



# TR150 Embedded BACnet Operating Instructions

BAS-SVX066A-EN

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# 1 Safety

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## 1.1.1 Warnings, Cautions and Notices

Warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in personal injury or death. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

### Symbols

The following symbols are used in this manual.

#### **⚠ WARNING**

Indicates a potentially hazardous situation which could result in death or serious injury.

#### **⚠ CAUTION**

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

#### **NOTICE**

Indicates important information, including situations that may result in damage to equipment or property.

★	Indicates default setting
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Table 1.1

## 1.1.2 Safety Note

#### **⚠ WARNING**

Failure to follow instructions could result in death or serious injury.

### Safety Regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [Off/Reset] key on the LCP of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective grounding of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The ground leakage currents are higher than 3.5 mA.
5. Protection against motor overload is set by *1-90 Motor Thermal Protection*. If this function is desired, set *1-90 Motor Thermal Protection* to data value [WR] *ETR Trip* (default value) or data value [ETR warning].

**NOTICE**

The function is initialized at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. The frequency converter has more voltage inputs than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) and external 24 Vdc have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

**WARNING**

**Warning against Unintended Start**

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [Off/Reset] must always be activated; following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

Consequently, disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Failure to follow recommendations could result in death or serious injury.

1.1.3 Before Commencing Repair Work

**WARNING**

**Hazardous Voltage!**

1. Disconnect the frequency converter from mains
2. Disconnect DC bus terminals 88 and 89
3. Wait at least the time mentioned in section General Warning above
4. Remove motor cable

Failure to follow recommendations could result in death or serious injury.

1.1.4 Special Conditions

**Electrical ratings**

The rating indicated on the nameplate of the frequency converter is based on a typical 3-phase mains power supply, within the specified voltage, current and temperature range, which is expected to be used in most applications.

The frequency converters also support other special applications, which affect the electrical ratings of the frequency converter.

Special conditions which affect the electrical ratings might be:

- Single phase applications
- High temperature applications which require de-rating of the electrical ratings
- Marine applications with more severe environmental conditions.

Other applications might also affect the electrical ratings.

Consult the relevant sections in this manual and in the Design Guide for information about the electrical ratings.

**Installation requirements**

The overall electrical safety of the frequency converter requires special installation considerations regarding:

- Fuses and circuit breakers for over-current and short-circuit protection
- Selection of power cables (mains, motor, brake, loadsharing and relay)
- Grid configuration (grounded delta transformer leg, IT, TN, etc.)
- Safety of low-voltage ports (PELV conditions)

Consult the relevant clauses in these instructions and in the *Design Guide* for information about the installation requirements

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## 2 Introduction

### 2.1.1 Purpose of the Manual

This manual provides the information required to install and set up communication using BACnet protocol.

First-time users can obtain the most essential information for quick installation and set-up in these chapters

*chapter 2 Introduction*

*chapter 3 How to Install*

*chapter 4 How to Configure the System*

For more detailed information including the full range of set-up options and diagnosis tools refer to the chapters:

*chapter 6 Parameters*

*chapter 7 Troubleshooting*

### 2.1.2 Technical Overview

BACnet (Building Automation and Control Network) is an open data communications protocol, American National Standard (ANSI/ASHRAE 135-2004). BACnet enables computer-based control equipment from different manufacturers to work together. BACnet is designed to handle many types of building controls, including HVAC, lighting, security, fire, access control, maintenance and waste management. BACnet permits flexibility for expansion and different equipment combinations.

Background information	
Protocol name	BACnet
Technology developer	ASHRAE
Year introduced	1995
Governing standards	ANSI/ASHRAE Standard 135-2008 version 4, ISO 16484-5
Openness	Open specification
Physical characteristics	
Network topology	Bus
Physical media	Shielded twisted pair
Max. Distance at low speed	1200 m (4000 ft)
Transport mechanism	
Communication methods	MS/TP
Baud Rates Supported	9600, 19200, 38400, 76800
Termination	120 Ω

Table 2.1 Overview

### 2.1.3 Assumptions

This manual assumes that the BACnet Protocol is used with a TR150 series frequency converter. It is also assumed that the system is equipped with a firmware supporting the BACnet communication services required by the application and that all requirements stipulated in the BACnet standard, as well as those pertaining to the frequency converter are strictly observed as well as all limitations therein fully respected.

### 2.1.4 Background Knowledge

The Trane implementation of the BACnet Protocol is designed to communicate with any system complying with the BACnet MS/TP standard. Familiarity with the PC, BMS or PLC used as a master in the system is assumed. Issues regarding hardware or software produced by other manufacturers are beyond the scope of this manual and are not the responsibility of Trane.

In case of questions regarding set-up of master-to-master communication or communication to a non-Trane follower, consult the appropriate manuals.

### 2.1.5 Available Literature

- TR150 Quick Guide BAS-SVX58 provides the necessary information for getting the drive up and running.
- TR150 Design Guide BAS-SVX59 entails all technical information about the drive and customer design and applications.
- TR150 Programming Guide BAS-SVP16 provides information on how to programme and includes complete parameter descriptions.

