
PROFI-5000 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.

Warning

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Revision Note

Date	Author	Version	Revision
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1. Introduction

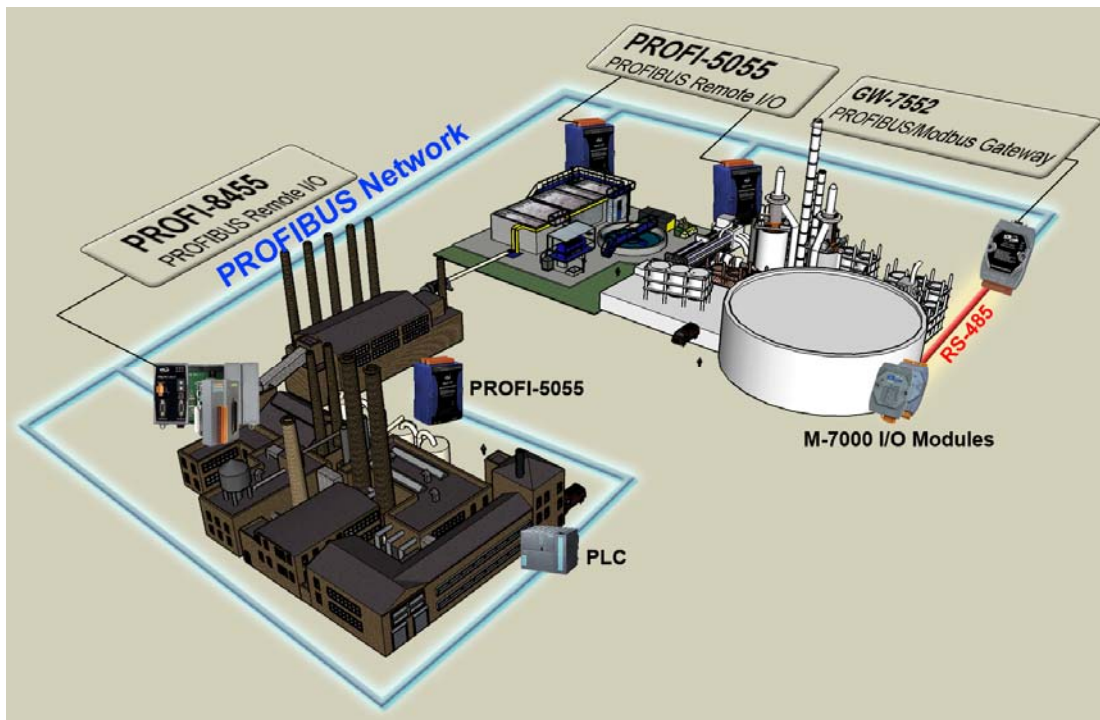
1.1. Overview

PROFIBUS is an open, digital communication system with a wide range of applications, particularly in the fields of factory automation and process automation. PROFIBUS is suitable for both fast, time-critical applications and complex communication tasks. PROFIBUS-DP is a famous protocol that enables simple, fast, cyclic and deterministic process data exchange between Master and assigned Slave.

The PROFI-5000 Compact Remote I/O Module is specially designed for the slave device of PROFIBUS DP protocol. It supports up to 32 channels Digital I/O. To setup PROFIBUS network, users can choose and configure I/O modules by using the GSD file without any other setting tools.

1.2. Applications

- Industrial Automation
- Factory Automation
- Process Automation
- Etc...



