TA640 & LN322BAC

Product Specification

Controller, Thermostat and Monitoring Panel
BACnet

Revision Summary:

Date	Revision	Details / Amendment
7 July 2023	0.8	• BACnet object list. Power-cycle no longer needed for change in baud rate • Internal Parameter menu
14 Jun 2023	0.7	• Role of External Temp Sensor • Description of “Off Mode”
1 Jun 2023	0.6	• Color choice for LN322BAC changed to black • TB arrangement and wire size amended
2 May 2023	0.5	Responses on April 28
17 April 2023	0.4	Monitoring Panel TS010 removed
27 March 2023	0.3	• Updates following Zoom meeting March 10 Includes BMS in User Case diagram • Adds 24VAC power supply to Actuator
1 March 2023	0.2	• Second Draft
21 February 2023	0.1	• First Draft

Feature List

- System mode: Cooling only
- Communication: BACnet
- 2 components (hardware) –
  1. Thermostat. TA640
  2. Controller. LN322BAC

Room Wall Module | Thermostat

- 3.4” TN LCD with backlight
- Touch keys x5
  - UP key to adjust setpoint temperature or parameter value upward
  - DW key to adjust setpoint temperature or parameter value downward
  - FAN key to adjust fan speeds high / med / low / off / auto
  - ON/OFF to turn Thermostat on or off
  - CLK to adjust clock and day of week manually. NTP for real-time clock not supported.
- Direct connection to Controller
  - Via UART at baud rate, 9600.
  - Recommended distance (max): 10 meters
  - Connected by 4-wire cable, AWG20
  - Wiring: PWR, RX, TX, GND
  - Wire diameter (max): 1.6 mm
  - Power taken from Controller at the $20V_{DC}$ lead
- Displays ambient room temp to occupants
- Reports ambient room temp to Controller via serial communication
- For surface mount installation

Controller

- Power supply: **$220V_{AC}$**
- Control signal to Actuator
  - Model of choice: MFN0.2
  - Power supply to Actuator: $24V_{DC}$
  - AO signal: **0 ~ $10V_{DC}$** 10mA max
  - FB signal to Controller: **0 ~ $10V_{DC}$** max
  - Connected by 5-wire 20AWG
  - Recommended distance (max): 8 meters
  - Wiring: AO, GND, FB, 24V, COM
- Connection to Wall Module a.k.a. Thermostat
  - Power supply to Room Unit: $20V_{DC}$
  - Serial communication
  - Wiring: 20V, RX, TX, GND
  - Recommended distance (max): 10 meters
- Control signal to FCU. AC type
  - 3-fan speed control Low / Med / High
  - Relay rating: $220V_{AC}$ 5(1)A max
  - Wiring: Q1, Q2, Q3
- Control signal to FCU. DC type
  - AO signal: 0 ~ $10V_{DC}$ 10mA max
  - Wiring: AO_v1, GND
- LED status indicator x5
  - PWR, In, Ext, Rx, Tx

