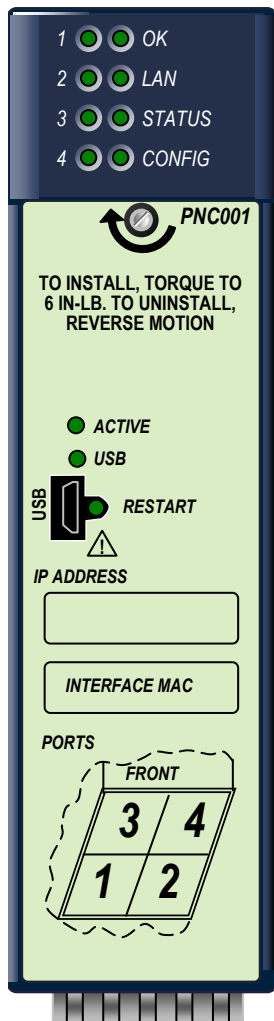


PACSystems* RX3i

IC695PNC001

PROFINET Controller Module

GFK-2573A
December 2011



The PACSystems* RX3i PROFINET Controller (PNC) module, IC695PNC001, connects a PACSystems RX3i controller to a high-speed PROFINET local area network. It enables the RX3i controller to communicate with IO-Devices on the LAN. The PNC provides all the functions, services, and protocols required for certification as a PROFINET IO Version 2.2 IO Controller, running at both 100 Mbps and 1 Gbps.

The PNC supports 10/100/1000 Mbps Copper, 100/1000 Mbps Multi-mode Fiber, and 100/1000 Mbps Single-mode Fiber. The LAN can include media interfaces of more than one type. PROFINET communications on the LAN require 100 and 1000 Mbps link speed. 10 Mbps cannot be used for PROFINET communications. However, 10 Mbps can be used for other types of Ethernet traffic such as ping and telnet.

Features of the RX3i PNC include:

- Full programming and configuration services for the PROFINET Controller, VersaMax PROFINET Scanner and third-party IO-Devices using Proficy Machine Edition .
- Firmware upgrades using the WinLoader software utility.
- Built-in Command Line Interface function that provides direct monitoring and partial configuration via the micro USB port or using telnet.
Note: The USB port is for system setup and diagnostics only. It is not intended for permanent connection.
- Support for star, ring, and daisy-chain/line network topologies.
- Four switched Ethernet ports - two 8-conductor RJ-45 shielded twisted pair 10/100/1000 Mbps copper interfaces and two Small Form-factor Pluggable (SFP) cages for user-supplied SFP devices.
- Internal clock synchronized with the RX3i CPU for time-stamped diagnostics entries.
- Restart pushbutton to manually restart the PNC without power cycling the system.
- LEDs: OK, LAN, STATUS, CONFIG, ACTIVE, USB, and four Port LEDs.
- Compliant with EU RoHS Directive using the following exemptions identified in the Annex: 7c-I and 7c-III.

Ordering Information

IC695PNC001	PACSystems RX3i PROFINET Controller Module 10/100/1000, 4 Ports - 2 SFP connections, 2 Copper
IC200PNS001	VersaMax PROFINET Scanner, 10/100, 2 Ports, Copper
IC200PNS002	VersaMax PROFINET Scanner, 10/100, 2 Ports, Multimode Fiber
IC695SPC100**	RX3i 10/100/1000base-TX (CAT5 100m) SFP
IC695SPF002**	RX3i 100Base-FX (fiber 2 km) SFP

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** Available at a later date.

