStartStop) and to reset after a fault (nviResetFault) are described in the table below.

	nviStartStop		nviResetFault		
Bit	0	1	0	1	Description
00	0	0	No value is written to the control word	0	Preset Ref LSB
01	0	0		0	Preset Ref MSB
02	1	1		1	No DC Brake
03	1	1		1	No Coast Stop
04	1	1		1	No Quick Stop
05	1	1		1	No Freeze Freq.
06	0	1		0	Start
07	0	0		1	Reset
08	0	0		0	Jog
09	0	0		0	No function
10	1	1		1	Bit 10
11	0	0		0	Relay 1 On
12	0	0		0	Relay 2 On
13	0	0		0	Setup LSB
14	0	0		0	Setup MSB
15	0	0		0	Reversing

Start/Stop and Fault Reset Control Word Bit Descriptions

Network Drive Control Input (continued)

Control Word

The input network variable nviControlWord is a 16-bit word that provides additional operational control of the drive, as listed in the table below. The settings shown represent the *Coast Stop* command. The *Control Word* is not supported by Tracer Summit.

Bit	Setting	0	1
00	0	Preset Ref. LSB	
01	0	Preset Ref. MSB	
02	1	DC Brake	no DC Brake
03	0	Coast Stop	no Coast Stop
04	1	Quick Stop	no Quick Stop
05	1	Freeze Freq.	no Freeze Freq.
06	0	Ramp Stop	Start
07	0	no Reset	Reset
08	0	no Jog	Jog
09	0	no function	
10	1	see Parm. 805	
11	0	Relay 1 OFF	Relay 1 ON
12	0	Relay 2 OFF	Relay 2 ON
13	0	Setup LSB	
14	0	Setup MSB	
15	0	no Reversing	Reversing

Control Word Bit Descriptions for Coast Stop

NOTE

Drive always stops and ignores serial bus commands to run when OFF/STOP function is activated from drive keypad.

Precedence of the stop commands is:

1. Coast stop
2. Quick stop
3. DC brake stop
4. Ramp (Normal) stop

Coast stop

The drive output stops immediately and the motor coasts to a stop.

- Drive display show UN.READY (unit ready) when coast stop is active.
- Drive cannot run in any mode.
- Parameter 503, *Coasting stop*, determines interaction with input 27.

Quick stop

The drive output frequency ramps down to 0 Hz according to time set in parameter 207, *Ramp Down Time*.

- Drive display shows STOP.
- Drive cannot run in AUTO mode but can run in HAND mode.

DC brake stop

The drive brakes the motor to a stop using DC injection braking.

- Parameters 114 and 115 determine amount and time of DC current applied for braking.
- Drive display shows DC STOP.
- Drive cannot run in AUTO mode but can run in HAND mode.
- Parameter 504, *DC Brake*, determines interaction with inputs 19/27.

Ramp stop

The drive output frequency ramps down to 0 Hz according to time set in parameter 207, *Ramp Down Time*.

- Factory setting is 60 sec for fan applications and 10 sec for pump applications.
- Drive display shows STAND BY.
- Drive can run in HAND mode or AUTO through a digital input command.
- Parameter 505, *Start*, determines interaction with input 18.

Drive Feedback to Network

The TR1 LonWorks option provides 16 output variables to the network containing important drive and motor feedback data. Feedback data is sent when there is a change in value. The drive will only transmit bound network variables. Since some data changes continuously, the transmission rate of those variables is limited. *Min send time* specifies the minimum time between transmissions of variables.

The Drive Outputs (1 or 3) will have a maximum time between transmission set by the *Max send time.* This function acts as a transmit heartbeat and allows a controller node to determine the health of the controller/TR1 connection. The *Max send time* function is disabled when the configuration network variable nciMaxsendT is not configured or is set to "0."

Function	SNVT Type	Variable Name	Units	Min.	Max.
Drive status	SNVT_state	nvoDrvStatus	16 Boolean	NA	NA
Drive output 1	SNVT_lev_percent	nvoOutputPcnt	0.005%	-163.840	163.840
Current*	SNVT_amp	nvoDrvCurnt	0.1 amps	0	3276.7
Energy*	SNVT_elec_kwh	nvoDrvEnrg	1 kWh	0	65535
Power*	SNVT_power_kilo	nvoDrvPwr	0.1 kW	0	6553.5
Status word	SNVT_state	nvoStatusWord	16 Boolean	NA	NA
Drive output 3	SNVT_freq_hz	nvoOutputHz	0.1 Hz	0	6553.5
Output voltage	SNVT_volt	nvoVoltage	0.1 V	0	6553.5
Digital input	SNVT_state	nvoDigitalInput	16 Boolean	NA	NA
Alarm	SNVT_state	nvoAlarmWord	16 Boolean	NA	NA
Warning 1	SNVT_state	nvoWarning1	16 Boolean	NA	NA
Warning 2	SNVT_state	nvoWarning 2	16 Boolean	NA	NA
DC voltage	SNVT_state	nvoDCVolt	0.1 V	0	3276.7
Motor temp	SNVT_lev_cont	nvoTempMtr	0.5%	0	100
Inverter temp	SNVT_lev_cont	nvoTempInvtr	0.5%	0	100
Analog input Term. 53	SNVT_volt	nvoAnalog1	0.1 V	0	10
Analog input Term. 54	SNVT_volt	nvoAnalog2	0.1 V	0	10
Analog input Term. 60	SNVT_amp_mil	nvoAnalog3	0.1 mA	0	20
Running hours*	SNVT_time_hour	nvoDrvRunHours	1 hr	0	65534
Feedback	SNVT_lev_percent	nvoFeedback	0.01%	0	100.000
Frequency	SNVT_freq_hz	nvoOutputHz1	0.1 Hz	0	6553.5
Drive speed*	SNVT_lev_percent	nvoDrvSpeed	0.01%	0	100
Output voltage*	SNVT_volt	nvoDrvVolt	0.1 V	0	3276.7

*Part of the LonMark Functional Profile for Variable Speed Drive 6010 starting with version 1.1

Network Variable Outputs from TR1 Series VFD

Drive status

NvoDrvStatus, nvoStatusWord, nvo-DigitalInput, nvoAlarmWord, nvoWarning1 and nvoWarning2 are all 16 bit Boolean values using the SNVT_state variable type. Individual bits represent specific drive status states. The tables provided in *Drive Status Bit Definitions* define each bit.

