neptronic®

TFxB Series Thermostat Controller

BACnet® Communication Module
User Guide

BACnet

TFxB-SERIES-BACNET-USER GUIDE
TFxB24-Bacnet-121026-EUA.doc

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Introduction

This document provides information on using the Neptronic thermostat controller communications feature. This product provides a BACnet® network interface between BACnet® client devices and Neptronic controllers. It uses the BACnet® Master Slave/Token Passing (MS/TP) protocol at the BACnet® MAC layer.

This document assumes you are familiar with BACnet® and BACnet® terminology.

BACnet® Overview

Performance

The thermostat controller uses a synchronous implementation for BACnet® messages. Each BACnet® confirmed service request is answered as quickly as possible without using Reply Postponed. In particular, MS/TP implementation performs within Tusage_delay of 15ms in order to assure Tusage_timeout values within 20ms.

Support for MS/TP

The thermostat controller supports a Full Master Node state machine for MS/TP. All parameters are configured via the thermostat menu or via the BACnet® WriteProperty service. Changes made via the WriteProperty take effect immediately and does not require a restart of the thermostat controller. For more information the configurable properties, please refer to the *Getting Started* section on page 3. For more information on the thermostat menu, please refer to the thermostat controller's *Specification & Installation Manual* for more details.

BIBB Support

The thermostat controller generally behaves as a B-ASC type profile server. The following specific BIBBs are supported per their relevant definitions in Annex K to BACnet®: DS-RP-B, DS-RPM-B, DS-WP-B, DS-WPM-B, DM-DDB-B, DM-DOB-B, DM-DCC-B

Object Support (in general)

The thermostat controller supports a table-based fixed list of BACnet®-visible values which appear as Present_Values of various BACnet® standard object types, in addition to a Device object.

Alarms

Although the thermostat controller supports the ability to indicate various alarm conditions through value changes in properties of several of its objects, it **does not** generate BACnet® Event Notifications.

Features

Neptronic thermostat controllers also offer the following time-saving features.

Auto Baud Rate Detection
The thermostat controller automatically configures its baud rate by detecting the network speed upon connection.

Auto Device Instance Configuration
The thermostat controller automatically configures its device instance to 153000 + MAC address.

Copy Configuration
Copy the thermostat controller's entire configuration and broadcast it to other thermostat controllers of the same type on the same network.

Getting Started

The following BACnet® properties are configurable and may need to be modified to effectively establish communication on the network and to guarantee uniqueness of each device in a BACnet® system.

- **MAC Address** (Default: 001)
  Set between 000 and 254 via thermostat menu* (128-254 represent MS/TP non-token-passing slave devices).

- **Device Instance** (Default: Auto)
  The thermostat controller automatically configures its device instance to 153000 + MAC address. Can also be set manually via thermostat menu* or through the WriteProperty service to *Device Object.Object_Identifier.* The device's Object_Identifier is a combination of the Device Object_Type (8) and the Device_Instance (0-4194302), therefore its decimal or hexadecimal representation tends to be incomprehensible. For example, the Device_Instance=1000 has an equivalent Object_Identifier of 0x020003E8 hexadecimal or 33555432 decimal. While it's the device's Object_Identifier property that can be changed using a BACnet® WriteProperty service, this document refers mostly to Device_Instance.

- **Baud Rate** (Default: 0 = Auto)
  The thermostat controller automatically configures its baud rate by detecting the network speed upon connection. Can also be set manually via thermostat menu* or through the WriteProperty service to *Device Object.proprietary property #1001*. This value is Unsigned type, and available values are 9600, 19200, 38400, 76800.

- **Max_Master** (Default: 127)
  To increase network efficiency or if there are less than 127 devices on the network, the Max_Master value can be configured through WriteProperty service to the *Device Object.Max_Master*. For more information, refer to the MAC address and Max_Master section on page 4.

- **Device Object.Object_Name**
  Name of device, for example TFCB24XYZ3. This value can be configured through WriteProperty service to the *Device Object.Object_Name*.

