Universal kit for motorized outlets
communicating with Modbus TCP

Product Specification

ZN020MOD
TA640MOD
Zone thermostats and 3-speed fan and valve controller

Revision Summary:

Date	Revision	Details/ Amendment
19 Oct 2022	0.1	• First Draft
24 Oct 2023	0.2	• Correction to Controller input and output spec on Page 4

Requirements in brief

- a universal kit with PLC to be placed next to the plenum
  - connects the valves
  - manages the three-speed fan,
  - manages the activation of the air-conditioning unit
  - manages the hot and cold exchange.
- Zone controls communicate via RS485 to the PLC
- Web portal presents current status and controls for each individual zone
- [future version] smart zone controls with mobile app management

Zone Thermostat

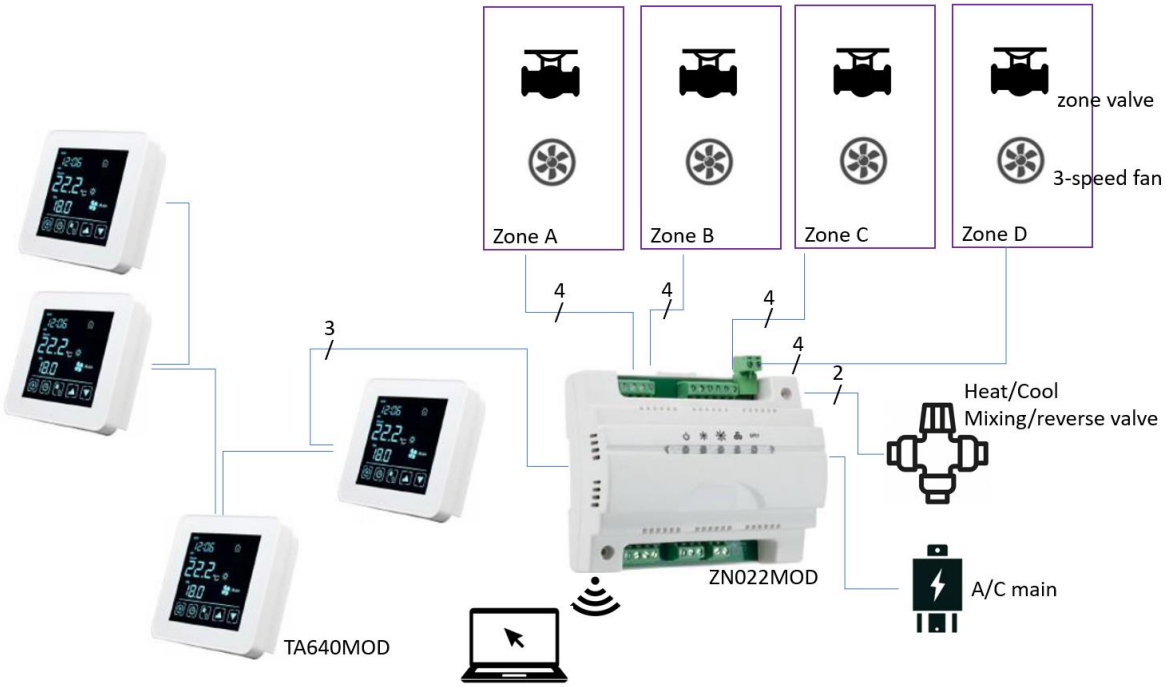
- Operating temperature: 32 ~ 122 °F / 0 ~ 50 °C
- Resolution: 1°F / 0.5°C
- Temperature: °F / °C
- Voltage supply: $24V_{AC}$
- Mode: Heat/Cool/Auto/Off
- Fan: Low/Med/High/Auto
- remote temperature sensor
- Terminals: refer to E*lectrical Interface*
- 12-hour format clock display
- LCD Backlight
- Temperature calibration: -5°C ~ +5°C
- Terminals: 2 mm^2 cable
- Open/close detection: 1
- Modbus RTU interface
- Surface mounting installation