Drive output 1

Network variable nvoOutputPcnt provides an analog indication of the drive's operation. In open loop, this is the drive output frequency in percentage within the reference range. To avoid negative numbers, or numbers above 100%, set parameter 204, *Min. Reference* to 0 Hz, and parameter 205, *Max. Reference* equal to *Max. Frequency*, set in parameter 202. In closed loop, this is the drive's feedback signal within the reference range. For best operation, set *Min. Reference* to equal parameter 413, *Min. Feedback*, and *Max. Reference* to equal parameter 414, *Max. Feedback.*

Drive output 2 and Drive output 3

Output 2 is useful in open loop to report the drive output frequency in tenths of a rad/sec. Output 3 in open loop reports the drive output in Hz. For best results, set *Min. Reference* to 0 Hz and *Max. Reference* equal to *Max. Frequency*. These variable are rarely used in closed loop.

Drive Status Bit Definitions

Bit	Value	0	1
00	32768	33 OFF	33 ON
01	16384	32 OFF	32 ON
02	8192	29 OFF	29 ON
03	4096	27 OFF	27 ON
04	2048	19 OFF	19 ON
05	1024	18 OFF	18 ON
06	512	17 OFF	17 ON
07	256	16 OFF	16 ON
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	no function	
13	4	no function	
14	2	no function	
15	1	no function	

nvoDigitalInput

Bit	Value	0	1
00	32768	no function	
01	16384	no function	
02	8192	no function	
03	4096	no function	
04	2048	no function	
05	1024	no function	
06	512	no function	
07	256	no function	
08	128	no function	
09	64	no function	
10	32	no function	
11	16	no function	
12	8	no function	
13	4	Stopped	Running
14	2	no Warning	Warning
15	1	no Alarm	Alarm

nvoDrvStatus

Bit	Value	0	1
00	32768	Alarm	Ctrl. Ready
01	16384	Alarm	Drive Ready
02	8192	Safety Open	Safety Closed
03	4096	no Alarm	Alarm
04	2048	not used	
05	1024	not used	
06	512	not used	
07	256	no Warning	Warning
08	128	not at Ref.	at Ref.
09	64	Hand Mode	Auto Mode
10	32	Fr. Range Warn	Freq. in Range
11	16	Stopped	Running
12	8	not used	
13	4	normal	Voltage Warn
14	2	normal	Current Lim.
15	1	normal	Therm. Warning

nvoStatusWord

Bit	Value	0	1
00	32768	normal	Unknown Fault
01	16384	normal	Trip Lock
02	8192	normal	AMA Fault
03	4096	normal	HPFB Timeout
04	2048	normal	RS-485 Timeout
05	1024	normal	Short Circuit
06	512	normal	SMPS Fault
07	256	normal	Ground Fault
08	128	normal	Over Current
09	64	normal	Current Limit
10	32	normal	Mtr. Thermistor
11	16	normal	Motor Thermal
12	8	normal	Inverter Thermal
13	4	normal	Undervoltage
14	2	normal	Overvoltage
15	1	normal	In. Phase Loss

nvoAlarmWord

Bit	Value	0	1
00	32768	normal	Ref. High
01	16384	normal	Ctrl. Crd. Fault
02	8192	normal	Pwr. Crd. Fault
03	4096	normal	HPFB Timeout
04	2048	normal	RS-485 Timeout
05	1024	normal	Overcurrent
06	512	normal	Current Limit
07	256	normal	Thermistor O.T.
08	128	normal	Motor O.T.
09	64	normal	Inverter O.T.
10	32	normal	U.V. Alarm
11	16	normal	O.V. Alarm
12	8	normal	U.V. Warn
13	4	normal	O.V. Warn
14	2	normal	Input Phase Loss
15	1	normal	Live Zero

nvoWarning1

Bit	Value	0	1
00	32768	normal	Autoramping
01	16384	normal	Start Delay
02	8192	normal	Sleep Boost
03	4096	normal	Sleep
04	2048	normal	AMA Done
05	1024	normal	AMA Running
06	512	normal	Rev. Start
07	256	no Ramp	Ramping
08	128	Forward	Reverse
09	64	not at Ref.	at Reference
10	32	Stopped	Running
11	16	Remote Ref.	Local Ref.
12	8	normal	OFF (HOA)
13	4	Auto Start/Stop	Hand
14	2	normal	Run Request
15	1	Run Permission	no Run Perm.

nvoWarning2

Network Timer Functions

Function	SNVT type	Variable Name	Max	Min	Default
Min send time	SNVT_elapsed_tm	nciMin-SendT	1 min 5 sec 535 msec	0 sec	5.0 sec
Max receive time	SNVT_elapsed_tm	nciMax-ReceiveT	18 hours 12 min 15 sec	1.0 sec	0 sec (Off)
Max send time	SNVT_elapsed_tm	nciMax-SendT nvoOutputPcnt nvoOutputHz	1 min 5 sec	0 sec	0 sec (Off)
Heartbeat timer	SNVT_time_sec	nciSndHrtBt nvoDrvSpeed nvoDrvCurnt nvoDrvPwr nvoDrvVolt	6553.5 sec	1.0 sec	0 sec (Off)

Network Timer Functions

Min send time
Sets the minimum period between transmissions for all output network variables, using the network variable nciMinSendT. This function is used to keep the transmission of variables that change continuously from dominating the network communication.

Max receive time
This drive function is replaced by the value set in parameter 803, *Bus Time Out.* The LonWorks option will initiate bus time out activities when the time set in parameter 803 expires without receiving an input network variable directed to the drive. This acts like a LonWorks receive heartbeat. The action taken by the drive is determined by the setting selected in parameter 804, *Bus time out function*. See the parameter description section of this manual. The value of nciMaxReceiveT has no effect on the operation of the drive.

Max send time
This function sets the maximum time between transmissions for the network variables Drive Output 1 and 3 using the configuration network variable nciMaxSendT. It can be used by the controller to monitor the drive and controller connection. It acts like a LonWorks send heartbeat.

Heartbeat timer
Normally, a LonWorks device only sends information to the network when a value changes. However, if nothing changes the rest of the network doesn't know if the drive stopped functioning or if the drive simply had nothing to report. With nciSndHrtBt, the drive will transmit as often as a pre-set time interval, even if values didn't change. In this way, the network knows that the drive is still connected and functioning.