1.3. Features

Protocol & Hierarchy	DP-V0 Slave
Supports Transmission Rate (Kbps)	9.6, 19.2, 45.45, 93.75, 187.5, 500, 1500, 3000, 6000, 12000
Transmission Rate Setting	detected automatically
Address Setting	0~99 set by Rotary switches
Indicators	PWR and RUN LED
I/O modules Configuration	Configured by GSD file
Network Isolation Protection	High Speed iCoupler
DC Isolation Protection	3000VDC on PROFIBUS side

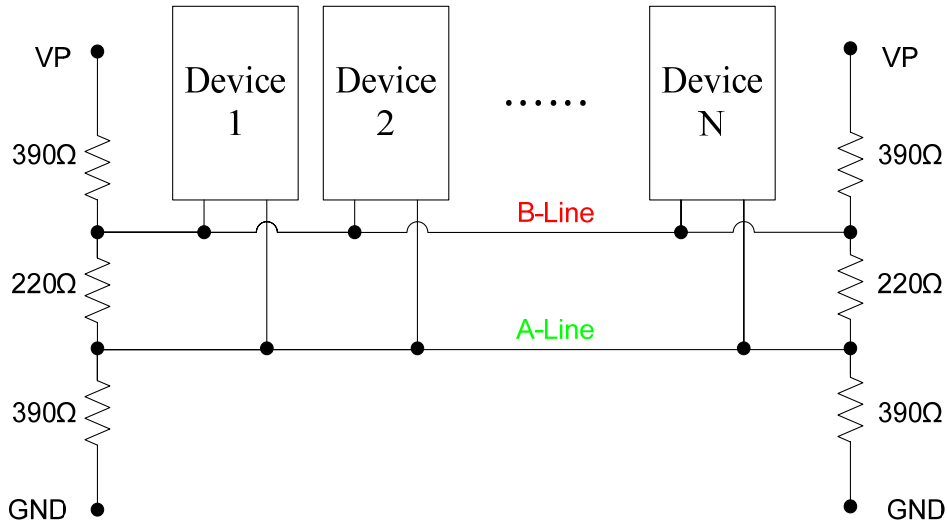
1.4. Specifications

Model	PROFI-5000
PROFIBUS Interface	9-pin D-Sub(Female)
PROFIBUS Controller	Profichip VPCLS2
PROFIBUS Transceiver	ADI ADM2486 iCoupler Isolated transceiver
Transmission Rate	Up to 12Mbps
Power Requirement	10V ~ 40V
Power Consumption	1W
Operating Temp.	-25°C ~ +75°C
Storage Temp.	-30°C ~ +85°C
Humidity	5% ~ 95%(Non Condensing)
Dimensions	91x132x52 mm

2. Hardware

2.1. Bus Wiring

In order to minimize the reflection effect of the signal transmission, PROFIBUS device has to fit with an active terminal resistor at both first node and last node, as shown below



However, the number of station in PROFIBUS network is also restricted. According to PROFIBUS specification, it is up to 32 stations connected in a PROFIBUS segment. If more than 32 stations are connected, the PROFIBUS repeater must be used to link the individual bus segments.

2.2. PROFIBUS Cable and Transmission Distance

The PROFIBUS cable with following properties has different transmission distance with respect to different transmission rate, shown in the following table

1. Impedance :135~165Ω
2. Capacity : lower than 30 pF/m
3. Loop resistance : lower than 110Ω/Km
4. Wire diameter : larger than 0.65mm
5. Core cross-section : larger than 0.34mm²

Transmission Rate(Kbps)	Transmission Distance per Segment (meter)
9.6, 19.2, 45.45, 93.75	1200
187.5	1000
500	400
1500	200
3000, 6000, 12000	100

2.3. Status Indicator

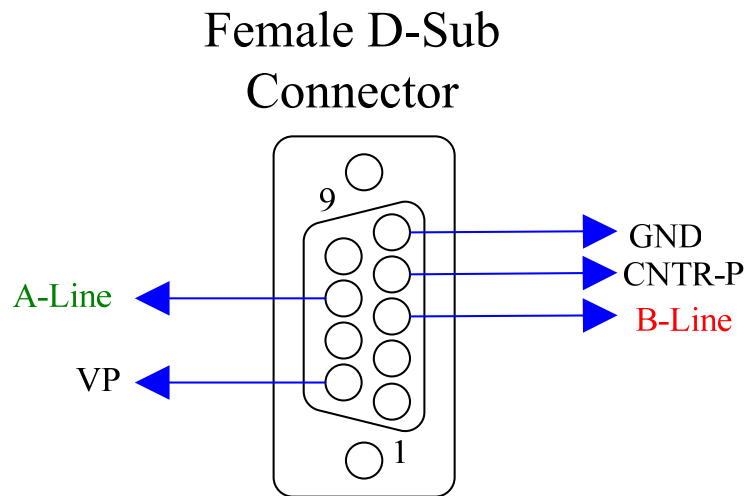
PROFI-5000 provide two status indicators, they are PWR LED (red) and RUN LED (green). When the power is supplied to PROFI-5000, PWR LED will turn on; If CHK_CFG procedure is finished, RUN LED will turn on. The table explains the relationship between them.

