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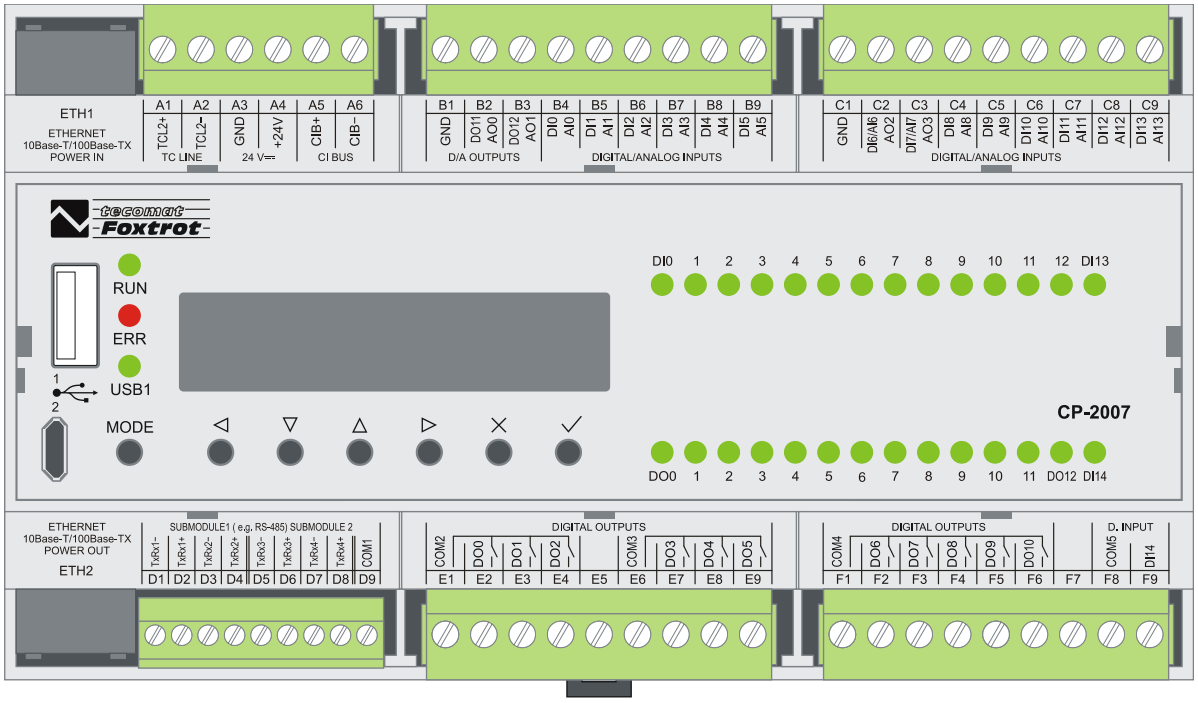

PROGRAMMABLE CONTROLLERS
TECOMAT FOXTROT
CP-2007

PROGRAMMABLE CONTROLLERS TECOMAT FOXTROT CP-2007

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1. FIRST ACQUAINTANCE WITH TECOMAT FOXTROT 2 PROGRAMMABLE LOGIC CONTROLLERS

TECOMAT FOXTROT 2 programmable controllers represent a new generation of control systems based on the previous TECOMAT FOXTROT series. These are small compact machines with the possibility of modular expansion. They combine the advantages of compact automata in terms of size and modular systems in terms of scalability and variability.

The individual modules of the system are enclosed in plastic protective cases, which are mounted on the U-rail ČSN EN 50022. Thanks to this, they can be handled without risk of damage to sensitive CMOS components. The whole system is designed according to the standard ČSN EN 61131.

The basis of the system

The basis of the FOXTROT 2 system is a basic module containing a central unit, various combinations of inputs and outputs and in most variants also a built-in display of 4 x 20 characters and 7 buttons.

Communication interface

The basic modules of the TECOMAT FOXTROT 2 series are equipped with two independent 10/100 Mb Ethernet interfaces. Optionally, they may include a WLAN interface for WiFi communication and an LTE interface for communication over a GSM network.

For serial communication, up to 2 submodules containing 1 or 2 serial channels with RS-232 or RS-485 interfaces can be optionally installed in the basic module. So the basic module can be equipped with a maximum of four serial channels. An additional 6 serial channels can be added using the SC-11xx modules on the TCL2 bus. RS-232 / RS-485 interfaces, CAN interfaces and wireless networks are available here.

Construction of an extensive system

The PLC base module can be extended by connecting peripheral modules if necessary. The expansion peripheral modules are connected to the central unit via serial buses. As a result, the individual parts of the TECOMAT FOXTROT system can be deployed in a decentralized manner so that the individual modules are located directly next to the controlled technologies and thus save power cabling.

Connection with superior system

The entire system can communicate with master systems (computers [NOHRES]PC, operator panels, etc.), which can be used for both monitoring and controlling the controlled process. The personal computer is also used to create and debug the PLC user program.

2. FOXTROT CP - 2007 BASIC PARAMETERS

2.1. TECOMAT FOXTROT 2 SYSTEM PARAMETERS

The TECOMAT FOXTROT 2 PLCs are designed for U-rail mounting. Plastic module housings allow installation in standard house distribution boards. The basic parameters of the PLC are shown in Table 2.1 to Table 2.5.

All modules of the FOXTROT 2 PLC are equipped with a plastic protective case and a holder for mounting the module on the U-rail.

Attention!	**The modules contain components sensitive to electrostatic charge, therefore we observe the principles for working with these circuits! Handling is performed only on the module with disconnected power supply of both the module itself and the input and output signals!**

The widths of all modules of the assembly are always the whole multiple of the dimension 17.5 mm marked with the letter M. This value usually corresponds to the width of circuit breakers and other wiring elements mounted on the U-rail. The width of the base module CP-2090 corresponds to 3M, the width of the peripheral modules corresponds to 4M, 3M or 1M. The dimensions of the basic modules are shown in Pic. 2.1.

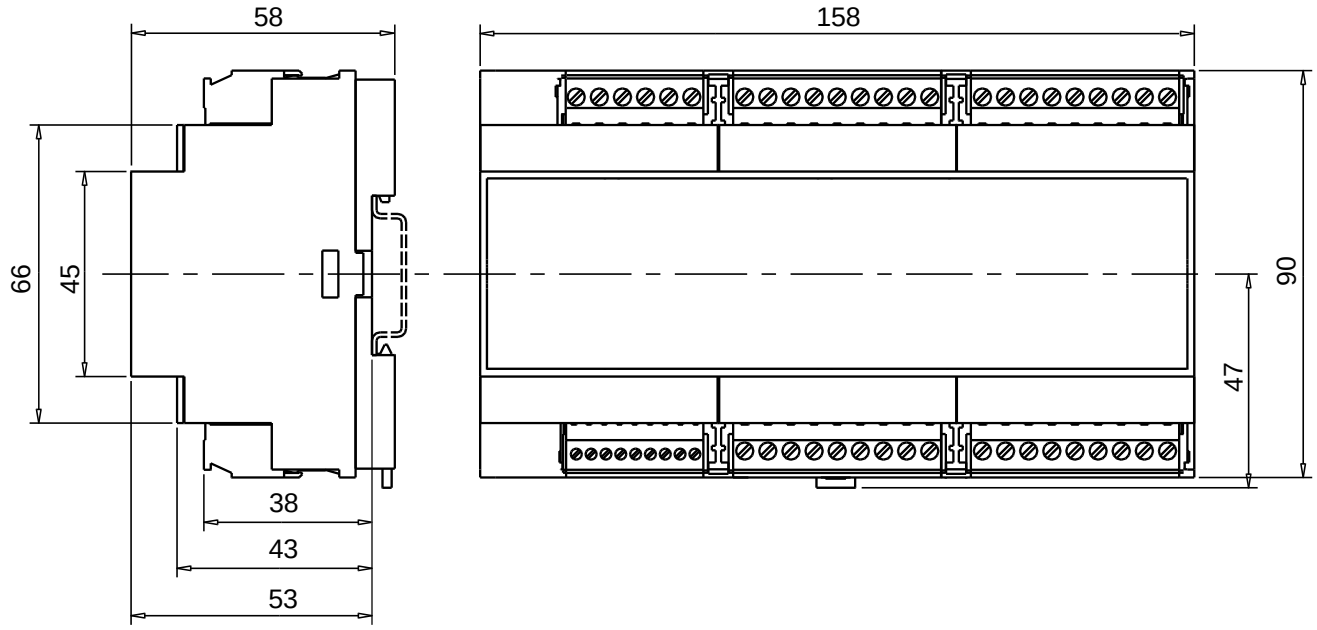


Fig.2.1 Dimensions of basic modules CP-2007

Tab.2.1 Basic parameters

Product standard	ČSN EN 61131-2:2008 (idt IEC 61131-2:2007)
Protection class of electrical object (ČSN EN 61140:2003, idt IEC 61140:2001)	II
Type of device	built-in
Degree of protection (ČSN EN 60529:1993, idt IEC 529:1989)	IP20
Lifetime	10 years

Tab.2.2 Operating conditions

Spaces (ČSN 33 2000-3:1995, idt. IEC 364-3:1993)	normal
Operating temperature range	–20 °C up to + 55 °C
Permissible temperature during transport	–25 °C up to +70 °C
Relative air humidity	10 % up to 95 % without condensation
Atmospheric pressure	min. 70 kPa (< 3000 m n. m.)
Degree of pullution (ČSN EN 60664-1:2004, idt. IEC 60664-1:1992)	1
Overvoltage category of installation (ČSN EN 60664-1:2004, idt. IEC 60664-1:1992)	II
Working position	vertical
Type of operation	permanent
Vibration resistance (sinusovým) [1]	10 up to 57 Hz - amplitude 0,075 mm 57 up to 150 Hz - acceleration 1G
Electromagnetic compatibility:	
Emission (EN 55022:1999, idt. CISPR22:1997)	Class A [2]
Immunity	min. as required ČSN EN 61131-2:2008

[1] Fc test according to EN 60068-2-6: 1997 (idt IEC 68-2-6: 1995), 10 cycles per axis.

[2] This product may cause radio interference in areas where radio and television receivers are expected to be within 10 m of the listed equipment. In this case, the user may be required to take appropriate action.

Tab.2.3 Storage conditions

Storage environment	dry clean rooms without conductive dust, aggressive gases or acid vapors for a period not exceeding the warranty period
Storage temperatures	–25°C up to +70°C without sudden temperature changes
Relative humidity	max. 80% without condensation vapors

Tab.2.4 Transport conditions

Transport environment	covered transport means, transport packaging must not be exposed to rain and snow
Transport temperatures	–25°C up to +70°C

Tab.2.5 System characteristics

Executing the user program • • Cyclic, multi-loop control
User program • programming according to IEC 61131 (languages: ST, LD, FBD, CFC, SFC) • 1 MB of memory for user program code • 320 KB for program variables, of which max. 48 KB is backed up (RETAIN) • automatic storage of program code in non-volatile memory • possibility to automatically save program source code in PLC system during programming • uploading the user program to the PLC via USB / Ethernet / WiFi / LTE
Basic PLC modes • RUN - user program execution, technology control • HALT - zastavení vykonávání uživatelského programu, programování PLC • Possibility to change mode by command over communication channel
Blocking of PLC outputs • command over the communication channel • automatically after a serious system error
Hardware diagnostics • watchdog • Power fail monitoring, data protection in case of power failure • securing serial communications • securing data transmission over the I / O bus
Software diagnostics • checking the validity of the user program • monitoring the cycle time of the user program • continuous checking of the correctness of the user program (non-existent jump destination, memory overflow, division by zero, unknown instruction, etc.)
Communication • Serial in EPSNET, MODBUS, CAN • general serial asynchronous • Ethernet UDP / TCP / IP interface, USB host, USB device, WLAN, LTE, RS-232, RS-485
Other functions • automatic recognition of connected peripheral modules • user program backup and project archiving in PLC memory • communication support for data monitoring by the superior system • možnost vykonávání uživatelského programu bez aktivace periferních modulů • Additional memory for archiving DataBox data • RTC circuit • Support for PLC variable analyzer • Possibility of fixing inputs and outputs of peripheral modules • program change on the fly (online editing) • micro SD card • integrated Web server • Datalogger function

2.2. TECOMAT FOXTROT CP-2007 BASIC MODULES

Basic module assembly

The basic module TECOMAT FOXTROT CP-2007 contains a central unit with two independent Ethernet interfaces, one USB device interface for connection of the master system and one USB host interface for connection of external memory (USB Flash drive).

The peripheral part of the basic module contains 14 universal inputs (binary / analog), 1 230 V AC input, 11 relay outputs and 2 10 V analog outputs. These two analog outputs can be switched to binary output mode supporting PWM mode by using jumpers. Two additional analog outputs can be obtained instead of two universal inputs by switching over additional jumpers.

The basic module has an integrated display of 4 x 20 characters and 7 buttons. In addition to system setup and diagnostics, the display and buttons can also be used in the user program.

The basic module also includes a slot for mounting an additional micro SD memory card (not available with WLAN1). Some variants of the basic module are equipped with internal WLAN1 interface for WiFi network or LTE1 interface for GSM network (see below).

A TCL2 system bus can be connected to the base module to communicate with FOXTROT family peripheral modules and CIB Common Installation Bus® (trademark of Teco a.s., hereinafter referred to as CIB) for communication with CFox family modules.

Optionally, the basic module can be equipped with two submodules with serial channels.

Basic module variants

The TECOMAT FOXTROT CP-2007 basic module is available in several variants distinguished by a combination of numbers and characters following the dot in the order number (eg TXN 120 07.11NDNN). In this way, the combined variants with different memory sizes for the DataBox, with optional WLAN1 and LTE1 interfaces and with different integrated display sizes are defined. The principle of marking individual variants is given in Table 2.6.

Tab.2.6 Identification of variants of basic modules TECOMAT FOXTROT CP-2007

variant	**2007**	CP-2007
Databox	**1**	Databox size 128 KB
	2	Databox size 256 KB
procesoru type	**1**	ARMv7 792 MHz, 1 core
WLAN interface	**N**	unfitted
	W	internal WLAN1 interface
display	**D**	OLED display 55 x 13 mm
LTE modem	**N**	unfitted
	L	fitted with LTE1 modem
reserve	**N**	

TXN 1 2007 . 1 1 N D N N

Note.: If no WLAN1 is installed, an internal micro SD card slot can be used. If the WLAN1 interface is fitted, the use of an additional micro SD card is not possible.
All CP-2007 variants include an integrated 55 x 13 mm display.

As shown in Table 2.6, a specific TXN 120 variant 07.11NDLN represents the basic CP-2007 module with inputs and outputs in 14 DI / AI, 1 DI, 11 DO, 2 AO configuration, as well as 128 KB memory for DataBox, single core ARMv7 792 processor MHz, without internal WLAN1 interface, integrated display is 55 x 13 mm and internal LTE1 interface is fitted.

An overview of the features of the variants of the basic modules CP-2007 is given in Table 2.7.

Tab.2.7 Variants of basic modules CP-2007

Type	Description	Order number
Common features of the basic modules CP-2007:		
CP-2007	14 optional inputs - binary 24 V / analogue (unipolar voltage and current ranges, passive resistance sensors, 12 bits), 4 of these inputs usable for counters 1 binary input 230 V AC 11 relay outputs 250 V / 3 A 2 selectable analog outputs 0 - 10 V (12 bit) / transistor 24 V DC usable as PWM outputs 2 analog outputs 0 - 10 V (12 bits) selectable by jumper instead of two binary / analog inputs central unit series I OLED display 4 x 20 characters, 6 user buttons 2 10/100 Mb Ethernet interfaces 1 USB device interface 1 USB host interface 1 TCL2 bus line 1 CIB bus line 2 slots for submodules with serial channels (up to 4) or other devices	TXN 120 07.x1xDxN
Other features of individual variants:		
	DataBox memory size selection (available for all variants) - 128 KB DataBox memory - 256 KB DataBox memory	 TXN 120 07.11xDxN TXN 120 07.21xDxN
	optional internal WLAN1 interface - unditted - fitted	 TXN 120 07.x1NDxN TXN 120 07.x1WDxN
	optional internal LTE1 interface - unfitted - fitted	 TXN 120 07.x1xDNN TXN 120 07.x1xDLN

Basic parameters of the basic modules CP-2007 are given in Table 2.8.

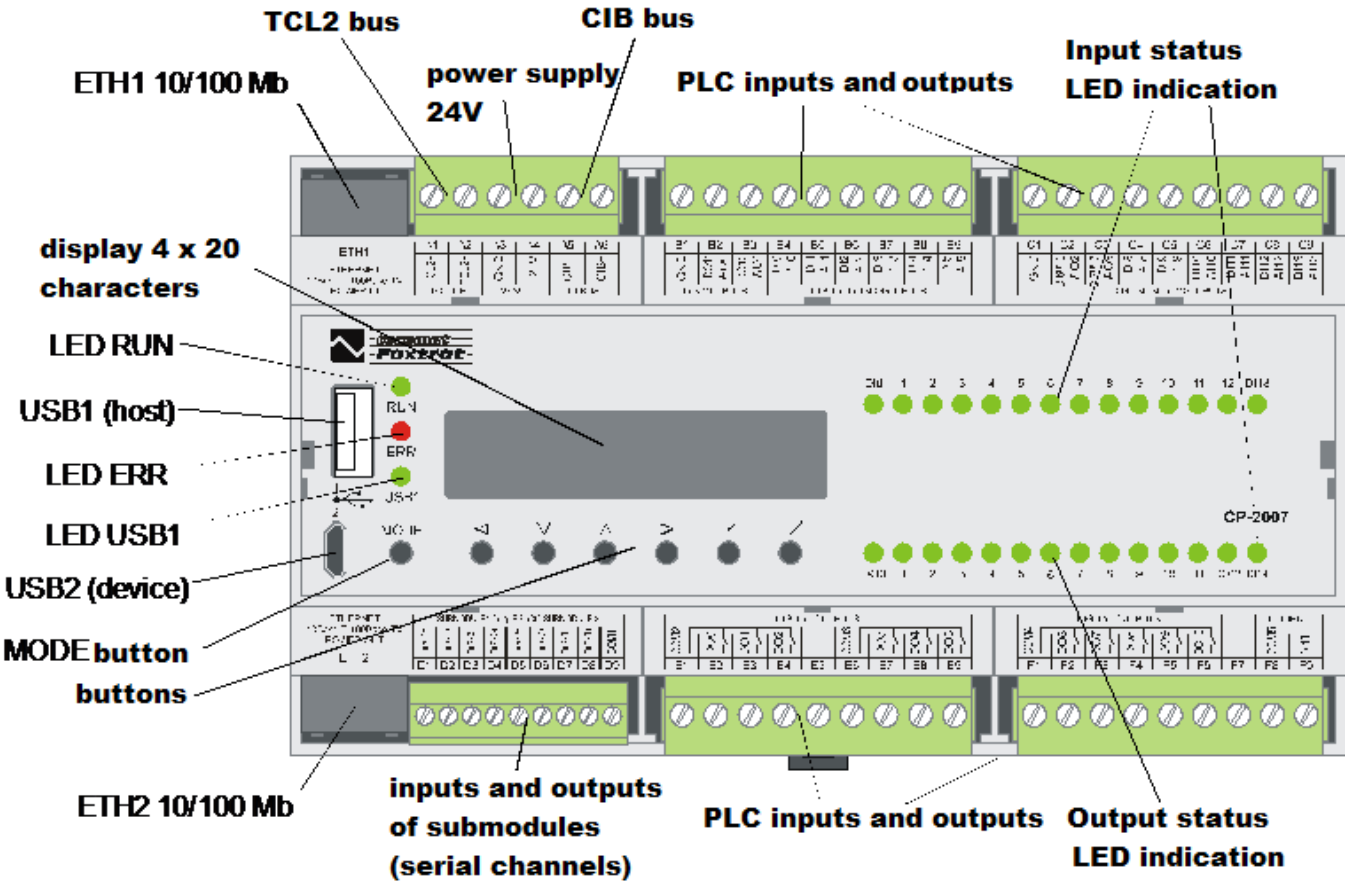


Fig.2.2 CP-2007 basic module without WLAN1 or LTE1 interface (TXN 120 07.x1NDNN)

Tab.2.8 Basic parameters of basic modules

Central unit type	CP-2007
Module power supply	
Supply Voltage (SELV)	24 V DC, +25%, –15%
Internal protection	reversible fuse
Maximum power consumption	10 W
Connection of wires to the module	
Type of terminals	removable terminal blocks
Conductor cross-section	max. 2,5 mm^2 max. 1,5 mm^2
- power supply, buses, inputs and outputs	RJ-45 connector
- bringing out submodules	connector type micro B
Ethernet interface	connector type A
USB device interface	
USB host interface	158 × 90 × 58 mm
Mechanical design of the module	9M
Module dimensions	yes
Module width in multiples of M (17.5 mm)	
Holder for U rail	no [1]
Inputs and outputs	15 [2]
Galvanic separation of power supply from internal circuits	14 [2]
Number of inputs	4
of which optionally binary / analogue	1
including optional binary / analog / counter	15 [2]
of which binary 230 V AC	11
Number of outputs	2 [2]
of which relay	2
of which analogue	
of which optionally analog / transistor	2
Communication channels	1
Ethernet 10/100 Mb	1
USB device interface	optional
USB host interface	optional
WLAN interface	4
LTE interface	6
Serial channels on submodules	
Additional serial channels via separate modules	4 x 20
SC-11xx on TCL2 bus	6
User display	
User display (number of characters)	1 10 I/O modules, 4 operator panels
Number of custom buttons	1 32 CFox I/O modules

[1] Only relay outputs and submodules are galvanically isolated.

