VARIABLE FREQUENCY DRIVE

USER MANUAL

IB0009

innergy tech

setting the standard
for energy recovery

innergytech.com

HEAT PIPES • PLATES
WHEELS • CORES

Révision 09

TABLE OF CONTENTS

ABOUT THIS MANUAL

This manual should be used as your main reference through the Installation, operation and maintenance of your new Variable Frenquency Drive (VFD).

By following the instructions listed in this document, years of economical and satisfactory operation will be obtained. Please read this manual thoroughly.

Please take note that this manual uses the following symbols to emphasize particular information:

WARNING: Identifies an instruction which, if not followed, might cause serious personal injuries including possibility of death.

CAUTION: Denotes an instruction which, if not followed, may severely damage the unit and/or its components.

NOTE: Indicates supplementary information needed to fully complete an instruction.

If more information is needed, please contact your local Innergy tech Sales Representative or the Innergy tech Service Department.

For more information:

Innergy tech inc.
605 Rocheleau
Drummondville,
Québec, Canada, J2C 6L8

Canada 819-475-2666
Canada/USA 1-800-203-9015
Fax 819-475-9541
Visit our website! www.innergytech.com
For info: sales@innergytech.com

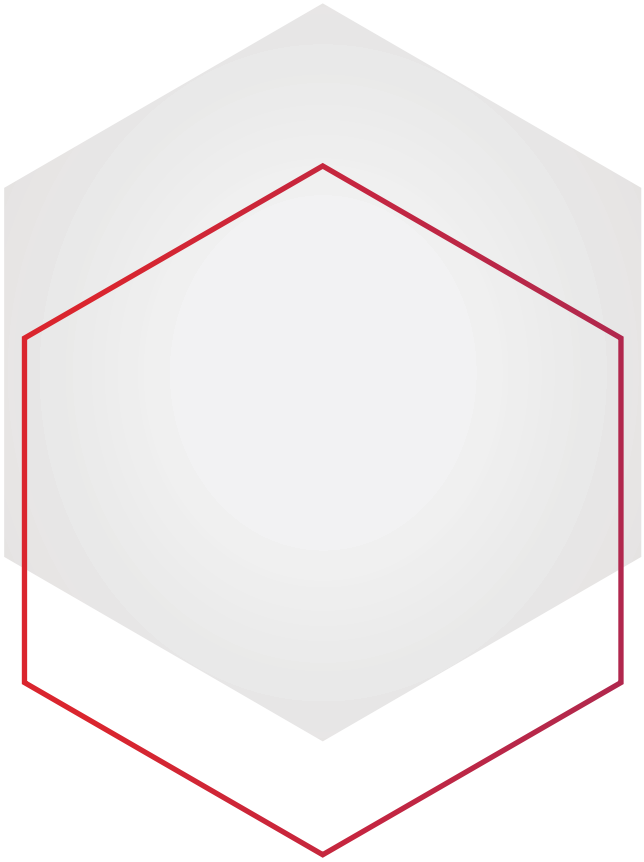
1. UNIT DESCRIPTION

The A1000 VFD Controller package from Innergy tech is designed to provide full energy recovery wheel control for the HVAC industry.

Unlike other controllers which rely on a separate variable frequency drive and controller, the A1000 VFD Controller package benefits from the extensive Yaskawa A1000 programming capacity to eliminate the need of a separate controller entirely. The drive and controller are therefore united and form an ''intelligent'' drive system.

By using a total of four 0-10 Volts analog temperature sensors located in the outdoor air (TEMP1), supplied air (TEMP2), return air (TEMP3) and exhaust air (TEMP4) streams, the A1000 VFD Controller package will regulate the speed of the energy recovery wheel for full frost control and free-cooling (with summer changeover) operations. Wheel rotation speed will vary proportionally with the VFD's frequency variation from its maximum speed of 20 RPM (60 Hz input) to its minimum speed of 1/4 RPM (0.75 Hz input). This 80:1 speed ratio results in total capacity control (0 to 100%) of the energy recovery wheel.

The drive package is fully compatible with Building Management Systems (BMS) with default S-422/485 MEMOBUS/Modbus or optional BACnet or Lonworks communication protocols. An induction rotation sensor is also available as a separate option to monitor wheel rotation speed and send an alarm signal in case of rotor failure.



2. VFD TERMINOLOGY

A1000 - X - YY - M - O - N1

VOLTAGE	
208 - 230V	2
460V	4
575V	6
HP	
1/3 HP	13
1/2 HP	12
3/4 HP	11
1 HP	10
CONNECTION PROTOCOL	
STANDARD (MODBUS)	M
BACNET	B
LONWORKS	L
ROTATION DETECTION	
NO ROTATION DETECTION (STANDARD)	0
ROTATION DETECTION	1
ENCLOSURE	
NEMA 1 (STANDARD)	N1
NEMA 12	N12
NEMA 3R	N3R
NEMA 3R (WITH HEATER)	N3RH

IR0010

Figure 1

3. SEQUENCE OF OPERATION

COOLING MODE: When outdoor air temperature (TEMP1) is greater than the return air temperature (TEMP3), the wheel operates in cooling mode at its full effectiveness and maximum speed of 20 RPM.

FROST CONTROL MODE: When the exhaust air temperature (TEMP4) reaches the frost control setpoint (default 34°F), the wheel's speed is modulated in order to avoid ice formation within the wheel's media.

FREE COOLING (ECONOMIZER) MODE: When outdoor air temperature (TEMP1) is lower than the return air temperature (TEMP3) but supplied air temperature (TEMP2) reaches the free cooling setpoint (default 60°F), the wheel's speed is modulated in order to prevent the supplied air (TEMP2) from exceeding the free cooling setpoint.

HEATING MODE: When outdoor air temperature(TEMP1) is lower than the return air temperature (TEMP3); when the exhaust air temperature (TEMP4) is above the frost setpoint (default 34°F) and supplied air temperature (TEMP2) is below the free cooling setpoint (default 60°F), the wheel operates in heating mode at its full effectiveness and maximum speed of 20 RPM.

Innergy tech A1000 VFD flow chart

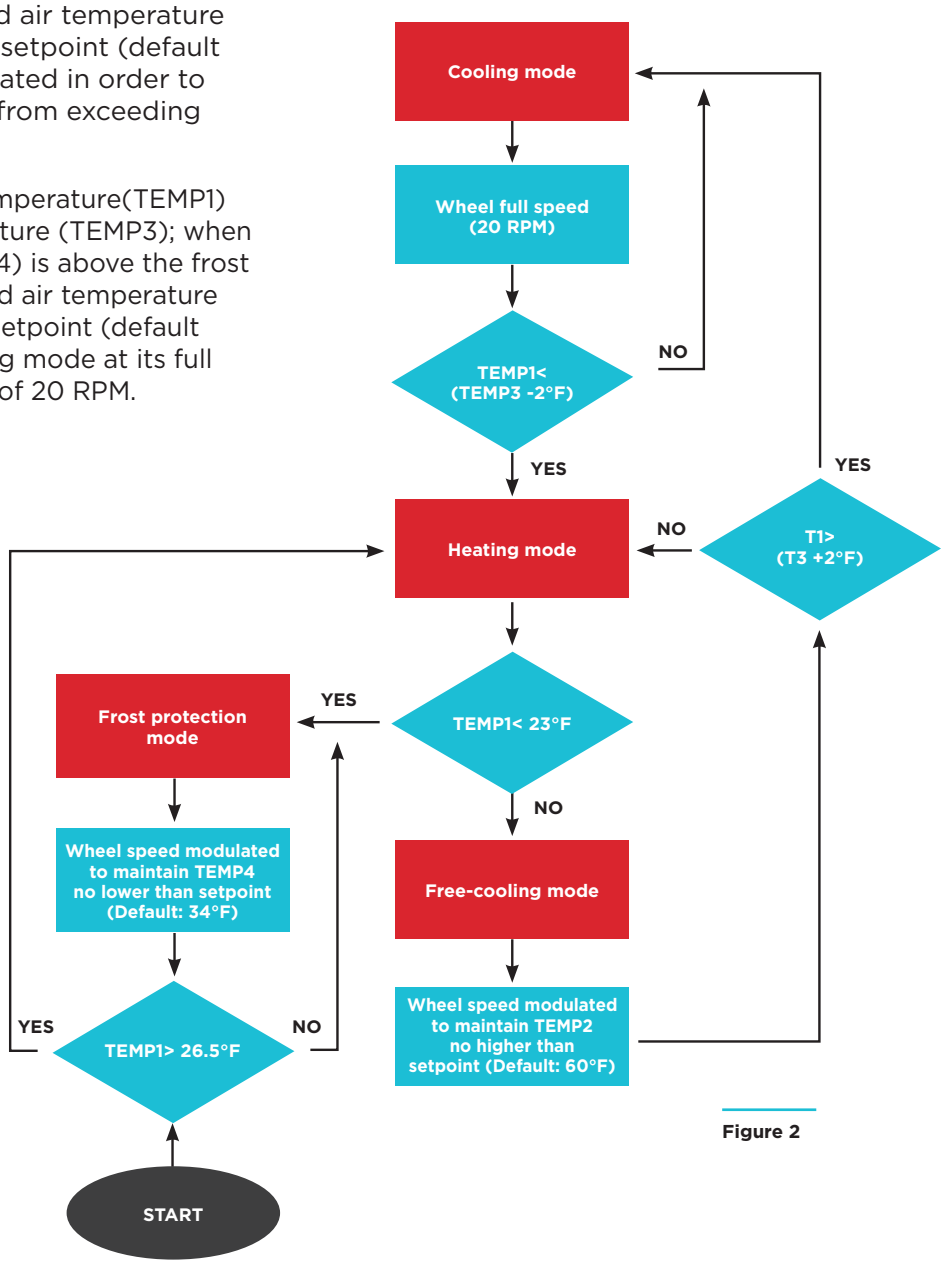


Figure 2

Note: Frost control and free cooling setpoints can be changed to suit specific projects.