Trane technical literature is available in print from local Trane Sales Offices or online at: [www.trane.com/vfd](http://www.trane.com/vfd)

ACI	Acyclical Control Interval
ACK	Acknowledge
ADF	Internal Floating Points
ADI	Internal Integers
AI	Analog Inputs
AO	Analog Outputs
AOC	Application Orientated Controller
AV	Analog Values
BI	Binary Inputs
BMS	Building Management System
BO	Binary Outputs
BV	Binary Values
COS	Change Of State
CTW	Control Word
EEPROM	Electrical Erasable Programmable Read Only Memory
EIA	Electronic Industries Association: Specifies of the EIA Standard RS-485-A
EMC	Electromagnetic Compatibility
HPFB	High Performance Field Bus
I/O	Input/Output
ISO	International Standards Organization
JCI	Johnson Controls Inc. developers of the METASYS N2 protocol
LCP	Local Control Panel
LED	Light Emitting Diode
MAV	Main Actual Value
MRV	Main Reference Value
N2	METASYS N2
N2 master	A N2 master is either a PC with JCI software or a dedicated JCI controller
NAK	Not acknowledged
NPA	N2 Point Address (Each N2 Point Type has a address range from 0 to 255)
NPT	N2 Point Type
PC	Personal Computer
PDU	Protocol Data Unit
PELV	Protected Extra Low Voltage
PLC	Programmable Logic Control
PNU	Parameter Number
STW	Status Word

Table 2.2 Abbreviations

**Conventions**

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicised text indicates

- cross reference
- link
- footnote
- parameter name, parameter group name, parameter option
- \* indicates default setting

### 3 How to Install

#### 3.1 The BACnet Interface

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##### 3.1.1 Cabling

###### Cable lengths and number of nodes

For the correct function of a BACnet MS/TP system, it is mandatory to fulfill installation of the communication cables given in this manual. Under correct installation it is possible to have up to 250 nodes (125 masters and 125 slaves) on 1200 m (4000 ft) cable.

The use of drop cable connection (i.e. T-connection) is not allowed in a BACnet MS/TP system. Drop cables lead to reflection and malfunction of the system. In locations where the cabling demands a T-connection the use of repeaters is recommended.

###### **NOTICE**

A repeater is a node in both of the two segments it connects. The number of frequency converters is based on a single master system. If there are two or more devices (e.g. PC tools, Routers), reduce the number of frequency converters correspondingly.

- Maximum length of an MS/TP segment: 1200 m (4000 ft)
- Characteristic impedance: 100 to 130 Ω
- Resistance: <110 Ω/km
- Distributed capacitance: <100 pF/m, between conductors
- Cross section: 0.82 mm<sup>2</sup> conductor area, corresponding to AWG 18
- Cable type: twisted in pairs, 1 x 2, or 2 x 2 wires
- Screening: Copper-braided screen or braided screen and foil screen

###### **NOTICE**

Use of the same cable type throughout the entire segment is recommended to avoid impedance mismatch.

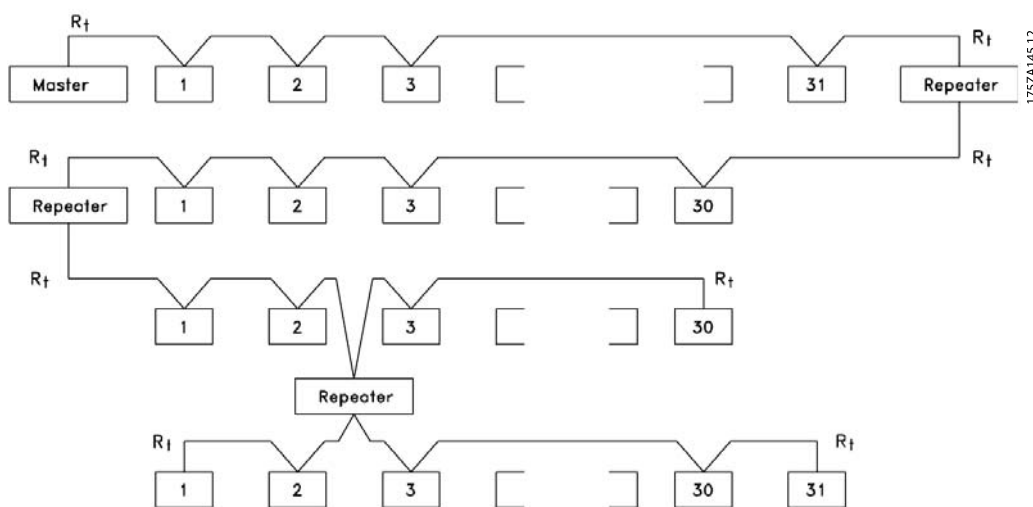


Illustration 3.1 BACnet Interface

### 3.1.2 Network Connection

Connect the frequency converter to the RS-485 network as follows (see *Illustration 3.2*):

1. Connect signal wires to terminal 68 (P+) and terminal 69 (N-) on the main control board of the frequency converter.
2. Connect the cable screen as described in *chapter 3.2 Bus Cabling*.

**Note**

Screened, twisted-pair cables are recommended in order to reduce noise between conductors.