[2] Two analog outputs are selectable by jumpers instead of two binary / analog inputs (each separately).

[3] The CP-2007 modules have an internal CIB power supply, the power of which allows modules to be consumed less than 100 mA on the CIB. In case of higher consumption, an external separation module C-BS-0001M should be used.

Power supply for the basic module and bus connection

CP-2007 basic modules are supplied with 24 V voltage, which is connected to terminals A3 and A4 in the field marked 24 V DC. Note that both internal and peripheral circuits (except for relay outputs and submodules) are not galvanically isolated. Thus, at terminal A3 there is a common ground for the entire module.

Attention! Pay close attention to connecting the power supply. If 24 V is connected to terminals other than the power supply, part of the system may get damaged!

In the TC LINE field, the TCL2 system bus is connected to terminals A1 and A2, which is used to connect additional peripheral modules (Chapter 2.3.). The connection is made by connecting one TCL2 + terminal of all modules and the other TCL2– terminal. For details, refer to the TECOMAT FOXTROT 2 Programmable Controllers (TXV 004 50.01) documentation.

In the CI BUS field, CIB is connected to terminals A5 and A6. For details on the CIB bus and modules connected via this bus, see the CIB Bus Peripheral Modules (TXV 004 13.01) manual.

Tab.2.9 Terminal board A connection

A1	TCL2+	TCL2 system bus
A2	TCL2–	TCL2 system bus
A3	GND	ground module
A4	+24V	power supply
A5	CIB+	CIB bus
A6	CIB–	CIB bus

The CP-2007 base module can also be powered via the ETH1 interface using a power injector. The 24 V supply voltage is routed through the Ethernet cable by two pairs of wires not used for signals (see chapter 3.3.1.).

The connected operating panel of the ID-3x type can be powered via the ETH2 interface (see chapter 3.3.1).

2.3. TECOMAT FOXTROT PERIPHERAL MODULES

Peripheral modules of the FOXTROT system

All FOXTROT peripheral modules listed in Table 2.10 are fitted with a plastic protective case and a holder for mounting the module on the U-rail. They are connected to the basic FOXTROT PLC module via TCL2 bus.

For details on these modules, refer to the TECOMAT FOXTROT PLC Peripheral Modules (TXV 004 12.01) manual.

Tab.2.10 FOXTROT system peripheral module variants

Type	Description	Order number
UC-1203	MP-BUS connection for Belimo elements	TXN 112 03
UC-1204	Open Therm bus connection	TXN 112 04
IB-1301	12 24 V binary inputs, 4 of which can be used as counter inputs	TXN 113 01
OS-1401	12 binary transistor outputs 24 V	TXN 114 01
IR-1501	4 24 V binary inputs usable as counter inputs 8 relay outputs	TXN 115 01
IT-1602	8 analog inputs (bipolar low voltage ranges, thermocouples, 16 bit) 2 analog bipolar voltage outputs (10 bits)	TXN 116 02
IT-1604	8 analog inputs (unipolar voltage and current ranges, passive resistance sensors, 16 bit) 2 analog unipolar voltage outputs (10 bits)	TXN 116 04
IT-1605	8 analog inputs (bipolar low voltage ranges, thermocouples, 16 bit, differential connection) 2 analog bipolar voltage outputs (10 bits)	TXN 116 05
OT-1651	4 analog unipolar voltage and current outputs (12 bits)	TXN 116 51
IC-1701	8 binary inputs 5 - 24 V usable as inputs up to 4 counters, 2 counters up to 100 kHz and 2 counters up to 5 kHz depending on the mode 4 transistor outputs 10 - 30 V DC usable as outputs PWM, or for controlling up to 2 stepper motors	TXN 117 01

System communication modules of FOXTROT system

With the help of system communication modules, the FOXTROT 2 PLC can be extended with additional serial channels, which become part of the central unit. Communication parameters are set in the Mosaic development environment within the project.

These modules are fitted with a plastic protective sleeve and a U-rail mounting bracket. They are connected to the FOXTROT 2 PLC basic module via TCL2 bus. Due to the transmission capacity of this bus, these serial channels are suitable for data and time-consuming communication. For details on how to install these modules, refer to the TECOMAT FOXTROT PLC Peripheral Modules (TXV 004 12.01) manual.

For a more detailed description of serial communications and their use, see the TECOMAT FOXTROT 2 Programmable Logic Controller (TXV 004 50.01) manual.

Tab.2.11 Variants of peripheral modules of FOXTROT system

Type	Description	Order number
SC-1101	1 serial channel RS-232 / RS-485 (UNI mode)	TXN 111 01
SC-1102	1 CAN bus line (CSJ mode)	TXN 111 02
SC-1111	communication with RFox 2 wireless devices (UNI mode)	TXN 111 11
SC-1112	wireless M-Bus communication (UNI mode)	TXN 111 12

Operator panels

The operator panels listed in Table 2.12 are connected to the basic PLC FOXTROT module via the TCL2 bus, the same way as conventional peripheral modules. Up to four panels can be connected to one base module.

Tab.2.12 Variants of operator panels connectable to the FOXTROT system on the TCL2 bus

Type	Description	Order number
ID-14	4 x 20 characters display, 25 buttons	TXN 054 33

Text operator panel ID-14

The ID-14 operator panel features a 4 x 20 character display and 25 buttons. The display supports Windows charsets CP1250 (WinLatin2 - Central European), CP1251 (WinCyrillic - Cyrillic) and CP1252 (WinLatin1 - Western European).

For correct connection, select the Foxtrot CPU type in the panel setup mode and then set the panel address in the range 8 to 11 (of course, if several panels on one bus, each address must have a different address). The rack address must always be 0.

The ID-14 operator panel enables the installation of a short U-rail, on which the FOXTROT PLC back-up module can be mounted. This makes it easy to obtain a compact PLC with display and keyboard.

For detailed information on connecting and operating the ID-14 panel, refer to the ID-14 Operator Panel (TXV 002 33.01) manual.

Attention! All modules contain components sensitive to electrostatic charge, therefore we observe the principles for working with these circuits!
Handling is performed only on the module with disconnected power supply of the module itself, as well as input and output signals!

3. CENTRAL UNIT CP-2007

Central unit properties

The central unit is the main component of the FOXTROT 2 PLC basic module.
Its main task is to execute the user program, control the PLC inputs and outputs and communicate with the PLC environment.

Each central unit in TECOMAT PLC systems has an assigned letter that determines the series. Each serie of central units has its specific features important for the user program compiler, such as the scope of the instruction file and the way it is coded, the variable mapping and the memory space, etc..

Tab.3.1 Basic parameters of the central unit CP-2007

Module type	**CP-2007.x1xxxx ARMv7 792 MHz, 1 core**
Row of central unit	I
User program memory	1 MB
Instruction length	4 bytes
Backup of program source code in PLC	yes, optional in Mosaic
On-line program change in PLC	yes, including I / O configuration changes
Memory for user program variables	320 KB
of which for RETAIN variables	48 KB
IEC timers / counters	supported
Number of IEC timers / counters	limited only by memory size
Cycle time per 1k of logic instructions	0.036 ms
Cycle time for 1k integer operations	0.043 ms
Cycle time for 1k floating point operations	0.044 ms
Additional DataBox memory (internal)	128/256 KB (depending on variant)
Memory for I / O data	64 KB / 64 KB
File system	
PLC internal disk	128 MB, journaling FS
RAM disk PLC	16 MB
USB Flash Drive	supported
Micro SD card	supported (except WLAN1 variants)
Development environment	Mosaic v2018.2 or higher
Programming languages	ST, LD, FBD, CFC, SFC (from 2Q 2019)
Real Time Circuit (RTC)	Yes
RTC backup	type. 500 h
Integrated Web server	Yes
Integrated Datalogger	Yes
Access to PLC variables via web API	Yes

The central units in the FOXTROT CP-2007 systems are Series I. These units have the following features:

- 1 MB of memory for user programs
- internal 128 MB file system for project archiving
- optional 128/256 KB FRAM memory for DataBox archiving)
- 320 KB of memory for variables, of which 48 KB for RETAIN variables
- RTC real time circuit

- integrated Web server
- integrated Datalogger
  possibility of on-line change of user program (without stopping control)

Mode and diagnostic messages are displayed on the integrated display.

Configuration of the whole PLC

The configuration of the whole PLC is done from a web browser at the IP address set by the user or the address assigned by the DHCP server on port 8080 or 8443. For the factory default IP address of the ETH1 interface set by the manufacturer (192.168.134.176), enter http: //192.168. 134.176: 8080 or https://192.168.134.176:8443. The computer must be in the same local network as the PLC system. If the PLC IP address is assigned from a DHCP server, it is possible to display this address on the basic module display using the buttons. The same address must then be entered in the browser's address bar instead of the default IP address.

PLC configuration pages can also be accessed from the browser by entering https: //foxtrot.local: 8443. The advantage of this procedure is that you do not need to know the IP address of the PLC. This option can be used only on computers that support the so-called ZeroConf, which is a technique by which the PLC computer in the local network can only communicate based on the name (foxtrot.local). Only one PLC system can be connected in the local network at a time.

Built-in web server allows:

- get information about installed firmware versions and hardware used
- update the entire PLC firmware
- set the PLC date and time, including the time zone
- set automatic time synchronization with NTP server (s)
- access to system logs (system start, boot system, system update)
- setting of all network interfaces (ETH1, ETH2, WLAN1, LTE1)
- PLC parameter settings (EPSNET communication parameters, PLC web server settings, TecoRoute settings, access to PLC log files, application profile management)
- PLCComS server settings
- service settings (Avahi, FTP, Samba)
- web server settings (user settings, certificate settings)

The first time you access the PLC configuration site, you must first enter the login information (access name and password). After login, it is possible to add other users, edit their login data or remove some users (see the Web / Users tab).

If the user loses or forgets the login data, then it is possible to delete the currently set login data in the PLC using the buttons and the display on the basic module. If you then access the configuration site, you will be required to set a new username and password for access.

For details on the operation and behavior of the central apartment unit, refer to the TECOMAT FOXTROT 2 programmable logic controllers (TXV 004 50.01) documentation.

3.1. INDICATING ELEMENTS AND SETTINGS

Indication LED diodes

The basic modules contain RUN and ERR LEDs, which indicate the central unit mode (see table 3.2). The USB1 LED indicates the status of the USB host interface and the LTE LED indicates the status of the LTE interface, if present.

The remaining LEDs located on the right side of the front panel of the base module indicate that the inputs and outputs are energized.

Tab.3.2 Overview of basic module LEDs

name	color	behaviour	function
RUN	green	shines	central unit working, user program not executed (HALT, PROG mode)
		flashes	the central unit works, the user program is executed (RUN mode)
ERR	red	shines	error indication reported by the central apartment unit
USB1	green	shines	A USB storage device has been connected to the USB host
LTE	green	shines, flashes	the LTE interface is active
		off	LTE interface not fitted
other	green	shines	Indication of excitation of DI inputs and DO outputs

MODE button

The basic module is equipped with seven buttons. While the six buttons beneath the display are intended, among other things, for application use, the MODE button on the far left is used to switch the display between the user and system display modes.

In RUN mode, the display is switched to user mode and displays the texts defined by the running application program. By briefly pressing the MODE button, the display switches to the system mode, displaying the PLC mode. Use the arrow keys to scroll through other screens showing PLC firmware version information, ETH1 and ETH2 interface parameters, the total size of available storage media, and user program information (name, version, and user program compilation date and time). Press the MODE button briefly again to switch the display back to user mode.

In other modes, when the user program is not running, the display is switched to system mode by default. If the user program does not operate the display, the display remains in system mode.

When the PLC power is turned on during the power up sequence, the MODE button has several functions. If the button is not pressed during the switch-on sequence, the PLC switches to one of the operating modes (RUN, HALT with error, etc.).

If you press and hold the MODE button while the PLC firmware version is displayed (after the PLC power is turned on), the following menu appears on the display:

- Set ETH1 - setting of ETH1 parameters
- Set ETH2 - setting of ETH2 parameters
- Web Pass - deletion of PLC site configuration data
- Exit - end setting, change to RUN or HALT mode

By means of the buttons marked with cursor arrows we can choose between offered actions. Selection can be made with the □ (enter) button, the X (cancel) button can be used to cancel the selected action.

3.2. BACKUP REAL TIME CIRCUIT POWER SUPPLY

When the PLC supply voltage is turned off, the real-time and calendar (RTC) data is backed up. Backup is provided by a supercap, which lasts for about 500 hours.

3.3. COMMUNICATION INTERFACE

As already mentioned, the basic FOXTROT 2 PLC modules contain two independent Ethernet interfaces, two USB interfaces. Serial channels are realized by replaceable submodules MR-013x and external modules SC-11xx.

Tab.3.3 Communication options of the central unit

Module type	CP-2007
Ethernet 10/100 Mb	2
USB device interface	1
USB host interface	1
WLAN1 interface	by variant
LTE1 interface	by variant
Number of serial channels	
on the MR-0130 - MR-0134 submodule	4
on SC-11xx modules on TCL2	6
TCL2 bus	1
CIB bus	1

Communication options

serial channels on the MR-0130 - MR-0134 submodule
- **UNI** mode - general channel with any asynchronous communication

serial channels on modules SC-1101, SC-1111, SC-1112
- **UNI** mode - general channel with any asynchronous communication

serial channels on SC-1102 modules
- **CSJ** mode - CAN bus connection

Ethernet interface ETH1, ETH2, WLAN1, WLAN2, LTE1
- **PC** mode - communication with superior systems using EPSNET UDP and EPSNET TCP protocols
- **PLC** mode - data sharing between PLCs, FOXTROT (CP-1xxx) and TC-700 systems can be in the network
- **PLD** mode - data sharing between PLC FOXTROT 2 with possibility to encrypt shared data
- **UNI** mode - exchange of general data by UDP and TCP protocols with support for SSL / TLS encoding

Custom communication parameters are set in the Mosaic development environment within the project. The Ethernet, LTE, WLAN interface configuration is done via the web server directly on the basic module (see below).

The default Ethernet interface setting is as follows:

ETH1 - fixed IP address 192.168.134.176, mask 255.255.255.0, gateway not set
ETH2 - DHCP enabled - IP address assignment expected by DHCP server (including mask, gateway address and DNS server addresses)

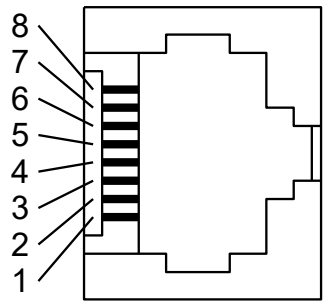
A more detailed description of the communication modes can be found in the TECOMAT FOXTROT 2 programmable logic controllers (TXV 004 50.01) documentation.

3.3.1. Ethernet interface

The basic modules are equipped with two independent 10/100 Mb Ethernet interfaces labeled ETH1 and ETH2. Each Ethernet interface is fitted with a standard RJ-45 connector. The connector is ready for use with common UTP patch cables. Both interfaces are designed to allow both straight and crossover cables.

The CP-2007 base module can also be powered via the ETH1 interface using a power injector. The 24 V supply voltage is routed through an Ethernet cable of two pairs of wires not used for signals (Table 3.4). Power is supplied to each pole by a pair of wires. The polarity of the power supply does not matter, it is treated by the input rectifier on the PLC side. As a result, both straight and crossover cables can be used in this case.

Tab.3.4 Connection of ETH1 interface (PLC front view)



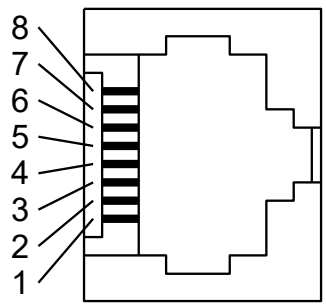
Pin	Signál	Wire color
8	PWRB	Brown
7	PWRB	white / brown
6	RD– or TD–	green or orange
5	PWRA	white / blue
4	PWRA	blue
3	RD+ or TD+	white / green or white / orange
2	TD– or RD–	orange or green
1	TD+ or RD+	white / orange or white / green

PWRA, PWRB one and the other pole of 24 V DC PLC power supply (polarity doesn't matter)
RD+, RD– positive and negative wire of the receiver signal
TD+, TD– positive and negative transmitter signal wires

Note.: The variant connection of RD and TD signals depends on the cable used (straight or cross). The color of the wires allows accurate signal identification.

The connected ID-3x operating panel can be powered via the ETH2 interface via the power injector. The wiring of the ETH2 interface is similar to the ETH1, with the exception that the 24 V power supply output for the operating panel is shown here (tab 3.5).