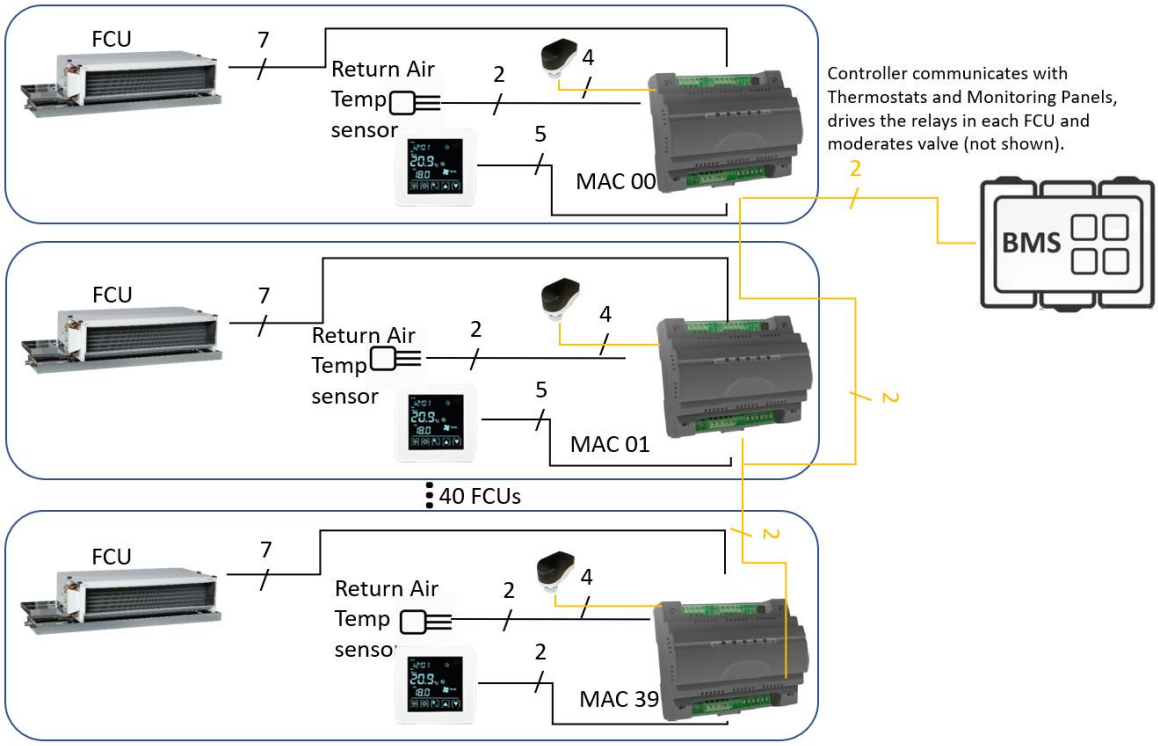
- Connection to return air temperature sensor
  - NTC sensor at the tip of a 3-meter long cable
  - Wiring: ExT, ExT
- Terminals:
  L, N, Rx, Tx, 20V, GND, FB, GND, AO, 24V, COM, Q_1, Q_2, Q_3, AO_V1, GND, ExT, GND A+, B+
- Wire diameter (max) for L, N, $24V_{DC}$, COM, $20V_{DC}$, GND: 1.6 mm
- Wire diameter (max) for others: 1.3 mm
- Din-rail mounting installation
- Black matte housing with silkprinted logo at the center of the housing

Remote temperature sensor

- NTC sensor at the tip
- Cable length: 3 meters
- Coating: plastics

Use Case

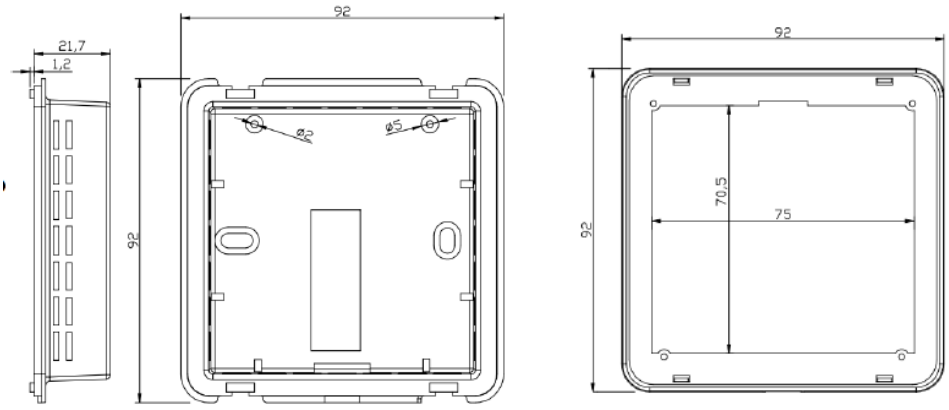
- Max of 40 sets of FCU, temp sensor, thermostats and controllers in each setup.
- One monitoring panel in each setup
- Thermostats may or may not be present in each setup



