FR-2017iT

8/16-channel Isolated Analog Input Module With High Voltage Protection And Isolated Communication Line

User Manual

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

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1. Introduction

The FR-2017iT is a 12-bit, 8-channel differential or 16-channel single-ended analog inputs module that provides two ways to select input range (+/-150mV, +/-500mV, +/-1V, +/-5V, +/-10V, +/-20mA, 0~20mA and 4~20mA). One way provides switch selectable the same range at all channels and another each analog channel is allowed to configure an individual range by software selectable. It also has 240Vrms high over voltage protection for all analog inputs.

The FR-2000 I/O module has an FRnet interface. The users can daisy chain several FR-2000 modules together. Via FRnet, the FR-2000 modules can extend the remote I/O control of PC, PAC and PLC easily. Further information about the networking of FR-2017iT/2024iT; refer to literatures related to I-7188EF, I-8172W, and FRB-100/200/200U.

The FR-2017iT module provides 8-channel differential or 16-channel single-ended analog inputs in the FRnet. The “-T” denotes the screw terminal connector, allowing users to connect to the AO signals on module directly. The I/O data transmission is controlled by the FRnet control chip which was developed by ICPDAS. It was designed to provide for a deterministic high speed network communication. The communication mechanism is dominated by the token-stream, which is generated by the network manager located at a specific node (**SA0**). This manager provides for

fixed scan-time and I/O synchronization capability without the need of any special communication protocol. Furthermore, special anti-noise circuitry has also been considered and built into the FRnet control chip to ensure communication reliability. This distributive digital output module must be connected to other module or a host controller with a network manger built in.

However, the effectiveness of the FRnet connection depends on and is then ensured when the correct hardware configurations for the sender address (SA) and receiver address (RA) on the host controller and the remote module in the network have been installed properly. In general, the operating principle is structured by the strategy of delivering the 16-bit data from the specified sender address (SAn) to the corresponding receiver address (RAn) via the broadcasting method controlled by the token-stream of the network manager, SA0. Based on this algorithm, there are some general rules that need to be followed:

(1) The sender address needs to be unique in order to avoid any communication collisions.
(2) Each of the FRnet needs at least one network manager defined as SA0. It plays the important role of producing the token-stream in the network.
(3) The baud rates of the controller and the remote modules need to be the same as on the FRnet.
(4) The communication method is controlled by delivering the data of the specified sender address (SA) to the corresponding receiver address (RA) in the sequence

of token 0 to N cyclically, as depicted below.

(5) Due to the broadcasting algorithm adopted, the receiver address is not required to be unique. Therefore, it is easy to build a data delivery from one node (16-bit data) to a multi-node.

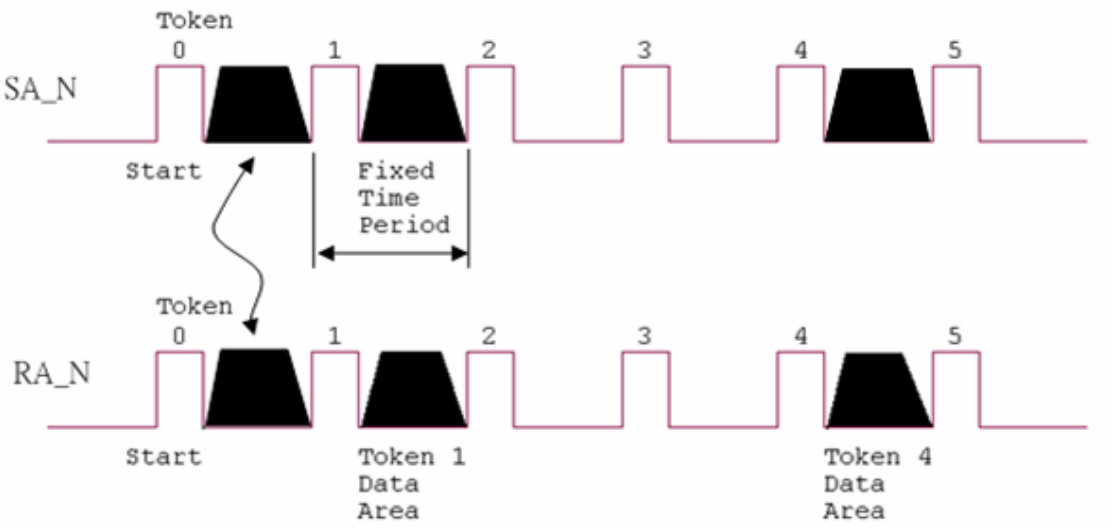


Figure 1.1 Token stream controlled by network manager, SA0

An example of the FRnet application structure for delivering data from the specified sender address (SAn) to the corresponding receiver address (RAn) by a 4-wire inter module cable, including a 2-wire power supply cable, is shown in the figure below.