### 3.1.3 Network Termination

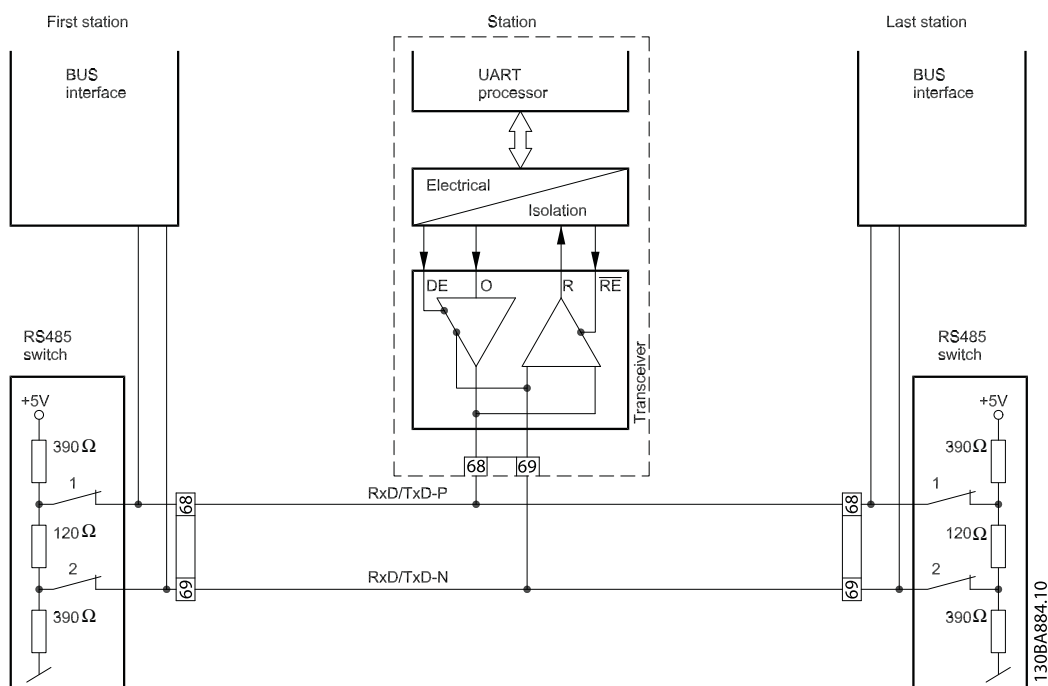


Illustration 3.2 Network Termination

**Maximum cable lengths**

Maximum total bus cable length: 4000 ft ~ 1200 m

### 3.1.4 S801

S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

**Default setting:**

S801 (Bus termination) = OFF

**Note**

When changing the function of S201, S202 or S801 be careful not to use force for the switch over. It is recommended to remove the keypad fixture (cradle) when operating the switches.



Illustration 3.3 Switches

**NOTICE**

The switches must not be operated with power on the frequency converter.



### 3.1.5 Cable Routing

The BACnet communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to the other. Normally a distance of 200 mm (7.9 in.) is sufficient, but maintaining the greatest possible distance between cables is generally recommended, especially where cables run in parallel over long distances.

When crossing is unavoidable, the BACnet cable must cross motor and brake resistor cables at an angle of 90°.

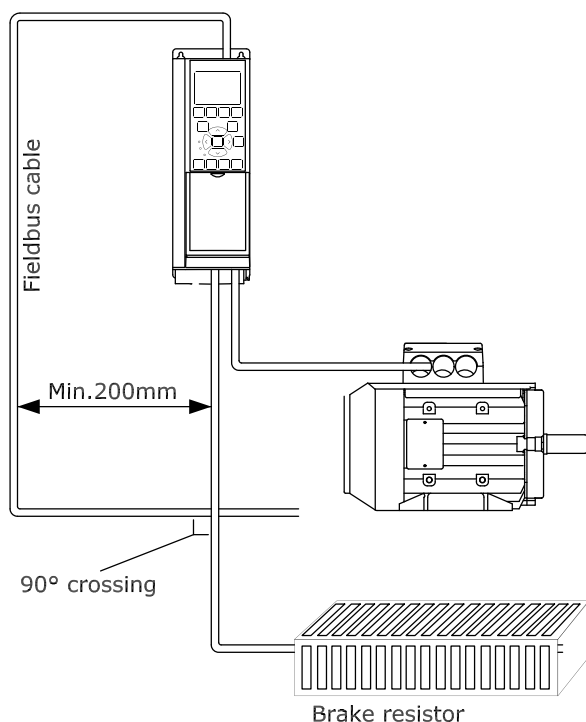


Illustration 3.4 Cable Routing

## 3.2 Bus Cabling

### 3.2.1 EMC Precautions

The following EMC precautions are recommended to achieve interference-free operation of the BACnet network. Additional EMC information is available in the *Design Guide*.

**Note**

Ensure compliance with relevant national and local regulations, for example in protective ground connection.

### 3.2.2 Single Ground Shielding

For installing the bus cable on MS/TP, two different strategies can be followed, Single ground of shield and multiple ground of shield. Each strategy has both advantages and disadvantages. The following chapter explains the difference between the two strategies. The single ground shield is specified in the ANSI/ASRAHE 135-2004 standard. The solution benefits by having only one ground connection of the shield, by doing so the possibility for ground loop of equalizing current is heavily reduced. In these systems the shield of the MS/TP cables has to be isolated from ground at all stations, except one. At each station the shield from the two cables has to be connected with each other, and isolated from ground. The best solution for this has been proven to be the use of shrink tubes. The single ground shielding is a good approach where the system uses long bus cables. If two buildings have to be connected over the same MS/TP bus cable, the use of fibre optic has to be considered. This prevents that a lightning stroke is carried from one building to another, and problem with difference in ground potential can be neglected.

