

General

The IMC BACnet® module allows communication between the Lennox IMC (M1-7, v5.02+) controller and a BACnet MSTP network. The module translates input and output variables between the Lennox SysBus protocol and the BACnet protocol.

The BACnet® module has been developed to communicate with building automation systems that support the BACnet Application Specific Controller (B-ASC) device profile.

A Lennox zone sensor, a BACnet® network zone sensor, or a BACnet thermostat may be used to send the zone temperature or thermostat demands to the IMC.

Table of Contents

General	1
Hardware Specifications	1
Network Limitations	2
Network Cable	2
Network Bus Termination	2
Configuring IMC Unit Controller	3
Data Update Rate	3
Start Up Unit Operation	4
Normal Unit Operation	4
Communication Check Out	5
Connection Failure	5
BACnet Datapoints	6
Zone Sensor Setpoints	8
IMC Alarm Codes	8
Interpretation of Datapoints	9
BACnet PIC Statement	23

Table 1. IMC BACnet® Hardware Specifications

Electrical	
Power Supply	24VAC 50/60Hz (18-30VAC)
Power Consumption	<=7 watts
Connector	Two position terminal block (Polarity Sensitive) (Hot, Com)
Environment	
Operating Temperature Range	-40F to 155F
Storage temperature Range	-40F to 185F
RH	10-95% RH non-condensing
Field Connections	
BACNET MSTP	
Transceiver	RS-485
Connector	Three position terminal block (+ - G)
Baud Rate	38.4K
Cable Type	Twisted pair w/shield, 22AWG min. Belden type 88761 or 8761. Lennox 27M19, 94L63 or 68M25
Max. Cable Length	4000 ft Repeater is required for longer lengths.
Bus Termination	120 ohms on last module in chain.
LENNOX SysBus	RS485
Connector	Two position terminal block
Baud Rate	9600
Cable Type	Twisted pair w/shield, 22AWG min. Belden type 88761 or 8761. Lennox 27M19, 94L63 or 68M25.
Max. Cable Length	4000 ft. Repeater is required for longer lengths
Bus Termination	None
Physical	
Dimensions	3.1 x 3.5 x 1.25 in. (WxDxH)
Weight	0.1 lbs (0.04Kg)
PCB Material	FR4 Conformal coated
Mounting	Four brass 5 in. standoffs for #6 screws.

Network Limitations

The Lennox BACnet module does not support the COV (change of value) service.

Lennox supports up to 31 unique MAC addresses utilizing the IMC address DIP switches. Specific performance with the controls being used is the responsibility of the controls integrator and/or the controls manufacturer.

While there are 31 unique MAC addresses allowed, they must be in the range of 1-31.

All modules have the same device name "Lennox". The device name cannot be made unique.

Network Cable

The IMC BACnet® Module is compatible with MSTP EIA-485 daisy-chain networks communicating at 38.4 kbps. Connect the BACnet MSTP network cable to the IMC BACnet module. The module operates at a 38.4K baud rate. It is compatible with twisted pair, shielded 22AWG minimum cable such as Belden 8761, 88761 and Lennox catalog numbers 27M19, 94L63 or 68M25. A maximum of 31 IMC BACnet modules can be included per network.

The network cable should be routed using best practices to avoid induced noise. Do not route alongside power lines, or in proximity to high voltage or high frequency devices,

such as ignition controls and variable frequency drives. The BACnet MSTP maximum total bus length (without repeater) of 4000ft. (1219m) applies to this device. Daisy-chain each module to the network and connect the network cable shield to the earth ground at the control panel, and at the G terminal of each BACnet module in the chain.

Network Bus Termination

A 120 ohm 1/4 watt resistor (provided in field kit) must be added between the + and - terminals on the BACnet connection on the last module in the daisy chain.

! IMPORTANT

Install the resistor on the LAST module only. Do not add a resistor to each module.

! IMPORTANT

A qualified systems integrator with adequate training and experience is required to integrate and commission the IMC BACnet Module into a third party BACnet building automation system. A BACnet configuration software tool is required to commission the BACnet network.

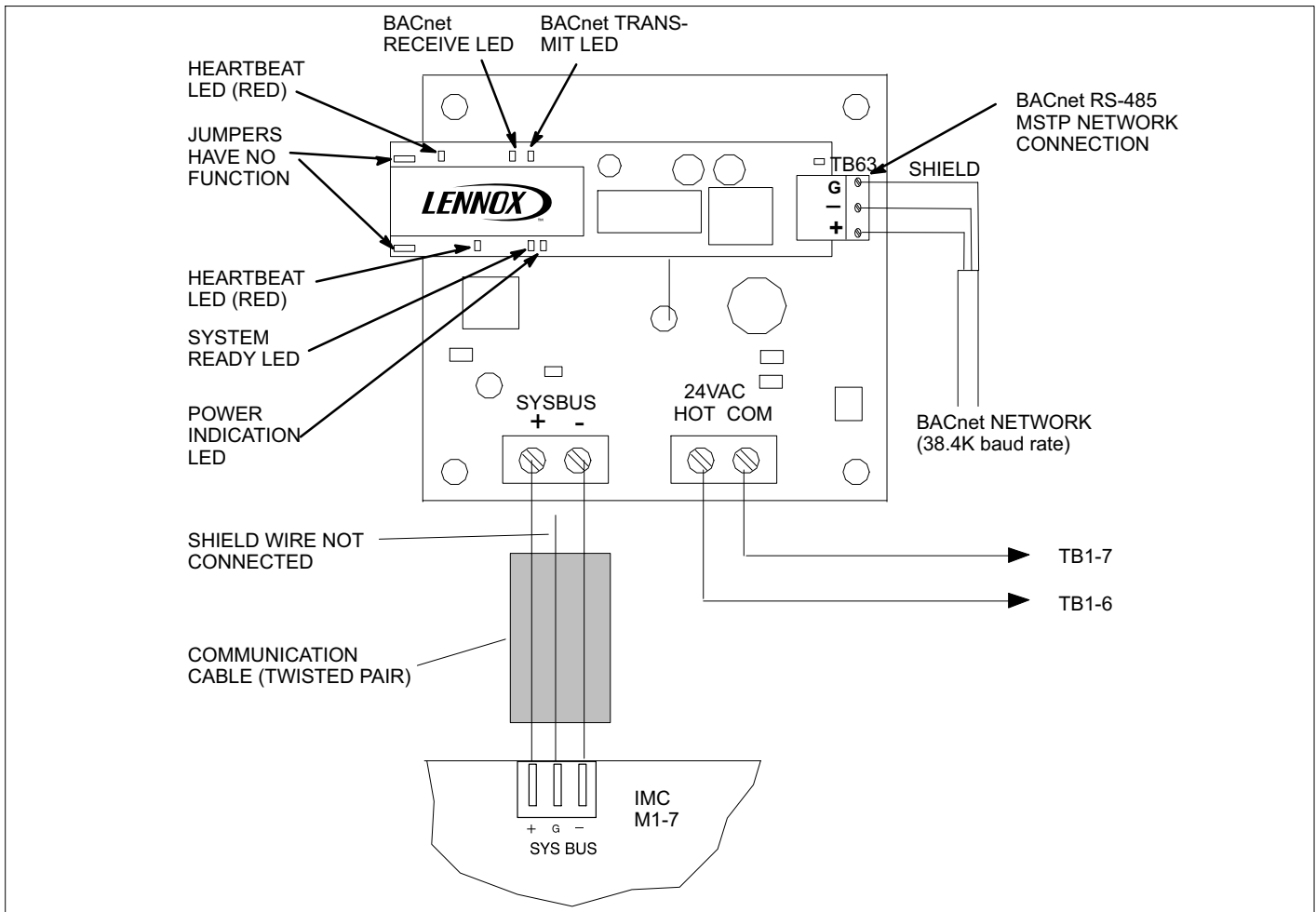


Figure 1. IMC BACnet® Module (A146)