Both nciSndHrtBt and nciMaxSendT provide this capability but to different variables, as shown in the table above.

Standard Object Support

The TR1 LonWorks option supports two standard objects and three SNVTs, per the LonMark standard object philosophy. The standard objects are the *Node Object* (containing the *Object request, Object status,* and *Object alarm)* and the *Controller object*, (containing the network variables described in the preceding sections). The *Object request* is a LonMark device used to obtain status and alarm information from a node.

It is not necessary for a controller to support the *Node Object* network variables. The *Object request, Object status* and *Object alarm* provide status and alarm information for controllers that only support this type of functionality. The status and alarm functions described in the preceding sections contain more drive specific information than *Object status* and *Object alarm.*

1. The TR1 sends an *Object status* containing drive status information and an *Object alarm* containing fault information in response to the following *Object requests*:
   RQ_NORMAL,
   RQ_UPDATE_STATUS, and
   RQ_UPDATE_ALARM.
   The nviRequest.object_id should be set to "1" (controller node). The network uses nviRequest, nvoStatus and nvoAlarm variables for these functions.

2. The TR1 sends an *Object status* containing a bit map of supported status fields in response to all other *Object requests,* including undefined requests.

3. The TR1 *Object status* supports the following status fields: invalid_id, invalid_request,open_circuit, out_of_service, electrical_fault, comm_failure, manual_control, and in_alarm. All other fields are always set to "0."

4. The TR1 sends an *Object alarm* following any set or reset of a drive fault condition.

5. The *Object alarm* supports the AL_ALM_CONDITION and AL_NO_CONDITION alarm types.

Function	SNVT type	Variable Name	Input/Output
Object request	SNVT_obj_request	nviRequest	Input
Object status	SNVT_obj_status	nvoStatus	Output
Object alarm	SNVT_alarm	nvoAlarm	Output

Network Variables for Node Object Support

Alarm Descriptions

Alarm numbers and descriptions that correspond to nvoAlarmWord bit numbers are shown in the table below. See the *TR1 Series VFD Installation and Operation Manual* for more details.

Bit number	Alarm number	Alarm Description
02	22	AMA failed
03	18	HPFB timeout
04	17	Serial communication timeout
05	16	Short circuit
06	15	Switch mode fault
07	14	Ground fault
08	13	Overcurrent
09	12	Current limit
10	11	Motor thermistor
11	10	Motor overtemperature
12	9	Inverter overload
13	*8	Undervoltage
14	**7	Overvoltage
15	4	Mains failure

* also bit 10 of nvoWarning 1

** also bit 11 of nvoWarning 1

Parameter List

PNU	Parameter Description	Default Value	Range	Conversion Index	Data Type
803	Bus time out	1 sec	1 - 99 sec.	0	3
804	Bus time out function	no function		0	3
805	Bit 10 function	Bit 10 = > CTW ACT		0	6
927	Parameter edit	Enable		0	6
928	Process control	Enable		0	6
970	Edit setup	Active Setup		0	5
971	Store data values	no action		0	5

In addition to the parameters listed above, the drive's control terminals issue digital inputs that control functions similar to those provided by nviStartStop, nviResetFault, and nviControlWord. Parameters 503, 504, 505, 506, 507 and 508 determine how the drive responds to commands for coasting stop, DC brake, start, reverse, setup select and preset reference select. See *Network Drive Control Input* in this manual and the *TR1 Series VFD Installation and Operation Manual* for more information.

Parameter Descriptions

803 Bus time out

Selection:

1 - 99 sec ★ 1 sec

Function:

Sets the duration for the bus time out function. If the set time passes without the drive receiving a LonWorks message addressed to it, the drive will take the action specified in parameter 804, *Bus Time Out Function.*

NOTE

After time out counter is reset it must be triggered by valid control word before new time out can be activated.

★ Indicates factory default setting.

804
Time out function

Selection:

★ Off
(NO FUNCTION) [0]
Freeze output frequency
(FREEZE OUTPUT FREQ.) [1]
Stop with auto restart
(STOP) [2]
Output frequency = JOG freq.
(JOGGING) [3]
Output frequency = Max. freq.
(MAX SPEED) [4]
Stop with trip
(STOP AND TRIP) [5]
Control without DeviceNet
(NO COM OPT CONTROL) [6]
Select set-up 4
(SELECT SET UP 4) [7]

Function:
The time out timer is triggered at the first reception of a valid control word, i.e., bit 10 = ok.

The time out function can be activated in two different ways:

1. The drive does not receive a LonWorks command addressed to it within the specified time.
2. Parameter 805 is set to “bit 10 = 0 time out” and a control word with “bit 10 = 0” is sent to the drive.

The TR1 remains in the time out state until one of the following four conditions is true:

1. A valid control word (Bit 10 = ok) is received and the drive is reset through the bus, the digital input terminals or the local control panel. (Reset is only necessary when the time out function *Stop w/trip* is selected.) Control via LonWorks is resumed using the received control word.
2. Local control via the local control panel is enabled.
3. Parameter 928, *Access to process control*, is set to *Disabled*.
   Normal control via the digital input terminals and the RS-485 interface is now enabled.
4. Parameter 804, *Bus time out function*, is set to *Off.*
   Control via LonWorks is resumed and the most recent control word is used.

Description of Selections:

- *Freeze output frequency*. Maintain present output frequency until communication is resumed.
- *Stop with auto restart*. Stop and automatically restart when communication is resumed.
- *Output frequency = JOG freq*. Drive will produce JOG frequency set in parameter 209, *Jog frequency*, until communication is resumed.
- *Output frequency = Max. freq*. Drive will produce maximum output frequency (set in parameter 202, *Output frequency*) until communication is resumed.
- *Stop with trip.* Drive stops and requires a reset command before it will restart.
- *Control without LonWorks*. Control via LonWorks is disabled. Control is possible via digital input terminals and/or standard RS-485 interface until LonWorks communication is resumed.
- *Select setup 4*. Setup 4 is selected in parameter 002, *Active setup*, and settings of setup 4 are used. Parameter 002 is not reset to the original value when communication is resumed.

★ Indicates factory default setting. Numbers in brackets [ ] represent selection as displayed on the serial bus.

