

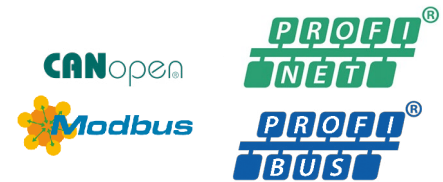
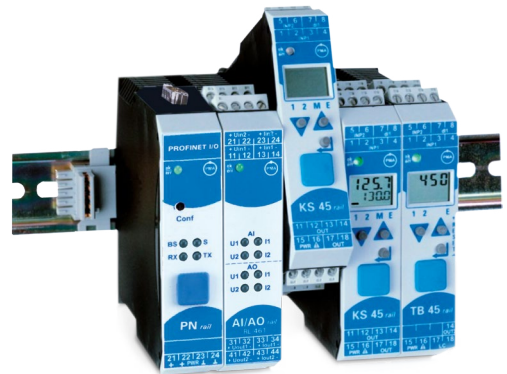
PMA Rail-line System

Field bus couplers and I/O expansion modules

Overview

The Rail Line system is designed to offer high accuracy data acquisition and independent control, monitoring and supervision in decentralised automation installations. It provides connectivity to the important field bus systems and that way perfectly complements PLC systems.

RL400 offers a variety of sophisticated I/O modules with high precision analogue inputs, output modules with fast on board signal processing, reinforced galvanic isolation, linearisation and measured value correction. Furthermore the independent control- transmitter- and limiter-modules (KS45, CI45, SG45 and TB45) can be part of the system to provide a safe autonomous management of local tasks.



Key Features

- Broad range of available sensor and standard signal in-/outputs
- Support of common field bus interfaces
- Cost-effective module range
- Well defined galvanic isolation concept
- Modules with configurable multifunctions
- Fast and easy module exchange (Hotswap)
- Configuration via BlueControl
- Superb signal resolution
- High accuracy
- 2-point measured value correction
- Small housing size
- Flexible and easy to extend

Description

System Design

Rail-line consists of a bus coupler for „top hat“ rail mounting and the possibility to connect up to 62 I/O-modules.

The I/O modules are interconnected by means of quick-connect plugs. One power supply module must be installed per 16 I/O modules.

Power supply

The system supply of 24 VDC is connected to the bus coupler module. Apart from bus communication, the quick-connect facility also distributes the supply voltages to the I/O modules.

Internal communication

An internal bus connects the I/O modules with the bus coupler module, where the statuses/values of the connected I/Os are continuously updated and stored. The stored data also contains information about the type and diagnostic results of the relevant I/O module. The scanning

cycle depends on the type and number of inserted modules and the bus load.

Galvanic isolation

In the bus coupler module, the bus system and the internal communication circuits are galvanically isolated from each other and from the 24 VDC system supply. Furthermore, the I/O modules provide galvanic isolation for the internal system bus and for the I/O circuits. Depending on the module, analog inputs/outputs are either galvanically connected or isolated up to 300 V working voltage. Galvanic isolation between modules is always provided. The eight digital outputs of the DO-modules are combined into groups with four outputs each. The groups are galvanically isolated from each other and from the remaining electronics. The eight digital inputs of the DI-modules are grouped together to four inputs each which are galvanically isolated from each other.

Sensor energization

Transmitter supply

The analog input module RL422-0 provides 10V/24V DC for energizing external two-wire transmitters.

Digital inputs

The RL 442 -1 / 442-0 provides 24V DC for operating proximity switches as well as NPN or PNP transistors.

Input circuit monitoring

Analog input signals are monitored for short circuit, open circuit, or polarity. A triggered monitoring circuit is signaled as a status change. Hereby, the status value for the fault signal can be defined in the configuration.

Electrical connections

The signal leads are connected to plug-in terminals levels at top and bottom of the module. Screw terminals or spring-clamp connectors are available, and a connecting diagram is printed on the module front.

Configuration

Available as an accessory, the BlueControl® Engineering Tool not only contains a complete description, but also the EDS or GSD file (max. version with standard mapping of the variables) required for linking into field bus systems.