** NOTE: When referring to the thermostat menu in this section, it includes the Quick Access Menu when in operation mode (RUN) and the Installer Menu when in programming mode (PGM).Refer to the thermostat controller's Specification & Installation Manual for more details.*

Quick Setup

Take advantage of the thermostat controller's Auto Baud Rate Detection, Auto Device Instance Configuration, and default Max_Master value, to get up and running with no programming.

1) Connect the thermostat controller to the network and then power up the unit. The thermostat controller automatically configures the baud rate and device instance.
2) If you need to set a unique MAC address (default 001), continue to step 3. If not, setup is complete.
3) With the thermostat controller in Operation Mode (jumper = RUN), go to the Quick Access Menu by pressing and holding both function buttons on the thermostat for 5 seconds. Refer to the *Specification & Installation Manual* for more details.
4) Enter the password (637).
5) Set a unique MAC address.
6) Power down and then power up the thermostat controller.

Manual Setup

If your site has more than one TFxB network and/or you wish to use a Device_Instance other than 153,000, follow these instructions.

1) With the thermostat controller in Operation Mode (jumper = RUN), go to the Quick Access Menu by pressing and holding both function buttons on the thermostat for 5 seconds. Refer to the *Specification & Installation Manual* for more details.

2) Enter the password (637).
3) In this mode you can manually configure the MAC address, Device Instance and Baud Rate.
4) Power down the thermostat controller, connect it to the network and then power up the unit.
5) Repeat steps 1 to 4 for each thermostat controller.
6) To increase network efficiency or if there are less than 127 devices on the network, the Max_Master value can be configured through WriteProperty service to the *Device Object.Max_Master*. For more information, refer to the *MAC address and Max_Master* section on page 4.

Copy Config

Copy the thermostat controller's entire configuration and broadcast it to other thermostat controllers of the same type on the same network.

1) With the thermostat controller in Operation Mode (jumper = RUN), go to the Quick Access Menu by pressing and holding both function buttons on the thermostat for 5 seconds. Refer to the *Specification & Installation Manual* for more details.
2) Enter the password (637).
3) Scroll to "Copy Config" and select yes. Follow onscreen instructions.

MAC address and Max_Master

The MAC address must be unique on the entire MS/TP network. However, having a unique MAC address and a high baud rate does not guarantee efficient operation of the thermostat controller and other MS/TP units on the MS/TP network. Some MAC address and Max_Master combinations are more efficient than others. BACnet® requires token-passing units to occasionally "poll" for other masters based on the MAC address and Max_Master. A "poor" combination of MAC addresses and Max_Master can lead to a slower network due to lost time polling for masters that are not present. Unless there are 126 other units on the MS/TP network, the default Max_Master of 127 is not the most efficient choice for the thermostat controller. The Max_Master default of 127 was selected to ensure that any master, specifically a BACnet® client, can be found when the thermostat controller is first started.

Example 1:
This example is slow and inefficient because every time either unit is required to find another master unit it has to poll 126 units until it finds the right one to pass the token.

- MAC=0. Max_Master=127
- MAC=1, Max_Master=127

Example 2:
This example is better but it's still slower. The Max_Master is set to the most efficient value; however because of the gap between the two MAC addresses, each unit must poll 4 units until it finds the right one to pass the token.

- MAC=0. Max_Master=5
- MAC=1 to MAC=4 are not used
- MAC=5, Max_Master=5

Example 3:
This example is an incorrect configuration. The MAC=0 will never find MAC=2 because it will never poll for the master MAC address=2.

- MAC=0. Max_Master=1
- MAC=2, Max_Master=2

Example 4:
As a general guideline, the most efficient set up for an MS/TP network is one in which the units are consecutively numbered starting at MAC address 0 and all have Max_Master=the maximum MAC address in the system. If consecutive numbering is not possible, then the next most efficient set up is one in which all units have Max_Master=the maximum MAC address in the system.

- MAC=0. Max_Master=3
- MAC=1, Max_Master=3
- MAC=2, Max_Master=3
- MAC=3, Max_Master=3

Device Object Properties

The following table lists all the BACnet® properties supported for the device object. The "W" indicates if the property is writable using the BACnet® WriteProperty service.