Configuring the IMC Unit Controller

ECTO Settings

Use the IMC pushbutton and DIP switches to manually adjust the following control parameters (see IMC manual). A PC can also be used with Unit Controller software and a PC converter.

Lennox Zone Sensor Installed:

1. Set ECTO 6.01 to option 3 (zone sensor system mode with return air sensor back-up).
2. Set ECTO 6.17 to option 1 (continuous blower during occupied).
3. Set ECTO 6.02-6.05 as specified (back-up occupied and unoccupied heating and cooling setpoints).

BACnet® Zone Sensor Installed:

1. Set ECTO 6.01 to option 3 (zone sensor system mode with return air temperature back-up).
2. Set ECTO 6.17 to option 1 (continuous blower during occupied).
3. Set ECTO 5.27 to option 2 (network zone sensor option).

BACnet Thermostat Installed:

Set ECTO 6.01 to option 6 (remote demand system mode with return air sensor back-up).

IMC Settings

1. Be sure the occupied 24 VAC input is energized by adding a jumper wire between TB1-8 and 9. In the event that communication is lost between the IMC BACnet module and the IMC, the IMC will operate in the occupied mode and use the occupied backup setpoints.
2. Set the BACnet device I.D. (and MAC address) with the unit address DIP switch on the IMC main board (M1-7). See figure 2. Each IMC on the BACnet network must have a different address between 1 and 31. Do not use 0 for addressing.

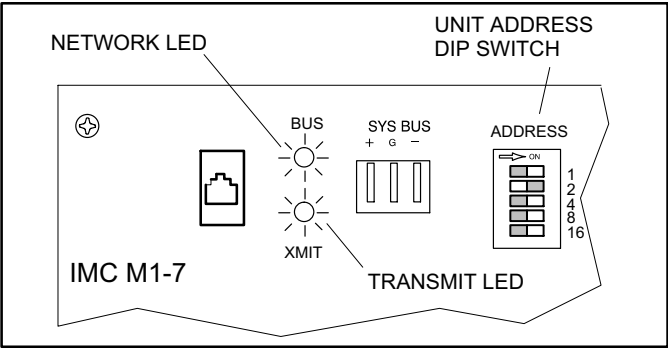


Figure 2. IMC LEDS

The value of the five switches on the address DIP switch are labeled on the printed circuit board (1, 2, 4, 8, or 16). Add the values of the five switches set to the ON position. See figure 3.

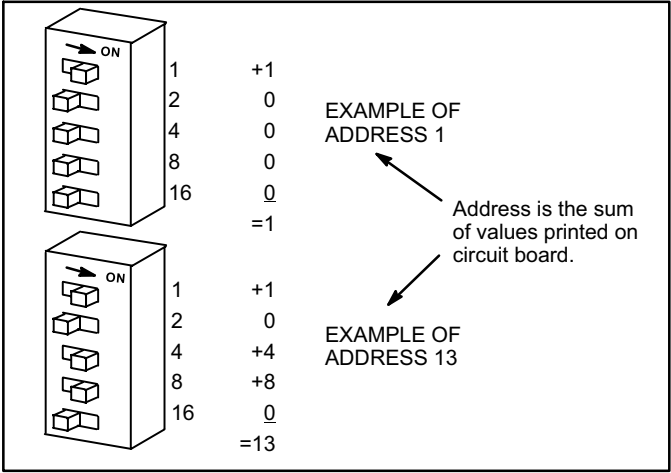


Figure 3. Address DIP Switch

IMC Version

This module requires a rooftop unit IMC M1-7 version 5.02 or higher. An IMC upgrade kit is available for older M1-7 versions. M1-6 and earlier IMCs cannot be used with the BACnet module; contact Lennox Technical Support at 800-453-6669. Check IMC version as follows:

1. Locate IMC board in compressor area. Refer to IMC manual provided with rooftop unit.
2. Set the MODE DIP “UNIT TEST” and “RECALL” switches to “ON”. See figure 4.
3. The IMC LEDs will display the current IMC version.
4. Be certain to return the “UNIT TEST” and “RECALL” switches to “OFF” after viewing the version number. Communication to the IMC is interrupted while these MODE DIP switches are “ON”.

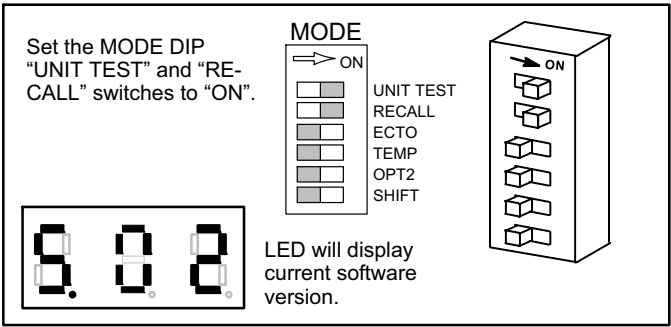


Figure 4. Check Software Version and Address

Data Update Rate

If the following BACnet® variables are not updated for a period of 5 minutes, the IMC will go into the back up modes described in the BACnet Connection Failure Section.

- Application Mode Control AO:101 (when ECTO 6.01=4-7)
- Space Temperature Input AO:113 (when ECTO 5.27=2)

Whenever either of these ECTO selections are made, it is highly recommended the IMC get updated in less than 2 minutes.

Start Up Unit Operation - Before BACnet Network is Commissioned

Lennox Zone Sensor Installed:

Prior to commissioning, no BACnet setpoint is available. The unit will be off.

Two minutes after power-up (ECTO 5.25), the IMC will operate the unit based on the IMC ECTO unoccupied backup setpoints (heating = 60°F, cooling = 85°F) and current zone temperature read by the Lennox zone sensor.

BACnet Zone Sensor Installed:

Prior to commissioning, neither BACnet setpoint nor sensor data are available. The unit will be off.

Five minutes after power-up, the IMC will operate the unit based on the IMC ECTO unoccupied backup setpoints (heating = 60°F, cooling = 85°F) and the current zone temperature read by an additional Lennox zone sensor if installed. If the Lennox zone sensor is not installed, the IMC return air temperature sensor is used as backup (ECTO 6.01).

