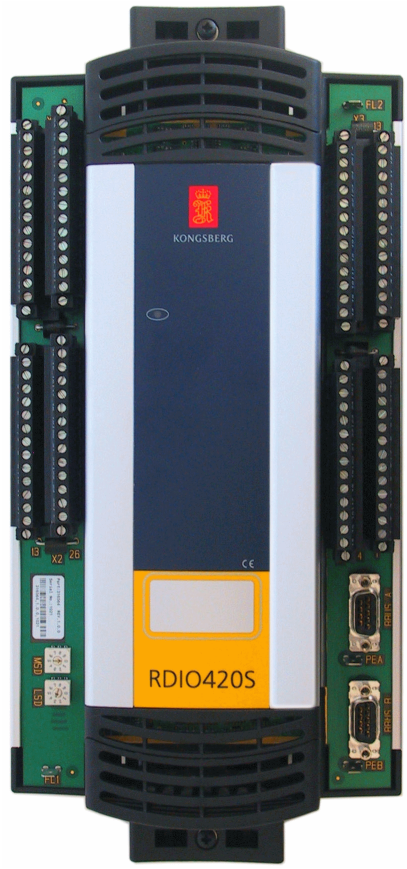
RDIO420S

Hardware Module Description

Kongsberg Maritime Part no.316564



323936/B

Document history

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Rev. A	July 2008	First version.
Rev. B	January 2011	Updated grounding information and figures.

Note

Warning

The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment and/or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.
Kongsberg Maritime disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.

Comments

To assist us in making improvements to the product and to this manual, we welcome comments and constructive criticism.
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Glossary

1oo2	One-out-of-two
DI	Digital Input
DO	Digital Output
ESD	Electrostatic Discharge
EOL	End Of Line
EX	Explosive
FOST	Final Output Stage Test
GND	Ground
HS	Hot Stand-by
HSD	High Side Driver
IE	Instrumentation Earth
I/O	Input/Output
IP	Ingress Protection
KM	Kongsberg Maritime
LED	Light Emitting Diode
MTBF	Mean Time Between Failure
NDE	Normally De-energized
NE	Normally Energized
PDU	Power Down Unit
PE	Protective Earth
RBUS	Remote I/O Bus
RCU	Remote Controller Unit
RDIO420S	Remote Digital Input Output Safety module series 420S
RIO	Remote Input Output
SIL	Safety Integrity Level
SUC	Step-up Converter
WD	Watchdog

1 Module overview

The Remote Digital Input Output module RDIO420S is an advanced interface module. The module interfaces a total of 32 field I/O through a single or dual remote I/O process bus (RBUS) to the host computer(s). The 32 channels are clustered into 4 digital input or digital output groups.

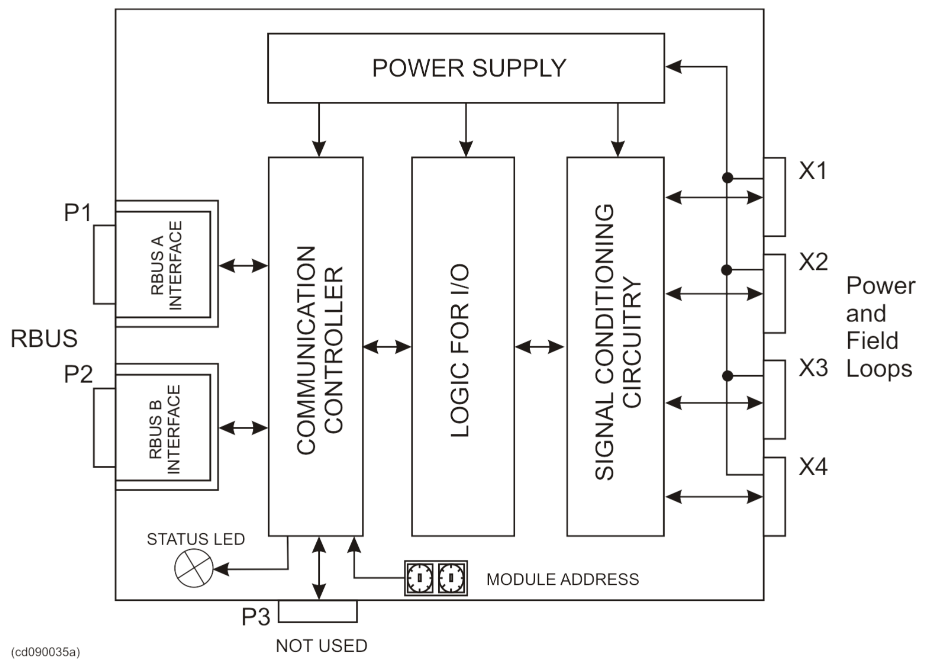
Features of RDIO420S:

- Up to 32 digital input or 32 digital output signals, configured in four DI or DO groups of eight channels each
- Identical input and output channels from two different modules can be connected in parallel (redundant operation)
- Two serial process bus interfaces (RBUS A and RBUS B) for redundant communication to the redundant controllers
- Each serial process bus interface is galvanically isolated from other circuitry
- Easy installation and replacement:
  - DIN-rail mounting
  - Plug-in connections
  - Two digit address switch
- Status LED on the front shows running or error status
- Loop monitoring of digital input and output signals
- Loop-check and debugging possible from operator station
- Short-circuit proof I/O loops
- Module temperature and voltage monitored and alarmed if outside limits
- Fail-safe activation of outputs upon loss of communication
- Built-in tests for self-diagnostics and fault identification while running
- Suitable for use in SIL applications
  - SIL 2 as single module configuration
  - SIL 3 as redundant module configuration
- Built in FOST (Final Output Stage Test)
- Ex Zone 2 type approval

2 Module function

The RDIO420S is provided with 32 digital input or output channel interfaces on the field side and dual serial process bus (RBUS) interface on the controller computer side (see illustration below).