Fig.1 : RL400 with different applications

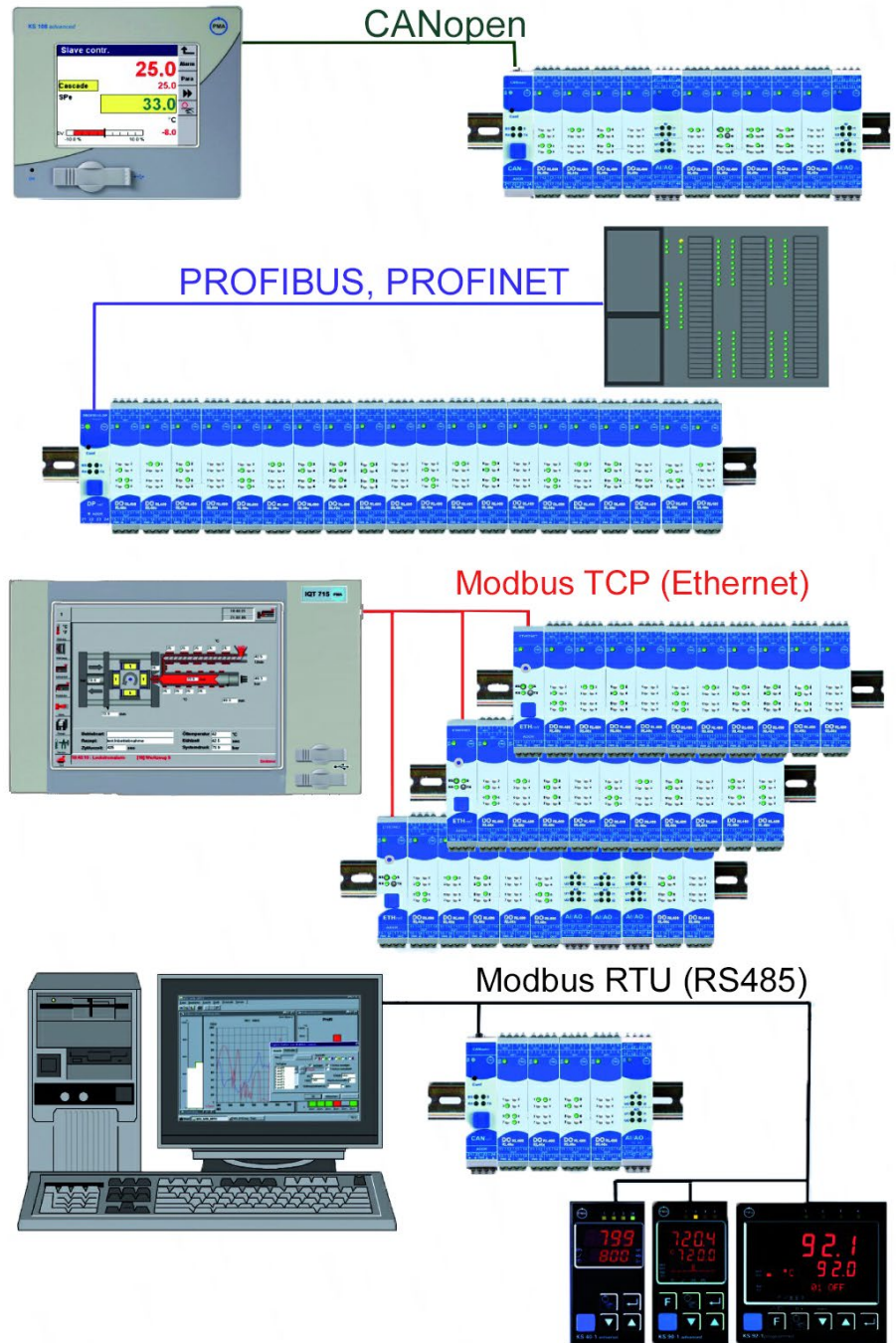
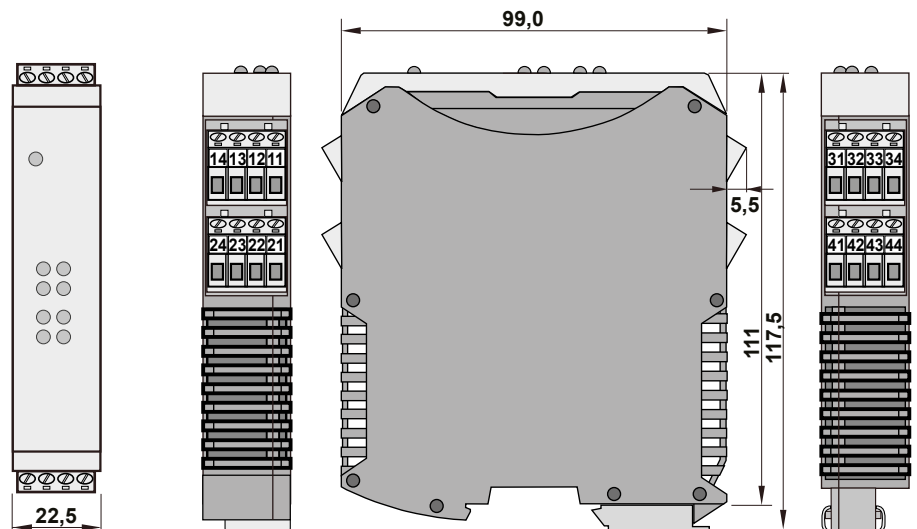


Fig. 2: Dimensions (Example RL 461)



TECHNICAL DATA

SYSTEM

Basic module

Internal scanning cycle of the I/O modules: t_s = 10ms (depending on the type and number of connected inserted I/O modules and the bus load).