BACnet Thermostat Installed:

Prior to commissioning, no BACnet thermostat command is available. The unit will be off.

Five minutes after power-up, if no application mode command has been received, the IMC will operate the unit based on the IMC ECTO unoccupied backup setpoints (heating = 60°F, cooling = 85°F) and the current zone temperature read by the Lennox zone sensor or the IMC return air temperature sensor depending on the choice of backup (ECTO 6.01).

Normal Unit Operation - After BACnet Network Is Commissioned

The occupancy of the space can be determined using any combination of the following control points:

- BACnet Network scheduling
- Manual override
- Space occupancy sensor

Lennox Zone Sensor Installed:

The unit is off for up to two minutes after power-up (ECTO 5.25) unless the BACnet Network sends a setpoint. The unit will operate based on this setpoint and the temperature from the Lennox zone sensor.

In addition to control points, space occupancy can be manually overridden using a Lennox zone sensor equipped with an optional after hours switch.

BACnet Zone Sensor Installed:

The unit is off for up to five minutes after power-up unless the BACnet Network sends a setpoint and BACnet zone sensor data. The unit will operate based on this setpoint and temperature data.

BACnet Thermostat Installed:

The unit remains off for up to five minutes after power-up unless the BACnet Network sends a thermostat command. The unit will operate based on the most recently received thermostat command.

Communication Check

Use the following table as a guide once the IMC and BACnet Module are connected and powered. See figure 3.

Table 2. IMC to BACnet® Module Communication

LED	Action
IMC BUS and XMIT LEDs flash.	None. Indicates normal communication.
IMC BUS and XMIT LEDs are off.	<ol style="list-style-type: none"> 1- Check cable connection between the IMC module. 2- Reverse polarity of the cable between the IMC and BACnet Module. 3- Check 24VAC power to BACnet module.
IMC BUS LED flashes but XMIT LED is off.	<ol style="list-style-type: none"> 1- Make sure unit addresses are between 1 and 31. 2- Make sure MODE DIP RECALL switch is OFF. 3- Make sure MODE DIP ECTO switch is OFF. 4- Make sure MODE DIP UNIT TEST switch is OFF.

Table 3. BACnet Network Communication

Use the following table as a guide once the BACnet network is set up and operating.

LED	Action
BACnet communication transmit and receive LEDs flash.	None. Indicates normal communication.
BACnet communication LEDs are off.	<ol style="list-style-type: none"> 1- Check BACnet network connections. 2- Make sure BACnet network is commissioned. 3- Make sure 24 volts is connected to the BACnet module. 4- Make sure unit address is between 1 and 31.

Connection Failure

Table 4. Connection Failure

Control following a connection failure depends on where the failure occurs, and which input device has been used.

	Between IMC and BACnet Module	BACnet Network
Lennox Zone Sensor	<ol style="list-style-type: none"> 1- During the 5 minutes following a failure, the IMC cycles on last setpoint. 2- IMC resets. No heating or cooling during 2 minutes (ECTO 5.25) following reset. 3- IMC cycles based on ECTO backup setpoints. 4- Occupancy is determined by hardware input at TB1. 	<ol style="list-style-type: none"> 1- IMC cycles on last setpoint. 2- Last occupancy input is used.
BACnet Zone Sensor	<ol style="list-style-type: none"> 1- During 5 minutes following failure, IMC continues current operation: heat, cool, or off. 2- IMC resets. No heating or cooling during 5 minutes following reset. 3- IMC uses ECTO backup setpoints. 4- IMC attempts to use Lennox zone sensor as backup. If this fails, IMC uses return air sensor backup. 5- Occupancy is determined by hardware input at TB1. 	<ol style="list-style-type: none"> 1- During 5 minutes following failure, IMC continues current operation: heat, cool, or off. 2- IMC uses ECTO backup setpoints. 3- IMC attempts to use Lennox zone sensor as backup. If this fails, IMC uses return-air-sensor backup. 4- Last occupancy input is used.
BACnet Thermostat	<ol style="list-style-type: none"> 1- During 5 minutes following failure, IMC continues current operation: heat, cool, or off. 2- IMC resets. No heating or cooling during 5 minutes following reset. 3- IMC uses ECTO backup setpoints. 4- IMC uses return-air-sensor backup. 5- Occupancy is determined by hardware input at TB1. 	<ol style="list-style-type: none"> 1- During 5 minutes following failure, IMC continues current operation: heat, cool, or off. 2- IMC uses ECTO backup setpoints. 3- IMC uses return-air-sensor backup. 4- Last occupancy input is used.

BACnet® Data Points

By convention input and output are described from the point of view of a client device communicating with the interface module. Outputs are values written to the interface

module, and inputs are values read from the interface module (see tables 5 and 6).

Table 5. Inputs To IMC		
BACnet Object Name	Object Type: ID: Units	Description
Application Mode Control	AO: 101:95 (No_Units)	Unit application
0 -Auto		Heating or cooling. Default after reset.
1 -Heat		Heating only.
3 -Cool		Cooling only.
6 -Off		Unit off.
9 -Fan only		No heating or cooling allowed.
208 -Fan auto		Main fan (blower) auto. Default after reset.
209 -Fan on		Main fan (blower) on.
216 -Exhaust auto		Power exhaust fan auto. Default after reset.
217 -Exhaust on		Power exhaust fan on.
218 -Exhaust off		Power exhaust fan off.
224 -Idle		Heat / cool off. Default after reset.
225 -Heat1		Heat 1
226 -Heat2 (heat pump only)		Heat 2. Heat pump emergency heat.
227 -Heat3		Heat 3. Full heating.
228 -Cool1		Cool 1
229 -Reheat lo		Supermarket reheat (lo)
230 -Reheat high		Supermarket reheat (hi)
232 -Cool2		Cool 2
236 -Cool3		Cool 3. Full cooling.
254 -Reset		Force controller reset
255 -Null		Same as auto.
Outdoor Air Min Pos Control	AO: 102 : 98 (Percent)	Min economizer damper position
Occupancy Override Control	AO: 103: 95 (No_Units)	Zone occupied status
Occupancy Scheduler Control	AO: 104: 95 (No_Units)	Occupancy scheduler input used to put controller unit into different occupancy modes.
Occupancy Sensor Input	AO: 107: 95 (No_Units)	Occupancy sensor input. Used to indicate the presence of occupants
Space Dehumidification Setpt	AO: 108: 98 (Percent)	Zone relative humidity set point
Temperature Setpoint (abs)	AO: 109: 64 (Deg. F)	Zone temperature setpoint
Temperature Setpoint Offset	AO: 110: 64 (Deg. F)	Zone temp setpoint offset
Space Temperature Input	AO: 113: 64 (Deg. F)	Remote zone temp.
Emergency Override Control	AO: 114: 95 (No_Units)	Emergency smoke override
Compressor Enable Control	AO: 115: 98 (Percent)	Compressor enable
Primary Heat Enable Control	AO: 117: 98 (Percent)	Primary heat enable
Auxiliary Heat Enable Control	AO: 119: 98 (Percent)	Auxiliary heat enable
Duct Static Setpoint	AO: 123: 58 (Inches-of-water)	Duct static pressure setpoint
Building Static Setpoint	AO: 124: 58 (Inches-of-water)	Building static pressure setpoint
Discharge Air Cooling Setpoint	AO: 125: 64 (Deg. F)	Discharge air cooling setpoint
Discharge Air Heating Setpoint	AO: 126: 64 (Deg. F)	Discharge air heating setpoint
Supply Fan Capacity Input	AO: 127: 98 (Percent)	Supply fan capacity setting
Exhaust Fan Capacity Input	AO: 128: 98 (Percent)	Exhaust fan capacity setting