4. ROTATION DETECTION

4.1 Optional rotation sensor

As a separate option, our VFD controller package can be equipped with an induction rotation sensor (no magnet on rotor necessary). This rotation sensor detects if the rotor is turning and if not, sends an error signal (Modbus = 1B19h, Bit no. 5) to the BMS.

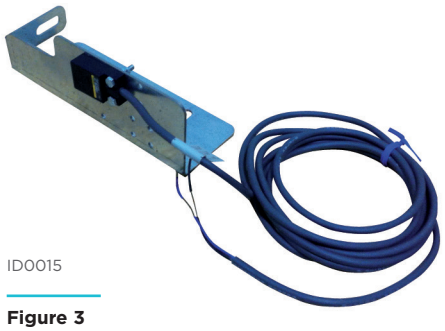


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Figure 3

Note: The rotation sensor will send an alarm signal if the wheel is stopped through the remote start/ stop command.

4.2 Rotation sensor installation

First step:
Make sure the sensor is installed using the correct set of holes for your wheel's diameter. Default location is the 48 to 62 diameter location as shown.

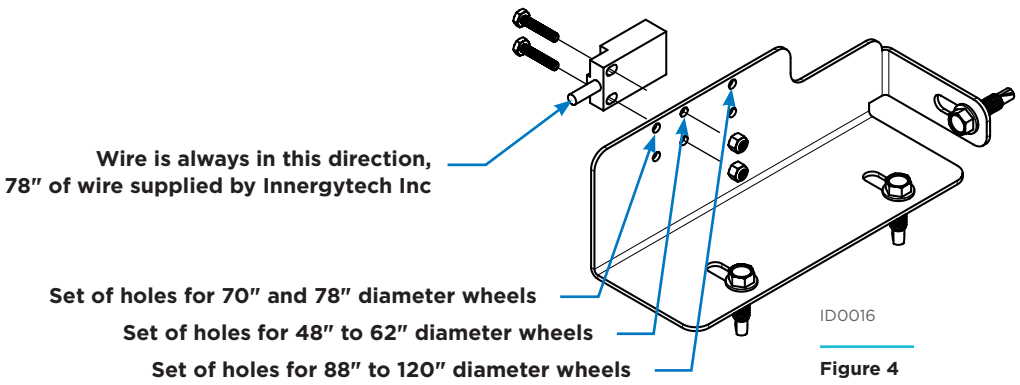

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Figure 4

Note: Different configuration may call for different installation location; installing the bracket in different quadrant might be necessary.

4. ROTATION DETECTION (CONT'D)

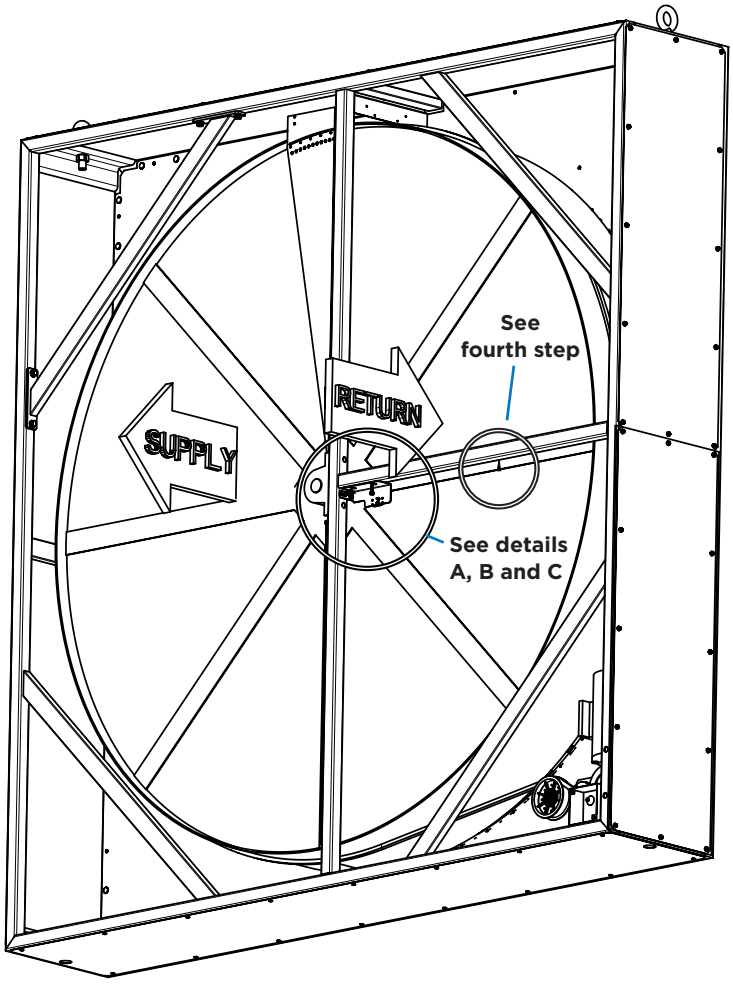
4.2 Rotation sensor installation (cont'd)

Second step:
With the sensor installed in its correct location on the bracket, install the bracket as shown (details a and B, below) using the suplied self tapping screws (do not screw the bracket completely yet).

Third step:
Based on the stainless steel rivets of the center plate, adjust the sensor's distance as shown on detail C (below). For the sensor to work properly, the distance between the sensor and the rivets should not exceed 1/8".

Fourth step:
Using the supplied tie wrap, firmly attach the wire to the steel tubing as illustrated below in **figure 5** to avoid any contact with the rotor.

Fifth step:
With the bracket's three screws now tightened completely and the wire correctly attached to the wheel frame, slowly turn the wheel by hand to make sure neither the sensor nor the wire touch the rotor.



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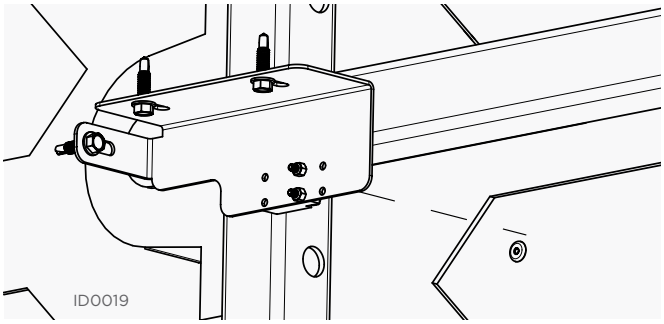
DETAIL A



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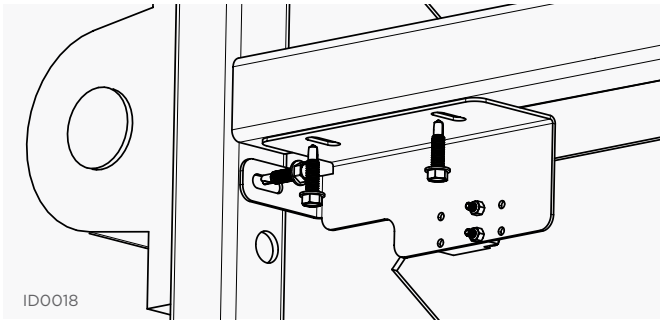
DETAIL B



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DETAIL C

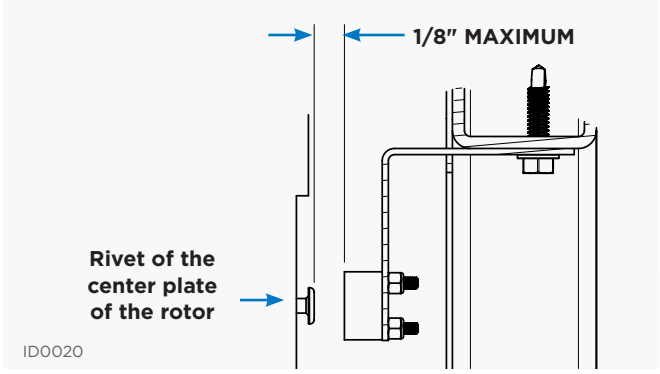

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Figure 5

5. TEMPERATURE SENSORS

5.1 General considerations

The standard temperature sensors provided with the VFD are 1/4" diameter stainless steel probes. They provide an analog output linear proportional to the calibrated temperature range. Signal conditioning is performed by industrial quality factory calibrated integrated circuits to provide a true linear output. For VFD packages ordered separately, the temperature sensors are shipped loose for field installation (please refer to our sensor installaton guide document for further details). For VFD packages ordered with our energy recovery wheels, all sensors will be pre-installed on the wheel in their correct locations as shown in figure 6.