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PNC Specifications

PROFINET Support	PROFINET Version 2.2 General Class A IO-Controller
CPU Compatibility	Requires CPU315 or CPU320, with firmware version 7.0 or higher.
Power Requirements	3.3 V: 0.5 A with no SFP devices installed 1.2 A maximum (two SFP devices installed, 0.35 A per SFP device)
	5 V: 1.5 A maximum
Operating Temperature Range	0 to 60°C maximum surrounding air temperature without a fan. A lower maximum temperature may be required depending on PNC location and SFP population. Refer to "Operating Range for Air Temperature" in the <i>PACSystems RX3i PROFINET Controller Manual</i> , GFK-2571.
Number of Port Connectors	Two RJ-45 and Two SFP Cages (Not included, available separately)
Micro USB Connector	One, for communication with a computer using Command Line Interface.
LAN	IEEE 802.2 Logical Link Control Class I IEEE 802.3 CSMA/CD Medium Access Control 10/100/1000 Mbps
Maximum I/O Memory	128 Kbytes of combined input/output memory per PROFINET Controller
CPU Status Bits	32
PROFINET I/O Device Data Update Rates on the PROFINET LAN	Configurable: 1 ms, 2 ms, 4 ms, 8 ms, 16 ms, 32 ms, 64 ms, 128 ms, 256 ms and 512 ms
Number of IP addresses	One
Number of MAC Addresses	Five. One per external port and one internal.
System Maximum Limits	
PROFINET Controllers per RX3i CPU	4. Must be located in main rack. Cannot be located in a remote node.
IO-Devices per IO-Controller	64 per PROFINET Controller
IO-Devices per Network	128 per network, spread across up to 8 IO-Controllers
IO-Devices per RX3i CPU	128 per RX3i CPU, spread across up to 4 PROFINET Controllers
IO-Controllers per network	8
Number of PROFINET Slots per device	256
Number of PROFINET Subslots per slot	256
Number of PROFINET Submodules per RX3i CPU	2048
Programmer Limits	
Number of IO-Controllers	128 (32 RX3i CPU targets × 4 IO-Controllers per RX3i CPU)
Number of IO-Devices	2048 (128 per network × 16 PROFINET networks)
Total number of devices	2176 (does not include backplanes, power supplies, or I/O modules)
Hot-swappable	Yes

For product standards, general operating specifications, and installation requirements, refer to the *PACSystems RX3i System Manual*, GFK-2314.

Sweep Impact of PNC and PROFINET I/O

The PLC CPU sweep impact for a PROFINET I/O network is a function of the number of PNCs, the number of PROFINET devices, and the number of each PROFINET device's I/O modules. The table below shows the measured sweep impact of the RX3i PROFINET Controller, supported VersaMax PROFINET devices, and I/O-modules.

Sweep Impact (μs)

	CPU315/CPU320
RX3i PROFINET Controller (PNC)	50
VersaMax Product Family	
Profinet Scanner (PNS) (IC200PNS001)	40
Discrete Input Module (8/16/32 pt.)	23
Discrete Output Module (8/16/32 pt.)	18
Analog Input Module (15 channel)	59
Analog Output Module (12 channel)	21
CMM020 (64AI/64AQ)	204

To calculate the total expected PLC sweep impact for a PROFINET I/O network, add the individual sweep impact times for each PROFINET Controller, PROFINET Device, and PROFINET Device I/O module, using the times provided above.

Example

For a PROFINET I/O network that consists of one PNC and one VersaMax Profinet Scanner that has both an 8 point input and an 8 point output module:

$$\begin{aligned} \text{Expected PLC sweep Impact} &= 50 \text{ (PNC)} + 40 \text{ (PNS)} + 23 \text{ (8pt. Input)} + 18 \text{ (8pt. Output)} \\ &= 131 \text{ } \mu\text{s.} \end{aligned}$$

Installation in Hazardous Areas

The following information is for products bearing the UL marking for Hazardous Locations or ATEX marking for explosive atmospheres:

- EQUIPMENT LABELED WITH REFERENCE TO CLASS I, GROUPS A, B, C & D, DIV. 2 HAZARDOUS LOCATIONS IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY
- WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;
- WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES; AND
- WARNING - EXPLOSION HAZARD - DO NOT CONNECT OR DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.
-  WARNING - EXPLOSION HAZARD - USB PORT IS ONLY FOR USE IN NONHAZARDOUS LOCATIONS, DO NOT USE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.

ATEX Marking

 II 3 G Ex nA IIC T5 X Ta: 0 - 60C

Quick Start

Installation and initial startup procedures for the PNC include the following steps. Before installing and operating the PNC, refer to the *PACSystems RX3i PROFINET Controller Manual*, GFK-2571 for detailed information.

1. Pre-Installation check

2. Installing the PNC in an RX3i backplane

The PNC must be installed in the main (CPU) rack of the RX3i system, using a Universal Backplane such as IC695CHS007, CHS012 or CHS016. The PNC supports insertion/removal while power is applied to the system (hot swap). This includes backplane power and field power supplied to the PNC.

