Air-Farm User Manual

CO2 / Temperature / Humidity Transmitter

Features

- CO2, Temperature and Humidity measurement
- Three high sensitivity sensors
- RS485(MODBUS) Communication
- Analog Voltage and 4-20mA Current Output
- Alarm function for Air Status Warning
- Compact waterproof box of size 120mm x 80mm x 55mm

Model : TT200

Application

Air-Farm (Model: TT200) can measure the Air Status such as: CO2, Temperature and Humidity values.
This model has three sensitive sensors, which makes it an optimum choice for installation in Factories or Greenhouses.

This interface supports RS485 communication and two analog output types (i.e, Voltage and Current).
So, this model can be connected to other systems. Maximum 100 devices are possible to be connected on RS485 bus,
Each of these device can have 0-5V, 4-20mA Output.

This model has Active Low Output (NPN driven Output) for the systems such as Relays, LEDs, etc, for CO2 quality warning.

Table 1. General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Power Supply	8	12	36	V	
Current Consumption	0.04	0.05	0.15	A	Test with Vin = 12V Supply Voltage
Operating Temperature	-10	-	50	℃	

Table 2. Sensors Specifications

Parameter	Min	Typ	Max	Unit	Notes
CO2 Measuring Range	0	-	10000	ppm	
Accuracy (CO2)	+/-30Ppm +/-5%				Above 0 ℃
	+/-50ppm +/-7%				Below 0 ℃
Temperature Measuring Range	-10	-	50	℃	
Accuracy (Temperature)	-0.4	-	+0.4	℃	
Humidity Measuring Range	0	-	80	%	
Accuracy (Humidity)	-4	-	4	%	

Table 3. Interface Specifications

Parameter	Min	Typ	Max	Unit	Notes
RS485 Recommended Request Time	500	1000	-	ms	
Analog Output Range	0	-	5	V	
4-20mA Current Output Range	4	-	20	mA	
Response Time (for Analog and Current Output)	1.7	2	-	s	
Alarm 'On' State (NPN Out)	-	2000	-	ppm	Alarm will be triggered

RS485 Interface

The TT200 communicates with other devices over RS485 bus. MODBUS follows RS485 communication standard. See, Table 4, for configuration of RS485 communication.

Table 4. Communication Configuration

Baud rate	9600 bps
Stop Bits	1 bit
Parity Check	None
Data Length	8 bits

The details about request and response protocols are given in, Table 5. And this protocol is followed by RTU (Remote Terminal Unit). Description of MODBUS Protocol is given in, Table 6.

Table 5. MODBUS Protocol

No. of Bytes	1	1	2	2	2
Tx	Slave ID	Function Code	Starting Address	Request Quantity	CRC

No. of Bytes	1	1	1	n	2
Rx	Slave ID	Function Code	Data Length	Data[n]	CRC

Table 6. MODBUS Protocol Byte Description

Name	Bytes	Description
Slave ID	1	Set Device ID, through a rotary switch.
Function Code	1	Reading and Writing Request Code.
Starting Address	2	Starting address of data bytes.
Request Quantity	2	Number of sensors to be loaded with data.
Data Length	1	Number of data bytes.
Data[n]	n	Number of data bytes (n), sent by sensor. (Each device sends 2 data bytes)
CRC	2	Error checking according to CRC16 standard.

See Picture1, This rotary switch is for configuration of RS485 Slaves' Device ID.
The left switch is for tens digit and right switch is for ones digit of decimal Device ID.
So, User can easily configure Slaves' Device ID (a decimal number).

For example, If left switch is set at "3" and right switch is set at "1", then, RS485 Slave ID will be "31", which is equivalent to 0x1F (in hexadecimal notation).

Picture 1. Rotary Switch

List of functions is given in Table 7 and List of TRUEYES functions is given in Table 8 and address of each sensor is given in Table 9.