5.2 VFD kits ordered with your Innergy tech energy recovery wheel

For all VFD packages ordered with an energy recovery wheel, the four temperature sensors as well as rotation sensor (when the option is selected) will already be fully installed on the wheel and linked to the sensor junction box (figure 6).

Installation steps:

1. Connect the male Amp connector to the wheel sensors junction box.

2. Run the 50ft of wire to the VFD terminal board (if the provided 50ft of wire is not enough, a junction can be made and the wire lengthen for up to 300ft without affecting the signal. Note that an 8 strands, 18 Gauge wire is required).

3. Final connections at the main terminal board should be made following the wiring diagram of section 11.1.

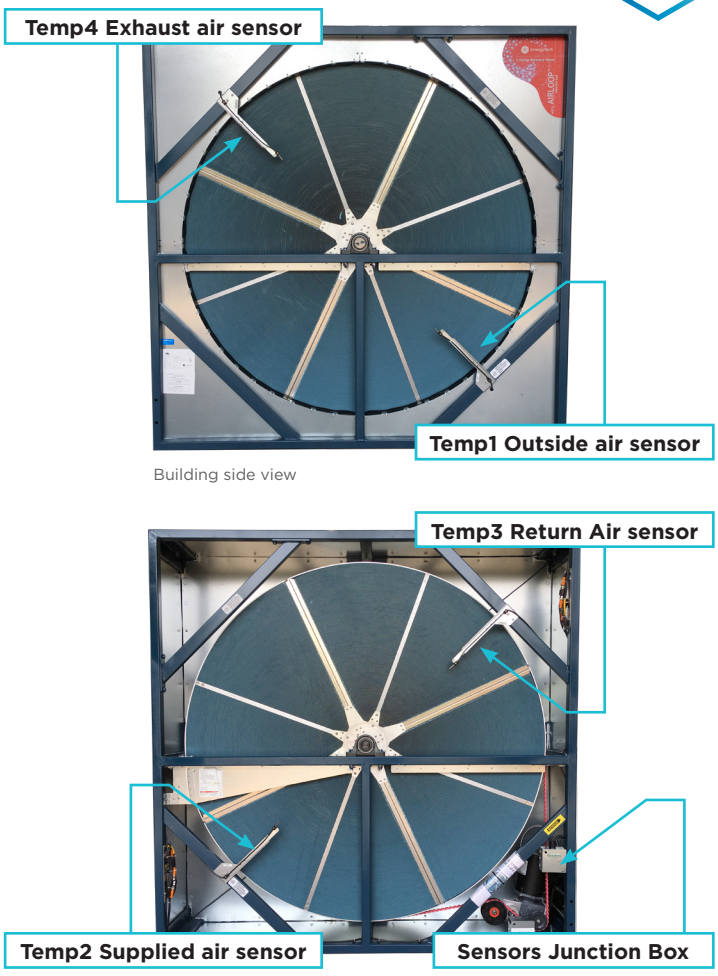


Figure 6

Note: Configuration #3 shown. Please note that sensor locations will vary based on your wheel configuration.

Note: Please refer to your specific wheel drawing for exact sensor locations. With all configurations, Temp1 sensor will always be installed in the Outside air stream, Temp2 sensor in the Supplied air stream, Temp 3 sensor in the Return air stream and Temp4 sensor in the Exhaust air stream.

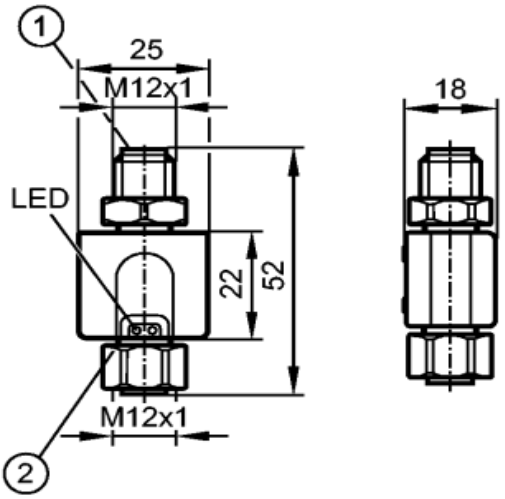
5.3 VFD kits ordered separately

For VFD kits ordered separately, the VFD package, sensors and all required hardware will be shipped loose for field installation by the customer. Please follow the supplied sensor installation guide carefully to complete the installation. Contact the Innergy tech sales team for any questions (sales@innergytech.com, 1-800-203-9015).

5. TEMPERATURE SENSORS (CONT'D)

5.4 Connections

Brand:	Efector600
Model:	**TP9237 (Converter for temperature sensors)**
Analog Output:	0-10V ; Rmin: 2000 ff
Measuring range:	-58°F to 572°F (-50°C to 300°C)
Innergy tech factory setting:	-40°F to 122°F (-40°C to 50°C)
Analog output accuracy:	+/- 0.3K + (+/- 0.1% MS)
Electrical design:	DC
Operating voltage:	18-32 DC
Protection class:	III
Reverse polarity protection:	yes
Short-circuit protection:	yes (non-latching)
Overload protection:	yes
Power-on delay time:	1s
Measuring/display cycle:	100ms
Storage temperature:	-40°F to 185°F (-40°C to 85°C)
Protection:	IP67
Connection:	M12 connector; gold-plated contacts



1: connection for voltage supply and output signals
2: connection for temperature sensor

Figure 7

Brand:	Efector600
Model:	**TS2269 (Temperature Sensor)**
Measuring probe:	Ø 6 mm
Measuring range:	-40°F to 194°F (-40°C to 90°C)
Measuring element:	1 x Pt 1000, to DIN EN60751, Class A
Application:	Liquids and gases
Probe material:	316L SS
Minimum installation depth (mm):	15
Protection class:	III
Accuracy:	+/- 0.15K + (+/- 0.002 x Itl)
Connection:	PUR cable / 2m; M12 connector; gold-plated contacts

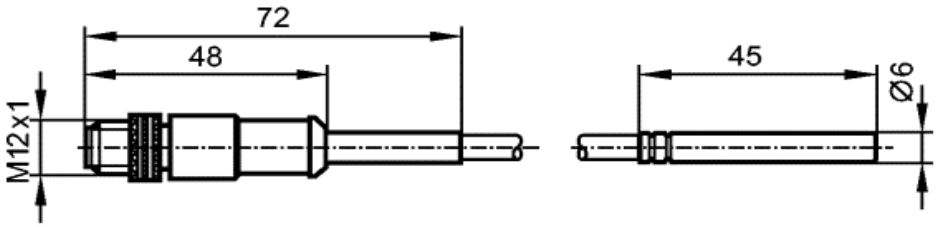


Figure 8

6. INSTALLATION SPECIFICATIONS

6.1 Installation environment

Install the drive in an environment matching the specifications below to help prolong its optimum performance life.

ENVIRONMENT CONDITIONS	CONDITIONS
Installation Area	**Indoors**
Ambient temperature	14°F (-10°C) to 104°F (40°C) (IP20/NEMA Type 1 enclosure) -40°F (-40°C) to 104°F (40°C) (IP14/NEMA Type 3R with Heater Enclosure) Drive reliability improves in environments without wide temperature fluctuations. When using the drive in an enclosure panel, install a cooling fan or air conditioner in the area to ensure that the air temperature inside the enclosure does not exceed the specified levels. Do not allow ice to develop on the drive.
Humidity	95% RH or less and free of condensation
Storage temperature	-4°F (-20°C) to 140°F (60°C)
Surrounding area	Install the drive in an area free from: • Oil mist and dust • Metal shavings, oil, water, or other foreign materials • Radioactive materials • Combustible materials (e.g., wood) • Harmful gases and liquids • Excessive vibration • Chlorides • Direct sunlight
Altitude	1000 m or lower, up to 3000 m with derating
Vibration	10 to 20 Hz at 9.8 m/s^2* 20 to 55 Hz at 5.9 m/s^2 (Models CIMR-AU2A0004 to 2A0211, 4A0002 to 4A0165, and 5A0003 to 5A0099) or 2.0 m/s^2 (Models CIMR-AU2A0250 to 2A0415, 4A0208 to 4A1200, and 5A0125 to 5A0242)
Orientation	Install the drive vertically to maintain maximum cooling effects

* Models CIMR-AU4A0930 and 4A1200 are rated at 5.9 m/s2.