Controller

- Operating temperature: 32 ~ 122 °F / 0 ~ 50 °C
- Voltage input: $24V_{AC}$
- 2.4GHz Wi-Fi 802.11b/g/n
- Multiple terminals: On/Off outputs x20
- Analog output and input ports reserved
- Zone controls: 4
  - Fan: Low/Med/High/Auto
  - Valve: open/close
- All parameters monitored and adjusted on embedded HTTP web browser
- Terminals: refer to E*lectrical Interface*
- Terminals: 2 mm^2 cable
- [future version] RJ45 for ethernet connection
- Din-rail mounting installation

Illustration

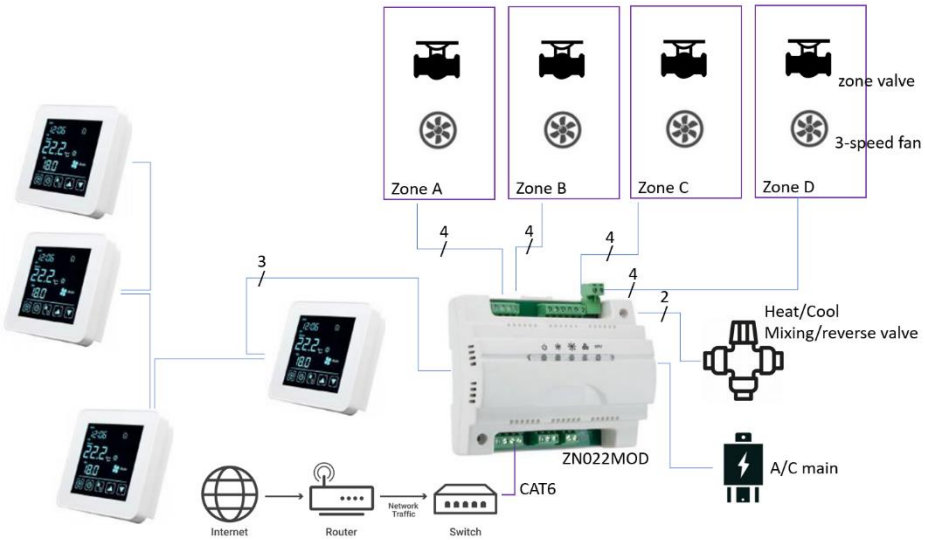
Diagram below shows all the essential elements in the system.
The system is made up of an air convoy box, zone thermostats and a controller.
The air convoy box a.k.a. air-handling unit is installed in the plenum. It has 4 motorized outlets and 3-speed fan, one for each of the 4 zones.
The ambient temperature in each zone is monitored by Modbus thermostat, TA640MOD.
In return, setpoint temperature in each zone is sent via RTU to the controller, ZN020MOD.
Equipped with multiple relays and terminals, the controller is capable of adjusting the fan-speeds, turning on/off the motorized valves in each of the 4 zones. It also controls the heat/cool mixing valve and turns on/off the main switch at the air-conditioning unit.



Administrator of the system can monitor and override the control by accessing wirelessly the web portal of the controller.
The controller is identified by the Wi-Fi SSID and its login credentials are pre-programmed in factory.

Future version

The controller will be equipped with PHY and capable of Modbus TCP communication with BMS server on the subnet or accessible to the internet.



