FSTS®
SMS.MONITOR SYSTEM

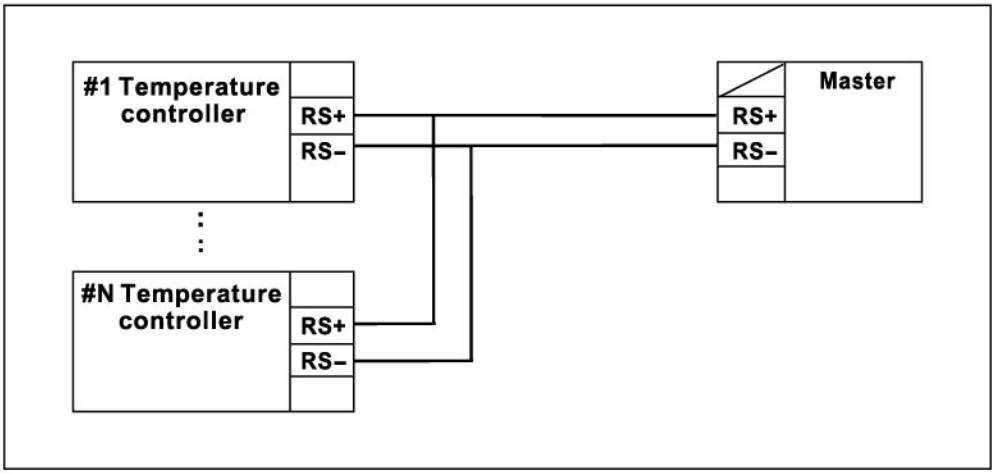
# PC-1000 通訊協定使用手冊

## RS-485 Communication Protocol 通訊協定

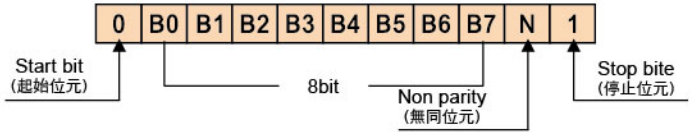
PC-1000 series Temperature controller 溫度控制器

Thanks you very much for using FSTS® series temperature controller
Please read this instruction manual before operating it to avoid from the malfunction.

## Connection diagram 接線圖




| Communication standard | EIA － RS 485 | Communication speed | 9600 or 19200 bps or 38400 |
|---|---|---|---|
| Communication protocol | RS=0:「MODBUS-RTU code」<br>RS=1:「MODBUS-ASCII code」 | Communication station No. | Id No. = 01H ~ FFH<br>( Id NO. = 01 ~ 255 ) |
| Date configuration | bit=0:「8N1」; bit=1:「8E1」<br>bit=2:「8O1」; bit=3:「7O1」 | | |