Notes: **1. Avoid placing drive peripheral devices, transformers, or other electronics near the drive as the noise created can lead to erroneous operation. If such devices must be used in close proximity to the drive, take proper steps to shield the drive from noise.**

2. Prevent foreign matter such as metal shavings and wire clippings from falling into the drive during installation. Failure to comply could result in damage to the drive. Place a temporary cover over the top of the drive during installation. Remove the temporary cover before drive start-up, as the cover will reduce ventilation and cause the drive to overheat.

6. INSTALLATION SPECIFICATIONS

6.2 A1000 package drive specifications

Yaskawa model	Voltage	Phase	Hertz	Max moto HP	Drive MAX AMPS
CIMR-AU2A0008FAA	208-230	3	60	1	5,1
CIMR-AU4A0007FAA	460	3	60	1	2,6
CIMR-AU5A0004FAA	600	3	60	0.75	1,8

6.3 Local mode jumper

Your new Yaskawa A1000 VFD package comes with a local jumper that should be installed between the S1 and +24 terminals when using the local mode of the drive (as shown at right). Note that the drive **WILL NOT WORK** in local mode if this jumper is not installed.

This jumper **SHOULD NOT BE INSTALLED** if using the drive in remote mode (when wiring the drive to a building management system). Instead, a dry contact relay should be installed and may be used for the drive remote start/stop feature.

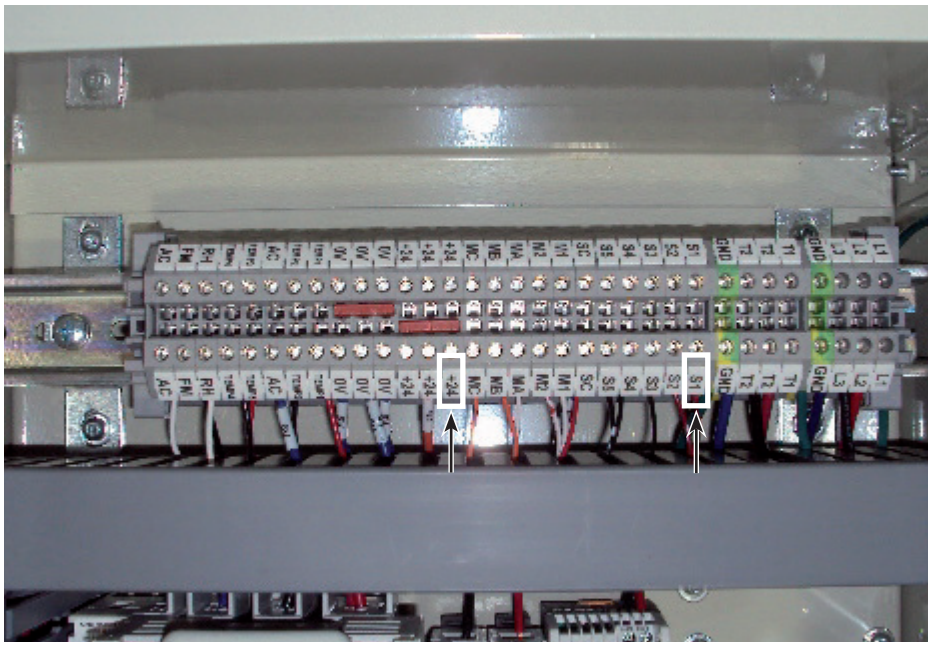


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Figure 9

6. INSTALLATION SPECIFICATIONS (CONT'D)

6.4 VFD Dimensions

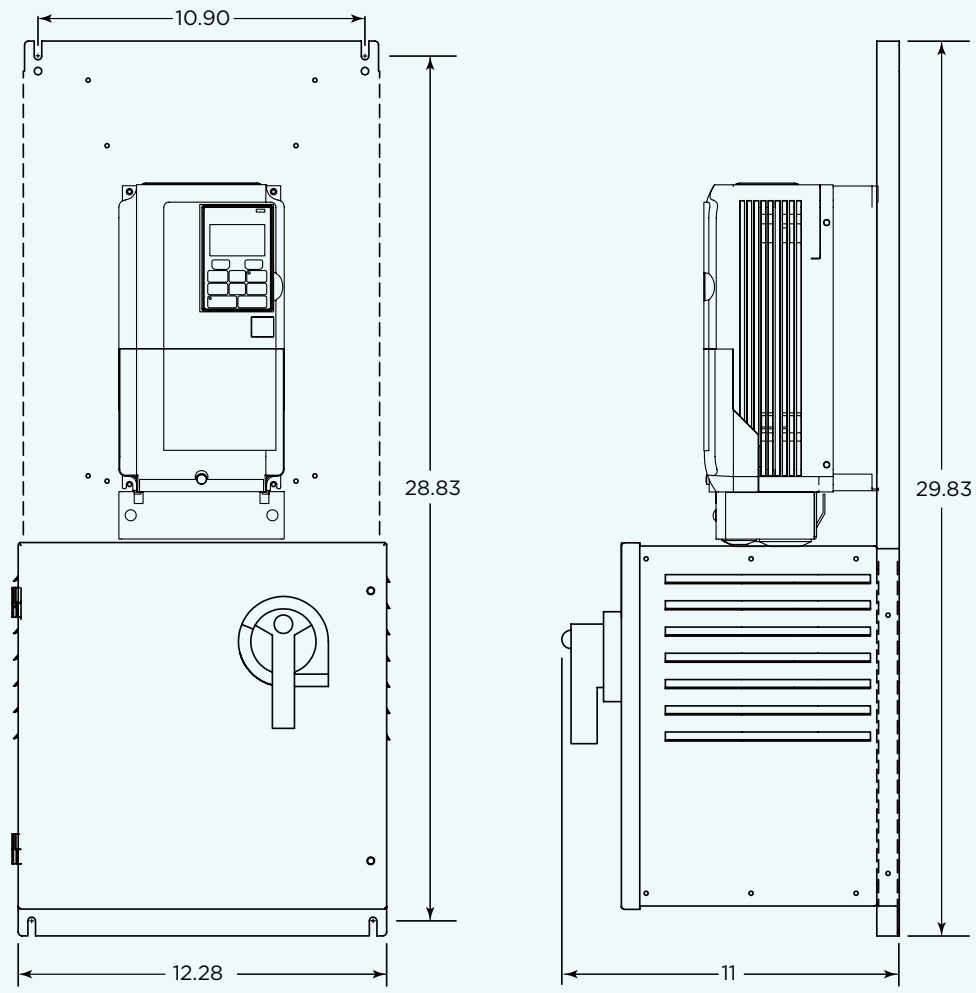

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Figure 10
(NEMA 1 Enclosure shown)

Note: **Dimensions shown are in inches.**

7. MOTORS AND INPUT CURRENTS

Our A1000 VFD Controller package was designed for our I3 energy recovery wheel standard motors but should work with all inverter duty motors of 1/3HP to 1HP, 208/230/460 or 575 volts and 3 phases input currents.

240 volts, 1 phase current can also be transferred by the VFD package into 208 volts, 3 phases current. Please contact Innergy tech's technical sales team for any questions or other input currents.

IMPORTANT: Note that a motor inverter constant of at least 1000:1 is needed in order to ensure equal torque values for all rotation speeds.

