HRT-227CS

(HART to Single Mode Fiber Converter)

User's Manual

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year, beginning from the date of delivery to the original purchaser.

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Table of Contents

1. Introduction

The HRT-227CS is a HART to Fiber converter paired used to extend HART communication distance via single mode fiber optic transmission medium. In order to solve the problem between HART and fiber transmission medium, HRT-227CS is specially designed for converting the HART signal to fiber optic cables. Built-in a HART 250 Ω loop resistor adjustable by dip switch. Therefore, users can make data collection and processing of HART network easier and quicker by applying HRT-227CS. In addition, we also provide the free HC_Tool utility for module configuration easily.

The following is the application structure of HRT-227CS.

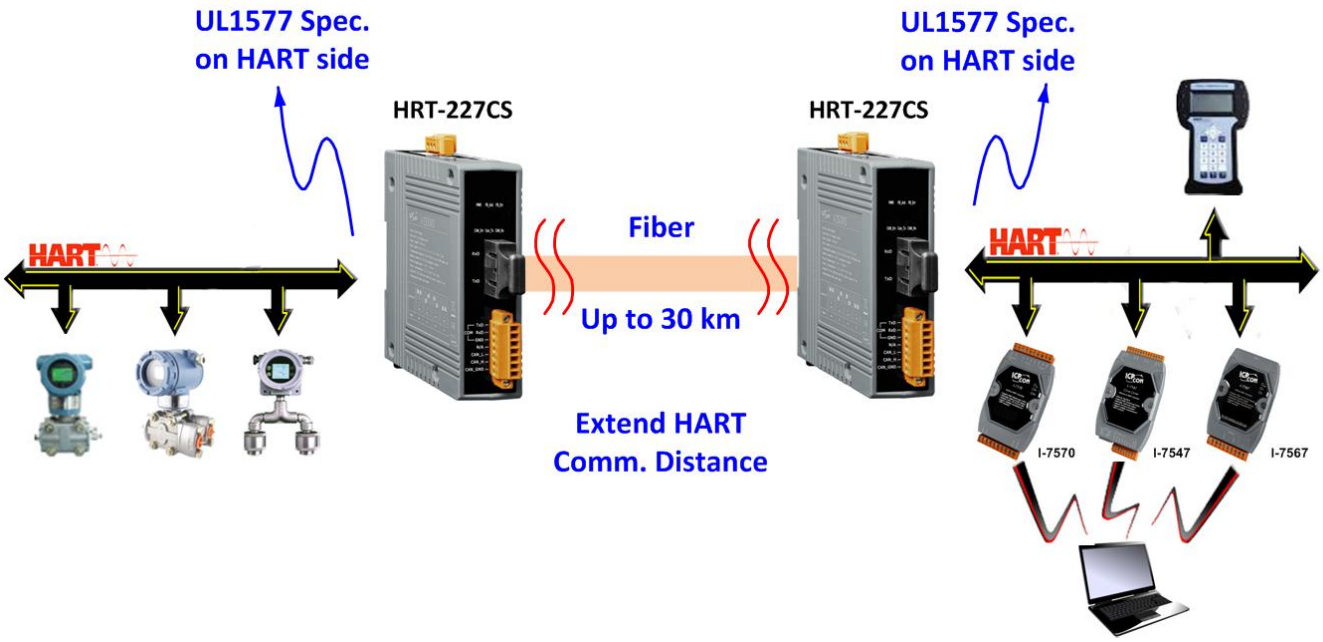


Figure 1-1 HART to Fiber application

1.1. Specifications

HART Interface	
Channel	1
Connector	2-pin screwed terminal block (HART+, HART-)
Terminator Resistor	Selectable 250Ω loop resistor
HART Data	Only Digital Data
Isolation	UL1577 Spec.
Fiber Interface	
Type	SC Duplex type ; Single mode ; 100 Base-FX
Wave Length (nm)	1310
Fiber Cable (μm)	8.3/125, 8.7/125, 9/125 or 10/125
Transmission Distance (km)	30 (indicative only)
Min./Max. TX Output (dBm)	-15 / -8
Max. RX Sensitivity (dBm)	-34
Max. RX Overload (dBm)	-5
Budget (dBm)	19
UART Interface	
COM	RS-232 (TXD / RXD / GND) for configuration (1200, O, 8 ,1)
LED	
Round LED	PWR, FB_Ack, FB_Err, HT_Err, HT_Tx and HT_Rx
Power	
Power supply	Unregulated +10 ~ +30 VDC
Protection	Power reverse polarity / Over-voltage brown-out protection
Power Consumption	3W
Mechanism	
Installation	DIN-Rail
Dimensions	33.0 mm x 126 mm x 101 mm (W x L x H)
Environment	
Operating Temperature	-25 to 75 °C
Storage Temperature	-30 to 80 °C
Humidity	10 to 90% RH, non-condensing

1.2. Features

- Support HART Short/Long frame
- Support HART Burst mode
- Support point-to-point or multi-drop HART mode
- Support connecting up to 15 HART slave devices
- Allow two HART masters.
- Provide HC_Tool for module configuration
- Support firmware update via ComPort
- Fiber Type**:** SC ; Single mode ; 100 Base-FX
- Fiber maximum transmission distance up to 30 km
- Adjustable 250Ω loop resistor by dip switch
- Provide Fiber broken line detection
- Provide PWR/Fiber/HART LED
- Built-in Watchdog
- The HART port can communicate with each other with the same Group ID

2. Hardware

2.1. Block Diagram

The following figure is the block diagram of HRT-227CS.