Table 7. Function Code Table

Function Description	Function Code
Read Holding Registers	0x03

Table 8. TRUEYES Function Code Table

Function Description	Function Code
Read Serial Number	0x50
Read Firmware Version	0x51
Request Manual Calibration	0x70
Read Manual Calibration State	0x71

Table 9. Sensor Address Table

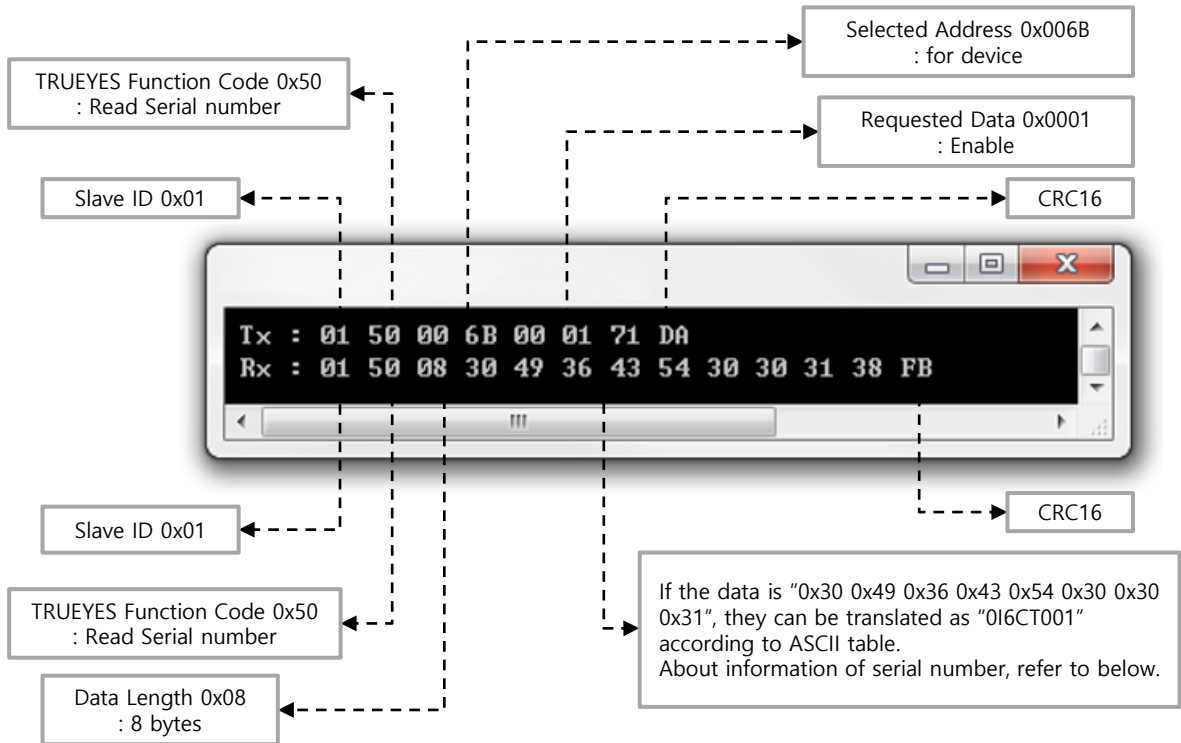| Sub Device	Starting Address
CO2	0x0065
Temperature	0x0066
Humidity	0x0067
Slave (This Transmitter)	0x006B

This is an example of serial communication protocol.
There is an example of CRC calculation for serial communication, on the page 9.
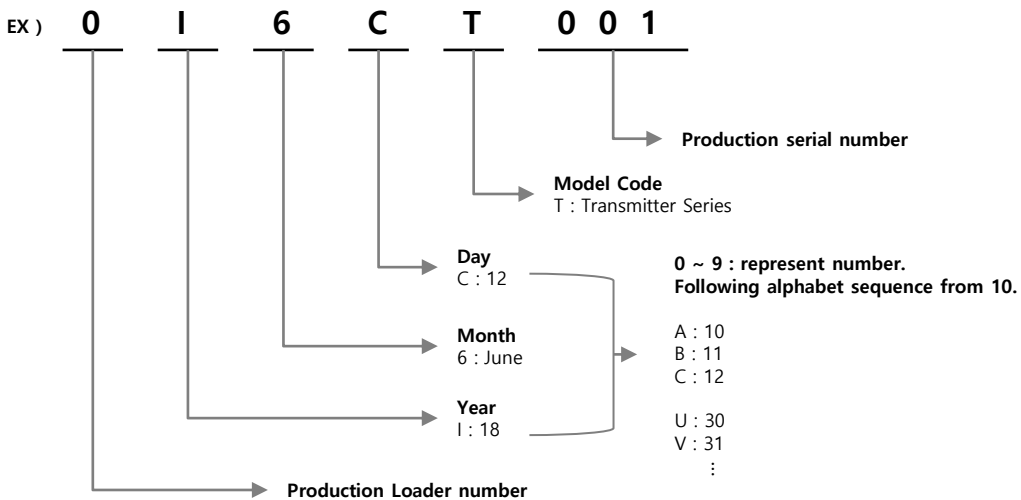
Example 1. Read Holding Registers