805 Control Word Bit 10 Function

Selection:

	No function (NO FUNCTION)	[0]
★	Bit 10 = 1: control word active (BIT 10 = 1 >CTW ACTIVE)	[1]
	Bit 10 = 0: control word active (BIT 10 = 0 >CTW ACTIVE)	[2]
	Bit 10 = 0: bus time out (BIT 10 = 0 >TIME OUT)	[3]

Function:
According to the drive's standard communications profile, control word and speed reference will be ignored if bit 10 of the control word is *0*. Parameter 805 lets the user change the function of bit 10. This is some times necessary, as some masters set all bits to *0* in various fault situations. In these cases, it makes sense to change the function of bit 10 so that the TR1 is commanded to stop (coast) when all bits are *0*.

Description of Selections:

- *No function*. Bit 10 is ignored, i.e., control word and speed reference are always valid.
- *Bit 10 = 1 >CTW active*. The control word and speed reference are ignored if bit 10 = 0.

⚠CAUTION

With *Bit 10 = 0 >CTW active* selected, nviStartStop and nviResetFault commands will not function.

- *Bit 10 = 0 >CTW active*. The control word and speed reference are ignored if bit 10 = 1. If all bits of the control word are 0, the TR1 reaction will be coasting.
- *Bit 10 = 0 >time out*. The time out function selected in parameter 804 is activated when bit 10 is *0*.

---

927 Parameter edit

Data Value:

	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

This parameter determines if LonWorks can be used to access and edit drive parameters.

---

928 Process control

Data Value:

	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

This parameter determines LonWorks control of the drive. When *Enable* is selected, drive parameters 503 through 508 determine the interaction between various LonWorks and digital drive input commands. See the *TR1 Series VFD Instruction Manual* for details.

---

970 Edit setup select

Data Value:

	Preprogrammed (FACTORY SETUP)	[0]
	Setup 1 (SETUP 1)	[1]
	Setup 2 (SETUP 2)	[2]
	Setup 3 (SETUP 3)	[3]
	Setup 4 (SETUP 4)	[4]
★	Active Setup (ACTIVE SETUP)	[5]

This parameter selects the setup being edited, through either the drive control panel or LonWorks. The drive may operate in one setup while editing another. *Active setup* selects the parameter being edited as the setup controlling drive operation.

---

971 Store data value

Data Value:

★	No action (NO ACTION)	[0]
	Store all setups (STORE ALL SETUPS	[1]
	Store edit setup (STORE EDIT SETUP)	[2]
	Store active setup (STORE ACTIVE SETUP)	[3]

When this parameter is set to *Store active setup*, LonWorks downloaded parameters are written to EEPROM and stored. *Store edit setup* stores the setup selected in parameter 970. *Store all setups* stores all setups in parameter 970. When finished (appx. 15 sec.), it automatically returns to *No action*. Any parameters values written via the serial bus with *No action* selected are lost when power is removed from the drive. The function is only activated with the TR1 in stop mode.

★ Indicates factory default setting. Numbers in brackets [ ] represent selection as displayed on the serial bus.

APPENDIX

Application Notes

Interface Overview

The factory mounted Trane TR1 VFD will most typically be utilizing discrete I/O for control, the LCP (Local Control Panel) for set-up and troubleshooting, and will probably not be using a serial interface. In many cases, this will also be the direction for field applied TR1s. There has been an increasing number of requests where customers would like to acquire additional data from the VFD. For these cases, there are 4 different scenarios that will be discussed to aid in describing possible architectures.

A. TR1 is factory mounted or field applied using discrete I/O. A customer may wish to monitor the VFD at the Trane BAS by mapping its values using the Generic LonTalk Device (GLD) object.
B. TR1 is field applied and using “closed loop” control. The VFD is utilizing its internal PID loop for operation and the customer may want to enable/disable, change settings, and monitor the drive from the Trane BAS.
C. TR1 is field applied and using “open loop” control. The VFD is receiving a frequency reference from an outside source such as Trane’s AH540s and MP580s. In this case the VFD is dependent upon another controller for input. In addition to control over the LON network, a customer may want to change settings and monitor the drive from the Trane BAS.
D. Hybrid – A customer may want “open loop” control and, under certain circumstances, may want the drive to default to “closed loop” control. There may also be a need to override the VFD to a preset condition, either through an I/O contact closure or through the LON interface based upon some event.

Note: It is not recommended to send frequency references via the GLD object.

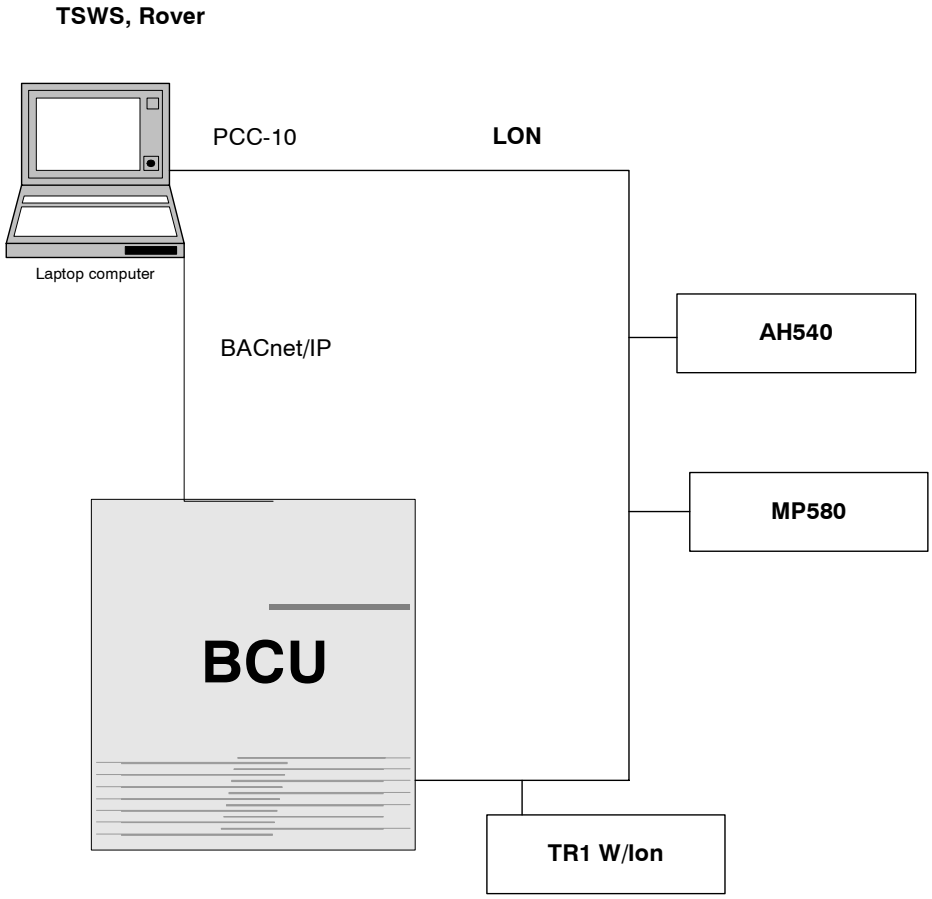
Interface Type:

☒ Provides data to Tracer Summit (Server)
☐ User of data from Tracer Summit (Client)
☐ Provides and uses data from Tracer Summit (Client / Server)

Interface Protocol:

☐ BACnet
☐ Modbus ☐ RTU ☐ ASCII ☐ TCP
☒ LonTalk
☐ Other _____

System Architecture Schematic



Interface Background

Interfacing with Tracer Summit requires a set of tools and methods to proceed. This section provides those details.

Rover w/PCC 10 interface
Nodeutil.exe or Nlutil (www.newron-system.com)

Model Number:

Trane TR 1 w/ LON Option card PN 175L1515

Cabling Details:

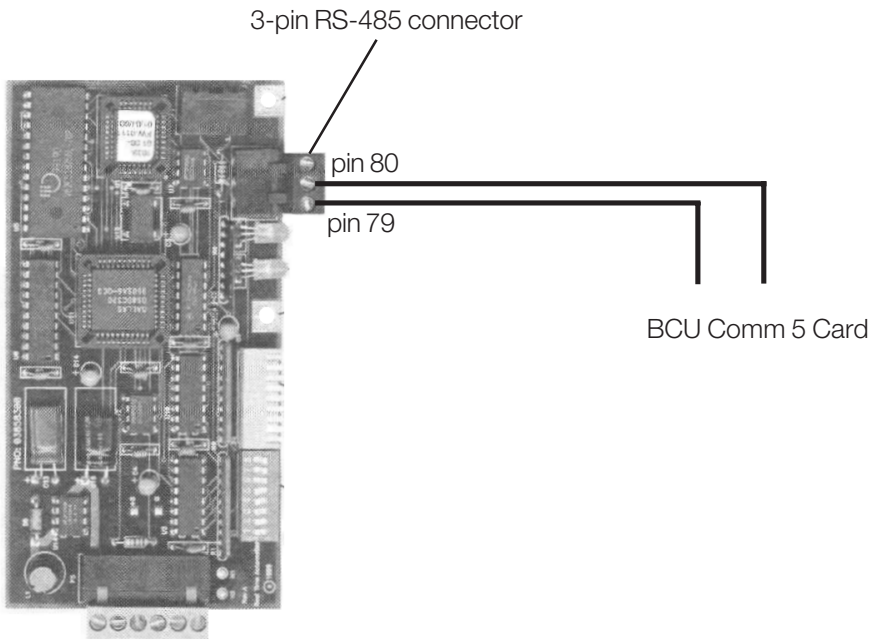
This section details how the device is physically connected from the vendor's device to Tracer Summit.

Type of physical connection to Tracer Summit:

☐ RS-232 ☐ Ethernet ☐ ARCNET ☒ Other __Comm 5___

Cable Details:

The connection from the Trane TR1 LON Option Card to the BCU's Comm 5 card is an RS-485 twisted pair connection.



TR1 LON Option Card

Equipment for Trane to Provide:

☐ BCU with RS-232 card
☐ TSCB
☒ Other – Comm 5 Card
☒ TSWS
☒ BCU With LAN Card

Other documents for Reference

Tracer Summit Connections to LonTalk Devices	BAS-PRB003-EN
Trane TR1 IOM	TR1-SVX10A-EN

Application Restrictions

- Rover can be used to logically install and bind variables to and from an MP580 and TR1. TGP doesn't allow for an analog connection to nvoSNVT_switch. The MP580 requires a SNVT_Switch to be bound to both nviDrvSpeedStPt for VFD enable and nviRefPcnt for speed control.
- Tracer Summit doesn't allow for BOs to be mapped to SNVT_state (nviControlWord) and therefore Start/Stop and Frequency Reference needs to be provided by another method, described previously.
- Due to timing constraints, it is not recommended to provide the frequency referencer using the GLD object.

Special Programming required

- CPL is required for alarm annunciation. NvoWarning and nvoAlarm words could be monitored using CPL routines.
- Check for offline status of each device. (Do this by monitoring the GLD Objects communication status from each drive and checking for CPL error condition, i.e., "????" will be returned if the VFD is not communicating.)

Installation Tasks

Integration from Tracer Summit to Trane TR1 devices requires the following components:

- A PC running Tracer Summit software with an Ethernet LAN adapter installed.
- A Tracer Summit Building Control Unit (BCU) with an Ethernet LAN adapter installed.
- A Comm 5 card installed into the BCU.
- Rover service software.

Programming Trane provided GLD

Follow the procedure outlined within Tracer Summit Connections to LonTalk Devices BAS-PRB003-EN.

Programming vendor provided hardware

The Trane representative will need verify the all TR1s on the link have the appropriate parameters set to allow for LON communications. It is also recommended that Rover Service Tool utility be used to verify the TR1s are properly communicating upon the LON link prior to adding to the BCU. The basic parameters that need to be set to allow for LON communications include:

Parameter 500, *Protocol* = FC protocol

Modify these parameters by pushing the extended [Extend Menu] button and then use the [+] and [-] buttons to display the 500 series "Serial Comm" parameters. Use the [+] button to advance the parameters and [Change Data] and [OK] to make changes.

⚠WARNING

During programming of parameters, motor may start wothout warning. Be certain that no one is in area of motor or driven equipment when changing parameters.

