SHS400-W Series

Wi-Fi MODBUS TCP/ IP
Full Configurable Digital Unitary Controllers

DATA SHEET

The SHS400-W series are full configurable, Wi-Fi Modbus TCP/ IP networked direct digital unitary controllers. They are suitable for a variety of applications including 2-pipe or 4-pipe Fan-coil unit, PAHU, CAV/ VAV, Heat Pump, heating system, and other HVAC unitary equipment of on/ off, controls for a variety applications.

The controller measures temperature of air or liquid and then use control on/ off valve actuators in the HVAC system to maintain the room space near the desired temperature set point. The optional 1- to 3-fan speed can be operated in the mode of auto changeover or manual selected continuous mode.

This controller has an optional Wall Setter with LCD screen for showing set point and the other settings. And it also has optional digital inputs for a variety of detection devices such as room occupied/unoccupied detection, window or door open/close detection...etc.

FEATURES

- Wi-Fi Modbus TCP/ IP open protocol communication
- IEEE 802.11 b/g
- Web Server based Configuration to configure the Wi-Fi module
- Suitable for 2-pipe or 4-pipe Fan-coil, AHUs, heat pumps, and other HVAC system of On/Off controls
- Effective run time accumulation for system reading/ resetting
- Optional 1- to 3- fan speed can be operated in the mode of auto changeover or manual selected continuous mode.
- Cool, heat, or both auto/ manual changeover with adjustable zero energy band
- Full configurable parameters such as switching differential, cycle time, and etc.
- Proportional plus integral (PI) algorithm applied to on/off control
- Optional Wall Setter
- Optional Remote sensor (RS) input interface for connecting to remote temperature sensor
- Selectable temperature sensor input from wall setter or RS interface
- Optional energy saving input (ESI) interface for room occupied/unoccupied detection device
- Optional one extra digital input interfaces for window or door open/close detection device
- Adjustable unoccupied set points for heating and cooling mode control
- Optional settable countdown Timer (0 to 24 hours) function to stop control outputs when time expires
- Optional sleep mode function for raising 2 ℃ temperature set point in 2 hours
- Non-volatile memory (EEPROM) retains user settings during power loss
- Control off output when system at “OFF” status
- Maximum and minimum set-point limits settable

SPECIFICATIONS

Supply Voltage：
24Vac (+/-10%) or 85~260Vac, 50/60 Hz

Wi-Fi Modbus TCP/ IP Communications：
Wi-Fi (2.4GHz, IEEE802.11b/g),
WPA2-PSK(AES) secure Wi-Fi authentication,
Configuration Web Server to configure Wi-Fi module via smart phone, pad, and notebook.
Support DHCP and IPv4
Selectable data rates and ranges
Associate Wi-Fi Access Point (AP) automatically
Modbus TCP/ IP server open protocol
External antenna

Display Range：
-20 to 80.0 °C (-4.0 to 176.0 °F)

Display Temperature Unit and Resolution:
0.1 °C/°F

Indication Accuracy：
+/-1.0 °C (1.8 °F) at 25 °C

Set-point Range:
0~50 °C / 32~122 °F (default: 10~30 °C /50~86 °F, adjustable), 0.5 °C/°F per setting step

Set point Adjustment：
Through Wall Setter or networking communication

Valve, Fan, and Interlock Control Outputs：
1 SPST/SPDT relay for 2-pipe on/off valve control,
2 SPST/SPDT relays for 4-pipe on/off valves control,
1 SPST relay for interlock control,
Up to 3 SPST relays for Fan control

Electrical Rating：
SPDT – **8**A/250Vac, (Resistive load)
SPST **-- 10**A/250Vac,(Resistive Load)

Minimum Relay Operating Life：
Contacts: 100,000 cycles

Remote Sensor (RS) Input Interface：
For connecting to external NTC Thermistor 3K ohm

Energy Savings Input (ESI) Interface：
For saving energy by entering into unoccupied mode when ESI is triggered by Normally open (N.O.) or normally close (N.C.) dry contact

Extra Digital Input (DI) Interface：
For saving energy by stop cooling/heating and Fan control outputs when DI is triggered by Normally open (N.O.) or normally close (N.C.) dry contact

Control Performance：
Proportional plus integral (PI) applied to differential on/off control

Countdown timer Function (optional):
1~24 hours settable countdown timer to turn off control outputs when enable

Sleep mode Function (optional):
For raising 2 °C set-point temperature automatically in 2 hours (0.5 °C per 30 minutes) if enable this mode.

Operating Environment：
0 ~ 50°C, 5 ~ 95% RH (non-condensing)

Dimensions： 156×150x50 mm (W × H × D)

Mounting： Wall Mounting

Wiring：
Up to 20 screw-in terminals, each terminal is suitable for 14 to 22 AWG wires or 1.5 mm^2 wires.