Starting Address 0x0065
: for Slave Sensors

Request Quantity 0x03
: Number of Sensors

CRC16

Function Code 0x03
: Read Holding Registers

Slave ID 0x01

```
Tx : 01 03 00 65 00 03 15 D4
Rx : 01 03 06 01 B3 00 CB 01 0A D5 17
```

Slave ID 0x01

Function Code 0x03
: Read Holding Registers

Data Length 0x06
: 6 bytes

CRC16

Data2 0x010A : Humidity Level
= Data2 / 10 = 26.6%

Data1 0x00CB : Temperature Level
= Data1 / 10 = 20.3 ℃

Data0 0x01B3: CO2 Level
= 435 PPM

TRUEYES

This is an example to read a Serial number of Air-Farm.

Example 2. Read Serial Number

Selected Address 0x006B
: for device

TRUEYES Function Code 0x50
: Read Serial number

Requested Data 0x0001
: Enable

Slave ID 0x01

CRC16

```
Tx : 01 50 00 6B 00 01 71 DA
Rx : 01 50 08 30 49 36 43 54 30 30 31 38 FB
```

CRC16

Slave ID 0x01

TRUEYES Function Code 0x50
: Read Serial number

If the data is "0x30 0x49 0x36 0x43 0x54 0x30 0x30 0x31", they can be translated as "0I6CT001" according to ASCII table.
About information of serial number, refer to below.

Data Length 0x08
: 8 bytes

Figure 1. Serial Number Format

EX)   **0   I   6   C   T   0 0 1**

Production serial number

Model Code
T : Transmitter Series

Day
C : 12

0 ~ 9 : represent number.
Following alphabet sequence from 10.

A : 10
B : 11
C : 12

Month
6 : June

U : 30
V : 31
⋮

Year
I : 18

Production Loader number
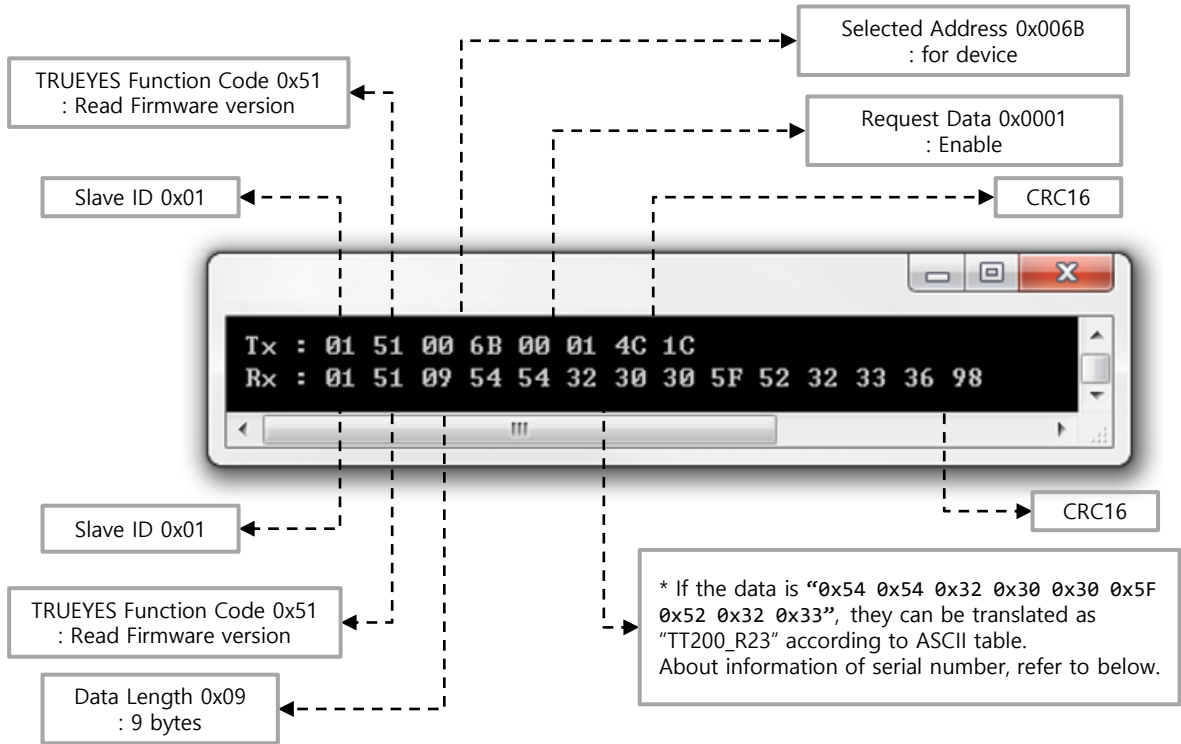
The "0I6CT001" is translated like below description.
The transmitter was first produced on June 18, 2018.