### 3.2.3 Multiple Ground Shielding

If the distance between the individual frequency converter is limited (e.g. inside a cabinet or in one control room) Trane recommends connecting the screen to ground at both ends of the bus cable. This ensures the maximum protection from EMC noise. Connecting the screen at each end requires that each BACnet device has the same ground potential or an equalizing current flows in the screen of the cable and cause disturbance and poor performance of the system. Low impedance to ground connection of the screen can be achieved by connecting the surface of the screen to ground, with a cable clamp or a conductive cable gland. The various clamps and brackets supplied enable a proper ground connection of the BACnet cable screen.

Trane recommends to connect the screen to ground at both ends of the bus cable. This ensures the maximum protection from EMC noise. Connecting the screen at each end requires that each BACnet device has the same ground potential or else an equalizing current flows in the screen of the cable and cause disturbance and poor performance of the system. Where this is not possible, the screen can be isolated from the chassis of the drive by use of shrink-tubing. It must be pointed out that the routing of the BACnet cable must be established with a maximum distance to other cables such as mains, motor cable, etc.

## 4 How to Configure the System

### 4.1 Configuring BACnet

#### 4.1.1 Initialization Procedure

Parameter	Default Value	Setting for BACnet
Parameter 8-01 Control Site	Digital and control word	Digital and control word
8-02 Control Source	Drive RS-485	FC RS-485
8-03 Control Timeout Time	1 s	<sup>1)</sup>
8-04 Control Timeout Function	Off	<sup>1)</sup>

**Table 4.1 General Settings**

Parameter	Default Value	Setting for BACnet
8-30 Protocol	Drive	BACnet
8-31 Address	1	<sup>1)</sup>
8-32 Baud Rate	38400	9600 baud
Parameter 8-35 Minimum Response Delay	10 ms	10 ms
Parameter 8-36 Maximum Response Delay	5,000 ms	5,000 ms

**Table 4.2 Drive Port Settings**

<sup>1)</sup> Depending on the application.

<sup>2)</sup> Depending on the BMS system

<sup>3)</sup> The address setting is dependent on the system. Each device connected to the BACnet MS/TP must have a unique address on this MS/TP network. See also chapter 6.1.1 Parameter List.

Parameter	Default Value	Setting for BACnet
Parameter 8-50 Coasting Select	Logic-or	Set according to the wiring of the application
Parameter 8-52 DC Brake Select	Logic-or	Logic-or
Parameter 8-53 Start Select	Logic-or	Logic-or
Parameter 8-54 Reversing Select	Digital input	Digital input
Parameter 8-55 Set-up Select	Logic-or	Logic-or
Parameter 8-56 Preset Reference Select	Logic-or	Logic-or

**Table 4.3 Digital/Bus Settings**

Name	Default Value	Setting for BACnet
8-70 BACnet Device Instance	1	<sup>1)</sup>
8-72 MS/TP Max Masters	127	Dependent on the Number of Masters in the system
Parameter 8-74 "I-Am" Service	At power up	At power up
Parameter 8-75 Initialization Password	"admin"	"admin"

**Table 4.4 BACnet Settings**

<sup>1)</sup> The device instance setting is dependent on the system. Each device connected to the BACnet MS/TP must have a unique device instance in the complete system.

## 4.1.2 Control Word Time-out Function

8-03 Control Timeout Time and 8-04 Control Timeout Function are not used.

## 4.2 Example of a Simple Set-up of BACnet

This example shows the necessary steps to set up the BACnet interface with the following system requirements:

- MS/TP running at 38,400 Baud
- MAC address 20 for the frequency converter on the MS/TP network
- Device Instance number 1025 for the frequency converter
- Highest number of a Master device is 35
- Start/stop of Drive from BACnet only
- Reference from BACnet
- Read status of Drive (Actual speed)

Set the following parameters	
Parameter	Value
8-30 Protocol	[5] BACnet
8-31 Address	20
8-32 Baud Rate	[4] 38,400 Baud
Parameter 8-50 Coasting Select	[1] Bus
8-70 BACnet Device Instance	1025
8-72 MS/TP Max Masters	35

**Table 4.5 BACnet Set-up Example**

After the parameters have been set according to *Table 4.5*, the frequency converter has to be unpowered and repowered before the changes take effect. When the frequency converter is detected by the BMS, it can be controlled by BV:1, which starts the motor if set to [1]. Setting AV:1 sets the speed reference of the frequency converter. The actual speed can be monitored via AV:3. See also .

## 5 BACnet Objects

### 5.1.1 Analog Input- and Output Objects

Control the frequency converter from the BACnet network using 'objects'. The various types of 'objects' and their descriptions are shown in the following tables.

