EAGLE Controller

Installation & Commissioning Instructions

CENTRA LINE by Honeywell

TABLE OF CONTENTS

Trademark Information

LON, LONWORKS, and Neuron are trademarks of Echelon Corporation registered in the United States and other countries.

CE

EN0Z-0970GE51 R1112

SAFETY INFORMATION

General Safety Information

- ► When performing any work, all instructions given by the manufacturer and in particular the safety instructions provided in these Installation and Commissioning Instructions are to be observed. Make sure that the local standards and regulations are observed at all times.
- ► The EAGLE System (including the EAGLE Controller, Panel Bus I/O modules, manual disconnect modules, and auxiliary terminal packages) may be installed and mounted only by authorized and trained personnel.
- ► It is recommended that devices be kept at room temperature for at least 24 hours before applying power. This is to allow any condensation resulting from low shipping / storage temperatures to evaporate.
- ► The EAGLE System must be installed in such a manner (e.g., in a lockable cabinet) as to ensure that uncertified persons have no access to the terminals.
- ► In the case of vertical mounting on DIN rails, the EAGLE controller should be secured in place using a commercially-available stopper.
- ► If the EAGLE System is modified in any way, except by the manufacturer, all warranties concerning operation and safety are invalidated.
- ► Rules regarding electrostatic discharge should be followed.
- ► Use only accessory equipment which comes from or has been approved by Honeywell.

Information as per EN 60730

Purpose

The EAGLE Controller is a multifunctional non-safety control device intended for HVAC in home (residential, commercial, and light-industrial) environments.

Construction

The EAGLE Controller is an independently mounted electronic control unit with fixed wiring.

Mounting Method

The EAGLE Controller is suitable for mounting as follows:

- ► in cabinets;
- ► in fuse boxes conforming with standard DIN43880, and having a slot height of max. 45 mm;
- ► in cabinet front doors (using accessory MVC-80-AC2);
- ► on walls (using accessory MVC-80-AC1).

Table 1. Information as per EN 60730

Shock protection	Class II
Pollution degree	2
Installation	Class 3
Rated impulse voltage	2500 Vac
Automatic action	Type 1.C (micro-interruption for the relay outputs)
Software class	Class A
Ball-pressure test temperature	housing parts >75 °C terminals >125 °C

WEEE Directive

WEEE: Waste Electrical and Electronic Equipment Directive	
	▪ At the end of the product life, dispose of the packaging and product in an appropriate recycling center. ▪ Do not dispose of the device with the usual domestic refuse. ▪ Do not burn the device.

Standards, Approvals, etc.

Device meets EN 60730-1 and EN 60730-2-9.
Refer to Code of Practice standards IEC 61000-5-1 and -2 for guidance.
The device complies with ETHERNET Protocol versions IEEEC 802.3.
The device supports BACnet IP and BACnet MS/TP communications as per ANSI / ASHRAE 135-2010.

SPECIFICATIONS OF CONTROLLER

Table 2. EAGLE specifications

Power supply	19 … 29 VAC or 20 … 30 VDC
Power consumption	typically dc: 5 W; max. 6 W typically ac: 9 VA; max. 11 VA
Current consumption	typically dc: 210 mA; max. 240 mA typically ac: 370 mA; max. 410 mA
Ambient temperature	0 … 50 °C
Storage temperature	-20 … +70 °C
Humidity	5 … 95% r.h. non-condensing
Dimensions	See Fig. 15 and Fig. 16.
Degree of protection	IP20
Fire class	V0

SYSTEM OVERVIEW

Overview of Models

Table 3. Overview of models

feature	**description**	**max. cable length**	**order no.**					
			CLEA2014B21	**CLEA2014B01**	**CLEA2026B21**	**CLEA2026B01**	**CLEA2000B21**	**CLEA2000B01**
UI	NTC20kΩ / 0…10V / slow BI	400 m	4	4	8	8	-	-
	NTC20kΩ / 0…10V fix pull-up / slow BI	400 m	-	-	2	2	-	-
BI	open = 24 V / closed 2.0 mA / totalizer 15 Hz	400 m	4	4	4	4	-	-
AO	0..11 V (max. 1 mA)	400 m	2	2	4	4	-	-
BO	Relay N.O. contact	400 m	3	3	4	4	-	-
	Relay N.O. contact (high in-rush)	400 m	1	1	1	1	-	-
	Relay N.O. contact with one common	400 m	-	-	3	3	-	-
bus interfaces	RS485-1, isolated, BACnet MS/TP or Panel Bus communication	*1000 m	1	1	1	1	1	1
	RS485-2, not isolated, BACnet MS/TP or Panel Bus communication	40 m	1	1	1	1	1	1
	Ethernet Interface, BACnet IP communication	100 m	-	-	1	1	1	1
	USB 2.0 Device Interface (as Network Interface)	3 m	1	1	1	1	1	1
	USB 2.0 Host Interface (max. 500 mA)	3 m	1	1	1	1	1	1
user interface	HMI with graphic LCD	--	X	-	X	-	X	-
	Fast Access buttons	--	6	-	6	-	6	-
	push and turn button	--	1	-	1	-	1	-
HMI	power LED (green)	--	1	1	1	1	1	1
	status LED (red, controllable by firmware)	--	1	1	1	1	1	1
	applications-specific LED L1 (yellow)	--	1	1	1	1	1	1
	USB-A LED (yellow)	--	1	1	1	1	1	1
	bus status LEDs (for isolated RS485-1 interface)	--	2	2	2	2	2	2
*Depending upon baud rate (see Table 6 on pg. 8).								

System Architecture

An EAGLE System consists of the EAGLE Controller and various Panel Bus I/O modules. The EAGLE Controller provides interface connections, which allow connection to external systems (e.g., BACnet controllers). Via the IF-LON External interface, the EAGLE can also communicate with LONWORKS systems, including CentraLine LONWORKS I/O Modules.

Auxiliary parts (see section “Extra Parts” on page 18) enable special features.

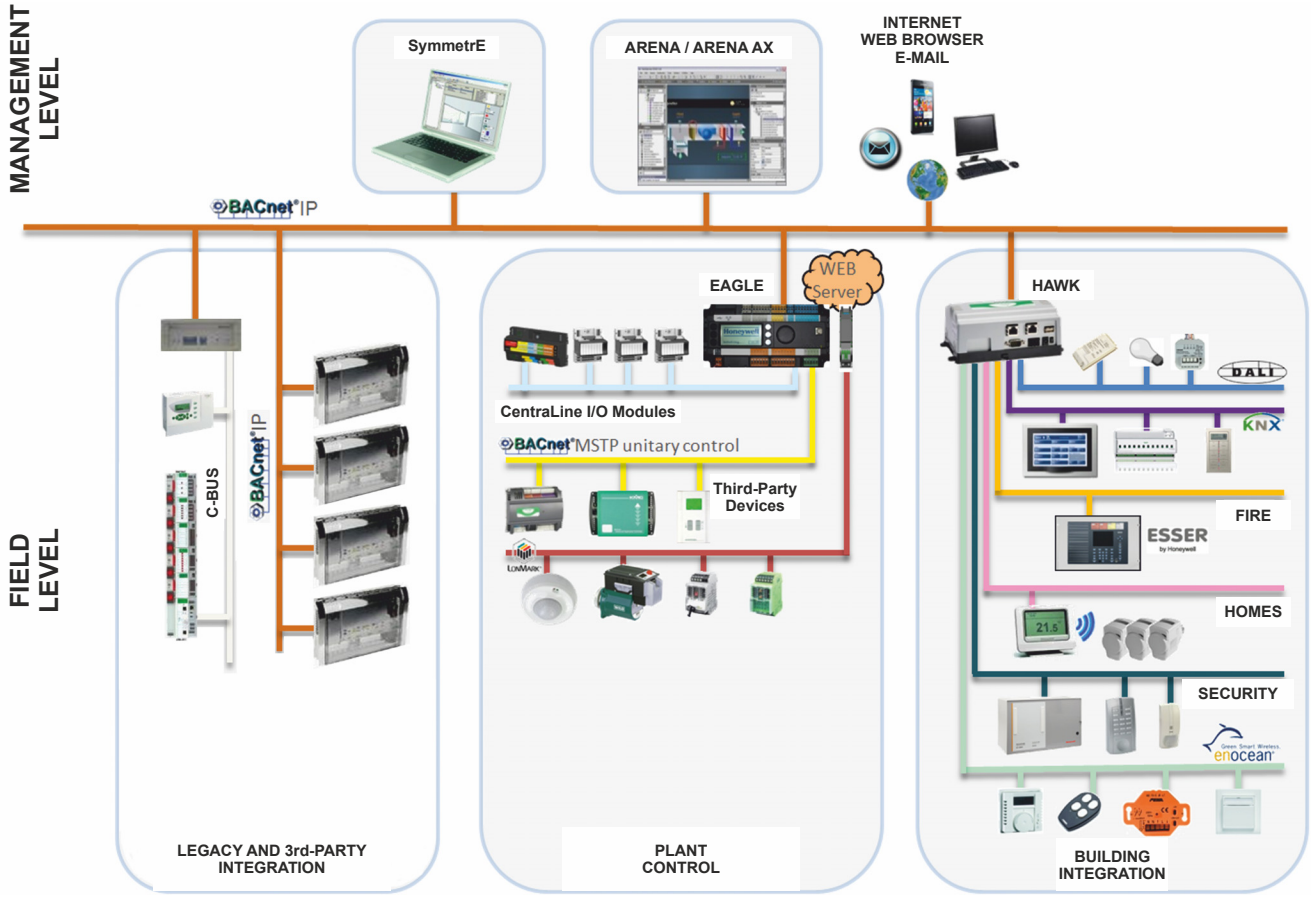


Fig. 1. CentraLine BACnet System architecture

Bus and Port Connections

⚠ WARNING

Risk of electric shock or equipment damage!

- ► Do not touch any live parts in the cabinet!
- ► Disconnect the power supply before making connections to or removing connections from terminals of the EAGLE Controller or Panel Bus I/O modules.
- ► Do not reconnect the power supply until you have completed installation.
- ► Observe the rules regarding electrostatic discharge.

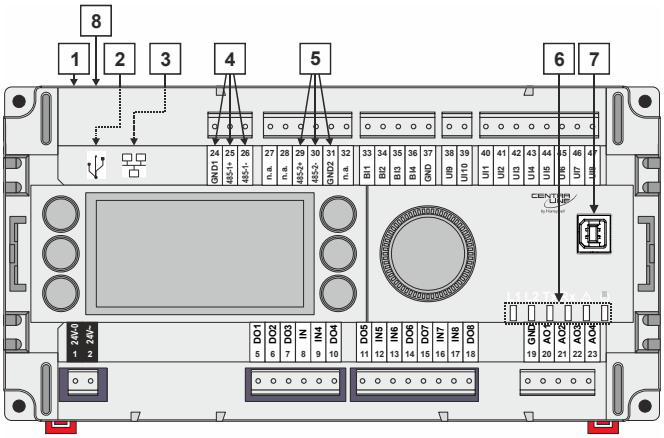


Fig. 2. Bus and port connections, LEDs (top view)

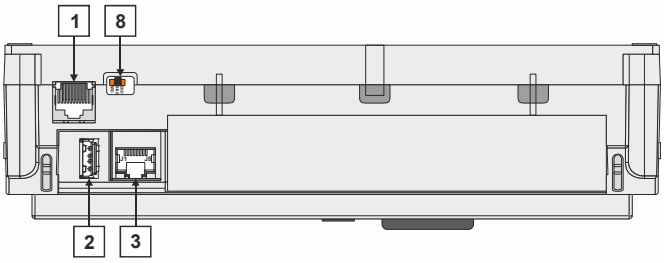


Fig. 3. Bus and port connections (side view)

Legend

1 RS232 / RJ45 socket (for factory debugging, only)
2 USB 2.0 Host Interface (for connection of external communication interfaces, e.g., the IF-LON)
3 ETHERNET / RJ45 socket (CLEA2000Bxx and CLEA2026Bxx, only)
4 RS485-1 (isolated)
5 RS485-2 (non-isolated)
6 LEDs (see also Fig. 9)
7 USB 2.0 Device Interface (for connection to CARE / XW-Online)
8 Slide switch (for setting bias and termination resistance of RS485-1)

USB 2.0 Host Interface

Via its USB 2.0 Host interface, the EAGLE Controller can be connected to, e.g., the IF-LON External Interface Adapter and thus to LONWORKS networks. See also IF-LON External Interface Adapter – Mounting Instructions (EN1Z-0974GE51).