Figure 1 Block diagram



The RDIO420S provides a number of interfaces and functions. The main function blocks are:

- Power Supply
- RBUS Interfaces
- Communication Controller
- Logic for DI/DO
- I/O Channels with Signal Conditioning Circuitry
- Module Address Switches
- Status Indicator (LED)

2.1 Power supply and loop power

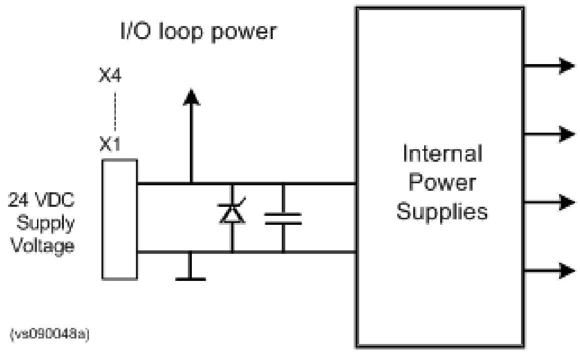
The RDIO420S is supplied with 24 VDC supply voltage via the terminal blocks X1 through X4. The four power supply terminals (one on each terminal block) are interconnected within the module and feed the 32 HSD (High Side Driver) loop driver circuits.

Note

If the total field load is more than 5 A, more than one power connection (among X1 through X4) must be used. If the total field load exceeds 10 A, more than two power connections (among X1 through X4) should be used.

The supply voltage supplies 24 VDC also to several internal power supplies (DC/DC converters) generating voltages for internal use.

Figure 2 Power supply principles



2.2 RBUS interface

Two mulitdrop RS485 serial lines are used. RBUS A and RBUS B are galvanically isolated from each other and from the I/O part of the module.

The RBUS cable also supply power (+24 volt) to the isolated part of the module's RS485 line. The RBUS 24VDC supply can be the same as the host computer supply.

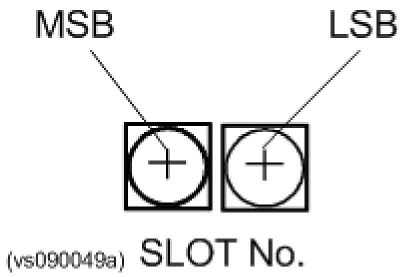
2.3 Status indicator – LED

A status LED is located on the front of the module. It is green when the system is running and no error is detected. It is otherwise red.

2.4 Module Address

Each module must be given a unique address that identifies this module among the other modules connected to the serial process bus (RBUS). The address is represented by two decimal switches (see illustration below), MSD (most significant digit) and LSD (least significant digit), making a two digit decimal number.

Figure 3 Module Address switches



The module address is compared to the RBUS address being in the message sent from the RCU. If they are equal, the module responds.

The maximum number of modules on one RBUS is 99 (address range 1 to 99).

2.5 Field channel interface

2.5.1 Field loop power driver capability

Each of the 32 channels is provided with a High Side Driver (HSD) for driving the DI/DO loop.

The HSD is designed for handling both resistive and inductive loads, and provides short circuit protection.

Upon short circuit or overload the HSD must be manually reset from the application after the condition that caused the short-circuit has been repaired or removed.

2.6 Digital input

Digital inputs can be monitored for loop faults such as short circuit or open loop. EOL resistors are needed for such monitoring.

Digital inputs also accepts most NAMUR proximity switches which can be powered up to 30 VDC.

Digital inputs are read by the module as an internal analog voltage named Ui (see figure *DI interface diagram – Monitor Mode 0 and 1* on page 9.) A corresponding voltage, Uc, can be measured manually between the channel input terminal CH_n_L and channel 0V terminal CH_n0V. Values for Uc are used in the tables in the following descriptions.

Digital inputs are connected as shown in figure *DI interface diagram – Monitor Mode 0 and 1* on page 9 and figure *DI interface diagram – Monitor Mode 2* on page 11.

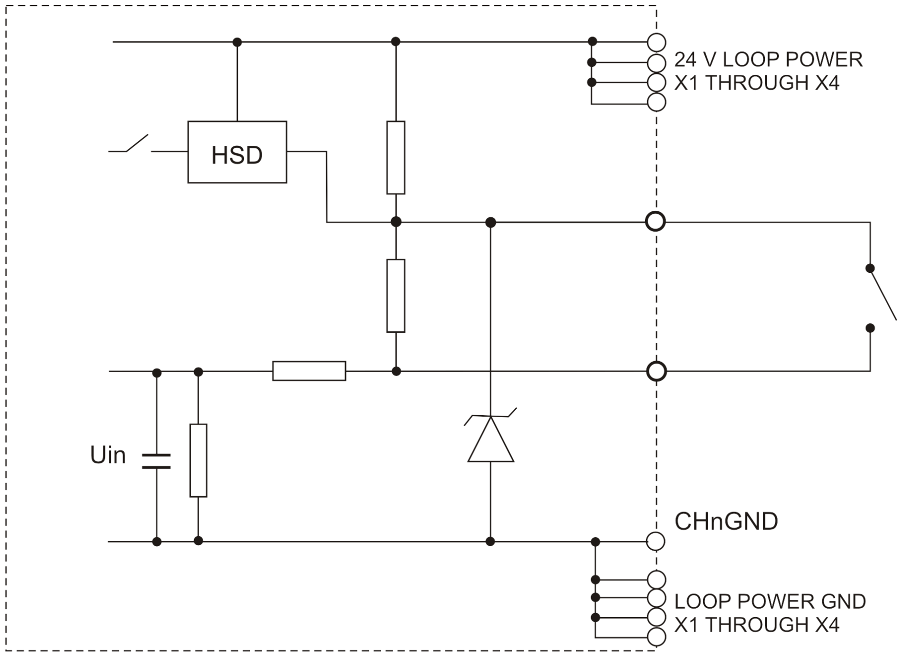
Note

There is no difference between how RDIO420S handles Single or Redundant DI configurations.

2.6.1 RDIO420S DI field channel – Monitor Mode 0 and 1

The figure below illustrates a simplified diagram where the input field device is a switch element.

Figure 4 DI interface diagram – Monitor Mode 0 and 1



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There are two monitoring modes when no external resistors are used.

- DI Monitor Mode 0

  This mode is used for monitoring the channel HSD for over-current only. It should be used for a DI with no need for channel monitoring.

Table 1 Monitor Mode 0 voltage ranges and descriptions

DI state	Voltage ranges measured at Uc	Description
(HSD = “1”)	Uc < 4.5 V	Short to 0V
	4.5 V < Uc < 15.2 V	OK "open switch”
	15.2 V < Uc	OK “closed switch”

Note

The values in the table above are valid for 24 VDC supply voltage. When the supply voltage is in the range 19 VDC to 30 VDC the values will be linearly scaled accordingly.