Table 6. Outputs from IMC		
BACnet Object Name	Object Type: ID: Units	Description
IMC Version [00].....[07]	AI: 200-207 : 95 (No_Units)	IMC firmware version. (null terminated ASCII)
Unit ID	AI: 231 : 95 (No_Units)	Unit ID \$3x-Gas/Elect. \$4x-Elect/Elect. \$5x-Heat Pump
Unit Status	AI :232 : 95 (No_Units)	Unit operation mode (i.e. cool, heat, etc.)
1 - HVAC heat		
2 - HVAC morning warm-up		
3 - HVAC cool		
5 - HVAC pre-cool		
6 - HVAC off		
7 - HVAC test		
8 - HVAC emergency heat		
9 - HVAC fan only		
12 - HVAC max heat		
14 - HVAC dehumidification		
129 - HVAC fresh air heating		
131 - HVAC fresh air cooling		
145 - HVAC defrost 1		
161 - HVAC defrost 2		
177 - HVAC defrost 1, 2		
Space Temperature	AI: 239 : 64 (Deg. F)	
Discharge Air Temperature	AI: 240 : 64 (Deg. F)	Supply air temperature
Effective Occupancy	AI: 241 : 95 (No_ Unit)	Zone occupied status
Local Outside Air Temperature	AI: 242 : 64 (Deg. F)	Outdoor air temperature
Local Space Temperature	AI: 243 : 64 (Deg. F)	Zone Temperature, local
Outside Air Damper	AI: 244 : 98 (Percent)	Economizer damper position
Heat Primary	AI: 245 : 98 (Percent)	Primary heating status
Heat Secondary	AI: 246 : 98 (Percent)	Heat pump electric strip heating status
Cool Primary	AI: 247 : 98 (Percent)	Cooling compressor 1-4 status (on/off)
Economizer Enabled	AI: 248 : 95 (Percent)	Economizer outdoor air suitable
Supply Fan Status	AI: 250 : 98 (Percent)	Supply fan status
Space Temperature Set Point (Eff)	AI: 252 : 64 (Deg. F)	Zone temperature set points
Current Error	AI: 253 : 95 (No_Units)	Currently displayed error code
Error Pointer	AI: 254 : 95 (No_Units)	Error pointer. This value points to the next available alarm code location. It runs from 0 to 83 and then rolls-over to 0. Tracking this value and using the ten most recent error codes (below) allows an application to determine when new errors are logged by the IMC, what those errors are, and if any errors have been missed due to network delays or for any other reason.
Most recent Error 1..10	AI: 255-264 : 95 (No_Units)	IMC alarm codes as listed in the IMC manual.
Space CO2 Sensor (Local)	AI : 274 :96 (Parts per million)	Zone CO ₂ level (PPM), local
Space Humidity (Local)	AI: 276 : 98 (Percent)	Zone relative humidity, local
Dehumidification Set Point (Eff)	AI: 278 : 98 (Percent)	Zone relative humidity set point
Dehumidification Status	AI: 279 : 95 (No_Units)	Dehumidification status
Return Air Temperature	AI: 281 :64 (Deg. F)	Return air temperature
Building Static Pressure	AI: 282 : 64 (Inches of water)	Analog Input 2 (GP1 - VAV Bldg Static)

table continued on next page

Table 6. Outputs from IMC		
BACnet Object Name	Object Type: ID: Units	Description
Duct Static Pressure	AI: 283 : 64 (Inches of water)	Analog Input 1 (GP1 - VAV Supply Static)
Exhaust Fan Status	AI: 285 :98 (Percent)	Exhaust fan status
Controller Online	B1:100 :95 (No_Units)	IMC Communicating

Zone Sensor Setpoints

The IMC typically uses four setpoints and the zone temperature to operate the unit when a zone sensor is installed. Because the BACnet network provides a single setpoint input, the IMC will use the zone temperature setpoint and

ECTO 6.15 to determine the heat / cool setpoint in the occupied mode. During the unoccupied mode, the IMC will use the zone temperature setpoint and the difference between ECTO 6.05 and 6.03. See figure 5 for an example of setpoints when the IMC is operating using ECTO default values.

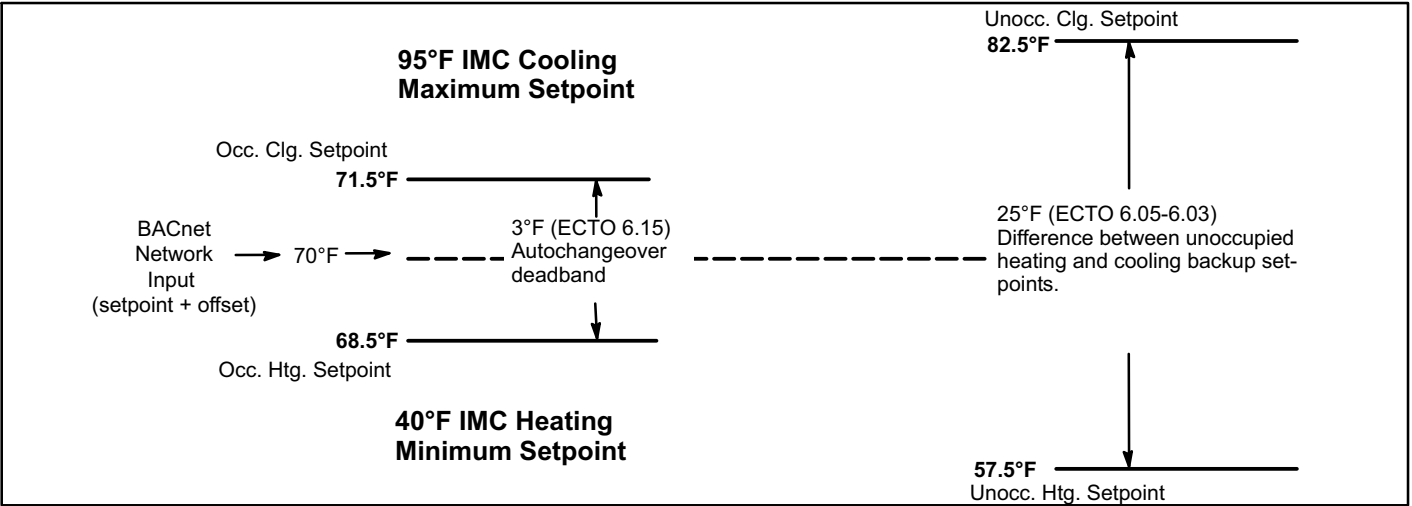


Figure 5. IMC Default Setpoint Example (Zone Sensor Installed)

IMC Alarm Codes See the IMC user guide for a list of alarm codes.