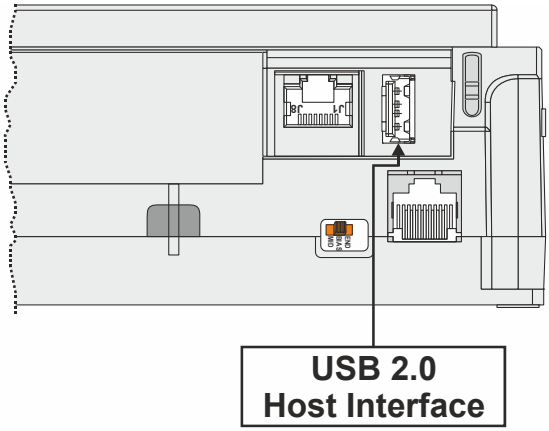


Fig. 4. USB 2.0 Host interface

USB 2.0 Device Interface

All models of the EAGLE Controller are equipped with a USB 2.0 Device Interface at the front.

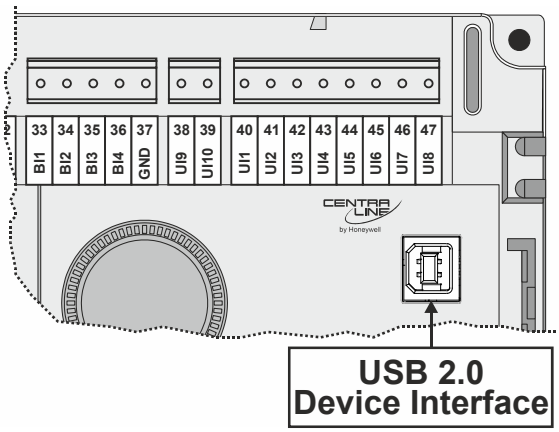


Fig. 5. USB 2.0 Device Interface

A standard USB type-B connector can be inserted into this USB 2.0 Device Interface. This USB 2.0 Device Interface is the recommended interface for connection to CARE.

Ethernet Interface

The CLEA2000Bxx + CLEA2026Bxx are equipped with an Ethernet / RJ45 socket featuring one LED.

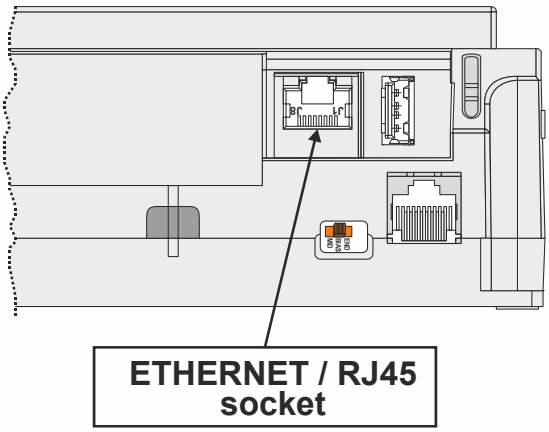


Fig. 6. Ethernet / RJ45 socket (CLEA2000Bxx + CLEA2026Bxx, only)

This Ethernet / RJ45 socket is a 10/100-Mbaud Ethernet interface permitting communication (as per IEEEC 802.3) on BACnet IP networks.

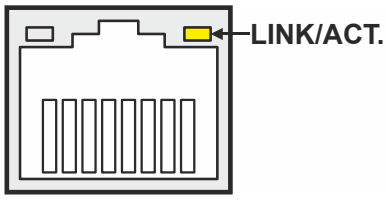


Fig. 7. Ethernet interface

NOTE: The Ethernet interface is usually earth-grounded. For additional information on earth grounding, see also “Appendix 1: Earth Grounding” on pg. 26.

LonWorks Connection

Via its USB 2.0 Host interface, the EAGLE Controller can be connected to the IF-LON and thus to LONWORKS networks. See also IF-LON External Interface Adapter – Mounting Instructions (EN1Z-0974GE51).

Fig. 8. IF-LON

The IF-LON is equipped with a free-topology transceiver (FTT10A) for communication (at a data transmission rate of 78 Kbaud) on LONWORKS® networks (using the LonTalk protocol).

The LONWORKS network is insensitive to polarity, eliminating the possibility of installation errors due to miswiring.

Different network configurations (daisy-chain, loop, and star configurations, or any combination thereof) are possible. See Excel 50/5000 LONWORKS Mechanisms (EN0B-0270GE51) for details.

LEDs

The EAGLE Controller features the following LEDs:

Fig. 9. EAGLE Controller LEDs

Table 4. EAGLE Controller LEDs

symbol	color	function, description
L1	yellow	application-specific LED indicating status information (“Cooling Mode”, “Heating Mode” “Service Interval” etc.)
L2	yellow	Indicates connection of operationally ready device to USB 2.0 Host Interface.
Tx	yellow	BACnet MS/TP status LED indicating transmission of communication signals via RS485-1
Rx	yellow	BACnet MS/TP status LED indicating reception of communication signals via RS485-1
⚠	red	status LED indicating hardware problems, lack of application, sensor failure, or Panel Bus failure
⏻	green	power LED

See also section “EAGLE Controller Troubleshooting” on page 25 for a detailed description of the behaviors of the Tx and Rx LEDs, the status LED, and the power LED and their meanings.

RS485 Interfaces

General

The EAGLE features two RS485 interfaces located at the top side of the EAGLE Controller:

- RS485-1 (consisting of push-in terminals 24 [GND-1], 25, and 26) is isolated and can be connected to a BACnet MS/TP bus or a Panel Bus.
- RS485-2 (consisting of push-in terminals 29, 30, and 31 [GND-2]) is non-isolated (i.e. GND-2 is internally connected with terminal 1 [24V~0] and terminals 19+37 [system ground]) and can be connected to either a BACnet MS/TP bus or a Panel Bus.

RS485-1 Bias and Termination Resistors

RS485-1 is equipped with a three-position slide switch which can be used to switch its bias resistors OFF (position “MID” – this is the default), ON (position “BIAS”), and ON with an additional 150Ω termination resistor (position “END”).

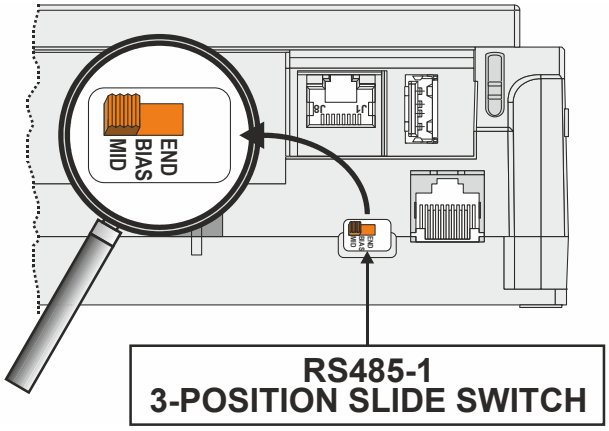


Fig. 10. RS485-1 three-position slide switch

The recommended slide switch setting depends upon the location and usage of the given EAGLE – see Fig. 11 and Table 5; it also depends upon the selected communication protocol (BACnet MS/TP or Panel Bus, respectively).

Table 5. Recommended slide switch settings

setting	location / usage
END	Controllers located on both ends of bus should have this setting.
BIAS	In small bus networks, one controller should have this setting.
MID	All other controllers (not set to “END” or “BIAS”) on bus should have this setting (which is the default).

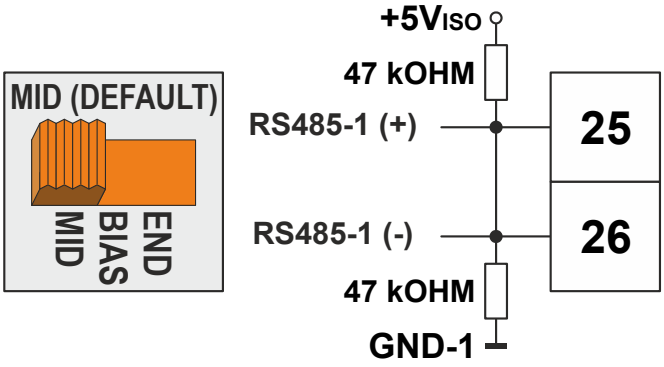


Fig. 11. RS485-1 three-position slide switch setting MID

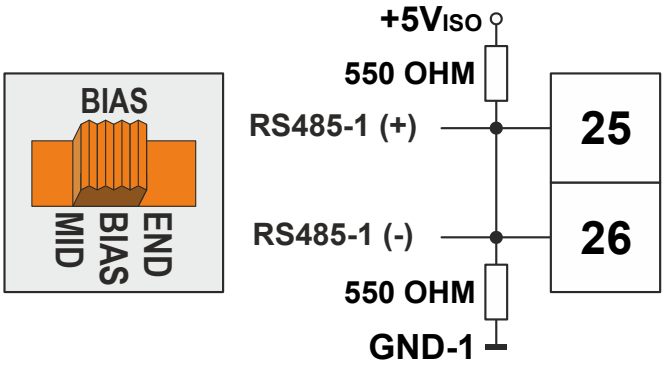


Fig. 12. RS485-1 three-position slide switch setting BIAS

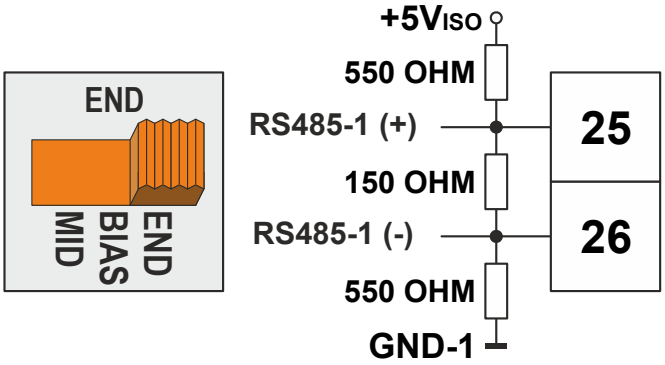


Fig. 13. RS485-1 three-position slide switch setting END

NOTE: All terminals are protected (up to 24 Vac) against short-circuiting and incorrect wiring - except when the 3-position slide switch is set to “END,” in which case the terminals of the RS485-1 bus (24, 25, and 26) have no such protection. Higher voltages may damage the device.

NOTE: According to BACnet standards, at least one BACnet device must have its bias resistors switched ON, and at most two BACnet devices may have their bias resistors switched ON.

RS485-2 Bias and Termination Resistors

RS485-2 is not equipped with a slide switch. The 550Ω bias resistors and 130Ω termination resistor of the RS485-2 are thus always ON.

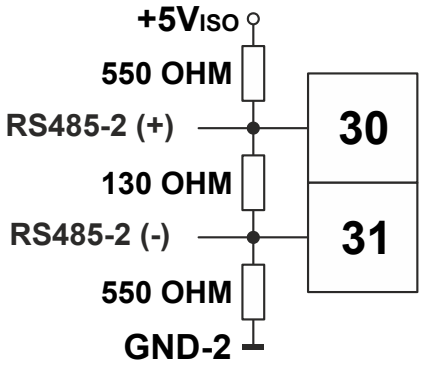


Fig. 14. RS485-2 bias and termination resistors

NOTE: GND-2 is internally connected with 24V-0 (terminal 1) and system GND (terminals 19+37)

RS485 Standard

According to the RS485 standard (TIA/EIA-485: "Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems"), only one driver communicating via an RS485 interface may transmit data at a time. Further, according to U.L. requirements, each RS485 interface may be loaded with a max. of 32 unit loads. E.g., CentraLine devices have as little as ¼ unit load each, so that up to 128 devices can be connected.

BACnet MS/TP connections to the RS485 interfaces must comply with the aforementioned RS485 standard. Thus, it is recommended that each end of every connection be equipped with one termination resistor having a resistance equal to the cable impedance (120 Ω / 0.25 – 0.5 W).

RS485 systems frequently lack a separate signal ground wire. However, the laws of physics still require that a solid ground connection be provided for in order to ensure error-free communication between drivers and receivers – unless all of the devices are electrically isolated and no earth grounding exists.

IMPORTANT

In the case of new EAGLE controller installations, we strongly recommend using a separate signal ground wire. Doing otherwise may possibly lead to unpredictable behavior if other electrically non-isolated devices are connected and the potential difference is too high.
In the case of the installation of EAGLE controllers in already-existent RS485 two-wire systems (e.g., when replacing PANTHER or LION controllers with EAGLE controllers), not using a separate signal ground wire will probably have no undesirable effects.

The cable length affects the baudrate. The following table provides a few examples.

Table 6. Baud rate vs. max. cable length for RS485

Baud rate	Max. cable length (L)
9.6 - 76.8 kbps	1200 m
*115.2 kbps	800 m
** In the case of configuration of RS485-2 for Panel Bus, the communication rate is set to 115.2 kbps.	