Wall setter (optional)：
WBS091 series wall setter

PRODUCT ORDERING INFORMATION

SHS4 □ □ □ - □ □ □ □ □ - □ □ □ □ □ -W

(1) (2) (3) - (4) (5) (6) (7) (8) - (9) (10)(11)(12)(13)

MODEL: SHS4

Item	CODE	Cooling, On/Off Control Outputs*
(1)	0	None
	1~2	No. of stages
	3~7	Reserved
	X	Specified

Item	CODE	Heating, On/Off Control Outputs*
(2)	0	None
	1~2	No. of stages
	3~7	Reserved
	X	Specified

Item	CODE	Application
(3)	A	2-Pipe Cooling only
	B	4-Pipe Cooling or Heating (Manually Selectable)
	C	4-Pipe Cooling and Heating (Auto Changeover)
	D	2-Pipe Heating only
	E	2-Pipe Heating or Cooling (Manually Selectable)
	X	Specified

Item	CODE	FAN Control Output*
(4)	0	None
	1~3	No. of Fan speeds

Item	CODE	Power voltage of Thermostat, Valve/actuator, FAN – refer to wiring diagram for details
(5)	0	24Vac, 24Vac, None
	1	Reserved
	2	24Vac, 24Vac, External power
	3	24Vac, 24Vac, 24Vac
	4	Reserved
	5	Reserved
	6	Reserved
	7	Reserved
	8	85~260Vac, 85~260Vac, None
	9	Reserved
	A	85~260Vac, 85~260Vac, 85~260Vac
	B	85~260Vac, 85~260Vac, External power
	X	Specified

Item	CODE	Wiring for an On/Off Valve/actuator
(6)	0	None
	2	2 Wires
	3	3 Wires
	4	3+2 Wires (3-wiring cooling valve/actuator and 2-wiring heating device)

Item	CODE	Reserved
(7)	1	None
	2	Reserved

Item	CODE	Reserved
(8)	0	None
	1	Reserved
	2	Reserved

Item	CODE	No. of input interfaces for Remote Temperature Sensor (RS) or analog input (AI)
(9)	0	None
	1	1 RS input
	X	Reserved

Item	CODE	No. of input interfaces for Energy Saving (ESI) or Digital inputs (DI)
(10)	0	None
	1	1 ESI input
	2	1 ESI input with 1 extra Digital input
	3	Reserved

Item	CODE	Function of sleep mode
(11)	0	None
	1	With Sleep mode function

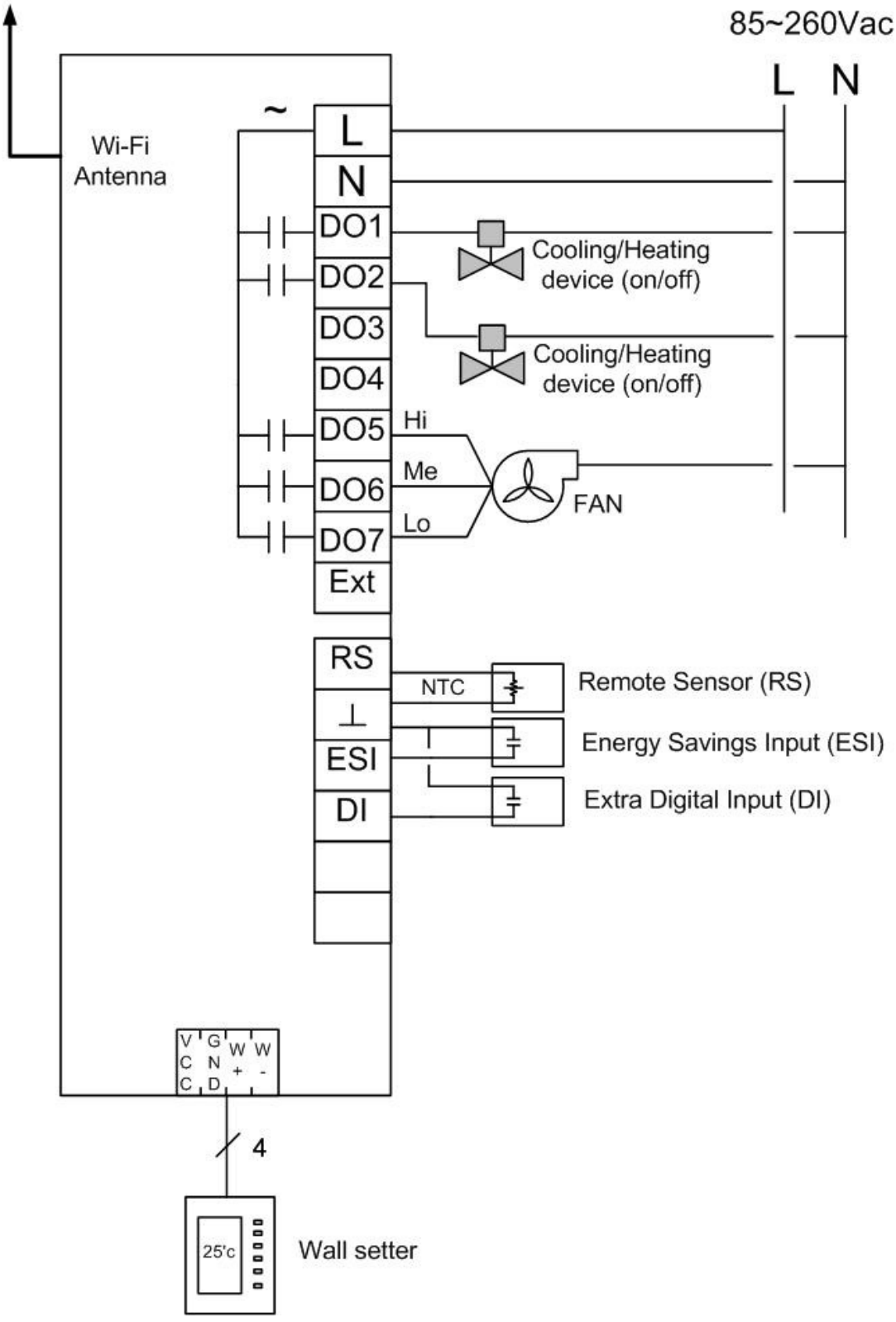
Item	CODE	Function of Timer mode
(12)	0	None
	1	With Timer mode function