Object ID	Object name	Read/Write	Non volatile RAM store	Drive parameter	Remarks
AI:1	Analog Input 53	R	No	16-62	
AI:2	Analog Input 54	R	No	16-64	

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Table 5.1 Analog Inputs

Object ID	Object name	Read/Write	Non volatile RAM store	Drive parameter	Remarks
AO:1	Terminal 42 Output Bus Control	W/R	No	6-53	Commandable

Table 5.2 Analog Outputs

Object ID	Object name	Read/Write	Non volatile RAM store	Drive parameter	Remarks
AV:1 <sup>1)</sup>	Input Reference 1	W/R	No		Commandable
AV:2 <sup>1)</sup>	Input Reference 2	W/R	No		Commandable
AV:3 <sup>2)</sup>	Output Speed	Read	No		
AV:4 <sup>3)</sup>	PID Feedback	Read	No		
AV:5	Motor Current	Read	No	16-14	
AV:6	Power [kW]	Read	No	16-10	
AV:7	kWh Counter	Read	No	15-02	
AV:8	Inverter Thermal	Read	No	16-35	
AV:11	Motor Voltage	Read	No	16-12	
AV:12	Frequency	Read	No	16-13	
AV:13	Torque [%]	Read	No	16-22	
AV:14	DC Link Voltage	Read	No	16-30	
AV:15	Motor Thermal	Read	No	16-18	
AV:16	Heatsink Temp.	Read	TR150	16-34	
AV:17	Operating Hours	Read	TR150	15-00	
AV:18	Running Hours	Read	TR150	15-01	
AV:19	Bus Feedback 1	W/R	TR150	8-94	
AV:20	Bus Feedback 2	W/R	TR150	8-95	
AV:21	Bus Feedback 3	W/R	TR150	8-96	
AV:22	PID Start Speed [Hz]	W/R	TR150	20-83	
AV:23	On Reference Bandwidth	W/R	TR150	20-84	
AV:24	PID Proportional Gain	W/R	TR150	20-93	
AV:25	PID Integral Time	W/R	TR150	20-94	
AV:26	PID Differentiation Time	W/R	N/A	20-95	
AV:27	PID Diff. Gain Limit	W/R	TR150	20-96	
AV:28	Slave Messages Rcvd	Read	TR150	8-82	
AV:29	Slave Error Count	Read	TR150	8-83	
AV:30	Slave Messages Sent	Read	N/A	8-84	
AV:50	Alarm Log: Error Code	Read	TR150	15-30	
AV:51 <sup>4)</sup>	Fault Code	Read	TR150		

**Table 5.3 Analog Values**

<sup>1)</sup> Either AV:1 or AV:2 controls the drive reference. Only one of them can control the frequency converter at a time and BV:2 decides which one.

<sup>2)</sup> This value is not directly available in the frequency converter. The value must be calculated as follows:  $AV\#3 = \frac{Par. 16 - 13}{Par. 4 - 14} \times 100\%$

<sup>3)</sup> This value is not directly available in the frequency converter. The value must be calculated as follows:  $AV\#4 = \frac{Par. 16 - 52}{Par. 3 - 303} \times 100\%$

<sup>4)</sup> fault codes are transmitted as an analog value in AV:51. The Fault codes are mapped as shown in Table 5.4. The alarm codes are shown as well for comparison.

Table 5.4 shows the mapping of the TR150 alarm codes and their mapping to the BACnet's fault codes.

Fault codes	Fault Code	Alarms	Fault Descriptions
Communication Error	1	17, 34	Loss of communication with the network
Over Current	2	59	Instantaneous Output Current has exceeded inverter rated or programmed value
Over Temperature	3	29, 65, 69, 143, 244, 245	Heat sink Temperature Limit has been reached
Over Speed Deviation	4	49, 62	Inverter has exceeded maximum or programmed limit
Over Voltage	5	5, 7, 64	DC Bus Voltage has exceeded inverter limit
Under Voltage	6	1, 6, 8	DC Bus Voltage is lower than required inverter limit
Short Circuit	7	16	Inverter Output has shorted Phase to Phase
Ground Fault	8	14	Inverter Output Grounding Current has exceeded manufacturer
Motor Overload	9	10, 50-58, 74, 222	Motor is overloaded
Inverter Overload	10	9	Timed over current fault
Over Torque Detection	11	12	Programmed limit for torque has been exceeded
External Fault	12	22, 24, 25, 26, 28, 43, 60, 63, 68, 71, 142, 150	External fault has been activated in the inverter. This is a hard fault that must be reset
Operator Interface Error	13	2, 50, 51, 52, 53, 54, 55, 56, 57, 58, 67	Inverter programming or operational interface malfunction
Load Loss	14	3, 92, 93, 94, 95, 229	Load on the Motor is less than programmed limit of system. An Example is a broken belt or coupling
Configuration Error	15	13, 40, 41, 42, 70, 72, 76, 79, 81, 82, 85, 86, 91, 96, 97, 98, 99, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 154	Errors exist in the programmed or operational configuration of the inverter
Feedback Failure	16	90, 192, 78, 108	Required system operational feedback (signal or sensor) is not responding as expected for correct system operation
Output Phase Loss	17	30, 31, 32	One or more of the output phases from the inverter to the motor are open
Motor Stall	18	11, 61, 204	Motor is operating in stall region and not able to accelerate
Power Unit Error	19	4, 23, 33, 36, 37, 46, 142, 220, 221, 222, 223, 224, 225, 226, 227, 228, 246	Error sensed on the power section of the inverter
Input Phase	20	-	Input single phase or low line voltage condition
Internal Drive Failure	21	4, 27, 36, 37, 38, 46, 76, 79, 81, 82, 91, 103, 105, 106, 107, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 125, 149, 151, 155, 162, 170, 171, 179, 180, 181, 182, 183, 184, 187, 190, 191, 230, 231, 232, 240, 241, 242, 246, 248	Manufacturer defined internal operations that have failed their-self checks.

