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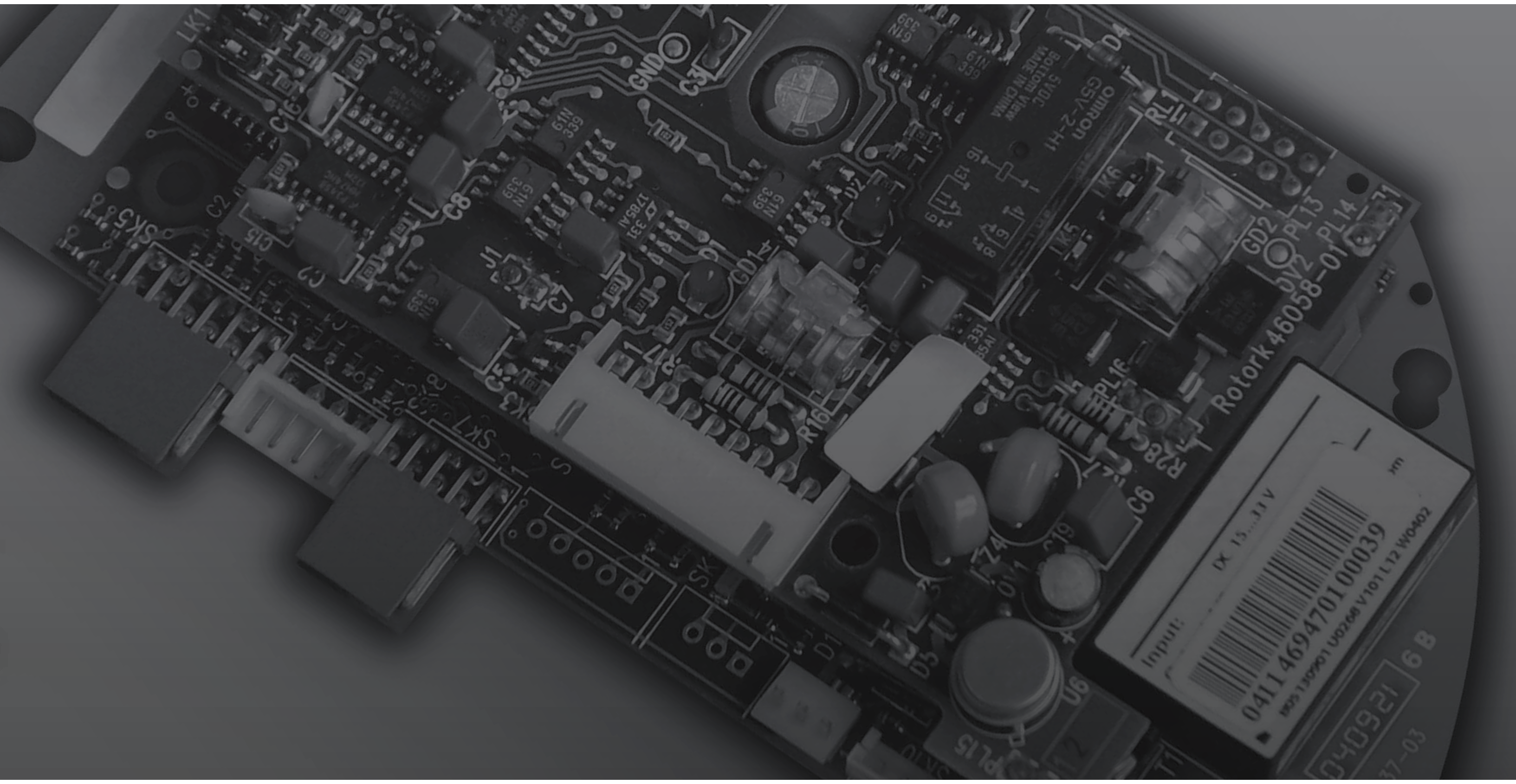
Keeping the World Flowing
for Future Generations

Profinet

Start up guide



PROFI®
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Contents

1. Introduction

Industrial Ethernet is becoming an increasingly popular choice for connecting industrial equipment together. It is also being used more frequently to connect field devices back to the control room.