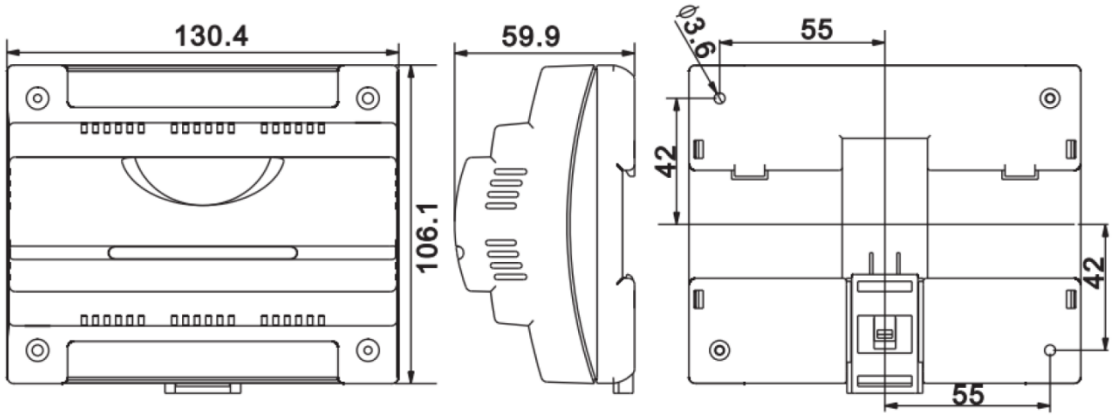
light orange lines indicate MSTP wiring

Dimensions & Line Drawing

- Room Wall Module | Thermostat : TA640



- Controller : LN322BAC



Electrical interface

(A) Thermostat | TA640

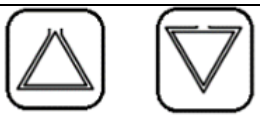
Symbols	Terminals
20V	$20V_{DC}$
GND	Reference $0V_{DC}$
Rx	UART Communication
Tx	UART Communication

(B) Controller | LN322BAC

Symbols	Terminals
L	$220V_{AC}$ Live
N	Neutral
AO	Actuator control
GND	0V reference for AO
Q_1	Low Fan Speed relay. $220V_{AC}$ On/Off type. 5A max
Q_2	Med Fan Speed relay. $220V_{AC}$ On/Off type. 5A max
Q_3	High Fan Speed relay. $220V_{AC}$ On/Off type. 5A max
AO_V1	AO signal to DC fan motor
GND	0V reference for AO_V1
EXT	Remote 10kΩ return air temperature sensor
GND	Remote 10kΩ return air temperature sensor
Rx	UART Communication
Tx	UART Communication
A+	MSTP Communication
B+	MSTP Communication
20V	$20V_{DC}$ output
GND	Reference $0V_{DC}$
24V	$24V_{AC}$ Power supply to Actuator
COM	$24V_{AC}$ Common

User Interface

Room Wall Module | Thermostat

Touch Keys	Description
	Long press to access Menu (see below)
	Long press to access clock setting
	Short tap to change fan speed: OFF → Low → Med → High → Auto → OFF Long press: on/off (see below)
	Adjust settings

Home screen
At Home screen, LCD displays time, room temperature, fan speed, cool output status icons.
LCD backlight stays on for 5 to 120 seconds after key presses.

Clock and Date setting

Press [▲] / [▼] to change the day of week
Press [] again to confirm day of week setting and start to adjust hour
Press [▲] / [▼] to change the hour
Press [] again to confirm hour setting and start to adjust minutes
Press [▲] / [▼] to change the minutes
Press [] again to confirm minutes setting and start to adjust day of week
Press [blank key] in the middle to confirm and exit. Or it will automatically exit in 5 to 120 seconds

Turning Room Wall Module (Thermostat) Off a.k.a. "Off Mode"

Long press-n-hold [] to turn the thermostat off.
When off, all outputs at the Controller are suppressed to 0 volt.
LCD of the Thermostat shows *off* in dimmed backlight.
Default screen-saver option is "1", allowing the word, "*off*", to be displayed.
All touch keys are disabled except the [] key.
Long press-n-hold [] to turn it on.