Table 5.4 Mapping of Fault Codes

### 5.1.2 Binary Input- and Output Objects

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Object Id	Object Name	Read/Write	Non volatile RAM Store	Drive Parameter	Remarks
BI:1	Digital Input 18	Read	No	16-60/05	Commandable
BI:2	Digital Input 19	Read	No	16-60/04	Commandable
BI:3	Digital Input 27	Read	No	16-60/03	Commandable
BI:4	Digital Input 29	Read	No	16-60/02	Commandable
BI:5	Digital Input 32	Read	No	16-60/01	16-60/05 Commandable
BI:6	Digital Input 33	Read	No	16-60/00	Commandable
BI:7	Digital Input 37	Read	No	16-60/06	

Table 5.5 Binary Inputs

Object Id	Object Name	Read/Write	Non volatile RAM Store	Drive Parameter	Remarks
BO:1	Digital Output 27	W/R	No	5-90/00	Commandable
BO:2	Digital Output 29	W/R	No	5-90/01	Commandable
BO:3	Relay 1 Output	W/R	No	5-90/04	Commandable
BO:4	Relay 2 Output	W/R	No	5-90/05	Commandable
BO:5	GPIO Output Term X30/6	W/R	No	5-90/02	Commandable
BO:6	GPIO Output Term X30/7	W/R	No	5-90/03	Commandable

Table 5.6 Binary Outputs

Object ID	Object Name	Read / Write	Non volatile RAM Store	Drive Parameter	Remarks
BV:1	RUN/STOP Command	W/R	No	CTW	Commandable
BV:2	REF1 / REF2 Select	W/R	No		Commandable
BV:3	Fault Reset Command	W/R	No	CTW	
BV:4	RUN / STOP Monitor	R	No	CTW	
BV:5	OK / FAULT Monitor	R	No	CTW	
BV:6	HAND / AUTO Reference	R	No	16-95	
BV:7	Running	R	No	STW	
BV:8	Coast	R/W	No	STW	Commandable
BV:9	Reverse	R/W	No	STW	Commandable
BV:10	Jog	R/W	No	STW	Commandable
BV:11	Ramp 1/Ramp 2	R/W	No	STW	Commandable
BV:12	Warning	R	No	STW	
BV:13	Trip	R	No	STW	
BV:14	Triplock	R	No	STW	
BV:15	Reset KWh Counter	R/W	No	15-06	
BV:16	Reset Running Hours Counter	R/W	No	15-07	
BV:17	At Reference	R	No	STW	
BV:22	Reset Slave msg Recv	R/W	No	8-82	
BV:23	Reset Slave error Count	R/W	No	8-83	
BV:24	Reset Slave msg Sent	R/W	No	8-83	

Table 5.7 Binary Values

### 5.1.3 Multi-state Value Objects

The analog value objects BV:1, BV:2, BV:3, BV:4 and BV:5 must be commandable and they must support Priority\_Array and Relinquish\_Default.

Object Id	Object Name	Read/Write	Changeable Description	Drive Parameter	Remarks
MSV:1	Active Setup	W/R	No	Bit13&14 in CTW	
MSV:2	Smart Logic Controller Stage	R	No	16-38	

Table 5.8

### 5.2 Drive Feedback to Network

The BACnet interface provides several objects to the network, containing important drive -, motor- and I/O feedback data.

Influence of the digital input terminals upon the Drive Control Mode, *parameter 8-50 Coasting Select* to *parameter 8-56 Preset Reference Select*

The influence of the digital input terminals upon control of the frequency converter can be programmed in *parameter 8-50 Coasting Select* to *parameter 8-56 Preset Reference Select*.

**Note**

*Parameter 8-01 Control Site* overrules the settings in *parameter 8-50 Coasting Select* to *parameter 8-56 Preset Reference Select* and *Terminal 37, Safe Stop* overrules any parameter.

Each of the digital input signals can be programmed to logic AND, logic OR, or to have no relation to the corresponding bit in the control word. In this way a specific control command i.e. stop/coast, can be initiated by the fieldbus only, fieldbus AND Digital Input, or Fieldbus OR Digital input terminal.

**Note**

In order to control the frequency converter via BACnet, *parameter 8-50 Coasting Select* must be set to either [1] Bus, or to [2] Logic AND and *parameter 8-01 Control Site* must be set to Digital and [0] ctrl. word or [2] Controlword only.

### 5.3 BIBBs

ReadProperty	Execute
WriteProperty	Execute
DeviceCommunicationControl	Execute
ReinitializeDevice	Execute
I-Am	Initiate
I-Have	Initiate
TimeSynchronization	Execute
Who-Has	Execute
Who-Is	Execute