- DI Monitor Mode 1

  This mode is used for monitoring a DI loop with no EOL resistors. It should be used for a DI with some need for channel monitoring.

Table 2 Monitor Mode 1 voltage ranges and descriptions

DI state	Voltage ranges at Uc	Description
(HSD = “1”)	Uc < 4.5 V	Short to 0V
	4.5 V < Uc < 8.0 V	OK “open switch”
	8.0 V < Uc < 19.1 V	Error if in transition area too long
	19.1 V < Uc < 24.6 V	OK “closed switch”
	24.6 V < Uc	Field loop short circuit to an external voltage

Note

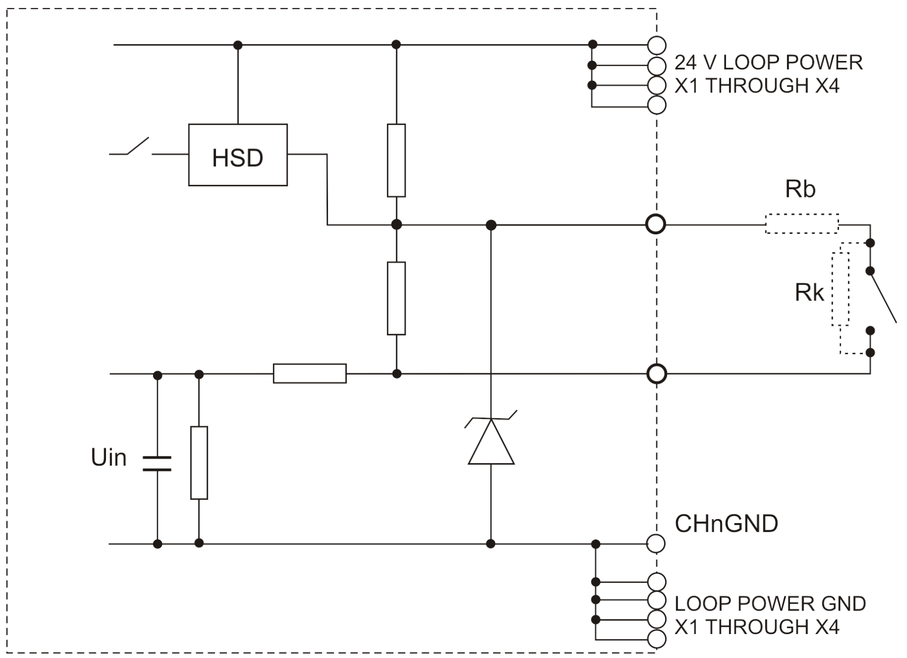
The values in the table above are valid for 24 VDC supply voltage. When the supply voltage is in the range 19 VDC to 30 VDC the values will be linearly scaled accordingly.

2.6.2 RDIO420S DI field channel – Monitor Mode 2

In this example the input field device is a switch element with resistor network for field loop monitoring (EOL).

The figure below illustrates a simplified diagram of a monitored Digital Input (DI) loop.

Figure 5 DI interface diagram – Monitor Mode 2



- DI Monitor Mode 2

  This mode is used for loop-monitored DI and requires EOL resistors Rb = 820 ohm, Rk = 2.7 kohm.

Table 3 Monitor Mode 2 voltage ranges and descriptions

Di state	Voltage ranges at Uc	Description
(HSD = "1")	Uc < 4.5 V	Short circuit to 0V
	4.5 V < Uc < 12.3 V	Field wires broken (open loop)
	12.3 V < Uc < 17.6 V	OK "open switch"
	17.6 V < Uc < 19.1 V	Error if in transition time too long (short circuit)
	19.1 V < Uc < 23.1 V	OK "closed switch"
	23.1 V < Uc	Field wires short circuit to an external voltage

Note

The values in the table above are valid for 24 VDC supply voltage. When the supply voltage is in the range 19 VDC to 30 VDC the values will be linearly scaled accordingly.

2.6.2.1 How the monitored input channels work

The digital input loop is powered from the terminal CH_n_H and status is read as input signal from the terminal CH_n_L. It is read by the module as an internal analog voltage Ui, which makes it possible to test the loop for different states of validity. Using the resistors Rb and Rk of the input loop, (see figure *DI interface diagram – Monitor Mode 2* on page 11) read back of legal and illegal voltage will indicate whether the loop is OK, broken or short circuit.

The HSD provides the loop power for the input loop and is always ON. The diode D1 is used in DI mode to prevent reverse current through the HSD when connecting two inputs in parallel (DI redundancy).

2.6.2.2 Open loop detection

An **open loop**, which occurs if the loop wires are broken, differs from the OFF input signal. In the first case no current is flowing. In the second case a small current is flowing, which is limited by the serial connected resistors Rb and Rk.

2.6.2.3 Short circuit loop detection

A **short circuit loop**, which occurs if the channel High and Low terminals are short circuit, differs from the ON input signal. In the first case the resistor R3 is bypassed. In the second case R3 is connected in parallel with resistor Rb. The voltage read between CH_n_L and CH_n_0V (Uc) will in the short circuit case be measured higher than in the ON input signal case.

2.6.2.4 Short-to-0V detection

There are two short-to-0V options:

- The loop power terminal CH_n_H is short circuit to 0V

  A short-to-0V of the CH_n_H (loop power) terminal will: i) cause a Ui value close to 0 VDC and thus detect the short circuit; ii) cause the corresponding HSD to be turned off due to high current through it. Manual reset of the HSD will then be required re-establish this loop.

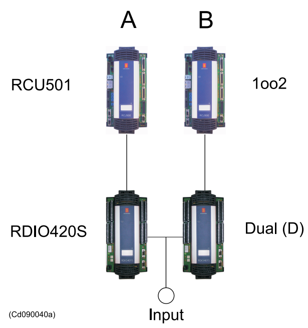
- The return terminal CH_n_L is short circuit to 0V

  A short to 0V of the CH_n_L (return) terminal will cause a Ui value to be close to 0 VDC and thus detect the short circuit. Due to the serial resistor Rb (820 ohm) between CH_n_H and CH_n_L the current is limited and the corresponding HSD will not be affected.