Technical Specifications

(A) TA640MOD

Power supply	$24V_{AC}$ ± 10%
Controlling temperature	32 ~ 122 °F / 0 ~ 50 °C
Measuring accuracy	±1 °F / ±0.5 °C
Touch keys	x5
Output	nil
Modbus	RS485 RTU
External sensor	103AT NTC10KΩ
Installation	surface-mounting

(B) ZN020MOD

Power supply	$24V_{AC}$ ± 10%
Digital output	$24V_{AC}$ 2A
Modbus	RS485 interface
Terminals	20 ~ 24AWG
Operating temperature	32 ~ 122 °F / 0 ~ 50 °C
Storage temperature:	23 ~ 140 °F / -5 ~ 60 °C
Operating humidity	5 ~ 95% RH non-condensing
Power consumption	TBD
Installation	Din-rail mounting

Modbus protocol

RS-485 RTU: Data – 8bit, Stop bit – 1, None parity, Baud rate: 9600/19200, Device: 1-127

Register Address	Parameter Description	Data Type	Value	Range
Function code 01 Read Coils				
0001	Temperature Sensor	Bit	Internal (0) / External (1)	0 / 1
0002	Power	Bit	Off (0) / On (1)	0 / 1
0003	System Mode	Bit	Heat (0) / Cool (1)	0 / 1
0004	Fan Override by ZN020	Bit	Off (0) / On (1)	0 / 1
0005	Valve Override by ZN020	Bit	Off (0) / On (1)	0 / 1
Function code 02 Read Discrete Inputs				
0001	Reserved	Bit	Off (0) / On (1)	0 / 1
0002	Reserved	Bit	Off (0) / On (1)	0 / 1
Function code 03 Read Holding Registers				
0001	Setpoint Heat	Signed 16	50...350	5…35°C
0002	Setpoint Cool	Signed 16	50...350	5…35°C
0003	Heat Span	Signed 16	10...40	1...4°C
0004	Cool Span	Signed 16	10...40	1...4°C
0005	Fan Mode	Signed 16	Off(0)/L(1)/M(2)/H(3)/Auto(4)	0…4
Function code 04 Read Input Registers				
0001	Room Temperature	Signed 16	0….400	0...40°C
0002	External Temperature	Signed 16	0….400	0...40°C
0003	Calibration(*)	Signed 16	-40...40	-4...4°C
Function code 05 Write Single Coil				
0001	Temperature Sensor	Bit	Internal (0) / External (1)	0 / 1
0002	Power	Bit	Off (0) / On (1)	0 / 1
0003	System Mode	Bit	Heat (0) / Cool (1)	0 / 1
0004	Fan Override by ZN020	Bit	Off (0) / On (1)	0 / 1
0005	Valve Override by ZN020	Bit	Off (0) / On (1)	0 / 1
Function code 06 Write Holding Registers				
0001	Setpoint Heat	Signed 16	50...350	5…35°C
0002	Setpoint Cool	Signed 16	50...350	5…35°C
0003	Heat Span	Signed 16	10...40	1...4°C
0004	Cool Span	Signed 16	10...40	1...4°C
0005	Fan Mode	Signed 16	Off(0)/L(1)/M(2)/H(3)/Auto(4)	0…4

(*) Calibration applies equally to embedded thermistor and external sensor

Web portal in ZN020MOD

Login page
Prompts for user name and password. Default is admin | admin.

Landing page
Displays network time, firmware date-code, online/offline status of each of the zone thermostat.

Administrator page

1. Change in login credential
2. Firmware uploader
3. Configuration file downloader
4. Configuration file uploader
5. [future version] NTP server setting

Main page
Presents a table made up of 16 rows and 8 columns.

Rows

1. Master air-conditioning
2. Zone1
3. Zone2
4. Zone3
5. Zone4

Columns

1. System mode
    a. For Mater, drop-down menu with Off/Heat/Cool/Auto for selection
    b. For Zone1~4, drop-down menu with Off/On for selection
2. Current ambient temperature. Value updated every 5 sec ~ 15 sec.
3. External temperature. Value updated every 5 sec ~ 15 sec.
4. Setpoint temperature. Blank space for numeric entry.
5. Fan mode. Drop-down menu with Off/L/M/H/Auto for selection

"**OK**" button at the bottom of the page for confirmation and saving to memory in ZN020MOD