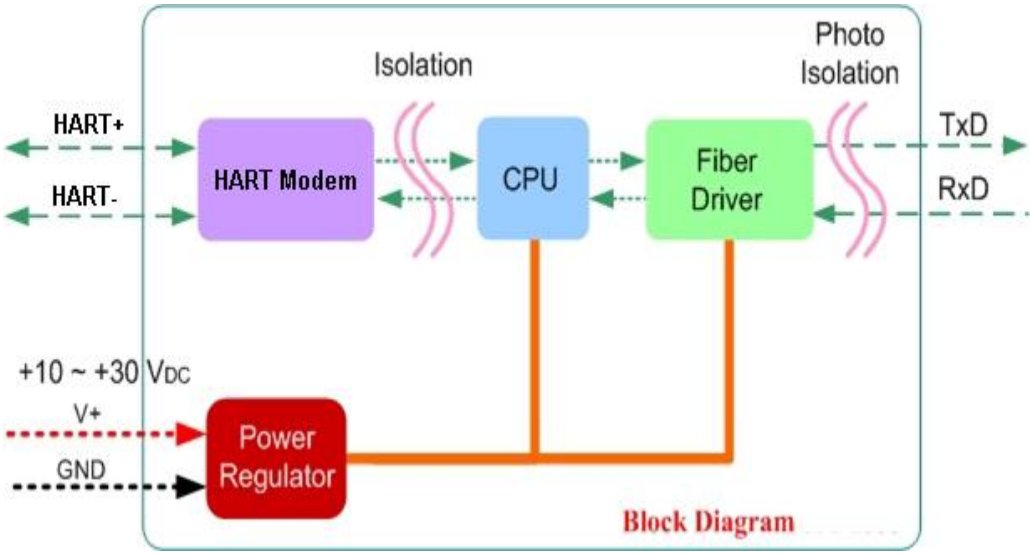


Figure 2-1 HRT-227CS block diagram

2.2. Appearance

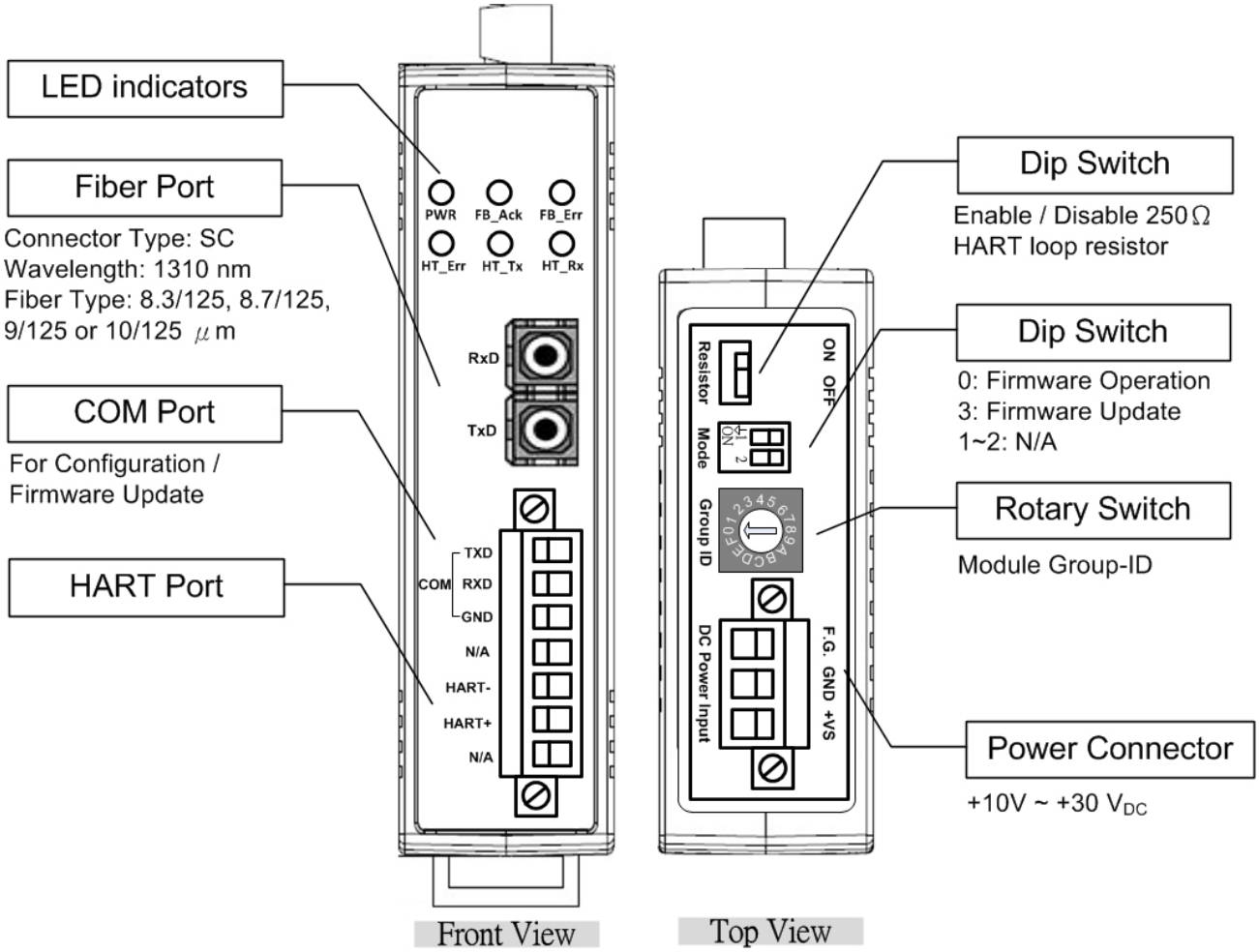


Figure 2-2 Appearance of HRT-227CS

2.3. LED Indicator

HRT-227CS provides 6 LED indicators.
(1) Power LED * 1 => PWR
(2) Fiber LED * 2 => FB_Ack / FB_Err
(3) HART LED * 3 => HT_Err / HT_Tx / HT_Rx

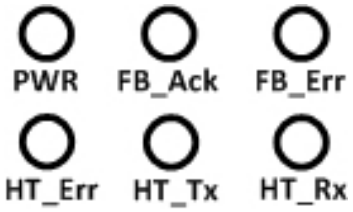


Figure 2-3 LED Indicator of HRT-227CS

Table 2-1 LED Description

LED Name	Color	Description
PWR	Red	When power on, the LED will be on.
FB_Ack	Green	When the fiber send/receive message, the LED will flash.
FB_Err	Orange	When detecting the fiber RXD line off, the LED will be on.
HT_Err	Red	When HART send/receive message failed, the LED will flash.
HT_Tx	Green	When HART send messages, the LED will flash.
HT_Rx	Green	When HART receive messages, the LED will flash.

[NOTE]
1. "**Firmware Update**" mode**:** HT_Err / HT_Tx / HT_Rx LED will flash every 500ms.