Tab.3.5 Connection of the ETH2 interface (PLC front view)



Pin	Signál	Wire color
8	PWO–	Brown
7	PWO–	white / brown
6	RD– nebo TD–	green or orange
5	PWO+	white / blue
4	PWO+	blue
3	RD+ nebo TD+	white / green or white / orange
2	TD– nebo RD–	orange or green
1	TD+ nebo RD+	white / orange or white / green

PWO+, PWO– the positive and negative terminals of the 24 V DC power output for the ID-3x operating panel (the jumper must be plugged into position ETH2 PWR)
RD+, RD– the positive and negative wire of the receiver signal
TD+, TD– the positive and negative conductors of the transmitter signal

Note.: The variant connection of RD and TD signals depends on the cable used (straight or cross). The color of the wires allows accurate signal identification.

This function is conditioned by inserting the jumper on the tips marked ETH2 PWR on the back of the bottom plate next to the replaceable submodules (Fig. 3.1). Use the screwdriver to release the latches on the bottom of the PLC base module housing. After removing the bottom of the housing, the bottom plate with replaceable sub-modules and ETH2 PWR tips is accessible.

ATTENTION! The modules contain components sensitive to electrostatic charge, therefore we observe the principles for working with these circuits!
We only handle the module without power supply!

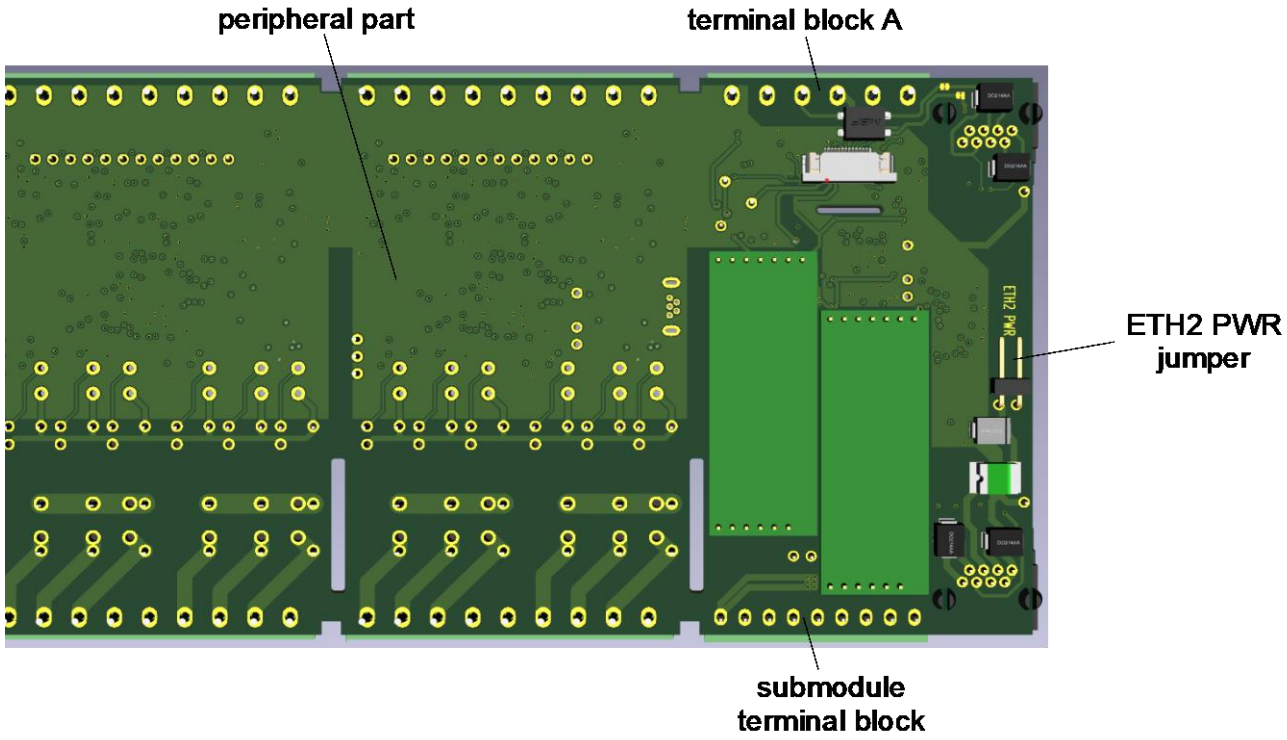


Fig.3.1 Placing the ETH2 PWR jumper on the base plate of the base module after removing the bottom of the housing

3.3.2. USB interface

Basic modules are equipped with USB host interface with type A connector for external memory (USB1) and USB device interface with micro B connector for connection of Mosaic development environment (USB2).

3.3.3. Serial channels

The basic module itself does not contain serial channels, but up to 4 serial channels can be supplemented with replaceable submodules MR-0130 - MR-0134. These are standard serial channels with RS-232 or RS-485 interface. Their list and configuration are given in chapter 4.8.1.

An additional 6 serial channels can then be added via separate SC 11xx communication modules on the TCL2 bus, which contain both standard serial channels and a connection to the CAN bus or to a wireless network (Chapter 2.3).

4. PERIPHERAL PART

The peripheral part of the CP-2007 modules contains 14 multi-purpose inputs, 1 230 V AC input, 11 relay outputs and 4 analog outputs. Multipurpose inputs can be used as binary inputs DI0 - DI13 or as analog inputs AI0 - AI13. Two analog outputs can also work as transistor outputs in PWM mode. The other two analog outputs are available alternatively instead of two multi-purpose inputs.

Table 4.1 shows the wiring of the terminals in terminal blocks A to F. The wiring of terminal block D is dependent on the installed submodules and its variants are given in chapter 3.4.

Tab.4.1 Connection of terminal blocks of basic module CP-2007

A1	TCL2+	TCL2 system bus
A2	TCL2–	TCL2 system bus
A3	GND	ground module
A4	+24V	power supply
A5	CIB+	CIB
A6	CIB–	CIB
B1	GND	ground module
B2	AO0 / DO11	AO0 analog output / DO11 transistor output
B3	AO1 / DO12	AO1 analog output / DO12 transistor output
B4	DI0 / AI0	binary input DI0 / analogue input AI0
B5	DI1 / AI1	binary input DI1 / analogue input AI1
B6	DI2 / AI2	binary input DI2 / analog input AI2
B7	DI3 / AI3	binary input DI3 / analogue input AI3
B8	DI4 / AI4	binary input DI4 / analogue input AI4
B9	DI5 / AI5	binary input DI5 / analogue input AI5
C1	GND	ground module
C2	DI6 / AI6 / AO2	binary input DI6 / analog input AI6 / analog output AO2
C3	DI7 / AI7 / AO3	binary input DI7 / analogue input AI7 / analogue output AO3
C4	DI8 / AI8	binary input DI8 / analogue input AI8
C5	DI9 / AI9	binary input DI9 / analogue input AI9
C6	DI10 / AI10	binary input DI10 / analog input AI10
C7	DI11 / AI11	binary input DI11 / analog input AI11
C8	DI12 / AO2	binary input DI12 / analog input AI12
C9	DI13 / AO3	binary input DI13 / analogue input AI13
D1	wiring according to mounted submodule 1	
D2		
D3		
D4		
D5	wiring according to mounted submodule 2	
D6		
D7		
D8		
D9	COM1	ground submodules

Tab.4.1 CP-2007 Base Module Terminal Wiring (continued)

E1	COM2	common wire of outputs DO0 - DO2
E2	DO0	relay output DO0
E3	DO1	relay output DO1
E4	DO2	relay output DO2
E5		
E6	COM3	common wire of outputs DO3 - DO5
E7	DO3	relay output DO3
E8	DO4	relay output DO4
E9	DO5	relay output DO5
F1	COM4	common conductor of outputs DO6 - DO10
F2	DO6	relay output DO6
F3	DO7	relay output DO7
F4	DO8	relay output DO8
F5	DO9	relay output DO9
F6	DO10	relay output DO10
F7		
F8	COM5	neutral wire of input DI14
F9	DI14	binary input DI14

The setting field on the front side of the CP-2007 basic module under the label of the terminal blocks B and C (fig. 4.1) allows configuration of inputs and outputs DI0 / AI0 - DI13 / AI13, DO11, DO12, AO0 - AO3.

Connect the peaks of the respective signal in the field (for position see fig.4.1) or do not connect the jumper in accordance with table 4.2.

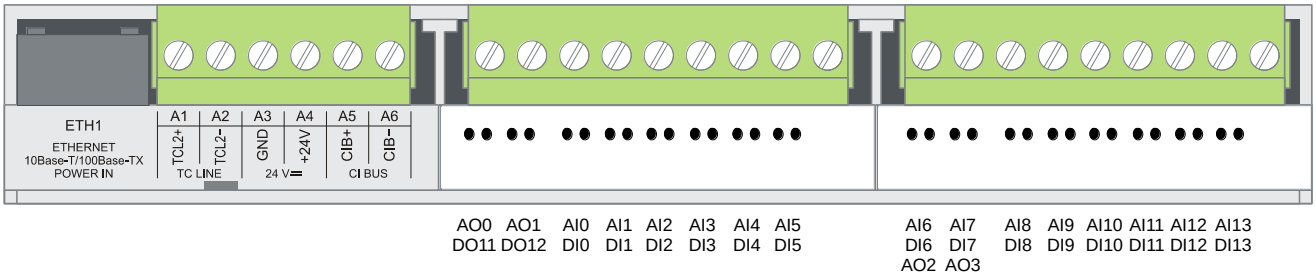


Fig.4.1 Adjustment field on the front of CP-2007

Tab.4.2 Input mode setting

Clamp	Signal	Jumper settings	Signal function
B2	DO11 / AO0	●●	Binary output DO11, PWM11
		■	Analog output AO0
B3	DO12 / AO1	●●	Binary output DO12, PWM12
		■	Analog output AO1
B4	DI0 / AI0	●●	Binary input DI0 Analog input AI0 - voltage or resistence measurement
		■	Analog input AI0 - current measurement
B5	DI1 / AI1	●●	Binary input DI1 Analog input AI1 - voltage or resistance measurement
		■	Analog input AI1 - current measurement

Tab.4.2 Setting the input mode (continued)

Clamp	Signal	Jumper settings	Signal function
B6	DI2 / AI2	●●	Binary input DI2 Analog input AI2 - voltage or resistance measurement
		■	Analog input AI2 - current measurement
B7	DI3 / AI3	●●	Binary input DI3 Analog input AI3 - voltage or resistance measurement
		■	Analog input AI3 - current measurement
B8	DI4 / AI4	●●	Binary input DI4 Analog input AI4 - voltage or resistance measurement
		■	Analog input AI4 - current measurement
B9	DI5 / AI5	●●	Binary input DI5 Analog input AI5 - voltage or resistance measurement
		■	Analog input AI5 - current measurement
C2	DI6 / AI6 / AO2	●●	Binary input DI6 Analog input AI6 - voltage or resistance measurement
		■	Analog output AO2
C3	DI7 / AI7 / AO3	●●	Binary input DI7 Analog input AI7 - voltage or resistance measurement
		■	Analog output AO3
C4	DI8 / AI8	●●	Binary input DI8 Analog input AI8 - voltage or resistance measurement
		■	Analog input AI8 - current measurement
C5	DI9 / AI9	●●	Binary input DI9 Analog input AI9 - voltage or resistance measurement
		■	Analog input AI9 - current measurement
C6	DI10 / AI10	●●	Binary input DI10 Analog input AI10 - voltage or resistance measurement
		■	Analog input AI10 - current measurement
C7	DI11 / AI11	●●	Binary input DI11 Analog input AI11 - voltage or resistance measurement
		■	Analog input AI11 - current measurement
C8	DI12 / AI12	●●	Binary input DI12 Analog input AI12 - voltage or resistance measurement
		■	Analog input AI12 - current measurement
C9	DI13 / AI13	●●	Binary input DI13 Analog input AI13 - voltage or resistance measurement
		■	Analog input AI13 - current measurement

4.1. BINARY INPUTS

The binary inputs are used to connect two-state signals of the controlled object to the PLC. CP-2007 basic modules contain 15 binary inputs DI0 - DI14.

Inputs DI0 - DI13 are not galvanically isolated from the PLC internal circuits. The switching on of the input is signaled by the lighting of the corresponding LED. Inputs DI0 - DI13 have one

common terminal minus connected to the module ground as well as outputs DO11, DO12, AO0 - AO3.

The inputs can also be used as analog inputs AI0 - AI13. If a single input is not used for analog measurement, it acts as a binary input.

The DI14 input is galvanically isolated from the PLC's internal circuits and allows to connect a 230 V AC signal, such as a HDO signal. The switching on of the input is signaled by the lighting of the corresponding LED. Input DI14 has both ends separately.

Inputs DI3 - DI5 and DI8 - DI12 enable short pulse capture. This function extends the selected input signal level until the PLC turns. This ensures that we do not miss a single pulse on the input, less than the PLC cycle time.

Inputs DI4, DI5, DI8 and DI9 can also be used as counter inputs. Even when used as counter inputs, the inputs are simultaneously usable as binary inputs.

Note: If a short pulse capture function is activated on an input, the counter object that uses that input must not be turned on at the same time. If this happens, the short pulse capture function is automatically turned off..
When an input is set in analog metering mode, neither the short pulse capture function nor the counter object can be activated on it.

Inputs DI6 / AI6 and DI7 / AI7 are connected to the same terminals as outputs AO2 and AO3. The function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

The other jumpers are used to select the analog current input.

Attention! Inputs used as binary must not have any jumpers inserted in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

Tab.4.3 Basic parameters of binary inputs

Module type	**CP-2007**	
Number of inputs	15	
Diagnostics	signaling of energized input on the panel	
Designation	DI0 - DI13	DI14
Number of inputs per group	14	1
Galvanic separation from internal circuits	ne	yes
Common wire	minus	-
Input type	typ 1	conventional switch
Input voltage		
for log.0 (UL)	max. +5 V DC	max. 120 V AC min. 0 V AC
for log.1 (UH)	min. +15 V DC typ. +24 V DC max. +30 V DC	min. 200 V AC typ. 230 V AC max. 250 V AC
Input current at log.1	typ. 5 mA	typ. 5 mA
Delay from log.0 to log.1	500 µs	10 ms
Delay from log.1 to log.0	500 µs	10 ms
Minimum pulse width	500 µs	-

The binary inputs are connected to terminals in the DIGITAL / ANALOG INPUTS field. Fig. 4.2 and Fig.4.3 show schematically the connection of switches.

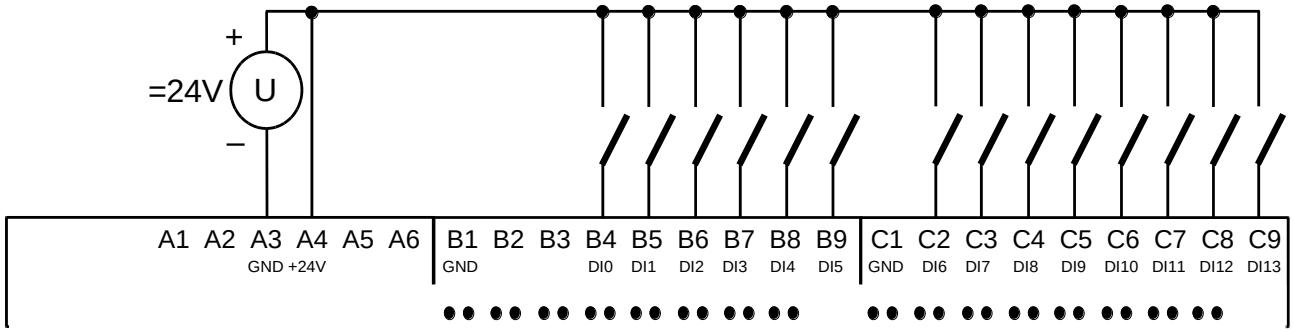


Fig.4.2 A typical example of connecting switches to binary inputs DI0 - DI13

Attention! Note that the GND terminals in the 24 V DC (A3), D / A OUTPUTS (B1), and DIGITAL / ANALOG INPUTS (C1) arrays are connected inside the system. It is not desirable to connect the terminals B1 and C1 to the negative pole of the power supply to the system and the inputs, as this would cause the loop to be closed through terminal A3 and thus the possible induction of interfering signals. Terminals B1 and C1 are designed for connecting analog signals.

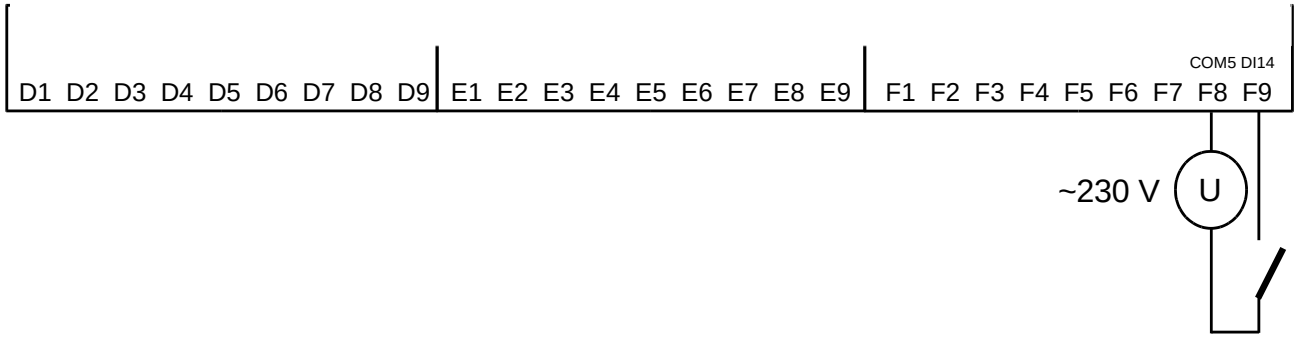


Fig.4.3 A typical example of connecting a switch to binary input DI14

4.2. RELAY OUTPUTS

Relay outputs are used to control two-state control and signaling elements of a control object powered by AC or DC voltage up to 250 V. Outputs are realized by a normally open normally open relay contact grouped with one common terminal. CP-2007 basic modules contain 11 DO0 - DO10 relay outputs organized in two groups of three outputs with a common terminal. Outputs are galvanically separated from both PLC internal circuits and both groups. The energizing (switching) of the output is signaled by the lighting of the respective LED.

The binary output relay contacts are routed to the terminals in the DIGITAL OUTPUTS field. Fig.4.4 shows schematically the connection of loads supplied from independent sources. Overload and short circuit protection is provided by fuses separately for each output, eventually for the whole group. The rated current and fuse type are chosen according to the load and the nature of the load, taking into account the maximum current and overload capacity of the output or group of outputs. For example, when using tube fuses with fusing characteristics T and F and a tripping capacity of 35 A, the fuse rating can be selected up to 3 A when fusing individual outputs, and the fuse current rating up to 10 A.

The principle of various methods of inductive load treatment, aids for design of RC suppressors, an overview of sets of suppressors supplied by the PLC manufacturer and other recommendations are given in the TECOMAT FOXTROT TXV 004 11.01 Programmable Controller Design Guide.