Property	Value	Writable
Object_Identifier	Programmable where the instance part of the Object_Identifier is in the range of 0-4194302. The device instance must be unique system-wide. The default value for the device instance=153000 (Vendor_Identifier*1000)	W
Object_Name	Programmable up to 32 characters. The device name must be unique system-wide. The default value is Model_Name.	W
Description	Programmable up to 32 characters. The default value= "BACnet thermostat"	W
Object_Type	8	
System_Status	*Non-Operational if major error on device.*	
Vendor_Identifier	Always 153	
Vendor_Name	Always "National Environmental Products Ltd"	
Model_Name	Example : "TFCB24F3XYZ3"	
Firmware_Revision	currently "1.17"	
Application_Software_Version	currently "1.20"	
Protocol_Version	Always 1	
Protocol_Revision	Always 4	
DataBase_Revision	Default = 0, will be incremented if Object_Name and/or Oject_Identifier is modified	
Max_APDU_Length_Accepted	Always 107	
Segmentation_Supported	(3) = No Segmentation	
APDU_Timeout	3000	
Number_of_APDU_Retries	Always 0	
Protocol_Services_Supported	Always 0x00 0x09 0x40 0x00 0x60 (i.e. a *bitstring* in BACnet® order)	
Protocol_Object_Types_Supported	Always 0x00, 0xB4, 0x80, 0x10 (i.e. a bitstring in BACnet® order) - analog-input, analog-value, binary-input, binary-value - device - multi-state-value	
Object_List	Per the standard. Because of restrictions on the size of the transmit buffers, the entire Object_List cannot be returned at once, rather the Object_List must be read, one-at-a-time.	
Device_Address_Binding	Always empty.	
Max_Master	Programmable in the range of 0-127. Default value=127	W
Max_Info_Frames	Always 1	
Proprietary property #1000	Programmable. This proprietary property represents the MS/TP MAC address in the range of (0-254). Values 128 to 254 represent MS/TP non-token-passing slave devices. Default value=1	W
Proprietary property #1001	Programmable. This proprietary property represents the MS/TP baud rate. This value is Unsigned type, and available values are 9600, 19200, 38400, 76800. Writing 0 will activate auto baud rate functionality. Reading this property will always return actual baud rate. Default : Auto* (Auto Baud Rate Detection requires V1.17 and up)	W
Proprietary property #1002	Programmable. This proprietary property represents that period of time that an object in/out of service will automatically return to normal. Range = 0-120 minutes (unsigned type). Writing 0 means no automatic return to normal. Default: 15 minutes.	W

Object Types Supported

A complete list of all BACnet® objects for the thermostat controller is listed in the following section:

The Device Object has already been described. The following tables list all the BACnet® properties supported for each object type. Most of the properties are locked in. The exception is Present_Value, which represents the dynamic operating values of the device, and the Status_Flag, Event_State and Reliability properties which reflect the availability of the Present_Value. Unless otherwise specified, properties are not changeable.

Object Type	Supported	Optional Properties Supported	Writable Properties	If "Out of Service" is True
Analog Input	☑	Reliability Description Min_Present_Value Max_Present_Value Resolution	Out_of_Service	Present_Value Status_Flag
Analog Value	☑	Reliability Description	Present_Value[1] Out_of_Service[2]	Present_Value Status_Flag
Binary Input	☑	Reliability Active_Text Inactive_Text Description	Out_of_Service	Present_Value Status_Flag
Binary Value	☑	Reliability Active_Text Inactive_Text Description	Present_Value[3] Out_of_Service[4]	Present_Value Status_Flag
Device	☑	Max_Master Max_Info_Frame Description #1000 (MAC) #1001 (BAUD RATE) #1002 (TIME OUT)	Object_Identifier Object_Name Max_Master Description #1000 #1001 #1002	N/A
Multi-State Value[5]	☑	Description Reliability States_Text	Present_Value[6] Out_of_Service[7]	N/A

Out of Service

Neptronic thermostat controllers offer the use of the "Out of Service" writable property. When set to true, this property disconnects the object from the physical input, enabling you to input other values. This could be useful for special applications or when troubleshooting. For example, you can ignore the temperature read from a sensor and input the desired temperature value in order to perform specific tests.