2.4. Pin Assignment

The below table is the pin assignment for Fiber / COM / HART port of HRT-227CS.

Table 2-2 Pin Assignment

Port	Name	Description
Fiber	RxD	Receive optic data
	TxD	Transmit optic data
COM	TXD	TXD pin of RS-232 port
	RXD	RXD pin of RS-232 port
	GND	SG (or GND) pin of RS-232 port
HART	HART-	HART- signal line of HART port
	HART+	HART+ signal line of HART port
Power	F.G.	Frame Ground
	GND	Power Ground
	+VS	Voltage Source Input. $+10V_{DC}$ ~ $+30V_{DC}$

2.5. HART Loop Resistor

HRT-227CS provides a built-in 250Ω (1/4W) HART loop resistor as figure 2-4 and adjustable by DIP switch (Resistor). When setting to be ‘ON’ position, the loop resistor will connect to HART network. The default position of the dip switch is ‘ON’.

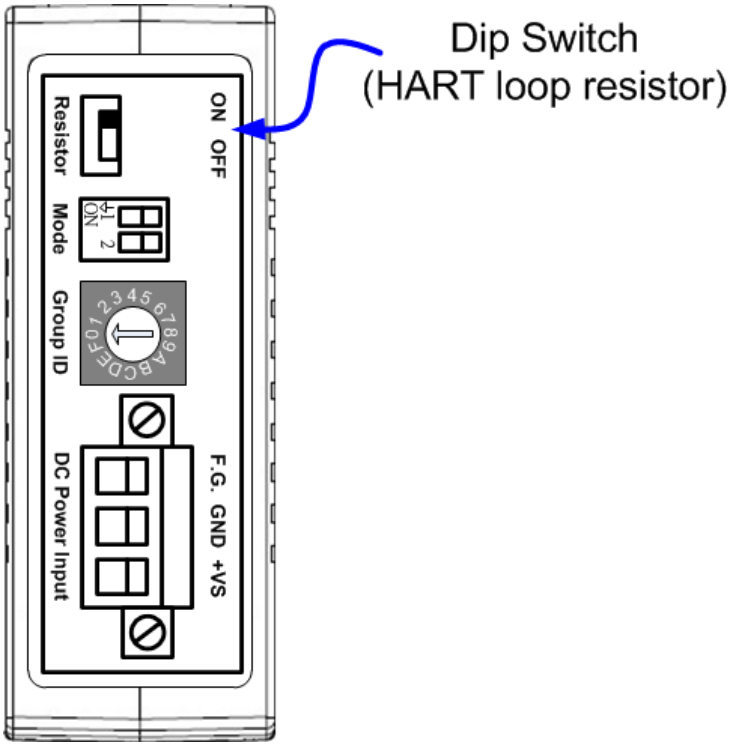


Figure 2-4 The DIP Switch (Resistor) Location

2.6. Dip Switch (Mode)

The dip switch (Mode) is used to switch module firmware function (firmware operation or firmware update) of HRT-227CS. (The detailed description for firmware update refers to chapter 5)

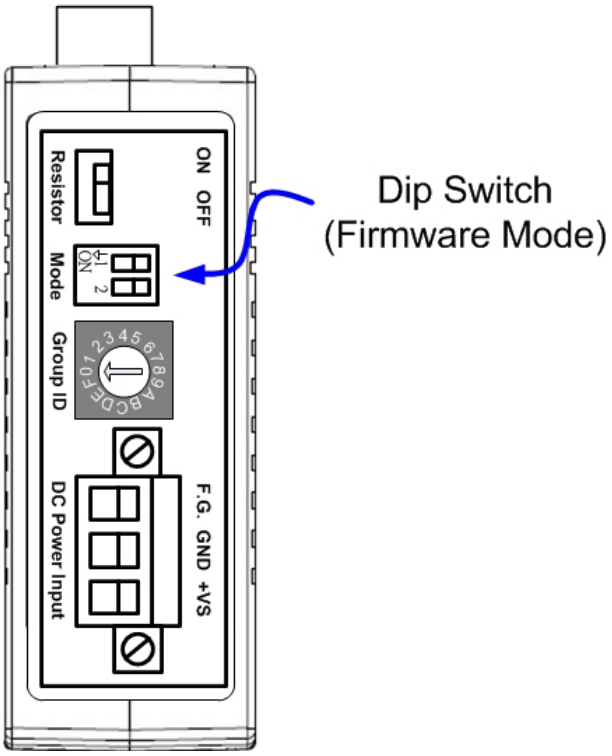
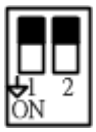
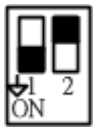
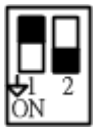
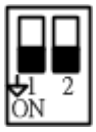


Figure 2-5 The Dip Switch (Mode) Location

There are 4 values on the dip switch and described as the below table.

Table 2-3 Function Description of Dip Switch

Dip Switch State	Value	Function
	**00**	**Firmware Operation**
	**01**	**Reserved**
	**02**	**Reserved**
	**03**	**Firmware Update**

2.7. Module Group ID

The HART port in HRT-227CS with the same module “Group ID” can communicate with each other via fiber optics. When using on star topology application, it can be used to distinguish the different HART networks connected together with fiber switch.

[Example]

(1) The above HART network 1 uses two HRT-227CS with Group ID=1.
(2) The below HART network 2 uses two HRT-227CS with Group ID=2.
(3) These two HART networks connected together via HRT-227CS with fiber switch.
⇨ The HART network 1 and network 2 can communicate simultaneously without any interfere.