Tab.4.4 Basic parameters of relay outputs

Module type	**CP-2007**		
Number of outputs	11		
Number of groups x number of outputs per group	2 x 3	1 x 5	
Designation	DO0-2, DO3-5	DO6	DO7-10
Galvanic separation from internal circuits	yes (even groups to each other)		
Diagnostics	signaling of energized output on the panel		
Output type	electromechanical relay, unprotected output		
Contact type	switching		
Switching voltage	max. 250 V min. 5 V	max. 250 V min. 5 V	max. 250 V min. 5 V
Switching current	max. 3 A min. 100 mA	max. 10 A min. 100 mA	max. 3 A min. 100 mA
Short-term output overload capacity	max. 4 A	max. 10 A	max. 4 A
Common clamp current	max. 10 A	max. 10 A	max. 10 A
Contact closing time	typ. 10 ms	typ. 10 ms	typ. 10 ms
Contact opening time	typ. 4 ms	typ. 4 ms	typ. 4 ms
Switching load limit values			
for resistive load (at 30 V DC or	max. 3 A	max. 10 A	max. 3 A
230 V AC)	max. 3 A	max. 10 A	max. 3 A
for inductive DC13 load (at 30 V DC)	max. 3 A	max. 10 A	max. 3 A
for inductive load AC15 (at 230 V AC)	max. 300 switches / min.	max. 300 switches/ min.	max. 300 switches/ min.
Switching frequency without load	max. 20 switches / min.	max. 6 switches/ min.	max. 20 switches/ min.
Switching frequency with rated load	min. 5 000 000 cycles		
Mechanical life			
Electrical life at maximum load	min. 100 000 cycles		
for resistive load	min. 100 000 cycles		
for inductive DC13 load	min. 100 000 cycles		
for inductive load AC15	none		
Short-circuit protection	external - RC element, varistor, diode (DC)		
Treatment of inductive load			
Insulation voltage	3750 V AC		
between outputs and internal circuits	3750 V AC		

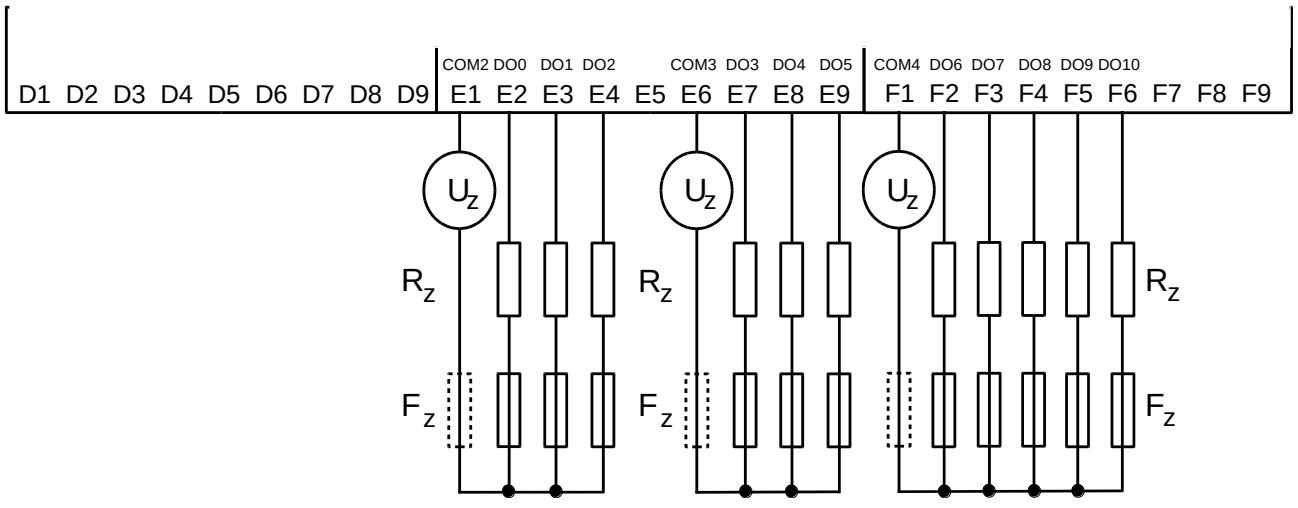


Fig.4.4 Typical example of load connection to relay outputs

4.3. TRANSISTOR OUTPUTS

The transistor outputs are used to control two-state actuating and signaling elements of a controlled object powered by 24 V DC. The CP-2007 basic modules contain 2 transistor outputs DO11 and DO12. Outputs DO11 and DO12 are not galvanically separated from PLC internal circuits, they have common ground with universal inputs DI0 - DI13 and analog outputs AO0 - AO3. They enable independent operation in PWM mode (pulse width modulation - chapter 5.3.5.).

Outputs DO11 and DO12 are connected to the same terminals as outputs AO0 and AO1. The function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

Tab.4.5 Basic parameters of transistor outputs DO11 and DO12

Module type	**CP-2007**
Number of outputs	2
Number of outputs in group	2 (together with DI0 - DI13)
Galvanic separation from internal circuits	No
Diagnostics	signaling of energized output on the panel
Output type	transistor output MOSFET (low side switch)
Switching voltage	max. 30 V min. 5 V
Switching current	constant max.0,5 A short term max. 3 A
Output resistance	typ. 0,16 Ω max. 0,4 Ω
On / off time	typ. 9 / 13 µs
Protection against overvoltage, short circuit and overheating	Yes

The transistor outputs are connected to the terminals in the D / A OUTPUTS field on the terminal B. Fig. 4.5 schematically indicates the load connection to the transistor outputs.

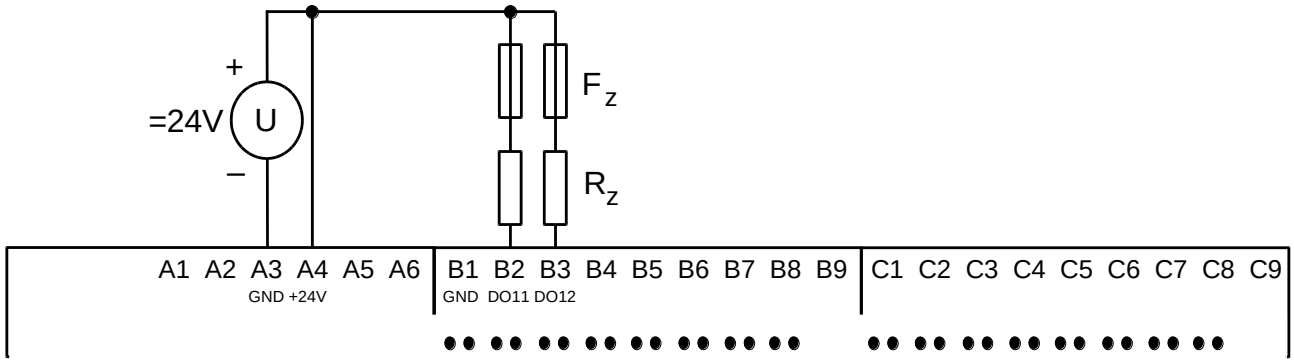


Fig.4.5 A typical example of connecting loads to transistor outputs

In order to increase the durability and service life of the inductive load, it is necessary to treat the switched loads with appropriate interference suppression elements. Principles of different methods of inductive load treatment, design tools for RC suppressors, overview of suppressor sets supplied by the PLC manufacturer and other recommendations are given in the TECOMAT FOXTROT TXV 004 11.01 Programmable Controller Design Guide.

4.4. ANALOG INPUTS

The analog inputs are used to connect the analog signals of the controlled object to the PLC. CP-2007 basic modules contain 14 analog inputs AI0 - AI13, which are physically identical with binary inputs DI0 - DI13. The inputs are not galvanically isolated from the PLC internal circuits. All inputs have one common negative terminal.

If a single input is not used for analog measurement, it acts as a binary input.

Analog inputs AI0 - AI5, AI8 - AI13 also allow current measurement. To do this, use the setting field on the front of the basic module CP-2007 under the label of the terminal blocks B and C (Fig. 4.1). If you want to measure the current, connect the corresponding peaks in the setting field with the jumper (chap.4, tab.4.2).

Analog inputs AI6 and AI7 are connected to the same terminals as outputs AO2 and AO3. The function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

Tab.4.6 Basic parameters of analog inputs

Module type	**CP-2007**
Number of inputs	14 (variant function of inputs DI0 - DI13)
Number of inputs per group	14 (together with AO0 - AO3)
Galvanic separation from internal circuits	No
Diagnostics	overload signaling in status word
Common wire	minus
External power supply	No
Converter type	approximation
Time of transfer	20 µs
Digital resolution	12 bit
Measuring range / resolution (1 LSB)	
voltage ranges	0 to +10 V / 2.579 mV
	0 to +2 V / 805.9 µV
current ranges *	0 to 20 mA / 8.059 µA
	4 to 20 mA / 8.059 µA
passive temperature sensors	Pt1000 1,385 (-90 to +400 ° C)
	Pt1000 1,391 (-90 to +400 ° C)
	Ni1000 1,617 (–60 to +200 ° C)
	Ni1000 1,500 (–60 to +200 ° C)
	NTC thermistor 5 kΩ / 25 °C (–40 až +125 °C)
	NTC thermistor 10 kΩ / 25 °C(–40 až +125 °C)
	NTC thermistor 12 kΩ / 25 °C(–40 až +125 °C)
	NTC thermistor 15 kΩ / 25 °C(–40 až +125 °C)
	NTC thermistor 20 kΩ / 25 °C(–40 až +125 °C)
resistance ranges	0 to 2 kΩ
	0 to 200 kΩ

* Analog inputs AI6 and AI7 do not allow current measurement

Tab.4.7 Basic parameters of voltage input ranges

Module type	CP-2007
Input impedance in signal range	> 20 kΩ
Analog input error	
maximum error at 25 ° C	± 0.4% of full scale
temperature coefficient	± 0.03% of full scale / K
nonlinearity	± 0.07% of full scale
repeatability under steady state conditions	0.05% of full scale
Max. permissible permanent overload (without damage)	–20 - +30 V (each AI terminal against GND) *
Overload signaling	in the status word
Open input detection	No

* The corresponding input jumper **must not be set for current measurement**. In current measurement mode, the input can withstand a permanent overload without damage only ± 5 V!

Tab.4.8 Basic parameters of current input ranges

Module type	CP-2007
Input impedance in signal range	100 Ω
Analog input error	
maximum error at 25 ° C	± 0.4% of full scale
temperature coefficient	± 0.03% of full scale / K
nonlinearity	± 0.07% of full scale
repeatability under steady state conditions	0.05% of full scale
Max. permissible permanent overload (without damage)	± 5 V / 50 mA (each AI terminal against GND)
Overload signaling	in the status word
Open input detection	in status word (under-range - 4 ÷20 mA only)

Tab.4.9 Basic parameters of input ranges for passive resistance sensors

Module type	CP-2007	
Ranges	Pt1000, Ni1000, KTY81-121, 2 kΩ	NTC termistor, 200 kΩ
Input impedance in signal range	> 20 kΩ	
Analog input error		
maximum error at 25 ° C	± 0,5% of full scale ± 10% of full scale 1	± 0,5% of full scale ± 10% of full scale 1
temperature coefficient	± 0.05% of full scale / K	
nonlinearity	± 0.09% of full scale	
repeatability under steady stateconditions	0.07% of full scale	
Maximum permissible permanent overload	–20 - +30 V	
(without damage)	(each terminal AI against GND) 2	
Overload signaling	in the status word	
Open input detection	No	

[1] When measuring resistances larger than approx. 50 kΩ, the converter resolution decreases significantly and the measurement error increases. This range is primarily intended for NTC and similar thermistors where the accuracy of negative temperature measurements is not critical.

[2] The corresponding input jumper must not be set for current measurement. In current measuring mode, the input can withstand a permanent overload without damage only ± 5 V!

The analog inputs are connected to terminals in the DIGITAL / ANALOG INPUTS field. Fig. 4.6 shows schematically the connection of individual signal sources to analog inputs.

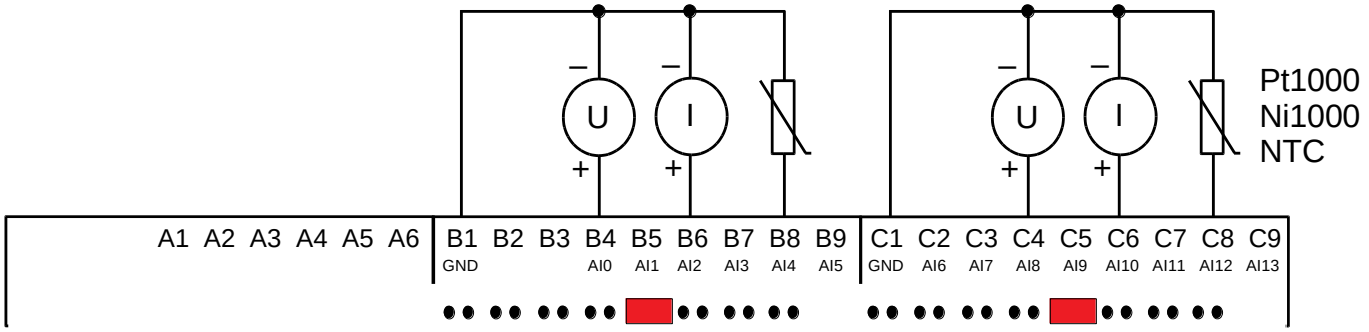


Fig.4.6 A typical example of connecting signals to analog inputs

4.5. ANALOG OUTPUTS

The analog outputs are used to control the analog actuators and control elements of the control object. CP-2007 basic modules contain 4 analog outputs AO0 - AO3. Outputs are voltage 0 ÷ 10V. Voltage over 10.5 V can be set at 105% overload. Analog outputs are not galvanic separated from internal circuits. Common terminals minus universal inputs DI0 / AI0 - DI13 / AI13 and analog outputs are connected.

Outputs AO0 and AO1 are connected to the same terminals as outputs DO11 and DO12. Outputs AO2 and AO3 are connected to the same terminals as inputs DI6 / AI6 and DI7 / AI7. In all cases, the function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2)..

Tab.4.10 Basic parameters of analog outputs

Module type	**CP-2007**
Number of outputs	4
Number of outputs in group	4 (together with AI0 - AI13)
Output type	active voltage output
Galvanic separation from internal circuits	No
Common wire	minus
External power supply	No
Time of transfer	10 µs
Digital resolution	12 bit
Output Range / Resolution (1 LSB)	0 to +10 V / 2.589 mV
Maximum output value	105% of the upper limit of the output range
Max. permissible permanent overload (without damage)	± 20 V (each AO against GND)
Maximum output current	10 mA
Analog output error	
maximum error at 25 ° C	± 2% of full scale
temperature coefficient	± 0.3% of full scale / K
linearity	± 0.7% of full scale
repeatability under steady state conditions	0.5% of full scale

The analog outputs are connected to terminals in the D / A OUTPUTS field (AO0 and AO1) respectively. DIGITAL / ANALOG INPUTS (AO2 & AO3). Fig. 4.7 schematically shows the connection of the load to the analog outputs.

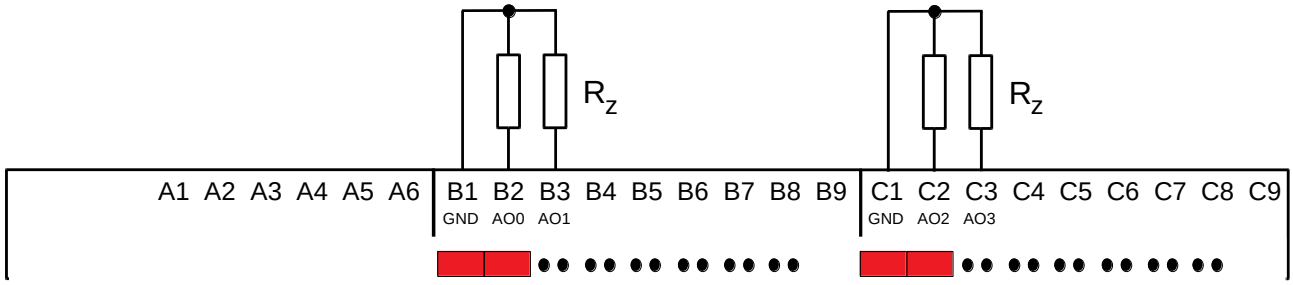


Fig.4.7 A typical example of connecting loads to analog outputs

4.6. COUNTERS

The binary inputs DI4, DI5, DI8 and DI9 can be used as counter inputs. Each input includes one counter object that can work in the unidirectional counter mode or PWM input (DI4, DI5).

Even when used for these alternative functions, the inputs are simultaneously usable as normal binary. The inputs are connected to terminals in the DIGITAL / ANALOG INPUTS field.

The electrical parameters of the inputs are given in tab.4.3 in chapter 4.1., Time parameters in tab.4.11.

Tab.4.11 Time parameters of counter inputs

Module type	CP-2007
Input frequency	1 kHz
Pulse width	min. 500 µs
Delay from log.0 to log.1	500 µs
Delay from log.1 to log.0	500 µs
Scope of registers	0 to 4 294 967 295 (32 bits)

Counter functions are described in detail in chapter 5.3.4. Counter inputs are connected in the same way as common inputs according to Fig. 4.1.

4.7. PULSE-WIDTH MODULE OUTPUTS (PWM)

The binary transistor outputs DO11 and DO12 can also be operated in pulse width modulation (PWM) mode. In Idle mode, a constant pulse repetition period (for each output separately) can be set during initialization. The actual pulse width is variable and is determined for each output separately by the value of the corresponding output variable of the PWM object. Another mode allows you to change the pulse repetition period during operation. The third special mode is the generation of individual pulses of defined length.

The electrical parameters of the outputs are given in Table 4.5 in Chapter 4.3. The setting options are described in detail in chapter 5.1. The PWM outputs are connected in the same way as conventional outputs according to Fig. 4.5.

4.8. EXCHANGEABLE SUBMODULES

Exchangeable submodules can contain serial channels or common inputs and outputs. They behave essentially as additional peripheral modules connected directly to the fast internal bus of the base module.

Optional submodules are mounted in the base module CP-2007 on the bottom plate from the outside (area towards the bottom of the module housing) in the positions marked in Fig. 4.8.

If you need to install or replace the submodule, use the screwdriver to release the latches on the bottom of the housing. After removing the bottom of the housing, the bottom plate with replaceable sub-modules is accessible.

