INVERTEK DRIVES
www.invertek.co.uk

OPTIDRIVE™ HVAC

BACnet User Guide

Declaration of Conformity:

Invertek Drives Ltd hereby states that the Optidrive ODV-2 product range conforms to the relevant safety provisions of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and has been designed and manufactured in accordance with the following harmonised European standards:

EN 61800-5-1: 2003	Adjustable speed electrical power drive systems. Safety requirements. Electrical, thermal and energy.
EN 61800-3 2nd Ed: 2004	Adjustable speed electrical power drive systems. EMC requirements and specific test methods
EN 55011: 2007	Limits and Methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment (EMC)
EN60529 : 1992	Specifications for degrees of protection provided by enclosures

About

This document provides the essential information for using BACnet communication with Optidrive HAVC. Certain drive parameters need to be setup in order to active BACnet communication. Please refer to drive user guide for more information on drive installation and setup.

This User Guide is for use with Optidrive HVAC Firmware Version 1.20

Earlier firmware versions may require an upgrade to ensure compatibility.

User Guide Revision 1.01

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

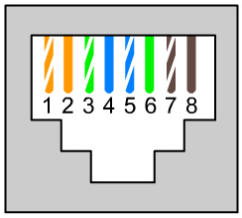
1. Technical information:

1.1. BACnet MSTP

1.1.1. Interface Format – BACnet MSTP

Protocol	:	BACnet MS/TP
Physical signal	:	RS485, half duplex
Interface	:	RJ45
Baudrate	:	9600bps, 19200bps, 38400bps, 76800bps
Data format	:	8N1, 8N2, 8E1, 8O1,

1.1.2. Signal Connector Layout – BACnet MSTP



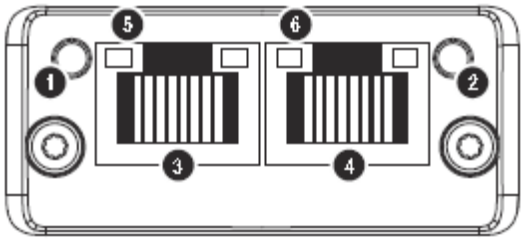
1: Not Used 2: Not Used
3: 0V 4: RS485- (Optibus)
5: RS485+ (Optibus) 6: +24V
7: RS485- (Modbus/BACnet) 8: RS485+ (Modbus/BACnet)

1.2. BACnet IP

1.2.1. Interface Format – BACnet IP

BACnet IP requires an optional external interface option – OPT-2-BCNET. The interface should be inserted into the option moduel slot of the drive. Ensure the drive is fulyl powered down before inserting or removing the module.

Number	Item
1	Network Status LED
2	Module Status LED
3	Ethernet Interface, Port 1
4	Ethernet Interface, Port 2
5	Link / Activity Port 1
6	Link / Activity port 2



1.2.2. Network Status LED

LED State	Description
Off	No power or No IP Address
Green	Online, one or more messages have arrived
Flashing Green	Online, waiting for first message
Red	Duplicate IP address or fatal error
Flashing Red	Connection Timeout. No message received within the configured timeout period

1.2.3. Module Status LED

LED State	Description
Off	No power
Green	Normal Operation
Flashing Green / Red Alternate	Firmware update in progress
Red	Major Fault
Flashing Red	Recoverable Fault

1.2.4. Link / Activity LED

LED State	Description
Off	No link, no activity
Green	100 Mbit/s/ Link established
Flickering Green	100 Mbit/s Activity
Yellow	10 Mbit/s/ Link established
Flickering Yello	10 Mbit/s Activity

2. BACnet Protocol Implementation Conformance Statement

Date: 19th February, 2013
Vendor Name: Invertek Drives Ltd
Product Name: OPTIDRIVE HVAC
Product Model Number: ODV-2-xxxxx-xxxxx-xx
Application Software Version: 1.20
Firmware Revision: 1.20
BACnet Protocol Revision: 7
Product Description: Invertek Optidrive HVAC

BACnet Standardized Device Profile (Annex L):

☐ BACnet Operator Workstation (B-OWS)
☐ BACnet Advanced Operator Workstation (B-AWS)
☐ BACnet Operator Display (B-OD)
☐ BACnet Building Controller (B-BC)
☐ BACnet Advanced Application Controller (B-AAC)
☑ BACnet Application Specific Controller (B-ASC)
☐ BACnet Smart Sensor (B-SS)
☐ BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks Supported (Annex K):

DS-RP-B, DS-WP-B, DM-DDB-B, DM-DOB-B, DM-DCC-B, DM-RD-B

Segmentation Capability:

☐ Able to transmit segmented messages Window Size
☐ Able to receive segmented messages Window Size

Standard Object Types Supported:

An object type is supported if it may be present in the device. For each standard Object Type supported provide the following data:
1) Whether objects of this type are dynamically creatable using the CreateObject service
2) Whether objects of this type are dynamically deletable using the DeleteObject service
3) List of the optional properties supported
4) List of all properties that are writable where not otherwise required by this standard
5) List of all properties that are conditionally writable where not otherwise required by this standard
6) List of proprietary properties and for each its property identifier, datatype, and meaning
7) List of any property range restrictions