Restrictions:

Max. 62 modules can be used per coupler module.
One power supply module must be installed per 16 I/O modules.

BUS COUPLER MODULES

Bus coupler module CANopen

Full CAN controller according to CAN specification V2.0A; physical coupling according to ISO 11898.

Cycle time on the CANbus:

Depends on the selected transmission speed, and on the number and type of inserted I/O modules (PDOs).

Transmission speed:

10 / 20 / 50 / 100 / 125 / 500 kBd; adjustable with DIP switches or via automatic selection.

Bus cable length

Depending on baudrate (10kBd...500kBd):

≤1000/1000/1000/500/250/100/50/25 m

Address configuration:

Addresses 1...99, adjustable with DIP switches; ≤42 using the default mapping
With engineering-tool 1...126

Terminating resistor:

External

CAN protocol:

CANopen Slave, supports DS301 V4.02 (communication profile)

Process data objects (PDOs):

1 Multiplex PDO send, 1 Multiplex PDO receive
Receive: ≤5

Transmit: ≤10, of which max. 5 can be requested per RTR (Remote Transmit Request)

EDS file:

Maximum version; component part of the Engineering Set ES/RL 400; not necessary in conjunction with KS98.

Galvanic isolation:

Supply voltage, CANbus and logic circuits are galvanically isolated from each other.

Indicator LEDs:

Function: State;

1 x State

1x State of the fieldbus 1 x internal bus

2x yellow (Transmit, Receive)

Bus coupler RL400DP

PROFIBUS-DP to EN 50 170

Cycle time on the PROFIBUS: Depends on the selected transmission speed and number of I/O modules.

Fig.3: Rail-line system with I/O-modules



Transmission speed

9600 bit/s up to 12 Mbit/s via automatic selection

Bus cable length:

≤1000 ... 100m, depending on baudrate

Address configuration:

Address 1...99, adjustable with DIP switches.

With engineering-tool 1...126

Terminating resistor: external

GSD file:

Component part of the Engineering Set ES/RL 400

Galvanic isolation:

Supply voltage, PROFIBUS and logic circuits are galvanically isolated from each other.

Indicator LEDs:

Function: State;

1x green (system state);

1x yellow (bus state);

1x yellow (internal bus);

2x yellow (Transmit/Receive)

Bus cable length:

RS 232: ≤3 m

RS 485: ≤1200 m

Bus coupler Ethernet

Ethernet interface with MODBUS protocol.

MODBUS/TCP server via TCP port 502

Network connector:

RJ45 10BaseT (socket) according to IEEE 802.3

Bus cable length:

Ethernet segment length: 100m with Cat5 - wire

Address configuration:

Adjusted via bootp or engineering-tool

Galvanic isolation:

Supply voltage, network and logic circuits are galvanically isolated from each other.

Indicator LEDs:

1x green (system state);

1x yellow (bus state);

1x yellow (internal bus);

2x yellow (Transmit/Receive)

Bus coupler Modbus

Protocol:

MODBUS RTU

Serial interface:

RS 422/485

Transmission speed: 2.400 / 4.800 / 9.600 / 19.200

Baud, adjustable with DIP switch;

Via parameter in addition selectable:

38.400 / 57.600 / 115.200 Baud

Byte format:

Data bits: 8

Stop bits: 1

Parity: even or none (with DIP switch adjustable)

Bus cable length:

≤1200 m

Address configuration:

With DIP switch adjustable: 1...127 Via parameter selectable: 1 ... 247

MODBUS timeout:

0...600s (adjustable)

Internal bus cycle (HPR):

0,5...10ms (adjustable)

Boot time: 0...25s (adjustable)

Galvanic isolation:

Supply voltage, MODBUS and logic circuits are galvanically isolated from each other.

Indicator LEDs

Function, status:

1x Green: Power;

2x Yellow: Tx, Rx activ (Transmit, Receive)

1 x Yellow: internal system bus (HPR) activ

1x Yellow: MODBUS interface OK

Bus coupler PROFINET

Profinet-IO interface with Ethernet switch

Network connector:

2x RJ45 100BaseT (socket) according to IEEE 802.3

Bus cable length:

Ethernet segment length: 100m with Cat5 - wire

Address configuration:

via Profinet master

Galvanic isolation:

Supply voltage, network and logic circuits are galvanically isolated from each other.