ATTENTION!	**The modules contain components sensitive to electrostatic charge, therefore we follow the rules for working with these circuits! We only handle the module without power supply!**

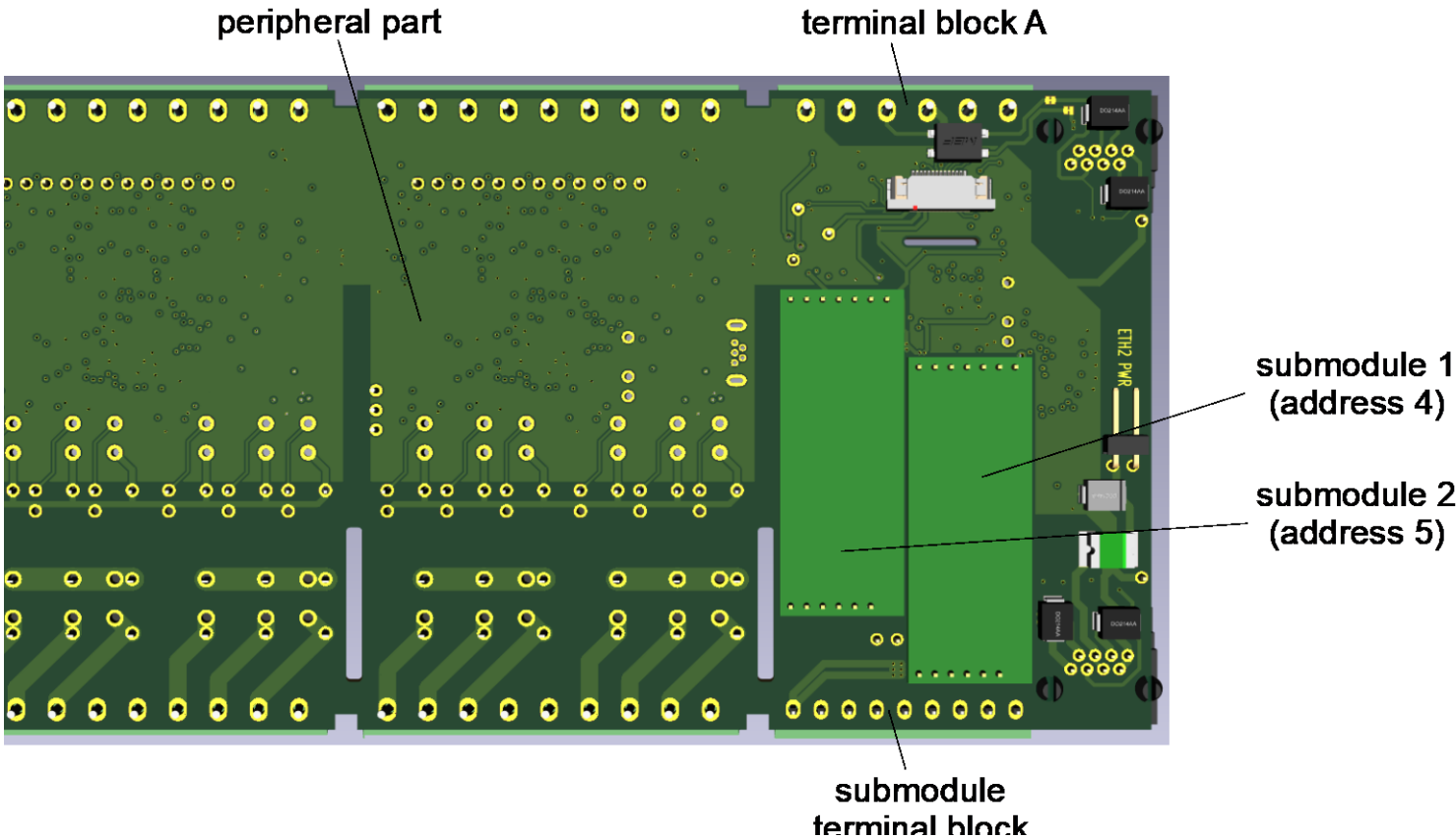


Fig.4.8 Placing replaceable submodules on the base plate of the base module after removing the bottom of the housing

The sub-modules occupy addresses 4 and 5 on the internal bus. The sub-module with address 5 is located in position 2 and is connected to terminals D5 - D8. Both submodules have ground led out to terminal D9 marked COM1. It follows that the galvanically isolated submodules are separate from the internal circuits of the CP-2007 basic module, but not from each other.

Tab.4.12 Connection of terminal block D of basic modules CP-2007

D1	wiring according to mounted submodule 1 (adr. 4)
D2	
D3	

D4		
D5	wiring according to installed submodule 2 (adr. 5)	
D6		
D7		
D8		
D9	COM1	ground submodules

4.8.1. MR-0130 sub-modules - MR-0134 - serial channels

Serial channel designations in the CH1 - CH10 range are assigned by the user when configuring the user program. This applies both to the serial channels on the submodule and to other communication channels on the SC-11xx modules connected to the TCL2 bus.

The operation of the serial channels is described in the TECOMAT FOXTROT 2 programmable logic controllers (TXV 004 50.01) documentation.

Tab.4.13 Order numbers and supported exchange submodule modes

Type	Modification	Order number	Supported modes
MR-0130	1x UART RS-232 interface galvanically isolated	TXN 101 30	UNI
MR-0131	1x UART RS-485 interface galvanically isolated	TXN 101 31	
MR-0133	2x UART RS-485 interface galvanically isolated	TXN 101 33	
MR-0134	2x UART RS-232 interface galvanically isolated	TXN 101 34	

RS-232 and RS-485 interface parameters

The MR-0130 - MR-0134 sub-modules contain RS-232 or RS-485 serial channels. The parameters of these interfaces are listed in tab.4.14 and tab.4.15.

Tab.4.14 Technical parameters of the RS-232 interface

Galvanic separation	yes
Isolation voltage of galvanic isolation	1000 V DC
Maximum bit rate	200 kBd
Receiver input resistance	min. 7 kΩ
Output signal level	typ. ± 8 V
Max. length of connected line	15 m

Tab.4.15 Technical parameters of the RS-485 interface

Galvanic separation	yes
Isolation voltage of galvanic isolation	1000 VDC
Maximum bit rate	1 MBd
Receiver sensitivity	min. ± 200 mV
Output signal level	typ. 3 V
Max. length of connected line	1200 m*

* The maximum length applies to twisted and shielded cable and communication speed max. 120 kBd.

For proper operation of the RS-485 communication line it is necessary to terminate it at both ends. On the submodule, it is flown by flying the soldering jumper marked BT1 (first channel), resp. BT2 (second channel).

Involvement of submodules

Sub-modules contain 1 or 2 serial channels with RS-232 or RS-485 interface depending on the selected variant. Both submodules mounted in the basic PLC module have a common signal ground COM1, which is galvanically separated from the internal PLC circuits.

Tab.4.16 Connection of terminal block C with mounted MR-0130 - MR-0134 submodule

position 1	position 2	MR-0130	MR-0131	MR-0133	MR-0134
addr. 4	addr. 5	1x RS-232	1x RS485	2x RS485	2x RS-232
D1	D5	RxD	TxRx–	TxRx1–	RxD1
D2	D6	TxD	TxRx+	TxRx1+	TxD1
D3	D7	CTS		TxRx2–	RxD2
D4	D8	RTS		TxRx2+	TxD2
D9		COM1	COM1	COM1	COM1

TxD transmitted RS-232 data
RxD received RS-232 data
RTS Broadcast Call for Modem (RS-232)
CTS Modem Readiness (RS-232)
TxRx– received and transmitted RS-485 data
TxRx+ receive and transmit RS-485 data
COM1 signal ground of the submodule

5. USER OPERATION

The peripheral part of the CP-2007 modules contains a block of binary inputs and outputs, an analog input block and an analog output block. It uses the I / O Configurator to configure these objects. Configuration using this tool is described in the following chapters.

5.1. CONFIGURATION

Open the parameter setting panel in the I / O Configurator window (fig. 5.1) by double-clicking the Central Unit item in the assembly tree.

If this item was not previously selected by a mouse click, the first click will first show the structure of the variables in the bottom window. Only then does it respond to the double-click that opens the parameter settings window (fig. 5.2).

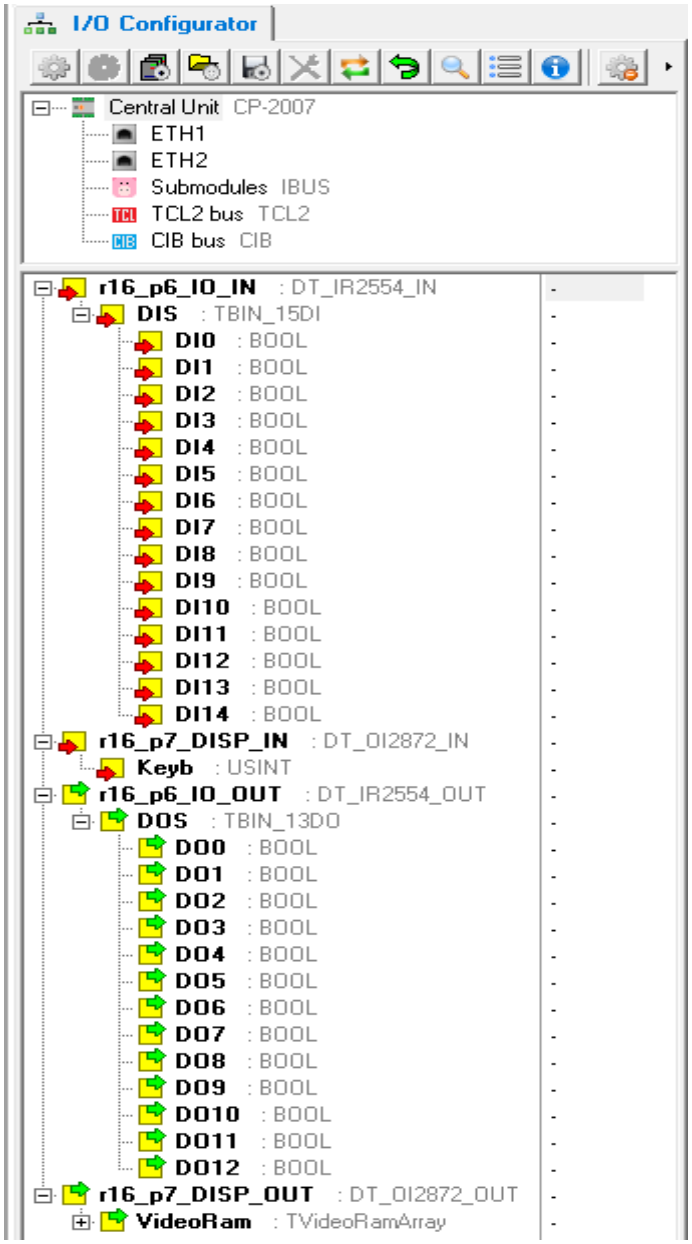


Fig.5.1 I / O Configurator tool windows

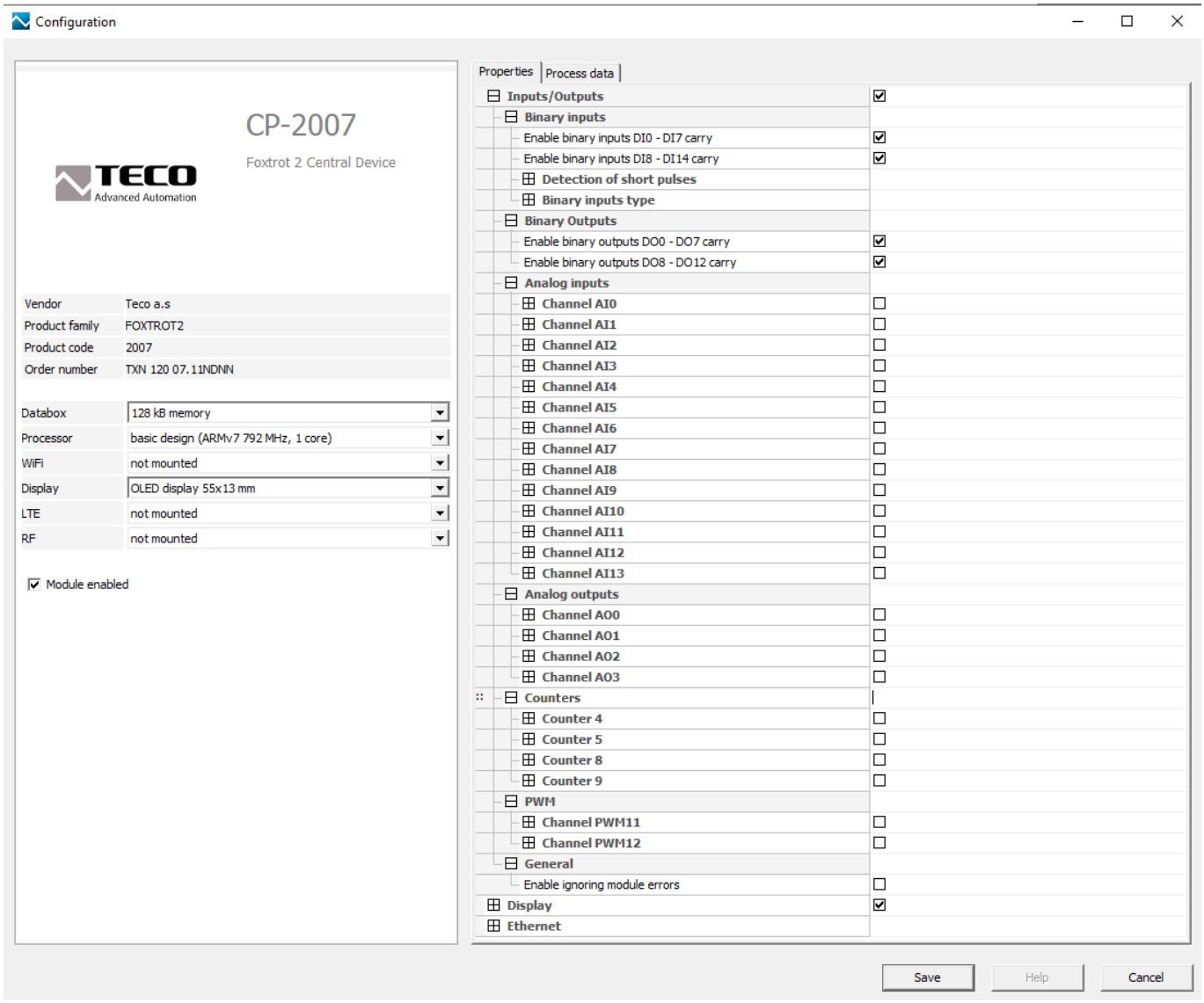


Fig.5.2 CP-2007 module configuration

In the left part of the Configuration panel, in addition to the configured module description, there is the Module enabled item. If checked, the module is operated according to the settings available on the right side of the panel. If the item is unchecked, all module functions set on the right side of the panel are disabled without losing the current settings. This can be used when debugging a user program.

In the right part of the panel there are all the configuration items of the module in the Properties tab. In the Process data tab you can find a list of all variables provided by the module, with the possibility of their own naming (see chapter 5.2).

Inputs / Outputs

The function of the peripheral part of the basic module CP-2007 is conditioned by checking the box in the Input / Output node. If the check box is unchecked, all peripheral options will be grayed out and therefore inoperable. This option allows you to temporarily disable the peripheral part of the basic module while losing the user program without losing its settings.

Fig.5.3 Activation of the peripheral part of the module

Binary inputs

The configuration of the binary inputs is located in the Binary inputs node (Fig.5.4). Checking the option Enable transmission of binary inputs DI0 - DI7 enables transmission of current states of the first eight inputs to the PLC scratchpad. Checking the option Enable transmission of binary inputs DI8 - DI14 enables transmission of the current states of the remaining inputs to the PLC scratchpad. If these options are unchecked, the corresponding values are not transmitted and do not appear in the PLC scratchpad.

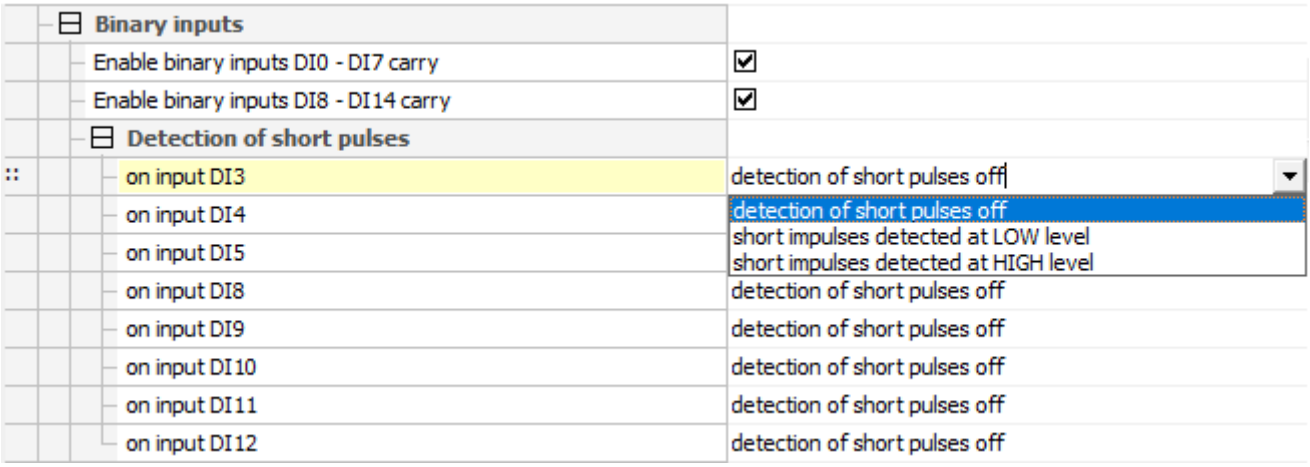


Fig.5.4 Configuration of binary inputs

On inputs DI3 - DI5, DI8 - DI12 it is possible to activate the function of short pulse capture for each input separately. In the Short pulse detection node, you can activate the short pulse capture function for the respective input. Short pulse detection at log.0 or log.1 can be selected. If an option is inaccessible (grayed out), it means that the corresponding input is assigned to the counter function.

The behavior of this function is described in chapter 5.3.1.

Binary outputs

Configuration of binary outputs can be found in the Binary outputs node (Fig.5.5). By checking the option Enable transmission of binary outputs DO0 - DO7 we enable transmission of actual states of the first eight outputs from the PLC notebook to the module. By ticking the option Enable transmission of binary outputs DO8 - DO12 we enable transfer of actual states of the remaining five outputs from the PLC notebook to the module. If these options are not checked, the corresponding values are not transmitted and the corresponding outputs are not set.

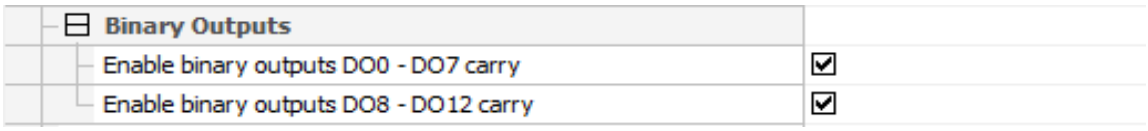


Fig.5.5 Configuration of binary outputs

Analog inputs

The configuration of analog inputs is located in the node Analog inputs (Fig. 5.6). The CP 2007 module contains 14 analog inputs AI0 - AI13, which have different measuring ranges. To activate a particular analog input, check the box on the line with the channel name, eg Channel AI0. This makes the other options available and allows you to select the desired measuring range in Input type.