For security reasons there is a timeout that will set the Out of Service property back to false after 15 minutes. This value can be modified to between 0 and 120 minutes (see proprietary property #1002).

[1] Present_Value property is writable for every AV object except: AV.1, AV.2, AV.3, AV.4, AV.28, AV.36, AV.41, AV.42
[2] Out_of_Service property is writable for objects that Present_Value is not writable: see list above. Object will automatically return to normal after a programmable period of time. See Proprietary property #1002 of Device object.
[3] Present_Value property is writable for every BV object except: BV.7
[4] Out_of_Service property is writable for objects that Present_Value is not writable. See list above. Object will automatically return to normal after a programmable period of time. See Proprietary property #1002 of Device object.
[5] MSV object states number and text can vary depending of system set-up. Use carefully.
[6] Present_Value property is writable for every MSV object except: MSV.14
[7] Out_of_Service property is writable for objects that Present_Value is not writable. See list above.
Object will automatically return to normal after a programmable period of time. See Proprietary property #1002 of Device object.

Objects Table

The TFxB24 Thermostat series of controllers use the following BACnet® object table. The *type* is the BACnet® Object type, the *instance* is the BACnet® Object. Together the *type* and *instance* form the BACnet® Object_Identifier for an object according to the following C-language algorithm:

- object_identifier=(unsigned long)((unsigned long)*type*<<22)+*instance*

ID[8]	Name	Writable Property	TFCB24F3XYZ1	TFCB24F3XY2	TFHB24F3XYZ1	TFHB24F3XYZ2	TFCB24P3-OE1	TFHB24P3-OE1	TFHB24P3-OE2	Notes
AI.1	Intern.Temper.	Out of service	x	x	x	x	x	x	x	0-50ºC or 32-122ºF, Resolution 0.01ºC/0.02ºF
AI.2	Extern.Temper.	Out of service	x	x		x	x	x	x	0-50ºC or 32-122ºF, Resolution 0.01ºC/0.02ºF
AI.3	ChangeOverTemper.	Out of service	x	x	x	x	x	x	x	0-50ºC or 32-122ºF, Resolution 0.01ºC/0.02ºF
AI.4	Intern.Humidity	Out of service				x			x	5-95%RH, Resolution 0.1%RH
AI.9	Extern.Humidity	Out of service			x			x		5-95%RH, Resolution 0.1%RH
AV.1	ControlTemper.	Out of service	x	x	x	x	x	x	x	0-50ºC or 32-122ºF, Resolution 0.01ºC/0.02ºF
AV.2	HeatingDemand	Out of service	x	x	x	x	x	x	x	0-100%, Resolution 0.1%
AV.3	CoolingDemand	Out of service	x	x	x	x	x	x	x	0-100%, Resolution 0.1%
AV.4	FanDemand	Out of service	x	x	x	x	x	x	x	0-100%, Resolution 0.1%
AV.5	Intern.Temper.Offset	Present Value	x	x	x	x	x	x	x	± 5.0ºC, Resolution 0.1ºC
AV.6	Extern.Temper.Offset	Present Value	x	x		x	x	x	x	± 5.0ºC, Resolution 0.1ºC
AV.7	Temper.SetPointOcc.	Present Value	x	x	x	x	x	x	x	AV.8 to AV.9, Resolution 0.5ºC/1ºF
AV.8	Min.SetPointOcc.	Present Value	x	x	x	x	x	x	x	0 to AV.9, Resolution 0.5ºC/1ºF
AV.9	Max.SetPointOcc.	Present Value	x	x	x	x	x	x	x	AV.8 to 40ºC or 104ºF, Resolution 0.5ºC/1ºF
AV.10	Temper.SetPointCoolNoOcc.	Present Value	x	x	x	x	x	x	x	AV.11 to 40ºC or 104ºF, Resolution 0.5ºC/1ºF
AV.11	Temper.SetPointHeatNoOcc.	Present Value	x	x	x	x	x	x	x	10.0ºC or 50ºF to AV.10, Resolution 0.5ºC/1ºF