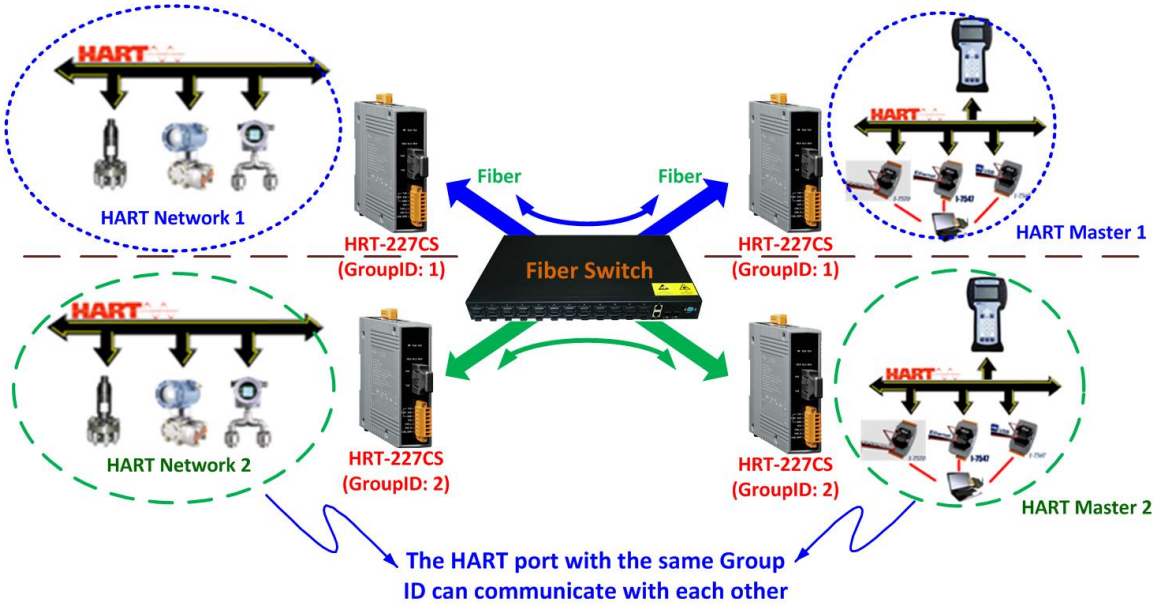


Figure 2-6 “Group ID” application

The “Group ID” value can be set by using rotary switch like Figure 2-7 and the range is from 0 to F(15).

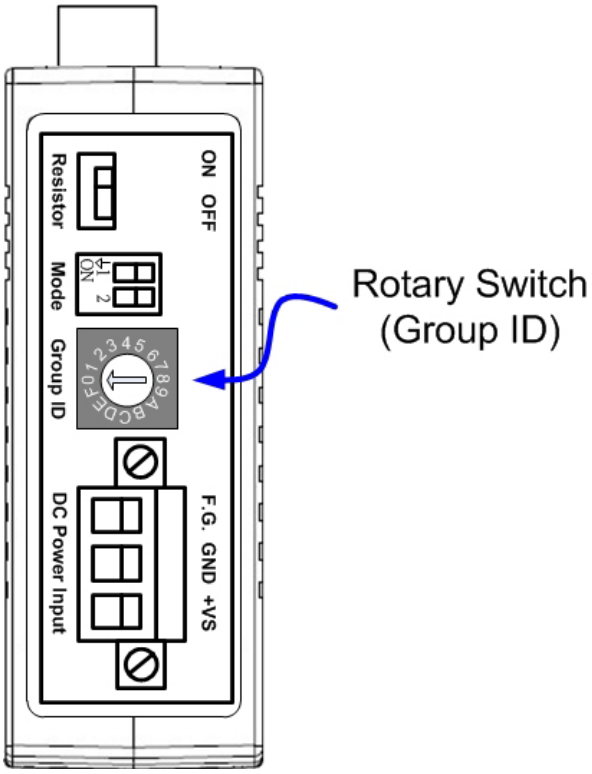


Figure 2-7 The Rotary Switch (Group ID) Location

Table 2-4 Group ID Settings

Switch Value	Description
0x0~0xE	Group ID (by hardware) (If changed, need to reboot for new setting)
0xF	Group ID (by software, range from 0~255, set by HC_Tool) (If changed, the new setting will work immediately without reboot)

2.8. Wire Connection

The wire connection of the HRT-227CS is as below.