Rotork has developed a solution that allows a Profinet connection to its IQ and CK range of actuators.

Rotork Profinet actuators use a gateway to convert Profinet messages into Modbus RTU messages. This means that the standard Rotork Modbus manual (e.g. PUB091-004 for IQ3/IQ3 Pro) can be used for information about data locations. This document will be invaluable when commissioning the actuator. It can be downloaded from here:

http://www.rotork.com/products-and-services/control-networks/modbus/modbus-literature

The Profinet gateway manual is also available to provide further details about the operating conditions and settings. It can be downloaded here:

https://www.icpdas.com/en/download/show.php?num=1638&model=GW-7662

This guide details how to set up the ICP DAS gateway that converts Profinet messages into Modbus RTU. This gateway is usually housed within the actuator enclosure.

⚠ **The person commissioning the Profinet actuator must have an understanding of Ethernet/Profinet and know which IP address and Subnet to use. The gateway should only be connected to an existing network once all settings are confirmed as correct. Communication issues may occur if settings are incorrect.**

2. Change Profinet gateway settings

The gateway includes a rotary switch that defines the number of I/O bytes required. By default the switch will be set to the 0 position (32 bytes in/out). Set the rotary switch to match the number of I/O bytes set in the GSDML file. The table below shows the setting values for the rotary switch.

Position	Mode	Module configuration
0	AP mode	Output: 32 bytes Input: 32 bytes
1	AP mode	Output: 64 bytes Input: 64 bytes
2	AP mode	Output: 128 bytes Input: 128 bytes
3	AP mode	Output: 256 bytes Input: 256 bytes
4	AP mode	Output: 384 bytes Input: 384 bytes
5	AP mode	Output: 512 bytes Input: 512 bytes
6~7	AP mode	Reserved
8~F	Bootloader mode	N/A

Figure 1: Rotary switch settings

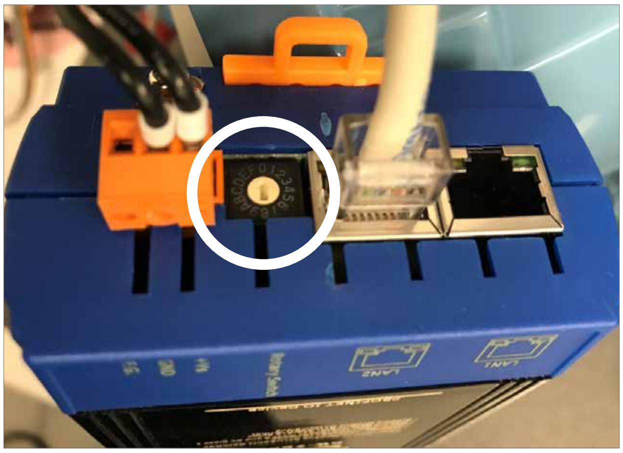


Figure 2: Rotary switch position

3. Install the setup software

Download the setup software (PROFINET Series Tool – latest version) from the gateway manufacturer's website; it is also possible to download software to enable the Profinet gateway's firmware to be updated:

https://www.icpdas.com/en/download/show.php?num=1630&model=GW-7662

Rotork recommends downloading and installing software from the website linked above.

Administrator rights may be required to install third party software. Consult your IT department if installation is not possible.

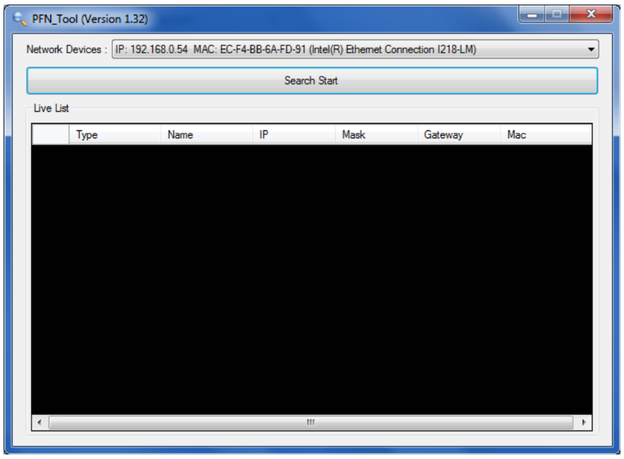
The GSDML file can be downloaded from the gateway manufacturer's website here:

https://www.icpdas.com/en/download/show.php?num=1639&nation=US&kind1=&model=GW-7662&kw=

4. Connect to the Profinet gateway

Connect the actuator to the computer/laptop via an RJ45 (Ethernet) cable and open the gateway setup software (PFN_Tool). Version number may differ from that shown in this manual (version 1.32).