Warning

Inserting or removing a PNC with power applied to the system may cause an electrical arc. This can result in unexpected and potentially dangerous action by field devices. Arcing is an explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power appropriately before removing or inserting a PNC.

3. Connecting the PNC to the PROFINET network and to a 10BaseT, 100BaseTX or 1000BaseT IEEE 802.3 network for general Ethernet communications

Caution

Do not connect two or more ports on the PNC to the same device, either directly or indirectly, unless Media Redundancy is enabled in the PNC's configuration.

If Media Redundancy will be used, do not close the network ring until after the Media Redundancy configuration which contains one node as a Media Redundancy Manager (MRM) has been downloaded to the PNC. If a Media Redundancy Manager is not present, packets can continuously cycle on the network, using up significant network bandwidth.

Note: Shielded cable is required for 1 Gbps operation.

4. Installing SFP devices

Warning

Optical SFPs use an invisible laser to generate a fiber-optic signal. Always keep the port covered if a cable is not installed. Do not look into the open port if a cable is not installed.

Warning

If the surrounding air operating temperature of the PNC is greater than 40 °C, SFP devices could have operating temperatures over 70 °C (158 °F). Under these conditions, for your safety, do *not* use bare hands to remove an SFP device from the SFP cage. Use protective gloves or a tool (needle-nose pliers) to avoid handling the hot SFP device directly when removing the SFP device.

5. Installing the USB port driver (optional)

The PNC provides a micro USB port for connection to a computer running Windows 2000, Windows XP, Windows Vista, or Windows 7 operating system. The computer can access the PNC's Command Line Interface function using a terminal application such as Hyperterm. The PNC is provided with a driver-install application that can be used to enable a computer to communicate with a PNC via its USB port. For details on using the Command Line Interface, refer to the *Command Line Interface Manual*, GFK-2572.

6. Configuring the PNC and its IO Devices on a PROFINET network

Proficy Machine Edition is the primary tool used to configure an RX3i PROFINET network. In addition, certain parameters can be set from a computer through the PNC's Command Line Interface. For details on system planning and configuration, refer to chapter 3 of the *PACSystems RX3i PROFINET Controller Manual*, GFK-2571.

Caution

If an RX3i PNC is extracted from a powered RX3i backplane, it loses power immediately which may result in data loss. Do not remove or insert the device while downloading hardware configuration to the system.

When the PNC is plugged back into a powered backplane, the PNC restores data from the internal non-volatile memory. If however, the RX3i CPU has configuration data for the PROFINET Controller, it re-delivers the data to the PNC, superseding parameters previously stored in non-volatile memory.

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Important Product Information for this Release

Release History

Version	Firmware Revision	Date	Comments
IC695PNC001-AB	1.10	Dec. 2011	Adds support for SNMP and LLDP standards to facilitate network management. Provides enhanced Revision Information in the Explore PROFINET Networks tool.
IC695PNC001-AA	1.00	Jun. 2011	Initial release. Supports GSDML Version 2.2 and previous.

Upgrades

The PNC can be field upgraded to firmware version 1.10 using the Winloader firmware upgrade utility and upgrade kit 82A1790-MS10-000-A1, which can be downloaded from <http://support.ge-ip.com>.

Compatibility

The following CPU firmware, programming software and backplane hardware versions are required to use the features introduced in PNC release 1.10:

RX3i CPU firmware	Models CPU315 or CPU320, with firmware version 7.00 or higher
Programmer software	Proficy Machine Edition version 7.0 SIM 4 or later
VersaMax PROFINET Scanner	IC200PNS001/002 with firmware version 1.00
RX3i backplane hardware	The following backplane hardware revisions must be used: IC695CHS012-BAMP IC695CHS016-BAMP IC695CHS012CA-BAMP IC695CHS016CA-BAMP or IC695CHS012-CA (or later) IC695CHS016-CA (or later) IC695CHS012CA-CA (or later) IC695CHS016CA-CA (or later) or IC695CHS007-AA (or later)

Problems Resolved in Release 1.10

No interoperation with Beckhoff I/O	The initial version of the PNC is unable to connect to or transfer I/O with Beckhoff Bk9053/Bk9103 I/O. RX3i PROFINET controller firmware 1.10 and later has corrected this issue and is able to connect to and transfer I/O with Beckhoff Bk9053/Bk9103 I/O.
Occasional Loss of Device when storing large configuration	When storing a hardware configuration containing a large number of PROFINET devices, sometimes (~5%) the initial version of the PNC will not successfully complete a connection to one or more of the devices. A Loss of Device fault will be logged (with no subsequent Add of Device). Storing the same configuration again will cause the PNC to restart itself and then it typically connects to all devices. A manual restart, via the pushbutton or the CLI command, will also result in successful reconnection. RX3i PROFINET controller firmware 1.10 and later corrects this issue.