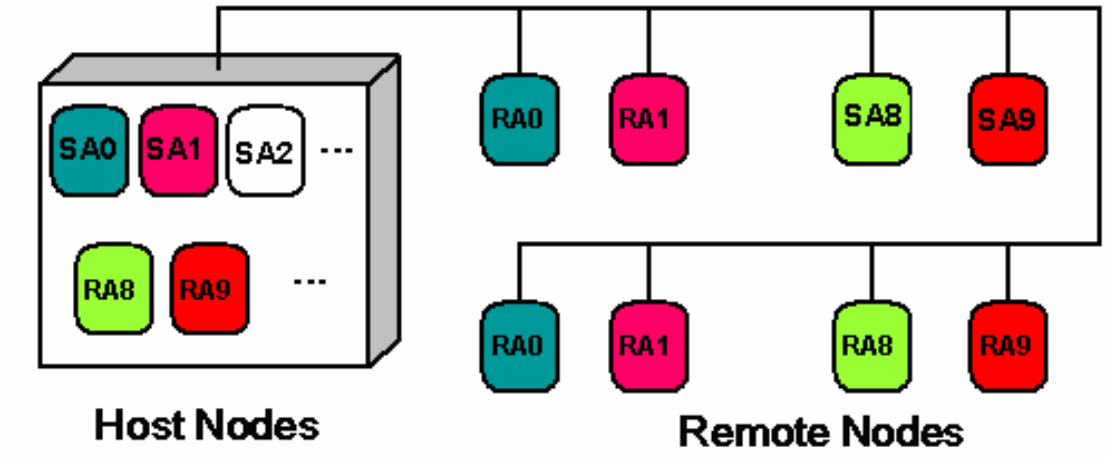


Figure 1.2 The example of an FRnet application structure

1.1. Features

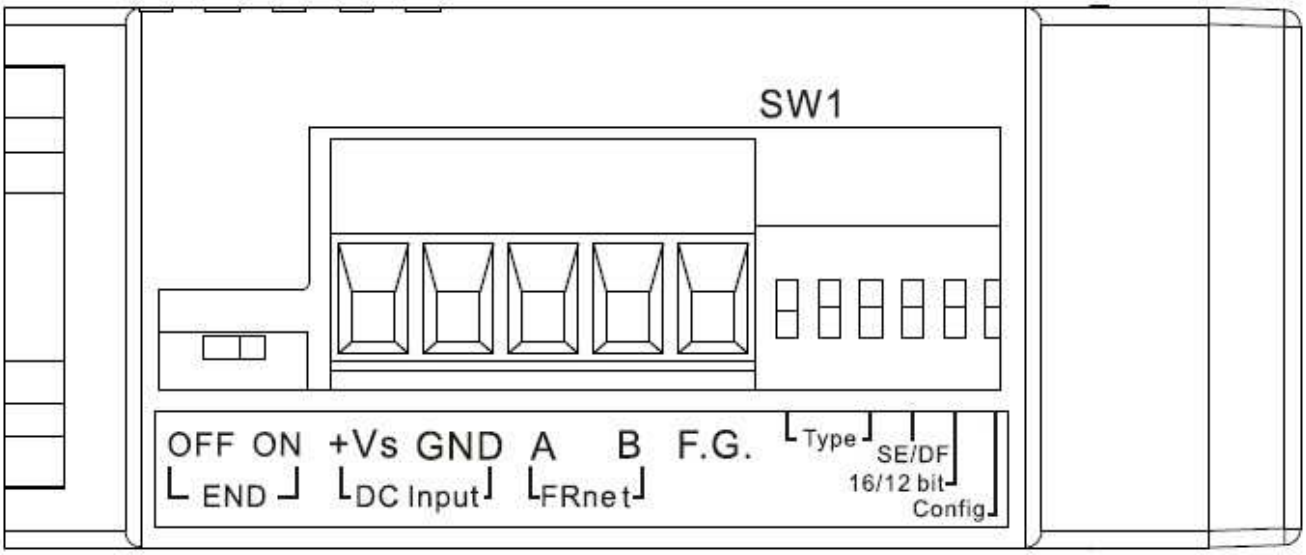
- The Token stream is used to activate data transmission from the specified SA node to the corresponding RA nodes.
- The Network Manager is defined as SA0. Each of the FRnet must have SA0 because it issues the Token stream into the network.
- The Token stream is produced cyclically by the hardware system (SA0) at the fixed time interval, see Figure 1.1. Therefore, the FRnet system can provide for both Isochronous and Deterministic functionalities.
- It can provide data transmission from one node (16-bit) to one node or from one node to multiple nodes at the same time because FRnet uses the principle of delivering the data from the sender address to the receiver address. Therefore, the sender address must be unique, but the receiver address can be different or the same in the network.
- The FRnet system can easily be extended by adding new modules to the network according to the FRnet principle.
- Device Inter-communication: A single device can talk to other devices by setting appropriate SA and RA node configurations.
- No software overhead: All data transmissions are performed automatically via the FRnet control chip. Therefore, there is no need for the CPU or firmware to process transmission protocols.
- It only needs simple RS-485 wiring.
- The DIN-Rail mounting is provided.