Columns

Rows

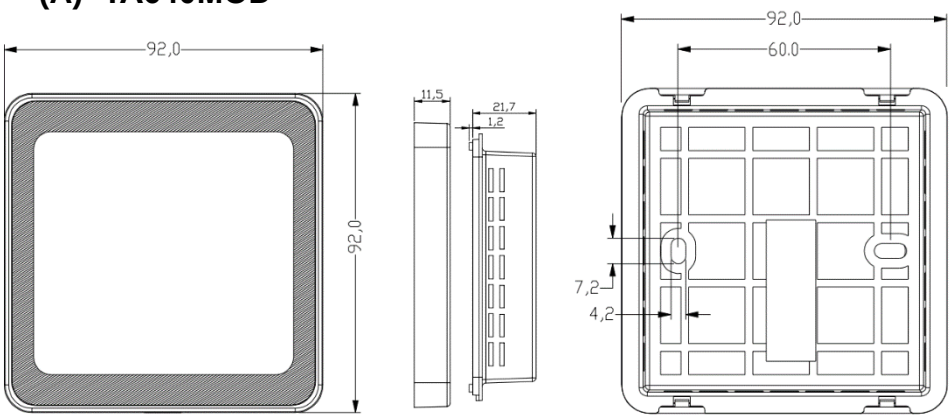
MODBUS

		Nombre	Tipo de datos	Offset	Valor de arranq...	Remanen...	Visible en
1		Static					
2		HREG	Struct	0.0			
3		400001	Word	0.0	0		
4		400002	Word	2.0	0		
5		400003	Word	4.0	0		
6		400004	Word	6.0	0		
7		400005	Word	8.0	0		
8		400006	Word	10.0	0		
9		400007	Word	12.0	0		

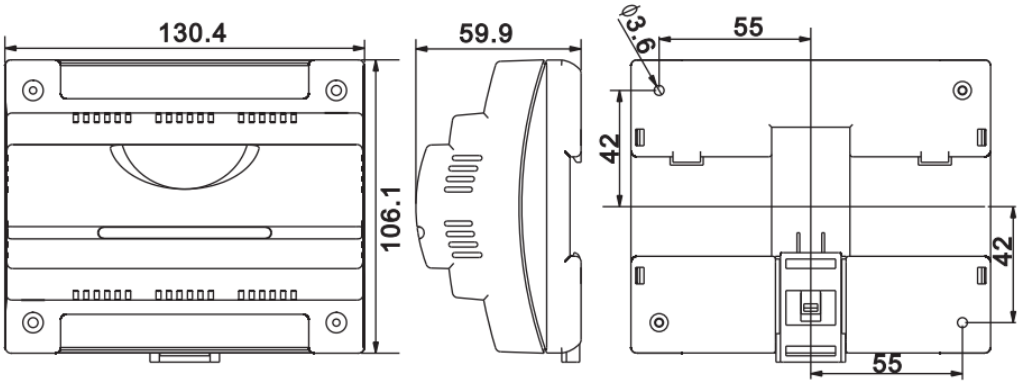
- screen-cap above shows S7-1200 PLC Modbus TCP server

Dimensions and Line Drawing

(A) TA640MOD



(B) ZN020MOD



Electrical interface

(A) TA640MOD

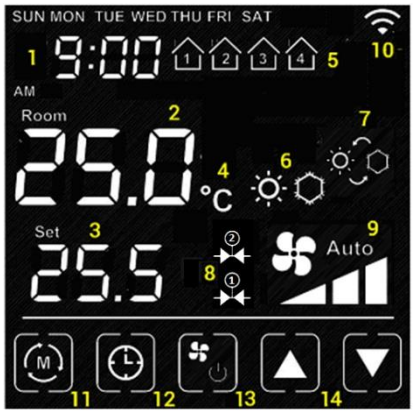
Symbols	Terminals
R	$24V_{AC}$ Hot
C	$24V_{AC}$ Common
Ex-T	Connection to external temperature sensor
Ex-T	Connection to external temperature sensor
DI	Digital input
DI	Digital input
D+, D-	RS485
EARTH	True ground connection