The following parameters are most typically set as described when using the TR1 LON interface option:

General Parameter Settings			
Parameter	**Description**	**Setting**	**Comment**
100	CONFIG. MODE	OPEN LOOP for GLD, MP580, AH540 control or CLOSED LOOP for local PID controls.	In open loop mode the drive will directly follow a speed reference signal. If this was set to CLOSED LOOP, the drive's PID controller would determine the drive's speed based on a set point and a feedback signal. In Closed Loop mode the nvoOutputPcnt (most commonly used), nvoOutputHz and nvoOutputRads do not represent output speed. Instead they represent the feedback signal whose range is set by parameters 413 and 414.
102	MOTOR POWER	As required	Motor power is entered in kW.
103	MOTOR VOLTAGE	As required	
104	MOTOR FREQUENCY	As required	Generally 60 Hz.
105	MOTOR CURRENT	As required	Motor full load nameplate current.
106	MOTOR NOM. SPEED	As required	Full load nameplate rpm.
201	MIN. FREQUENCY	6.0 Hz for ventilation fans 18.0 Hz for pumps 20.0 Hz for gearbox-driven cooling tower fans	These are the standard default settings. They can, of course, be adjusted to meet the needs of the applications.
202	MAX. FREQUENCY	60.0 Hz	For US applications, it is seldom necessary to adjust this.
203	REFERENCE SITE	LINKED TO HAND/AUTO	In this way, any time you press the AUTO START key on the drive's control panel you are also following the change to Remote speed reference if wanting to control through LON.
204	MIN. REFERENCE	0 Hz	This is generally set for either 0 Hz or the value of parameter 201, MIN. FREQUENCY. The selection depends on how the speed reference signal is set up.
205	MAX. REFERENCE	60 Hz	Generally 60 Hz, the same as the setting of parameter 202, MAX. FREQUENCY.
206	RAMP UP TIME	60 s for fans 10 s for pumps	The inertia of the driven system or the need for system responsiveness may dictate modifying these values.
207	RAMP DOWN TIME	60 s for fans 10 s for pumps	The inertia of the driven system or the need for system responsiveness may dictate modifying these values.
208	AURORAMPING	ENABLE for fans DISABLE for pumps	This setting is useful for fan applications. It allows the drive to protect against tripping if regenerated energy from the motor decelerating becomes too great.
210	REF. FUNCTION	EXTERNAL - LON PRESET others	The drive has four internally programmable preset speeds. With other settings of this parameter, these preset speeds may add or subtract from the LON speed reference command. This setting ensures that the drive will either use the external speed reference (like LON) OR the internal preset speed, but not a combination of both.
211	PRESET REF. 1	0 %	With the setting described above for parameter 210, it really shouldn't be necessary to set all of these references to 0. nviControlWord is used to select a preset if required.
212	PRESET REF. 2	0 %	‘’
213	PRESET REF. 3	0 %	‘’
214	PRESET REF. 4	0 %	‘’

General Parameter Settings (Continued)			
Parameter	**Description**	**Setting**	**Comment**
215	FREQ BYPASS B.W.	OFF	This allows the drive to "step over" troublesome speeds, like speeds where the balance of a large axial fan isn't quite right. For your tests you don't want to exclude any operating speeds.
300 – 328	Refer to IOM		These settings are for Closed Loop, local override and safety controls.
402	FLYING START	DISABLE	In normal fan applications, enabling flying start helps the drive synchronize with a motor that might be rotating. In demonstration applications, this synchronization procedure can be confusing.
415	Reference Feedback Units	%	Set according to transmitter type used in Closed Loop control.
500	PROTOCOL	FC	Set parameter 927, PARAMETER EDIT, to ENABLE. Set parameter 928, PROCESS CONTROL to ENABLE. There is no need to specifically select the LonWorks protocol. Installing the board does that. The parameters above simply activate the installed protocol.
501	ADDRESS	Not Required	LonWorks does not require the assignment of a device address. The Neuron ID takes care of this.
502	BAUD	Not Required	LonWorks Free Topology has a fixed BAUD rate of 78 Kbaud.
803	BUS TIME OUT	1 sec.	Used for LON only
804	TIME OUT FUNCTION	No Function	Used foe LON only

Parameters for Open Loop Control and Monitor through LON (Scenario C)			
Parameter	**Description**	**Setting**	**Comment**
100	CONFIG. MODE	OPEN LOOP	Sets up the drive to follow a speed reference signal.
204	MIN. REFERENCE	As required	This is generally set for either 0 Hz or the value of parameter 201, MIN. FREQUENCY. The selection depends on how the speed reference signal is set up.
205	MAX. REFERENCE	As required	Generally 60 Hz, the same as the setting of parameter 202, MAX. FREQUENCY.
308	AI [V] 53 FUNCT.	REFERENCE or NO OPERATION	This determines if analog input 53 is used for the speed reference signal. If it is, the scaling of this input is controlled by parameters 309 and 310. If it isn't, this should be set to NO OPERATION.
311	AI [V] 54 FUNCT.	REFERENCE or NO OPERATION	This determines if analog input 54 is used for the speed reference signal. If it is, the scaling of this input is controlled by parameters 312 and 313. If it isn't, this should be set to NO OPERATION.
314	AI [mA] 60 FUNCT	REFERENCE or NO OPERATION	This determines if analog input 60 is used for the speed reference signal. If it is, the scaling of this input is controlled by parameters 315 and 316. If it isn't, this should be set to NO OPERATION.