Interpretation Of Datapoints

IMC BACnet® Properties – Value_Decoding

Object Name: Controller Online
Object Type: BI (read)
Object ID: 100
Object Units: (95) No_Units
Value = 0 - 1

0: Lennox IMC is not communicating.

1: Lennox IMC is communicating.

Object Name: Application Mode Control
Object Type: AO (write- datatype unsigned)
Object ID: 101
Object Units: (95) No_Units
Value = 0 - 255

Set the application mode input to Value.

The IMC controller can be set locally during commissioning to operate in either of two modes: remote zone sensor control mode (with local or remote zone sensor), or remote thermostat control mode. Several application mode command values are recognized by either IMC mode, while some can only be used when the IMC is in the remote thermostat control mode.

Common Application Mode Values

Value	Mode	Description
0 \$00	AUTO	Heating or cooling. Default after reset.
1 \$01	HEAT	Heating only.
3 \$03	COOL	Cooling only.
6 \$06	OFF	Unit off.
9 \$09	FAN ONLY	No heating or cooling allowed.
255 \$FF	NUL	Same as AUTO.
208 \$D0	FAN AUTO	Main fan (blower) auto. Default after reset.
209 \$D1	FAN ON	Main fan (blower) on.
216 \$D8	EXHAUST AUTO	Power exhaust fan auto. Default after reset.
217 \$D9	EXHAUST ON	Power exhaust fan on.
218 \$DA	EXHAUST OFF	Power exhaust fan off.
254 \$FE	RESET	Force controller reset.

The four command groups (0-9, 255), (208-209), (216-218), and (224-236, see below) are independent of each other. Selecting a command from one group does not affect any previously sent command from another group. Except for OFF and RESET, which also set FAN AUTO, EXHAUST AUTO, and heat/cool demand IDLE.

AUTO is the default application mode input. When in a remote zone sensor mode, AUTO allows the IMC control to generate heating and cooling demands based on zone temperature and zone temperature setpoint. Auxiliary functions such as dehumidification or emergency override (i.e. smoke mode) will still operate as needed. Also the blower and exhaust fan functions operate.

HEAT and COOL allow the servicing of only heating or cooling demands. These set a mode only, and do not generate a demand.

Application mode OFF is a unit-disable state, causing the controller to become idle, and clearing all outputs and timers. All outputs are kept off while application mode is OFF.

Application mode FAN ONLY disables heating and cooling operation. No effect on fan operation. Return to normal operation with AUTO, HEAT, or COOL.

Application modes FAN ON and FAN AUTO are used to turn on the main unit fan (blower), or return it to automatic operation.

Application modes EXHAUST ON, EXHAUST OFF, and EXHAUST AUTO are used to turn on/off a power exhaust fan, or to return it to automatic operation. The IMC may delay up to 30 seconds before responding to an exhaust command.

Application mode RESET causes the system to reset itself and go through the controller's startup and initialization routines. This takes about 8 seconds in an IMC controller, during which time the analog and digital inputs are settling to correct values. The controller will return to AUTO operation.

AUTO, FAN AUTO and EXHAUST AUTO are the defaults after reset.

Application Modes Specific To Remote Thermostat Operation

These values are only recognized if the IMC control is placed in a remote thermostat mode of operation (set locally during commissioning).

Value	Mode	Y2	Y1	W2	W1	Description
224 \$E0	IDLE	0	0	0	0	Heat / Cool off. Default after reset.
228 \$E4	COOL1	0	1	0	0	Cool 1.
232 \$E8	COOL2	1	0	0	0	Cool 2.
236 \$EC	COOL3	1	1	0	0	Cool 3. Full cooling.
225 \$E1	HEAT1	0	0	0	1	Heat 1.
226 \$E2	HEAT2	0	0	1	0	Heat 2.
227 \$E3	HEAT3	0	0	1	1	Heat 3. Full heating.
229 \$E5	REHEAT LO	0	1	0	1	Supermarket reheat (lo)
230 \$E6	REHEAT HI	0	1	1	1	Supermarket reheat (hi)

For all \$Ex values the fan runs if it is already on, otherwise the fan turns on after a fan on-delay. For \$E0 the fan turns off after a fan off-delay.

COOL2 and COOL3 are equivalent unless 3-stage cooling has been selected locally at the controller during commissioning.

HEAT2 and HEAT3 are equivalent except in heat pump equipment types, when HEAT2 acts as "emergency heat", running auxiliary strip heat and turning off the compressor(s). So in a heat pump, normal heating is commanded using HEAT1 or HEAT3.

If a mode not defined in the above list is sent, then the application mode is not changed.

When an IMC is commissioned for BACnet® gateway remote thermostat operation, it will wait for 5 minutes following startup to receive application mode data. The IMC will remain in AUTO mode until data is received, or until the 5 minute period has expired.

If 5 minutes passes without data being received, then the IMC will enter the backup mode of operation (set locally during commissioning).

It is recommended that the application mode data be updated at intervals of no more than 2 minutes to be sure that a single missed-data event will not constitute an application mode data failure. Any application mode data will serve as a valid update; either common or remote thermostat values.

If application mode data appears while the IMC is in a backup mode, then the IMC will reset and normal operation will resume.

Object Name: Outdoor Air Min Pos Control
 Object Type: AO (write- datatype unsigned)
 Object ID: 102
 Object Units: (98) Percent

Value = 0 - 255

0 -100: Set the minimum position of the outdoor air economizer damper; % open.
 101 - 255: Relinquish to local control. Min damper position depends on the setting in IMC ECTO 5.24:
 ECTO 5.24
 =101: Min damper position set by potentiometer on economizer control.
 <101: Min damper position set by ECTO 5.24.

The minimum damper position is only effective when the system is occupied and the main blower is running. Otherwise the damper remains closed.

Object Name: **Occupancy Override Control**
Object Type: AO (write- datatype unsigned)
Object ID: 103
Object Units: (95) No_Units

Value = 0-255

0: space occupied
1: space unoccupied (IMC does not support; gives auto operation)
2: refresh space occupied timer defined at local controller
3-255: auto; clear timer and return to occupancy scheduler state

Object Name: **Occupancy Scheduler Control**
Object Type: AO (write- datatype unsigned)
Object ID: 104
Object Units: (95) No_Units

Value = 0 - 255

0: space occupied
1-255: space unoccupied

Object Name: **Occupancy Sensor Input**
Object Type: AO (write- datatype unsigned)
Object ID: 107
Object Units: (95) No_Units

Value = 0 - 255

0: occupancy sensor indicates space occupied
1: occupancy sensor indicates space unoccupied (IMC does not support; gives auto operation)
2-255: auto; return to occupancy scheduler state

The occupancy inputs are logically "OR"; if any one is "OCCUPIED" then the space is occupied, otherwise the space is "UNOCCUPIED". No single input can force the space "UNOCCUPIED".