You will be presented with this screen:



PFN_Tool (Version 1.32)

Network Devices : IP: 192.168.0.54 MAC: EC-F4-BB-6A-FD-91 (Intel(R) Ethernet Connection I218-LM)

Search Start

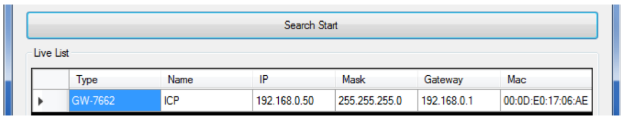
Live List

Type	Name	IP	Mask	Gateway	Mac

Figure 3: Scanning for gateways

Select the GW-7662 Ethernet adapter from the **Network Device** dropdown list and click **Search Start**. Gateways found by the program will be populated in the **Live List**.

The gateway should be appear similar to below:



Search Start

Live List

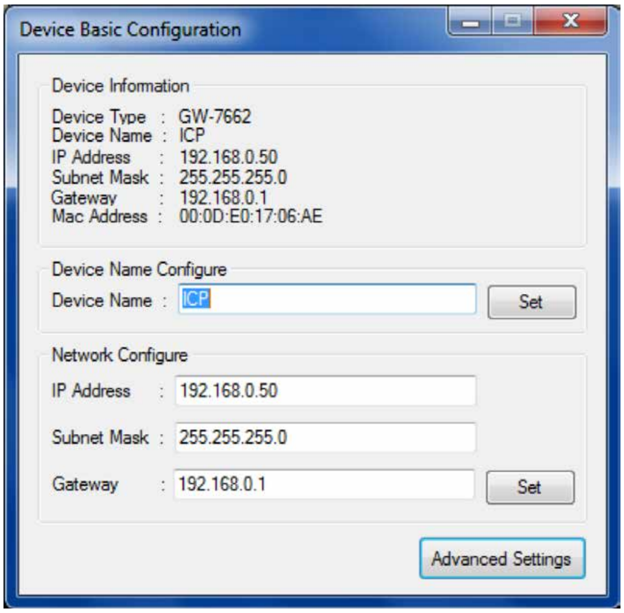
Type	Name	IP	Mask	Gateway	Mac
GW-7662	ICP	192.168.0.50	255.255.255.0	192.168.0.1	00:0D:E0:17:06:AE

Figure 4: Selecting discovered gateways

The Profinet gateway will show as type GW-7662. Take note of the gateway IP address and Subnet mask. Now reconfigure the computer/laptop settings so you can join the gateway network. On Windows 10 machines this can be done in the **Network and Sharing Center**. Other operating systems may vary. Consult your IT department if in doubt. Once settings are reconfigured, restart the setup software and scan for the gateway.

If changing the computer/laptop IP address is not possible, the gateway IP settings can be temporarily changed to communicate with the computer/laptop.

Double-click the gateway device in the **Live List** to open the settings for the gateway device.



Device Basic Configuration

Device Information

Device Type : GW-7662
Device Name : ICP
IP Address : 192.168.0.50
Subnet Mask : 255.255.255.0
Gateway : 192.168.0.1
Mac Address : 00:0D:E0:17:06:AE

Device Name Configure

Device Name : ICP [Set]

Network Configure

IP Address : 192.168.0.50
Subnet Mask : 255.255.255.0
Gateway : 192.168.0.1 [Set]

[Advanced Settings]

Figure 5: Changing IP settings and gateway name

It is advisable to set a relevant name for the gateway (usually associated to the actuator or MOV). IP address settings can be changed to communicate with the computer/laptop.