1.2. Specifications

Analog Input	
Input Channels	8 differential or 16 single-ended, switch selectable
Input Type	+/-150mV, +/-500mV, +/-1V, +/-5V, +/-10V +/-20mA ,0~20mA, 4~20mA (requires optional external 125 Ohm resistor for current input)
Resolution	16-bit (1 channel) / 12-bit (8/16 channels)
Sampling Rate	10 samples/ second (1 channel) / 50 samples/ second(8/16 channels) total
Accuracy	+/-0.1% (1 channel) / +/-0.5%(8/16 channels) or better
Bandwidth	15.7Hz (1 channel) / 78.7Hz (8/16 channels)
Zero Drift	+/-20uV/℃
Span Drift	+/-25ppm/℃
Input Impedance	Voltage: 2M Ohm (Differential), 1M Ohm (Single-ended)
Common Mode Rejection	86dB min.
Normal Mode Rejection	100dB
Individual Channel Configuration	Yes (by software, requires optional CA-0904 cable)
Over Voltage Protection	Differential: 240 Vrms, Single-ended: 150Vrms
Connection	20-Pin Removable Terminal Block
Interface	
Isolation Voltage	3000VDC
2-wire Cabling	Belden 8941 (2P twisted-pair cable), When different cables are used, the transmission distance may be changed
Transfer Distance	Max. 400m for speed 250K Max. 100m for speed 1M (Default)
LED Indicators	Power, Communication Run, Communication Error, Terminal resistor
Transfer Speed	250Kbps and 1Mbps (Default) DIP Switch Selectable
Cyclic Scan Time	2.88ms for speed 250K 0.72ms for speed 1M (Default)
Power	
Input Voltage Range	+10 ~ +30VDC (Non-isolation)
Power Consumption	1.7W Max
Connection	5-Pin Removable Terminal Block

EMS Protection	
ESD (IEC 61000-4-2)	4 kV contact for power line, communication line and each channel 8 kV air for random point
EFT (IEC 61000-4-4)	4 kV for power liner
Surge (IEC 61000-4-5)	3 kV for FRnet and power liner
Case	
Mechanical	Plastic
Flammability	UL 94V-0 materials
Dimensions	32.5 x 110 x 102 mm (W x H x D)
Installation	DIN-Rail
Environmental	
Operating Temperature	-25 ℃ ~ +75 ℃
Storage Temperature	-30 ℃ ~ +85 ℃
Ambient Relative Humidity	10% to 90% non-condensing

2. Hardware description



OFF (END) **:** 120R terminating resistor Disable

ON (END) **:** 120R terminating resistor Enable

In additional to these connectors, there is also one switch on the side of the module which can decide to use the internal terminal resistor on the network or not. If you switch it on, it means that the module will provide the terminal resistor on the network. Note that each network needs two modules to be on, which are usually the first and last module on the network.

+Vs (DC Input): Power input (+10 to +30V) and should be connected to the power supply (+)

GND (DC Input) : Ground and should be connected to the power supply (-)

A (FR-net) **:** Communication line “A(Data+)”

B (FR-net) **:** Communication line “B(Data-)”

F.G. **:** F.G. stands for Frame Ground (protective ground). It is optional. If you use this pin, it can reduce EMI radiation; improve EMI performance and ESD protection.

SW1 **:** The SW1 can be used to configure the module address, 8-ch differential/16-ch single-ended, 12/16-bit resolution and Individual/all Channel Configuration.

The configuration of SW1 is as follows.

Pin1	Type code: 000~111, for +/-500mV, +/-1V, +/-5V, +/-10V +/-20mA (requires optional external 125ohm resistor)
Pin2	
Pin3	
Pin4	SE/DF: ON➔ 16 Single-ended OFF➔ 8 Differential
Pin5	Resolution: ON➔ 16-bit OFF➔ 12-bit
Pin6	Configuration: ON➔ Software Selectable OFF➔ Switch Selectable

The max. and min. mapping table of analog inputs.

Type	SW1			Min	Max
	1	2	3		
0 ~ 20mA	ON	ON	ON	000 (0mA)	FFF (20mA)
4 ~ 20mA	OFF	ON	ON	000 (4mA)	FFF (20mA)
+/-10V	ON	OFF	ON	800 (-10V)	7FF (+10V)
+/-5V	OFF	OFF	ON	800 (-5V)	7FF (+5V)
+/-1V	ON	ON	OFF	800 (-1V)	7FF (+1V)
+/-500mV	OFF	ON	OFF	800 (-500mV)	7FF (+500mV)
+/-150mV	ON	OFF	OFF	800 (-150mV)	7FF (+150mV)
+/-20mA	OFF	OFF	OFF	800 (-20mA)	7FF (+20mA)

The data format for 12-bit resolution of 8-ch differential or 16-channel single-ended analog input:

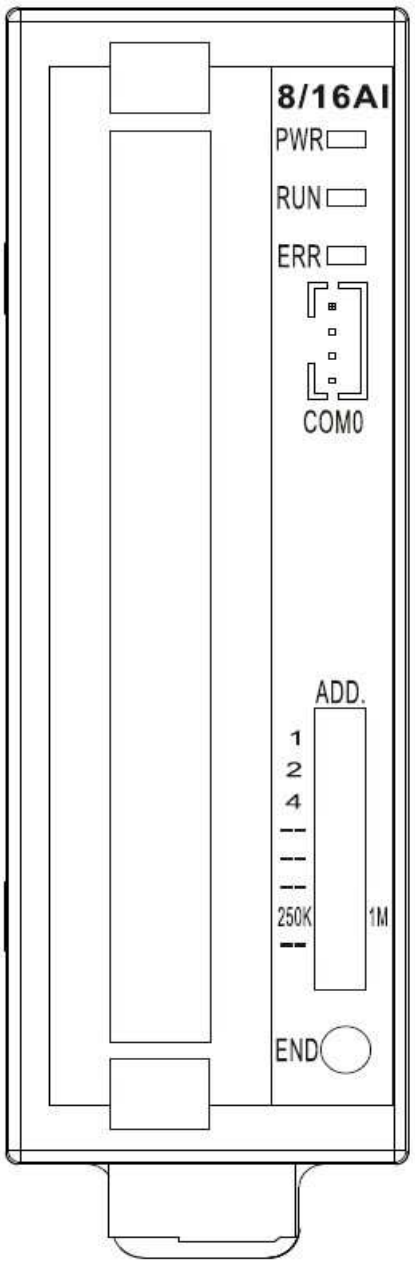
MSB															LSB
bit15	bit14	bit13	bit12	bit11	bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
12-bits AD data												AD channels			

The data format for 16-bit resolution of ch0 analog input:

MSB															LSB
bit15	bit14	bit13	bit12	bit11	bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
16-bits AD data															

2.1. LED indicator:

There are several LED indicators located on the top side of the module. They are Power LED, Communication Run LED, Communication error LED, I/O LED and termination resistor LED. Users can understand the meaning directly from the label on the LED indicator. Note that the Communication Run LED and the Communication error LED illustrate whether the quality of communication is OK or not.



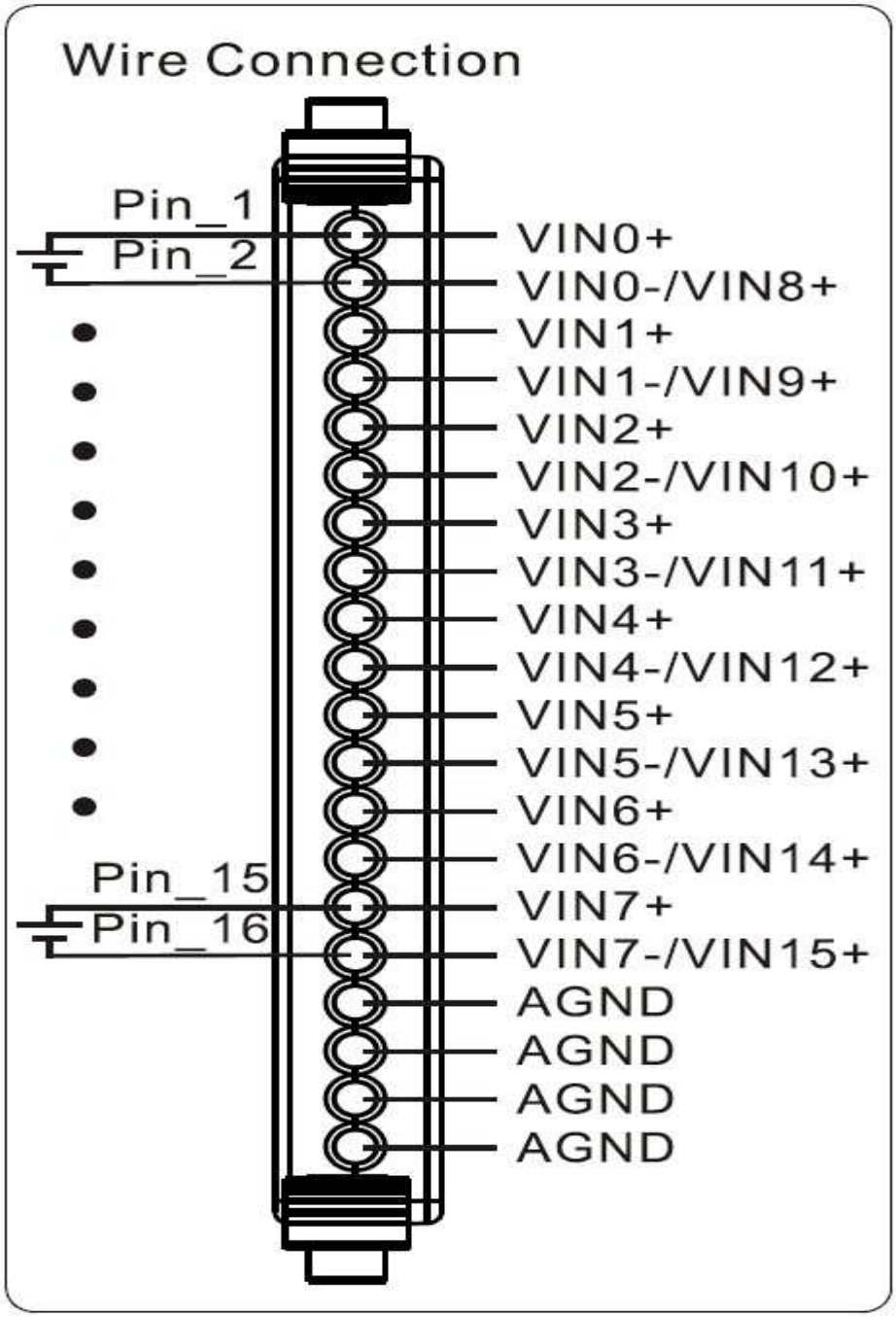
LED Mapping	
PWR	Power LED
RUN	Communication Run LED
ERR	Communication Error LED
END	Terminal resistor On