## Address of parameter register 參數儲存位址

| Address | Description | Address | Description | Address | Description |
|---|---|---|---|---|---|
| 0001H | **Lck :** Lock setting<br>Range : 0 ~ 3 | 0010H | **HYS :** Hysteresis<br>Range : 0000~9999 | 001FH | **bPS :** Baud rate<br>Refer to Communication speed |
| 0002H | **AL1 :** #1 alarm<br>Range : -0099~0999 | 0011H | **At :** Auto-tuning setting<br>0=Controlling;1=Auto-tuning | 0020H | **bit :** Data configuration<br>Refer to Data configuration |
| 0003H | **AL2 :** #2 alarm<br>Range : -0099~0999 | 0012H | **Tu :** Auto-tuning bias<br>Range : 0000~0999 | 0021H | **it :** Communication Interval time<br>Range : 0 ~ 250ms |
| 0004H | **tnr :** Process timer<br>Refer to Alarm mode | 0013H | **P :** Proportion band<br>Range : 0000~0999 | 0023H | **SV :** Setting value<br>Range : -0999~9999 |
| 0005H | **ALH :** Hysteresis<br>Range : 0 ~ 999 | 0014H | **I :** Integral time<br>Range : 0000~3999 | 0024H | **ON_OFF : Controller ON/OFF**<br>0000=ON ; 0001=OFF |
| 0006H | **T :** Flicker timer<br>Range : 0~99s | 0015H | **D :** Derivative time<br>Range : 0000~3999 | 0025H | **M_A :** Auto/Manual selecting<br>0=Auto ; 1=Manual |
| 0007H | **SLH :** High limit of set<br>Range : 0000~9999 | 0016H | **Gain :** | 0026H | **SV_Un :** Display selecting<br>0=SV ; 1=Un |
| 0008H | **Out :** Limit of out<br>Range : 0 ~ 100 | 0017H | **Int :** Input type<br>0=Pt;1=K;2=J;3=R;4=S<br>5=T;6=B;7=E;8=N;9=L | 0100H | **SV :** Setting value<br>Range : -999~9999 |
| 0009H | **nUn :** Manual output volume<br>Range : 0~100 | 0018H | **Unt :** Unit selecting<br>0=℃ ; 1=℉ | 0101H | **PV :** Process value<br>Range : -0999~9999 |
| 000AH | **Hb :** Current setting<br>Range : 0~99.99 | 0019H | **d P:**Decimal point setting<br>0=Non;1=One decimal | 0102H | **Un :** Output volume<br>Range : 0 ~ 100 |
| 000BH | **CtL :** Min. CT value<br>Range : -9.99~99.99 | 001AH | **Sht :** Input shift<br>Range : -0999 ~ 0099 | 0103H | **Ctu :** Process current value<br>Range : 0~99.99 |
| 000CH | **Cth :** Max. CT value<br>Range : 0~99.99 | 001BH | **H_C:**Heating-cooling selecting<br>0= Heating;1= Cooling | 0104H | **Status of Out1/Out2/AL1/AL2**<br>Refer to Status of Out/AL1/AL2 |
| 000DH | **noL :** Limit of HB output<br>Range : 0 ~ 100 | 001CH | **ALt :** Alarm mode<br>Range : 00 ~ 18 | 0105H | **AL1 :** #1 alarm<br>Range : -999~9999 |
| 000EH | **Lot :** Min. output volume<br>Range : 0 ~ 100 | 001DH | **Id :** Station No.<br>Range : 01H ~ FFH | 0106H | **AL2 :** #2 alarm<br>Range : -999~9999 |
| 000FH | **CT :** Cycle time<br>Range : 0000~0099S | 001EH | **RS:**Communication mode<br>Refer to Communication mode | 0107H | **HB :** Current setting<br>Range : 0~99.99 |

## Status of Out1 / Out2 / AL1 / AL2

**Data bit : 0 0 0 0**

1. 1st bit : bit=0 → Out1 OFF ; bit = 1 → Out1 ON
1. 2nd bit : bit=0 → Out2 OFF ; bit = 1 → Out2 ON
1. 3rd bit : bit=0 → AL1 OFF ; bit = 1 → AL1 ON
1. 4th bit : bit=0 → AL2 OFF ; bit = 1 → AL2 ON

## Message format 資料格式

Ex: 「Read the PV value of No.01 controller : PV = 100」 and 「Write the SV value of No. 01 controller : SV = 100」

【Station No. = 01H, PV address = 0100H、PV = 100 (64H) , SV address = 0101H】

讀取 # 1 溫控器的「PV」值時PV是「100」；改寫 #1 溫控器的「SV」值為「100」

【站號.= 01H，PV位址 = 0100H、PV = 100 (64H)，SV位址 = 0101H，SV = 100 (64H)】

**Communication code:「RS = 0 : MODBUS-RTU code」**

| | | | | | |
|---|---|---|---|---|---|
| Read command | Station No. | Function Code | Address | Batches of data | CRC |
| | 01H | 03H | 01H 00H | 00H 01H | |
| Read response | Station No. | Function Code | Data byte Counts | Data | CRC |
| | 01H | 03H | 02H | 00H 64H | B9H AFH |
| Write command | Station No. | Function Code | Address | Data | CRC |
| | 01H | 06H | 01H 01H | 00H 64H | |
| Write response | Station No. | Function Code | Address | Data | CRC |
| | 01H | 06H | 01H 01H | 00H 64H | |