8. VFD CONTROLLER REGISTER GUIDE

VFD CONTROLLER OUTPUTS					
Description	**Input**	**Modbus**		**A1000 Drive**	
		Register no.	**Units**	**LCD screen field**	**Units**
Temperature of outdoor air entering enthalpy wheel (TEMP1)[1]	0-10 Volts	4Eh	0.1%	U1-13	1%
Temperature of supply air leaving enthalpy wheel (TEMP2)[1]	0-10 Volts	50h	0.1%	U1-15	1%
Temperature of return air entering enthalpy wheel (TEMP3)[1]	0-10 Volts	77h	0.1%	U1-21	1%
Temperature of exhaust air leaving enthalpy wheel (TEMP4)[1]	0-10 Volts	72Ah	0.1%	U1-22	1%
Speed of the wheel [2]	0-10 Volts	41h	0.01Hz	U1-02	1Hz
TEMP1 Sensor alarm field (sensor incorrectly wired or defective)	N/A	1B19h, Bit no. 1	N/A	Will be displayed automatically	N/A
TEMP2 Sensor alarm field (sensor incorrectly wired or defective)	N/A	1B19h, Bit no. 2	N/A	Will be displayed automatically	N/A
TEMP 3 Sensor alarm field (sensor incorrectly wired or defective)	N/A	1B19h, Bit no. 3	N/A	Will be displayed automatically	N/A
TEMP 4 Sensor alarm field (sensor incorrectly wired or defective)	N/A	1B19h, Bit no. 4	N/A	Will be displayed automatically	N/A
Rotation sensor alarm field (wheel still)	N/A	1B19h, Bit no. 5	N/A	Will be displayed automatically	N/A

[1] All temperatures are expressed as a percentage of the voltage input. To convert voltage input to temperature, see section 10.1

[2] Speed is expressed in hertz. To convert hertz to RPM, see section 10.2

CUSTOMER FREE COOLING/ECONOMISER SETPOINT						
Description	**Input**	**Factory setting**	**Modbus**		**A1000 Drive**	
			register no.	**Unit**	**LCD screen field**	**Unit**
Free cooling / Economiser supply air temperature (V)[1]	0-10 Volts	6.12 (60°F)	1601h	0.01V	Q1-02	1V

[3] To convert voltage input to temperature and vice versa, see section 10.1 On A1000 Display, default display is in percentage, however value is in volt.

8. VFD CONTROLLER REGISTER GUIDE (CONT'D)

OTHER VFD CONTROLLER INPUTS						
Description	**Input**	**Default setting**	**Modbus**		**A1000 Drive**	
			Register no.	**Unit**	**LCD screen field**	**Unit**
Remote start / stop command	N/A	1 (on) or 0 (off)[4]	1B09h, Bit no. 0	N/A	None, use main switch	N/A
Frost prevention exhaust air (TEMP 4) temperature setpoint [1, 3]	0-10 Volts	4.56 (34°F)	1600h[5]	0.01V	Q1-01	1V
Low temperature sensor alarm setpoint[1]	0-10 Volts	0.1 (-38.4°F)	1606h[5]	0.01V	Q1-07	1V

[4] To convert voltage input to temperature and vice versa see section 10.1 On A1000 Display, default display is in percentage, however value is in volt.

[5] CAUTION: Frost damage may occur, please contact Innergy tech Technical support before changing this value.

[6] Remote start/stop feature is also possible using a dry contact (jumper needed between S1 and + 24 terminals).

[7] After changing these values via Modbus, the user must send the value 0 to the Modus registry 900h (ENTER command).

ENTHALPY WHEEL MANUAL CONTROL					
Step 1: Install Jumper between S1 and +24V. Step 2: Install Jumper between S2 and +24V. Step 3: Call customer service (1-800-203-9015) to obtain password 1 Step 4: In programmning mode, on the drive LCD screen, set the parameter H5-11 to one ([1]).					
Customized Enthalpy Wheel Speed	**Input**	**Modbus**		**A1000 Drive**	
		Register no.	**Units**	**LCD screen field**	**Units**
Password needed, as well as jumper (between S2 and +24V)	Ask Innergy tech Technical support	1605h	0.01%	Q1-06	1%
Manual enthalpy wheel speed setting [2]	0-10 Volts	1607h	0.1% of 0-60Hz	Q1-08	1% of 0-60Hz

All values given by the VFD controller are in hexadecimal units.

All temperatures are expressed as a percentage of the voltage input on Modbus and A1000 LCD displays.

[1] Manual speed control will give you direct control over the rotation speed of the wheel and disable the Innergy tech built-in program.Innergy tech will not be responsible for any damage resulting from an improper frost control sequence.

[2] All speeds are expressed as a percentage. See section 10.2 for wheel speed conversion.

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.1 Introduction

The SI-B3 BACnet option card for Yaskawa AC Drive A1000 is a separate option available when BACnet communication protocol is required. This section covers its installation and effect on the drive parameters.

The SI-B3 BACnet option card is used to connect A1000 drives to a BACnet network and facilitates the exchange of data. The SI-B3 BACnet option card is a simple, Networking solution that reduces the cost and time to wire and install factory automation devices, while providing interchangeability between components from multiple suppliers.

Drives can be monitored and controlled by a controller on a Building Automation and Control network (BACnet) using RS-485 technology and MS/TP (Master-Slave/Token Passing) protocol. The A1000 drive with the SI-B3 BACnet option card conforms to the BACnet application specific controller (B-ASC) device profile.

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.2 Installation

WARNING: Do not connect or disconnect wiring while the power is on. Failure to comply will result in death or serious injury. Before installing the option, disconnect all power to the drive. The internal capacitor remains charged even after the power supply is turned off. The charge indicator LED will extinguish when the DC bus voltage is below 50 Vdc. To prevent electric shock, wait at least five minutes after all indicators are off and measure the DC bus voltage level to confirm safe level.

CAUTION: Observe proper electrostatic discharge procedures (ESD) when handling the option, drive, and circuit boards. Failure to comply may result in ESD damage to circuitry.

1. Remove front cover and digital operator

Shut off power to the drive, wait the appropriate amount of time for voltage to dissipate, then remove the digital operator and front cover.

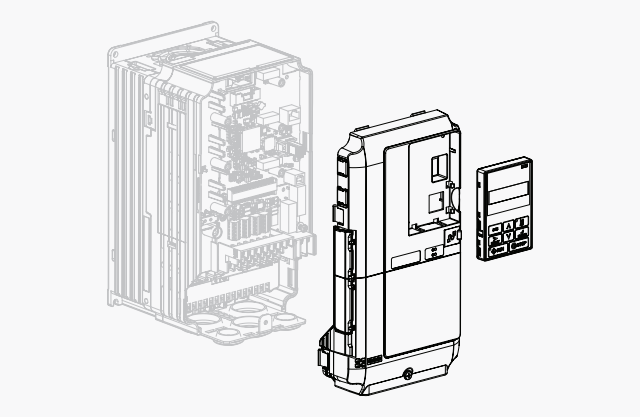

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Figure 11

2. Connect option and ground wire

Insert the option into the CN5-A connector located on the drive and secure it using one included screw. Connect the ground wire to the ground terminal using one of the remaining provided screw, then connect the other end to the remaining ground terminal and installation hole using the last included screw.

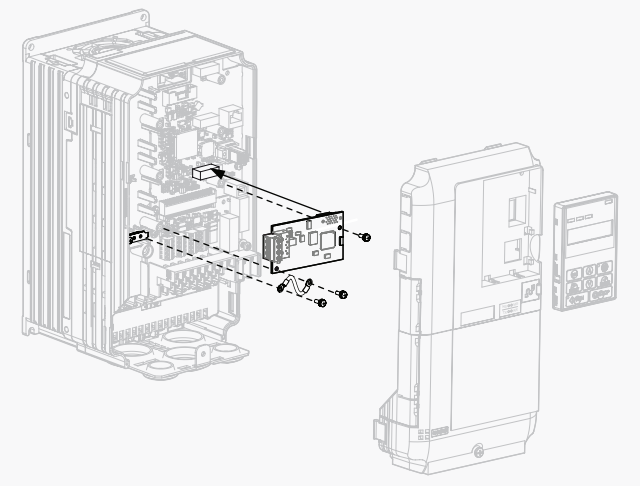

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Figure 12

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.2 Installation (cont'd)

3. Wire the option

Route the option wiring

The VFD require routing the wiring through the side of the front cover to the outside to provide adequate space for the wiring. Using diagonal cutting pliers, cut out the perforated openings on the left side of the VFD front cover. Sharp edges along the cut out should be smoothed down with a file or sand paper to prevent any damage to the wires.

Option connection

Connect the BACnet communication cables to the option modular connector terminal block (TB1).

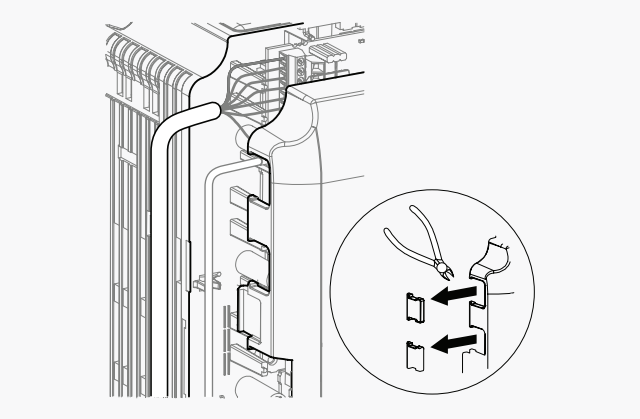

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Figure 13

Note: Separate the communications cables from the main circuit cables and other wiring and power cables. Use properly grounded shielded cables for the communication cables to prevent problems caused by electrical interference.