DIP Switch	
Pin1	Module Address: 0~7
Pin2	
Pin3	
Pin4	Reserved
Pin5	Reserved
Pin6	Reserved
Pin7	Speed: ON ➔ 250k bps OFF➔ 1M bps
Pin8	Reserved

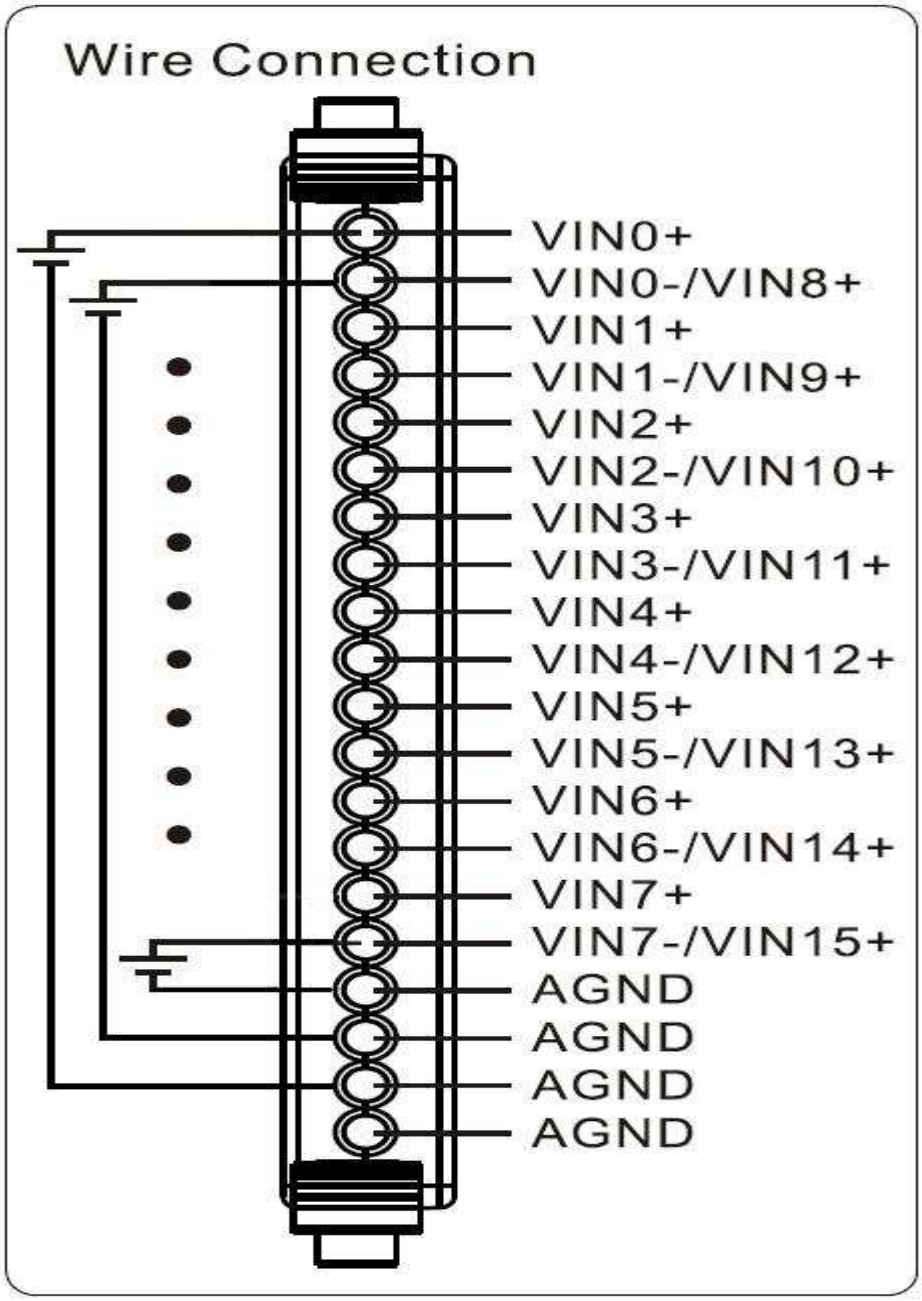
COM0
Each analog channel is allowed to configure an individual range by CA-0904 cable.