This is an example to read a Firmware version of Air-Farm.

Example 3. Read Firmware Number

Selected Address 0x006B
: for device

TRUEYES Function Code 0x51
: Read Firmware version

Request Data 0x0001
: Enable

Slave ID 0x01

CRC16

```
Tx : 01 51 00 6B 00 01 4C 1C
Rx : 01 51 09 54 54 32 30 30 5F 52 32 33 36 98
```

CRC16

Slave ID 0x01

TRUEYES Function Code 0x51
: Read Firmware version

Data Length 0x09
: 9 bytes

* If the data is **"0x54 0x54 0x32 0x30 0x30 0x5F 0x52 0x32 0x33"**, they can be translated as "TT200_R23" according to ASCII table.
About information of serial number, refer to below.

The firmware version of this transmitter be displayed as follows.
The firmware version is different for each firmware version. The firmware version shown below is one example.
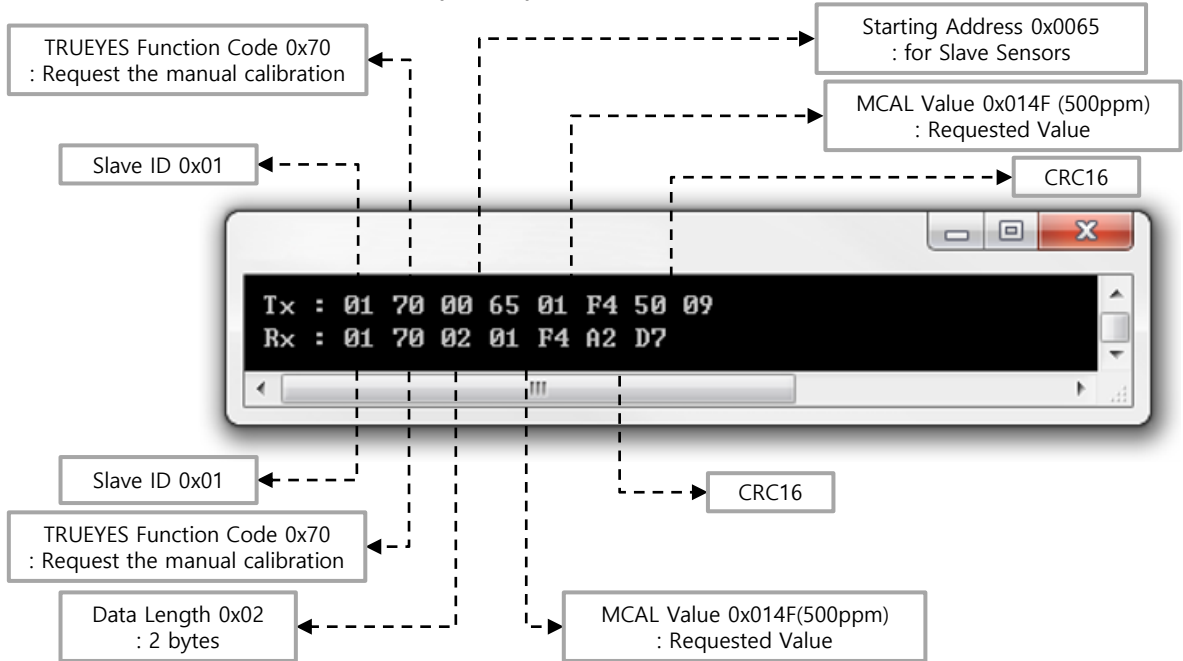
Figure 2. Firmware Version Format