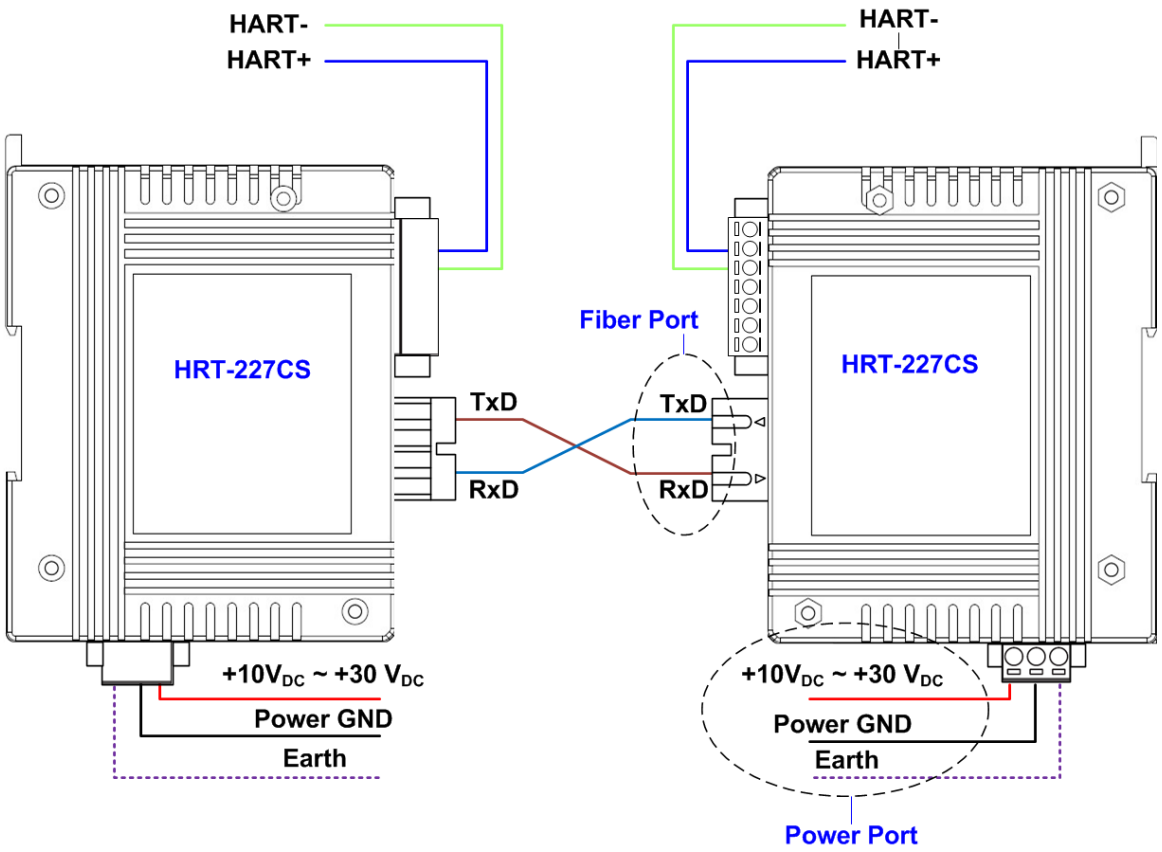


Figure 2-8 Wire Connection for HRT-227CS

3. Cable Selection

3.1. HART Cable Selection

The HART bus is a balanced (differential) 2-wire interface running over a Shielded Twisted Pair (STP), Un-shielded Twisted Pair (UTP), or Ribbon cable. In general, the minimum conductor size is 0.51mm diameter (#24 AWG) for cable runs less than 1,500 meters (@ 5,000 ft.) and 0.81mm diameter (#20 AWG) for longer distances. However, the electrical characteristics of the cable – primarily its capacitance – and the number of connected devices can affect the maximum allowable cable length. The table below shows the effect of cable capacitance and the number of network devices on cable length.

No. Network Devices	Cable Capacitance – pf/ft (pf/m)			
	20 pf/ft (65 pf/m)	30 pf/ft (95 pf/m)	50 pf/ft (160 pf/m)	70 pf/ft (225 pf/m)
1	9,000 ft (2,769 m)	6,500 ft (2,000 m)	4,200 ft (1,292 m)	3,200 ft (985 m)
5	8,000 ft (2,462 m)	5,900 ft (1,815 m)	3,700 ft (1,138 m)	2,900 ft (892 m)
10	7,000 ft (2,154 m)	5,200 ft (1,600 m)	3,300 ft (1,015 m)	2,500 ft (769 m)
15	6,000 ft (1,846 m)	4,600 ft (1,415 m)	2,900 ft (892 m)	2,300 ft (708 m)

Allowable cable lengths for 1.0 mm (#18 AWG) shield twisted pair

3.2. Fiber Selection & Fiber Length

The specification of fiber cable for HRT-227CS is shown as below table.

Table 3-1 Specification of Fiber

Fiber Type	Diameter [μm] (Core/Cladding)	Operating Wavelength [nm]
Single mode	8.3/125, 8.7/125, 9/125, 10/125	1310

The HRT-227CS allows the maximum 30km fiber length. The higher attenuation of fiber will reduce the transmission distance. The below table is the relationship between fiber attenuation and length.

Table 3-2 Attenuation & Fiber Length

Module Name	Attenuation [dB/km]	Allowed Fiber length [km]
HRT-227CS	0.4	30
	> 0.4	< 30

4. HC_Tool Utility

HC_Tool utility is provided to configure ICP DAS HART converters (like I-7567 / I-7570 / I-7547 / HRT-227CS) or transmit / receive HART frame for HART communication easily and quickly. HC_Tool utility can be downloaded from the ICP DAS web site **:** http://ftp.icpdas.com/pub/cd/fieldbus_cd/hart/converter/hrt-227CS/software/

4.1. Set up HRT-227CS

Please follow the below steps to set up HRT-227CS.

Step1**:** In the product box, the CA-0910 cable can be used to connect the com port between PC and HRT-227CS together.
(1) Connect the TXD / RXD GND pins together between PC and HRT-227CS.

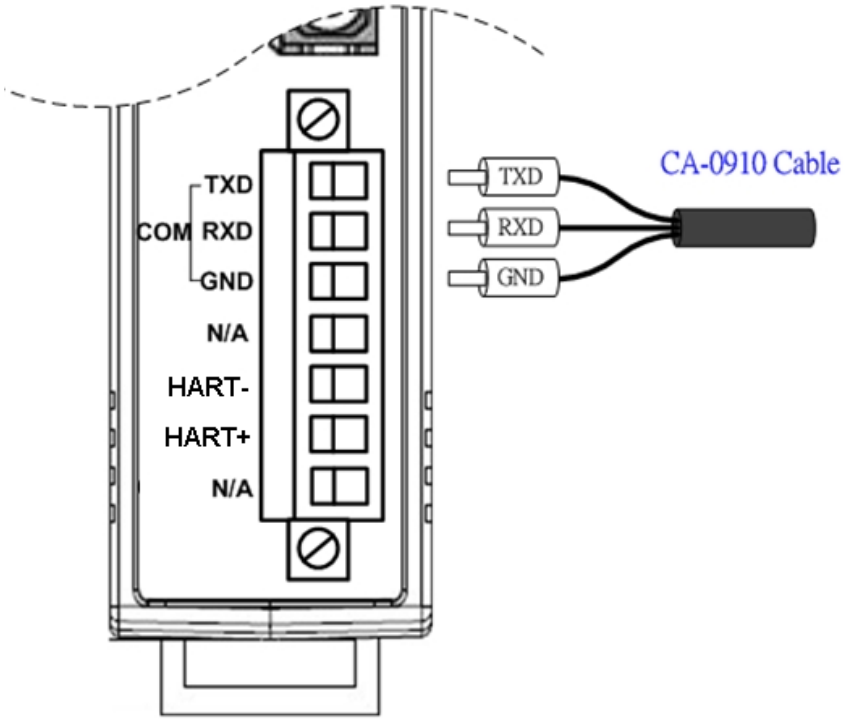


Figure 4-1 RS-232 wire connection between PC and HRT-227CS

Step 2**:** (1) Execute HC_Tool, like Figure 4-2.
If users can't run "HC_Tool", please install .NET Framework 3.5 first. (http://www.microsoft.com/downloads/details.aspx?familyid=333325FDAE52-4E35-B531-508D977D32A6&displaylang=en).