For information on wire gauge, max. permissible cable length, possible shielding and grounding requirements, and the max. number of devices which can be connected to a bus, refer to standard EIA-485.

MOUNTING/DISMOUNTING

Before Installation

IMPORTANT

To allow the evaporation of any condensation resulting from low shipping / storage temperatures, keep the controller at room temperature for at least 24 h before applying power.

US requirement, only: This device must be installed in a UL-listed enclosure offering adequate space to maintain the segregation of line voltage field wiring and Class 2 field wiring.

In the case of vertical mounting on DIN rails, the EAGLE controller should be secured in place using a commercially-available stopper

See also the EAGLE Mounting Instructions (MU1Z-0970GE51).

Dimensions

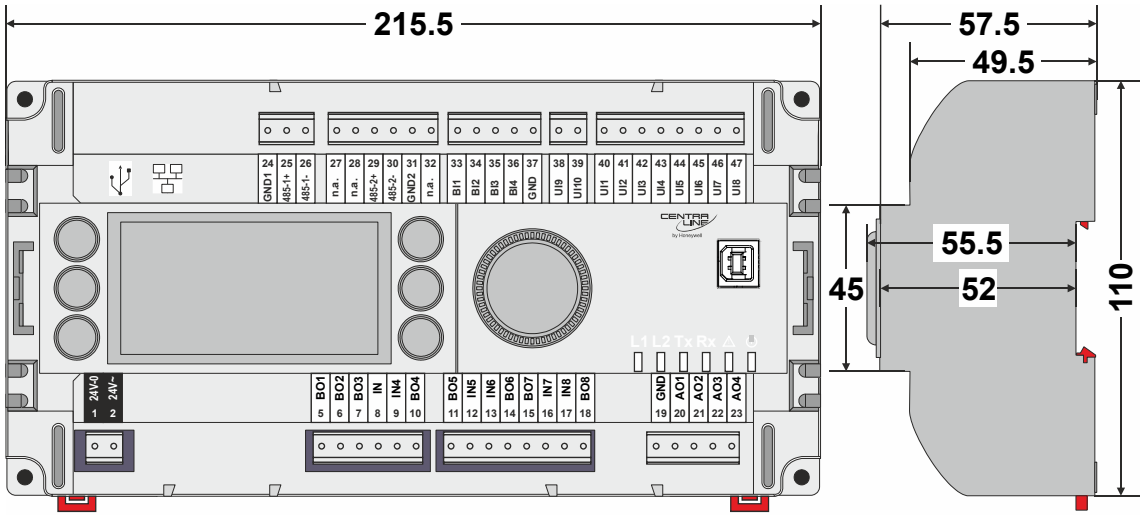


Fig. 15. EAGLE Controller, dimensions (in mm)

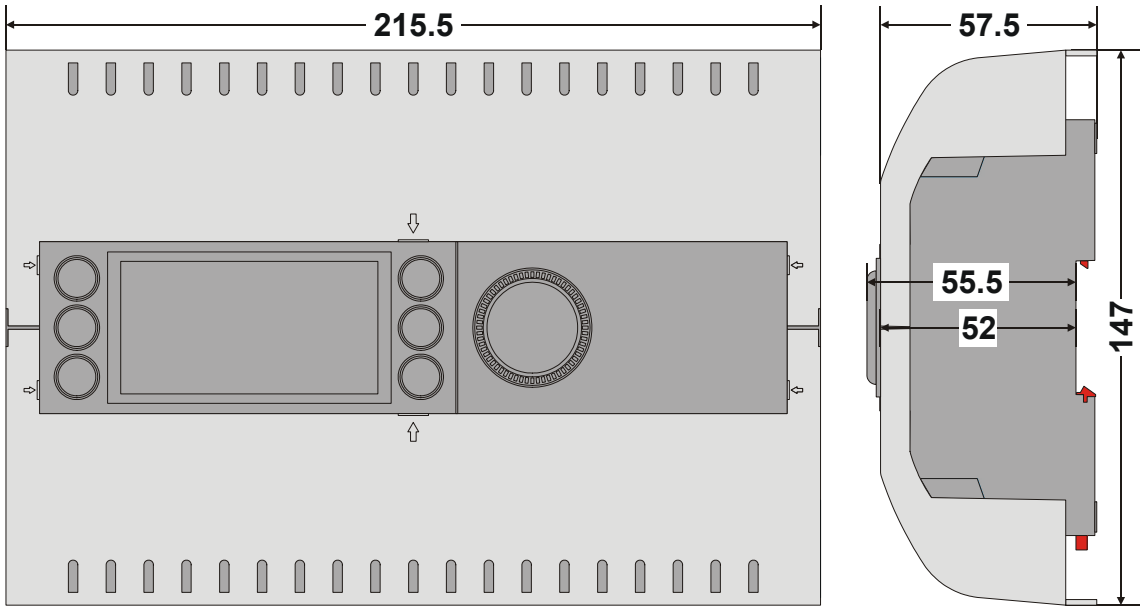


Fig. 16. EAGLE Controller (shown here with two MVC-80-AC1 covers in place), dimensions (in mm)

NOTE: Use of the MVC-80-AC1 will obstruct access to the ETHERNET and USB 2.0 Device Interfaces

WIRING AND SET-UP

General Safety Considerations

- When connecting the EAGLE, both VDE, National Electric Code (NEC) or equivalent, and any local regulations must be observed.
- Electrical work should be carried out by a qualified electrician.
- Electrical connections must be made at terminal blocks.
- For Europe only: To comply with CE requirements, devices with a voltage in the range of 50 ... 1000 VAC or 75 ... 1500 VDC which are not provided with a supply cord and plug or with other means for disconnection from the supply having a contact separation of at least 3 mm in all poles must have the means for disconnection incorporated in the fixed wiring.

⚠ WARNING

Risk of electric shock or equipment damage!

- ► Do not touch any live parts in the cabinet.
- ► Disconnect the power supply before making connections to or removing connections from terminals of the EAGLE Controller and devices wired to it.
- ► Do not use spare terminals as wiring support points.
- ► Do not reconnect the power supply until you have completed the installation.
- ► Mixing of different voltages (e.g., 24 V and 230 V) within individual relay blocks of the EAGLE is not allowed
- ► To prevent a risk of injury due to electrical shock and/or damage to the device due to short-circuiting, low-voltage and high-voltage lines must be kept separate from one another.
- ► All terminals are protected (up to 24 Vac) against short-circuiting and incorrect wiring (except when the 3-position slide switch is set to “END,” in which case the terminals of the RS485-1 bus [24, 25, and 26] have no such protection). Higher voltages may damage the device.
- ► Do not open the controller housing.
- ► Observe precautions for handling electrostatic sensitive devices.

NOTE: All wiring must comply with applicable electrical codes and ordinances. Refer to job or manufacturer’s drawings for details. Local wiring guidelines (e.g., IEC 364-6-61 or VDE 0100) may take precedence over recommendations provided in these instructions.

Fusing Specifications

System Fusing

We recommend that the user equip the system with an external fuse.

Fusing of Active Field Devices

F2 (depends upon loads in use).

Wiring Terminals

The EAGLE is equipped with push-in terminal plugs.

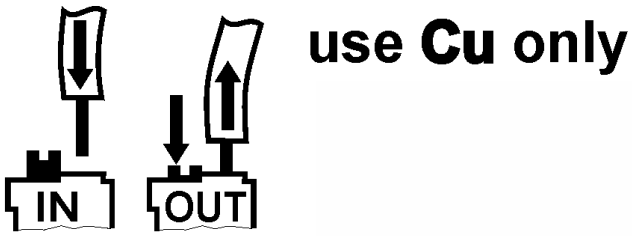


Fig. 17. Inserting/removing wires from push-in terminals

NOTE: In the case of solid conductors, the use of ferrules is prohibited.

NOTE: Use only one conductor per push-in terminal.

NOTE: If two stranded wires are to be connected to a single push-in terminal, twin wire end ferrules must be used.

Table 7. EAGLE push-in terminal wiring specifications

plug gauge	0.2 … 1.50 mm^2
solid conductor H05(07) V-K	0.2 … 1.50 mm^2
stranded conductor H05(07) V-K	0.2 … 1.50 mm^2
stranded conductor with wire end ferrules (w/o plastic collar)	0.2 … 1.50 mm^2
stripping length	10.0 +1.0 mm

Power Supply

Powering EAGLE

Power is supplied via a removable terminal plug (attached to terminals 1 and 2). See also Fig. 19.

The power supply of the EAGLE Controller must conform to Safety Class II.

NOTE: To reduce overall current consumption, the EAGLE can also be powered by a switch power supply (rather than by a transformer). See also Table 2 on pg. 3.

Terminal Assignment

Table 8. Terminal assignment

terminal no.	signal	Description	CLEA2014Bxx	CLEA2026Bxx	CLEA2000Bxx
1	24V-0	supply voltage (GND), internally connected with term. 31 and system GND (term. 19+37)	X	X	X
2	24V~	supply voltage (24V)	X	X	X
3,4	-	not used	-	-	-
5	BO1	Binary output 1. N.O. relay contact switching input power connected to terminal 8	-	X	-
6	BO2	Binary output 2. N.O. relay contact switching input power connected to terminal 8	-	X	-
7	BO3	Binary output 3. N.O. relay contact switching input power connected to terminal 8	-	X	-
8	IN1,2,3	Common relay contact for BO1, BO2, and BO3	-	X	-
9	IN4	Common relay contact for BO4	X	X	-
10	BO4	Binary output 4. N.O. relay contact switching input power connected to terminal 9	X	X	-
11	BO5	Binary output 5. N.O. relay contact switching input power connected to terminal 12	-	X	-
12	IN5	Common relay contact for BO5	-	X	-
13	IN6	Common relay contact for BO6	X	X	-
14	BO6	Binary output 6. N.O. relay contact switching input power connected to terminal 13	X	X	-
15	BO7	Binary output 7. N.O. relay contact switching input power connected to terminal 16	X	X	-
16	IN7	Common relay contact for BO7	X	X	-
17	IN8	Common relay contact for BO8	-	X	-
18	BO8	Binary output 8. N.O. relay contact switching input power connected to terminal 17	-	X	-
19	GND	Ground terminal (see NOTE below)	X	X	-
20	AO1	Analog output 1	X	X	-
21	AO2	Analog output 2	X	X	-
22	AO3	Analog output 3	-	X	-
23	AO4	Analog output 4	-	X	-
24	GND-1	ref. GND of RS485-1 (isolated)	X	X	X
25	485-1+	“+” signal for RS485-1 (isolated)	X	X	X
26	485-1-	“-” signal for RS485-1 (isolated)	X	X	X
27,28		not used	-	-	-
29	485-2+	“+” signal for RS485-2 (non-isolated)	X	X	X
30	485-2-	“-” signal for RS485-2 (non-isolated)	X	X	X
31	GND-2	ref. GND of RS485-2, int. connected with 24V-0 (term. 1) and system GND (term. 19+37)	X	X	X
32	-	not used	-	-	-
33	BI1	Binary input 1 (static dry contact) / pulse counter (fast totalizer)	X	X	-
34	BI2	Binary input 2 (static dry contact) / pulse counter (fast totalizer)	X	X	-
35	BI3	Binary input 3 (static dry contact) / pulse counter (fast totalizer)	X	X	-
36	BI4	Binary input 4 (static dry contact) / pulse counter (fast totalizer)	X	X	-
37	GND	Ground terminal (see NOTE below)	X	X	-
38	UI9	Universal input 9 (for NTC20kΩ / 0..10V / slow BI)	-	X	-
39	UI10	Universal input 10 (for NTC20kΩ / 0..10V / slow BI)	-	X	-
40	UI1	Universal input 1 (for NTC20kΩ / 0..10V / slow BI)	X	X	-
41	UI2	Universal input 2 (for NTC20kΩ / 0..10V / slow BI)	X	X	-
42	UI3	Universal input 3 (for NTC20kΩ / 0..10V / slow BI)	X	X	-
43	UI4	Universal input 4 (for NTC20kΩ / 0..10V / slow BI)	X	X	-
44	UI5	Universal input 5 (for NTC20kΩ / 0..10V / slow BI)	-	X	-
45	UI6	Universal input 6 (for NTC20kΩ / 0..10V / slow BI)	-	X	-
46	UI7	Universal input 7 (for NTC20kΩ / 0..10V / slow BI)	-	X	-
47	UI8	Universal input 8 (for NTC20kΩ / 0..10V / slow BI)	-	X	-

NOTE: All AOs, UIs, and BIs share the same ground potential. It is thus possible to connect just one combined GND signal for all AOs, UIs, and BIs. Auxiliary terminals may be used if needed.