EX)   T   T   2   0   0   _   R   2   3

Firmware Version number
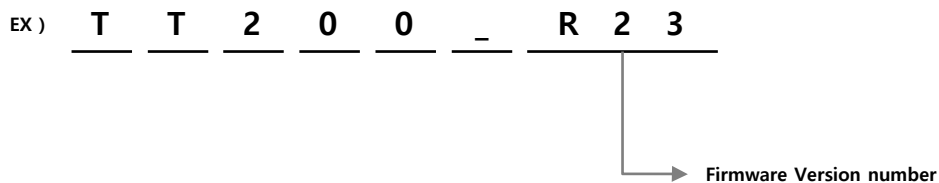
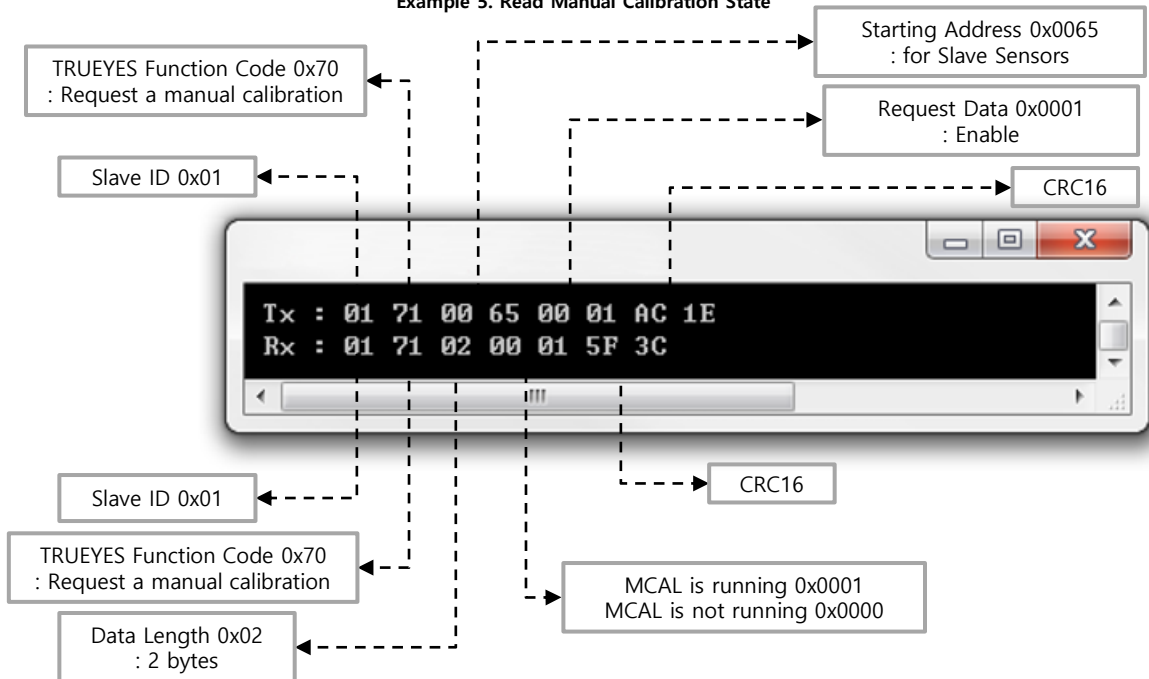※ **About manual calibration is on the TG100 Manual. Before start this command, Please Read the instructions**

This is an example for request the manual calibration to CO_2 sensor.

Example 4. Request the manual calibration

TRUEYES Function Code 0x70
: Request the manual calibration

Starting Address 0x0065
: for Slave Sensors

MCAL Value 0x014F (500ppm)
: Requested Value

Slave ID 0x01

CRC16

```
Tx : 01 70 00 65 01 F4 50 09
Rx : 01 70 02 01 F4 A2 D7
```

Slave ID 0x01

CRC16

TRUEYES Function Code 0x70
: Request the manual calibration

Data Length 0x02
: 2 bytes

MCAL Value 0x014F(500ppm)
: Requested Value

This is an example for Read manual calibration state to CO_2 sensor.