Indicator LEDs:

1x green (system state);

1x yellow (bus state);

1x yellow (internal bus);

2x yellow (Transmit/Receive)

ANALOG INPUT MODULES

General

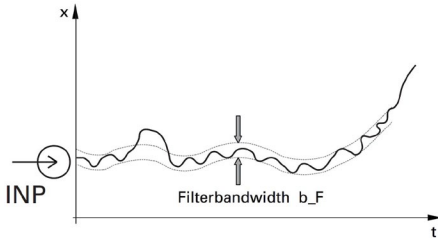
Measurement cycle:

≤160 ms for all channels of a module
 RL 422-1: ≤ 80 ms

Digital filter:

Every input is fitted with a 1st-order filter that is adjustable for time constant or bandwidth.

Fig.4: Filterfunction



A/D converter:

Successive approximation, 16 bits. Sigma-delta modulation.

Input span monitoring:

Error message in case the upper limit is exceeded by more than >160 digits (resolution 16 bit)
 Temperature drift: ≤0,08%/10K

Analog inputs/outputs

RL 422-0 to RL 461-0

Indicator LEDs:

Status per channel

Galvanic isolation

RL 422-0: Inputs only separated from logic circuit; not from internal supply. Inputs are connected galvanically.

RL 461-0: Inputs are separated from logic circuit and from internal supply. Inputs are galvanically connected.

Measuring range: selectable per channel

RL 422-0: Single-ended inputs
 4 x -20...20 mA / -10...10V / -5... 5V / -1...1V

RL 461-0: Difference inputs
 2 x -20...20 mA and/or
 2 x -10...10 V
 -5... 5V / -1...1V

Resolution: 16 bits

Temperature influence: ≤ 0,1 %/10K

Characteristic: linear

Deviation: ≤0,15%

Input resistance:

Current: approx. 47Ω Voltage: >730 kΩ(with ground reference)

Sensor monitoring:

Exceeded limit: "out of range" >22mA

Interface:

-Integer 16 (fixpoint)

-Float

Fig. 5: Blockdiagram RL 422

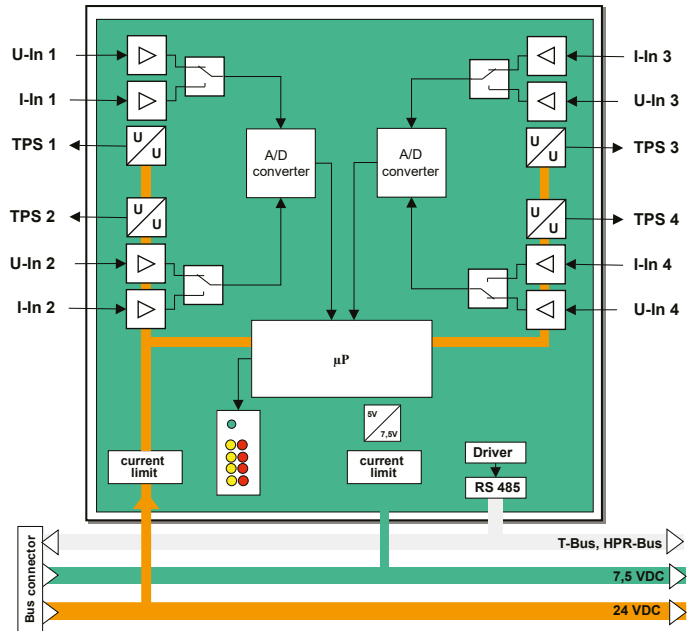


Table 1:

RL 422-0 /1			
Type of input	Single-ended		
Cycle time	160 ms		
Measuring range	Input resistance	Error	Resolution
-10...+10 V	>1MΩ	= 0,1%	0,4 mV
-5...+5V	>1MΩ	= 0,1%	0,2 mV
-1...+1V	>1MΩ	= 0,1%	0,05 mV
-20...+20 mA	45 Ω	= 0,1%	0,8 μA

Fig. 6: Blockdiagram 461

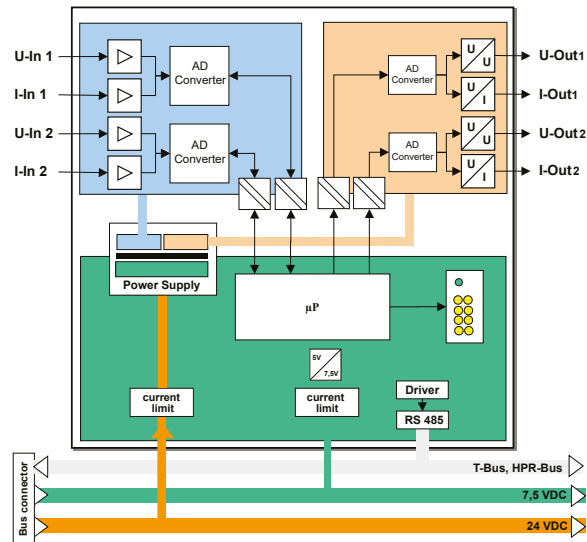


Table 2:

RL 461			
Type of input	Difference		
Cycle time	80 ms		
Measuring range	Input resistance	Error	Resolution
-10...+10 V	> 1,2 MΩ	= 0,1%	0,4 mV
-5...+5 V	> 1,2 MΩ	= 0,1%	0,2 mV
-1...+1 V	> 1,2 MΩ	= 0,1%	0,05 mV
-20...+20 mA	50 Ω	= 0,1%	0,8 μA

Two-wire transmitter supply(TPS) only RL 422-0

One supply voltage "+24V OUT" for energizing a two-wire transmitter.

Voltage: $U_s = 10/24 \text{ VDC} \pm 10\%$ (short-circuit proof)

Max. load: 20 mA at 10 V,
25 mA at 24 V

Potentiometer measurement:

(voltage-divider circuit)

Channels intended for voltage input can be configured in pairs for potentiometer measurement.

U_{const} : $U_s = 10 \text{ VDC}$ (output instead of +24V OUT); short-circuit proof Current limiting: 20mA

Temperature input Pt100 /PT1000

/Ni100/ Ni 1000 / KTY

RL 423-0 /-1 /-2 /-3

Sensor current: < 0.5 mA

Sensors: *selectable per channel for RL 423-0/RL 423-2/RL 423-3*

- Pt100/Ni 100
RL423-0/-1/-2: 2- and 3-wire configuration (selectable) RL423-3: 4-wire configuration
Measuring range:
Pt 100: -200...850°C
Ni100: -60...300°C

RL 423-1/RL 423-2

Pt 1000 / Ni 1000 / KTY 11-6

Characteristic: temperature-linear

Conformity error: negligible

Sensor monitoring:

Break and short circuit. Permissible voltage difference between inputs: = 4 VAC rms

Error

see table for RL 423

Resolution: 16 Bit

2-point measured value adaptation or zero offset (selectable)

Temperature influence: $\leq 0,05 \text{ \%}/10\text{K}$

Interface:

Data format:

-integer 16 (fixpoint)

-float

Galvanic isolation:

RL423-0/-1/-2: Inputs against logic and power supply; inputs are interconnected.

RL423-3: inputs among each other, against logic and power supply, up to 300 VAC operating voltage.

Fig. 7: Blockdiagram RL423-0/-1 /-2

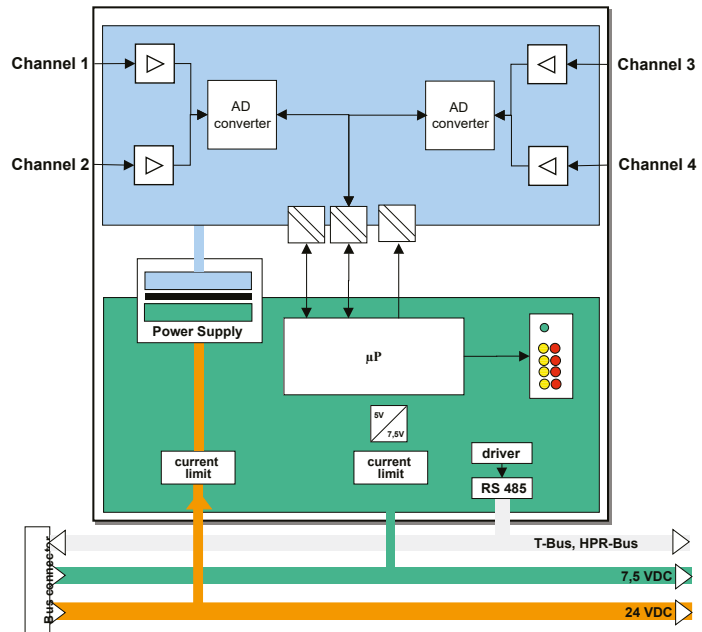


Table 3:

RL 423-x			
Type of input	3-wire (RL423-3: 4-wire)		
Cycle time	160 ms (RL423-3: 80ms)		
Type	Measuring range	Error	Resolution
Pt100/1000	-200...850°C	= 1K	0,04 K
Ni100/1000	-60...300°C	= 1K	0,04 K
KTY	-50...125°C	= 1K	0,04 K