(B) ZN020MOD

Symbols	Terminals
R	$24V_{AC}$ Hot
C	$24V_{AC}$ Common
V1	Valve control for Zone1
G11,G12,G13	Low, Med, High fan relays for Zone1
V2	Valve control for Zone2
G21,G22,G23	Low, Med, High fan relays for Zone2
V3	Valve control for Zone3
G31,G32,G33	Low, Med, High fan relays for Zone3
V4	Valve control for Zone4
G41,G42,G43	Low, Med, High fan relays for Zone4
A	activation of the air-conditioning
W	Heat valve relay
Y	Cool valve relay
O/B	Reversing valve relay
D+, D-	RS485
EARTH	True ground connection
WAN	RJ45 (reserved for next version)

- Max output ratings of all relays in ZN020MOD are $24V_{AC}$ 2A

User interface on TA640MOD



#	Description
1	Time
2	Room Temperature / External Temp Sensor / Relative Humidity
3	Temperature Set Point
4	Temperature Unit
5	Program schedule
6	Heat / Cool Mode
7	Auto Changeover (not applicable to f/w v0.2)
8	Output status. (1) for Terminal Y; (2) for Terminal W
9	Fan Status: Low/Med/High/Auto
10	Wi-Fi (not applicable)
11	Mode Key: Short-Press to change H/C Press-n-hold to access internal settings
12	Clock Key: Press to set clock. Press-n-Hold to Program the Schedule
13	Dual-function Fan/ON Key Short Press: Fan L/M/H/Auto Press-n-Hold: ON/OFF
14	Up/Down key: Adjust Set point or Value of setting.

Touch Keys	Description
	Mode / Menu
	reserved
	Select fan speed
	Adjust settings

Home screen

At Home screen, LCD displays room temperature, fan speed, heat/cool output status icons. LCD backlight stays on for 3 seconds after key presses.

Turning the Thermostat On/Off

Press-n-Hold  to turn On / turn Off the thermostat.
When the thermostat is Off. No Output is generated.

Internal Parameter Setting

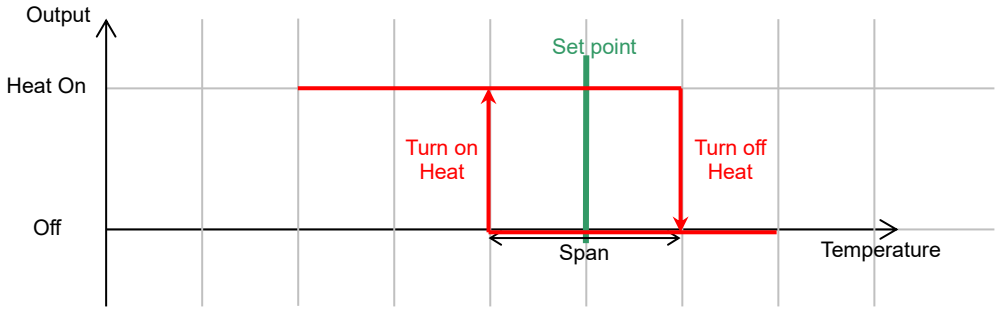
- Press-n-hold on  key
- Press  to advance to the next item
- Press [▲] / [▼] to adjust the value
- Press [blank key] in the middle to confirm and exit