**Communication code:「RS = 1 : MODBUS-ASCII code」**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Read command | Stat code | Station No. | Function code | Address | Batches of data | LRC | Stop code |
| | 3AH | 30H 31H | 30H 33H | 30H 30H 31H 33H | 30H 30H 30H 31H | 42H 37H | 0DH 0AH |
| Read response | Stat code | Station No. | Function code | Data byte counts* | Data | LRC | Stop code |
| | 3AH | 30H 31H | 30H 33H | 30H 32H | 30H 30H 36H 34H | 31H 30H | 0DH 0AH |
| Write command | Stat code | Station No. | Function code | address | Data | LRC | Stop code |
| | 3AH | 30H 31H | 30H 36H | 30H 30H 31H 30H | 30H 30H 36H 34H | 41H 45H | 0DH 0AH |
| Write response | Stat code | Station No. | Function code | address | Data | LRC | Stop code |
| | 3AH | 30H 31H | 30H 36H | 30H 30H 31H 30H | 30H 30H 36H 34H | 41H 45H | 0DH 0AH |

Data byte counts* : 2 ASCII code byte = 1 data byte

## Remarks

| Symbol | ASCII code | Description | Symbol | ASCII code | Description | Symbol | ASCII code | Description |
|---|---|---|---|---|---|---|---|---|
| @ | 40 | Start code | C | 43 | Hex | 4 | 34 | Hex / BCD |
| R | 52 | Read | D | 44 | Hex | 5 | 35 | Hex / BCD |
| W | 57 | Write | E | 45 | Hex | 6 | 36 | Hex / BCD |
| CR | 0D | Stop code | F | 46 | Hex | 7 | 37 | Hex / BCD |
| - | 2D | Minus | 1 | 31 | Hex / BCD | 8 | 38 | Hex / BCD |
| A | 41 | Hex | 2 | 32 | Hex / BCD | 9 | 39 | Hex / BCD |
| B | 42 | Hex | 3 | 33 | | : | 3A | |

## Calculation of「FCS」查核碼計算方式

【RS = 1：MODBUS RTU code】: FCS = CRC-16 ( Cyclic redundancy check )

**Procedure of CRC-16 calculation**

1>To load FFH FFH to the 16 bit CRC register
2>To exclusive OR (*) the first byte of the message format with the low order byte of the 16 bit CRC register, then put the result in the 16 bit CRC register.
3>To shift the CRC register one bit to right (toward the LSB) and fill the MSB with zero.
4>To repeat the step 3 if the carry flag is 0 (LSB is 0) ,Exclusive OR the CRC register with A001H which is the value of polynomial if the carry flag is 1 (LSB is 1), then put the result in the 16 bit CRC register
5>To repeat the step 3 and 4 until the 16 bit CRC register is shifted 8 times
6>To repeat from step 2 to step 5 for the next byte of the message format until final byte of message is completed. (Except the CRC bytes)
7>To get the CRC value by changing the high order and low order byte of the final CRC register.

【RS=3：MODBUS - ASCII code】: FCS=LRC

**Procedure of LRC calculation**

1>To add all bytes in the message format , excluding the start code ( : ) and ending code (0DH 0AH), then put this value in an 8-bit field.
2>To get a two's complement from this 8-bit field. It is named 「Y」 (8-bit field also)
3>To get LRC value by changing the Hex code to ASCII code from the 「Y」.

## Error response code 錯誤回應碼 (Message format 資料格式)

| RS = 0 : MODBUS-RTU code | | | | |
|---|---|---|---|---|
| Function | Station No. | Function Code | Error code | FCS |
| Read | 01H ~ 63H | 83H | 01H ~ 04H | CRC - 16 |
| Write | 01H ~ 63H | 86H | 01H ~ 04H | CRC - 16 |

| RS = 1 : MODBUS-ASCII code | | | | | | |
|---|---|---|---|---|---|---|
| Function | Start code | Station No. | Function Code | Error code | FCS | Stop code |
| Read | 3AH | 30H 31H ~ 36H 33H | 38H 33H | 30H 31H ~ 30H 34H | LRC | 0DH 0AH |
| Write | 3AH | 30H 31H ~ 36H 33H | 38H 36H | 30H 31H ~ 30H 34H | LRC | 0DH 0AH |

| Error code | | | | | |
|---|---|---|---|---|---|
| Error code | | Description (說明) | Error code | | Description (說明) |
| MODBUS-RTU | 01H | Command error (指令錯誤) | MODBUS-RTU | 03H | Data overflow error (資料長度錯誤) |
| MODBUS-ASCII | 03H 31H | | MODBUS-ASCII | 30H 33H | |
| MODBUS-RTU | 02H | Address overflow error (位址錯誤) | MODBUS-RTU | 04H | Data error (資料值錯誤) |
| MODBUS-ASCII | 30H 32H | | MODBUS-ASCII | 30H 34H | |