Item	CODE	No. of Interlock contact (ILC) signal outputs*
(13)	0	None
	1	1 ILC

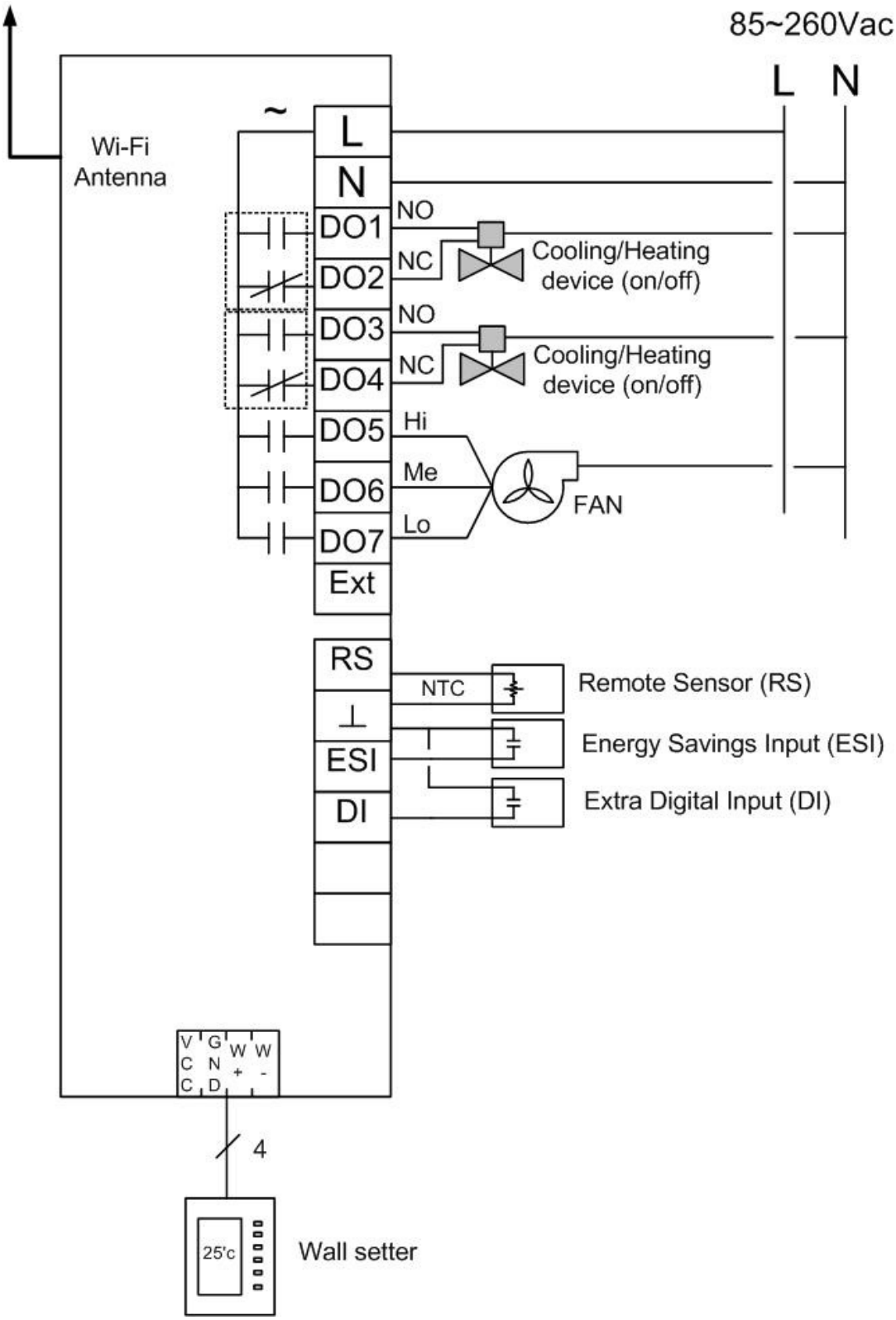
Example: SHS411C-3A200-11000-W: Wi-Fi Modbus TCP/IP communication, 1 on/off cooling, 1 on/off heating, Cooling & Heating auto changeover for 4-pipe system control, 3-speed FAN control, 85~260Vac power for all, Used with 2-wire valve/actuator, 1 RS, 1 ESI, No sleep mode function, No Timer function, No ILC.