#	Items	Values	Default
P00	User Interface Screen Saver	0 ~ 3(^)	2
P01	Screen Saver Countdown	5 ~120(^)	20
P02	System Mode	Heat / Cool / Auto	Heat
P03	Temperature Display Unit	°C / °F	C
P04	Time Display format	12 / 24	12
P05	Temperature Offset	-5°C ~ 5°C -10°F ~ 10°F	0°C / 0°F
P06	Switching Differential in Heat mode	2 ~ 4°C 4 ~ 8°F	2°C / 1.8°F
P07	Switching Differential in Cool mode	2 ~ 4°C 4 ~ 8°F	2°C / 1.8°F
P08	Forced Ventilation	Disable / Enable	Disable
P09	Temperature Sensor	Internal (IN) / External (EN)	IN
P16	Changeover temperature for Heat mode	10 ~ 25°C (*) / 50 ~ 77°F	18°C / 64.4°F
P17	Changeover temperature for Cool mode	20 ~ 40°C (*) / 68 ~ 104°F	23°C / 73.4°F

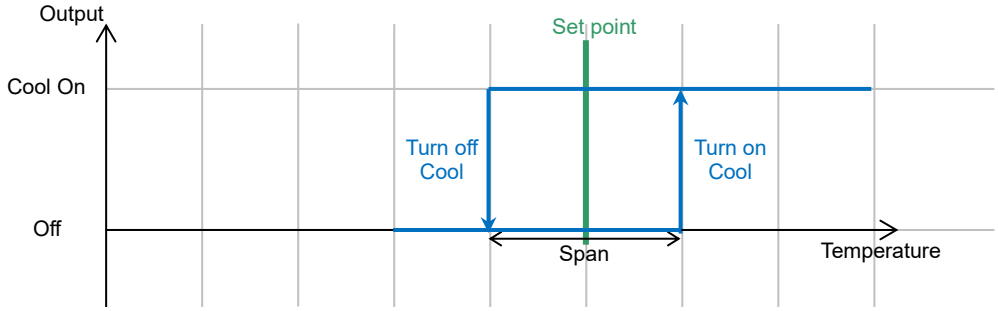
Operating modes

Refer to Internal Parameter Setting section for accessing Internal Parameter Menu.

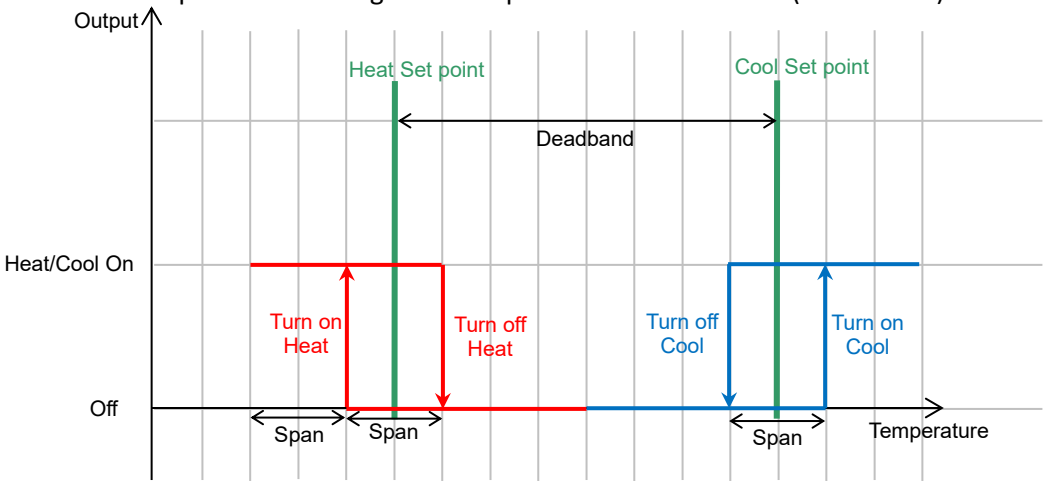
1. **Off mode**
   - Heat/Cool/Fan outputs are persistently off
2. **Heat mode**
   - Heat turns on when room temperature is lower than setpoint temperature
   - Heat Icon and W output must be in-sync
   - When call for heat, W goes high



3. **Cool mode**
   - Cool turns on when room temperature is higher than setpoint temperature
   - Cool Icon and Y output must be in-sync
   - When call for cool, Y goes high