Status Indicator	Meaning	Recommend solution
PWR ON & RUN OFF	Master not Ready, Address not Match or Cfg Fault	1. Check the address setting of PROFI-5000 and DP-master. 2. Sets the DP-Master to operation mode. 3. Make sure of the consistency of Module Selection.
PWR ON & RUN ON	PROFI-5000 is in clear mode or Operate mode*.	N/A

Note 1:“Cfg Fault” is the abbreviation of “Configuration Fault”, it means that configuration data which receive from DP-Master is not consistency with DP-Slave (PROFI-5000).

2.4. Connector

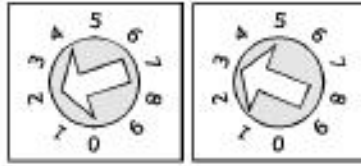
The connector of PROFI-5000 is shown below



Pin No.	Signal	Meaning
3	B-Line	Receive/Transmit data - plus
4	CNTR-P	Repeater control signal, RTS signal
5	GND	Power ground of active terminator
6	VP	Power 5 volt of active terminator
8	A-Line	Receive/Transmit data - minus

Note: The connector of PROFI-5000 has no terminators; users must use the connector with the terminator inside. The power of the terminator will provide by terminal device.

2.5. Node Address



The figure shown above is the decimal rotary switch. It dominates the node (station) address of PROFI-5000. The left side switch is high nibble of address and the other one is low nibble of address.

According to PROFIBUS specification, the station address which from 0 to 126 is valid, and the address 126 is a special address that supports the remote setting SSA telegram from Class 2 DP-Master. PROFI-5000 uses the value of rotary switch as its address if the address is valid and it don't support SSA service for setting node address.