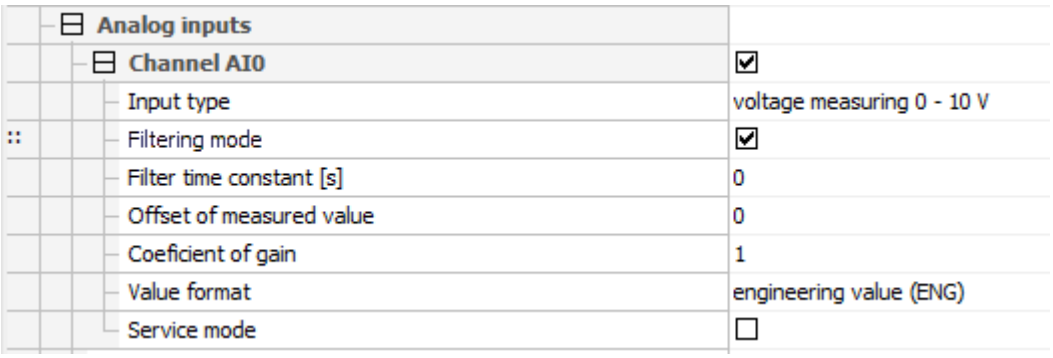


Fig.5.6 Configuration of analog inputs

If you want to filter the input analog value, check the Filtering mode option and set the filter time constant in the next item. The measured values of the respective channel then pass through the 1st order filter. The filter is given by the relation

$$y_t = \frac{y_{t-1} \cdot \tau + x}{\tau + 1}$$

x - converted value of analog input
y_t - output
y_{t-1} - past output
τ - 1st order filter time constant

The value of the time constant is set in the range 0.1 ,0 25.0 s. The filtration applies to all data formats of the given channel (FS, ENG and PCT) and is available in all measuring ranges.

If we need to correct the input analog value, for example, to compensate for the influence of the line, we can advantageously use the parameters Gain factor and Offset of the measured value. The resulting value is then given by the relation

$$y = (k * x) + q$$

x - value of analog input
y - final value
k - gain coefficient
q - offset of the measured value

Both of these entries are entered as decimal numbers.

Attention! The value of the measured value offset **is always entered in engineering units** regardless of the format in which the analog input is read!

The Value format item is used to select the format of the transmitted value of the analog input. We have three options to choose from.

The value passed in the FS variable is an int variable. The minimum value of the input unipolar value corresponds to the value 0, the maximum value to 31500. The relation is that 100% of the nominal range of the analog input input to FS = 30000.

The transferred value in the ENG variable is a real type variable and represents directly the value in engineering units according to the selected measuring range.

The transferred value in the PCT variable is a real variable and expresses the percentage relationship between the measured and nominal value of the analog input. The PCT variable is

related to the FS variable. For FS = 0, PCT = 0% and for FS = 30000, PCT = 100%. The PCT variable can have a maximum value of 105%, which corresponds to FS = 31500.

The last option Service mode is intended for service intervention. If you check this option and select the value format binary value (FS), then in the variable FS we find directly the numeric value transmitted by the AD converter without recalculations.

Behavior and ranges of analog inputs are given in chapter 5.3.2.

Analog outputs

The configuration of analog outputs can be found in the section Analog outputs (Fig. 5.7). CP 2007 module contains 4 analog outputs AO0 - AO3. To activate a particular analog output, check the box on the line with the channel name, eg Channel AO0. This will give us more options. Output range in Output type cannot be changed, it is fixed to 0 to 10 V.

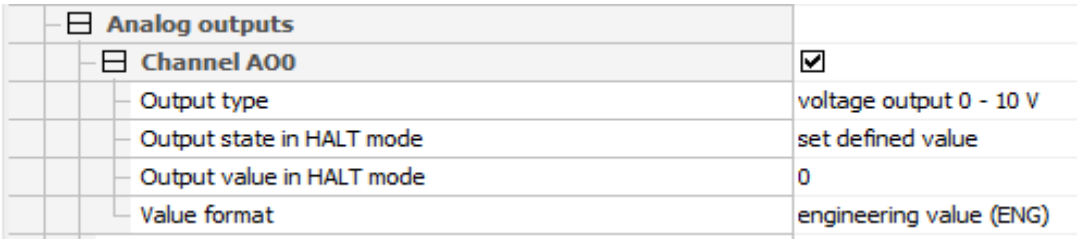


Fig.5.7 Configuration of analog outputs

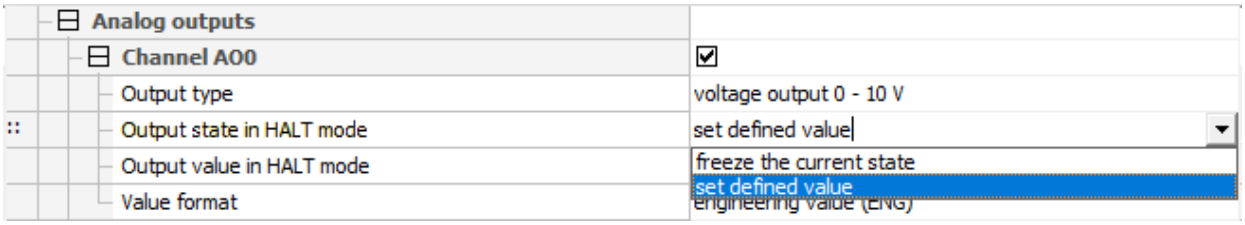


Fig.5.8 Configuration of analog outputs - behavior in HALT mode

The output behavior in HALT mode can be defined in two ways (Fig. 5.8). If we select the option Freeze current state in the Output status in HALT mode, then after the transition to HALT mode, the analog output remains set to the last value written by the user program.

If you select the option to set a defined value, then the value set in the following parameter Output value in HALT mode is set to analog output after switching to HALT mode. This value has a format that matches the selected transmitted variable. Ie. that if we use the FS format, the int value is in the range 0 to 31500, if we use the ENG format it is the real type in the range 0 to 10.5 V, and if we use the PCT format it is the real value in the range 0 up to 105%.

When the power is turned on, the analog outputs are always set to 0.

The Value format item is used to select the format of the transmitted value of the analog input. We have three options to choose from.

The value passed in the FS variable is an int variable. The minimum value of the output unipolar value corresponds to the value 0 and the maximum value is 31500. At the same time, it holds that 100% of the nominal range of the analog output corresponds to the value FS = 30000.

The passed value in the ENG variable is a real variable and represents the output voltage value in volts directly.

The transferred value in the PCT variable is a real variable and expresses the percentage relationship between the actual and nominal value of the analog output. The PCT variable is related to the FS variable. For FS = 0, PCT = 0% and for FS = 30000, PCT = 100%. The PCT variable can have a maximum value of 105%, which corresponds to FS = 31500.

Behavior and ranges of analog outputs are given in chapter 5.3.3.

Counters

The CP-2007 module contains 4 counter objects that use inputs DI4, DI5, DI8, DI9 and can be operated in either one-way counter or PWM input (DI4, DI5). Counter objects do not affect each other. If the counter is set to one-way counter or PWM input mode, the short pulse capture function cannot be activated on its counter input.

The counters configuration is located in the Counters node (Fig. 5.9). Counters are marked with indexes 4, 5, 8, 9 for easier orientation, ie their respective inputs. To activate a specific counter, check the box on the row with the counter name, such as Counter 4.

Note that activating the analog input AI4, AI5, AI8, AI9 will turn off the corresponding counter 4, 5, 8, 9.

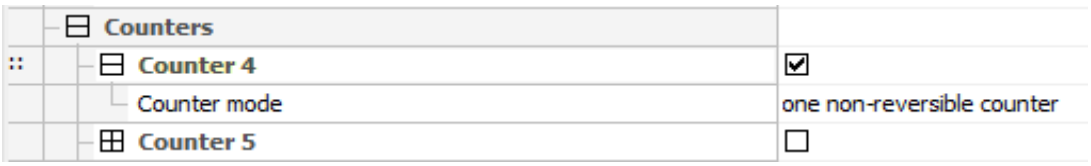


Fig.5.9 Configure counters

The behavior of the counters is described in chapter 5.3.4.

PWM outputs

The CP-2007 module contains 2 PWM objects that use DO11 and DO12 outputs.

The PWM output configuration is located in the PWM node (Fig. 5.10 - 5.12). PWM objects are indexed as well as their respective outputs. To activate a particular PWM channel, check the box on the line with the channel name, such as PWM11. This will give more options.

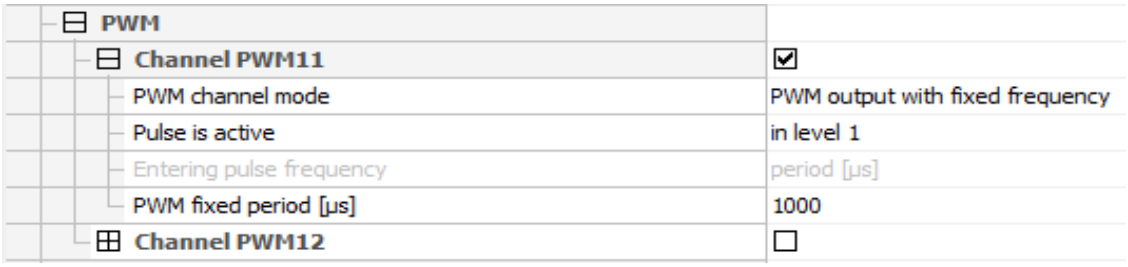


Fig.5.10 PWM Configuration - Constant Frequency Output

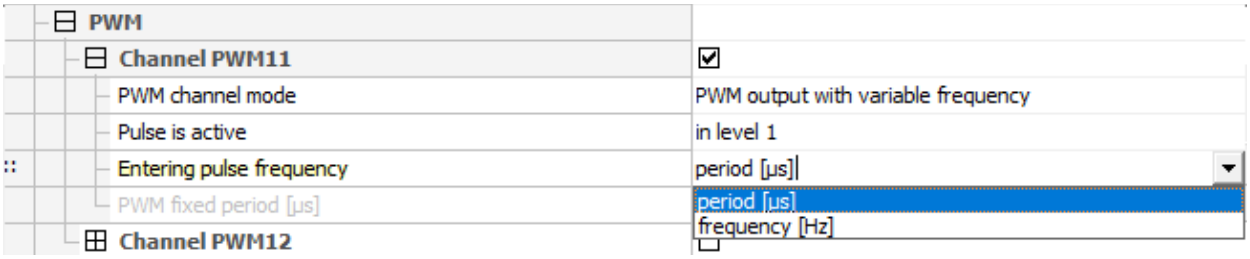


Fig.5.11 PWM configuration - variable frequency output

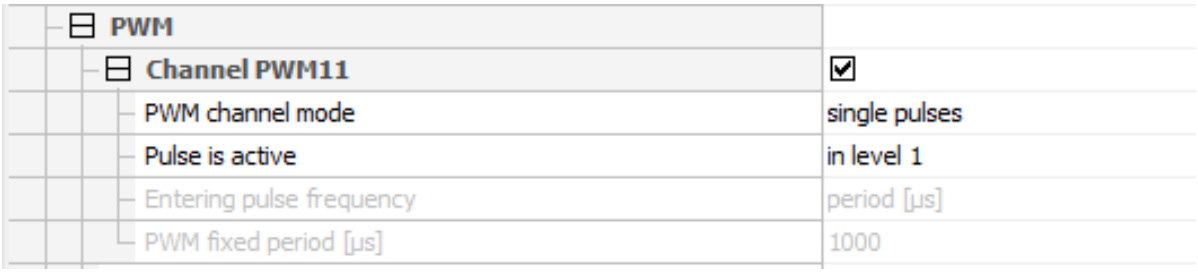


Fig.5.12 PWM configuration - single pulses

The PWM outputs can operate in three modes - fixed frequency, variable frequency, and as a single pulse generator.

In the item Pulse is active select the polarity with which we want to send pulses. If we select a variant in the log.1 level, the pulse level itself is log.1 and the idle level is log.0. If we select a variant at log.0 level, the opposite is true.

In PWM, variable frequency output is the period of the output signal determined by the value of the PERP variable, which is interpreted either as a period in µs or as a frequency in Hz. Interpretation mode is selected in Pulse frequency input method.

In single pulse mode, the length of each pulse is given by the current value of the PERP variable in µs.

In the PWM constant frequency output mode, the period value is entered in µs in the PWM constant period [µs] item.

The behavior of PWM outputs in individual modes is described in chapter 5.3.5.

General

If the Enable module error ignoring check box is enabled in the General node, the central unit does not stop the user program execution even if a fatal error occurs when exchanging data with the peripheral part, but tries to reinitialize it and restore the data exchange. The current status of the peripheral part and the validity of its data can be determined from the status zone of the peripheral system.

For quick information during debugging, just mouse over a specific item in the assembly tree and if the system is connected to the Mosaic environment, then a window with current information about the module status will appear..

Integrated display

The integrated display allows characters to be written to the display and user keys to be read. The configuration of the display for operation in the user mode is located in the Display node (Fig. 5.13). If the box assigned to this node is unchecked, the display is not in use by the user and operates continuously in system mode. If the box is checked, the display automatically enters the user display mode when the PLC user program is started. It will return to system mode either when the user program execution is stopped (transition to HALT mode or a fatal error occurs) or after pressing the MODE button on the PLC front panel to manually switch the display mode.

⊟ Display	☑
Character set	Central European
Delay of autorepeat key [ms]	1500
Use end delimiter	☑
Display off delay [min]	60
Display mode	4 x 20 char.

Fig.5.13 Display configuration

In the Character set item, select the character set according to which the display will decode the displayed ASCII text. They are available:

- *central european* (CP1250)
- *cyrillic* (CP1251)
- *western european* (CP1252)
- *greek* (CP1253)

Keypad autorepeat timeout determines the time delay after which the keypad autorepeat is activated when the key is pressed long. a state in which the code of the pressed button is

permanently transmitted until it is released. The autorepeat delay can be set from 0 to 1500 ms, in 100 ms increments. If you want to turn off autorepeat, set the value of timeout to 0.

By checking the Use ending character check box, the function of passing the ending character (code $ FF) is activated after releasing the button. This function is especially useful when using the autorepeat function and is used to distinguish short and long keystrokes.

Display timeout specifies the time delay since the last key press before the display goes out. The display is reactivated by pressing any button or by switching the PLC to another mode (HALT, RUN), or when a serious PLC error occurs.

In the Display mode item we can select the number of displayed characters on the display in the user mode. Full 4 x 20 characters and reduced 3 x 20 characters are available. Reduced three-line display is used when we want to increase the readability of displayed characters on a small display due to a larger space between lines.

The behavior and coding of displayed characters and keys are given in chapter 5.3.6.

5.2. DATA PROVIDED

The CP-2007 basic module provides input and output information. The data structure is shown in Table 5.1.

Structure items have symbolic names that always start with r0_p0_. The Full Notation column always lists the specific symbolic name for the item. If you want to use the data in the user program, we either use this symbolic name, or write down our symbolic name in the Alias column, which we can then use. In any case, we do not use absolute operands, because after a new compilation of the user program.

To create an alias in the I / O Configurator, follow these steps. Double-click the module name in the configuration tree to open the Configuration panel. On the Process data tab, enter the required name in the appropriate row in the Alias column.

Tab.5.1 Data structure

Data structure	Full write	Clamp (signal)	Description of the object
DIS	r0_p0_IO_IN.DIS		binary inputs
DI0: bool	r0_p0_IO_IN.DIS.DI0	B4 (DI0)	
DI1: bool	r0_p0_IO_IN.DIS.DI1	B5 (DI1)	
DI2: bool	r0_p0_IO_IN.DIS.DI2	B6 (DI2)	
DI3: bool	r0_p0_IO_IN.DIS.DI3	B7 (DI3)	
DI4: bool	r0_p0_IO_IN.DIS.DI4	B8 (DI4)	
DI5: bool	r0_p0_IO_IN.DIS.DI5	B9 (DI5)	
DI6: bool	r0_p0_IO_IN.DIS.DI6	C2 (DI6)	
DI7: bool	r0_p0_IO_IN.DIS.DI7	C3 (DI7)	
DI8: bool	r0_p0_IO_IN.DIS.DI8	C4 (DI8)	
DI9: bool	r0_p0_IO_IN.DIS.DI9	C5 (DI9)	
DI10: bool	r0_p0_IO_IN.DIS.DI10	C6 (DI10)	
DI11: bool	r0_p0_IO_IN.DIS.DI11	C7 (DI11)	
DI12: bool	r0_p0_IO_IN.DIS.DI12	C8 (DI12)	
DI13: bool	r0_p0_IO_IN.DIS.DI13	C9 (DI13)	
DI14: bool	r0_p0_IO_IN.DIS.DI14	F9 (DI14)	
DIP	r0_p0_IO_IN.DIP		binary inputs with short pulse detection
DIP3: bool	r0_p0_IO_IN.DIP.DIP3	B7 (DI3)	
DIP4: bool	r0_p0_IO_IN.DIP.DIP4	B8 (DI4)	
DIP5: bool	r0_p0_IO_IN.DIP.DIP5	B9 (DI5)	
DIP8: bool	r0_p0_IO_IN.DIP.DIP8	C4 (DI8)	
DIP9: bool	r0_p0_IO_IN.DIP.DIP9	C5 (DI9)	
DIP10: bool	r0_p0_IO_IN.DIP.DIP10	C6 (DI10)	
DIP11: bool	r0_p0_IO_IN.DIP.DIP11	C7 (DI11)	
DIP12: bool	r0_p0_IO_IN.DIP.DIP12	C8 (DI12)	
CNT_IN4	r0_p0_IO_IN.CNT_IN4	B8 (DI4)	counter object 4 - input data
SCNT: usint	r0_p0_IO_IN.CNT_IN4.SCNT		
SCNTB: usint	r0_p0_IO_IN.CNT_IN4.SCNTB		
VAL: udint	r0_p0_IO_IN.CNT_IN4.VAL		
VALB: udint	r0_p0_IO_IN.CNT_IN4.VALB		
CNT_IN5	r0_p0_IO_IN.CNT_IN5	B9 (DI5)	counter object 5 - input data
CNT_IN8	r0_p0_IO_IN.CNT_IN8	C4 (DI8)	counter object 8 - input data
CNT_IN9	r0_p0_IO_IN.CNT_IN9	C5 (DI9)	counter object 9 - input data
AI0	r0_p0_IO_IN.AI0	B4 (AI0)	analog input AI0
STAT	r0_p0_IO_IN.AI0.STAT		
UNF: bool	r0_p0_IO_IN.AI0.STAT.UNF		
UNR: bool	r0_p0_IO_IN.AI0.STAT.UNR		
OVR: bool	r0_p0_IO_IN.AI0.STAT.OVR		
OVF: bool	r0_p0_IO_IN.AI0.STAT.OVF		
FLS: bool	r0_p0_IO_IN.AI0.STAT.FLS		
FS: int	r0_p0_IO_IN.AI0.FS		
ENG: real	r0_p0_IO_IN.AI0.ENG		
PCT: real	r0_p0_IO_IN.AI0.PCT		
AI1	r0_p0_IO_IN.AI1	B5 (AI1)	analog input AI1

Tab.5.1 Data structure (continued)