*** Note:** Total number of cooling plus heating stages, fan control and ILC shall be within seven.

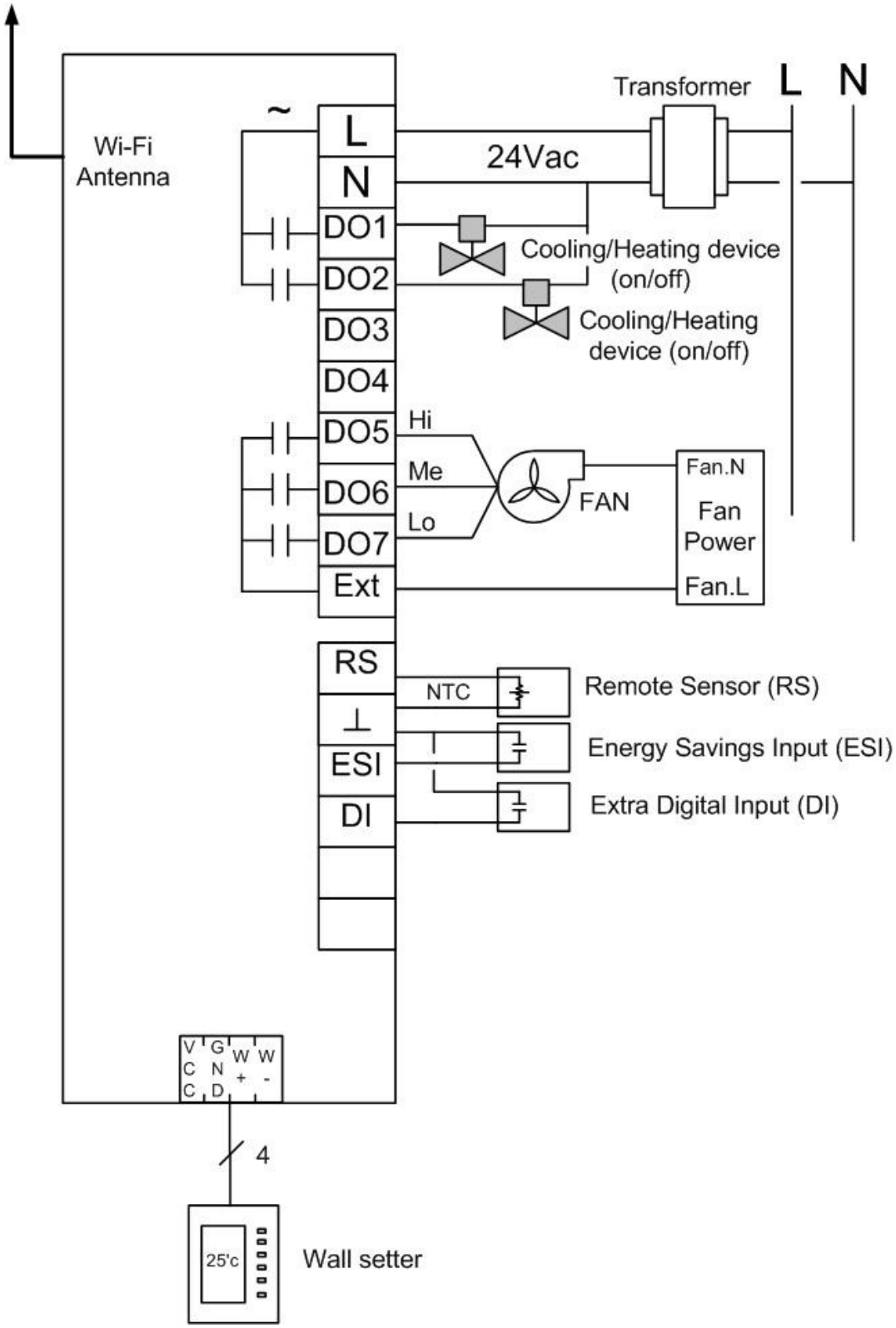
WIRING EXAMPLES