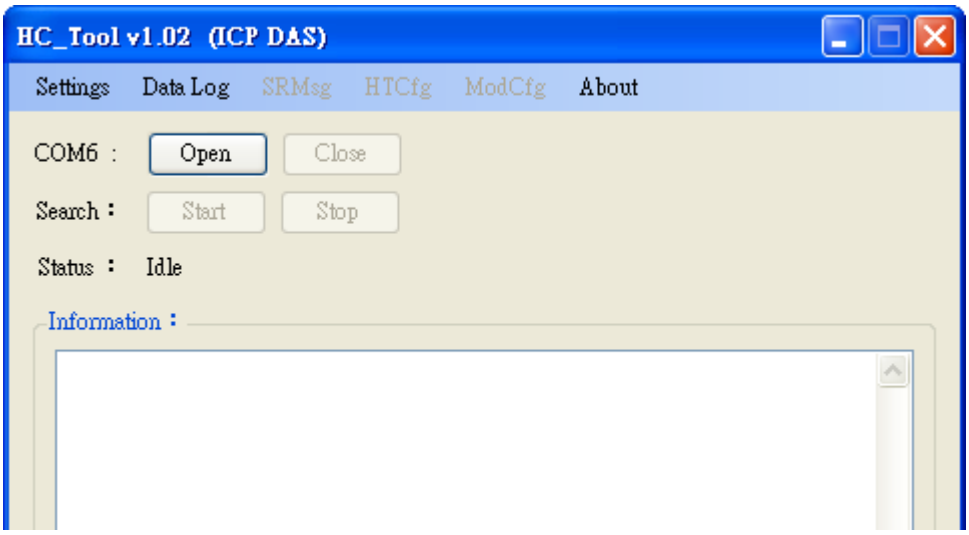


Figure 4-2 HC_Tool Utility

(2) Serial port settings ("Settings" Item)
Please click "**Settings**" item to open setting window of serial port and choose the com port number like Figure 4-3.

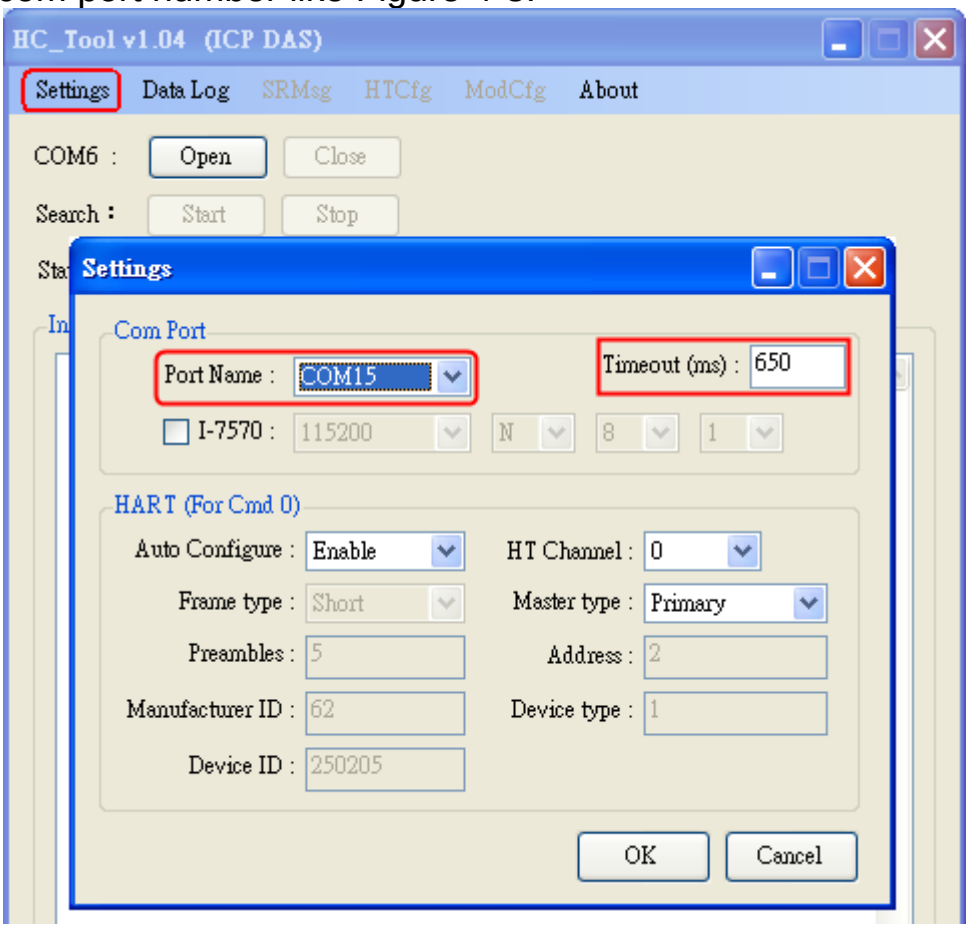


Figure 4-3 Serial Port No. Setting

Step 3**:** Click the "**ModCfg**" item and choose the "**For All**" option. Then it will open module configuration screen like Figure 4-4.