Internal Parameter Setting

- To access P00~P13, press-n-hold on  key
- To access P16~P21, 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	Notation	Values	Default
P00	Screen Saver option	UI	Black-out (“0”) / Temp (“1”) / Date + Time + Temp (“2”) / All on (“3”)	2
P01	Screen Saver Countdown	Scn	5 ~ 120 sec	20 sec
P02	Temperature Display Unit	Unl	°C	C
P03	Time Display format	Un’	12 / 24	12
P04	Temperature Offset	OF5	-5°C ~ 5°C	0°C
P05	Switching Differential for Cool Mode	CSP	2 ~ 4°C	2°C
P06	BMS override	b-5	Disabled / Enabled	disabled
P07	Forced Ventilation	FrC	Disabled / Enabled	disabled
P08	Analog output offset	Ao0	30 ~ 70	50
P09	Operating Mode	C0	Cool (CL)	CL
P10	Temp Sensor of Choice	Sen	Internal / External	In
P11	K-Factor i.e.1/K	FAC	1 ~ 9	3
P12	P-band Cool	PbC	1 ~ 4°C	4°C
P13	I-Time Cool	ItC	5 ~ 180 sec	30 sec
-	-	-	-	-
P16	MAC address	Add	00 ~ 7F	10
P17	Device address MSB	dA1	00 ~ 3F	01
P18	Device address 2	dA2	00 ~ FF	00
P19	Device address LSB	dA3	00 ~ FF	00
P20	BACnet Baud Rate	br	9600 (0) / 19200 (1) / 38400 (2) / 57600 (3) / 76800 (4) /115200 (5)	2
P21	Reset Parameter on the next power-cycle	PAr	yes / no	No

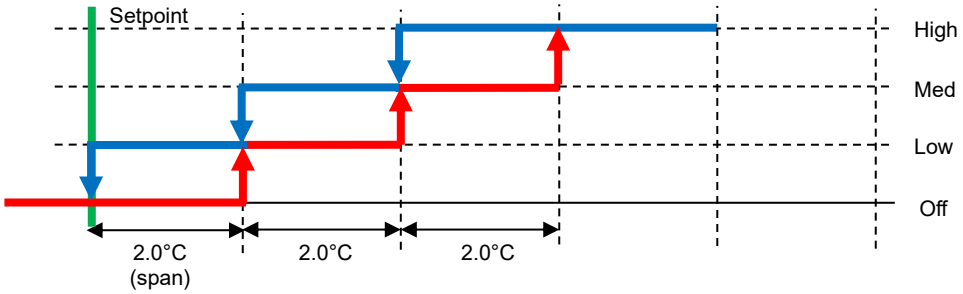
Fan speed selection

Fan speed can be directly adjusted on the Thermostat.

Short press on [ ]to select fan speed: Low/Med/High/Auto/Off.

If “Fan Auto” is selected:

- fan output depends on the difference between
  room temperature and setting temperature,
  or,
  remote air temperature and setting temperature.
- When the setting temperature is reached, fan turns off



Controller

LN322BAC has 2 DIP switches.

DIP1 is on the right.
Its first 3 bits determine the default baud rate for BACnet:

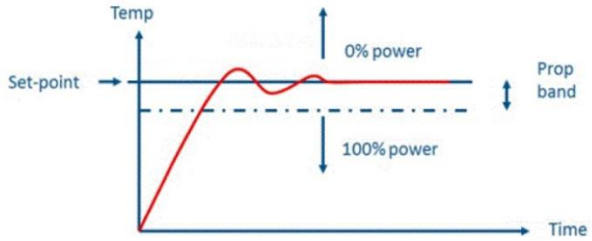
(000) 9600
(001) 19200
(010) 38400
(011) 57600
(100) 76800
(101) 115200
Bit #8 forbids(0)/allows(1) Factory Reset at power up
OFF position = 0; ON position = 1

DIP2 is to the left of the terminal block of GND AO FB.
Sets the default MAC Address for BACnet:

0~127 (0000000~1111111)

Valve Modulating / Control Algorithm

LN322BAC employs proportional integrative (PI) control on output signal to Actuator. AO voltage levels are determined dynamically on various parameters such as K Factor (P10), P-band (P11) and I-Time (P12) and the difference between setpoint and ambient temperature sampled every 10 seconds.
Diagram below illustrates temperature change in heat mode. The reverse is true in cool mode. When room temperature is significantly lower than set-point temperature, say 10 centigrade lower, AO generates $10V_{DC}$. As the room heats up, current temperature surpasses setpoint, AO1 generates $0V_{DC}$. Room cools down and drops below setpoint AO1 outputs 1.5V and the curve bends upward. The process continues until equilibrium is reached.