Parameters for Closed Loop Monitor through LON (Scenario B)			
Parameter	**Description**	**Setting**	**Comment**
100	CONFIG. MODE	CLOSED LOOP FORWARD	Sets up the drive to accept a feedback signal, to compare it to a setpoint reference signal, and to control the speed of the drive based on the difference between these two values.
204	MIN. REFERENCE	The value set in parameter 413 (most commonly) Units: as set in parameter 415	This is the lowest value that can be used as the setpoint reference. Generally it is set for the lowest value that the sensor can measure, although it can be set higher to restrict the possible range of the setpoint.
205	MAX. REFERENCE	The value set in parameter 414Units: as set in parameter 415	This is the highest value that can be used as the setpoint reference. Generally it is set for the highest value that the sensor can measure, although it can be set lower to restrict the possible range of the setpoint.
308	AI [V] 53 FUNCT.	FEEDBACK or NO OPERATION	This determines if analog input 53 is used for the feedback signal. If it is, the scaling of this input is controlled by parameters 309 and 310. If it isn't, this should be set to NO OPERATION.
311	AI [V] 54 FUNCT.	FEEDBACK or NO OPERATION	This determines if analog input 54 is used for the feedback signal. If it is, the scaling of this input is controlled by parameters 312 and 313. If it isn't, this should be set to NO OPERATION.
314	AI [mA] 60 FUNCT	FEEDBACK or NO OPERATION	This determines if analog input 60 is used for the feedback signal. If it is, the scaling of this input is controlled by parameters 315 and 316. If it isn't, this should be set to NO OPERATION.
317	LIVE ZERO TIME	10 s	If the minimum feedback signal is not 0 (e.g. 4 mA or 2 V), the drive can detect the loss of the signal and take the action selected in parameter 318. This parameter sets the time delay between when the signal is lost and when the action is taken. This timer is activated when an active analog signal drops to less than half of its minimum value. For example, when a 4 – 20 mA signal drops to less than 2 mA.
318	LIVE ZERO FUNCT.	As required	This parameter sets the drive's action when an active analog input signal with a non-zero minimum value. See the drive's Instruction Manual for choices. While the Live Zero function can be used in Open Loop operation, when the building automation system sends the drive a speed reference signal, it is most commonly used Closed Loop applications, where a loss of a feedback signal could cause the drive to accelerate to full speed.
413	MIN. FEEDBACK	0 (most commonly) Units: as set in parameter 415	This is the feedback signal that is represented by the minimum signal from the sensor.
414	MAX. FEEDBACK	As required Units: as set in parameter 415	This is the feedback signal that is represented by the maximum signal from the sensor.

Parameters for Closed Loop Monitor through LON (Scenario B)			
Parameter	**Description**	**Setting**	**Comment**
415	REF./FDBK.UNIT	As required	This is the unit that is used to express the feedback and setpoint reference.
416	FEEDBACK CONV.	LINEAR (most commonly)	The two choices here are LINEAR and SQUARE ROOT. SQUARE ROOT is generally used when a pressure feedback signal is used to measure flow.
417	2 FEEDBACK CALC	MAXIMUM (most commonly)	This parameter is used to determine how the drive deals with two feedback signals, which would be applied to terminals 53 and 54. If only one feedback signal is used, select MAXIMUM. Refer to the drive's Instruction Manual if more than one feedback signal is used.
418	SETPOINT 1	0 Units: as set in parameter 415	This scenario states that the setpoint should be entered via the serial bus. If that is the case, no value should be entered from the keypad. If the setpoint will instead be entered manually via the keypad, this parameter is used to store the setpoint.
419	SETPOINT 2	0 Units: as set in parameter 415	SETPOINT 2 is only needed when two feedback signals are compared against individual setpoints. This scenario states that the setpoint should be entered via the serial bus. If that is the case, no value should be entered from the keypad. If this setpoint will instead be entered manually via the keypad, this parameter is used to store SETPOINT 2.
420	PID NOR/INV.CTRL	NORMAL (most commonly)	This parameter determines how the motor's speed will be controlled by the drive's closed loop controller. NORMAL is used when a low feedback signal should cause the motor's speed to increase. INVERSE is used when a low feedback signal should cause the motor's speed to decrease.
421	PID ANTIWINDUP	ENABLE	There is seldom a need to change this.
422	PID START VALUE	As required	When the drive is given a start signal, it will first accelerate to this frequency before activating its PID controller. This can help ensure that the system is pressurized before closed loop control begins. It can also be used to help the drive quickly reach a stable operating point after it is started.
423	PID PROP. GAIN	As required	This is the proportional gain ("P") value for the drive's PID controller. The range is from 0 to 10.
424	PID INTEGR.TIME	As required	This is the integral time ("I") value for the drive's PID controller. The range is from 0.01 s to 9999.00 s to OFF. It is important to ensure that this value is NOT left in the OFF position.
425	PID DIFF. TIME	OFF	This is the differential gain ("D") value for the drive's PID controller. It is generally not used in HVAC applications.
426	PID DIFF.GAIN	5.0	This value sets the maximum effect of the "D" value of the PID controller for a step change in the error signal. This value is only used if parameter 415 is not set to OFF.
427	PID FILTER TIME	0.01 s	This is the time base for the feedback signal's low pass filter. The range is from 0.01 s to 10.00 s. Larger numbers provide more filtering.

XIF Review Summary

The following table is a summary of network variables found within the External Interface file for the Trane TR1 Series VFD. (VLTLON.XIF)
Contact Trane GCC Technical Product Support to request a soft copy of this file.

VAR Names	Index	Type	Comment
nviRequest	0	92 SNVT_obj_request	
nciMaxReceiveT	1	87 SNVT_elapsed_time	
nciMaxSendT	2	87 SNVT_elapsed_time	
VAR nciMinSendT	3	87 SNVT_elapsed_time	
VAR nvoStatus	4	94 SNVT_preset	
VAR nvoAlarm	5	88 SNVT_alarm	
VAR nviDrvSpeedStpt	6	95 SNVT_switch	
VAR nciSndHrtBt	7	107 SNVT_time_sec	
VAR nciMaxSpeed	8	81 SNVT_lev_percent	
VAR nciMinSpeed	9	81 SNVT_lev_percent	
VAR nciNmlSpeed	10	102 SNVT_rpm	
VAR nciNmlFreq	11	76 SNVT_freq_hz	
VAR nciRampUpTime	12	107 SNVT_time_sec	
VAR nciRampDownTime	13	107 SNVT_time_sec	
VAR nvoDrvCurnt	14	1 SNVT_amp	Units: Amp
VAR nvoDrvSpeed	15	81 SNVT_lev_percent	Output frequency Units: percent of maximum frequency
VAR nvoDrvVolt	16	44 SNVT_volt	
VAR nvoDrvPwr	17	28 SNVT_power_kilo	Units: kW
VAR nvoDrvRunHours	18	124 SNVT_time_hour	
VAR nviControlword	19	83 SNVT_state	
VAR nviRefPcnt	20	81 SNVT_lev_percent	
VAR nviRefHz	21	76 SNVT_freq_hz	
VAR nviStartStop	22	22 SNVT_lev_disc	
VAR nviResetFault	23	22 SNVT_lev_disc	
VAR nviSetpoint1	24	81 SNVT_lev_percent	
VAR nviSetpoint2	25	81 SNVT_lev_percent	
VAR nviFeedback1	26	81 SNVT_lev_percent	
VAR nviFeedback2	27	81 SNVT_lev_percent	
VAR nviParamCmd	28	94 SNVT_preset	
VAR nvoParamResp	29	94 SNVT_preset	
VAR nvoVoltage	30	44 SNVT_volt	
VAR nvoDigitlInput	31	83 SNVT_state	
VAR nvoWarning1	32	83 SNVT_state	
VAR nvoWarning2	33	83 SNVT_state	