Object Name: **Space Dehumidification Setpt**
Object Type: AO (write- datatype unsigned)
Object ID: 108
Object Units: (98) Percent

Value = 0 - 100

0-100: % relative humidity setpoint

Dehumidification begins when the effective space relative humidity rises to this setpoint value.

Dehumidification dead ends when the effective space relative humidity reaches falls below this setpoint value minus a dehumidification deadband that is typically 3%. The deadband value is set locally during commissioning.

Object Name: **Temperature Setpoint (abs)**
Object Type: AO (write- datatype real)
Object ID: 109
Object Units: (64) Degrees-Fahrenheit
Value = 36.25 – 100.00 degF, in 0.25 degF increments

The single-point “Temperature Setpoint (abs)” (including offset; see below) is converted locally to occupied and unoccupied heating and cooling setpoints. The occupied and unoccupied heating and cooling setpoints are computed to be centered (if possible) on the effective single-point setpoint. This is done while preserving the occupied and unoccupied deadbands, as well as any local restrictions on minimum or maximum values.

The occupied heat/cool auto-changeover deadband value is set locally during commissioning.

The unoccupied heat/cool auto-changeover deadband value is set locally during commissioning by adjusting the backup unoccupied heating and cooling setpoints. The difference between these setpoints will be used as the unoccupied heat/cool auto-changeover deadband value.

Object Name: **Temperature Setpoint Offset**
Object Type: AO (write- datatype real)
Object ID: 110
Object Units: (64) Degrees-Fahrenheit
Value = -32.00 – 31.75 degF, in 0.25 degF increments

A signed value added to the Temperature Setpoint (abs) value to provide an effective temperature setpoint. See above regarding deadbands and limits.

Object Name: **Space Temperature Input**
Object Type: AO (write- datatype real)
Object ID: 113
Object Units: (64) Degrees-Fahrenheit
Value = 36.25 – 100.00 degF, in 0.25 degF increments

A network value for the space temperature. Heating and cooling demands are generated based on the “Space Temperature Input”, and the “Temperature Setpoint (abs)” and “Temperature Setpoint Offset” values. See above.

When an IMC is commissioned for BACnet® gateway remote room sensor operation, it will wait for 5 minutes following startup to receive space temperature data. The IMC will remain in a no-run mode until data is received, or until the 5 minute period has expired.

If 5 minutes passes without data being received, then the IMC begins to use local data for the space temperature. If a local sensor is connected then it will be used. If not, then a failed-sensor error is recorded and the IMC will enter the backup mode of operation (set locally during commissioning).

It is recommended that network data be updated at intervals of no more than 2 minutes to be sure that a single missed-data event will not constitute a data update failure.

If data appears after a sensor failure is processed, it will be treated as an intermittent sensor. Normal operation will resume. If the IMC is in a backup mode, then it will reset before resuming.

Object Name: **Emergency Override Control**
Object Type: AO (write- datatype unsigned)
Object ID: 114
Object Units: (95) No_Units
Value = 0 - 255

Set the emergency mode defined by Value, decoded as:

Value	Mode	Supply Fan	Exhaust Fan	Outdoor Damper
0	NORMAL	auto	auto	auto
1	PRESSURIZE	on	off	open
2	DEPRESSURIZE	off	on (speed)	closed
3	PURGE	on	on (speed)	open
4	SHUTDOWN	off	off	closed
5	FIRE			
6	DEPRESSURIZE	off	on (pressure)	closed
7	PURGE	on	on (pressure)	open
>7	NUL (normal)	auto	auto	auto

auto - normal operation
(speed) - exhaust fan runs at speed pre-selected at equipment
(pressure) - exhaust fan runs to maintain building press setpoint; local or remote

Mode 5, FIRE, is a locally defined operation (set at commissioning).

For units without VFD exhaust fans, modes 6-7 are the same as 2-3.

“Emergency Override Control” input takes precedence over local smoke input.

Object Name: **Compressor Enable Control**
Object Type: AO (write- datatype unsigned)
Object ID: 115
Object Units: (98) Percent
Value = 0 - 255

0: output disabled
1-100: output limited to 1 – 100% of maximum
101-255: maximum output permitted

The following table shows the Value where the indicated compressor stage is disabled, for equipment having the indicated maximum number of compressor stages:

Maximum Stages	Stage Disabled When Value < x			
	1	2	3	4
1	Value < 50			
2	Value < 33	Value < 66		
3	Value < 25	Value < 50	Value < 75	
4	Value < 20	Value < 40	Value < 60	Value < 80

Free cooling using an economizer with outdoor air is not considered a stage. Only compressors are considered to be stages.

Disabled stages are re-enabled at the above values plus 3% hysteresis.

Object Name: **Primary Heat Enable Control**
Object Type: AO (write- datatype unsigned)
Object ID: 117
Object Units: (98) Percent

Value = 0 - 255

0: output disabled
1-100: output limited to 1 – 100% of maximum
101-255: maximum output permitted

The table shown above for “Compressor Enable Control” can also be applied here to the “Primary Heat Enable Control”. It shows the Value where the indicated primary heating stage is disabled, for equipment having the indicated maximum number of primary heating stages.

In heat pump systems during heating operation, the lower value of “Compressor Enable Control” and “Primary Heat Enable Control” is used to establish the compressors that can run.

Object Name: **Auxiliary Heat Enable Control**
Object Type: AO (write- datatype unsigned)
Object ID: 119
Object Units: (98) Percent

Value = 0 - 255

0: output disabled
1-100: output limited to 1 – 100% of maximum
101-255: maximum output permitted

The table shown above for “Compressor Enable Control” can also be applied here to the “Auxiliary Heat Enable Control”. It shows the Value where the indicated auxiliary heating stage is disabled, for equipment having the indicated maximum number of auxiliary heating stages.

The “Auxiliary Heat Enable Control” is only used in heat pump systems.

Object Name: **Duct Static Setpoint**
Object Type: AO (write- datatype real)
Object ID: 123
Object Units: (58) Inches-of-water

Value = 0.0 - 5.0 inWC

The setpoint for control of duct static pressure, in inches of water column. The main blower speed or bypass damper setting is varied to maintain this value. The setpoint can be selected from the range of 0.0 to 5.0 inches of water column.

Object Name: **Building Static Setpoint**
Object Type: AO (write- datatype real)
Object ID: 124
Object Units: (58) Inches-of-water

Value = -0.5 - 0.5 inWC

The setpoint for control of building static pressure, in inches of water column. The exhaust blower is cycled or, if a VFD is used, its speed is varied to maintain this value. The setpoint can be selected from the range of -0.5 to +0.5 inches of water column.