Transformer Data

In Europe, if the EAGLE is powered by transformers, then such transformers must be safety isolating transformers conforming to IEC61558-2-6.

In the U.S. and Canada, if the EAGLE is powered by transformers, then such transformers must be NEC Class-2 transformers.

Table 9. 1450 series transformers data

part # 1450 7287	primary side	secondary side
-001	120 Vac	24 Vac, 50 VA
-002	120 Vac	2 x 24 Vac, 40 VA, and 100 VA from separate transformer
-003	120 Vac	24 Vac, 100 VA, and 24 Vdc, 600 mA
-004	240/220 Vac	24 Vac, 50 VA
-005	240/220 Vac	2 x 24 Vac, 40 VA, and 100 VA from separate transformer
-006	240/220 Vac	24 Vac, 100 VA, and 24 Vdc, 600 mA

Table 10. Overview of CRT Series AC/DC current

transformer	primary side	max. AC current	max. DC current
CRT 2	230 Vac	2 A	500 mA
CRT 6	230 Vac	6 A	1300 mA
CRT 12	230 Vac	12 A	2500 mA

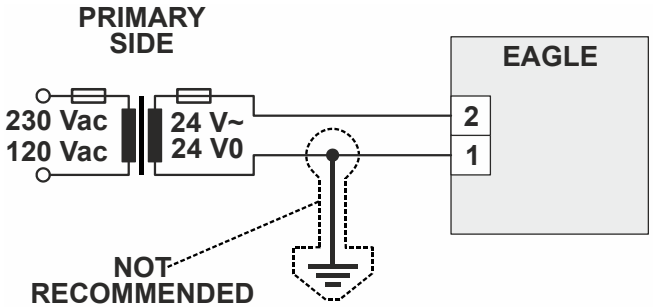


Fig. 18. Connection of EAGLE Controller

RIN-APU24

The RIN-APU24 Uninterruptable Power Supply can be directly wired to an EAGLE Controller.

See RIN-APU24 Uninterruptable Power Supply – Mounting Instructions (EN0B-0382GE51) for a detailed wiring diagram.

Powering Panel Bus I/O Modules and Field Devices

The EAGLE, Panel Bus I/O modules, and field devices can be powered by either separate transformers (see Fig. 19, Fig. 20, and Fig. 21) or by the same transformer (see Fig. 22 on pg. 13).

NOTE: Use a min. distance of 10 cm between power cables and 0…10 V / sensor cables in order to prevent signal disturbances on the 0…10 V / sensor cables. See also section “Cable Specifications” on page 22.

Powering Field Devices and EAGLE via Separate Transformers

- 24 V actuator connected to separate transformer
- Field device located max. 400 m from EAGLE

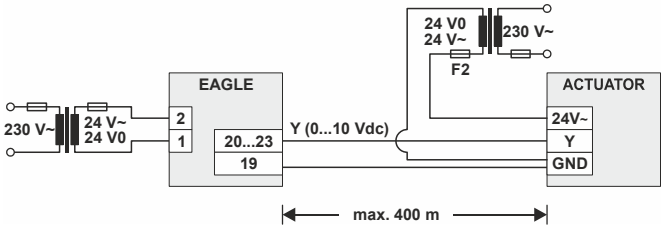


Fig. 19. Power supply of EAGLE and field devices by separate transformer

Powering Field Devices and Panel Bus I/O Module via Separate Transformers

- 24 V actuator connected to, e.g., an analog output module
- Field device located 100 … 400 m from EAGLE

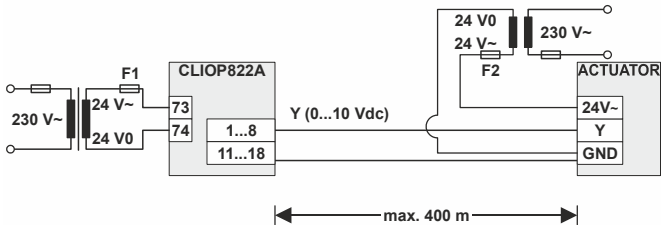


Fig. 20. Power supply via a separate transformer

Powering Field Devices via Panel Bus I/O Module

- 24 V actuator connected to, e.g., an analog output module
- Field device located max. 100 m from EAGLE

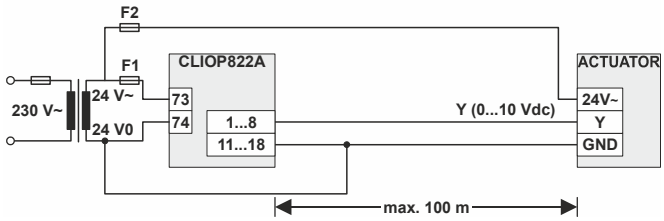


Fig. 21. Power supply via Panel Bus I/O Module

Lightning Protection

Please contact your local Honeywell representative for information on lightning protection.

CLEA2026Bxx Connection Examples

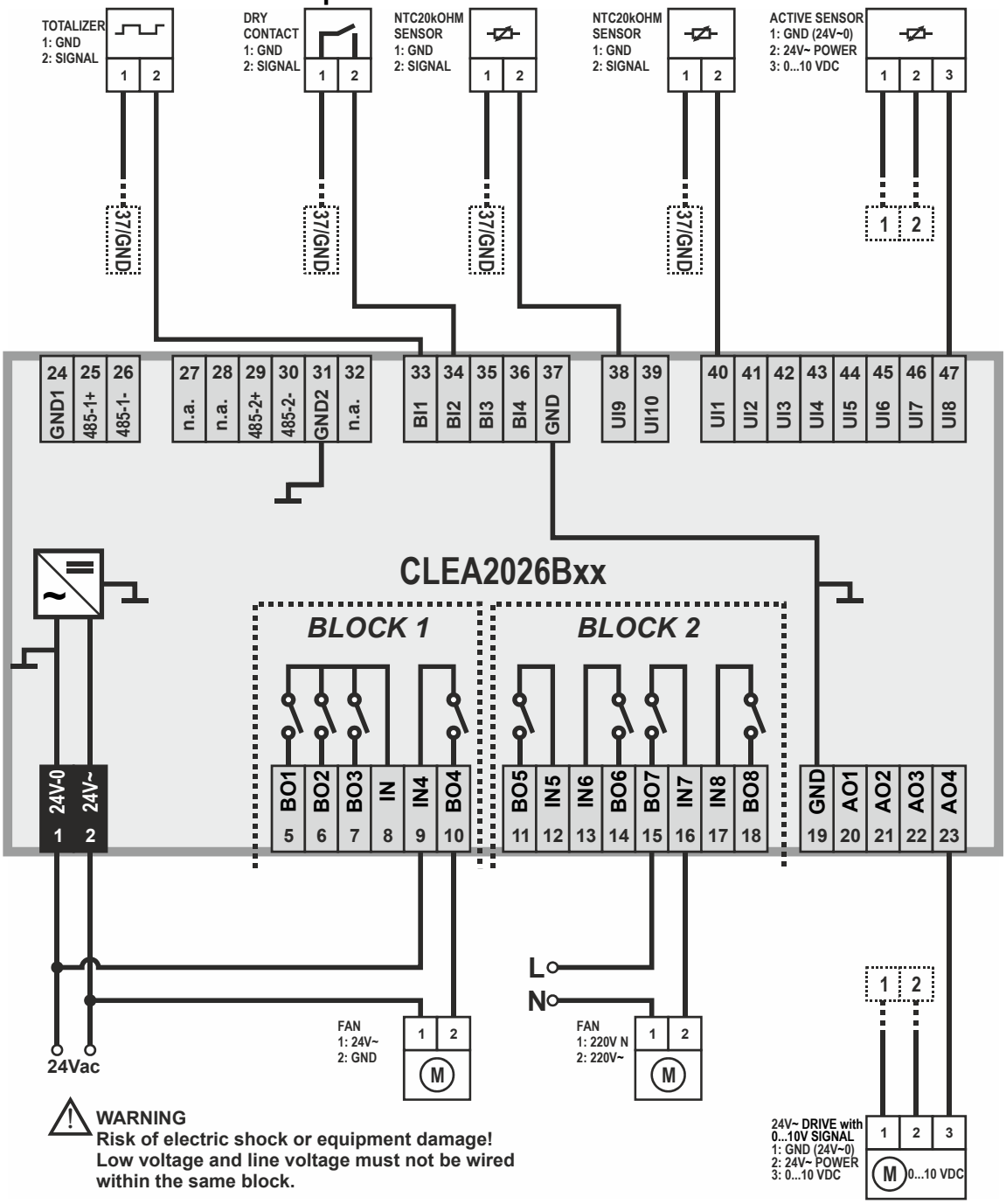


Fig. 22. CLEA2026Bxx connection example

For fusing specifications see section "**Fusing** Specifications" on page 10.

NOTE: Use a min. distance of 10 cm between power cables and 0…10 V / sensor cables in order to prevent signal disturbances on the 0…10 V / sensor cables.

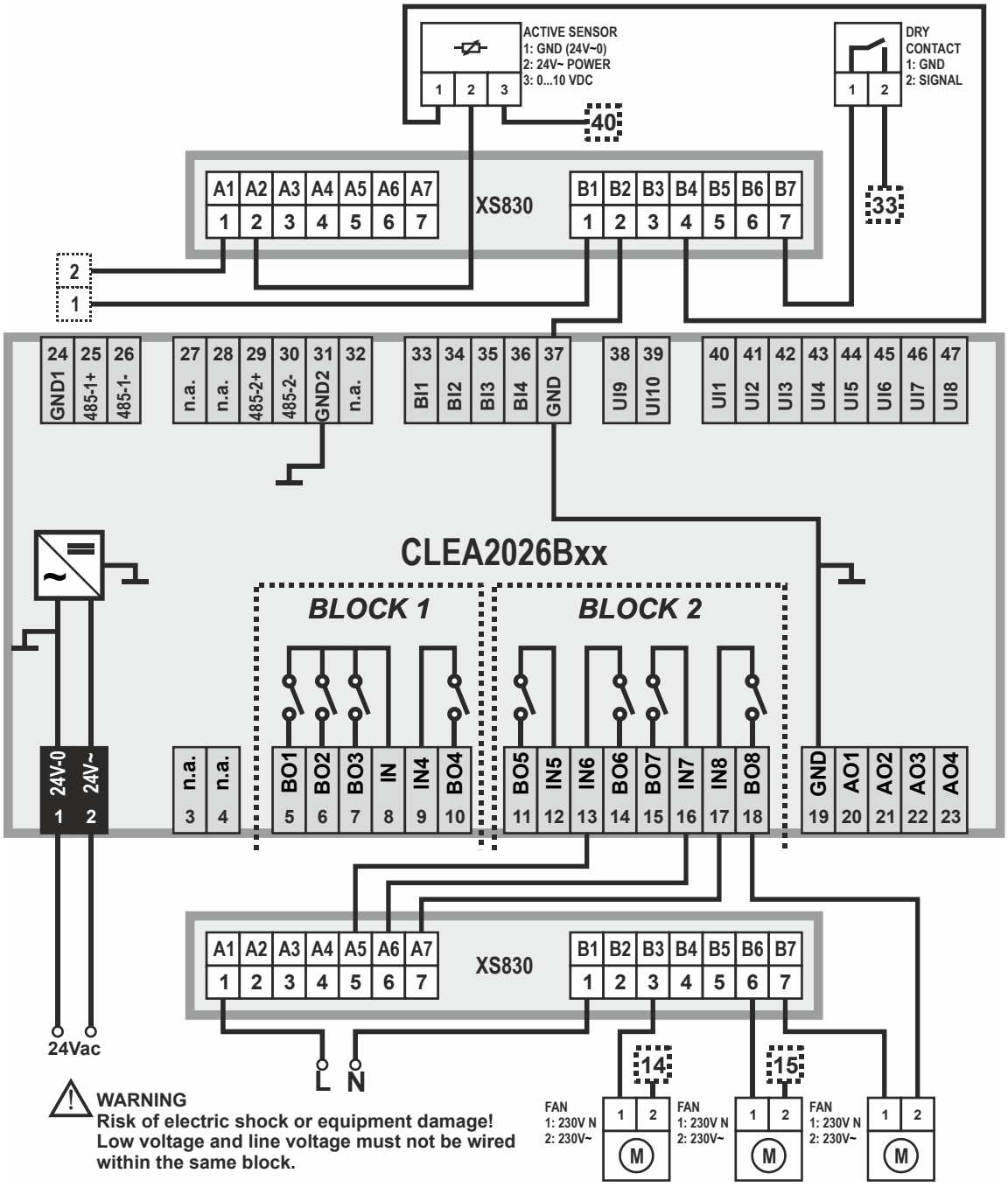


Fig. 23. CLEA2026Bxx connection example (with two XS830 Auxiliary Terminal Packages)

The XS830 and XS831 Auxiliary Terminal Packages are optional accessories which can be mounted onto the top and/or bottom of the EAGLE Controller in order to equip them with additional terminals for the connection of, e.g., shields, sensors, GND, N, 230 V, or 24 V (but not earth!).