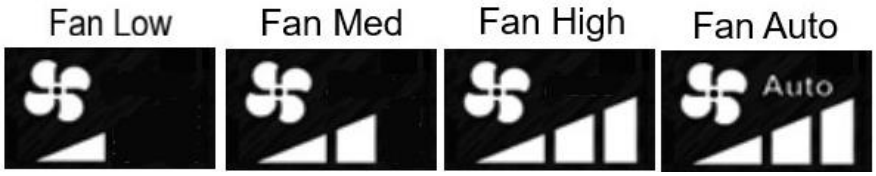
4. **Auto mode**
   - Output turns on On/Off according to both heat setpoint and cool setpoint
   - Heat setpoint and Cool setpoint must be separated by a dead band of 4°F / 2°C
   - There is a “4-minute Heat/Cool switching minimum off time”
   - Heat and Cool outputs do not turn On during Heat/Cool switching minimum off time
   - Heat icon flashes when Heat control; Cool icon flashes when Cool control
     - Control switches to Heat control when
       room temperature < Changeover temperature for Heat mode (18°C in P16)
     - Control switches to Cool control when
       room temperature > Changeover temperature for Cool mode (23°C in P17)



Fan modes

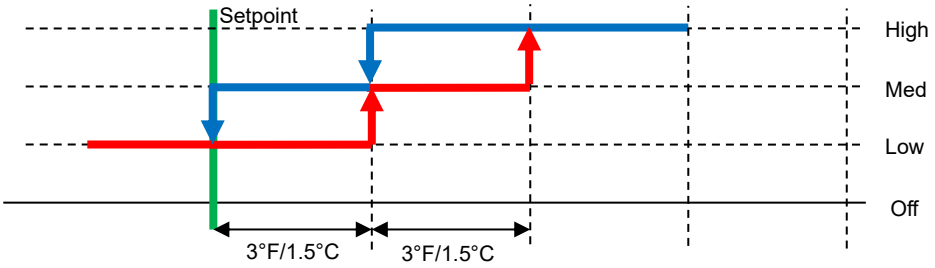
Fan speed can be directly adjusted at Home screen of TA640MOD

Press [ ] button to select fan speed: Low/Med/High/Auto.



If Auto Fan speed is selected:

- If there is no Heat/Cool demand, fan speed keeps at Low
- When the setting temperature is reached, fan turns to Low
- fan output depends on the difference between room temperature and setting temperature



Fan is always on in Heat/Cool/Auto mode. Fan only turns off in system Off mode.

- In Auto Fan Speed Mode, there is a minimum 4-minute switching back and forth (delay) between Fan Speeds.
- Fan icon flashes during the switching time.
- Fan icons and $G_1G_2G_3$ outputs must be synchronized.

Advanced settings

The following setting can be adjusted on TA640MOD:

- Modbus baud rate and address
  - Refer to Internal Parameter Setting section
- **User temperature calibration**
  - TA640MOD supports a temperature offset range of ±10°F / ±5°C

Wi-Fi

2.4GHz

802.11b/g/n

[Future version] Interop with Avan-Stat

Temperature measurement

- Measurable range: 32 – 99 °F / 0 – 40 °C
- Controllable range: 40 – 95 °F / 5 – 35 °C
- Resolution: 1°F / 0.5°C
- Temperature display: °F / °C

Embedded thermistor for measuring Room Temperature

- When temperature is below 32°F / 0°C, warning **LO** appears
- When temperature is above 99°F / 40°C, warning **HI** appears
- When sensor is opened/shorted, "- -" is shown on the screen
- Heat and Cool output will be off when sensor open/short

Remote temperature sensor

- When "IN" is selected for P09, remote temperature sensor must be connected
- "E1" flashes on LCD if disconnected
- All outputs disabled if disconnected
- Press-n-hold on [▲] / [▼] to view remote temp sensor measurement

Safety requirement

Design shall meet the following standards:

- CE (LVD)
- CE (EMC)