Example 5. Read Manual Calibration State

Starting Address 0x0065
: for Slave Sensors

TRUEYES Function Code 0x70
: Request a manual calibration

Request Data 0x0001
: Enable

Slave ID 0x01

CRC16

```
Tx : 01 71 00 65 00 01 AC 1E
Rx : 01 71 02 00 01 5F 3C
```

Slave ID 0x01

CRC16

TRUEYES Function Code 0x70
: Request a manual calibration

MCAL is running 0x0001
MCAL is not running 0x0000

Data Length 0x02
: 2 bytes

That is how the calculation of CRC (Cyclic Redundancy Check) is done. CRC16 is used in MODBUS RTU Mode.
See figure 1, This figure is flow chart of CRC16 calculation and an example in C language for it.

Figure 3. Flow Chart
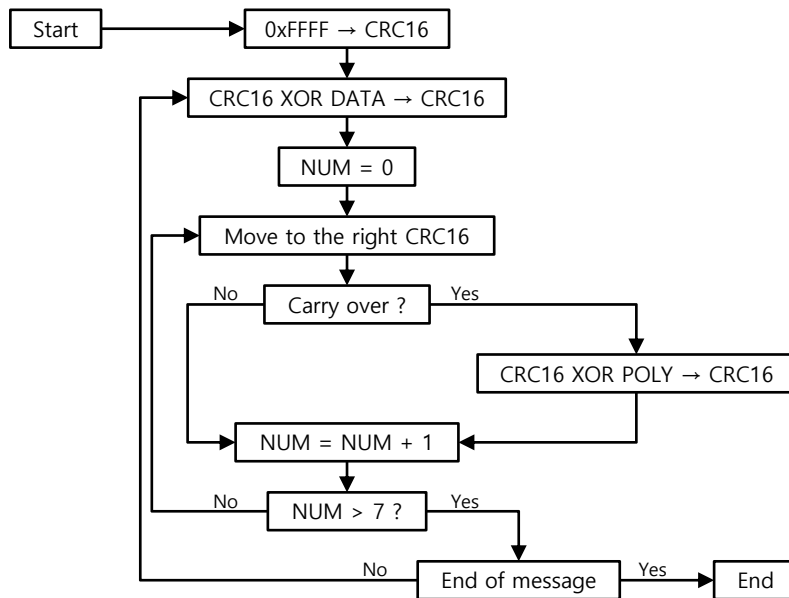
**Example 6. CRC16 Calculation**

```
#define POLYNORMIAL 0xA001
unsigned short CRC16(unsigned char *puchmsg, int dataLength){
    int i;
    unsigned short crc, flag;
    crc = 0xFFFF;

    while(usDataLen--){
       crc ^= *puchmsg++;
       for (i=0; i<8; i++){
          flag = crc & 0x0001;
          crc >>= 1;
          if(flag){ crc ^= POLYNORMIAL; }
       }
    }
    return crc;
}

void main(void){
    unsigned char data[8] = {0x01, 0x01, 0x00, 0x00, 0x00, 0x03, 0, 0};
    unsigned short crc16;
    crc16 = CRC16(data, 6);
    data[6] = (unsigned char)((crc16>>8) & 0x00FF);
    data[7] = (unsigned char)(crc16 & 0x00FF);
}
```