Thermocouple input TC (RL 424-0/-1/-2)

Sensors: selectable per channel

- Thermocouples: to DIN IEC 584 Types see table RL 424

Characteristic: temperature-linear

Conformity error: negligible

Resolution: 16 bits

TC type E, J, K, L, T, N: $\leq 0,01$ K/digit TC type S, R,

B: $\leq 0,01$ K/digit

TC type W: $\leq 0,01$ K/digit

Error

see table for RL 424

2-point measured value adaptation or zero offset (selectable)

Sensor monitoring:

For break and shortcut

Permissible voltage difference between inputs: ≤ 380 VAC / 50Hz, 500 VDC

Interface:

Data format:

-integer 16 (fixpoint)

-float

Galvanic isolation:

Inputs separated from logic circuit and supply.

RL 424-0 Isolation between channels (300 VAC operating voltage)

RL 424-1 and RL 424-1 Isolation in groups of 2 channels

Millivolt-/O2 (RL 424-1)/thermocouple input

Number of channels: 4; galvanic isolated

2 Kanäle mV/O2

2 Kanäle TC

Channel 1: Millivolt input

Measuring range: $1 \times \pm 2000$ mV, ± 1000 mV, ± 500 mV, ± 250 mV.

Input resistance: approx: 200MQ diff.

Connection with screened sensor leads.

Resolution: 16 bits

Characteristic: linear Error:

With 100 k Ω sensor output resistance: linearity: $\leq 0.05\%$

temperature: $\leq 0.05\%$

with 1 M Ω ensor output resistance: linearity: $\leq 0.5\%$

temperature: $\leq 0.4\%$

Internal calculation

-O2 content at measured temperature

-O2 content with heated sensor and a constant

2-point measurement adaptation

Interface:

Data format:

-integer 16 (fixpoint)

-float

Fig. 8: Blockdiagram RL424-0 and 423-3

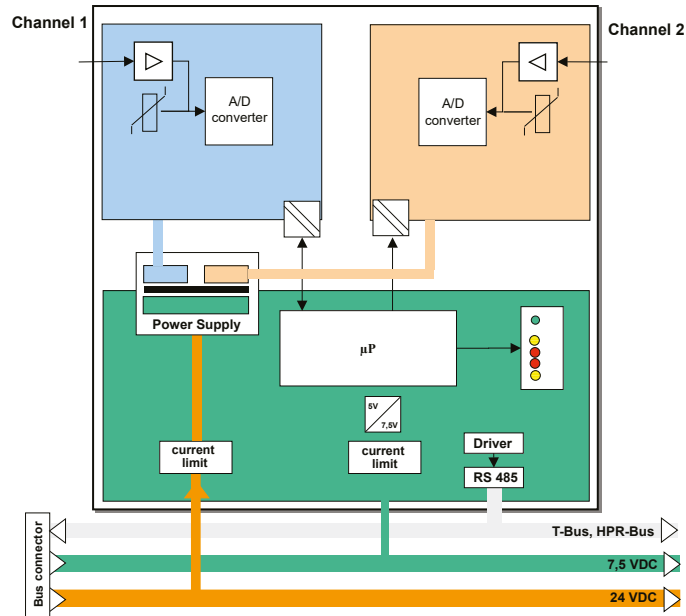


Fig. 8: Blockdiagram RL424-0 and 423-3

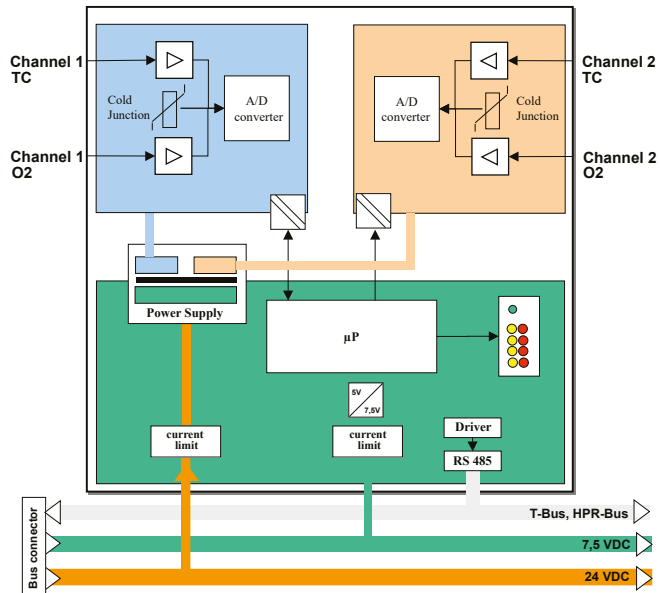


Table 4:

RL 424				
Type of input	difference			
Cycle time	160(240)** ms			
Measuring range	Input resistance	Measuring range	Error	Resolution
L	>1M Ω	-200...900°C	= 2K	0,05K
J	>1M Ω	-210...1200°C	= 2K	0,05K
K	>1M Ω	-270...1370°C	= 2K	0,08K
N	> 1M Ω	-196...1299°C	= 2K	0,08K
S	> 1M Ω	-50...1760°C	= 2K	0,07K
R	> 1M Ω	-50...1760°C	= 2K	0,07K
T	> 1M Ω	-270...400°C	= 2K	0,02K
E	> 1M Ω	-270...1000°C	= 2K	0,04K
B	> 1M Ω	25...1820°C	= 3K	0,1 K
W	> 1M Ω	0...2299°C	= 3K	0,1 K
80mV	> 1M Ω	-80...80mV	= 0,1%	3 μ V

ANALOG OUTPUT MODULES

Standard signals I,U (RL 461-0)

Number of channels: 4 (2AI, 2AO) For technical data of analog inputs, see "Analog Input Modules".
Signal ranges: selectable per channel All outputs are short-circuit proof.

Resolution: 12 bits

±20mA
-10...10V / -5...5V / -1...1V

Node guarding

Behaviour at communication failure: configurable
-Fail safe: output is set to 0V/0mA
-Hold: retain last value
-Vault value

Characteristic: linear

Overall error: ≤0,25% (0...10V);
≤0,6% (-10...10V); ≤0,63% (0...20mA) of measurement range.

Permissible load:

Current output: ≤ 500 Ω
Voltage output: 2: 1000 Ω
Load effect: 0,1%/100Ω
Temperature drift: ≤0,01%/10K

Interface:

Data format:
-Integer 16 (fixpoint)
-Float

Galvanic isolation:

Outputs are separated from logic circuit and from internal supply, but are galvanically connected.

Indicator LEDs:

Function: Display of the selected signal range (U or I) 4 x 2 x yellow

DIGITAL INPUT MODULES

RL 442-X, RL 443-0

24 VDC logic

Number of channels: 8

Input: Logic signals, contacts or 3-wire sensors (NPN or PNP transistors); according to module

Signal level: according to IEC 61131

„Low“: -3...5 VDC

„High“: 15...30 VDC

Messzyklus: ≤10 ms für alle Kanäle (Zykluszeit auf dem Systembus 10ms/Modul)

Operating sense: configurable

Input resistance: 6,8kΩ
Filter: analog, fg = 1 kHz
Surge voltage protection: fitted

Galvanic isolation:

Between inputs and logic circuits. Groups of 4 separated from each other, from logic circuits, and internal supply.

Indicator LEDs:

Function: signal status 8 x yellow

115V/230V AC-logic (RL 443-0)

Number of channels: 4

Signal level:

„Low“: 0...50 VAC

„High“: 90...250 VAC

Measurement cycle:

≤10 ms for all channels (cycle time on the system bus: 10 ms/module)

Operating sense: configurable

Input resistance: 240 kΩ
Filter: input delay ≤10 ms/ channel
Surge voltage protection: fitted

Galvanic isolation

Inputs from logic, between inputs

Indicator LEDs:

Function: signal status 4 x yellow

DIGITAL OUTPUT MODULES

RL 451-X, RL 452-0

Node guarding

Behaviour at communication failure configurable:
-Fail safe: outputs 0/1 (selectable)
-Hold: retain last value
-Fault value

24 VDC logic (RL 451-0)

Number of channels: 8 (2 groups of 4 channels); suitable for switching loads with 12 and 24 VDC.

Control voltage:

Uc = 2 x 24 VDC; separated according to groups.
Permissible range: 8...34 VDC
Forward resistance: ≤140 mΩ
(≤200 mΩ typical); voltage drop ≤1,2V

Leakage current:

Approx. 30 µA (non-conducting)

Load current:

Depends on ambient temperature:
At 25°C: ≤2A / output
At 50°C: ≤1,5A / output

Lead break and short circuit

Detected and made available as a status signal on the bus.

-Function can be switched off.

Protective circuits:

Fitted as standard against short circuit, and surge voltage; thermal current limiting. No reversed-polarity protection.