2.2. Pin Assignment and I/O wire connection

2.2.1 The wiring of 8-ch differential analog inputs



2.2.2 The wiring of 16-ch single-ended analog inputs



Note:

The wiring of 8 differential or 16 single-ended analog inputs is switch selectable by SW1 and refers the section 2 in details.

2.3. Address Setting:

■ **Sender address setting :**

Since the FR-2017iT is an analog input module, the module can only configure the sender address (SA) by the dip-switch, as shown in the following figure. This means that the FR-2017iT can only transmit 16-bit data of the analog input circuit to the node of the corresponding receiver address. The configuration method is depicted in the following figure:

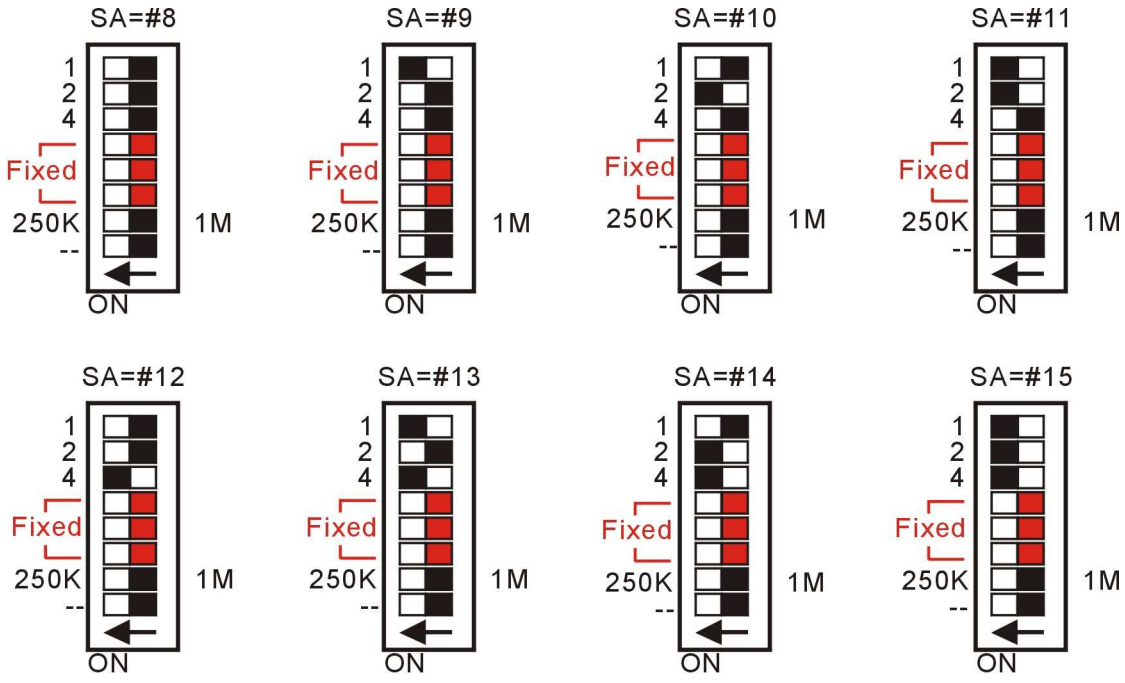


Figure 2.5 Sender address setting.

2.4. FRnet Application Structure

Within conventional communication methods in the control network system, the master (host) controller (CPU) must send a command with data to the slave module. Then it must wait for confirmation from the slave's response, which is based on a complicated and fixed transmission protocol. If there are many devices on the network, all the data transmission within the network must be controlled by the master (host) controller (CPU). Therefore, the performance of communication efficiency between the host controller and each of the devices will usually be deteriorated when more and more devices are added in. In contrast to this solution, our FRnet provides innovative data transmission method which adopts the hardware FRnet control chip to do communication broadcasting and gets rid of the software transmission protocol. It is easy to set up a reliable network merely by hardware setting both the "Sender Address" and "Receiver Address" of all the modules.

There are two FRnet host controllers provided by ICPDAS products, the FRB-100/200/200U and the 7188EF-016. The first one is a PCI interface add-on card, and the other one is an Ethernet embedded controller. Two possible application configurations are demonstrated as follows.

Case 1: If the PC-based FRB-200(U)/100 are used as the host controller.