After commissioning is complete, the gateway IP address configuration must be changed to the required settings for communication on the Profinet network.

4.1 Default IP address

The default IP settings for the gateway are:

- IP: 192.168.0.50
- Gateway: 192.168.0.1
- Mask: 255.255.255.0

Always check the gateway settings in the **Live List** shown in Figure 4.

5. Program actuator data reporting

By default the gateway is programmed to read actuator status/alarm registers, position feedback, instantaneous torque feedback, position control and commands. If the default settings cover all the required data, no further configuration is necessary.

Settings are saved as a .INI file. The default Rotork settings file is already loaded into the gateway device but it can also be downloaded from:

www.rotork.com/products-and-services/control-networks/ethernet

To edit configuration of the gateway device, open the gateway device settings (Figure 5) and click **Advanced Settings**. To check the current configured settings click **Download Settings**.

5.1 Add custom parameters

Extra parameters can be added using settings in the **Request Command** section of the **Modbus Settings** tab.

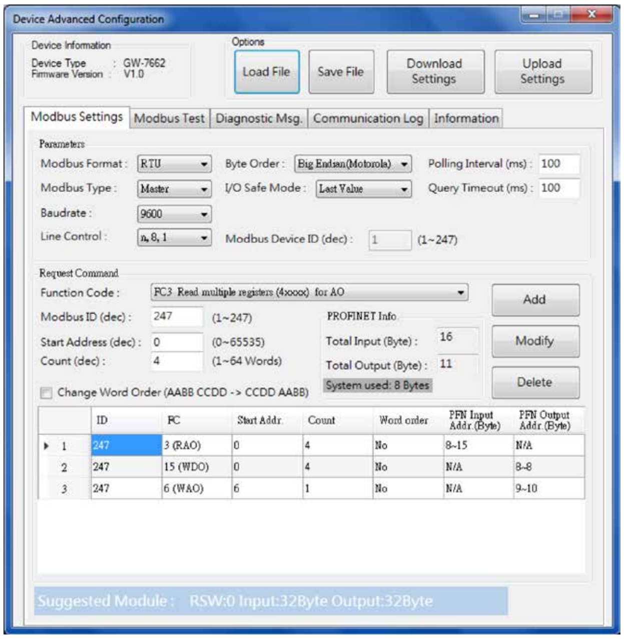
Parameters must be added in accordance with applicable Modbus manual available on the Rotork website:

www.rotork.com/products-and-services/control-networks/modbus/modbus-literature

Custom parameters can be modified or deleted using the respective buttons. Settings will not be saved to the gateway until they are uploaded.

Example

To add **Analogue Input** (requires extra option board) for an IQ3 or IQ3 Pro actuator, refer to Section 7.6.3 of PUB091-004. Select function code 03 from the drop down list. Input the actuator Modbus address into **Modbus ID (dec)** and input the register value (4) into the **Start Address (dec)**. **Count (dec)** defines the number of sequential registers to read. Leave as 1 for a single read. Click **Add** to include the new parameter in the gateway configuration.



Device Information
Device Type : GW-7662
Firmware Version : V1.0

Parameters
Modbus Format : RTU
Byte Order : Big Endian(Motorola)
Polling Interval (ms) : 100
Modbus Type : Master
I/O Safe Mode : Last Value
Query Timeout (ms) : 100
Baudrate : 9600
Line Control : n, 8, 1
Modbus Device ID (dec) : 1 (1~247)

Request Command
Function Code : FC3 Read multiple registers (4xxxx) for AO
Modbus ID (dec) : 247 (1~247)
Start Address (dec) : 0 (0~65535)
Count (dec) : 4 (1~64 Words)
□ Change Word Order (AABB CCDD -> CCDD AABB)

PROFINET Info
Total Input (Byte) : 16
Total Output (Byte) : 11
System used: 8 Bytes

	ID	FC	Start Addr.	Count	Word order	PFN Input Addr.(Byte)	PFN Output Addr.(Byte)
▸ 1	247	3 (RAO)	0	4	No	8~15	N/A
2	247	15 (WDO)	0	4	No	N/A	8~8
3	247	6 (WAO)	6	1	No	N/A	9~10