Dimension
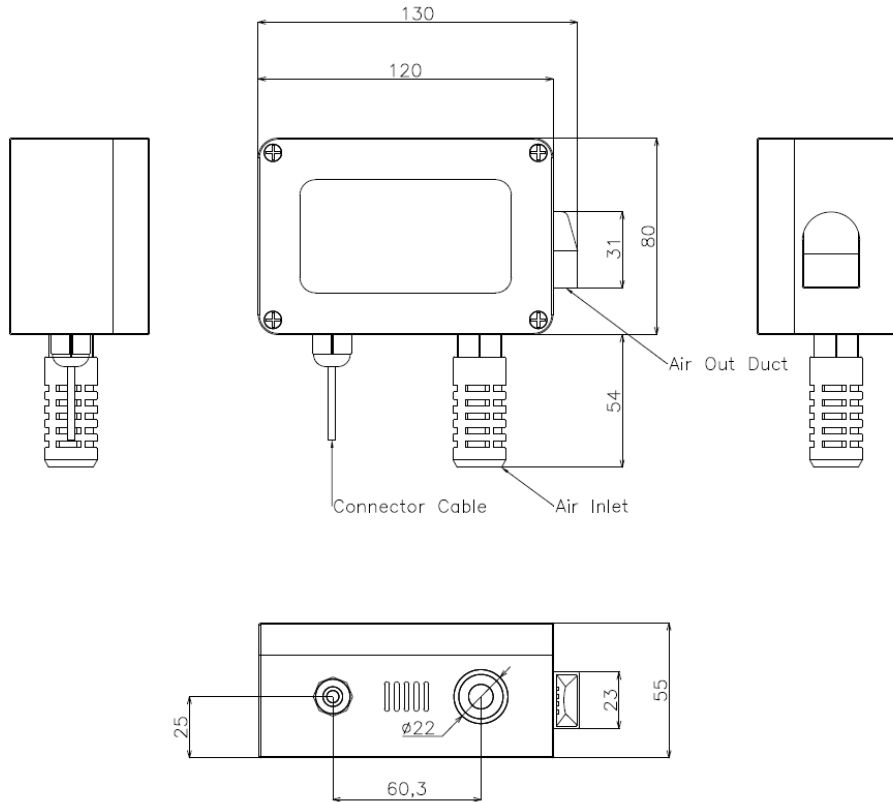
Connector Pin Description

Table 10. Pin Description
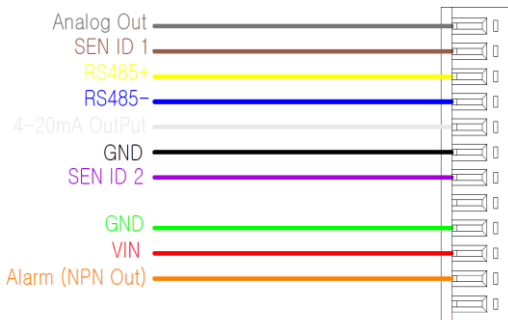
Pin Color.	Pin Assigned	Pin Color.	Pin Assigned
Grey	Analog Output	Black	GND
Brown	SEN_ID1	Purple	SEN_ID2
Yellow	RS485+	Green	GND
Blue	RS485-	Red	VIN
White	4-20mA Current Output	Orange	Alarm (NPN Out)

Figure 4. Connector by Color

"SEN_ID1" and "SEN_ID2" are for detecting open circuit.

Cautions on Usage

- Do not use this device for medical or safety purpose.
This product is designed only for industrial and ordinary use.

- This product must abide by the operating and storage
Temperature and humidity conditions. Do not leave or use
the device for longtime in a highly damped place, in which
humidity is over 95%RH.

- The standard test condition in which the product was
tested is 25℃±3℃, 50±30%RH. Signal may vary slightly with
environmental condition.

- Be careful while installation and using it, as it may cause
serious damage to the sensor in case of, vibration or shock
or falling on the hard surface.

- We do not guarantee the performance of this device in case
of user installation, disassembling, assembling it at anybody`s
discretion. If installation and inspection is required, then,
Please, contact our technicians.

- NDIR type CO2 sensor is influenced by air pressure. It can
be used without correction within 300m range, above sea level.
However, the output value may vary by ±1.0% / 100m height,
above, 300m from sea level.

- Use when it is fixed, not, while it is in motion.

Warranty Information

During this 1 year period, our liability hereunder is
limited to the replacement of the products.
The warranty will become void, if the product is been
damaged due to an accident, unreasonable use,
negligence, tampering or other causes not arising
from defects in material or workmanship and extends
to the original consumer of the product only.

Revision History

Revision	Description	Date	Owner
1.2	- Initial Release	2018-06-11	DH Jeong
1.3	- Added RS485 serial number, firmware number message. - On Page 5, added TRUEYES Function Code Table. - On Page 5, added Sensor Address Table of Slave (This Transmitter) - Added serial number and firmware number I2C packet. - Added how to read by Serial number and firmware number. - Added how to read by Request a manual calibration. - Added how to read by manual calibration state	2018-06-29	DH Jeong

TRUEYES

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