Data structure	Full write	Clamp (signal)	Description of the object
AI2	r0_p0_IO_IN.AI2	B6 (AI2)	analog input AI2
AI3	r0_p0_IO_IN.AI3	B7 (AI3)	analog input AI3
AI4	r0_p0_IO_IN.AI4	B8 (AI4)	analog input AI4
AI5	r0_p0_IO_IN.AI5	B9 (AI5)	analog input AI5
AI6	r0_p0_IO_IN.AI6	C2 (AI6)	analog input AI6
AI7	r0_p0_IO_IN.AI7	C3 (AI7)	analog input AI7
AI8	r0_p0_IO_IN.AI8	C4 (AI8)	analog input AI8
AI9	r0_p0_IO_IN.AI9	C5 (AI9)	analog input AI9
AI10	r0_p0_IO_IN.AI10	C6 (AI10)	analog input AI10
AI11	r0_p0_IO_IN.AI11	C7 (AI11)	analog input AI11
AI12	r0_p0_IO_IN.AI12	C8 (AI12)	analog input AI12
AI13	r0_p0_IO_IN.AI13	C9 (AI13)	analog input AI13
Keyb: usint	r0_p0_DISP_IN.Keyb		pressed button code
DOS	r0_p0_IO_OUT.DOS		binary outputs
DO0: bool	r0_p0_IO_OUT.DOS.DO0	E2 (DO0)	
DO1: bool	r0_p0_IO_OUT.DOS.DO1	E3 (DO1)	
DO2: bool	r0_p0_IO_OUT.DOS.DO2	E4 (DO2)	
DO3: bool	r0_p0_IO_OUT.DOS.DO3	E7 (DO3)	
DO4: bool	r0_p0_IO_OUT.DOS.DO4	E8 (DO4)	
DO5: bool	r0_p0_IO_OUT.DOS.DO5	E9 (DO5)	
DO6: bool	r0_p0_IO_OUT.DOS.DO6	F2 (DO6)	
DO7: bool	r0_p0_IO_OUT.DOS.DO7	F3 (DO7)	
DO8: bool	r0_p0_IO_OUT.DOS.DO8	F4 (DO8)	
DO9: bool	r0_p0_IO_OUT.DOS.DO9	F5 (DO9)	
DO10: bool	r0_p0_IO_OUT.DOS.DO10	F6 (DO10)	
DO11: bool	r0_p0_IO_OUT.DOS.DO11	B2 (DO11)	
DO12: bool	r0_p0_IO_OUT.DOS.DO12	B3 (DO12)	
CNT_OUT4	r0_p0_IO_OUT.CNT_OUT4	B8 (DI4)	counter object 4 - output data
CCNT: usint	r0_p0_IO_OUT.CNT_OUT4.CCNT		
CCNTB: usint	r0_p0_IO_OUT.CNT_OUT4.CCNTB		
SET: udint	r0_p0_IO_OUT.CNT_OUT4.SET		
SETB: udint	r0_p0_IO_OUT.CNT_OUT4.SETB		
CNT_OUT5	r0_p0_IO_OUT.CNT_OUT5	B9 (DI5)	counter object 5 - output data

CNT_OUT8	r0_p0_IO_OUT.CNT_OUT8	C4 (DI8)	counter object 8 - output data

Tab.5.1 Data structure (continued)

Data structure	Full write	Clamp (signal)	Description of the object
CNT_OUT9	r0_p0_IO_OUT.CNT_OUT9	C5 (DI9)	counter object 9 - output data
AO0	r0_p0_IO_OUT.AO0	B2 (AO0)	analog output AO0
FS: int	r0_p0_IO_OUT.AO0.FS		
ENG: real	r0_p0_IO_OUT.AO0.ENG		
PCT: real	r0_p0_IO_OUT.AO0.PCT		
AO1	r0_p0_IO_OUT.AO1	B3 (AO1)	analog output AO1
AO2	r0_p0_IO_OUT.AO2	C2 (AO2)	analog output AO2
AO3	r0_p0_IO_OUT.AO3	C3 (AO3)	analog output AO3
PWM11	r0_p0_IO_OUT.PWM11	B2 (DO11)	PWM11 output
CNTP: uint	r0_p0_IO_OUT.PWM11.CNTP		
PCTP: real	r0_p0_IO_OUT.PWM11.PCTP		
PERP: udint	r0_p0_IO_OUT.PWM11.PERP		
PWM12	r0_p0_IO_OUT.PWM12	B3 (DO12)	PWM12 output
VideoRam[0...79] : usint	r0_p0_DISP_OUT.VideoRam		field of 80 ASCII characters to be displayed

Peripheral Input Data (r0_p0_IO_IN)

DI - binary input values

	DI7	DI6	DI5	DI4	DI3	DI2	DI1	DI0
bit	.7	.6	.5	.4	.3	.2	.1	.0
	0	DI14	DI13	DI12	DI11	DI10	DI9	DI8
bit	.15	.14	.13	.12	.11	.10	.9	.8

DI0 - DI13 - 24 V binary inputs

If a single input is used for analog measurement, then the corresponding DI bit is permanently 0.

DI14 - binary input 230 V

DIP - binary input values with short pulse detection

	0	0	DIP5	DIP4	DIP3	0	0	0
bit	.7	.6	.5	.4	.3	.2	.1	.0
	0	0	0	DIP12	DIP11	DIP10	DIP9	DIP8
bit	.15	.14	.13	.12	.11	.10	.9	.8

DIP3 - DIP5, DIP8 - DIP12 - values of inputs DI3 - DI5, DI8 - DI12 with artificial extension of the selected level to the cycle turn (short pulses detection)

CNT_INn.SCNT - counter status n

	0	0	0	EPS	0	0	0	EV
bit	.7	.6	.5	.4	.3	.2	.1	.0

EV - 1 - active edge flag on DI
EPS - 1 - preset achievement flag

CNT_INn.SCNTB - status B counters n

	INFSB	INFSA	0	0	0	0	0	0
bit	.7	.6	.5	.4	.3	.2	.1	.0

INFSA - information transmitted in the VAL variable (PWM input mode)
0 - ratio of pulse width at log.1 level to PWM signal period [‰]
1 - PWM leading edge counter
INFSB - information transmitted in the VALB variable (PWM input mode)
0 - PWM signal period [µs]
1 - PWM signal frequency [Hz]

CNT_INn.VAL - counter value n
- counter value (one-way counter mode)
- ratio of pulse width of log.1 level to signal period [‰] (CCNTB.INFCA = 0) (PWM input mode)
- PWM signal leading edge counter (CCNTB.INFCA = 1) (PWM input mode)

CNT_INn.VALB - counter B value n
- PWM signal period [µs] (CCNTB.INFCB = 0) (PWM input mode)
- PWM signal frequency [Hz] (CCNTB.INFCB = 1) (PWM input mode)

AIn.STAT - analog input status AIn

	0	0	0	FLS	OVF	OVR	UNR	UNF
bit	.7	.6	.5	.4	.3	.2	.1	.0

	0	0	0	0	0	0	0	0
bit	.15	.14	.13	.12	.11	.10	.9	.8

FLS - 1 - Invalid delivery value (when starting the module after switching on)
OVF - 1 - range overflow (input variable exceeded nominal range by 5%)
OVR - 1 - exceeded range (input variable exceeded nominal range)
UNR - 1 - below the range (the input variable has fallen below the nominal range)
UNF - 1 - underflow range (input variable has fallen by nominal range by 5%)

Undervoltage and underflow signaling is only active for the 4 to 20 mA range and resistance temperature sensors. This function is not active for voltage and other current measuring ranges.

AIn.FS - value of analog input AIn
The minimum value of the input value corresponds to the value 0, the maximum value is then 31500, while 100% of the nominal range of the analogue input corresponds to the value FS = 30000.

AIn.ENG - value of analog input AIn
Measured value in engineering units (V, mA, ° C).

AIn.PCT - value of analog input AIn
The percentage relationship between the measured and nominal value of the analog input. For FS = 0, PCT = 0% and for FS = 30000, PCT = 100%.

Integrated display input data (r0_p0_DISP_IN)

Keyb - key code

If no button is pressed, the value 0 is passed. When the button is pressed, its code (tab. 5.24 in chapter 5.3.6.) Is transmitted once (in one cycle of the user program). The repeated passcode of the pressed key is only activated after the autorepeat timeout (if the autorepeat is set). After release stisknutého tlačítka je the so-called ending character $ FF (255) is sent once if the ending character transmission is set.

Peripheral Output Data (r0_p0_IO_OUT)

DO - binary values of outputs

	DO7	DO6	DO5	DO4	DO3	DO2	DO1	DO0
bit	.7	.6	.5	.4	.3	.2	.1	.0

	0	0	0	DO12	DO11	DO10	DO9	DO8
bit	.15	.14	.13	.12	.11	.10	.9	.8

DO0 - DO10 - relay outputs
DO11 - DO12 - relay outputs

CNT_OUTn..CCNT - counter control n

	0	0	0	0	FC	SET	RES	EN
bit	.7	.6	.5	.4	.3	.2	.1	.0

EN - 0 - counter 1 stands
1 - counter 1 counts
RES - 1 - reset counter 1 and reset it
SET - 1 - set counter 1 to SET
FC - 0 - free running counter 1
1 - reset counter 1 from the SET value

CNT_OUTn..CCNTB - control B counters n

	INFCB	INFCA	0	0	0	0	0	0
bit	.7	.6	.5	.4	.3	.2	.1	.0

INFCA - setting information transmitted in the variable VAL (PWM input mode)
0 - ratio of pulse width at log.1 level to PWM signal period [‰]
1 - PWM leading edge counter
INFCB - setting information transmitted in the variable VALB (PWM input mode)
0 - PWM signal period [µs]
1 - PWM signal frequency [Hz]

CNT_OUTn.SET - counter preset n

CNT_OUTn.SETB - not used

AOn.FS - value of analog output AOn
The minimum value of the output value corresponds to the value 0, the maximum value is then 31500, whereas 100% of the nominal range of the analog output corresponds to the value FS = 30000.

AOn.ENG - value of analog output AOn
Output voltage value in volts.

AOn.PCT - value of analog output AOn
The percentage relationship between the actual and nominal values of the analog output. For FS = 0, PCT = 0% and for FS = 30000, PCT = 100%.

PWMn.CNTP - PWMn output control

	0	0	0	0	0	0	0	PULSE
bit	.7	.6	.5	.4	.3	.2	.1	.0

	0	0	0	0	0	0	0	0
bit	.15	.14	.13	.12	.11	.10	.9	.8

PULSE- 1 - sending one pulse (rising edge) (only in single pulse mode)

PWMn.PCTP - current pulse width of the PWMn output
The transmitted value in the PCTP variable expresses the percentage relationship between the current pulse width and the PWM output period value.

PWMn.PERP - current PWMn output period
The value passed in the PERP variable indicates the PWM output period.

Integrated display output data (r0_p0_DISP_OUT)

VideoRam - field of 80 ASCII characters to be displayed
The display processor first decodes the received text according to the set character set, and then displays the corresponding characters on the display.

The behavior of individual data objects is described in chapter 5.3.

5.3. BEHAVIOR OF INDIVIDUAL DATA OBJECTS

The peripheral part of CP-2007 modules contains the following data objects:

- binary inputs and outputs (chapter 5.3.1.)
- analog inputs (chapter 5.3.2.)
- analog outputs (chapter 5.3.3.)
- counters (chapter 5.3.4.)
- PWM outputs (chapter 5.3.5.)
- integrated display (chapter 5.3.6.)

5.3.1. Binary inputs and outputs

The CP-2007 module contains 15 binary inputs and 13 binary outputs with different properties. The list of properties of individual binary inputs and outputs is clearly presented in Tab.5.2 and Tab.5.3. In all cases, the function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

Tab.5.2 Properties of binary inputs

Input	Type	Other functions			
		Short pulses capture	Counter input	Analog input	Analog output
DI0	input 24 V DC	-	-	AI0	-
DI1	input 24 V DC	-	-	AI1	-
DI2	input 24 V DC	-	-	AI2	-
DI3	input 24 V DC	DIP3	-	AI3	-
DI4	input 24 V DC	DIP4	counter 4	AI4	-
DI5	input 24 V DC	DIP5	counter 5	AI5	-
DI6	input 24 V DC	-	-	AI6	AO2
DI7	input 24 V DC	-	-	AI7	AO3
DI8	input 24 V DC	DIP8	counter 8	AI8	-
DI9	input 24 V DC	DIP9	counter 9	AI9	-
DI10	input 24 V DC	DIP10	-	AI10	-
DI11	input 24 V DC	DIP11	-	AI11	-
DI12	input 24 V DC	DIP12	-	AI12	-
DI13	input 24 V DC	-	-	AI13	-
DI14	input 230 V AC	-	-	-	-

Tab.5.3 Properties of binary outputs

Input	Type	Other functions	
		PWM output	Analog output
DO0	relay output	-	-
DO1	relay output	-	-
DO2	relay output	-	-
DO3	relay output	-	-
DO4	relay output	-	-
DO5	relay output	-	-
DO6	relay output	-	-
DO7	relay output	-	-
DO8	relay output	-	-
DO9	relay output	-	-
DO10	relay output	-	-
DO11	transistor output	PWM11	AO0
DO12	transistor output	PWM12	AO1

Binary inputs

The state of the binary inputs is contained in the DI object. The status of the universal inputs DI0 - DI13 is valid here only if the inputs are not used as analogue (the channel with the corresponding number is not checked in the configuration).

Capture of short pulses

On inputs DI3 - DI5, DI8 - DI12 it is possible to switch on the function of short pulse capture for each input separately.

If we have an input signal that is predominantly in log.1 and has pulses up to log.0 that are shorter than the longest possible cycle time of the PLC, then these pulses may be lost because only input states when the central unit passes the cycle. If we turn on short pulse detection for log.0 state, then its changes are detected on the corresponding input. If the input appears during the cycle hodnota log.0, udrží se v paměti modulu až do nejbližšího přenosu dat do centrální jednotky, i když na vstupu už je zase v okamžiku přenosu dat opět hodnota log.1.

The same applies analogously to an input signal that is predominantly in log.0 and has short pulses up to log.1. We switch on the detection of short pulses for the state of log.1 and the short-term value of log.1 on the input is extended until the cycle turns.

The DIP object contains the state of the inputs with the short pulse detection enabled.

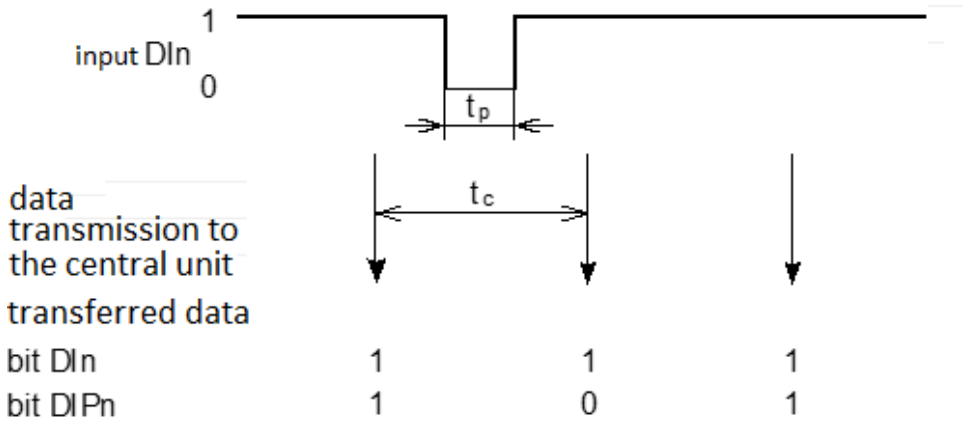


Fig.5.14 Short pulse detection function to log.0
t_p - pulse width, t_c = PLC cycle time

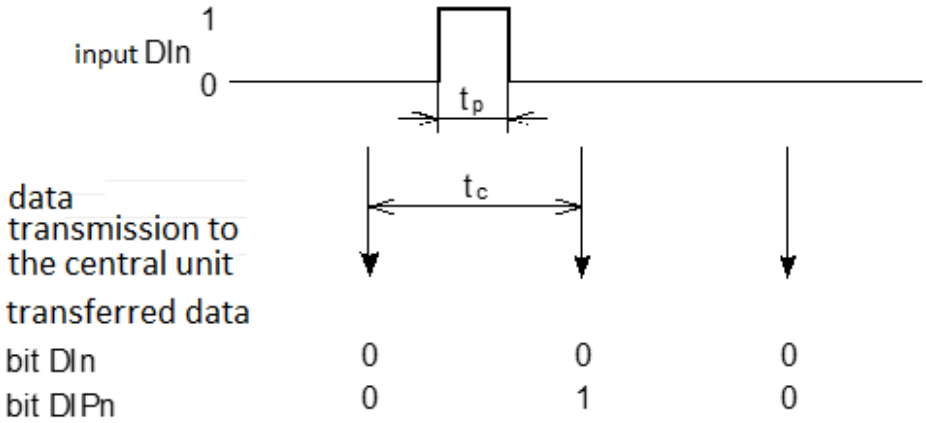


Fig.5.15 Short pulse detection function to log.1
t_p - pulse width, t_c = PLC cycle time

Binary outputs

The state of the binary outputs DO0 - DO12 contains the DO object.

5.3.2. Analog inputs

The CP-2007 module contains 14 analog inputs AI0 - AI13 with optional measuring range. Each input has four STAT, FS, ENG and PCT variables. STAT status is always transferred, between the variables FS, ENG and PCT is selected within the configuration one according to the interpretation of the measured value. The I / O Configurator shows only those actively used in the module's active variables window that are transferred between the PLC and the module.

Analog inputs AI0 - AI13 have the same behavior. Ranges are usually designed so that the input is capable of measuring a value up to 105% of the nominal range. The STAT variable is used to quickly evaluate the state of the input.

If the upper limit of the nominal range is exceeded, the OVR flag is set to 1. If the upper limit of the nominal range is exceeded by 5%, the OVF flag is also set to 1. Analogously, for ranges with a non-zero lower limit, if the lower limit of the nominal range is below, the UNR flag is set to 1. If the lower limit of the nominal range is lower than 5%, the UNF flag is also set to 1.

Table 5.4 gives an overview of the ranges of analog inputs, including their limit values.

Tab.5.4 Overview of analog input ranges

Input	Range	Lower limit - 5%	Lower limit	Upper limit	Upper limit + 5%
AI0 - AI13	0 to +10 V	-	0 V	10 V	10,5 V
	0 to +2 V	-	0 V	2 V	2,125 V
	input voltage to AD converter [1]	-	0 V	3,3 V	-
	Pt1000 1,385	–90°C	–74°C	+254°C	+270°C
	Pt1000 1,391	–90°C	–74°C	+254°C	+270°C
	Ni1000 1,617	–60°C	–50°C	+145°C	+155°C
	Ni1000 1,500	–60°C	–50°C	+145°C	+155°C
	KTY81-121	–55°C	–47°C	+117°C	+125°C
	NTC 5 k / 25°C	–40°C	–32,5°C	+117,5°C	+125°C
	NTC 10 k / 25°C	–40°C	–32,5°C	+117,5°C	+125°C
	NTC 12 k / 25°C	–40°C	–32,5°C	+117,5°C	+125°C
	NTC 15 k / 25°C	–40°C	–32,5°C	+117,5°C	+125°C
	NTC 20 k / 25°C	–40°C	–32,5°C	+117,5°C	+125°C
	0 to 2 kΩ	-	0 Ω	2000 Ω	2500 Ω [3]
	0 to 200 kΩ	-	0 Ω	200000 Ω	210000 Ω
AI0 - AI5, AI8 - AI13	0 to 20 mA	-	0 mA	20 mA	21 mA
	4 to 20 mA	0 mA [2]	4 mA	20 mA	20,8 mA

[1] the mode is intended for service purposes or for processing measured values in the user program in a way other than that offered by other modes (eg unsupported sensor type)

[2] The measuring range 4 to 20 mA is extended below the lower limit up to 0 mA, ie –25% of the range

[3] The measuring range 0 to 2 kΩ is extended beyond the upper limit up to 2.5 kΩ, ie +25% of the range

If a valid measured input value is not present, the FLS flag in the STAT variable is set to 1. This state is possible immediately after the start of the user program, waiting for the first input values to be measured if the PLC cycle time is shorter than the necessary to measure all analog inputs. Once the first input value is measured, it is published in the appropriate variable and the FLS flag is reset.