NOTE: Use a min. distance of 10 cm between power cables and 0…10 V / sensor cables in order to prevent signal disturbances on the 0…10 V / sensor cables.

Internal I/Os of the EAGLE

The CLEA2000Bxx is not equipped with inputs or outputs. The following sub-sections thus apply only to the CLEA2026Bxx and CLEA2014Bxx.

Universal Inputs

The CLEA2026Bxx is equipped with ten (CLEA2014Bxx: four) universal inputs (UIs) configurable (in CARE).

For information on the accuracy of the sensor inputs, their differential measurement error, the characteristics (i.e., resistances and resultant voltages in dependence upon temperature) of the various different sensor types which can be connected to them, and on the thresholds at which sensor failures are recognized, see section “Appendix 2” on page 28.

Table 11. Specifications of UIs

criteria	value
voltage input	• UI1-UI10: 0 … 10 VDC with pull-up resistor • UI1-UI8: 0…10 VDC w/o pull-up resistor • UI1-UI8: 2…10 VDC w/o pull-up resistor
current input	• UI1-UI10: 0 … 10 VDC w/o pull-up resistor, external 499Ω resistor required to measure 0…20 mA • UI1-UI8: 2…10 VDC w/o pull-up resistor, external 499Ω resistor required to measure 4…20 mA
supported sensor types	• NTC20kΩ (-50…+150 °C; default) • Slow binary input (static, dry-contact)
resolution	12-bit resolution
accuracy	±75 mV (0 ... 10 V)
protection	against short-circuiting, 24 VAC

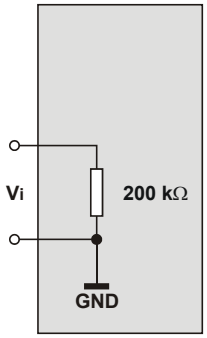


Fig. 24 Internal wiring of UI1-UI8 configured for voltage input (without pull-up resistor)

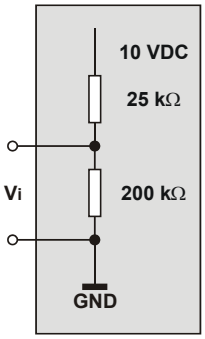


Fig. 25. Internal wiring of UI1-UI10 configured for input from NTC20kΩ or voltage input (with pull-up resistor)

Analog Outputs

The CLEA2026Bxx is equipped with four (CLEA2014Bxx: two) analog outputs (AOs).

In the event of an application stop (e.g., during application download), the analog outputs assume the safety positions configured in CARE.

The analog outputs can be configured in CARE as binary outputs (with an output of 0 V or 10 V, as the case may be).

Table 12. Specifications of AOs

criteria	value
output type	• 0…10 V • 2…10 V
max. output range	0 … 11 VDC (± 1 mA) (default)
min. resolution	8 bit
min. accuracy	± 150 mV
MCD3 connection	supported
max. wire length	400 m
wire cross section	See Table 7 on pg. 10.
protection	against short-circuiting, 24 VAC

Binary Inputs / Pulse Counters

Both the CLEA2026Bxx and the CLEA2014Bxx are equipped with four binary inputs (static dry-contact inputs) / pulse counters (fast totalizers).

Table 13. Specifications of BIs

criteria	value
input type	• binary input (static dry-contact) • pulse counter (fast totalizer)
current rating (closed input)	2 mA
open contact voltage	24 VDC
protection	against short-circuiting, 24 VAC

Binary Input Specifications

The binary inputs of the EAGLE are static dry-contact inputs. This reduces the wiring effort, as it is then not necessary to distribute an auxiliary voltage signal.

open circuit	≥ 3000 Ω (24 VDC on BI terminal)
closed circuit	≤ 500 Ω (short-circuit current: 2.0 mA)

The polarity (normal = N.O. contact or reverse = N.C. contact) configuration defines if a logical 1 or a logical 0 is detected for a closed contact. This is done by selecting (in CARE) one of the following options:

normal (default)	closed external contact →	state=1
	open external contact →	state=0
reverse	closed external contact →	state=0
	open external contact →	state=1

Pulse Counter Specifications

Using CARE, the binary inputs of the EAGLE can be configured as pulse counters (fast totalizers) for operation in conjunction with devices equipped with an open collector output.

If the duty cycle is 50% / 50%, the pulse counter supports up to 15 Hz. Counting is done on the rising edge.

Table 14. BIs of EAGLE configured as fast totalizers

frequency	max. 15 Hz
pulse ON	min. 25 ms
pulse OFF	min. 25 ms
bounce	max. 5 ms

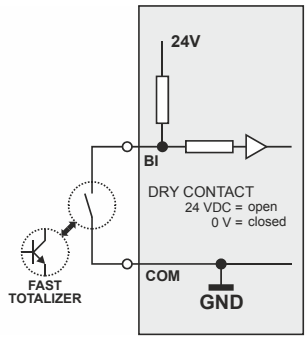


Fig. 26. Internal wiring of BI

Binary Outputs

The EAGLE features eight (CLEA2026Bxx) or four (CLEA2014Bxx) binary outputs arranged in two blocks (BO1…4 and BO5..8, respectively).

⚠ WARNING

Risk of electric shock or equipment damage!
Low voltage and line voltage must not be wired within the same block.

In the event of an application stop (e.g., during application download), the binary outputs assume the safety positions configured in CARE.

The polarity (normal = N.O. contact or reverse = N.C. contact) configuration defines if a relay is open or closed, depending upon whether there is a logical 1 or a logical 0. This is done by selecting (in CARE) one of the following options:

normal (default)	state=1 →	relay contact is closed
	state=0 →	relay contact is opened
reverse	state=0 →	relay contact is closed
	state=1 →	relay contact is opened

Table 15. Relay specifications of the EAGLE

	block 1		block 2
	BO1…3	**BO4**	**BO5…8**
contact volt. AC	5…253 V	5…253 V	5…253 V
contact volt. DC	5…30 V	20…30 V	5…30 V
max. contact current AC (resistive)	3 A	10 A	3 A
max. contact current AC (induct.)	0.3 A*	10 A	0.3 A*
max. contact current AC (induct.)	2 A**	10 A	2 A**
max. contact current DC	3 A	7 A	3 A
min. load	100 mA / 5 Vdc	40 mA / 24 Vdc	100 mA / 5 Vdc
* typically 250,000 cycles; ** typically 50,000 cycles			

NOTE: The total max. sum load for all binary outputs (BO1…8) equals 14 A.

NOTE: Binary output 4 supports the switching of high inrush currents (e.g., motors, incandescent lights, etc.). The max. allowed switch current is 80 A for a duration of max. 20 ms.

ENGINEERING, COMMISSIONING

Please refer also to CARE User Guide (Product Literature No.: EN2B-0182GE51) for detailed information.

Required Preparations

In order to access (with a laptop or PC) the EAGLE Controller via Ethernet/IP for the first time, you may employ any one of the following two options:

Option 1: USB 2.0 Device (recommended)

This USB 2.0 Device interface is the recommended interface for downloading applications and firmware via CARE. An “A-Male to B-Male” USB cable is required.

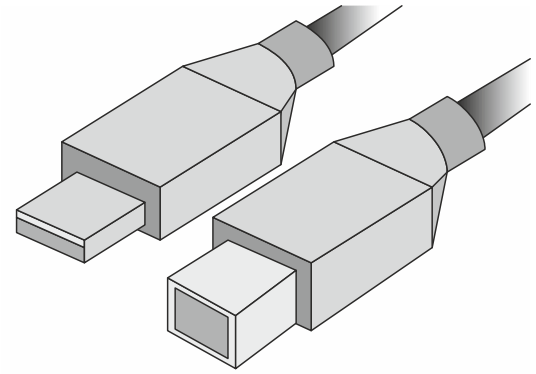


Fig. 27. A-male to B-male USB cable

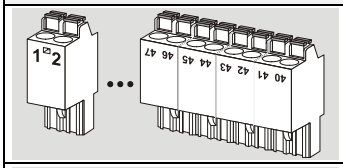
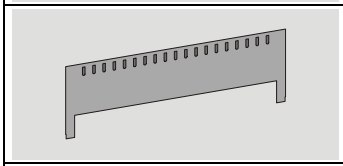
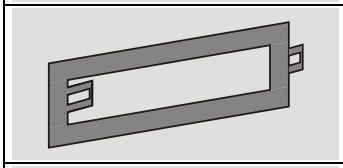
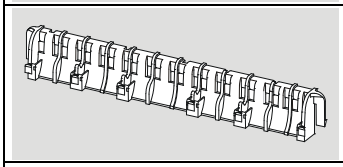
For access via USB, the EAGLE Controller has a permanent default IP address 192.168.255.241. Your PC's IP address must match the EAGLE Controller's default IP address subnet: We recommend using DHCP or “Obtain an automatic IP address”.

Option 2: Standard Ethernet Interface

The standard IP address can be set in CARE. For this purpose, connect first with the USB interface. In any case, your PC's IP address must match the EAGLE Controller's default IP address subnet. We recommend using DHCP or “Obtain an automatic IP address”.

EXTRA PARTS

Table 16. Extra parts

	order number	description
	**TPU-45-01**	removable terminal plugs, push-in type; complete set of 9 plugs (for terminals 1 - 47); for the CLEA2014Bxx and CLEA2026Bxx
	TPU-11-01	removable terminal plugs, push-in type; complete set of 3 plugs (for terminals 1 - 47); for the CLEA2000Bxx
	**MVC-80-AC1**	terminal cover (color: RAL9011); package of 20; for EAGLE Controllers
	**MVC-80-AC2**	front door mounting accessory (color: RAL9011); package of 20; for EAGLE Controllers
	**MVC-80-AC3**	strain relief; package of 10; for MVC-40x-xxxxxx and MVC-80x-xxxxxx Controllers
	**XS830**	Auxiliary Terminal Package for the Mixed Panel Bus I/O Module and the EAGLE Controller, only. Please refer to CentraLine I/O Modules - Installation & Commissioning Instructions (EN1Z-0973GE51) for more information
	**XS831**	Two groups of four pairs of push-in terminals, for converting 0…20 mA signals into 0…10 VDC signals, and one push-in ground terminal per group. Please refer to CentraLine I/O Modules - Installation & Commissioning Instructions (EN1Z-0973GE51) for more information

PANEL BUS CONNECTION

The EAGLE Controller features two RS485 interfaces to which Panel Bus modules can be connected: RS485-1 (consisting of push-in terminals 24 [GND-1], 25, and 26) and/or RS485-2 (consisting of push-in terminals 29, 30, and 31 [GND-2]).