4. Reinstall front cover and digital operator

Once the front cover and digital operator completely reinstalled, restore power to the drive.

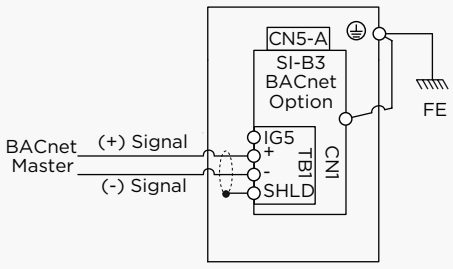

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Figure 14

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.3 Adapting VFD parameters to BACnet card

The following parameters are used to set up the drive for operation with the option. Parameter setting instructions can be found in the drive Quick Start Guide or Technical Manual.

Confirm proper setting of the all parameters in table below before starting network communications. After changing parameter settings, cycle power to the drive for the new settings to take effect.

NO.	NAME	DESCRIPTION	VALUES
b1-01 [1]	Frequency Reference Selection	Selects the frequency reference input source. 0: Operator - Digital preset speed d1-01 to d1-17 1: Terminals - Analog input terminal A1 or A2 2: MEMOBUS/Modbus communications 3: Option PCB 4: Pulse Input (Terminal RP)	Default: 1 Range: 0 to 4 (Set to 3 for BACnet)
b1-02 [1]	Run Command Selection	Selects the run command input source. 0: Digital Operator - RUN and STOP keys 1: Digital input terminals S1 to S7 2: MEMOBUS/Modbus communications 3: Option PCB	Default: 1 Range: 0 to 3 (Set to 3 for BACnet)
F6-45	Drive Node Address	Sets the BACnet MS/TP MAC address (physical node address).	Default: 1 Range: 0 to 127
F6-46	Communication Speed Selection	Sets the communication speed. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps 5: 38400 bps 6: 57600 bps 7: 76800 bps 8: 115200 bps	Default: 3 Range: 0 to 8
F6-47	Drive Transmit Wait Time	Sets the time the drive waits after receiving data from a master before transmitting response data.	Default: 5 ms Range: 5 to 65
F6-48 [2]	BACnet Device Object Identifier 0	Set the Instance Identifier of the BACnet Device Object, where the F6-48 value is the least significant word.	Default: 1 Range: 0 to FFFFH
F6-49 [2]	BACnet Device Object Identifier 1	Set the Instance Identifier of the BACnet Device Object, where the F6-49 value is the most significant word.	Default: 0 Range: 0 to 3FH

[1] To start and stop the drive with the option master device using serial communications, set b1-02 to 3. To control the drive frequency reference via the master device, set b1-01 to 3.

[2] These parameters set the Instance Identifier of the BACnet Device Object, where the F6-48 value is the least significant word and the F6-49 value is the most significant word.

Example 1: Set the Device Object Instance Identifier of "1234". 1234 decimal is equal to 4D2H (hexadecimal). Set F6-48 to 4D2H and F6-49 to 0.

Example 2: Set Device Object Instance Identifier to «1234567». 1234567 decimal is equal to 12D687H (hexadecimal). Set F6-48 to D687H and F6-49 to 12H.

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.4 BACnet communication protocol register guide

For all Modbus registers below, to read and edit data using BACnet communication protocol, follow these steps:

To read data:

1. Access BACnet register no. AV29; select "Write" in the drop-down list; input Modbus register no. corresponding to the value you wish to edit (register number is in decimals, see table below)

2. Access BACnet register no. AV30; select "Get" in the drop-down list

To input data:

1. Access BACnet register no. AV29; select "Write" in the drop-down list; input Modbus register no. corresponding to the value you wish to edit (register number is in decimals, see table below)

2. Access BACnet register no. AV30; select "Write" in the drop-down list; input value.

3. Access BACnet register no. BV56; select "On" in the drop-down list.

Alternatively, some Modbus registers can be accessed using specific BACnet registers, as listed in the table below:

VFD CONTROLLER OUTPUTS						
Description	Input	Modbus		BACnet		
		Register no.	Units	Register no.	Units	Alarm code [3]
Temperature of outdoor air entering enthalpy wheel (TEMP1)[1]	0-10 Volts	78	0.1%	AI1	1%	N.A.
Temperature of supply air leaving enthalpy wheel (TEMP2)[1]	0-10 Volts	80	0.1%	AI3	1%	N.A.
Temperature of return air entering enthalpy wheel (TEMP3)[1]	0-10 Volts	119	0.1%	See instructions above	0.1%	N.A.
Temperature of exhaust air leaving enthalpy wheel (TEMP4)[1]	0-10 Volts	1834	0.1%	See instructions above	0.1%	N.A.
Speed of the wheel [2]	0-10 Volts	65	0.01Hz	AV10	1 Hz	N.A.
TEMP1 Sensor alarm field (sensor incorrectly wired or defective)	N/A	6937	N/A	See instructions above	N.A.	1
TEMP2 Sensor alarm field (sensor incorrectly wired or defective)	N/A	6937	N/A	See instructions above	N.A.	2
TEMP 3 Sensor alarm field (sensor incorrectly wired or defective)	N/A	6937	N/A	See instructions above	N.A.	4
TEMP 4 Sensor alarm field (sensor incorrectly wired or defective)	N/A	6937	N/A	See instructions above	N.A.	8
Rotation sensor alarm field (wheel still)	N/A	6937	N/A	See instructions above	N.A.	16

[1] All temperatures are expressed as a percentage of the voltage input on Modbus and A1000 LCD displays. To convert voltage input to temperature, see section 10.1 Divide value displayed in Modbus by 10 to obtain percentage.

[2] Speed is expressed in hertz. To convert hertz to RPM, see section 10.2

[3] If alarm code is not listed in table, more than one sensor may be defective. Call Innergy tech customer service for details.

9. BACNET MS/TP COMMUNICATION PROTOCOL (OPTIONAL)

9.4 BACnet communication protocol register guide (cont'd)

CUSTOMER FREE COOLING/ECONOMISER SETPOINT						
Description	**Input**	**Factory setting**	**Modbus**		**BACnet**	
			Register no.	**Unit**	**Register no.**	**Unit**
Free cooling / Economiser supply air temperature (V)[1]	0-10 Volts	6.12 (60°F)	5633	0.01V	see instructions above	0.01V

[1] To convert voltage input to temperature and vice versa, see section 10.1

OTHER VFD CONTROLLER INPUTS						
Description	**Input**	**Default setting**	**Modbus**		**BACnet**	
			Register no.	**Unit**	**Register no.**	**Unit**
Remote start / stop command	N/A	1 (on) or 0 (off)[4]	6921	N/A	see instructions above	N/A
Frost prevention exhaust air (TEMP 4) temperature setpoint [1, 3]	0-10 Volts	4.56 (34°F)	5632	0.01V	see instructions above	0.01V
Low temperature sensor alarm setpoint[1]	0-10 Volts	0.1 (-38.4°F)	5638	0.01V	see instructions above	0.1V

[2] To convert voltage input to temperature and vice versa see section 10.1 On A1000 Display, default display is in percentage, however value is in volt.

[3] CAUTION: Frost damage may occur, please contact Innergy tech customer service before changing this value.

[4] Remote start/stop feature is also possible using a dry contact (jumper needed between S1 and + 24 terminals).

ENTHALPY WHEEL MANUAL CONTROL					
Step 1: Install Jumper between S1 and +24V. Step 2: Install Jumper between S2 and +24V. Step 3: Call customer service (1-800-203-9015) to obtain password[5]. Step 4: In programming mode, on the drive LCD screen, set the parameter H5-11 to one (1).					
Customized Enthalpy Wheel Speed	**Input**	**Modbus**		**BACnet**	
		Register no.	**Units**	**Register no.**	**Units**
Password needed, as well as jumper (between S2 and +24V)	Ask Innergy tech customer service	5637	0.01%	see instructions above	1%
Manual enthalpy wheel speed setting [6]	0-10 Volts	5639	0.1% of 0-60Hz	see instructions above	0.1% of 0-60Hz

All temperatures are expressed as a percentage of the voltage input on Modbus and BACnet displays.

[5] Manual speed control will give you direct control over the rotation speed of the wheel and disable the Innergy tech built-in program. Innergy tech will not be responsible for any damage resulting from an improper frost control sequence.

[6] All speeds are expressed as a percentage. See section 10.2 for wheel speed conversion.