Table 5.9 BIBBs



## 6 Parameters

### 6.1 Parameter Overview

#### 6.1.1 Parameter List

Parameter	Default value	Range	Conversion index	Data type
Parameter 8-01 Control Site	[0] Dig. and ctrl. word	[0-2]	-	5
8-02 Control Source	Option A	[0-4]	-	5
8-03 Control Timeout Time	1 s	0.1-18000	-1	7
8-04 Control Timeout Function	[0] Off	[0-10]	-	5
8-30 Protocol	Drive			
8-31 Address	1	[0-255]		
8-32 Baud Rate	38,400	[0-7]		
Parameter 8-33 Parity / Stop Bits	No Parity, 1 Stop Bit			
Parameter 8-35 Minimum Response Delay	10 mS			
Parameter 8-36 Maximum Response Delay	5000 mS			
Parameter 8-37 Maximum Inter-Char Delay	25.00 mS			
Parameter 8-50 Coasting Select	[3] Logic OR	[0-3]	-	5
Parameter 8-52 DC Brake Select	[3] Logic OR	[0-3]	-	5
Parameter 8-53 Start Select	[3] Logic OR	[0-3]	-	5
Parameter 8-54 Reversing Select	Digital input	[0-3]	-	5
Parameter 8-55 Set-up Select	[3] Logic OR	[0-3]	-	5
Parameter 8-56 Preset Reference Select	[3] Logic OR	[0-3]	-	5
8-70 BACnet Device Instance	1	[0-4194302]	-	
8-72 MS/TP Max Masters	127	[0-127]	-	
8-73 MS/TP Max Info Frames				
Parameter 8-74 "I-Am" Service	[0] Once at powerup	[0-1]	-	
Parameter 8-75 Initialization Password	"admin"	[19] String		

**Table 6.1 BACnet Specific Parameter List**

Refer to the *Drive Quick Guide*, BAS-SVX58 for a comprehensive parameter list or to the *Programming Guide*, BAS-SVP16 for detailed descriptions of parameters.

#### Conversion index

This number refers to a conversion figure used when writing or reading to and from the frequency converter.

Conv. index	100	67	6	5	4	3	2	1	0	-1	-2	-3	-4	-5	-6
Conv. factor	1	1/60	1000000	100000	10000	1000	100	10	1	0.1	0.01	0.001	0.0001	0.00001	0.000001

**Table 6.2 Conversion Index/Conversion Factor**

Data type	Description	Type
2	Integer 8	Int8
3	Integer 16	Int16
4	Integer 32	Int32
5	Unsigned 8	UInt8
6	Unsigned 16	UInt16
7	Unsigned 32	UInt32
9	Visible String	VisStr
33	Normalized value 2 bytes	N2

**Table 6.3 Data Type**

See the frequency converter *Design Guide* for further information about data types 33.

## 6.2 Parameter Description

### 6.2.1 8-\*\* Comm. and Options

8-01 Control Site		
Option:	Function:	
		The setting in this parameter overrides the settings in <i>parameter 8-50 Coasting Select</i> to <i>parameter 8-56 Preset Reference Select</i> .
[0]	Digital and ctrl.word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Controlword only	Control by using control word only.

8-02 Control Source		
Option:	Function:	
		Select the source of the control word.
[0]	None	
[1]	FC Port	

8-30 Protocol		
Option:	Function:	
[5]	BACnet	Select BACnet protocol

8-31 Address		
Range:	Function:	
1. *	[1. - 127. ]	Sets the drives MAC ID on the MS/TP network.

8-32 Baud Rate		
Option:	Function:	
		Baud rate selection depends on Protocol selection in <i>8-30 Protocol</i> .
[2]	9600 Baud	
[3]	19200 Baud	
[4] *	9600 Baud	
[6]	76800 Baud	

Default refers to the FC Protocol.

8-33 Parity / Stop Bits		
Option:	Function:	
		Parity and Stop Bits for the protocol <i>8-30 Protocol</i> using the Drive Port. For some of the protocols, not all options are visible. Default depends on the protocol selected.
[0]	Even Parity, 1 Stop Bit	
[1]	Odd Parity, 1 Stop Bit	
[2]	No Parity, 1 Stop Bit	
[3]	No Parity, 2 Stop Bits	

8-35 Minimum Response Delay		
Range:	Function:	
Size related*	[ 5 - 10000 ms]	Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Maximum Response Delay		
Range:	Function:	
Size related*	[ 11 - 10001 ms]	Specify the maximum permissible delay time between transmitting a request and receiving a response. Exceeding this delay time causes control word time-out.

8-37 Maximum Inter-Char Delay		
Range:	Function:	
Size related*	[ 0.00 - 35.00 ms]	Specify the maximum permissible time interval between receipt of two bytes. This parameter activates time-out if transmission is interrupted.

8-50 Coasting Select		
Option:	Function:	
		Select control of the coasting function via the terminals (digital input) and/or via the bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-52 DC Brake Select		
Option:	Function:	
		Select control of the DC brake via the terminals (digital input) and/or via the fieldbus. <b>NOTICE</b> Only selection [0] Digital input is available when 1-10 Motor Construction is set to [1] PM non-salient SPM.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.

8-52 DC Brake Select		
Option:	Function:	
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-53 Start Select		
Option:	Function:	
		Select control of the frequency converter start function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Start command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the fieldbus/serial communication port OR via one of the digital inputs.

8-54 Reversing Select		
Option:	Function:	
		Select control of the frequency converter reverse function via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Reverse command via a digital input.
[1]	Bus	Activates Reverse command via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Reverse command via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3]	Logic OR	Activates Reverse command via the fieldbus/serial communication port OR via one of the digital inputs.

**NOTICE**

This parameter is active only when parameter 8-01 Control Site is set to [0] Digital and control word.

8-55 Set-up Select		
Option:	Function:	
		Select control of the frequency converter set-up selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates the set-up selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the fieldbus/serial communication port OR via one of the digital inputs.

8-56 Preset Reference Select		
Option:	Function:	
		Select control of the frequency converter Preset Reference selection via the terminals (digital input) and/or via the fieldbus.
[0]	Digital input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port or fieldbus option.
[2]	Logic AND	Activates Preset Reference selection via the fieldbus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the fieldbus/serial communication port OR via one of the digital inputs.