AV.12	CoolingProp.Band	Present Value	x	x	x	x	x	x	x	0.5-5ºCor 1-10ºF, Resolution 0.5ºC/1ºF
AV.13	HeatingProp.Band	Present Value	x	x	x	x	x	x	x	0.5-5ºC or 1-10ºF, Resolution 0.5ºC/1ºF
AV.14	CoolingDeadBand	Present Value	x	x	x	x	x	x	x	0.3-5ºC or 0.6-10ºF, Resolution 0.1ºC/0.2ºF
AV.15	HeatingDeadBand	Present Value	x	x	x	x	x	x	x	0.3-5ºC or 0.6-10ºF, Resolution 0.1ºC/0.2ºF
AV.16	FanTimeOutDelay	Present Value	x	x	x	x	x	x	x	0-15 minutes, Resolution 1 minute
AV.17	Heat/CoolVoltageMin.2pipes	Present Value	x	x	x	x	x	x	x	0 Volt to AV.20, Resolution 0.1 Volt
AV.18	CoolingVoltageMin.4pipes	Present Value	x	x	x	x	x	x	x	0 Volt to AV.21, Resolution 0.1 Volt
AV.19	HeatingVoltageMin.4pipes *For TFHB24P3-OE1 and TFHB24P3-OE2* Heating4PipesOrHumid.Volt.Min.	Present Value	x	x	x	x	x	x	x	0 Volt to AV.22, Resolution 0.1 Volt
AV.20	Heat/CoolVoltageMax.2pipes	Present Value	x	x	x	x	x	x	x	AV.17 to 10.0 Volt, Resolution 0.1 Volt
AV.21	CoolingVoltageMax.4pipes	Present Value	x	x	x	x	x	x	x	AV.18 to 10.0 Volt, Resolution 0.1 Volt
AV.22	HeatingVoltageMax.4pipes *For TFHB24P3-OE1 and TFHB24P3-OE2* Heating4PipesOrHumid.Volt.Max.	Present Value	x	x	x	x	x	x	x	AV.19 to 10.0 Volt, Resolution 0.1 Volt
AV.23	ChangeOverSetPoint	Present Value	x	x	x	x	x	x	x	10-40ºC or 50-104ºF, Resolution 0.5ºC/1ºF
AV.25	FanDampingFactor	Present Value	x	x	x	x	x	x	x	0-10 seconds, Resolution 1 second
AV.26	Int.TimeFactor	Present Value	x	x	x	x	x	x	x	0-250 seconds, Resolution 5 seconds
AV.27	CoolingAntiCycleDelay	Present Value	x	x	x	x	x	x	x	0-15 minutes, Resolution 1 minute
AV.28	Loc.Heat.Demand	Out of service	x		x	x	x	x	x	0-100%, Resolution 0.1%
AV.29	Loc.Heat.Prop.Band	Present Value	x		x	x	x	x	x	0.5-5ºC or 1-10ºF, Resolution 0.5ºC/1ºF
AV.30	Loc.Heat.DeadBand	Present Value	x		x	x	x	x	x	0.3-5ºC or 0.6-10ºF, Resolution 0.1ºC/0.2ºF
AV.31	FloatingMotorTiming	Present Value	x		x	x	x	x	x	15-250 seconds, resolution 5 seconds
AV.32	Loc.Heat.VoltageMin.	Present Value	x		x	x	x	x	x	0 Volt to AV.33, Resolution 0.1 Volt
AV.33	Loc.Heat.VoltageMax.	Present Value	x		x	x	x	x	x	AV.32 to 10.0 Volt, Resolution 0.1 Volt
AV.34	FanVoltageMin.	Present Value	x		x	x	x	x	x	0 Volt to AV.35, Resolution 0.1 Volt
AV.35	FanVoltageMax.	Present Value	x		x	x	x	x	x	AV.34 to 10.0 Volt, Resolution 0.1 Volt
AV.36	Dehumid.Demand	Out of service			x	x		x	x	0-100%, Resolution 0.1%
AV.37	HumiditySetPoint	Present Value			x	x		x	x	10.0-65.0%RH, Resolution 0.5%RH
AV.38	Intern.HumidityOffset	Present Value				x			x	± 5.0%RH, Resolution 0.1%RH
AV.39	NoOcc.OverrideDelay	Present Value	x	x	x	x	x	x	x	0-180 minutes, Resolution 15 minutes
AV.40	HumidityControlRamp	Present Value			x	x		x	x	3.0-10.0%RH, Resolution 0.5%RH
AV.41	Humidif.Demand	Out of service						x	x	0-100%, Resolution 0.1%
AV.42	CoolingDemand2	Out of service					x	x	x	0-100%, Resolution 0.1%
AV.43	CoolingProp.Band2	Present Value					x	x	x	0.5-5ºC or 1-10ºF, Resolution 0.5ºC/1ºF
AV.44	CoolingDeadBand2	Present Value					x	x	x	0.3-5ºC or 0.6-10ºF, Resolution 0.1ºC/0.2ºF
AV.45	Extern.HumidityOffset	Present Value			x			x		± 5.0%RH, Resolution 0.1%RH