NOTE: GND-2 is internally connected with 24V-0 (terminal 1) and system GND (terminals 19+37)

Overview of Panel Bus I/O Modules

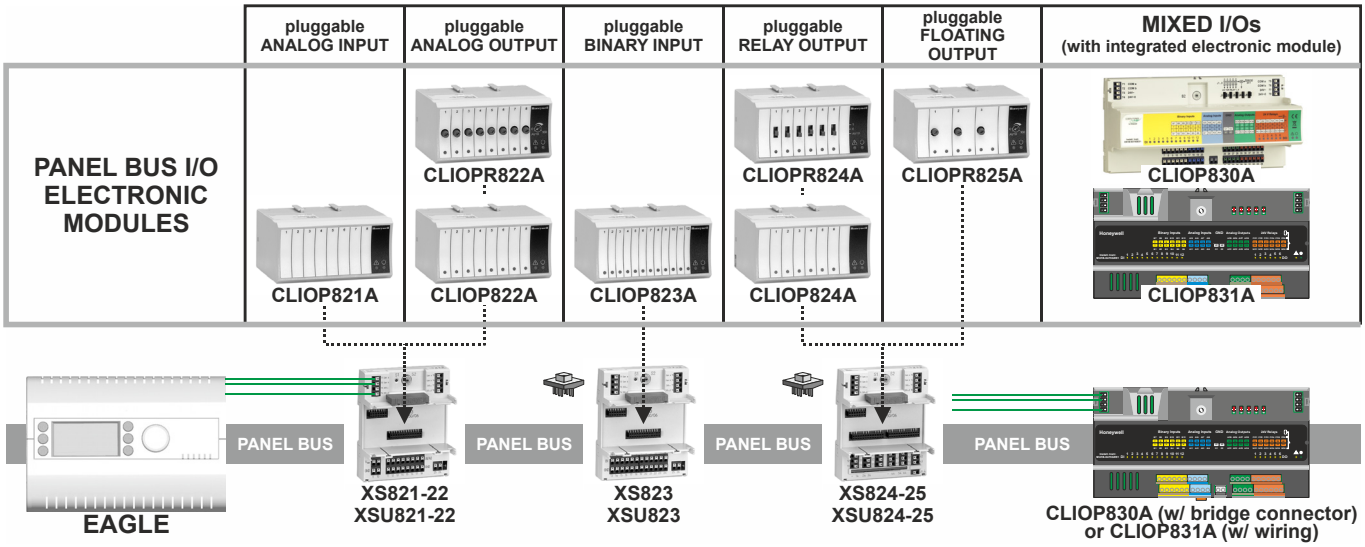


Fig. 28. Overview of Panel Bus I/O Modules

Considerations

- **RS485-1 (isolated)**
  - Max. Panel Bus length: 800-1200 meters, depending on baud rate (see section “RS485 Standard” on pg. 8)
- **RS485-2 (non-isolated)**
  - Max. Panel Bus length: 40 meters
  - Any type of cabling and topology possible (preferably twisted-pair cable and bus topology)
  - Must not extend beyond a single building or building floor
- **Max. no. of Panel Bus I/O modules per RS485 interface**
  - Max. no. of Panel Bus I/O modules of a given model: 16
  - Total max. no. of Panel Bus I/O modules: 64
- **Max. no. of Panel Bus I/O modules per EAGLE**
  - Max. no. of Panel Bus I/O modules of a given model: 32
  - Total max. no. of Panel Bus I/O modules: 128
- **Max. no. of hardware I/O points + NVs per EAGLE: 600**
  - Max. no. of mapped NVs allowed per EAGLE is thus 600 minus the no. of hardware I/O points.

Refer to CentraLine I/O Modules - Installation & Commissioning Instructions (EN1Z-0973GE51) for more information about connection, current requirements, power supply, overvoltage protection, cable specifications, fusing, effects of manual overrides, etc. of Panel Bus I/O modules and field devices connected to them.

Connecting RS485-1 to Panel Buses

NOTE: When connecting RS485-1 of the EAGLE with Panel Bus I/O modules, it is recommended that the slide switch be set to “END.”

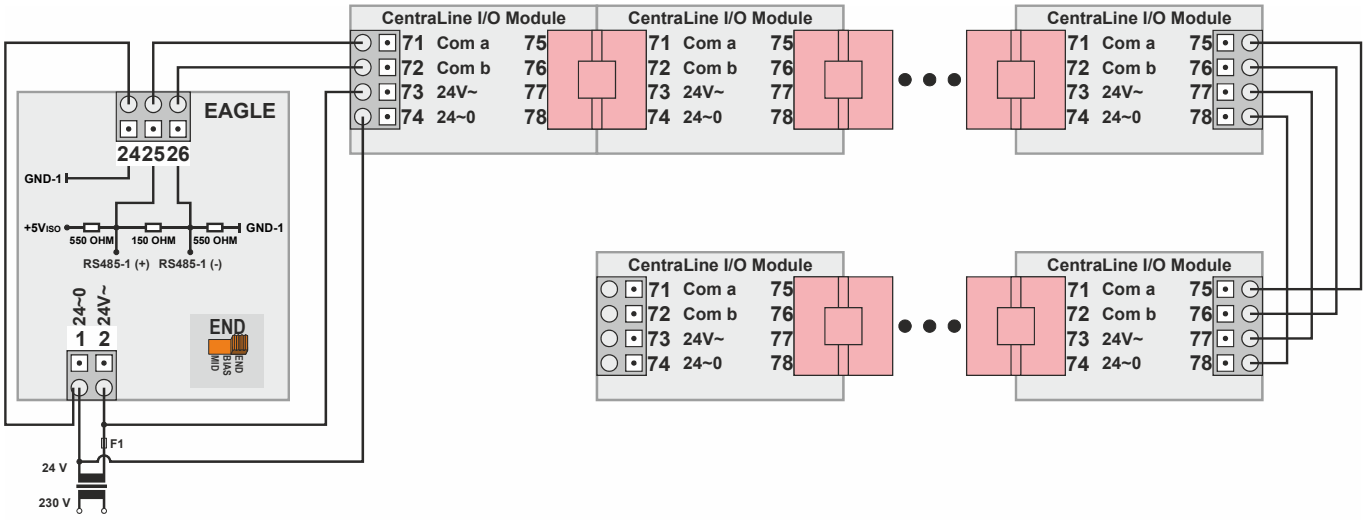


Fig. 29. Connecting RS485-1 of the EAGLE with Panel Bus I/O Modules (single transformer)

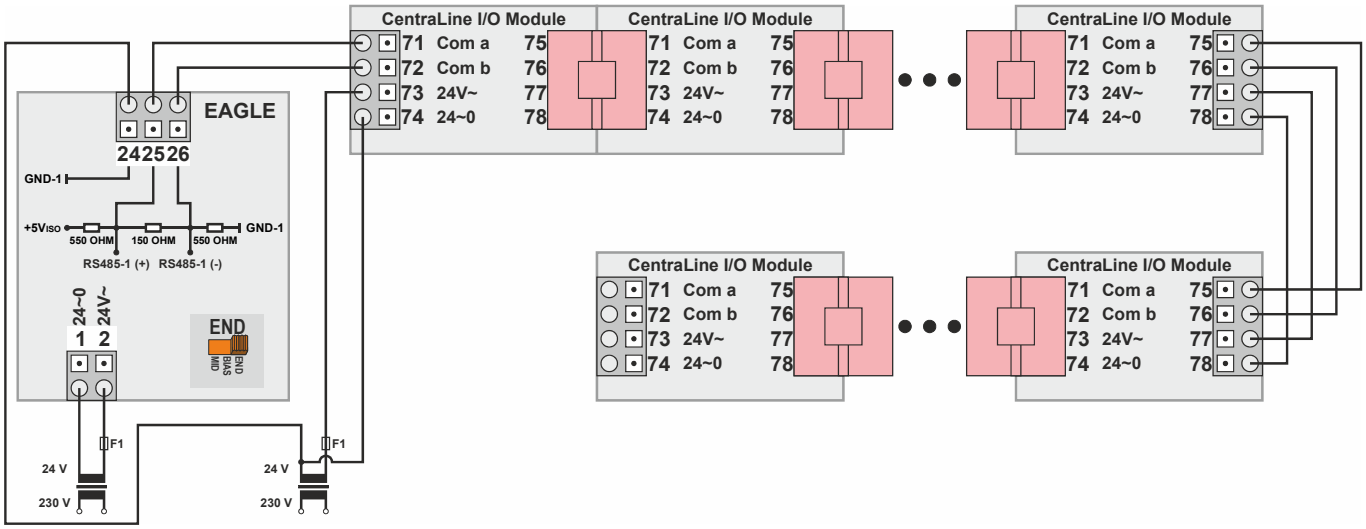


Fig. 30. Connecting RS485-1 of the EAGLE with Panel Bus I/O Modules (two transformers)

Connecting RS485-2 to Panel Buses

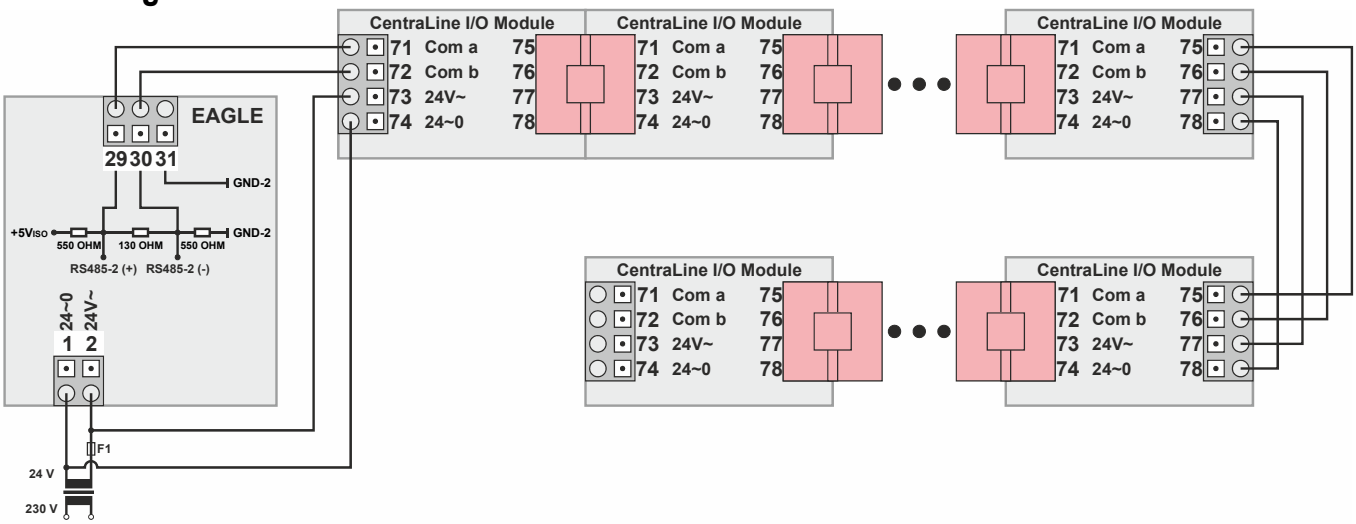


Fig. 31. Connecting RS485-2 of the EAGLE with Panel Bus I/O Modules (single transformer)

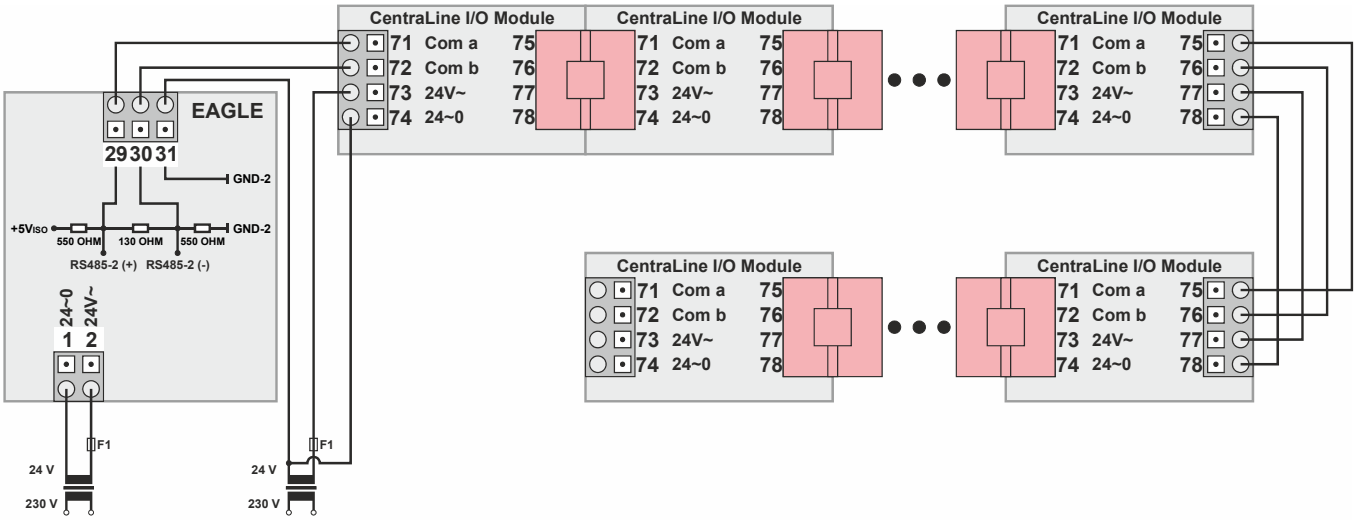


Fig. 32. Connecting RS485-2 of the EAGLE with Panel Bus I/O Modules (two transformers)

Cable Specifications

Panel Bus I/O Modules

When checking the length of the power supply cable, the connection cables to all Panel Bus I/O Modules must be taken into account.

Table 17. Power supply cable specifications

max. length	3 m (from transformer to final module)
cross section	min. 0.75 mm^2 (AWG 18)

Table 18. Communication cable specifications

max. length	40 m
cable type	twisted pair, e.g., J-Y-Y 2 x 2 x 0.8

Field Devices

Depending on the distance from the controller, field devices can be supplied with power by the same transformer used for the Panel Bus I/O Modules, or by a separate transformer, using cables as specified in Table 19.