2.6.3 DI configuration rules

The following rules are mandatory and restricts the DI configuration possibilities:

- It is not possible to mix DI and DO channels within a group of eight channels (ch. 1–8, ch. 9–16, ch. 17–24 or ch. 25–32).
- In a redundant I/O system DIs can only be connected to RDIO420S configured as Dual (D) (see illustration). These modules cannot be used for DOs.



2.7 Digital output

Digital outputs can maximum provide 500 mA each for the field device. This means that the minimum load (field device) resistance must be 50 ohm.

Minimum current from an active (ON) digital output must be 3.5 mA to measure an OK loop by the monitor. This means that the load must be less than 7.2 kohm in single I/O mode to achieve this current.

In a redundant I/O system there will be 3.5 mA from each of the two outputs through the common load/field device. This means that the current through the load will be minimum 7 mA in 1oo2 redundancy mode. This means that the load must be less than 3.6 kohm in redundant I/O mode to achieve this current.

Digital outputs can be monitored for loop faults such as short circuit or open loop. A built in 2 mA Test current is then enabled.

The output stage can be tested using FOST (see this).

Digital outputs can be defined with fail-safe settings (see this)

Outputs are monitored by read back an internal analog voltage named Ui (see *Digital output interface diagram* on page 14.) using internal resistor network. A corresponding voltage, Uc, can be measured manually between the channel input terminal CH_n_L and channel 0V terminal CH_n0V. Values for Uc are used in the tables in the following descriptions.

Digital outputs are connected as shown in *Digital output interface diagram* on page 14 .

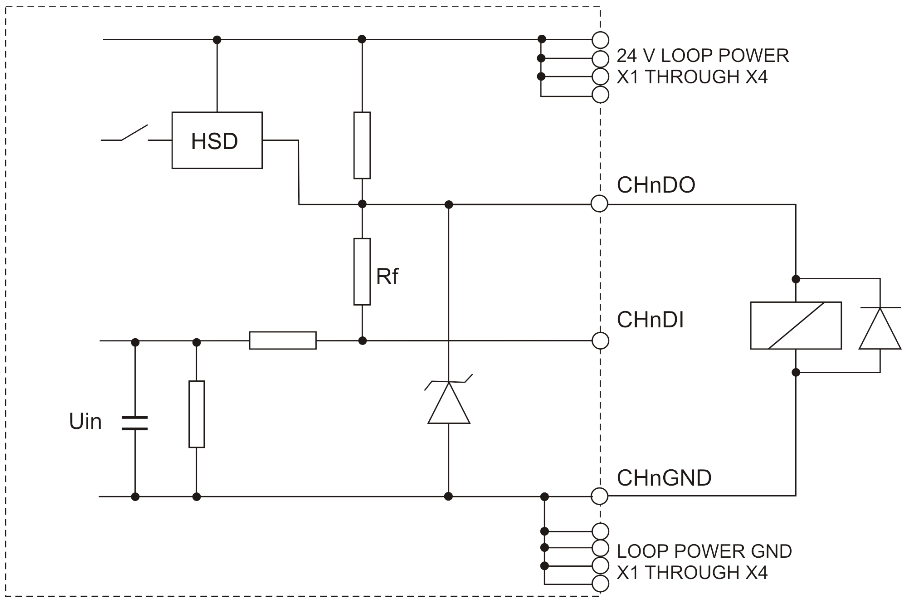
Note

There is no difference between how RDIO420S handles Single or Redundant DO configurations.

2.7.1 DO interface and monitoring

In the illustration below a simplified diagram of the digital output interface is shown with a relay as field device example.

Figure 6 Digital output interface diagram



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There are three monitoring modes for DOs.

- DO Monitor Mode 0

  This mode is used for monitoring the channel's HSD for over-current only. It should be used for a DO with no need for channel monitoring. PDU and Test current functions are not activated.

Table 4 DO Monitor Mode 0 voltage ranges and description

DO state	Voltage ranges at Uc	Description
DO = OFF (HSD = "0")	All values in the range 0 to 24 VDC	Always OK
DO = ON (HSD = "1")	Uc < 4.6 V	< 1 ohm to 0 V. Short circuit to 0 V.
	4.6 V < Uc	OK for "1"

- DO Monitor Mode 1

  This mode is used for monitoring DO loops with low impedance load from 50 ohm and higher. This mode monitors the loop for short circuit and open loop when the channel is OFF and for open circuit when the channel is ON. For loads between 50 ohm and 200 ohm this is the only monitoring mode that can be used. PDU and Test current functions are activated.

Table 5 DO Monitor Mode 1 voltage ranges and description

DO state	Voltage ranges at Uc	Description
DO = OFF (HSD = “0”)	Uc <= 18 mV	Not checked
	18 mV < Uc < 3.1 V	OK for “0”
	3.1 V < Uc < 6.8 V	HSD is not turned off
	6.8 V < Uc	Open loop detected (or connected to higher voltage)
DO = ON (HSD = “1”)	Uc < 4.6 V	< 1 ohm to 0 V. Short circuit 0 V.
	4.6 V < Uc < 6.8 V	OK for “1”
	6.8 V < Uc	Open loop detected (or connected to higher voltage)

- DO Monitor Mode 2

  This mode is used for monitoring DO loops with impedance load from 200 ohm and higher. This mode monitors short circuit and open loop both when channel is ON and OFF. PDU and Test current functions are activated.

Table 6 DO Monitor Mode 2 voltage ranges and description

DO state	Voltage ranges at Uc	Description
DO = OFF (HSD = “0”)	Uc <= 92 mV	Connection to 0 V
	92 mV < Uc < 3.1 V	OK for “0”
	3.1 V < Uc < 6.8 V	HSD is not turned off
	6.8 V < Uc	Open loop detected (or connected to higher voltage)
DO = ON (HSD = “1”)	Uc < 4.6 V	< 1 ohm to 0 V. Short circuit to 0 V.
	4.6 V < Uc < 6.8 V	OK for “1”
	6.8 V < Uc	Open loop detected (or connected to higher voltage)

2.7.1.1 How the output works

The output signal comprises both a **Logical signal** (ON/OFF) and a **Test current** (see this topic below) that is enabled when in Monitor Mode 1 or 2.

Note

The test current and its corresponding circuitry is used for the digital output only.