10. INNERGY TECH VFD CONTROLLER SOFTWARE

10.1 Temperature conversion

Innergy tech VFD controller software uses a voltage scale for its temperature parameters. This means that the output values read are in Volts and not in Fahrenheit. This is also true for the input value (supply air temperature). Hence, be careful when writing the requested value into the appropriate VFD register. Since the temperature sensors coming with your VFD controller are ranging from -40°F to 122°F, the conversion must be as shown below.

	RANGE	
	Min.	Max.
VFD Controller Software	0 V	10 V
↓	↓	↓
Temperature Sensor	-40°F	122°F

From this matrix, we can propose the following formula to convert temperature into voltage and the opposite:

V = 0.0617 T + 2.47 and T = (V - 2.47)/0.0617

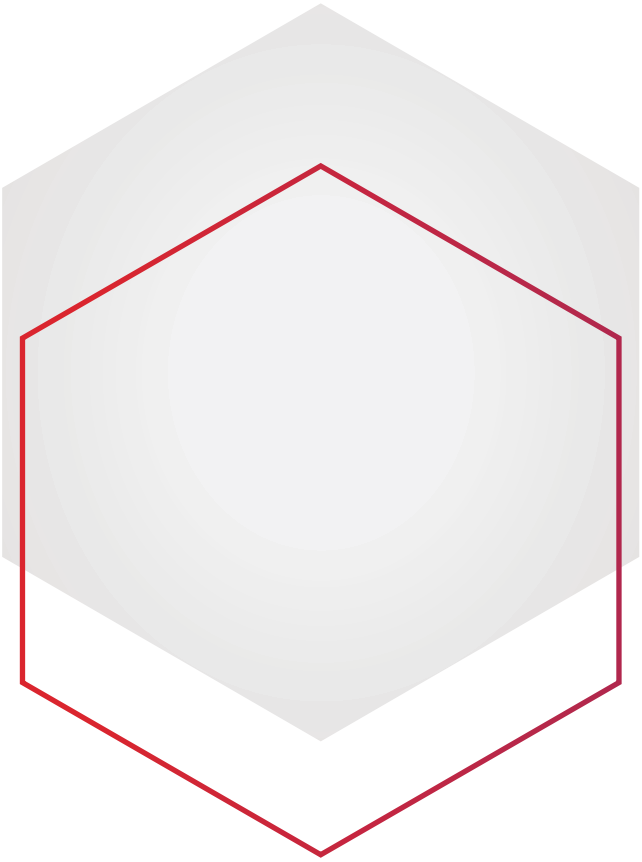
Where V: Voltage used in software

T: Temperature equivalent (°F)

10.2 Wheel speed conversion

The software running inside the VFD controller is using a percentage scale to settle the drive frequency output. This frequency is directly related to the wheel speed as shown in the matrix below.

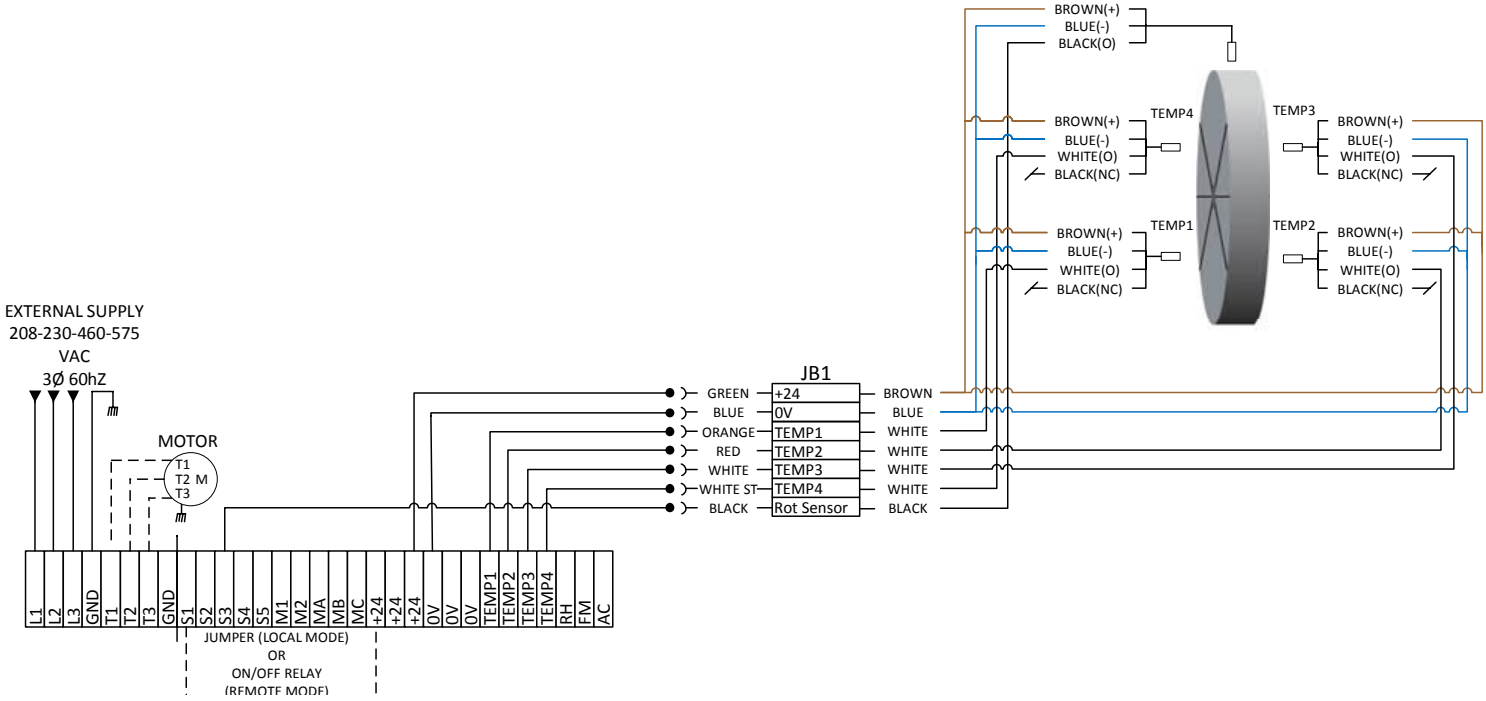
	RANGE	
	Min.	Max.
VFD Controller Software	1.25%	100%
↓	↓	↓
Frequency	0.75 Hz	60 Hz
↓	↓	↓
Wheel RPM	0.25 RPM	20 RPM



11. WIRING DIAGRAMS

11.1 Drive to wheel connections

WARNING: Electrical connections must be performed only by qualified personnel, and comply with all local and national codes and ordinances.