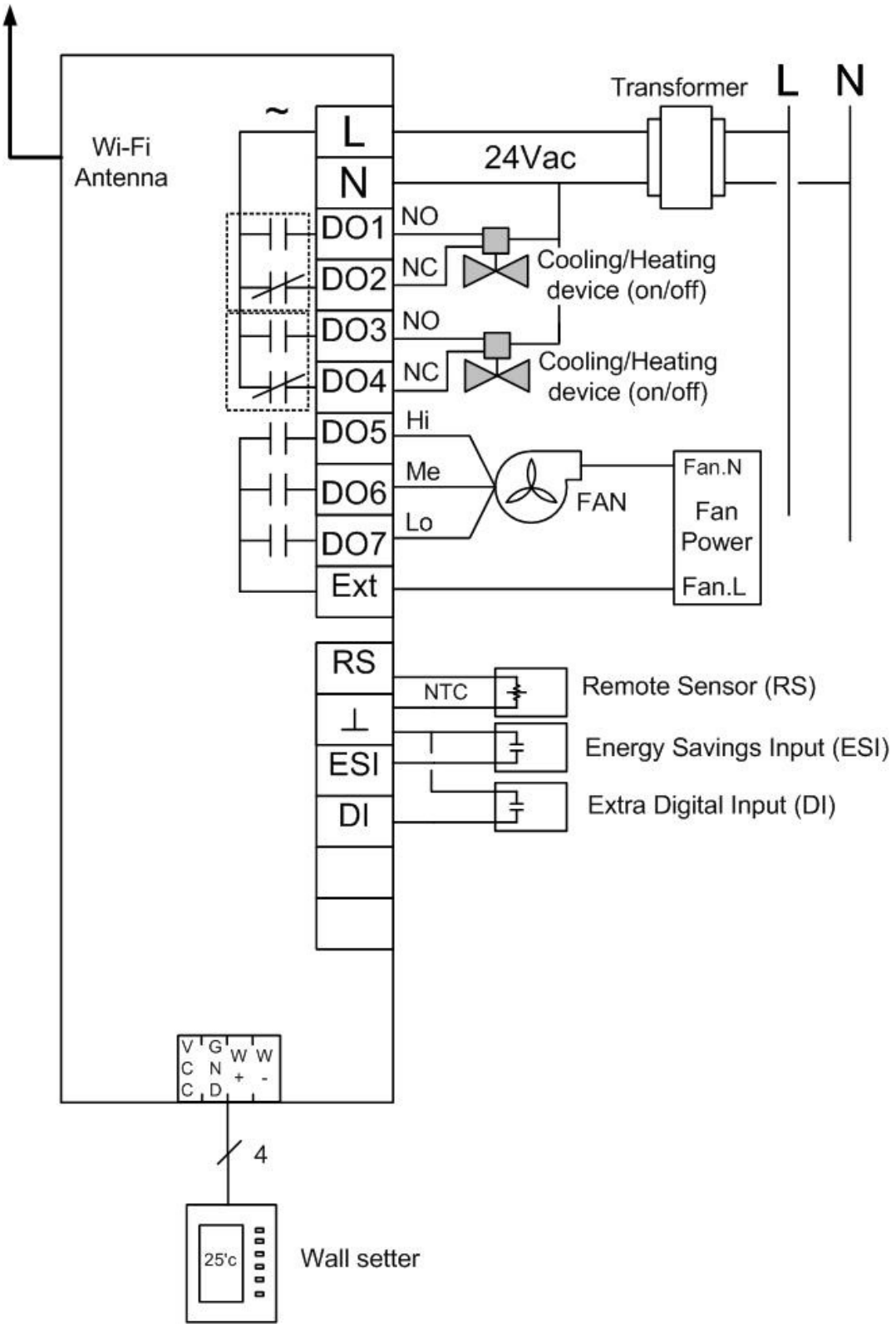
85~260VAC controller (for 2-wire valve actuator)



85~260VAC controller (for 3-wire valve actuator)