Logical signal generation

There are four PDUs (Power Down Unit) in an RDIO420S. Each PDU connects to a group of eight HSDs. The PDU is a safety switch and trips when the monitor detects an HSD that cannot be turned to OFF the normal way. Thus the monitor can turn off the whole group of eight channels including the defective HSD using the PDU.

The HSD is used for switching the digital output signal ON (High) and OFF (Low).

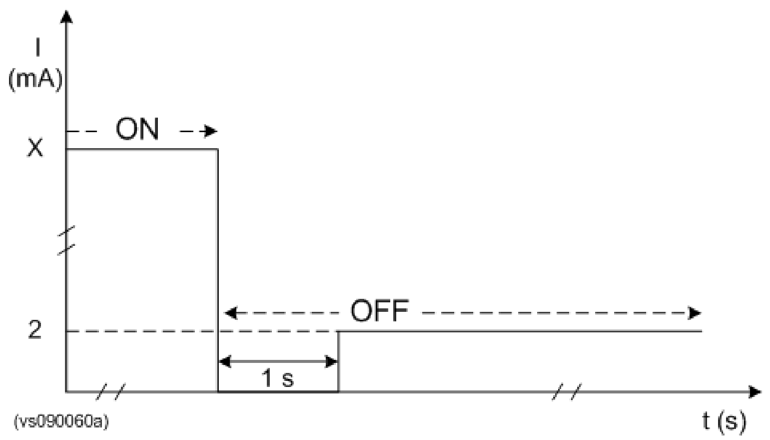
The diode D1 is used for preventing reverse current through HSD when connecting two outputs in parallel (redundant operation) and when monitoring the loop using the Test current (see this) while the logical signal is Low/OFF.

Test current

The test current is used to identify short circuit and open loops, and to verify the HSD function. The Test current is enabled by the MonSw (Monitor Switch).

When an output group is in Monitor Mode 1 or 2 and the output signal goes from ON to OFF, the 2 mA Test current is turned OFF for 1 second for the whole group to allow the field device having no electric power supplied for this period of time to ensure the load will enter its OFF state (see illustration). In the same period loop monitoring alarms are inhibited.

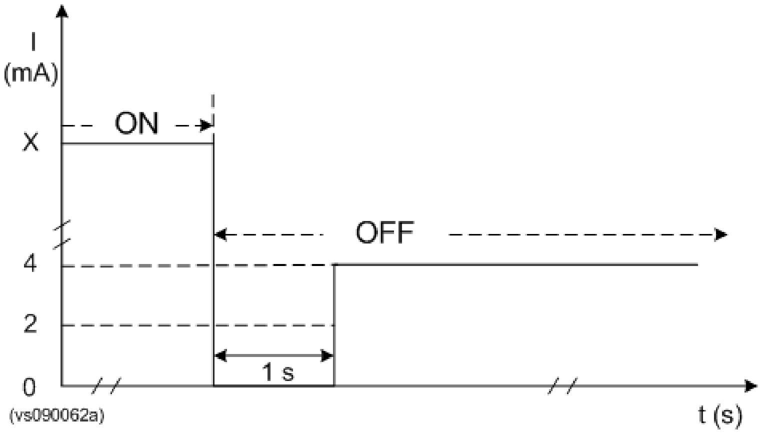
Figure 7 Single module DO signal – ON to OFF transition



Note

For redundant I/O systems with Test current enabled and the DO signal is OFF, the load (field device) will have an impressed current of 4 mA (2mA from each output). This larger test current through the load at OFF may trigger the load to turn ON (see illustration). Therefore only instruments that satisfy this requirement should be selected.

Figure 8 Redundant module DO signal



2.7.2 Fail-safe output

If the RDIO420S loses communication with the RCU and the fail-safe function is enabled, the digital outputs enter their predefined fail-safe values after a delay given by a local watchdog.

If the fail-safe function is enabled, this allows each channel to be individually programmed to either de-energized or energized.

If the fail-safe function is not enabled, the last received digital value from the controller is kept on the output.

All setting of the fail-safe function is available from the system configuration tool.

2.7.3 Final Output Stage Test (FOST)

The purpose of the Final Output Stage Test is to verify the RDIO420S's ability to control the output stage of a channel.

The FOST is executed on all channels that have this function enabled regardless if the channel is NE or NDE. Both PDU and HSD are tested by switching the element on or off for a very short time and reading its feedback for confirmation of functionality.

In a one-out-of-two (1oo2) redundancy I/O system one half of the systems is passivated before the other half is tested, and vice versa for the opposite side.

Note

*FOST is executed **only** for channels configured to be FOSTed.*

*FOST **will not** be executed on channels which are set logical active ("1" from a software function module output).*

*FOST **will not** be executed on a channel reporting ERROR.*

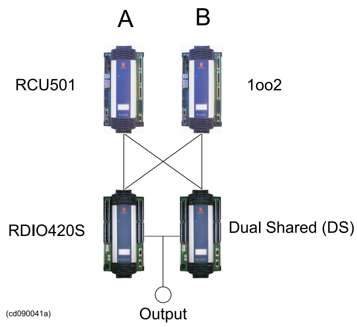
*FOST **does not** turn off any function or components. It only executes tests and provides alarms.*

FOST is independent of the monitor function.

2.7.4 DO configuration rules

The following rules are mandatory and should restrict the DO configuration possibilities:

- DI and DO channels cannot be mixed in the same group of 8 channels (ch. 1–8, ch. 9–16, ch. 17–24 or ch. 25–32).
- Only DOs can be allocated to a 1oo2 redundant system with Dual Shared (DS) I/O (see illustration).



- It is **not** possible to allocated different DO types within a group of 8 channels (DO Normal, DO NE, DO NDE)

The following rules are given as advice:

- Do **not** mix DOs having Monitor Mode 0 with those having Monitor Mode 1 or Monitor Mode 2.
- Do **not** accept DO field devices containing electronics such as flash lights (e.g. beacons using Xenon lamps), multi-voltage relays, 3rd party inputs or devices consuming less than 7 mA in redundant systems (3.5 mA in single systems) (e.g. LEDs). Such field devices cannot have loop monitoring enabled as it is in Monitor Mode 1 or Monitor Mode 2.

2.8 Module grounding

Module ground is wired to system ground (IE or PE).