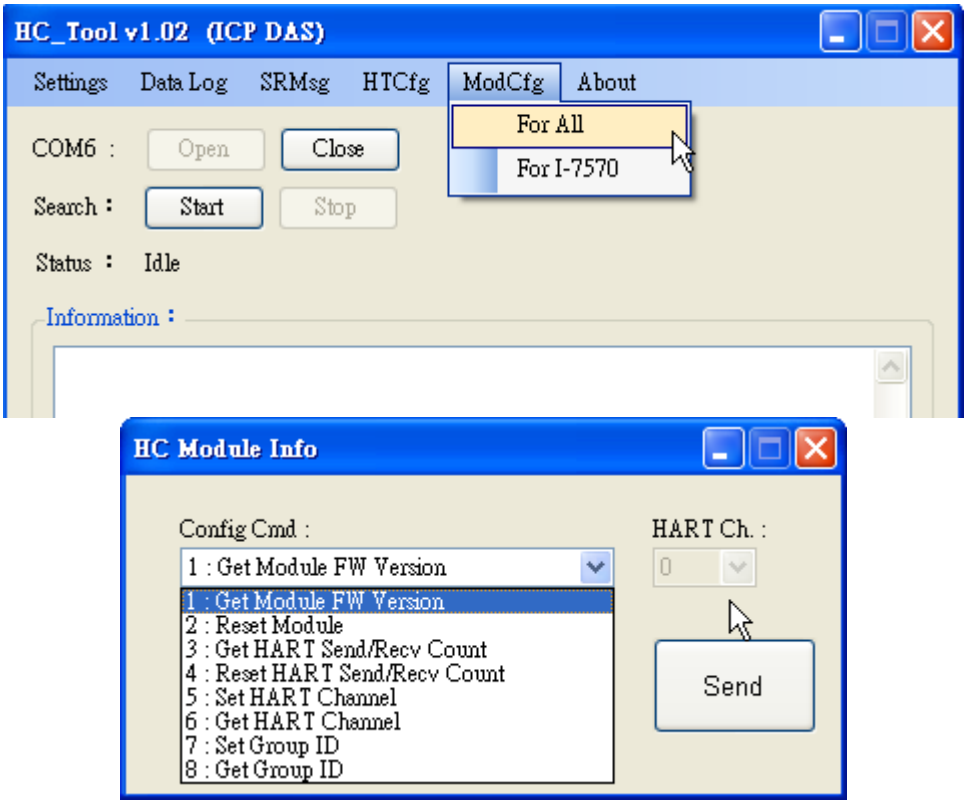


Figure 4-4 “For All” Option - Configuration Screen

(1) “Get Module FW Version”:

=> Return the firmware version of HART converter module.

(2) “Reset Module”:

=> Reset HART converter module.

(3) “Get HART Send/Recv Count”:

=> Return the total count of the sending and receiving HART messages in HART converter module.

(4) “Reset HART Send/Recv Count”:

=> Reset the total count of the sending and receiving HART messages in HART converter module.

(5) “Set HART Channel”: (Only for I-7547)

=> Set the HART channel (Range**:** 0 ~ 3) of I-7547 for HART communication by using ”HART Ch” option.

(6) “Get HART Channel”: (Only for I-7547)

=> Return the current HART communication channel (Range**:** 0 ~ 3) of I-7547.

(7) ”Set Group ID”:

=> Set Group ID (When the rotary switch value is ‘F’, it will be enabled and the range is from 0 to 255).

(8) ”Get Group ID”:

=> Return Group ID.

5. Firmware Update

Please follow the below steps to update the firmware of HRT-227CS.

Step 1**:** Power off the HRT-227CS.

Step 2**:** Set the value of dip switch (mode) to be 3. Then connect the COM port between PC and the HRT-227CS together with CA-0910 cable like Figure 5-1.
(1) Connect the TXD / RXD / GND pins together between PC and HRT-227CS.

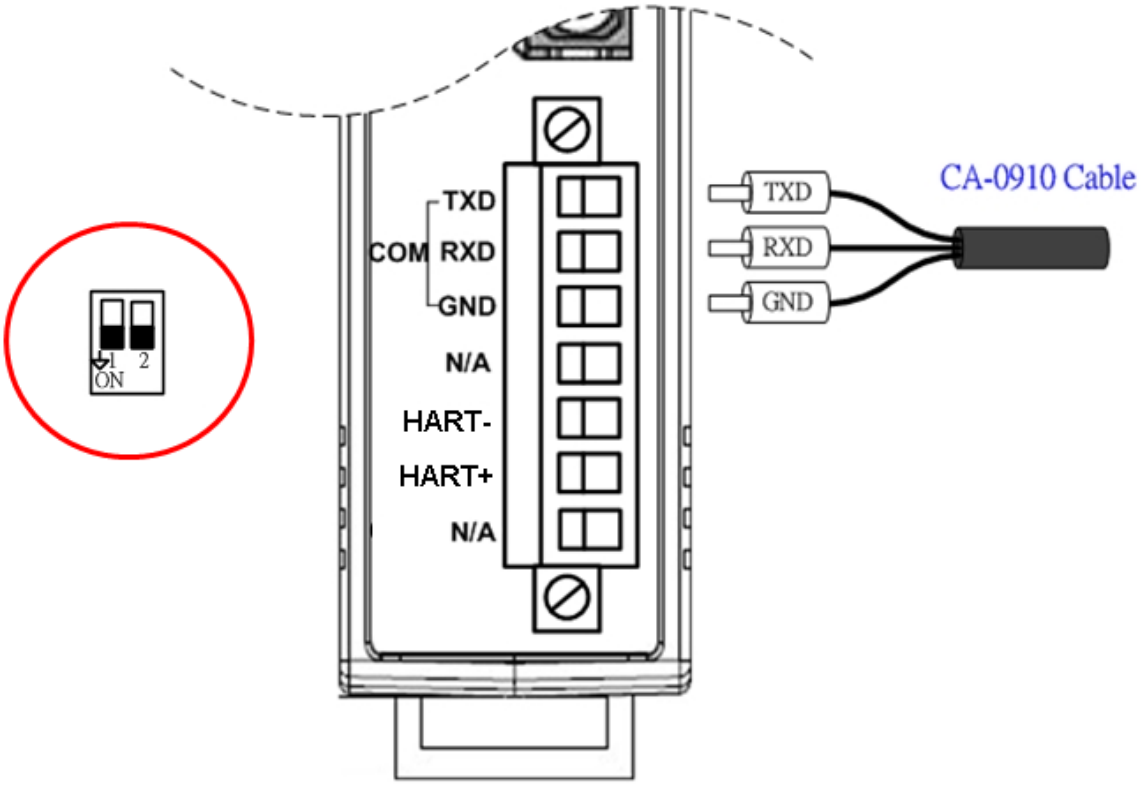


Figure 5-1 RS-232 wire connection between PC and HRT-227CS

Step 3**:** Power on the HRT-227CS. In firmware update mode, the HT_Err, HT_Tx, HT_Rx LEDs will flash every 500ms.

Step 4**:** Execute “FW_Update_Tool” (Download**:** http://ftp.icpdas.com/pub/cd/fieldbus_cd/hart/converter/hrt-227CS/firmware/) and follow the below steps to complete the firmware updating process.
[1] Choose “**COM**” interface and “COM Port” number (like **:** COM1).
[2] Click “**Browser**” button to choose FW file. (like **:** HRT227CS_v1.00.fw)
[3] Click “**Firmware Update**” button to start the FW update process.
=> The result will show in “Firmware Update” field.