New Features and Enhancements in Release 1.10

- Support for SNMP and LLDP standards to facilitate network management.
 - The PNC's built-in SNMP (Simple Network Management Protocol) Server/Agent function allows a third-party SNMP Client or Network Management Station to access network data.
 - The PNC implements the Link Layer Discovery Protocol (LLDP). A PROFINET IO-Supervisor or other network host can use LLDP to discover the PROFINET network topology prior to communicating with any individual IO-Devices on the network.
- Support for reading GE Intelligent Platforms manufacturer data using Explore PROFINET Networks. The Explore PROFINET Networks tool now supports the following additional revision information fields:
 - Manufacturer's Catalog Number – For GE Intelligent Platforms devices, this is the catalog number of the device as built. For 3rd party devices, the field is set to the Order Number.
 - Date Code – For GE Intelligent Platforms devices, this field indicates when the device was manufactured. Not available for 3rd party devices.
 - Primary Firmware Revision –For GE Intelligent Platforms devices, indicates the firmware revision and build ID (for example 22A1). For 3rd party devices, if available, indicates the firmware revision, but not a build ID.
 - Boot Firmware Revision – For GE Intelligent Platforms devices, indicates the firmware revision and build ID (for example 22A1). For 3rd party devices, if available, indicates the firmware revision, but not a build ID.

Restrictions and Open Issues

Restrictions and Open Issues related to PNC operational behavior

Subject	Description
Unintended LED blink pattern	When an overtemperature condition occurs, the PNC001 will blink this pattern: PORT 1, PORT 2 , and STATUS LEDs on red for 0.5 seconds (all other LEDs off), then PORT 3 and PORT 4 LEDs on red for 0.5 seconds (all other LEDs off). This is not the correct pattern, as documented in the <i>PACSystems RX3i PROFINET Controller Manual</i> (GFK-2571).
Unexpected Loss of Device faults	Loss of Device faults for currently connected devices may appear in the PLC I/O Fault table and/or PNC local log when the PNC is reset via its reset pushbutton.
Unintended operation of PNIO_DEV_COMM function block	The power flow output of the PNIO_DEV_COMM function block provides validation of the input parameters and confirms that the PNC has locally processed the configuration of the specified I/O Device. As currently implemented, the power flow output will not turn ON until after the PNC has made its first attempt to connect to the specified I/O Device. Therefore, we recommend the user not rely on power flow output for parameter validation.

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Restrictions and Open Issues related to the Command Line Interface

Subject	Description
Page function not available	The output paging function, as described in the <i>shConfig</i> command, is not currently functioning.
Response to invalid command entry	The error message displayed in response to an invalid show port help command does not provide useful information. Example: show port fdp help is an invalid command. To see a list of valid parameters for the <i>show port</i> command, type <i>show port ?</i>
"telnetd" command response	The CLI does not echo the new number of max connections in its response to the <i>telnetd <maxconnections></i> command. However, the command still functions properly, and updates the maximum number of telnet connections.
"log details" command response	When displaying numerous local log table entries using the <i>log details</i> command, sometimes erroneous blank characters appear within the display. Use the <i>log details <log entry number></i> command to view the disrupted log table entry. Example: <i>log details 99</i> .
"term" command response	Occasionally, the CLI does not respond to the "term" command. To recover, restart the terminal emulation program.