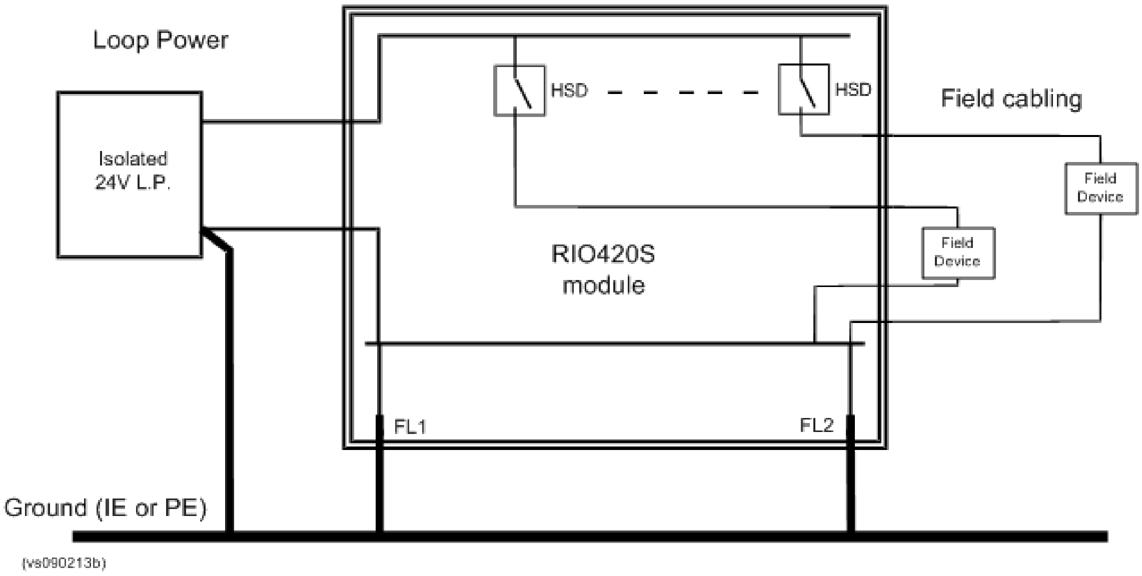
In a TN-S-DC system the module can be grounded to IE or PE using the fast-on terminals FL1 and FL2 according to IEC 60364.

Earth fault detection can be done by using external devices.

Note

This is the recommended ground alternative due to high noise immunity, over-voltage protection as well as EMC (ESD; RFI etc.).

Figure 9 Module grounding in a TN-S-DC system according to IEC 60364



2.9 Self diagnostics

Extensive self-diagnostics are built into the RDIO420S module to detect faults related to it.

2.9.1 Module identification code

Every module has been programmed with a unique identification code (ID-code). This ID-code also identifies the type of module installed, so that the system can supervise that correct type of module is installed at the correct address.

2.9.2 Monitoring using watchdog

A watchdog (WD), controlled from the RCU, drives a bi-colour LED visible on the front of the module.

Green light indicates that the RCU is sending module alive messages to the module, which means the RCU can see no error with this module.

Red light indicates that the module is not running in the system. The reason can be that:

- the RCU has stopped
- the watchdog of the RIO module has timed out
- the RCU has discovered a self diagnostic error in the RIO module and sends "module error message" to the module.

2.9.3 Module status shown on front LED

When a new module is powered, its front LED is red until the RCU starts sending "module alive message" to the module. In a system with no errors all RIO modules should have a green LED indicating OK.

2.9.4 Supply voltage monitoring

The supply voltage (+24 VDC) is monitored by the controller software. If the loop voltage is decreased below a certain limit, this incident is alarmed.

2.9.5 Module temperature monitoring

A temperature sensor located inside the RIO module is monitored by the controller software. If the temperature rises above a certain limit, this incident is alarmed.

3 Technical specification

Table 7 Technical specifications

Power supply requirements	
Power supply voltage	24 VDC (19 VDC to 29 VDC)
Heat Dissipation	Maximum 12 W
Power consumption 32 DI	Maximum 0.25 A
Power consumption 32 DO	Maximum 16 A
Power consumption per group of eight DO channels	Maximum 4 A
Input/output	
Number of I/O channels	32
Channel groups	4, each group with 8 channels
I/O configuration	Individually set to DI or DO
Connector types X1 to X4	Screw terminals handling 2.5 mm^2wires
Over-voltage without damage	Maximum 30 VDC
Digital input	
Loop voltage	24 VDC (19 VDC to 29 VDC, same as for power supply voltage)
Input loop current	4 mA maximum at 24 VDC loop power
Channel "OFF" current	< 0.5 mA (application dependent)
Channel "ON" current	> 3 mA (application dependent)
Maximum input voltage	Loop power
Sampling rate	Maximum 100 samples/sec.
Digital output	
Loop power	24 VDC (19 VDC to 29 VDC, same as for power supply)
Driver	Short circuit proof High Side Driver (HSD) Maximum continuous load: 500 mA Minimum continuous load: 3.5 mA
Driver leakage	< 0.1 mA (HSD)
Loop monitor current	Maximum 2 mA
RBUS	

Table 7 Technical specifications (cont'd.)