I-Time (P12)
The time period or simple time in PI equation. The shorter the time, the more responsive the change in AO.
K-Factor (P10)
The coefficient of I-term in PI control. The smaller the number, the faster the response.

BACnet Application Specific Controller (B-ASC)

Read Property –B	DS-RP-B
Read Property Multiple –B	DS-RPM-B
Write Property –B	DS-WP-B
Device Communication Control–B	DM-DCC-B
Dynamic Device Binding –B	DM-DDB-B
Dynamic Object Binding –B	DM-DOB-B

BACnet Object list

Type	Name	R/W	Description
AI-0	Room Temp	R	5 ~ 50°C, step 0.1°C
AI-1	Operating Mode	R	0: Cool
AI-2	Fan Mode	R	0: Off / 1: Low / 2:Mid / 3:High / 4:Auto
AI-3	Fan Status	R	0: Off / 1: Low / 2: Mid / 3: High
AI-4	Remote Air Temp	R	0 ~ 50°C, step 0.1°C
AI-5	Analog output	R	0 ~ 10V
AI-6	Analog output offset	R	30 ~ 70
AI-7	Room temperature offset	R	-5 ~ +5°C
AI-8	Switching Differential for Cool	R	2 ~ 4°C
AI-9	Temperature setpoint	R	5 ~ 40°C
AI-10	Analog input	R	0 ~ 10V
AV-0	P-band for Cool	R/W	1 ~ 4°C
AV-1	I-time for Cool	R/W	5 ~ 180s
AV-2	K-Factor i.e. 1/K	R/W	1 ~ 9
AV-3	Temperature setpoint	R/W	5 ~ 40°C, step 0.5°C
AV-4	Room Temperature offset	R/W	-5 ~ 5°C
AV-5	Fan Mode	R/W	0:Off / 1:Low / 2:Mid / 3:High / 4:Auto
AV-6	Screen Saver option	R/W	0 ~ 3
AV-7	Screen Saver Countdown	R/W	5 ~ 120s
AV-8	Analog output offset	R/W	30 ~ 70
AV-9	Analog output voltage	R/W	0 ~ 10V (^)
BI-0	Temperature display unit	R	Celsius
BV-0	Forced Ventilation	R/W	Disabled/Enabled
BV-1	BMS Override	R/W	0: Users have control / 1: BMS overrides
BV-1	System mode	R	0: off / 1: on
BV-3	Temp Sensor Selection	R/W	0: Embedded thermistor / 1: External

MS/TP master (Clause 9) baud rate(s): 9600, 19200, 38400, 57600, 76800bps, 115200

(^) note: output level determined by BMS when BV-1=1

Temperature measurement

Embedded thermistor inside the Room Wall Module

- Measures and displays ambient temperature under the font, “Room”.

External Temperature Sensor for measuring Return Air Temperature

- When remote sensor is selected either by users in the Internal Parameter Menu, or by BMS via BACnet, the remote temp sensor’s measurement is used for temperature control
- When remote sensor disconnects by accident, the LED labelled, “EXT” on the Controller turns off.
- Room Wall module displays icon “T” to signal the fault.

Communication

Between room unit and controller

- Icon, “P”, appears when connected
- Bi-directional RX/TX
- Baud rate at 512Hz (1.95ms)
- Data refresh time: 10 second max
- Room unit updates Controller when polled
- Data communicated:
  1. BACnet MAC address, device address, baud rate
  2. Room temp
  3. Setpoint
  4. Fan speed
  5. On/Off
  6. Remote Air Temp
  7. P.I.D. Valves
  8. Internal Setting

Error mode

Lost of communication

- LED labelled, “IN”, turns off when Controller loses communication with Thermostat
- RX & TX stop blinking Controller loses communication with BMS

Technical data

1.	Power supply:	$220V_{AC}$ ± 20%
2.	Relay contact voltage:	$220V_{AC}$ 50/60 Hz
3.	Relay contact current:	5(1)A max
4.	Sensing Element:	103AT
5.	Terminals:	2 mm^2 cable
6.	Operating Temperature:	0 ~ 50 °C
7.	Storage Temperature:	-5 ~ 50 °C
8.	Operating Humidity:	5 ~ 95%R.H. non-condensing