VAR Names	Index	Type	Comment
VAR nvoAlarmword	34	83 SNVT_state	Bit 01 indicates that the drive is tripped off and that power to the drive will have to be cycled to be able to reset the trip
VAR nvoOutputPcnt	35	81 SNVT_lev_percent	
VAR nvoOutputHz	36	76 SNVT_freq_hz	Units: Hz
VAR nvoStatusword	37	83 SNVT_state	Bit 08 Drive Running at reference Bit 07 Drive has warnings Bit 03 Drive has tripped off
VAR nvoDrvStatus	38	83 SNVT_state	Bit 13 Running at reference Bit 14 Drive has warnings Bit 11 Drive has tripped off
VAR nvoDrvEnrg	39	13 SNVT_elec_kwh	Units: kWh
VAR nvoDCVoltage	40	44 SNVT_volt	
VAR nvoTempMtr	41	21 SNVT_lev_cont	
VAR nvoTempInvrtr	42	21 SNVT_lev_cont	
VAR nvoFeedback	43	81 SNVT_lev_percent	
VAR nvoAnalog1	44	44 SNVT_volt	
VAR nvoAnalog2	45	44 SNVT_volt	
VAR nvoAnalog3	46	2 SNVT_amp_mil	
VAR nvoOutputHz1	47	76 SNVT_freq_hz	

Notes

If parameter 100 is set for “Closed Loop”, then nvoOutputPcnt, nvoOutputHz and nvoOutputRads do NOT represent output speed. Instead, they represent the value of the feedback signal. When operating in closed loop mode this is monitored as the value of the controlled variable - the feedback. The speed of the drive doesn’t really matter as long as the feedback signal is correct.

For practical purposes, nvoOutputPcnt is the one that is useful in closed loop mode, since it provides the information that is the easiest to understand. It represents the percent of the feedback signal from MIN. REFERENCE (parameter 204) to MAX. REFERENCE (parameter 205). It is generally best to define MIN. REFERENCE (parameter 204) = MIN. FEEDBACK (parameter 413) and MAX. REFERENCE (parameter 205) = MAX. FEEDBACK (parameter 414). In this way nvoOuptutPcnt is also a percent of the feedback sensor’s range, which is what most people expect.

Trane TR1 drives are supplied with multiple, active reference signals, that are typically added together. You can turn off summation by setting the appropriate MIN. REFERENCE (parameter 204) = 0. The analog “nvo” values are based on the REFERENCE range. Therefore, if the drive is running at minimum reference, all three of these values nvoOutputPcnt, nvoOutputHz, and nvoOutputRads will show up as being zero. It is suggested to set parameter 204, Minimum Reference, to 0. In that way nvoOutputPcnt, nvoOutputHz, and nvoOutputRads will read as expected
Also parameters 503 through 508 allow some prioritizing of source of the reference signals.

Start/Stop:
LonWorks has two ways of handling this.
The most common method is to simply use nviStartStop. This ramps the drive both for starting and stopping as used in the AH540.
A second method is to use nviControlWord. This 16-bit word allows a wider range of control of the drive, such as coast to stop and locking out all start commands (like a safety interlock). This is generally viewed as being overkill by most people and not supported by Tracer Summit. Either of these can be set to interact with the drive’s control terminals (a.k.a. digital inputs). Drive parameters 503 through 508 allow a selection of “SERIAL PORT”, “DIGITAL INPUT”, “LOGIC OR” and “LOGIC AND” for a variety of functions.

Notes (Continued)

Send PID Setpoint:
There are two different ways of inputting a setpoint. The most common method is to simply use nviRefPcnt. in closed loop operation, the reference is the setpoint reference. This value is sent as a percent. The other method requires the use of SNVT_preset to directly access the appropriate drive parameter. This is not supported by Tracer Summit or Rover.

Read back sensor value:
When the drive is in close loop mode (that is, using its internal PID controller), nvoOutputPcnt gives the value of the feedback signal. This value is given in percent.

Monitor Volts, Amps, etc:
Most commonly monitored analog data from the TR1.
* nvoDrvCurrent - drive output current, in Amps
* nvoDrvEnrg - drive output energy, in kW-hr
* nvoDrvPower - drive output power, in kW
* nvoVoltage - drive output voltage, in V
* nvoDCVolt - drive internal DC bus voltage, in V
* nvoTempMtr - the status of the drive's motor overload protection, in % of the way to trip
* nvoTempInvrtr - the status of the drive's own calculated thermal protection, in % of the way to trip

Faults:
The drive's LonWorks interface has an extensive set of alarm and warning outputs. These are presented in five variables of the type SNVT_state. Each bit in each word represents a particular operating condition. These can be general (like "running", "warning" or "alarm") or they can be quite specific (like "running at reference", "hand or auto mode", "input phase loss", and "current limit").

Digital Inputs:
The TR1 LonWorks interface can also display the status of all eight of the drive's hard-wired digital inputs, regardless of whether they are being used to control the drive. This uses the variable nvoDigitalInput. Using this, it is possible to wire external contacts to the drive and use the drive to report back their status.

Relay Control:
One other advanced capability of the TR1's LonWorks interface is the ability of LonWorks to control the status of one or both of the drive's internal relays. Using this, it is possible to issue a LonWorks command that will, for example, initiate motor alternation in a pumping application. To do this, nviControlWord is used to both control the status of the relay(s) and to start and stop the drive. Currently not supported by Tracer Summit.

TRANE®

Trane
A business of American Standard Companies
www.trane.com

For more information contact your local Trane office or e-mail us at comfort@trane.com

Literature Order Number	TR1-SVX01A-EN
File Number	SV-VEN-TR1-000-SVX01A-EN-1203
Supersedes	SL-VEN-TR1-000-SVX01A-EN-0403
Stocking Location	Commercial Communications, Inc.