Table 19. Power / communication cable specifications

type of signal	**cross-sectional area**	
	≤ 100 m (Fig. 21) single transformer	**≤ 400 m (Fig. 20) sep. transformers**
24 VAC power	1.5 mm^2 (16 AWG)	not allowed for > 100 m (300 ft)
0…10 V signals	0.081 – 2.08 mm^2 (28 – 14 AWG)	

For wiring field devices, see section “Powering Panel Bus I/O Modules and Field Devices” on page 12.

Routing Cables to Field Devices

Route low-voltage signal and output cables to field devices separately from mains cables.

Table 20. Minimum distances to power mains cables

cable	**min. distance**
shielded	10 mm (0.4 in.)
unshielded	100 mm (4 in.)

All low-voltage signal and output cables should be regarded as communication circuits in accordance with VDE 0100 and VDE 0800 (or NEC or other equivalent).

- If the general guidelines for cable routing are observed, it is not necessary to shield field device signal and power supply cables.
- If, for whatever reason, the routing guidelines cannot be observed, the field device signal and power supply cables must be shielded.
  - Shielding of cables leading to field devices must be grounded only at one end.
  - Do not connect the shield to the EAGLE Controller.

BACNET MS/TP BUS CONNECTION

The EAGLE Controller features two RS485 interfaces to which BACnet MS/TP devices can be connected: RS485-1 (consisting of push-in terminals 24 [GND-1], 25, and 26) and/or RS485-2 (consisting of push-in terminals 29, 30, and 31 [GND-2]).

NOTE: GND-2 is internally connected with 24V-0 (terminal 1) and system GND (terminals 19+37)

Considerations

- **RS485-1 (isolated)**
  - Max. BACnet MS/TP bus length: 800-1200 meters, depending on baud rate (see section “RS485 Standard” on pg. 8)
  - Must conform to EIA-RS485 cabling guidelines
- **RS485-2 (non-isolated)**
  - Max. BACnet MS/TP bus length: 1200 meters
  - Use only shielded, twisted-pair cable
  - Ground noise should not exceed the EIA-485 common mode voltage limit
  - Must conform to EIA-RS485 cabling guidelines
- **Max. no. of BACnet MS/TP devices per RS485 interface: 32**
- **Max. no of BACnet MS/TP devices per EAGLE: 64**

Connecting RS485-1 to BACnet MS/TP Buses

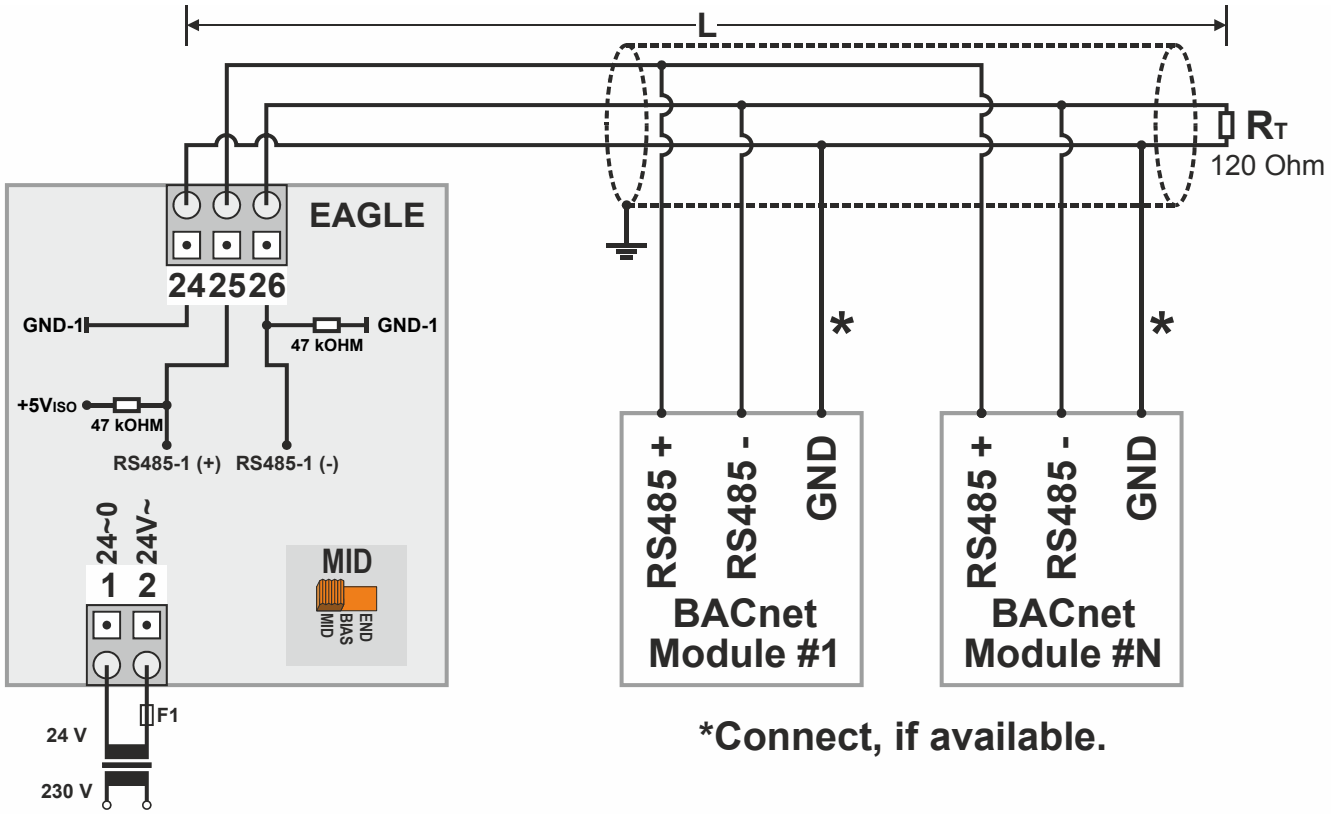


Fig. 33. Connection of RS485-1 to a BACnet MS/TP Bus

NOTE: Always power the EAGLE and connected BACnet MS/TP modules with separate transformers.

NOTE: N = max. 30 modules.

NOTE: For “L,” see section “RS485 Standard” on pg. 8.

NOTE: If any devices are not electrically isolated, signal ground connection is recommended. See section “RS485 Standard” on pg. 8).

Termination resistors must be inserted directly into the terminals of the individual BACnet MS/TP modules. In the above figure, the EAGLE is shown operating as the Master BACnet controller; its slide switch is hence set to “MID.”

Connecting RS485-2 to BACnet MS/TP Buses

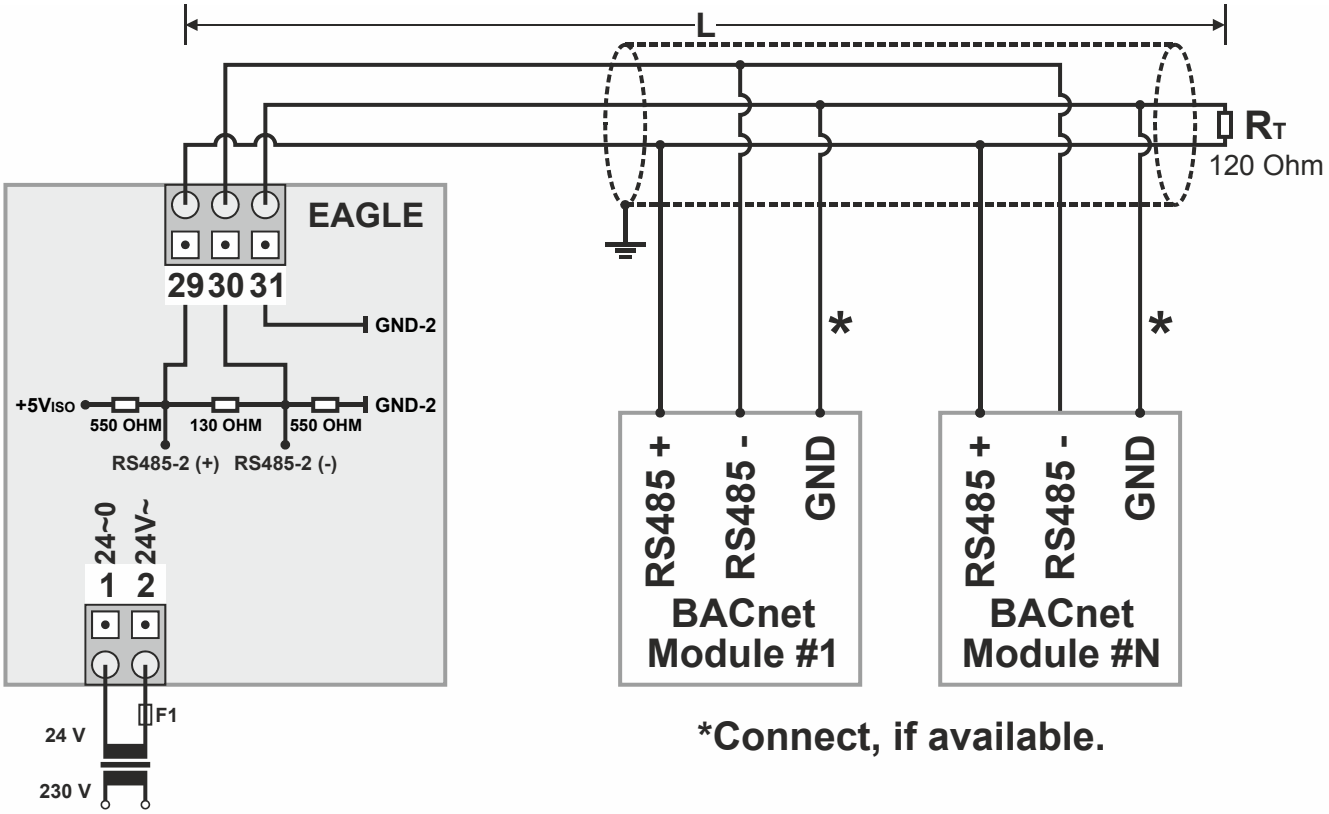


Fig. 34. Connection of RS485-2 to a BACnet MS/TP Bus

NOTE: Always power the EAGLE and connected BACnet MS/TP modules with separate transformers.

NOTE: N = max. 30 modules.

NOTE: For “L,” see section “RS485 Standard” on pg. 8.

NOTE: If any devices are not electrically isolated, signal ground connection is recommended. See section “RS485 Standard” on pg. 8.

NOTE: Between devices equipped with non-isolated RS485 bus interfaces, potential differences of max. ±7 V are allowed. Further, this bus should not extend beyond a single building.

Termination resistors must be inserted directly into the terminals of the individual BACnet MS/TP modules.

TROUBLESHOOTING

EAGLE Controller Troubleshooting

The following LEDs of the EAGLE Controller can be used for troubleshooting purposes:

- Power LED (green)
- Status LED (red)
- Tx (sending data on the isolated BACnet MS/TP Bus) and Rx (receiving data on the isolated BACnet MS/TP Bus) LEDs

Power LED (green) of EAGLE

Table 21. EAGLE Controller power LED

case	power LED	meaning	remedy
1	**ON**	Normal operation	No action necessary.
2	**OFF**	Power supply not OK.	► Check power supply voltage. ► Check wiring. ► If problem persists, replace hardware.

Status LED (red) of EAGLE

Table 22. EAGLE Controller status LED

case	status LED	meaning	remedy
1	LED remains OFF after power-up	Normal operation.	No action necessary.
2	LED remains ON continuously after power-up	– No or invalid firmware, or – No or corrupt application, or – License invalid or feature missing, or – I/O module not found or configuration mismatch, or – Communication error, or – Sensor failure on internal inputs, or – Hardware error detected, or – USB memory stick error.	► Try powering down and then powering up the EAGLE Controller. ► If problem persists, check and – if necessary – reload the application. ► If problem still persists, replace hardware.

Tx and Rx LEDs

Table 23. EAGLE Controller bus LEDs Tx and Rx

case	bus LEDs	meaning	remedy
1	Both Tx and Rx are flashing	Normal operation; the isolated BACnet MS/TP Bus is functioning properly.	No action necessary
2	Both Tx and Rx are OFF	No communication on the isolated BACnet MS/TP Bus.	► Switch ON communication on the isolated BACnet MS/TP Bus. L1 should then flash. Further handling like case 4 (below).
3	Rx is flashing and Tx is OFF	Communication on the isolated BACnet MS/TP Bus has been switched OFF, but the EAGLE is receiving data from other controllers.	► Switch ON communication on the isolated BACnet MS/TP Bus. If this proves unsuccessful, the hardware may be defective.
4	Tx is flashing and Rx is OFF	The EAGLE Controller is attempting to establish communication on the isolated BACnet MS/TP Bus, but there is no answer.	► The communication rate (Kbaud) on the isolated BACnet MS/TP Bus has not been correctly set; other controllers on the bus may have been incorrectly assigned the same device number; wiring problem or hardware defect.