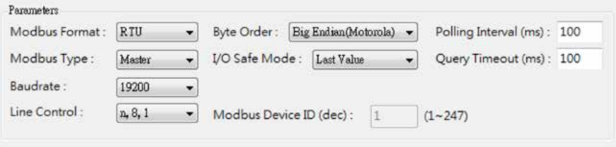
Suggested Module : RSW:0 Input:32Byte Output:32Byte

Figure 6: Programming gateway; custom data or restoring default file

5.2 Upload settings

Adjust the configuration settings as required or alternatively click **Load File** to open a .INI file containing a pre-configured setup. When the settings are correct, click **Upload Settings** to send the new gateway device configuration. It may take a few moments to complete the upload.

Settings can be saved as a .INI file for future use. Rotork recommend saving any files that differ from the default configuration.



Parameters
Modbus Format : RTU
Byte Order : Big Endian(Motorola)
Polling Interval (ms) : 100
Modbus Type : Master
I/O Safe Mode : Last Value
Query Timeout (ms) : 100
Baudrate : 19200
Line Control : n, 8, 1
Modbus Device ID (dec) : 1 (1~247)

Figure 7: Modbus RTU settings

6. Reading and writing Profinet data

The first 8 bytes of the Profinet gateway (bytes 0-7) are reserved inputs and outputs. Actuator data starts at byte 8.

Specific actuator data registers are visible in the **Advanced Settings** screen as shown below. You have an option to transmit an analogue command or a digital command but not both. The example below is for analogue control only.

ID	FC	Start Addr.	Count	Word order	PFN Input Addr. (Byte)	PFN Output Addr. (Byte)
247	3 (RAO)	0	4	No	8-15	N/A
247	6 (WAO)	6	1	No	N/A	8-9

Figure 8: Analogue command

Register locations start at address 0. If your control system starts at address 1, an offset must be applied.

6.1 Profinet database

6.1.1 Database commands

Profinet address register	Data	Read / Write	Value range
8-9	Analogue Command	W	0-1000 (0x0 3E8)

Figure 9A: Database commands – Analogue database command scaling (if Analogue Control selected)

Profinet address register	Data	Read / Write	Value range
8-8	Digital Command	W	0-3 (see note below)

Figure 9B: Database commands – Digital (if Digital Control selected)

Note: The value range of 0-3 is interpreted as follows:
0 - Stop, 1 - Closed, 2 - Open, 3 - ESD

6.1.2 Database feedback

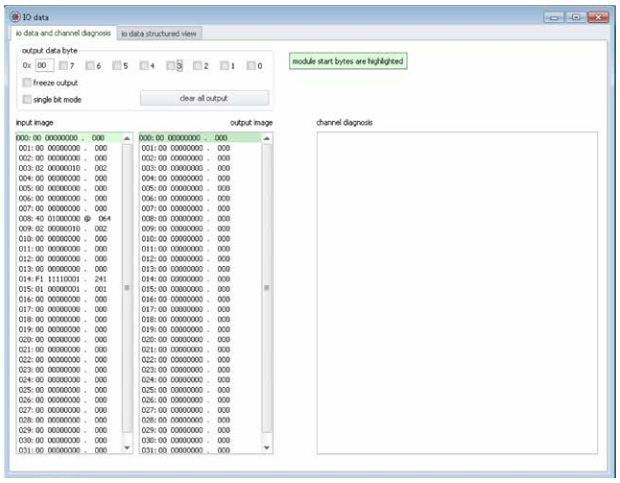
Profinet address register/bit		Data	Read / Write	Value range
8	0	Actuator moving	R	0 - 1
8	1	Closed position limit	R	0 - 1
8	2	Open position limit	R	0 - 1
8	3	Running closed	R	0 - 1
8	4	Running open	R	0 - 1
8	5	Remote selected	R	0 - 1
8	6	Local Stop selected (offline)	R	0 - 1
8	7	Local selected	R	0 - 1
9	8	Thermostat tripped	R	0 - 1
9	9	Monitor relay	R	0 - 1
9	10	Valve obstructed	R	0 - 1
9	11	Valve jammed	R	0 - 1
9	12	Valve moving by hand	R	0 - 1
9	13	Moving inhibited by MIT	R	0 - 1
9	14	Position control enabled	R	0 - 1
9	15	EEPROM Checksum failure	R	0 - 1
10	0	Battery low	R	0 - 1
10	1	Open interlock active	R	0 - 1
10	2	Close interlock active	R	0 - 1
10	3	DI-1	R	0 - 1
10	4	DI-2	R	0 - 1
10	5	DI-3	R	0 - 1
10	6	DI-4	R	0 - 1
10	7	Reserved	R	0
11	8	Reserved	R	0
11	9	Reserved	R	0
11	10	Control contention	R	0 - 1
11	11	Partial stroke test in progress	R	0 - 1
11	12	Partial stroke test error	R	0 - 1
11	13	General alarm	R	0 - 1
11	14	Reserved	R	0
11	15	Reserved	R	0
12/13	-	Actuator instantaneous torque	R	0 - 78 hex (0 - 120%)
14/15	-	Valve position	R	0 - 3E8 hex (0.0 - 100.0%)