Object Name: **Discharge Air Cooling Setpoint**
Object Type: AO (write- datatype real)
Object ID: 125
Object Units: (64) Degrees-Fahrenheit

Value = 40 - 80 degF, and -9 degF

The setpoint for control of discharge (or supply) air temperature during cooling. When the controller is in the correct mode of operation, sending this setpoint will cause cooling components to cycle, or vary their output, in order to maintain this temperature in the leaving air stream. The setpoint can be selected from the range of 40 to 80 degrees Fahrenheit. Selecting a value of -9 degF causes the control to revert to the use of its locally programmed setpoint.

Object Name: **Discharge Air Heating Setpoint**
Object Type: AO (write- datatype real)
Object ID: 126
Object Units: (64) Degrees-Fahrenheit

Value = 80 - 140 degF, and -9 degF

The setpoint for control of discharge (or supply) air temperature during heating. When the controller is in the correct mode of operation, sending this setpoint will cause heating components to cycle, or vary their output, in order to maintain this temperature in the leaving air stream. The setpoint can be selected from the range of 80 to 140 degrees Fahrenheit. Selecting a value of -9 degF causes the control to revert to the use of its locally programmed setpoint.

Object Name: **Supply Fan Capacity Input**
Object Type: AO (write- datatype unsigned)
Object ID: 127
Object Units: (98) Percent

Value = 0 - 255

0 - 100: Set the supply fan capacity as a % of maximum speed.

101 - 255: Relinquish to local control. Supply fan capacity depends on IMC ECTO values.

Supply fan capacity is only effective when the main blower is running.

Object Name: **Exhaust Fan Capacity Input**
Object Type: AO (write- datatype unsigned)
Object ID: 128
Object Units: (98) Percent

Value = 0 - 255

0 - 100: Set the exhaust fan capacity as a % of maximum speed.
101 - 255: Relinquish to local control. Exhaust fan capacity depends on IMC ECTO values.

Exhaust fan capacity is only effective when the exhaust fan is running.

Object Name: **IMC Version[00], IMC Version[01], ..., IMC Version[07]**
Object Type: AI (read)
Object ID: 200, 201, ..., 207
Object Units: (95) No_Units

Value = 0, 46, 48 - 57

0: end of string
46: "."
48: "0"
...
57: "9"

Each value is the ASCII code of a character in the IMC version number. The version number is found in a nul-terminated string, most-significant-character first, beginning in IMC Version[00]. Maximum length is 8 chars, including nul.

Object Name: **Unit ID**
Object Type: AI (read)
Object ID: 231
Object Units: (95) No_Units

Value = 0 - 255

48-63: gas heat, electric cool
64-79: electric heat, electric cool
80-95: electric heat pump, with or without electric resistive heat

These are the currently defined IMC unit types.

Object Name: **Unit Status**
Object Type: AI (read)
Object ID: 232
Object Units: (95) No_Units
Value = 0 - 255

- 1 – HVAC heat.
- 2 – HVAC morning warmup.
- 3 – HVAC cool.
- 5 – HVAC pre-cool.
- 6 – HVAC off.
- 7 – HVAC test.
- 8 – HVAC emergency heat.
- 9 – HVAC fan only.
- 12 – HVAC max heat.
- 14 – HVAC dehumidification.
- 129 – HVAC fresh air heating.
- 131 – HVAC fresh air cooling.
- 145 – HVAC defrost compressor 1.
- 161 – HVAC defrost compressor 2.
- 177 – HVAC defrost compressor 1 & 2.

These are the currently defined IMC unit status.

Object Name: **Space Temperature**
Object Type: AI (read)
Object ID: 239
Object Units: (64) Degrees-Fahrenheit
Value = 63.75 – 100.00 degF, in 0.25 degF increments

Space temperature from local IMC sensor, or from “Space Temperature Input”.

This is the actual value being used by the IMC. Its source is either a locally wired temperature sensor (see “Local Space Temperature”) or the network input (see “Space Temperature Input”).

Object Name: **Discharge Air Temperature**
Object Type: AI (read)
Object ID: 240
Object Units: (64) Degrees-Fahrenheit
Value = -8.7 – 164.4 degF, in 0.7 degF increments
Discharge air temperature measurement from IMC sensor.

Object Name: **Effective Occupancy**
Object Type: AI (read)
Object ID: 241
Object Units: (95) No_Units
Value = 0 - 2

- 0: space occupied
- 1: space unoccupied
- 2: space occupied (timed override)

The occupancy override timer is established locally for each controller during system commissioning.

The “Effective Occupancy” depends on the “Occupancy Scheduler Control”, the “Occupancy Override Control”, and the “Occupancy Sensor Input. The “Effective Occupancy” is occupied if any of these inputs are in the occupied state. Otherwise “Effective Occupancy” is unoccupied.

The local IMC occupied input is ignored when a BACnet® module is used.

Object Name: **Local Outside Air Temperature**
Object Type: AI (read)
Object ID: 242
Object Units: (64) Degrees-Fahrenheit
Value = -30.6 – 131.6 degF, in 0.6 degF increments
Outdoor air temperature measurement from IMC sensor.

Object Name: **Local Space Temperature**
Object Type: AI (read)
Object ID: 243
Object Units: (64) Degrees-Fahrenheit
Value = 63.75 – 100.00 degF, in 0.25 degF increments
Space temperature from IMC sensor.

Object Name: **Outdoor Air Damper**
Object Type: AI (read)
Object ID: 244
Object Units: (98) Percent
Value = 0 – 100, 255
0 - 100: Outdoor air damper position. Percent-open.
255: No damper.

Object Name: **Heat Primary**
Object Type: AI (read)
Object ID: 245
Object Units: (98) Percent
Value = 0 – 100
0 - 100: Current level of the primary heating capacity.
This is based on the number of gas stages operating in a gas/electric unit, or compressors operating in a heat pump, or electric resistance stages operating in an electric/electric unit.

Object Name: **Heat Secondary**
Object Type: AI (read)
Object ID: 246
Object Units: (98) Percent
Value = 0 – 100
0 - 100: Current level of the secondary heating capacity.
This is auxiliary (electric resistance “strip”) heat in a heat pump. Whether it is on in addition to the primary heat (compressor), or as emergency heat while the compressor is locked-out.

Object Name: **Cool Primary**
Object Type: AI (read)
Object ID: 247
Object Units: (98) Percent
Value = 0 – 100
0 - 100: Current level of the primary cooling capacity.
This is based on the number of compressors operating.
There is no secondary cooling.

Object Name: **Economizer Enabled**
Object Type: AI (read)
Object ID: 248
Object Units: (95) No_Units

Value = 0 – 1, 255

0: Economizer is disabled.
1: Economizer is enabled (outdoor air is suitable for free cooling).
255: No economizer.

The enabled state only indicates that the IMC has determined that the outdoor air is suitable for free cooling. The unit is actually executing free cooling operation if “Economizer Enabled” is 1, and “Unit Status” is 3, 5, or 131.