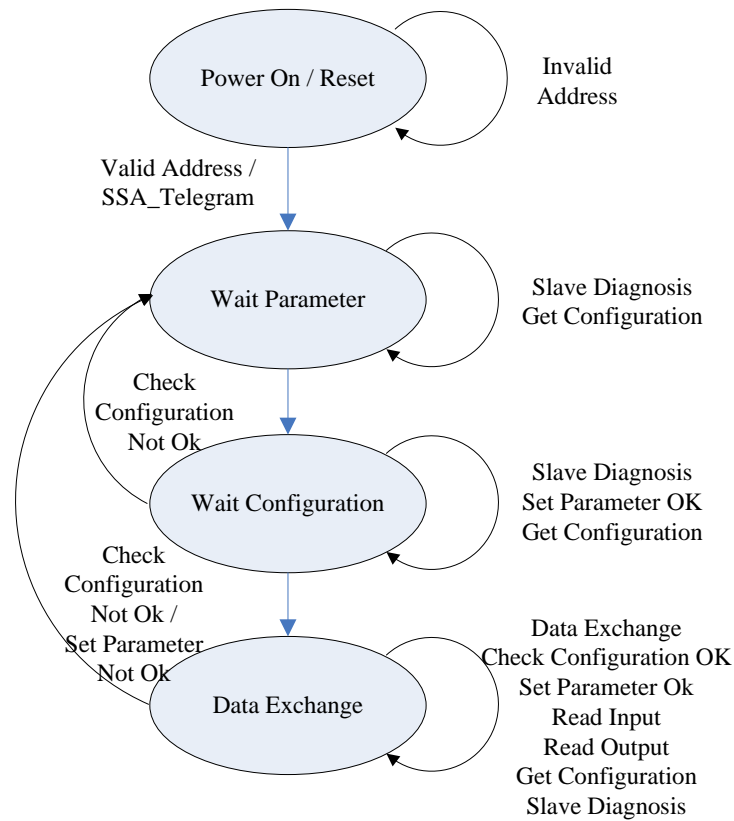
2.6. Baud rate support

PROFI-5000 supports the entire baud rates of PROFIBUS. They are 9.6Kbps, 19.2Kbps, 45.45Kbps, 187.5Kbps, 500Kbps, 1.5Mbps, 3Mbps, 6Mbps, and 12Mbps. Because PROFI-5000 has a functionality of auto- detection for baud rates, users don't need to set the baud rate manually.

Note: Many baud rates only are supported by the particular cable or speed. For the detail, please refer to the above section “**PROFIBUS Cable and Transmission Distance**”

3. PROFIBUS DP System

The flow chart of the DP-slave



Before DP-Slave changes to data exchange state, it employs some telegrams to initialize and establish the connection with DP-Master. These telegrams include Slave Diagnosis (Slave_Diag), Set Parameter (Set_Prm), Check Configuration (Chk_Cfg), Slave Diagnosis, Data Exchange (Data_Exch) and optional global control (GC). The explanation is as follows:

3.1. Power On / Reset

While the power supplied, PROFI-5000 loads the value of rotary switches first and decides to apply it immediately. Be attention to duplicate address setting with others, it may occur any unpredictable accident.

3.2. Wait Parameterization

PROFI-5000 has no parameterization data. This phase will skip while connection establish.

3.3. Wait Configuration

Configuration data generates by configuration tools according to GSD file. The users select the module he wants, and configuration data generate correspondingly.

If the module installed is not consistency with configuration, “configuration fault” diagnosis message will report by slave device.

3.4. Data Exchange

After the configuration procedure has been accomplished, PROFI-5000 exchanges I/O data with the DP-Master cyclically. In following section, we introduce the Numeric Notation and Byte Order briefly.

Byte Order

The Compact designed of PROFI-5000 series support only little-endian Byte Order.