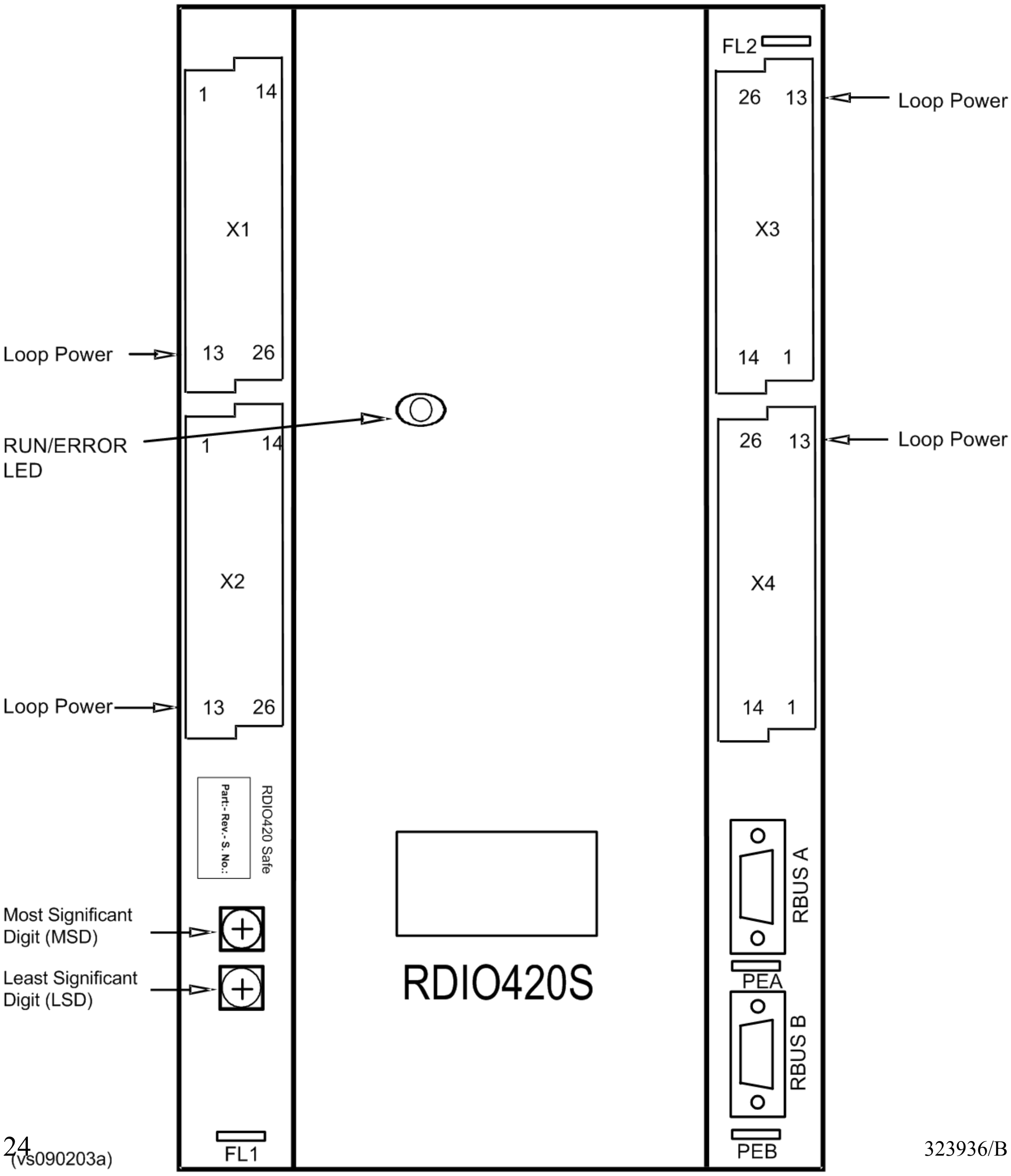
Number of addresses	99
Number of channels	2
Power supply	24 VDC ±20 % (maximum 50 mA)
Connector	9 Pin DSUB female
Bit rate	2 Mbit/sec
Signal code	Manchester encoded (self-clocked)
Copper wire topology:	
Insulation	500 V maximum (octocoupler)
Physical layer	RS-485 multidrop
Cable attenuation	< 6.5 dB/100 m at 10 MHz (CAT 5)
Cable length	Maximum 200 m between repeaters. Maximum 3 repeaters.
Fibre optics topology (w/additional fibre media converter):	
Fibre cable	62.5/125 µm, multi-mode
Connector	ST
Maximum cable length	1000 m (point to point), 500 m if fitted in patch panel topology
HW fail safe	
Watch-dog response	Maximum 65 ms
Internal test error (DSP)	Instantly set
SW fail safe (down counter)	
Programmed down-counter, time range	100 ms - 65 s (default 6 s)
Mechanical specifications	
Module size (W x H x D)	158 x 355 x 87 mm
Weight	1.35 kg
Mounting	Screw locks on DIN-rail T35-15/7.5
Compatibility	
EMC directive	CE mark compliant. Conform to 2004/108/EC
Atex directive	94/9/EC
EN directive 60079 for Electrical apparatus for explosive gas atmospheres	Ex nA II T4
Ex-protection specifications	II 3G EEx nA II T4 Ta: 55°C
Safety directive	SIL 3 approved according to IEC 61508
Ex/safety data	
Certificate for installation in Zone 2	07ATEX3090X
Ex-protection specifications	II 3G EEx nA II T4 Ta: 55°C
Environmental requirements	
Operating temperature	0°C – +70°C
Storage temperature	-25°C – +70°C

Table 7 Technical specifications (cont'd.)

IP class	IP 20
Life cycle prediction	
MTBF calculated according to MIL-HDBK-217E with component values also taken from the chip supplier database (T = 35°C, env. = NS)	57,550 hours

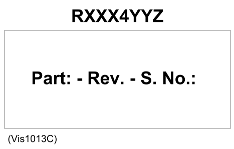
4 Module pin and connector description

Figure 10 Module layout



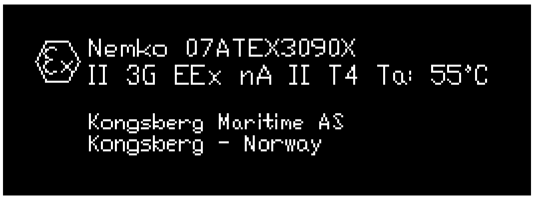
4.1 Module identification (when contacting KM)

For any written communication with KM regarding this module please refer to the module name (RDIO420S) and the information in the rectangle (Assembly-Revision-Serial No.).



4.2 Ex label

The Ex label contains two lines of information:



- Nemko 07ATEX3090X is the type approval certificate number.
- II 3G EEx nA II T4 Ta: 55ºC are the Ex requirements satisfied by the module.

4.3 X1, X2, X3, X4 terminal allocation

The module is provided with four different terminal groups, X1 to X4. Each terminal group, Xn, consists of two terminal blocks. Each terminal block is provided with 13 screw terminals. The first terminal block in a group contains the terminal numbers 1 through 13 and the second contains the terminal numbers 14 through 26.

For terminal block terminal layout see Figure 10 on page 24.