8-70 BACnet Device Instance		
Range:	Function:	
	0 - 4194302	The Device Instance number must be unique for the complete BACnet, not only for this MS/TP Branch.
1 *	[0 - 4194302 ]	Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters		
Option:	Function:	
	0 - 127	Define the address of the master which holds the highest address in this network. Decreasing this value optimises polling for the token.

8-73 MS/TP Max Info Frames		
Range:	Function:	
	1 - 65534	Define how many info/data frames the device is allowed to send while holding the token.
1*	[1 - 65534 ]	Define how many info/data frames the device is allowed to send while holding the token.

8-74 "I-Am" Service		
Option:	Function:	
[0] *	Send at power-up	
[1]	Continuously	Choose whether the device should send the "I-Am" service message only at power-up or continuously with an interval of approx. 1 min.

8-75 Initialization Password		
Range:	Function:	
[Size related]	0 - 0	Enter the password needed for execution of Drive Re-initialization from BACnet.
Admin*	[Str]	Enter the password needed for execution of Drive Re-initialization from BACnet.

## 7 Troubleshooting

### 7.1 Alarm, Warning and Extended Status Word

#### 7.1.1 Alarm and Warning Messages

##### General

There is a clear distinction between alarms and warnings. In the event of an alarm, the frequency converter enters a fault condition. After the cause for the alarm has been cleared, the master must acknowledge the alarm message to restart operation of the frequency converter. A warning, on the other hand, may appear when a warning condition arises, then disappear when conditions return to normal without interfering with the process.

Alarm words and warning word are shown on the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms is shown. Warning words and alarm word are displayed in parameters *16-90 Alarm Word* to *16-95 Ext. Status Word 2*. For more information on the individual alarms and warnings, refer to the Design Guide.

##### Warnings

All warnings within the frequency converter are represented by a single bit within a warning word. A warning word is always an action parameter. Bit status *[0] FALSE* means no warning, while bit status *[1] TRUE* means warning. Each bit status has a corresponding text string message. In addition to the warning word message the master will also be notified via a change to bit 7 in the status word.

##### Alarms

Following an alarm message the frequency converter enters a fault condition. Only after the fault has been rectified and the master has acknowledged the alarm message by setting bit 3 in the control word, can the frequency converter resume operation. All alarms within the frequency converter are represented by a single bit within an alarm word. An alarm word is always an action parameter. Bit status *[0] FALSE* means no alarm, while bit status *[1] TRUE* means alarm.

### 7.1.2 Alarm Words

Bit (Hex)	Alarm Word (16-90 Alarm Word)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
00000080	Motor thermistor over temp.
00000100	Motor ETR over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	Short circuit
00002000	
00004000	Mains phase loss
00008000	AMA not OK
00010000	Live zero error
00020000	Internal fault
00040000	
00080000	Motor phase U is missing
00100000	Motor phase V is missing
00200000	Motor phase W is missing
00800000	Control Voltage Fault
01000000	
02000000	VDD, supply low
04000000	Brake resistor short circuit
08000000	Brake chopper fault
10000000	DESAT Earth fault
20000000	Drive initialised
40000000	Safe Stop [A68]
80000000	

Table 7.1 16-90 Alarm Word

Bit (Hex)	Alarm Word 2 (16-91 Alarm Word 2)
00000001	
00000002	Reserved
00000004	Service Trip, Typecode / Sparepart
00000008	Reserved
00000010	Reserved
00000020	
00000040	
00000080	
00000100	Broken Belt
00000200	Not used
00000400	Not used
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans error
00080000	ECB error
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC 1 Safe Stop [A71]
80000000	Dangerous Failure [A72]

Table 7.2 16-91 Alarm Word 2

### 7.1.3 Warning Words

Bit (Hex)	Warning Word (16-92 Warning Word)
00000001	
00000002	Power card over temperature
00000004	Earth fault
00000008	
00000010	Control word timeout
00000020	Over current
00000040	
00000080	Motor thermistor over temp.
00000100	Motor ETR over temperature
00000200	Inverter overloaded
00000400	DC link under voltage
00000800	DC link over voltage
00001000	
00002000	
00004000	Mains phase loss
00008000	No motor
00010000	Live zero error
00020000	
00040000	
00080000	
00100000	
00200000	
00400000	
00800000	24V supply fault
01000000	
02000000	Current limit
04000000	
08000000	
10000000	
20000000	
40000000	Not used
80000000	Not used

Table 7.3 16-92 Warning Word

Bit (Hex)	Warning Word 2 (16-93 Warning Word 2)
00000001	
00000002	
00000004	
00000008	Reserved
00000010	Reserved
00000020	
00000040	
00000080	End of Curve
00000100	Broken Belt
00000200	Not used
00000400	Reserved
00000800	Reserved
00001000	Reserved
00002000	Reserved
00004000	Reserved
00008000	Reserved
00010000	Reserved
00020000	Not used
00040000	Fans warning
00080000	
00100000	Reserved
00200000	Reserved
00400000	Reserved
00800000	Reserved
01000000	Reserved
02000000	Reserved
04000000	Reserved
08000000	Reserved
10000000	Reserved
20000000	Reserved
40000000	PTC 1 Safe Stop [W71]
80000000	Reserved

Table 7.4 16-93 Warning Word 2



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