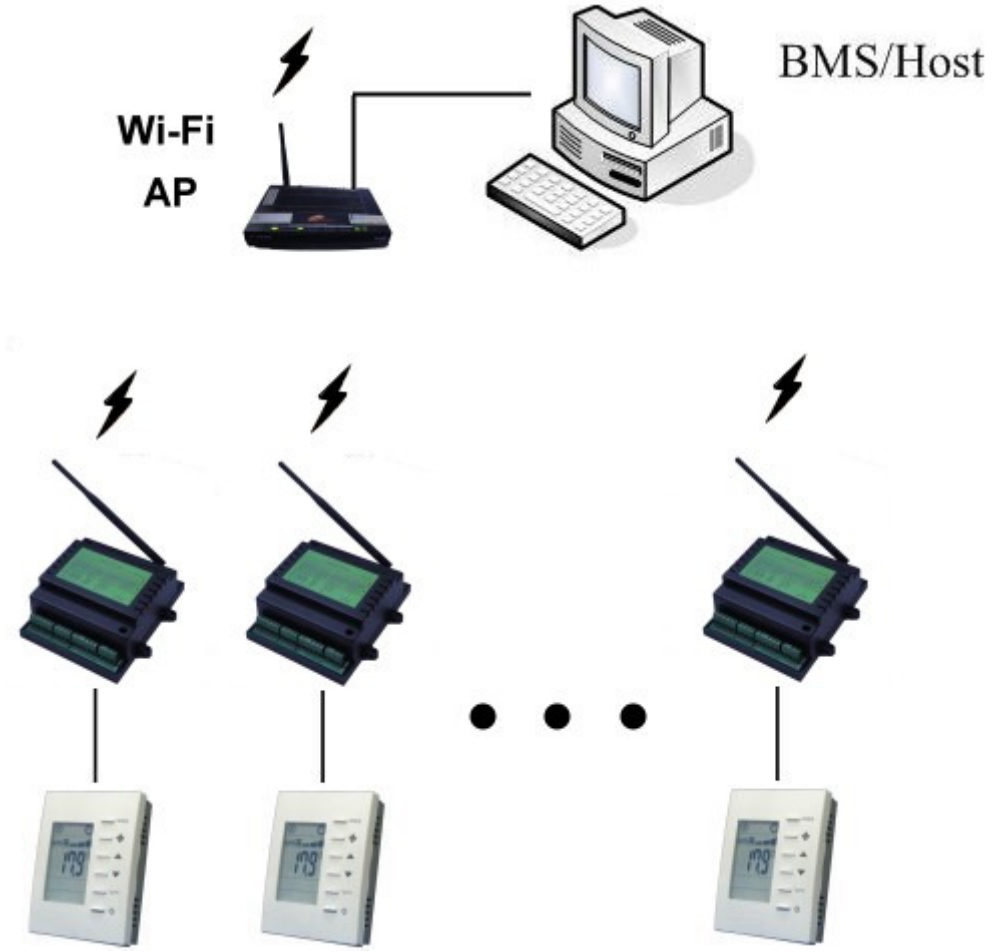


24VAC controller (for 2-wire valve actuator)



24VAC controller (for 3-wire valve actuator)

SYSTEM CONNECTIONS



Wi-Fi Modbus TCP/IP Communication

1. Engineer mode menu item descriptions:

Item	Mnemonic	Description	℃ Type		℉ Type		Step
			Default	Range	Default	Range	
1	db	Deadband	2.0	0~10.0		0~18.0	0.5 (℃/℉)
2	ESIC	Unoccupied(ESI) cooling set point	30.0	25.0~30.0		77.0~86.0	1.0 (℃/℉)
3	ESIH	Unoccupied(ESI) heating set point	10.0	10.0~22.0		50.0~72.0	1.0 (℃/℉)
4	I-t	Integral Time and Output Cycle Time	10	10~500		10-500	10 (Sec.)
5	OP-L	Not Used					
6	SPAn	Not Used					
7	SP-L	Low limit for temperature set point	18.0	0~50.0		32.0~122.0	1.0 (℃/℉)
8	SP-H	High limit for temperature set point	27.0	0~50.0		32.0~122.0	1.0 (℃/℉)
9	OFSt	Current temperature offset	0.0	-10.0~10.0		-18.0~18.0	0.1 (℃/℉)
10	Pb	Proportional band or stage width	2.0	0~10.0		0~18.0	0.1 (℃/℉)
11	diFF	Stage differential	0.5	0.1~1.0		0.1~1.8	0.1 (℃/℉)
12	LOC	Bit Definition --- bit 0: MODE button 1: Down buttons 2: Up button 3: FAN SPEED button 4: Power On/Off button 5: ℃/℉ button 6: ESI contact detection 7: Door/Window detection *Bit Value 0: Unlock / enable 1: Lock / disable Examples: 0- Unlock/enable all 1- Lock MODE Button 2- Lock Down Button 3- Lock MODE & Down Buttons 4-Lock Up Button 5- Lock MODE & Up Button … 8-Lock Fan SPEED Button … 15-Lock MODE & Down & Up & Fan SPEED Buttons 16-Lock Power On/off Button … 32-Lock ℃/℉ Button … 64-Disable ESI contact detection … 128-Disable Door/Window contact detection … 255- Lock/disable all	1	0-255		0-255	1