Figure 10: Database feedback

For details of the reported data see the Modbus manual PUB091-004 (Section 7.3 to 7.6.9).

6. Reading and writing Profinet data

6.2 Data read



```
000: 00 00000000 .  000     000: 00 00000000 .  000
001: 00 00000000 .  000     001: 00 00000000 .  000
002: 00 00000000 .  000     002: 00 00000000 .  000
003: 02 00000010 .  002     003: 00 00000000 .  000
004: 00 00000000 .  000     004: 00 00000000 .  000
005: 00 00000000 .  000     005: 00 00000000 .  000
006: 00 00000000 .  000     006: 00 00000000 .  000
007: 00 00000000 .  000     007: 00 00000000 .  000
008: 40 01000000 @  064     008: 00 00000000 .  000
009: 02 00000010 .  002     009: 00 00000000 .  000
010: 00 00000000 .  000     010: 00 00000000 .  000
011: 00 00000000 .  000     011: 00 00000000 .  000
012: 00 00000000 .  000     012: 00 00000000 .  000
013: 00 00000000 .  000     013: 00 00000000 .  000
014: F1 11110001 .  241     014: 00 00000000 .  000
015: 01 00000001 .  001     015: 00 00000000 .  000
016: 00 00000000 .  000     016: 00 00000000 .  000
017: 00 00000000 .  000     017: 00 00000000 .  000
018: 00 00000000 .  000     018: 00 00000000 .  000
019: 00 00000000 .  000     019: 00 00000000 .  000
020: 00 00000000 .  000     020: 00 00000000 .  000
021: 00 00000000 .  000     021: 00 00000000 .  000
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024: 00 00000000 .  000     024: 00 00000000 .  000
025: 00 00000000 .  000     025: 00 00000000 .  000
026: 00 00000000 .  000     026: 00 00000000 .  000
027: 00 00000000 .  000     027: 00 00000000 .  000
028: 00 00000000 .  000     028: 00 00000000 .  000
029: 00 00000000 .  000     029: 00 00000000 .  000
030: 00 00000000 .  000     030: 00 00000000 .  000
031: 00 00000000 .  000     031: 00 00000000 .  000
```

Figure 11: Example of data read

The above images shows a Profinet simulator software tool starting at register address 0.

Status data is visible in the left column. Bytes 0-7 are reserved and therefore actuator data starts at byte 8. Using the default configuration, information can be decoded using Figure 9 and Figure 10.

- Byte 8 is 40hex. Bit 6 is active which means Local Stop is selected.
- Byte 9 is 02hex. Bit 1 is active which means Monitor Relay is active.
- Byte 15 and 14 are 01F1hex. Actuator position is 497 in decimal which means 49.7%.

7. Troubleshooting tips

7.1 LED behaviour

The table below describes LED behaviour on the Profinet gateway device.