Panel Bus I/O Module Troubleshooting

Please refer to CentraLine I/O Modules - Installation & Commissioning Instructions (EN1Z-0973GE51) for more information about Panel Bus I/O module troubleshooting.

APPENDIX 1: EARTH GROUNDING

EAGLE Systems and SELV

In order to avoid distribution of noise or earth ground potential differences over networks or other connections, the EAGLE Controller is designed to be in compliance with SELV (Safety Extra-Low Voltage).

Furthermore, SELV offers the greatest possible safety against electrical impact.

To support SELV, all Honeywell external (CRT series) or internal transformers comply with standard EN60742.

Earth grounding is therefore not recommended.

EAGLE Systems and Standard EN60204-1

However, if compliance with EN60204-1 is required, note the following:

General Information about EN60204-1

EN60204-1 defines electrical safety for a complete application/machine including controllers, sensors, actuators and any connected/controlled electrical device.

EN60204-1 requires controllers to be powered by PELV (Protective Extra-Low Voltage) and earth grounding of the secondary side of the used transformers or earth grounding of the system ground.

Earth grounding is prescribed to prevent unexpected start-up of connected rotating/moving machines due to an insulation fault and double earth grounding somewhere in the plant.

In order to fulfill PELV (if earth grounding is prohibited), the use of an earth leakage monitor is also possible.

When is EN60204-1 Applicable to EAGLE Systems?

- **Safety against electrical impact**
  - EN60204-1 is not mandatory; this is because electrical safety is provided by the use of SELV and transformers according to standard EN60742.
- **Safety against unexpected start-up of rotating/moving machines**
  - If the application/plant does not contain machines that can be harmful to the operator due to an unexpected start-up, the standard EN60204-1 is not applicable.

If such machines are encountered, then EN60204-1 must be followed. Grounding is required.

Earth Grounding of EN60204-1 Applicable Systems

► If system protective earth grounding is planned, use a cable as short as possible for grounding: min. 1.5 mm² (16 AWG).

► For connection details, refer to the following examples.

Example 1

Connecting and earthing the EAGLE and its Panel Bus I/O Modules together with other controllers (e.g., the LION) and their I/O modules powered by a single transformer and earth-grounded as per EN60204-1.

► Connect earth ground to terminal 1 of the EAGLE Controller. Connect earth ground to terminal 74 of its corresponding Panel Bus I/O Module.

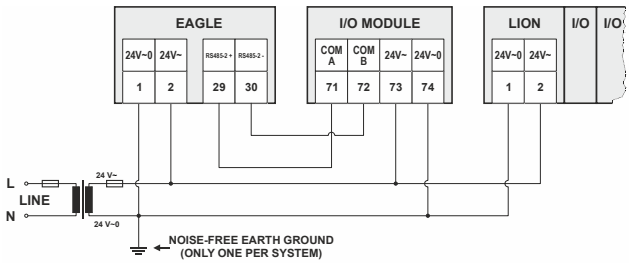


Fig. 35. Connecting and earthing the EAGLE Controller and its Panel Bus I/O Modules together with other controllers

Example 2

Connecting and earthing the EAGLE together with other, mixed controllers earth-grounded as per EN60204-1.

NOTE: Use a noise-free earth ground inside the cabinet.

NOTE: Use one star-point to split power for controllers and field devices.

NOTE: If the transformer is used for several controllers, each controller ground has to be wired separately to the star-point.

NOTE: If a field device that prohibits earth grounding is connected to the system ground, an isolation monitoring device must be used instead of earth grounding.

NOTE: If the field device transformer is physically far away from the controller, earth grounding must still be performed for the controller.

► Connect earth ground to the respective terminal of the controllers, see Fig. 36.

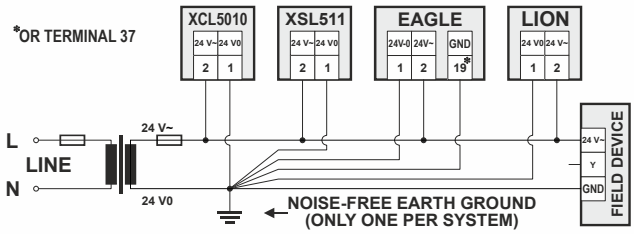


Fig. 36. Connecting and earthing the EAGLE together with other, mixed controllers

APPENDIX 2

Sensor Input Accuracy

The internal sensor inputs of the EAGLE Controller support NTC20kΩ sensors (see also section “Universal Inputs” on page 15). The following table lists the typical minimum accuracies of the hardware and software for temperature sensors.

Table 24. Accuracies of internal NTC20kΩ sensor inputs of the EAGLE

range	measurement error (excl. sensor characteristics)
-50 … -20 °C (-58 … -4 °F)	≤ 5.0 K
-20 … 0 °C (-4 … +32 °F)	≤ 1.0 K
0 … 30 °C (32 … 86 °F)	≤ 0.3 K
30 … 70 °C (86 … 158 °F)	≤ 0.5 K
70 … 100 °C (158 … 212 °F)	≤ 1.0 K
100 … 130 °C (212 … 266 °F)	≤ 3.0 K
130 … 150 °C (266 … 302 °F)	≤ 5.5 K
150 … 400 °C (302 … 752 °F)	--

NOTE: This is the accuracy of the internal sensor input (hardware + software [linearization]), only. This table does not include the characteristics of the sensors, themselves (see section “Sensor Characteristics” below). If a different sensor or sensor accuracy is required, one may instead use the inputs of, e.g., a connected Panel I/O module.

Recognition of Sensor Failure of Sensor Inputs

The thresholds at which sensor failures – i.e., sensor breaks (SB) and short-circuits (SC) – are recognized depends upon the given sensor type. In the event of a recognized sensor failure, the sensor inputs assume the safety values configured in CARE. Table 25 lists the measurement ranges and the corresponding thresholds for the recognition of sensor failure for the various different sensor types:

Table 25. Thresholds for short-circuit (SC) and sensor-break (SB) recognition

I/O configuration	measurement range	recognition thresholds
2…10 V	2…10 V / 4…20 mA (without pull-up)	SC: < 1.5 V / 3 mA; SB: no recognition
NTC20kΩ	-50 … +150 °C	SC: < 20 Ω; SB: < -70 °C

NOTE: In the case of temperatures lying *outside* the aforementioned ranges, the lowest/highest value *within* the range, instead, will be communicated. Thus a temperature of -51 °C will be communicated as “-50 °C.”

Sensor Characteristics

The characteristics (resistance in relation to temperature) of the sensors and the resultant voltage are listed on the following pages. The stated values do not include failures due to: sensor failures; wiring resistance or wiring failures; misreadings due to a meter connected to measure resistance or voltage at the input.

NTC 20 kΩ (same voltages for Panel Bus I/O Modules and EAGLE)

Temp. [°C]	Resistance [kΩ]	Terminal voltage [V]
-50.0	1659	8.78
-49.0	1541	8.77
-48.0	1432	8.76
-47.0	1331	8.75
-46.0	1239	8.74
-45.0	1153	8.72
-44.0	1073	8.71
-43.0	1000	8.70
-42.0	932	8.69
-41.0	869	8.67
-40.0	811	8.66
-39.0	757	8.64
-38.0	706	8.62
-37.0	660	8.60
-36.0	617	8.58
-35.0	577	8.56
-34.0	539	8.54
-33.0	505	8.52
-32.0	473	8.49
-31.0	443	8.47
-30.0	415	8.44
-29.0	389	8.41
-28.0	364	8.38
-27.0	342	8.35
-26.0	321	8.32
-25.0	301	8.28
-24.0	283	8.25
-23.0	266	8.21
-22.0	250	8.17
-21.0	235	8.13
-20.0	221	8.08
-19.0	208	8.04
-18.0	196	7.99
-17.0	184	7.94
-16.0	174	7.89
-15.0	164	7.83
-14.0	154	7.78
-13.0	146	7.72
-12.0	137	7.66
-11.0	130	7.60
-10.0	122	7.53
-9.0	116	7.46
-8.0	109	7.39
-7.0	103	7.32
-6.0	97.6	7.25
-5.0	92.3	7.17
-4.0	87.3	7.09
-3.0	82.6	7.01
-2.0	78.2	6.93
-1.0	74.1	6.85
0.0	70.2	6.76
1.0	66.5	6.67
2.0	63.0	6.58
3.0	59.8	6.49
4.0	56.7	6.40
5.0	53.8	6.30
6.0	51.1	6.20
7.0	48.5	6.10
8.0	46.0	6.00
9.0	43.7	5.90
10.0	41.6	5.80
11.0	39.5	5.70
12.0	37.6	5.59
13.0	35.7	5.49
14.0	34.0	5.38
15.0	32.3	5.28
16.0	30.8	5.17
17.0	29.3	5.07
18.0	27.9	4.96
19.0	26.6	4.85
20.0	25.3	4.75
21.0	24.2	4.64
22.0	23.0	4.53
23.0	22.0	4.43
24.0	21.0	4.32
25.0	20.0	4.22
26.0	19.1	4.12
27.0	18.2	4.01
28.0	17.4	3.91
29.0	16.6	3.81
30.0	15.9	3.71
31.0	15.2	3.62
32.0	14.5	3.52
33.0	13.9	3.43
34.0	13.3	3.33
35.0	12.7	3.24
36.0	12.1	3.15
37.0	11.6	3.06
38.0	11.1	2.97
39.0	10.7	2.89
40.0	10.2	2.81
41.0	9.78	2.72
42.0	9.37	2.64
43.0	8.98	2.57
44.0	8.61	2.49
45.0	8.26	2.42
46.0	7.92	2.34
47.0	7.60	2.27
48.0	7.29	2.20
49.0	7.00	2.14
50.0	6.72	2.07
51.0	6.45	2.01
52.0	6.19	1.94
53.0	5.95	1.88
54.0	5.72	1.82
55.0	5.49	1.77
56.0	5.28	1.71
57.0	5.08	1.66
58.0	4.88	1.61
59.0	4.69	1.56
60.0	4.52	1.51
61.0	4.35	1.46
62.0	4.18	1.41
63.0	4.03	1.37
64.0	3.88	1.32
65.0	3.73	1.28
66.0	3.59	1.24
67.0	3.46	1.20
68.0	3.34	1.16
69.0	3.21	1.13
70.0	3.10	1.09
71.0	2.99	1.06
72.0	2.88	1.02
73.0	2.78	0.991
74.0	2.68	0.960
75.0	2.58	0.929
76.0	2.49	0.900
77.0	2.41	0.872
78.0	2.32	0.844
79.0	2.24	0.818
80.0	2.17	0.792
81.0	2.09	0.767
82.0	2.02	0.744
83.0	1.95	0.720
84.0	1.89	0.698
85.0	1.82	0.676
86.0	1.76	0.655
87.0	1.70	0.635
88.0	1.65	0.616
89.0	1.59	0.597
90.0	1.54	0.578
91.0	1.49	0.561
92.0	1.44	0.544
93.0	1.40	0.527
94.0	1.35	0.511
95.0	1.31	0.496
96.0	1.27	0.481
97.0	1.23	0.466
98.0	1.19	0.452
99.0	1.15	0.439
100.0	1.11	0.425
101.0	1.08	0.413
102.0	1.05	0.401
103.0	1.01	0.389
104.0	0.98	0.378
105.0	0.95	0.367
106.0	0.92	0.356
107.0	0.90	0.346
108.0	0.87	0.336
109.0	0.84	0.326
110.0	0.82	0.317
111.0	0.79	0.308
112.0	0.77	0.299
113.0	0.75	0.290
114.0	0.73	0.282
115.0	0.70	0.274
116.0	0.68	0.266
117.0	0.66	0.259
118.0	0.64	0.252
119.0	0.63	0.245
120.0	0.61	0.238
121.0	0.59	0.231
122.0	0.57	0.225
123.0	0.56	0.219
124.0	0.54	0.213
125.0	0.53	0.207
126.0	0.51	0.201
127.0	0.50	0.196
128.0	0.49	0.191
129.0	0.47	0.186
130.0	0.46	0.181
131.0	0.45	0.176
132.0	0.43	0.171
133.0	0.42	0.167
134.0	0.41	0.162
135.0	0.40	0.158
136.0	0.39	0.154
137.0	0.38	0.150
138.0	0.37	0.146
139.0	0.36	0.142
140.0	0.35	0.139
141.0	0.34	0.135
142.0	0.33	0.132
143.0	0.32	0.128
144.0	0.32	0.125
145.0	0.31	0.122
146.0	0.30	0.119
147.0	0.29	0.116
148.0	0.29	0.113
149.0	0.28	0.110
150.0	0.27	0.107

INDEX

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