13	ESI	ESI contact definition	1	0~1		0~1	0: N.O. 1: N.C.
14	rE-C	Not Used					
15	rE-H	Not Used					
16*	rS	Present Temperature is getting from built-in temperature Sensor, remote temperature sensor, or assigned through Modbus **	0	0~2		0~2	0: built-in 1: remote 2: assigned through Modbus
17	-SP-	Display present value of temperature or set-point for Normal Displaying	0	0-1		0-1	0: display PV 1: display SP
18	door	Door or Windows contact definition	0	0~1		0~1	0: Close 1: Open
19	LFAn	Lowest Fan speed in Fan auto mode during normal operation (Note that during energy saving ESI operation, Fan stopped is lowest Fan speed.)	1	0~3		0~3	0: stop 1: low 2: Med. 3: Hi
20	Str	Stroke time	150	10~1600		10~1600	10 sec.
21	FAnd	Heating OFF FAN Delay	120	0-600		0-600	10 (Sec.)
22**	rAtE	Wireless data rate	6	1 2 5.5 6 9 11 12 18 24 36 48 54		1 2 5.5 6 9 11 12 18 24 36 48 54	Mbps
23	Phy1	MAC address 1st & 2nd bytes	NA	Hhhh			h: 0~F in hex
24	Phy2	MAC address 3rd & 4th bytes	NA	Hhhh			h: 0~F in hex
25	Phy3	MAC address 5th & 6th bytes	NA	Hhhh			h: 0~F in hex
26	IP-1	1st byte of IPv4 address	NA	0~255		0~255	
27	IP-2	2nd byte of IPv4 address	NA	0~255		0~255	
28	IP-3	3rd byte of IPv4 address	NA	0~255		0~255	
29	IP-4	4th byte of IPv4 address	NA	0~255		0~255	
30	tESt	Self-Diagnostic					
31	rSt	Reset all parameters as factory defaults					
32	End	Exit Engineer Mode					

Note:*: When the “rs” parameter is set as 2(present temperature is assigned by Modbus), if Modbus communication disconnects for more than 3 minutes, the present temperature will be changed to get from built-in temperature sensor automatically. I.e. The “rs” parameter will be automatically changed to 0 (present temperature is getting from built-in temperature sensor).

**: Lowering the data rate reduces the communication speed but increases the effective range of the WiFi module

Network Specifications:

Transmission

- Modbus/TCP Protocol

MODBUS

- Supported function code: 1, 2, 3, 4, 5, 6
- Temperature representation: the original temperature degree value has be multiplied by 10 to be saved in the register.
  ex.. 25.5 ℃ is represented by: 00 FF (in hex) i.e. 255 (in dec.)
  5.0 ℃ is represented by: 00 32 (in hex) i.e. 50 (in dec.)

Read/Write Coils (function code 01/05)

Function code	Register address	Description	Definition
01	1	On/Off status of thermostat	0:off, 1:on

Function code	Register address	Description	Definition
05	1	Remote thermostat On/Off control	0000: off FF00: on

Note: The “Remote thermostat On/Off control” is remote “working mode /standby “control.

Read discrete input (function code 02)

Function code	Register address	Description	Definition
02	1	Status of ESI (DI#1)	0:room occupied 1:room unoccupied
02	2	Status of Window/ Door (DI#2)	0: door/window closed 1: door/window open
02	3	Status of DI#3	0: deactivated 1: activated
02	4	Status of DI#4	0: deactivated 1: activated
02	5	Status of cooling/heating control output	0:close & off 1:open & on
02	6	Status of Relay 1 (used for Cooling control)	0:off, 1:on
02	7	Status of Relay 2 (used for Heating control)	0:off, 1:on
02	8	Status of Relay 3 (used for FAN Hi control)	0:off, 1:on
02	9	Status of Relay 4 (used for FAN Med. control)	0:off, 1:on
02	10	Status of Relay 5 (used for FAN Lo control)	0:off, 1:on
02	11	Status of Relay 6 (N/A)	0:off, 1:on
02	12	Status of Relay 7 (N/A)	0:off, 1:on

Read/write holding register (function code 03/06)