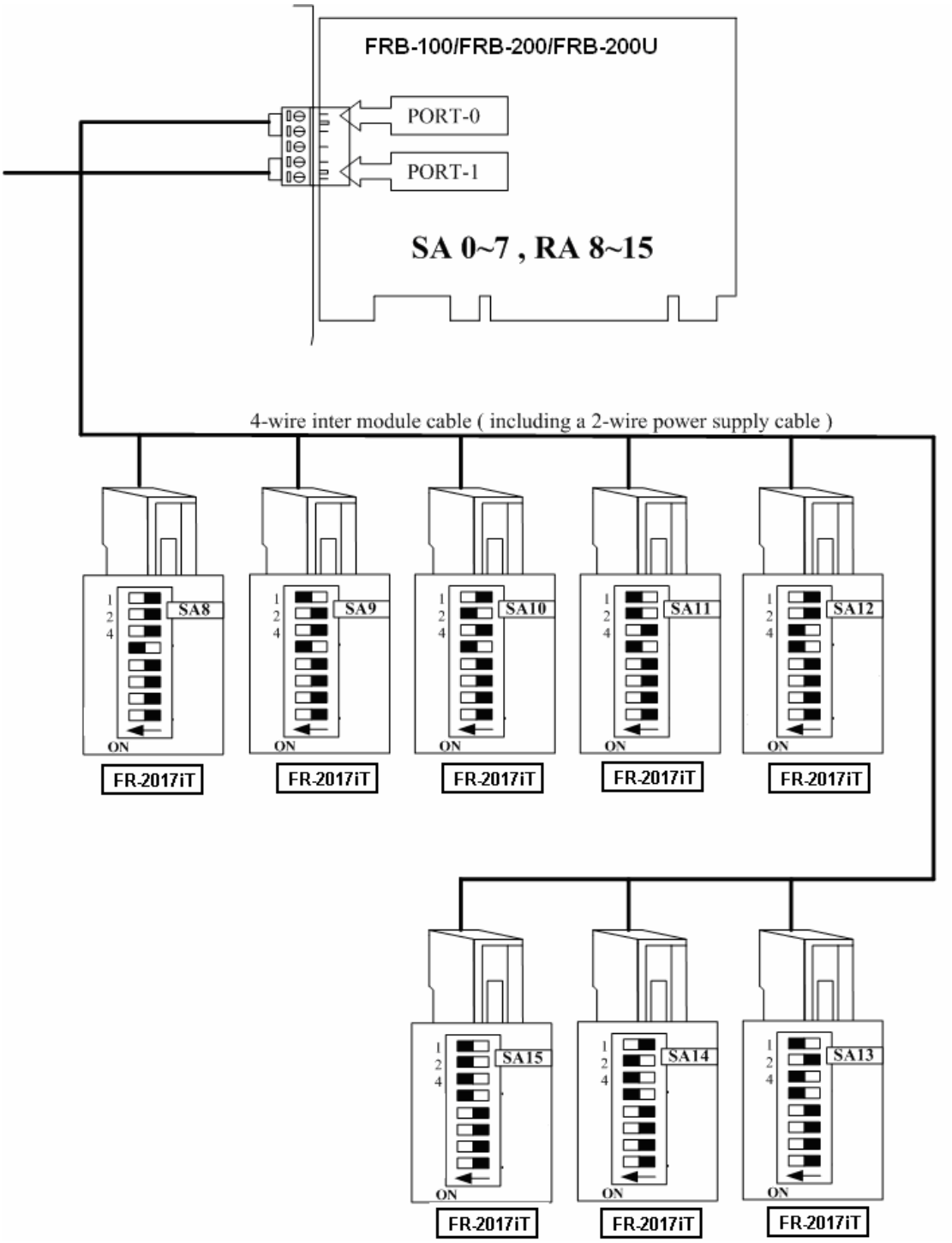


Figure 2.6 PCI interface FRnet card and distributed IO modules

Case 2: If the embedded controller i-7188EF-016 is used as the host controller.