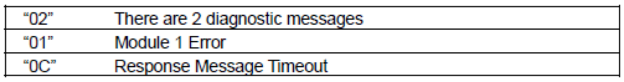
AP	BOOT	ERR	Description
OFF	OFF	Flash (Slow)	Waiting for PROFINET connection
ON	OFF	OFF	PROFINET connection is established
ON	OFF	Flash (Slow)	Device is at AP mode and the module received the incorrect parameters
ON	OFF	Flash (Fast)	Error GW-7662 has diagnostic message
ON	Flash (Slow)	Flash (Slow)	Hardware authentication error

Figure 12: Profinet gateway LED diagnositcs

7.2 Diagnostic messages

With the green AP LED on and red ERR LED flashing fast, Profinet is working but a a diagnostic message is present in the gateway. The first six bytes (0-5) will show details of the diagnostic message.

An example diagnostic message is shown below. This is common when a communication time out occurs, normally a result of the gateway and actuator Modbus settings not matching.



"02"	There are 2 diagnostic messages
"01"	Module 1 Error
"0C"	Response Message Timeout

Figure 13: Common error message

8. Ethernet security

Always consider security of the Profinet gateway when connecting it to an Ethernet network.

The user should ensure the Ethernet infrastructure is able to protect the Profinet gateway from unauthorised access.

It is important to involve the local plant or site IT department in conversations about security of control system networks. The local IT department should be involved with securing access between the business network and the control system network. IT professionals will already be utilising cyber security measures to protect the business networks.

Coordination between IT and the control system team is important to ensure cyber security is managed properly and functions for all networks on site. Security policies may require modification if the exact same policy is not appropriate for the control system and business network.

For example, IT departments can use remote access to periodically maintain and update devices on the business network; these routine updates could disrupt the control system network. Control system updates to software and configuration must be strictly controlled and remote connection like this could introduce security risks to the control system.

The traditional priorities for an IT department managing a business network are confidentiality, integrity and availability of data in the system. The same priority list is reversed for a control system network as availability of the data is the most important. The security of the system should not adversely affect the availability of data to users that need it. Confidentiality is less important as most of the control system data means nothing outside of the system.

The security guidance in this document is intended to help the user implement and maintain reasonable security of the Profinet gateway, however, no security implementation can guarantee to protect against all existing, new or previously unknown threats. Rotork does not guarantee that adherence to these and any other security recommendations will protect the Profinet gateway from security breaches and any subsequent impact on any process or processes in which the Profinet gateway and associated ancillary components are involved with.

Examples of security policies that can be employed on site:

- All control systems must be segmented from the business network using a firewall and a DMZ network.

  Recommendation: All control systems must be segmented from the business network using a firewall/ UTM (Unified Threat Management) device which has built-in Intrusion Prevention, Intrusion Detection System and a two-tier DMZ network.

- All users should be trained on the site security procedures and policies.
- Different job and responsibility level users should have different user names and passwords, preferably per individual.

  Recommendation: Each user should have an individual user account with a strong password (minimum of 8 characters using a mix of upper case and lower case alphanumeric characters).

- Default passwords for user accounts must be changed during system installation or site acceptance tests.

  Recommendation: The end-user should always change the default password to a suitable strong password.

- Security events should be logged in a security audit file, these include invalid logins and changes to user accounts.

8. Ethernet security

8.1 Security environment expected for the Profinet gateway

The Profinet gateway should be installed in an environment with suitable IT security protection to safeguard against internet attacks. Protection should include (but not be limited to) DMZs and firewalls between the Profinet gateway control system network and the plant network. A DMZ is an effective method of protection by separating networks. Direct connection between the Profinet gateway and control system host is excepted. Therefore, a DMZ and firewall is not required between these devices.

8.2 Defence in depth

A defence in depth strategy utilises multiple layers of security so that a threat has to overcome more than one security mechanism. Defence in depth has 3 fundamental types of security safe guards:

1) Physical controls – the physical access of a device and the protection of the device. Normally achieved through protective measures such as site perimeter fences, locked control rooms and cabinets plus deterrence measures such as CCTV.

2) Technical controls – content access restriction of the system or device.

3) Administrative controls – policies and procedures of the organisation.

Notes

Notes

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A full listing of our worldwide sales and
service network is available on our website.

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