Function code	Register address	Description	Definition
03/06	1	Set Point temperature (SP)	℃ :0~500 (0.0～50.0℃) ℉ : 320~1220 (32.0~122.0℉)
03/06	2	℃/ ℉	0: ℃ 1: ℉
03/06	3	Fan mode	0: auto 1: low 2: med. 3: hi
03/06	4	Assigned current temperature Note: 1. This is used only when Function 03 reg. addr.26 = “2”. 2. After power loss, this value will be automatically changed to “-30000.”	-999~9999 (-99.9～999.9℃/℉)
03/06	5	Working mode: Heat, Cool or ventilation	0: cool mode 1: heat mode 2: Ventilation @ cool mode 3: Ventilation @ heat mode
03/06	6	Sleep (only for models with Sleep function available).	0: disable, 1: 0 hr. sleep 2: 0.5 hr. sleep 3: 1 hr. sleep 4: 1.5 hrs. sleep, 5: 2 hrs. sleep
03/06	7	Timer off (only for models with countdown timer function available).	0~24 : 0~24 hours count down 25: disable
03/06	8*	Running time of Valve (Hr.)	0~65535 (Hr.) for reading but 0~30000 (Hr.) for writing.
03/06	9*	Running time of Valve (M.)	0~59 (Minute)
03/06	10*	Running time of Valve (Sec.)	0~59 (sec.)
03/06	11	Deadband	℃ :0~100 (0.0~10.0 ℃) ℉ : 0~180 (00~18.0 ℉)
03/06	12	Unoccupied (ESI) Cooling set point	℃ :250~300 (20.0~30.0 ℃) ℉ : 770~860 (77.0~86.0 ℉)
03/06	13	Unoccupied (ESI) Heating set point	℃ :100~220 (10.0~22.0 ℃) ℉ : 500~720 (50.0~72.0 ℉)
03/06	14	Integral Time and Output Cycle Time	10-500 (sec.)
03/06	15	Not used	

03/06	16	Not used	
03/06	17	Low limit for set-point temperature	℃ :0~500 (0.0～50.0℃) ℉ : 320~1220 (32.0~122.0℉)
03/06	18	High limit for set-point temperature	℃ :0~500 (0.0～50.0℃) ℉ : 320~1220 (32.0~122.0℉)
03/06	19	Offset for current temperature	℃ :-100~100 (-10.0~10.0 ℃) ℉ : -180~180 (-18.0~18.0 ℉)
03/06	20	Proportional band or stage width	℃ :0~100 (00~10.0 ℃) ℉ : 0~180 (00~18.0 ℉)
03/06	21	Stage differential	℃ :1~10 (0.1~1.0 ℃) ℉ : 1~18 (0.1~1.8 ℉)
03/06	22	LOCK	Bit Definition --- bit 0: MODE button 1: Down buttons 2: Up button 3: FAN SPEED button 4: Power On/Off button 5: SET (or ℃/℉) button 6: Local ESI contact detection 7: Door/Window contact detection *Bit Value 0: Unlock / enable 1: Lock / disable Examples: 0- Unlock/enable all 1- Lock MODE Button 2- Lock Down Button 3- Lock MODE & Down Buttons 4- Lock Up Button 5- Lock MODE & Up Button … 8-Lock Fan SPEED Button … 15-Lock MODE & Down & Up & Fan SPEED Buttons 16-Lock Power Button … 64-Disable local ESI contact detection … 128-Disable Door/Window contact detection … 255- Lock/disable all
03/06	23	ESI contact definition	0: N.O. 1: N.C.
03/06	24	Not used	

To be continued…

03/06	25	Not used	
03/06	26 **	Present Temperature is getting from built-in temperature Sensor, remote temperature sensor, or assigned through Modbus	0: built-in temp. sensor 1: remote temp. sensor 2: assigned through Modbus
03/06	27	Display present value of temperature or set-point for Normal Displaying	0: display PV 1: display SP
03/06	28	Door or Windows contact definition	0: N.O. 1: N.C.
03/06	29	Lowest Fan speed in Auto Fan mode	0: stop 1: low 2: Med. 3: Hi.
03/06	30	Stroke time of valve/actuator	10~1600 (sec.)
03/06	31	Heating OFF FAN Delay	0~600 (sec.)
03/06	32***	Wireless data rate	0: 1 Mbps, 1: 2 Mbps, 2: 5.5 Mbps 3: 6 Mbps, 4: 9 Mbps, 5: 11 Mbps 6: 12 Mbps, 7:18 Mbps, 8: 24 Mbps 9: 36 Mbps, 10: 48 Mbps, 11: 54 Mbps
03/06	33	MAC address 1st & 2nd bytes	hhhh
03/06	34	MAC address 3rd & 4th bytes	hhhh
03/06	35	MAC address 5th & 6th bytes	hhhh
03/06	36	1st byte of IPv4 address	0~255
03/06	37	2nd byte of IPv4 address	0~255
03/06	38	3rd byte of IPv4 address	0~255
03/06	39	4th byte of IPv4 address	0~255

Read input register (function code 04)

Function code	Register address	Description	Definition
04	1	Current temperature	-999~9999: -99.9～999.9℃/℉
04	2	Fan speed status	0: Stop 1: Low 2: Med 3: Hi

- **Note:** "**" When the present temperature is set as "2: assigned through Modbus"), if Modbus communication disconnects for more than 3 minutes, the present temperature will be changed to get from built-in temperature sensor automatically. I.e. This item will be automatically changed to "0: present temperature is getting from built-in temperature sensor).**Note:** "***" Lowering the data rate reduces the communication speed but increases the effective range of the WiFi module. **Note:** "*" For more accuracy, the scan rate from BMS/Host should be slow. It is recommended as no more than 1 time per second.