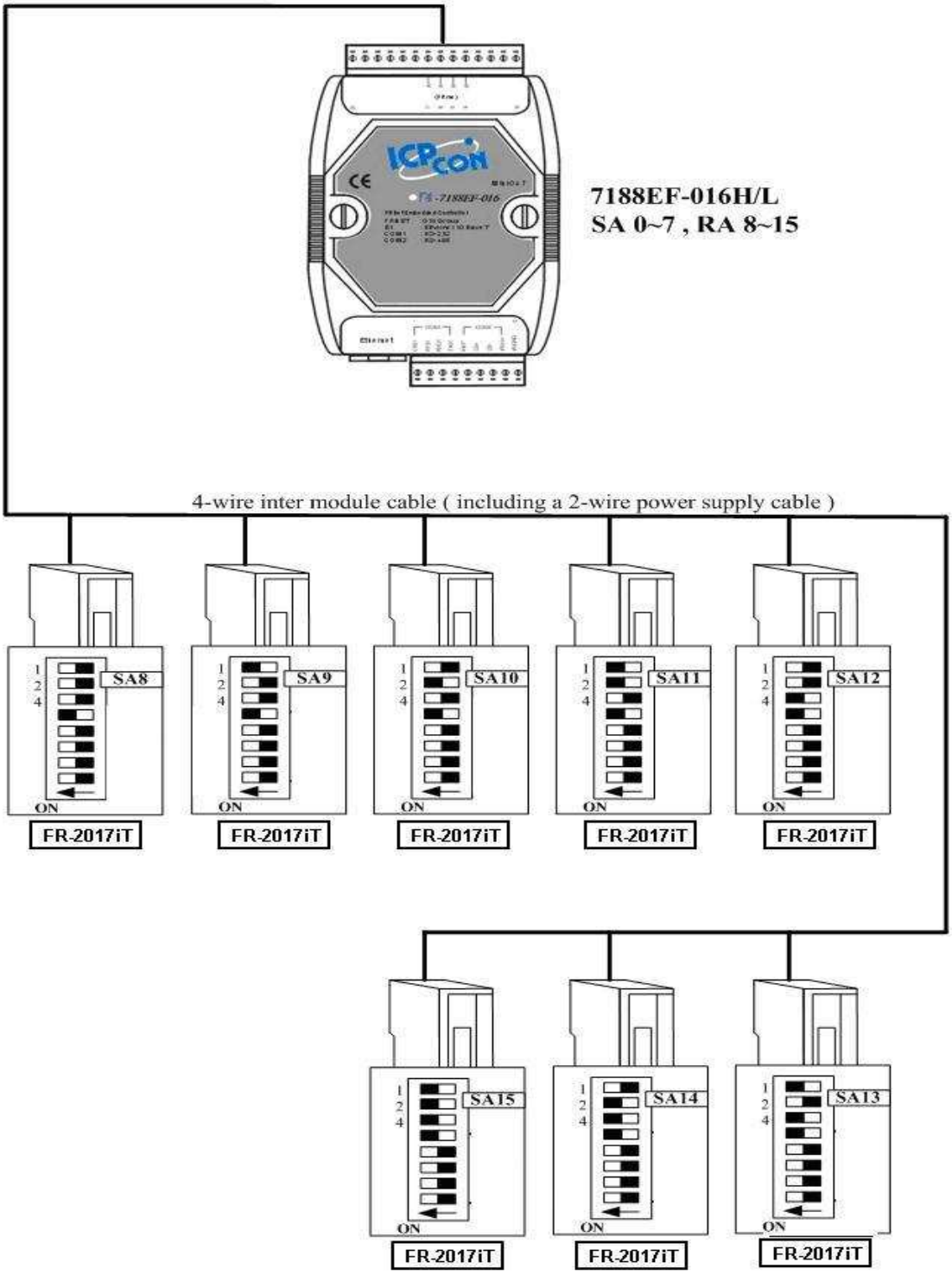
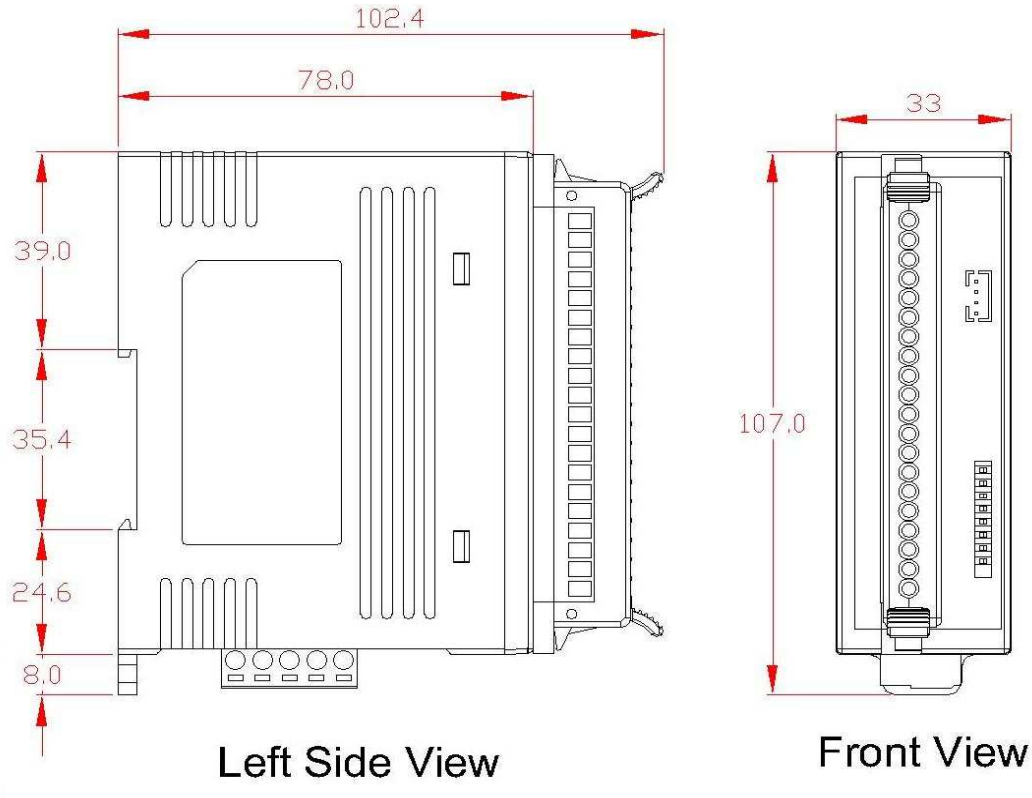


Figure 2.7 Embedded controller and distributed IO modules

2.5. Dimensions:



Unit: mm