Data Link Layer Options:

☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s):
☑ MS/TP master (Clause 9), baud rate(s): 9600, 19200,38400,76800
☐ MS/TP slave (Clause 9), baud rate(s):
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):
☐ Point-To-Point, modem, (Clause 10), baud rate(s):
☐ LonTalk, (Clause 11), medium:
☐ BACnet/ZigBee (ANNEX O)
☐ Other:

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.)
☐ Yes ☑ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No
Does the BBMD support network address translation? ☐ Yes ☐ No

Network Security Options:

☐ Non-secure Device - is capable of operating without BACnet Network Security
☐ Secure Device - is capable of using BACnet Network Security (NS-SD BIBB)
☐ Multiple Application-Specific Keys:
☐ Supports encryption (NS-ED BIBB)
☐ Key Server (NS-KS BIBB)

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☑ ANSI X3.4 ☐ IBM™/Microsoft™ DBCS ☐ ISO 8859-1
☐ ISO 10646 (UCS-2) ☐ ISO 10646 (UCS-4) ☐ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports.

3. Parameters

3.1. Parameter Settings – BACnet MSTP

The following parameters should be adjusted for correct operation.

Index	*Parameter*	*Description*
P1-12	Operation Mode	Set this parameter to 6 to activate BACnet MS/TP operation
P5-01	Drive Address	This parameter is used to set the drive address
P5-03	Baudrate	This parameter is used to set up communication baudrate. (Auto baudrate is not supported)
P5-04	Data Format	Use this parameter to set RS485 communication data format
P5-07	Fieldbus Ramp Control	Set to 1 if BACnet ramp control over acceleration and deceleration rates is required
P5-09	BACnet Device Instance ID Low	P5-09 and P5-10 are used to setup drive device instance ID value. Instance ID = P5-10 * 65536 + P5-09. Range from 0 ~ 4194304. Default value is set to 1.
P5-10	BACnet Device Instance ID High	
P5-11	Max Master	Set BACnet MS/TP max master property, range from 1 ~ 127. Default set to 127.

3.2. Parameter Settings – BACnet IP

Index	*Parameter*	*Description*
P1-12	Operation Mode	Set this parameter to 4 to active BACnet IP operation
P5-07	Fieldbus Ramp Control	Set to 1 if BACnet ramp control is needed

3.3. IP Address Setting – BACnet IP

In order to set the BACnet IP Address, the IP configuration software is available from the Invertek website, www.invertekdrives.com.

4. Object Dictionary

The following object dictionary applies to both BACnet MSTP and BACnet IP.

4.1. Binary Value Object:

Binary Value Objects Table				
Instance ID	Object Name	Access	Description	Active/Inactive Text
BV0	Run/Stop State	R	This object indicates drive run status	RUN/STOP
BV1	Trip State	R	This object indicates if drive is tripped	TRIP/OK
BV2	Hand Mode	R	This object indicates if drive is in hand or auto mode	HAND/AUTO
BV3	Inhibit Mode	R	This object indicates drive is hardware inhibit	INHIBIT/OK
BV4	Mains Loss	R	This object indicates if mains loss happened	YES/NO
BV5	Fire Mode	R	This object indicates drive is in fire mode	ON/OFF
BV6	Enable State	R	This object indicates if drive has enable signal	YES/NO
BV7	External 24V Mode	R	This object indicates drive is in external 24V mode	YES/NO
BV8	Maintenance Due	R	This object indicates if maintenance service is due	YES/NO
BV9	Clean Mode	R	This object indicates if pump clean function is on	ON/OFF
BV10	Terminal Mode	R	This object indicates if drive is in terminal control mode	ON/OFF
BV11	Bypass Mode	R	This object indicate if drive is in bypass mode	ON/OFF
BV12	Digital Input 1	R	Status of digital input 1	ON/OFF
BV13	Digital Input 2	R	Status of digital input 2	ON/OFF
BV14	Digital Input 3	R	Status of digital input 3	ON/OFF
BV15	Digital Input 4	R	Status of digital input 4	ON/OFF
BV16	Digital Input 5	R	Status of digital input 5	ON/OFF
BV17	Digital Input 6	R	Status of digital input 6	ON/OFF
BV18	Digital Input 7	R	Status of digital input 7	ON/OFF
BV19	Digital Input 8	R	Status of digital input 8	ON/OFF
BV20	Relay Output 1	R	Status of relay output 1	CLOSED/OPEN
BV21	Relay Output 2	R	Status of relay output 2	CLOSED/OPEN
BV22	Relay Output 3	R	Status of relay output 3	CLOSED/OPEN
BV23	Relay Output 4	R	Status of relay output 4	CLOSED/OPEN
BV24	Relay Output 5	R	Status of relay output 5	CLOSED/OPEN
BV25	Run/Stop CMD	C	Drive run command object	RUN/STOP
BV26	Fast Stop	C	Fast stop enable object	ON/OFF
BV27	Trip Reset	C	Trip reset object (rising edge active)	ON/OFF
BV28	Coast Stop	C	Cost stop enable object (overrides fast stop)	ON/OFF
BV29*	Relay 1 CMD	C	User specified relay output 1 status.	CLOSED/OPEN
BV30*	Relay 2 CMD	C	User specified relay output 2 status.	CLOSED/OPEN
BV31*	Relay 3 CMD	C	User specified relay output 3 status.	CLOSED/OPEN
BV32*	Relay 4 CMD	C	User specified relay output 4 status.	CLOSED/OPEN
BV33*	Relay 5 CMD	C	User specified relay output 5 status.	CLOSED/OPEN