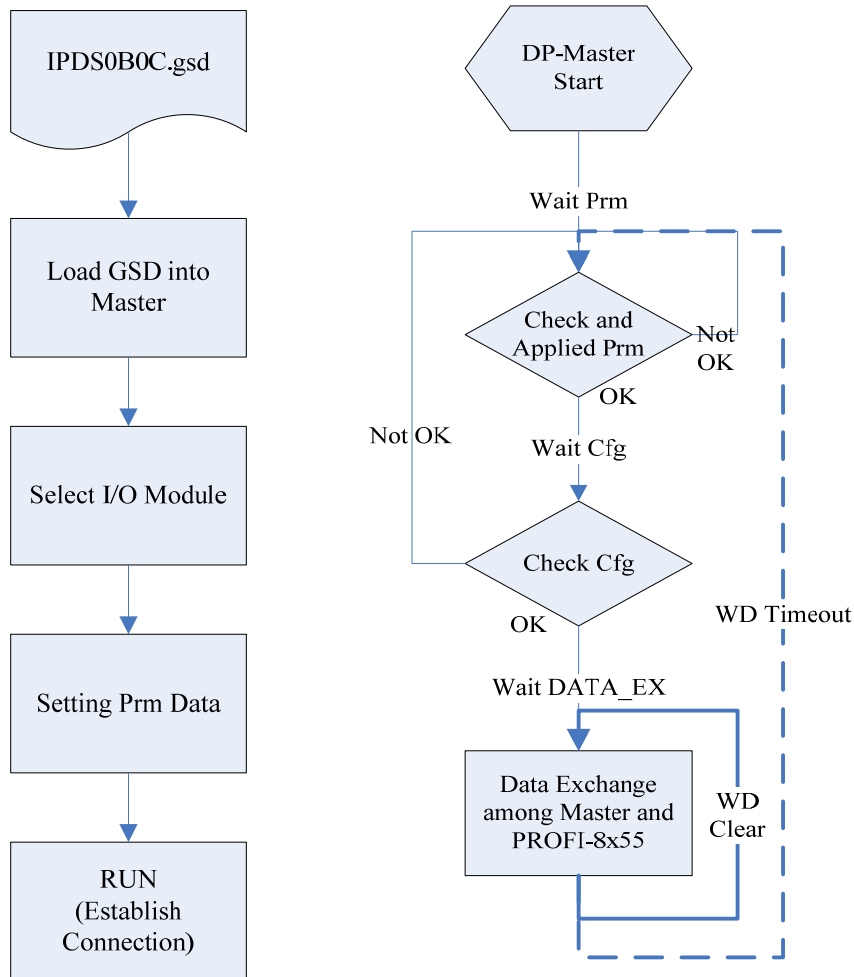
Numeric Notation and Byte Order

The digital input or output module arrange its data as follow (for example: 4-Byte INPUT).



3.5. Establish connection with PROFI-5000

Before establish the connection between DP-Master and PROFI-5000, user should obey the following step first.



First, users must load the electronic device description file(GSD file) of the PROFI-5000(IPDS0C47) into the DP-Master, and select the corresponding modules. Finally change your DP-master from Offline state to Operate state. While DP-Master changes to operate mode, PROFI-5000 will initial the modules and wait for Chk_Cfg telegram in order. If there is no error occurs, PROFI-5000 proceeds into data exchange state. Users can observe the status indicator LED to know the state of PROFI-5000. At the meantime, if there is any error occurs, PROFI-500 will return to wait configuration.

3.6. Telegram cycle of data exchange

If you want to know the round-trip time of a data exchange telegram, you must know how a byte enveloped into a serial stream. In series communication, the byte transmission includes start bit, stop bit, data field and optional parity. According to the PROFIBUS specification, there is no parity bit in transmission. Therefore, one data byte will be encoded to 11 bits. Consequently, the telegram cycle time of data exchange will calculate as follow.

$$T = (\text{Output data Bit Time (header include)} + \text{Station Reaction Bit Time} + \text{Input Data Bit Time (header include)} + \text{Bus Idle Bit Time} + \text{Sync-Bit Time}) * \text{Transmission Time per Bit.}$$

$$\text{Output Data Bit Time (header include)} = (9 + \text{length of output data in Byte}) * 11$$

Station Reaction Time = Any Value that large than Min.Tsdr and smaller than Max.Tsdr

There is look up table between Baud Rate and Max.Tsdr. (This information is in GSD file)

Baud Rate(in bit per second)	Max.Tsdr (in Tbit)
9600	60
19,200	60
454,500	60
937,500	60
187,500	60
500,000	100
1,500,000	150
3,000,000	250
6,000,000	450
12,000,000	800

$$\text{Input Data Bit Time (header include)} = (9 + \text{length of input data in Byte}) * 11$$

$$\text{Bus Idle Time} = \max (T_{\text{SYN}} + T_{\text{SM}} , \min T_{\text{SDR}} , T_{\text{SDI}})$$

For the detail, please refer to PROFIBUS Specification.

Sync. Bit Time = 33 (constant)

Transmission Time per Bit = the inverse of Baud Rate.

For example:

The data transmission time with 2 bytes output data and 2 bytes input data in 12Mbps is calculated as follows.

Parameter : $T_{\text{SYN}}=33$ Tbits

$T_{\text{ID1}}=75$ Tbits (1.5M BR)

$T_{\text{SDR}}=30$ Tbits (1.5M BR)

Min_Slave_Interval = 1

The time is as follows.

$$T = ((9+2) * 11 + 30 + (9+2) * 11 + 33 + 75) / 12 * 10^6 = 33.5\mu\text{S}$$