Table 8 X1, X2, X3, X4 terminal allocation

Terminal no.	**X1**	**X2**	**X3**	**X4**
1	CH_1_H	CH_9_H	CH_17_H	CH_25_H
2	CH_1_0V	CH_9_0V	CH_17_0V	CH_25_0V
3	CH_1_L	CH_9_L	CH_17_L	CH_25_L
4	CH_2_H	CH_10_H	CH_18_H	CH_26_H
5	CH_2_0V	CH_10_0V	CH_18_0V	CH_26_0V
6	CH_2_L	CH_10_L	CH_18_L	CH_26_L
7	CH_3_H	CH_11_H	CH_19_H	CH_27_H

Table 8 X1, X2, X3, X4 terminal allocation (cont'd.)

Terminal no.	X1	X2	X3	X4
8	CH_3_0V	CH_11_0V	CH_19_0V	CH_27_0V
9	CH_3_L	CH_11_L	CH_19_L	CH_27_L
10	CH_4_H	CH_12_H	CH_20_H	CH_28_H
11	CH_4_0V	CH_12_0V	CH_20_0V	CH_28_0V
12	CH_4_L	CH_12_L	CH_20_L	CH_28_L
13	0 V	0 V	0 V	0 V
14	CH_5_H	CH_13_H	CH_21_H	CH_29_H
15	CH_5_0V	CH_13_0V	CH_21_0V	CH_29_0V
16	CH_5_L	CH_13_L	CH_21_L	CH_29_L
17	CH_6_H	CH_14_H	CH_22_H	CH_30_H
18	CH_6_0V	CH_14_0V	CH_22_0V	CH_30_0V
19	CH_6_L	CH_14_L	CH_22_L	CH_30_L
20	CH_7_H	CH_15_H	CH_23_H	CH_31_H
21	CH_7_0V	CH_15_0V	CH_23_0V	CH_31_0V
22	CH_7_L	CH_15_L	CH_23_L	CH_31_L
23	CH_8_H	CH_16_H	CH_24_H	CH_32_H
24	CH_8_0V	CH_16_0V	CH_24_0V	CH_32_0V
25	CH_8_L	CH_16_L	CH_24_L	CH_32_L
26	24 V	24 V	24 V	24 V

Table 9 X1, X2, X3, X4 signal description

Name	Function
CH_n_L	Channel #n low – digital input and loop return terminal.
CH_n_H	Channel #n high – High Side Driver for output and input loops.
CH_n_0V	Channel #n 0V – signal ground reference for channel #n.
0 V	Module power 0 V – power voltage reference.
24 V	Module power 24 VDC – loop power.

4.4 RBUS A (P1), RBUS B (P2) pin allocation

RBUS A and RBUS B are 9-pin male D-sub connectors.

Figure 11 RBUS A and RBUS B pin layout

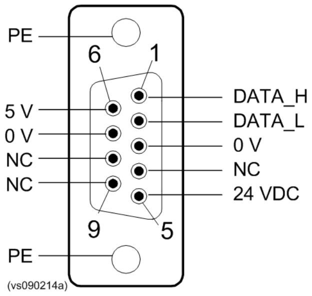


Table 10 RBUS A and RBUS B pin allocation

Pin no.	RBUS A	RBUS B	Function
1	A_DATA_H	B_DATA_H	RS485 serial line High
2	A_DATA_L	B_DATA_L	RS485 serial line Low
3	A_0V	B_0V	0 V ground reference for isolated RS485 transmitter/receiver
4			Not used (NC = Not Connected)
5	A_24V	B_24V	+24 VDC for isolated RS485 transmitter/receiver
6	A_5V	B_5V	Isolated +5V for the RBUS line. Termination use only.
7	A_0V	B_0V	0V ground reference for isolated RS485 transmitter/receiver
8			
9			

4.5 FL1 and FL2

Two fast-on terminals FL1 and FL2 are connected to 0 V for the RIO module.

4.6 PEA and PEB

PEA and PEB are two fast-on terminals internally wired to the RBUS connector bolt nuts of P1 and P2 (9-pin D-sub) respectively. The fast-ons are normally connected to IE or to system ground (PE).

5 Module installation

Note

The module is mounted vertically on a DIN rail. The module's top and bottom can be mounted with no spacing to any cabinet top, bottom, DIN-rail modules etc.

5.1 Ex Zone 2 installation requirements

The choice of enclosure, placement of modules, components and free volume inside enclosure will affect the temperature.

When the module is used in Ex Zone 2, the following requirements must be met:

- The RIO module shall be mounted in an enclosure which complies with the requirement of clause 26.3 of EN 60079-15 and fulfil IP 54, or alternatively is mounted in an EEx e-enclosure.
- Maximum surface temperature shall not exceed temperature class T4 corrected for the maximum ambient temperature at service (Ta: 55°C) within the safety margin of 5°K.
- Maximum ambient temperature inside enclosure shall not exceed 75°C.

5.2 Installation procedure

1 Label the module.

2 Set correct address to the module by rotating the two decimal switches to correct values (see Module Address).

3 Fix the module to the rail by fasten the screw on top and bottom.

4 Connect the fast-on connectors FL1, FL2, PEA and PEB as appropriate.

5 Connect all field wires and power wires to the appropriate screw terminals on X1 through X4.

6 Connect the RBUS cables to the RBUS A and RBUS B connectors and fasten the connectors by using the end-bolts.

7 Turn on power supply to the module.

8 Verify from the operator station that the module is working OK.

6 Module replacement

1 Turn off the power circuit that supplies the RIO module to be replaced.

2 Disconnect field wiring and power wiring by unscrewing the end-bolts and pulling off the snap-on terminal block for X1 through X4.

3 Disconnect the RBUS A and RBUS B connectors by loosen the bolts and unplug.

4 Disconnect the fast-on connectors FL1, FL2, PEA and PEB as appropriate.

5 Loosen the top and bottom screws that fasten the module to be replaced and remove it.

6 Unscrew the end-bolts and pull off the snap-on terminal blocks X1 through X4 of the new RIO module.

7 Label the new module.

8 Set correct address to the module by rotating the two decimal switches to the same values as for the replaced one (see Module Address).

9 Fix the module to the rail by fasten the screw on top and bottom.

10 Reconnect the fast-on connectors FL1, FL2, PEA and PEB as appropriate.

11 Reconnect all field wires and power wires to the appropriate connector X1 through X4 by snapping on the connector headers and fasten the end bolts.

12 Plug the RBUS cable plugs to the RBUS A and RBUS B connectors and fasten the them by using the end-bolts.

13 Turn on the power circuit to the module.

14 Verify from the operator station that the module is working OK.