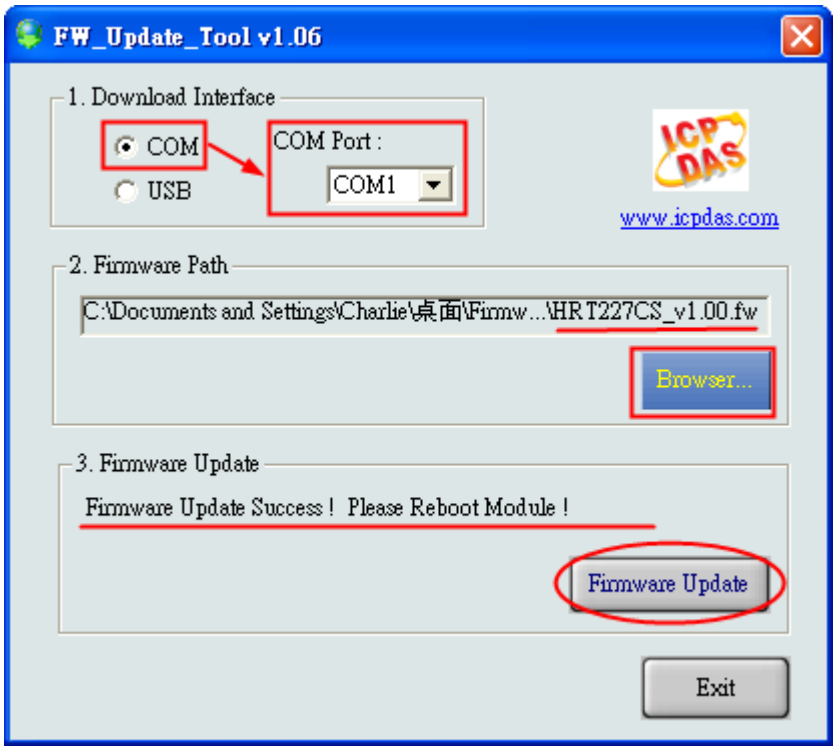
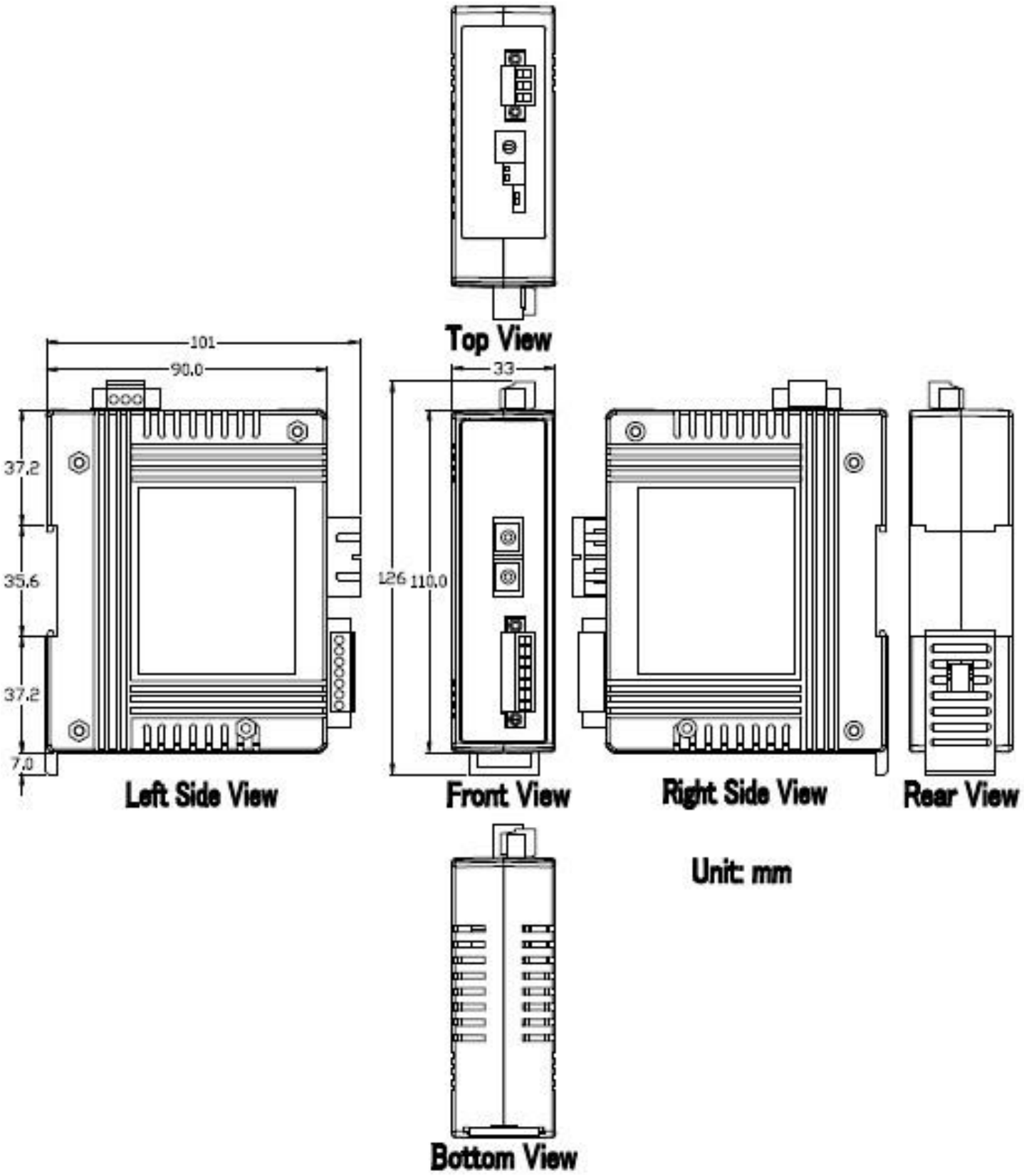


Figure 5-2 FW_Update_Tool

Step 5**:** After the firmware updates successfully, please set the value of dip switch (mode) to be 0 and then reboot the HRT-227CS.

6. Dimension



7. History Version

Ver.	Author	Date	Description
1.00	Edward	2015/02/02	1. First Version