Free-wheel diode for inductive loads:

At RL 451-1 included
Cycle time: ≤10 ms for all channels (cycle time on the system bus: 10 ms/module)
Operating sense: configurable

Galvanic isolation

Logic from output group, groups among each other

Indicator LEDs:

8 x yellow (signal status)

Relays (RL 452-0)

Number of channels: 4 relays
Contacts: potential-free change-over
Contact rating:
AC: ≤ 1250 W, 250 V, 5A

RC suppressor circuit:

Must be provided externally
Cycle time: ≤10 ms for all channels (cycle time on the system bus: 10 ms/module)
Operating sense: configurable

Galvanic isolation:

Relays from logic circuits and internal supply

Indicator LEDs:

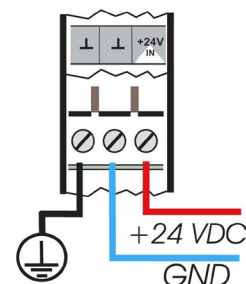
4 x yellow (signal status)

POWER SUPPLY

The basic module is energized via its bus coupler module.

Supply voltage: 24 V DC (20...30VDC) Current consumption: ≤1,5A Influence power supply: negligible

-The GND of the 24V power supply has to be connected to protective earth (PE).



ENVIRONMENTAL CONDITIONS

Permissible temperature:

Operation: -10...55 °C (32...122 °F)
Storage and transport: -20...70 °C (-4...158 °F)

Climatic category:

KUF according to DIN 40 040
Relative humidity: ≤75% yearly average, no condensation
Electrical safety:
DIN EN 61010-1
Contamination class 2, Overvoltage category II

Electromagnetic compatibility:

DIN EN 61000-6-3
DIN EN 61000-6-2

Shock and vibration:

To DIN 40046 IEC 60068-2-6

GENERAL

Electrical connection:

Screw terminals and spring-clamp connectors for leads with max. 2,5 mm² cross-section.
Mode of protection:
IP20

Housing:

Material: polyamide PA 6.6 Flammability class: V0 to UL 94

Mounting:

On 35 mm „top hat“ rails to DIN EN 50022
Mounting position: vertical Overall dimensions (W x H x D): RL 400 22,5 x 99,0 x 117,5 mm

Weight:

All modules: approx. 100 g (3,53 oz.)

Type	Short Name	Order Code
Fieldbus couplers		RL40 -1 x x-00000-x0 0
CAN	CANopen	1
DP	PROFIBUS DP V1	2
MOD	MODBUS RTU	3
ETH	Ethernet MODBUS/TCP	4
PN	PROFINET IO	5
Power module		
PWR	RL40-PWR Power module PWR	9
Analog inputs		RL40 -1x0-xxxx0-x00
AI	RL 422-0 Analog inputs, 4 x I / U / TPS / Poti	4220
AI	RL 422-1 Analog inputs 2 x I/U galv. isolated	4221
AI	RL 423-0 RTD 4 x Pt100 galvanic isolated	4230
AI	RL 423-1 RTD 4 x Pt1000 galvanic isolated	4231
AI	RL 423-2 RTD 4 x Pt100/Pt1000	4232
AI	RL 423-3 RTD 2 x Pt100 galvanic isolated	4233
AI	RL 424-0 2 x TC galvanic isolated	4240
AI	RL 424-1 2 x TC / O2 (mV)	4241
AI	RL 424-2 4 x TC galvanic isolation 2/2	4242
AIO	RL 461-0 Combi module, 2 x AI ($\pm U / \pm I$, 16 Bit) differential inputs; 2 x AO ($\pm U / \pm I$, 12 Bit)	4610
Analog outputs AO		RL40 -1x0-xxxx0-x00
AO	RL 431-0 4 x I / U ($\pm 10V / \pm 20mA$, 12 Bit)	4310
AIO	RL 461-0 Combi module, 2 x AI ($\pm U / \pm I$, 16 Bit) differential inputs; 2 x AO ($\pm U / \pm I$, 12 Bit)	4610
Digital outputs DO		RL40 -1x0-xxxx0-x00
DO	RL 451-0 Digital outputs 2 x 4 24 VDC/2A	4510
DO	RL 451-1 Digital outputs 2 x 4 24 VDC/2A (free wheeling diode)	4511
REL	RL 452-0 Relay outputs 4 x 230 VDC/5A	4520
Connectors		RL40 -1x0-xxxx0-x00
	Without terminal blocks	0
	Screw terminal	1
	Spring-clamp terminal	2
Approvals		RL40 -1x0-xxxx0-x00
	CE	0
	UL/cUL	U

ACCESSORIES

BlueControl®

RL Accessories

4 x Screw terminal blocks	9407-998-07101
4 x Spring-clamp terminal blocks	9407-998-07111
1 x Top-hat rail bus-connector	9407-998-07121
1 x Plug for busconnection left(for bus coupler)	9407-998-07131
1 x Plug for busconnection right (bus extension)	9407-998-07141

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