Object Name: **Supply Fan Status**
Object Type: AI (read)
Object ID: 250
Object Units: (98) Percent

Value = 0 – 100

0: Supply fan off.
1: Supply fan on (single-speed fan).
2 - 100: Supply fan on (variable-speed fan; percent of full speed).

Object Name: **Space Temperature Setpt (Eff)**
Object Type: AI (read)
Object ID: 252
Object Units: (64) Degrees-Fahrenheit

Value = 40.0 – 95.0 degF, in 0.25 degF increments

The effective space temperature setpoint, which depends on:
current “Temperature Setpoint (abs)”,
current “Temperature Setpoint Offset”,
current “Effective Occupancy”,
most recent heating or cooling demand indicated by “Unit Status”,
any local setpoint adjustment,
and heating and cooling deadbands and differentials set at system commissioning.

Object Name: **Current Error**
Object Type: AI (read)
Object ID: 253
Object Units: (95) No_Units

Value = 0 - 255

This is the code for the currently occurring alarm condition, if any. If no alarm is currently in progress, then the Value is 0. If the Value is not zero, then “Current Error” and “Most Recent Error 1” (see below) will be equal.

Refer to the IMC User’s Guide for alarm code descriptions.

Object Name: **Error Pointer**
Object Type: AI (read)
Object ID: 254
Object Units: (95) No_Units

Value = 0 - 83

This value points to the next available alarm code location. It runs from 0 to 83, and then rolls-over to 0. Tracking this value and using the ten-most-recent-error-codes (see below) allows an application to determine when new errors are logged by the IMC, what those errors are, and if any errors have been missed due to network delays or for any other reason.

Object Name: **Most Recent Error 1,
Most Recent Error 2
Most Recent Error 10**

Object Type: AI (read)

Object ID: 255, 256, ..., 264

Object Units: (95) No_Units

Value = 1 - 255

These are the ten most recently occurring diagnostic codes; “Most Recent Error 1” is the most recent.

The IMC does not time-stamp error codes. This must be done by the primary controller.

This is a first-in first-out buffer. Error codes are stored as they occur, and no filtering is done with respect to duplication or error code severity or priority.

When another error code is logged at “Most Recent Error 1”, the value in “Most Recent Error 10” is lost, being replaced by “Most Recent Error 9”.

Refer to the IMC User’s Guide for alarm code descriptions.

Object Name: **Space CO2 Sensor (Eff)**

Object Type: AI (read)

Object ID: 274

Object Units: (96) Parts-per-million

Value = 0 - 2000

0 - 6: no sensor

7 - 1992: valid CO₂ measurement

1993 - 2000: sensor error

This is the actual value being used by the IMC, and is the value measured at the IMC.

Object Name: **Space CO2 Sensor (Local)**

Object Type: AI (read)

Object ID: 275

Object Units: (96) Parts-per-million

Value = 0 - 2000

0 - 6: no sensor

7 - 1992: valid CO₂ measurement

1993 - 2000: sensor error

This is the actual value being used by the IMC, and is the value measured at the IMC.

Object Name: **Space Humidity (Eff)**

Object Type: AI (read)

Object ID: 276

Object Units: (98) Percent

Value = 0 - 100

0: no sensor

1 - 99: valid relative humidity measurement

100: sensor error

This is the actual value being used by the IMC, and is the value measured at the IMC.

Object Name: **Space Humidity (Local)**
Object Type: AI (read)
Object ID: 277
Object Units: (98) Percent

Value = 0 - 100

0: no sensor
1 - 99: valid relative humidity measurement
100: sensor error

This is the actual value being used by the IMC, and is the value measured at the IMC.

Object Name: **Dehumidification Setpt (Eff)**
Object Type: AI (read)
Object ID: 278
Object Units: (98) Percent

Value = 0 - 100

Relative humidity setpoint for dehumidification operation.
Deadband is set locally during commissioning.

Object Name: **Dehumidification Status**
Object Type: AI (read)
Object ID: 279
Object Units: (95) No_Units

Value = 0 – 2

0: No dehumidification installed.
1: Dehumidification installed but not running.
2: Dehumidification installed and running.

Object Name: **Return Air Temperature**
Object Type: AI (read)
Object ID: 281
Object Units: (64) Degrees-Fahrenheit

Value = -8.7 – 164.4 degF, in 0.7 degF increments

Unit return air temperature measurement from IMC sensor.

Object Name: **Building Static Pressure**
Object Type: AI (read)
Object ID: 282
Object Units: (58) Inches-of-water

Value = -0.500 – 0.500 inWC, in 0.004 inWC increments

Building (space) static pressure measurement from IMC sensor.

Object Name: **Duct Static Pressure**
Object Type: AI (read)
Object ID: 283
Object Units: (58) Inches-of-water
Value = 0.00 – 5.00 inWC, in 0.02 inWC increments

Duct (supply) static pressure measurement from IMC sensor.

Object Name: **Exhaust Fan Status**
Object Type: AI (read)
Object ID: 285
Object Units: (98) Percent

Value = 0 – 100

0: Exhaust fan off.
1: Exhaust fan on (single-speed fan).
2 - 100: Exhaust fan on (variable-speed fan; percent of full speed).

BACnet® Protocol Implementation Conformance (PIC) Statement

Date: January 30, 2008

Vendor Name: Lennox Industries, Inc.

Product Name: IMC BACnet® Module

Product Model Number: C0CTRL50AE1L

Firmware Revision: Lennox 1.03m, BACnet MSTP 1.15j

BACnet Protocol Revision: 1.2 ANSI/ASHRAE 135-2001

Product Description

The Integrated Modular Control (IMC) with optional IMC BACnet Module is a microprocessor-based unit controller designed to control Lennox' L Series and S-Class gas/electric, electric/electric and heat pump rooftop units.

BACnet® Standardized Device Profile (Annex L)

- BACnet Operator Workstation (B-OWS)
- 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)

BACnet® Interoperability Building Blocks (BIBBs) Supported (Annex K)

DS-RP-B, DS-WP-B, DM-DDB-B, DS-RPM-B, DM-DOB-B

Segmentation Capability—None

Standard Object Types Supported

- Device Object
- Analog Input
- Analog Output
- Analog Value
- Binary Input
- Binary Output
- Binary Value
- File
- Multi-State Input
- Multi-State Output

Data Link Layer Options

- BACnet® IP, (Annex J)
- BACnet IP, (Annex J), Foreign Device
- ISO 8802-3, Ethernet (Clause 7)
- ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
- ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s) _____
- MS/TP main (Clause 9), baud rate(s): 38.4K
- MS/TP sub (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: _____
- Other: _____

Device Address Binding

Static Device Binding: Yes No

Character Sets Supported

- ANSI X3.4
- IBM™/Microsoft™ DBCS
- ISO 8859-1
- ISO 10646 (UCS-2)
- ISO 10646 (UCS-4)
- JIS C 6226