[8] ID is equal to ObjectType.Instance

ID[8]	Name	Writable Property	TFCB24F3XYZ1	TFCB24F3XY2	TFHB24F3XYZ1	TFHB24F3XYZ2	TFCB24P3-OE1	TFHB24P3-OE1	TFHB24P3-OE2	Notes
BI.1	DigitalInput	Out of service	x	x	x	x	x	x	x	0= Open 1= Close
BV.1	Temper.Unit	Present Value	x	x	x	x	x	x	x	0= Celsius 1= Fahrenheit
BV.2	Temper.SetPointLock	Present Value	x	x	x	x	x	x	x	0= Disable 1= Enable
BV.3	UserControlOffMode[9]	Present Value	x	x	x	x	x	x	x	0= Enable 1= Disable
BV.4	UserFanAutoMode	Present Value	x	x	x	x	x	x	x	0= Enable 1= Disable
BV.5	ControlType	Present Value	x	x	x	x	x	x	x	0= 2Pipes 1= 4Pipes
BV.6	ControlTemper.Source	Present Value	x	x		x	x	x	x	0= Intern.Sensor 1= Extern.Sensor[10]
BV.7	ChangeOverMode	Out of service	x	x	x	x	x	x	x	0= Cooling 1= Heating
BV.9	CoolingRamp2	Present Value					x	x	x	0= Off 1= On
BV.10	Humidification	Present Value						x	x	0= Off 1= On
BV.16	AntiFreezeProtection[11]	Present Value	x	x	x	x	x	x	x	0= Off 1= On
MSV.1	UniversalInputFunction[12]	Present Value	x	x		x	x		x	1= Off 2= Extern.Sensor *States of TFCB24F3XY2 product.* States available if BV.5 is set to "2Pipe" 1= ChangeOverSensor 2= Ch.Ov.ContactNorm.Cool 3= Ch.Ov.ContactNorm.Heat States available if BV.5 is set to "4Pipe" 1= Off 2= Extern.Sensor
MSV.2	UserFanSpeed	Present Value	x	x	x	x	x	x	x	States available if BV.4 is set to "Enable" 1= Auto 2= Speed1_Low 3= Speed2_Medium *(available if MSV.8 is set to "Analog" or "3Speeds" or "2Speeds")* 4= Speed3_High *(available if MSV.8 is set to "Analog" or "3Speeds")* States available if BV.4is set to "Disable" 1= Speed1_Low 2= Speed2_Medium *(available if MSV.8 is set to "Analog" or "3Speeds" or "2Speeds")* 3= Speed3_High *(available if MSV.8 is set to "Analog" or "3Speeds")*

[9] Enable or Disable "off" state of UserControlMode (MSV.3).
[10] It can be set to "Extern.Sensor" only if one object MSV.1 or MSV.12 is set to "Extern.Sensor" (only in -OE1)
[11] Available on version 1.07 and above.
[12] Activating external temperature does not automatically modify the control source; it is necessary to also modify BV.6 to control external temperature.