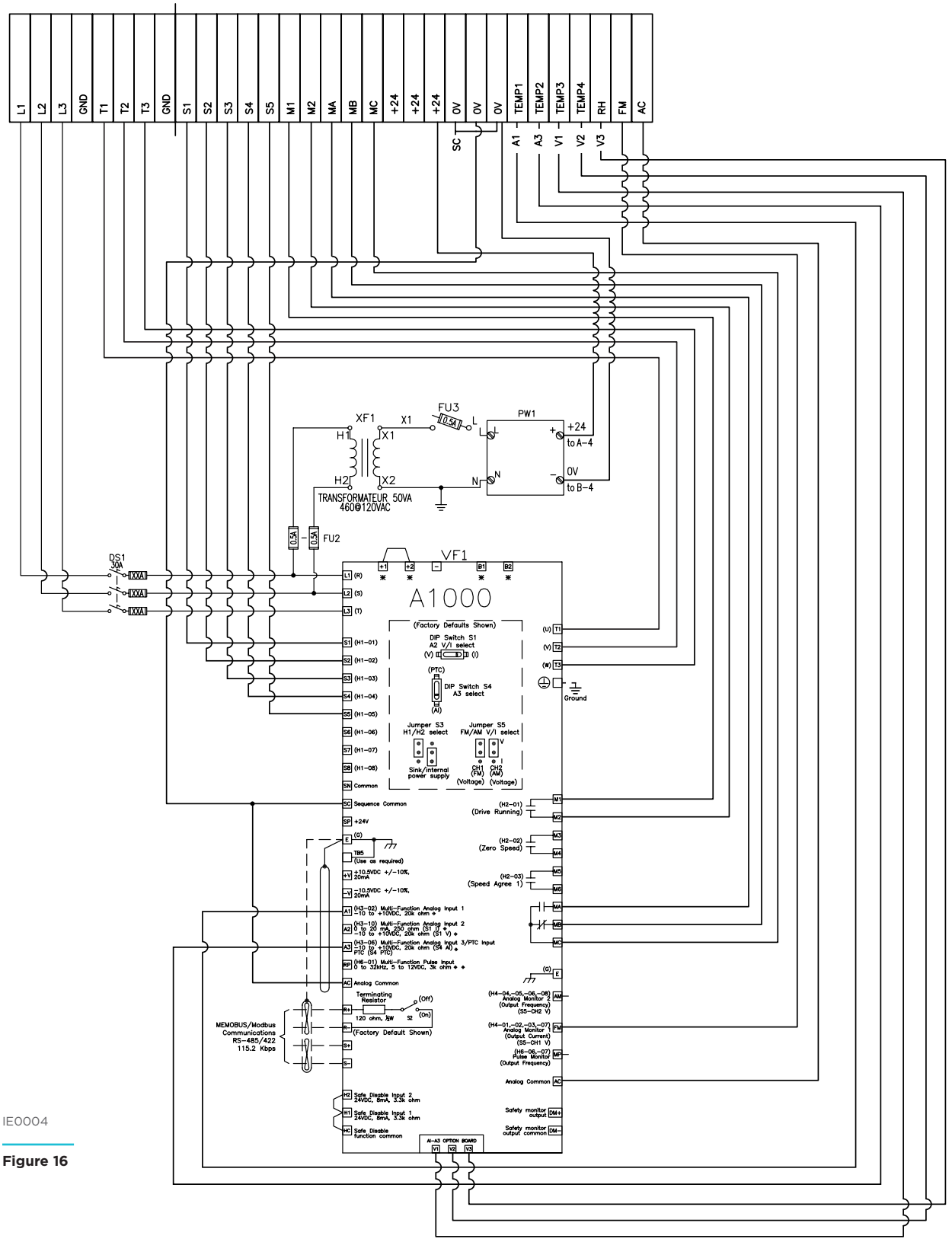


IE0009

Figure 15

11. WIRING DIAGRAMS (CONT'D)

11.2 Drive internal connections



IE0004

Figure 16

12. TROUBLESHOOTING

WARNING: Electric shock hazard: Before performing maintenance or servicing, always disconnect the unit from its power source.

CAUTION: Any work on the electric wires and control panel should be performed by a qualified electrician.

Issue	Possible causes	Solutions
The VFD screen displays DWEZALARM.	1) Temperature sensor fault.	1.1) Verify the register number of all 4 temperature sensors. If all registers show a 0 V input, go to step 2.1. If only one register shows a 0 V input, this temperature sensor is not working properly. Go to step 1.2. 1.2) Ensure that the color wires (0V, 24V and Signal) are connected in their appropriate terminals on the VFD main terminal board (see section 12.1: Wiring Diagrams). Ensure that no connection is loose. 1.3) Ensure the color wires (0V, 24V and Signal) are correctly connected at the temperature sensor (see section 6.2: Temperature Sensors Connections). Ensure that no connection is loose. 1.4) If 1.2 and 1.3 solutions do not work, connect one of the other sensors in the faulty sensor terminals and verify if the drive now reads temperature. If yes, replace the faulty temperature sensor. If no, contact Innergy Tech Customer Service.
	2) Rotation sensor fault (Only for VFDs equipped with the rotation sensor option).	2.1) Verify if the register number U1-10 bit no. 3 displays 0 and 1 alternatively. If yes, go to step 3.1. If no. go to step 2.2. 2.2) Check if the rotation sensor LED flashes. If yes, go to step 2.3. If no, check if the sensor is properly positioned. Refer to Section 5.2, Figure 5, Detail C. 2.3) Ensure that the rotation sensor wires are connected in their appropriate terminals on the VFD main terminal board (see section 12.1: Wiring Diagrams). Ensure that no connection is loose. If it still not working, change the rotation sensor.
	3) Power supply fuse is blown.	3.1) Locate the power supply fuse (FU3) in the control panel and conduct a continuity test. If the test fails, replace the fuse.
The VFD screen displays an alarm other than DWEZALARM.	1) VFD is not working properly.	1.1) Consult The Yaskawa A1000 Instruction Manual. 1.2) Contact Innergy Tech Customer Service

12. TROUBLESHOOTING

Issue	Possible causes	Solutions
The wheel is not turning.	1) VFD is in Local mode without the required jumper.	1.1) In Local mode, make sure the Local mode jumper is installed (see Section 7.3)
	2) VFD is in Remote mode but the dry contact relay is faulty.	2.1) In Remote mode, install a jumper (see Section 7.3). If the wheel is still not turning, remove jumper and go to step 3.1. If the wheel turns, remove jumper, verify relay connection and replace if needed.
	3) Some wires may be damaged or cut.	3.1) Inspect wires for any damages and replace when needed with the same or equivalent wire.
	4) Wires may have a bad connection.	4.1) Inspect the wiring connections and correct any misconnections.
The remote start/stop does not work.	1) VFD is in remote mode but the Local mode jumper is still installed.	1.1) If in Remote mode, make sure the Local mode jumper is not installed. See Section 7.3.
The wheel is turning in the wrong direction (opposite to the rotation arrows).	1) Some of the motor wire connections are inverted.	1.1) Invert the wires of two phases on the three-phase motor (see Section 12.1 Wiring diagrams).
Cannot connect to the drive when using a Building Management System with BACnet as a communication protocol.	1) Drive ID is over 255.	1.1) Make sure optional BACnet card is installed in **CN5-A port** (see Section 10). 1.2) Correct the address using an address between 1 and 255. 1.3) Contact Innergy Tech Customer Service.
The drive remains at 60 Hz.	1) The DriveWorks EZ program is disabled.	1.1) Disconnect one temperature sensor. If a DWEZALARM error signal occurs, go to step 2.1. If not, DriveWorks EZ is disabled, go to point 1.2. 1.2) Change the parameter A1-07 to 1 on the VFD LCD display and repeat step 1.1.
	2) The frost control setpoint or free cooling set point were changed and do not use correct values.	2.1) Verify that the control setpoints are using the default values: a) Frost control set point: Q1-01 should be set at 45.6% (4.56 volts or 34°F). b) Free cooling set point : Q1-02 should be set at 61.2% (6.12 volts or 60°F) 2.2) Contact Innergy Tech Customer Service.

GLOSSARY

Following are terms used throughout this manual that you need to become familiar with. Note that many of these terms are covered in more details throughout the many sections of this manual.

ENERGY RECOVERY WHEEL (ERW): Device that exchanges sensible and latent energy. As the ERW rotates between the outdoor and return airstreams, the higher temperature and more humid airstream transfers its sensible and latent energy to the coated aluminum. That energy is then released to the cooler and/or dryer airstream during the second half of the revolution.

ROTOR: Term used to describe the spokes and media assembly that turns and transfers sensible or sensible and latent energies.

BUILDING MANAGEMENT SYSTEMS (BMS): Computer-based control systems installed in buildings that control and monitor the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems.

CONTROLLER: Electronic device that receives the sensors' outputs, analyze them based on a pre-established program and send an analog output to the VFD. The A1000 VFD Controller package uses a VFD with a built-in controller.

VARIABLE FREQUENCY DRIVE (VFD): Electronic device that controls AC motor speed and torque by varying the motor's input frequency.

FROST CONTROL: Part of the control that prevents ice formation within the energy recovery wheel's media.

FROST CONTROL SETPOINT: Exhaust air (TEMP4) minimum dry bulb acceptable temperature before the speed of the wheel is reduced. Controller package will modulate the speed of the wheel to prevent the exhaust air from decreasing below the frost control setpoint.

FREE COOLING (ECONOMIZER): Part of the control that prevents overheating the building for cool outdoor air (TEMP1) conditions.

FREE COOLING SETPOINT: Supplied air (TEMP2) maximum dry bulb acceptable temperature when outside air (TEMP1) is cooler than the return air (TEMP3). Controller package will modulate the speed of the wheel to prevent the supplied air from exceeding the free cooling setpoint.

SUMMER CHANGEOVER: Defined as the automatic change of the ERW controller between heating or free cooling modes and cooling mode.

COOLING MODE: Energy recovery mode, with wheel operating at 100% capacity, when outside air (TEMP1) is warmer than the return air (TEMP3).

HEATING MODE: Energy recovery mode, with wheel operating at 100% capacity, when outside air (TEMP1) is colder than the return air (TEMP3).

OUTDOOR AIR STREAM (TEMP1): Fresh air that is brought in from the outside. This air goes through the ERW and then is ducted into the building.

SUPPLIED AIR STREAM (TEMP2): Air that is brought in from the outside, has passed through the ERW and is ducted into the building.

RETURN AIR STREAM (TEMP3): Stale air from the building that is being ducted to the ERW.

EXHAUST AIR STREAM (TEMP4): The return indoor air that has passed through the ERW. This air is being ducted outdoors.

LIST OF FIGURES

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605, Rocheleau, Drummondville, Quebec CANADA J2C 6L8 - Tel.: 819-475-2666 Fax.:819-475-9541 - sales@innergytech.com