* This function only works if the relay output can be controlled by user value (Refer to the Optidrive HVAC Parameter List for further details)

4.2. Analog Value Object

Analog Value Objects Table				
Instance ID	Object Name	Access	Description	Unit
AV0	Motor Frequency	R	Motor output frequency	Hertz
AV1	Motor Speed	R	Motor output speed (0 if P1-10=0)	RPM
AV2	Motor Current	R	Motor output current	Amps
AV3	Motor Power	R	Motor output power	Kilowatts
AV4	Reserved	R	Reserved	NONE
AV5	DC Bus Voltage	R	DC bus voltage	Volts
AV6	Drive temperature	R	Drive temperature value	˚C
AV7	Drive Status	R	Drive status word	NONE
AV8	Trip Code	R	Drive trip code	NONE
AV9	Analog input 1	R	Value of analog input 1	Percent
AV10	Analog input 2	R	Value of analog input 2	Percent
AV11	Analog output 1	R	Value of analog output 1	Percent
AV12	Analog output 2	R	Value of analog output 2	Percent
AV13	PID Reference	R	PID controller reference value	Percent
AV14	PID feedback	R	PID controller feedback value	Percent
AV15	Speed Reference	C	Speed reference value object	Hertz
AV16	User Ramp Time	W	User ramp value	Second
AV17	User PID Reference	W	PID controller user reference	Percent
AV18	User PID Feedback	W	PID controller user feedback	Percent
AV19	Kilowatt Hours	R	Kilowatt hours (can be reset by user)	Kilowatt-hours
AV20	Megawatt Hours	R	Megawatt hours (can be reset by user)	Megawatt-hours
AV21	KWh meter	R	Kilowatt hours meter (can not be reset)	Kilowatt-hours
AV22	MWh meter	R	Megawatt hours meter (can not be reset)	Megawatt-hours
AV23	Total Run Hours	R	Total run hours since date of manufacture	Hours
AV24	Current Run Hours	R	Run hours since last time enable	Hours

4.3. Access type – BACnet MSTP

R - Read only
W - Read or Write
C - Commandable

Supported Service:

- WHO-IS (Reply with I-AM, and I-AM will also be broadcasted on power up and reset)
- WHO-HAS (Reply with I-HAVE)
- Read Property
- Write Property
- Device Communication Control
- Reinitialize Device

4.4. BACnet IP Implemented BACnet BIBBs

The BACnet IP interface is implemented as a BACnet Application Specific Controller, with the following BACnet Interoperability Building Blocks implemented :-

BIBB	**Code**	**Corresponding BACnet Service**
Data Sharing – Read Property-B	DS-RP-B	ReadProperty (Execute)
Data Sharing – Read Property Multiple-B	DS-RPM-B	ReadPropertyMultiple (Execute)
Data Sharing – Write Property-B	DS-WP-B	WriteProperty (Execute)
Data Sharing – Write Property Multiple-B	DS-WPM-B	WritePropertyMultiple (Execute)
Device Management – Dynamic Device Binding-A	DM-DBB-A	Who-Is (initiate) I-Am (Execute)
Device Management – Dynamic Device Binding-B	DM-DBB-B	Who-Is (initiate) I-Am (Execute)
Device Management – Dynamic Object Binding-B	DM-DDB-B	Who-Has (initiate) I-Have (Execute)
Device Management – Device Communication Control-B	DM-DCC-B	DeviceCommunicationControl (Execute)
Device Management – Reinitialise Device	DM-RD-B	ReinitialiseDevice (Execute)

5. Object/Property Support Matrix

Property	Object Type		
	Device	Binary Value	Analog Value
Object Identifier	×	×	×
Object Name	×	×	×
Object Type	×	×	×
System Status	×		
Vendor Name	×		
Firmware Revision	×		
Application Software Revision	×		
Protocol Version	×		
Protocol Revision	×		
Protocol Services Supported	×		
Protocol Object Type supported	×		
Object List	×		
Max APDU Length Accepted	×		
Segmentation Supported	×		
APDU Timeout	×		
Number of APDU Retries	×		
Max Master	×		
Max Info Frames	×		
Device Address Binding	×		
Database Revision	×		
Present Value		×	×
Status Flags		×	×
Event State		×	×
Out-of-Service		×	×
Units			×
Priority Array		×*	×*
Relinquish Default		×*	×*
Polarity		×	
Active Text		×	
Inactive Text		×	

** For commandable values only*