ID[8]	Name	Writable Property	TFCB24F3XYZ1	TFCB24F3XY2	TFHB24F3XYZ1	TFHB24F3XYZ2	TFCB24P3-OE1	TFHB24P3-OE1	TFHB24P3-OE2	Notes
MSV.3	UserControlMode	Present Value	x	x	x	x	x	x	x	*States of all except TFxB24-OEy* States available if MSV.4 is set to "Auto" 1= Auto 2= Heating 3= Cooling 4= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "Cooling" 1= Cooling 2= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "Heating" 1= Heating 2= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "HeatingOrCooling" 1= Heating 2= Cooling 3= Off (only if BV.3 is set to "Enable") *States of TFxB24-OEy products.* States available if MSV.4 is set to "Auto" 1= Auto 2= Heating 3= Cooling 4= Fan 5= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "Cooling" 1= Cooling 2= Fan 3= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "Heating" 1= Heating 2= Fan 3= Off (only if BV.3 is set to "Enable") States available if MSV.4 is set to "HeatingOrCooling" 1= Heating 2= Cooling 3= Fan 4= Off (only if BV.3 is set to "Enable")
MSV.4	ControlMode[13]	Present Value	x	x	x	x	x	x	x	1= Auto 2= Heating 3= Cooling 4= HeatingOrCooling
MSV.5	Heat/CoolOutputSignal2pipes	Present Value	x	x	x	x	x	x	x	1= Analog 2= On_Off 3= Floating (except for TFCB24F3XY2)
MSV.6	HeatingOutputSignal4pipes	Present Value	x	x	x	x	x	x	x	1= Analog 2= On_Off 3= Pulsing
MSV.7	CoolingOutputSignal4pipes	Present Value	x	x	x	x	x	x	x	1= Analog 2= On_Off
MSV.8	FanOutputSignal	Present Value	x	x	x	x	x	x	x	1= Analog 2= 1Speed 3= 2Speeds 4= 3Speeds *State for TFCB24F3XY2 product.* 1= 1Speed 2= 2Speeds 3= 3Speeds
MSV.10	Loc.Heat.OutputSignal	Present Value	x		x	x	x	x	x	1= Off 2= On_Off 3= Pulsing 4= Analog 5= On_Off_w_Fan 6= Pulsing_w_Fan 7= Analog_w_Fan

[13] Locks user options. MSV.3, UserControlMode, will be affected or even locked in one state.

ID[8]	Name	Writable Property	TFCB24F3XYZ1	TFCB24F3XY2	TFHB24F3XYZ1	TFHB24F3XYZ2	TFCB24P3-OE1	TFHB24P3-OE1	TFHB24P3-OE2	Notes
MSV.11	DigitalInputMode	Present Value	x	x	x	x	x	x	x	1= OccNorm.Open 2= OccNorm.Close
MSV.12	UniversalInput2Function	Present Value	x		x	x	x	x	x	States available if BV.5 is set to 2Pipe: 1= ChangeOverSensor 2= Ch.Ov.ContactNorm.Cool 3= Ch.Ov.ContactNorm.Heat States available if BV.5 is set to 4Pipe except for OE1 version. 1=Off States available if BV.5 is set to "4 Pipe" in *OE1 version* 1= Off 2= Extern.Sensor
MSV.13	OccupancyMode[14]	Present Value	x	x	x	x	x	x	x	1= Occ.Locally 2= Occupancy 3= NoOccupancy
MSV.14	OccupancyStatus[15]	Out of service	x	x	x	x	x	x	x	1= NoOccupancy 2= Occupancy 3= Override

[14] Occ.Locally lets the thermostat locally manage the occupancy or noOccupancy status for energy conservation. The other 2 states force the thermostat into a specific state.
[15] Read only. Override will only be active if AV.39 is other than 0 and the user presses a button.

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