Operational Notes

Subject	Description
Ring network configuration and parameter considerations for bumpless PROFINET IO Device operation with Media Redundancy Protocol (MRP)	Use of the Media Redundancy Protocol (MRP) allows a user's ring network to automatically heal itself in the event of a single break of the ring network. If a user's application requires the PROFINET IO Devices to operate bumplessly through ring network recovery (no observed loss and subsequent addition of PROFINET IO Devices while the ring network recovers), the following network and application design guidelines must be observed: 1. If only one PNC is in the ring acting as the Media Redundancy Manager (MRM) and all of the Media Redundancy Clients (MRCs) are VersaMax PROFINET Scanners, customers can set minimum IO Update Rates as follows and expect PROFINET IO to operate bumplessly through ring network recovery: ▪ Using the fixed copper ring ports on the PNC, 1 ms IO Update Rate minimum ▪ Using SFPs on the PNC, 4 ms IO Update Rate minimum 2. If multiple PNCs are in the ring (one PNC acting as the MRM and other PNC(s) as MRC(s)) where VersaMax PROFINET Scanners are the only PROFINET IO Devices, customers can set minimum IO Update Rates as follows and expect IO to operate bumplessly through ring network recovery: ▪ 16 ms IO Update Rate minimum, regardless of ports utilized, and must set MRP Test Packet Interval to 10 ms and MRP Test Packet Count to 2. 3. If 3rd party MRCs are in use in the ring, customers can set a minimum IO update rate to the larger of the options that follow and expect IO to operate bumplessly through ring network recovery: ▪ Minimum IO Update Rate configurable in PME that is at least 1/3 the time of the worst-case ring recovery stated by 3rd party manufacturer, regardless of ports utilized. (i.e. if a manufacturer states their worst-case ring recovery is 90 ms, then the minimum IO update rate allowed would be $90/3 = 30 \text{ ms} \sim 32\text{ms}$.) or ▪ 16 ms IO Update Rate minimum, regardless of ports utilized, and must set MRP Test Packet Interval to 10 ms and MRP Test Packet Count to 2.

Subject	Description
Storing updated media redundancy protocol (MRP) configurations to large operating MRP ring networks with fast IO update rates configured can result in PROFINET IO device Loss/Add faults	When storing Media Redundancy Protocol (MRP) configuration updates to an operating MRP ring network, users may infrequently observe one or more pairs of "Loss of Device" and subsequent "Addition of Device" faults regarding PROFINET IO Device faults on the network. This is expected behavior and is more likely to occur on ring networks with a large number of PROFINET IO Devices acting as MRCs with very fast IO Update Rates configured. Because changing MRP configuration settings requires each MRC to break and reconnect its own connections to the ring network, IP packets on the network may be lost as this flurry of connection breaks/ reconnects occur on the network. Since a PROFINET IO Device is considered lost if it misses three consecutive IO data transactions, if three consecutive IO data packets from a particular PROFINET IO Device are lost due to network reconfiguration, the device will appear to be lost to the PNC and a Loss of IO Device is logged. When the network stabilizes, the PNC will be able to reestablish connection with the lost IO Device and an Addition of IO Device fault will be logged.
Data packets arriving on ports blocked by Media Redundancy Protocol (MRP) still forwarded over mirrored ports	When a network is configured for MRP operation, MRCs and Media Redundancy Managers (MRMs) can put one of their ring ports into a "Blocking" state. MRP uses this blocked port state to break the continuous ring and allow only MRP management traffic to pass through the blocked port. All of the non-MRP management traffic is blocked from ingress or egress of the blocked port. If the port has been set up using the port mirroring "monport" command, to monitor traffic on the blocked port, <u>all</u> of the traffic that arrives at the blocked port is mirrored to the configured monitor port regardless of whether or not the traffic is MRP management traffic. This makes it appear that the traffic is being sent or received on the blocked port even though it is not.
Network monitoring devices should be directly connected to mirrored PNC ports	When using the port mirroring "monport" command to monitor Ethernet traffic, you should directly connect your PC/Laptop to the port on the PNC that is monitoring the traffic. If there is an intervening switch in the mirrored path, the mirrored traffic will corrupt the intervening switch's routing table. A corrupted routing table can cause dropped Ethernet packets, resulting in the loss of PROFINET IO and/or other Ethernet communication.

References

For additional information, please refer to the manuals listed below. Manuals can be downloaded from the Support website, <http://support.ge-ip.com>.

PACSystems RX3i PROFINET Controller Manual, GFK-2571A

PACSystems RX3i PROFINET Controller Command Line Interface Manual, GFK-2572

VersaMax PROFINET Scanner User's Manual, GFK-2721

PACSystems CPU Reference Manual, GFK-2222

PACSystems RX3i System Manual, GFK-2314