If the FLS flag was permanently set to 1 during normal operation, this would indicate that the AD converter was unavailable due to a hardware error.

The following graphs and tables show the transmitted values for each analog input range.

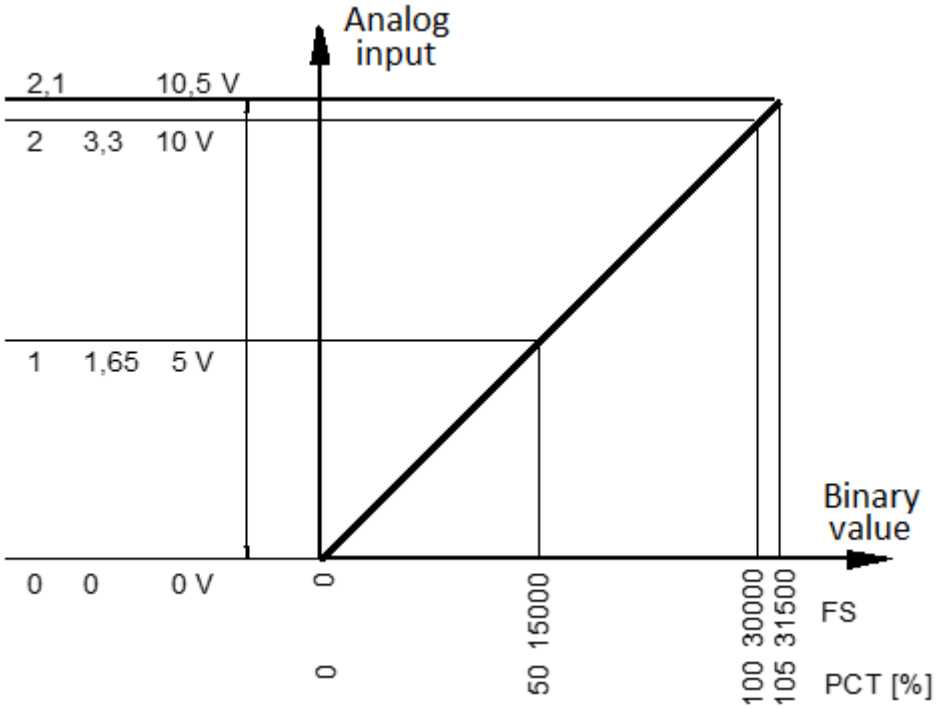


Fig.5.16 Voltage ranges of analog inputs

Tab.5.5 Transmitted analog input values for the 0 to 10 V range

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 10,5 V	$000C	31500	10,5	105	range overflow
10,5 V	$0004	31500	10,5	105	range overrun
:	$0004	:	:	:	
10 V	$0000	30000	10	100	nominal range
:	$0000	:	:	:	
0 V	$0000	0	0	0	

Tab.5.6 Transmitted analogue input values for the 0 to 2 V range

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 2,1 V	$000C	31500	2,1	105	range overflow
2,1 V	$0004	31500	2,1	105	range overrun
:	$0004	:	:	:	
2 V	$0000	30000	2	100	nominal range
:	$0000	:	:	:	
0 V	$0000	0	0	0	

Tab.5.7 Transmitted input voltage values on the AD converter

Measured value	Variable				
	STAT	FS	ENG	PCT	
:	$0004	:	:	:	range overrun
3,3 V	$0000	30000	3,3	100	nominal range
:	$0000	:	:	:	
0 V	$0000	0	0	0	

Note.: The upper limit of the range is given by the physical limit of the analog input.

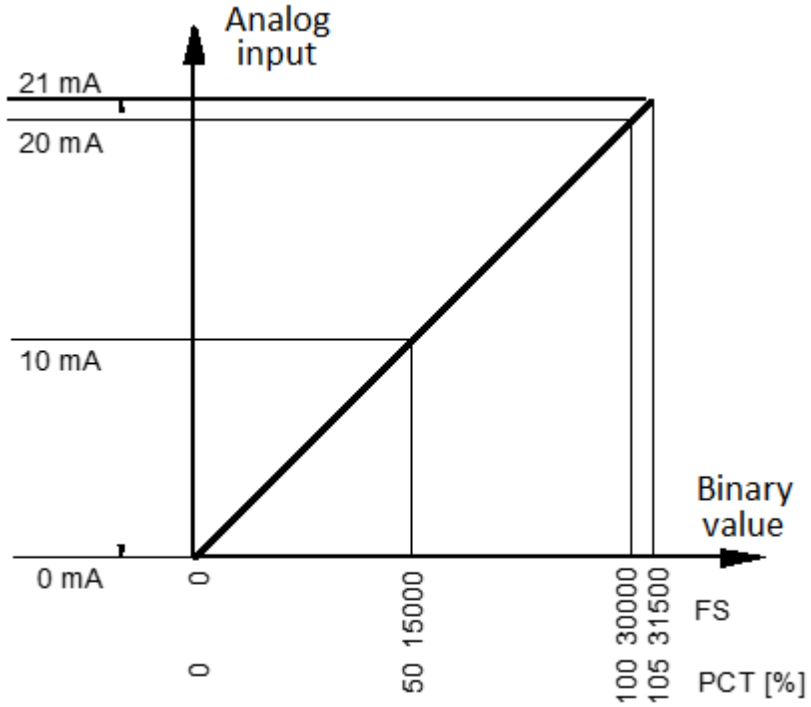


Fig.5.17 Current range 0 to 20 mA of analog inputs

Tab.5.8 Transmitted values of analog inputs for the range 0 to 20 mA

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 21 mA	$000C	31500	21	105	range overflow
21 mA	$0004	31500	21	105	range overrun
:	$0004	:	:	:	
20 mA	$0000	30000	20	100	nominal range
:	$0000	:	:	:	
0 mA	$0000	0	0	0	

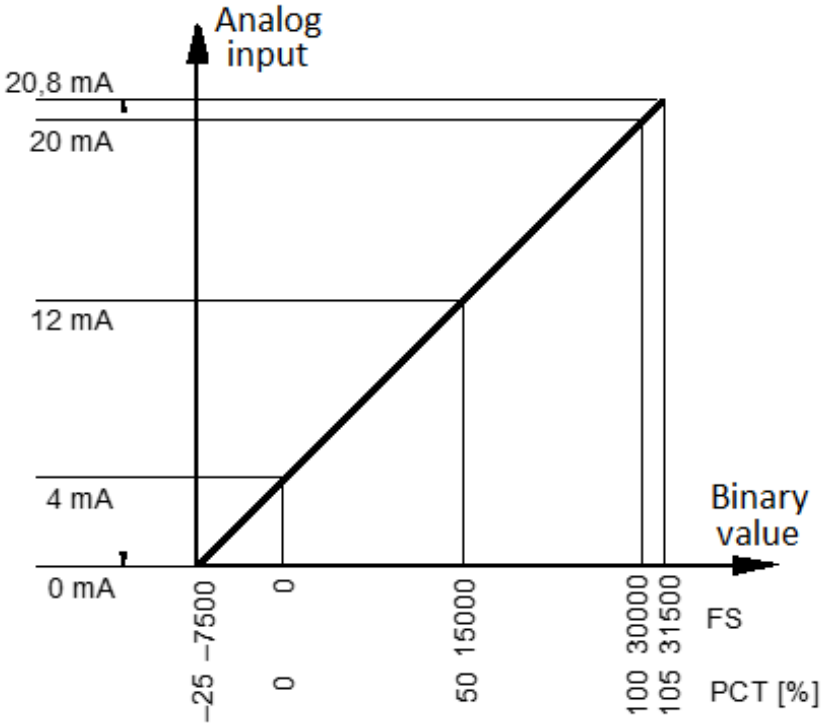


Fig.5.18 Current range 4 to 20 mA analog inputs

Tab.5.9 Transmitted values of analog inputs for 4 to 20 mA range

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 20,8 mA	$000C	31500	20,8	105	range overflow
20,8 mA	$0004	31500	20,8	105	range overrun
:	$0004	:	:	:	
20 mA	$0000	30000	20	100	nominal range
:	$0000	:	:	:	
4 mA	$0000	0	4	0	
:	$0002	:	:	:	range overrun
3,2 mA	$0002	–1500	3,2	–5	
:	$0003	:	:	:	range underflow
0 mA	$0003	–7500	0	–25	

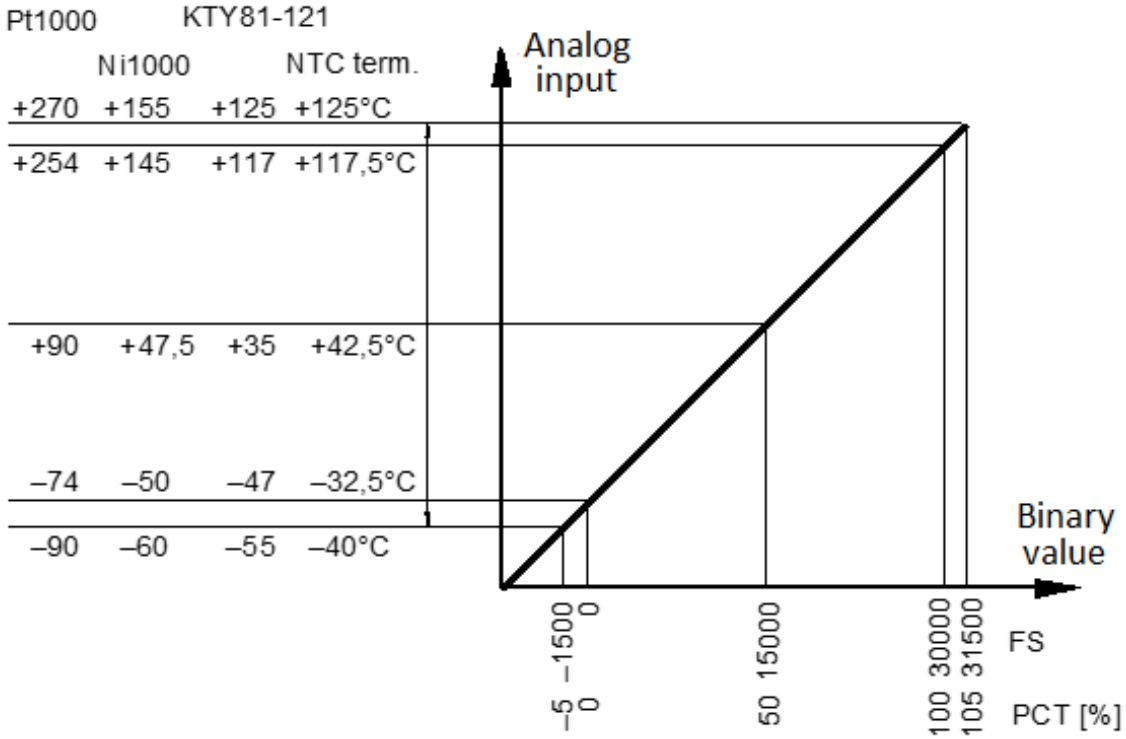


Fig.5.19 Analog Input Range for Pt1000, Ni1000, KTY81-121 and NTC Resistors

Tab.5.10 Transmitted values of analog inputs for Pt1000

Measured value	Variables				
	STAT	FS	ENG	PCT	
> 400 °C	$000C	31500	400	105	range overflow
400 °C	$0004	31500	400	105	range overrun
:	$0004	:	:	:	
378 °C	$0000	30000	378	100	nominal range
:	$0000	:	:	:	
–68 °C	$0000	0	–68	0	
:	$0002	:	:	:	range overrun
–90 °C	$0002	–1500	–90	–5	
< –90 °C	$0003	–1500	–90	–5	range underflow

Tab.5.11 Transmitted values of analog inputs for Ni1000

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 200 °C	$000C	31500	200	105	range overflow
200 °C	$0004	31500	200	105	range overrun
:	$0004	:	:	:	
188 °C	$0000	30000	188	100	nominal range
:	$0000	:	:	:	
–48 °C	$0000	0	–48	0	
:	$0002	:	:	:	range overrun
–60 °C	$0002	–1500	–60	–5	
< –60 °C	$0003	–1500	–60	–5	range underflow

Tab.5.12 Transmitted values of analog inputs for KTY81-121

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 125 °C	$000C	31500	125	105	range overflow
125 °C	$0004	31500	125	105	range overrun
:	$0004	:	:	:	
117 °C	$0000	30000	117	100	nominal range
:	$0000	:	:	:	
–47 °C	$0000	0	–47	0	
:	$0002	:	:	:	range underflow
–55 °C	$0002	–1500	–55	–5	
< –55 °C	$0003	–1500	–55	–5	range underflow

Tab.5.13 Transmitted values of analog inputs for NTC termistors

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 125 °C	$000C	31500	125	105	range overflow
125 °C	$0004	31500	125	105	range overrun
:	$0004	:	:	:	
117,5 °C	$0000	30000	117,5	100	nominal range
:	$0000	:	:	:	
–32,5 °C	$0000	0	–32,5	0	
:	$0002	:	:	:	range underflow
–40 °C	$0002	–1500	–40	–5	
< –40 °C	$0003	–1500	–40	–5	range underflow

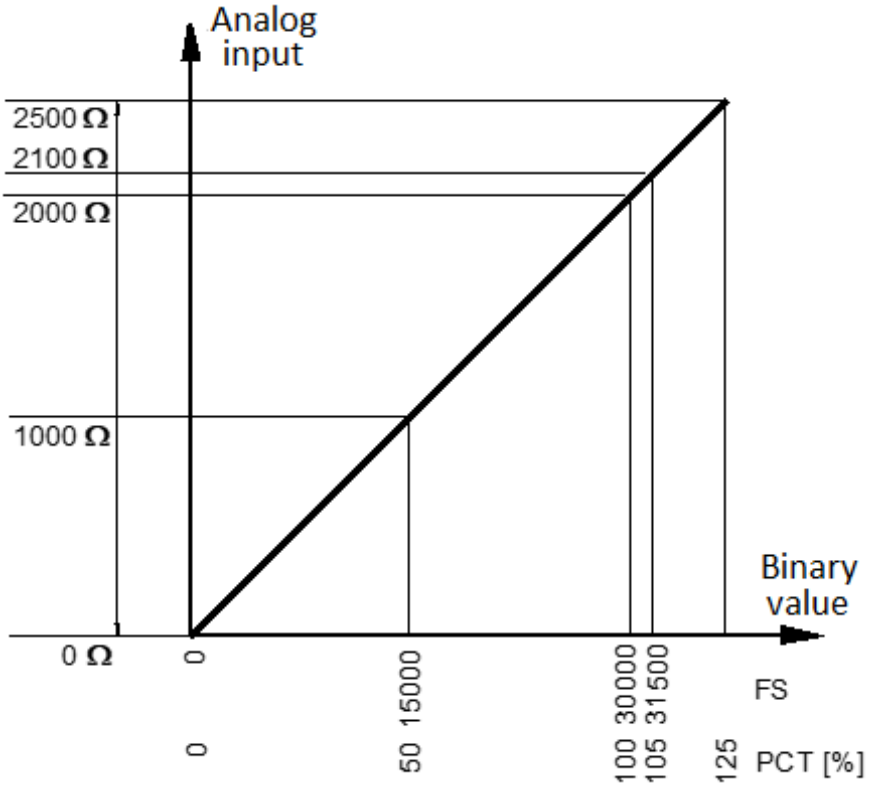


Fig.5.20 Resistance range of 2 kΩ analog inputs

Tab.5.14 Transmitted values of analog inputs for 0 to 2 kΩ range

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 2500 Ω	$000C	31500	2500	125	range overflow
2500 Ω	$000C	31500	2500	125	
2100 Ω	$0004	31500	2100	105	range overrun
:	$0004	:	:	:	
2000 Ω	$0000	30000	2000	100	nominal range
:	$0000	:	:	:	
0 Ω	$0000	0	0	0	

Note.: Due to the type of variable FS (int - ie 16-bit signed), its value is capped at 105% of the nominal range value. The ENG and PCT variables (type real) give the measured value up to 2.5 kΩ, resp. 125%.

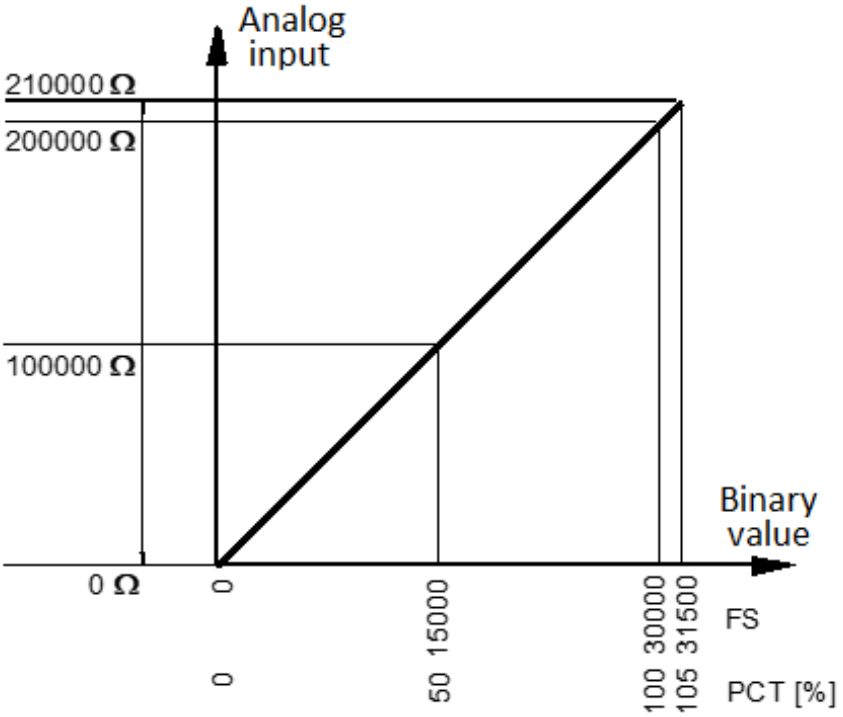


Fig.5.21 Resistance range up to 200 kΩ analog inputs

Tab.5.15 Transmitted values of analog inputs for the range 0 to 200 kΩ

Measured value	Variable				
	STAT	FS	ENG	PCT	
> 210 kΩ	$000C	31500	210000	105	range overflow
210 kΩ	$0004	31500	210000	105	range overrun
:	$0004	:	:	:	
200 kΩ	$0000	30000	200000	100	nominal range
:	$0000	:	:	:	
0 kΩ	$0000	0	0	0	

5.3.3. Analog outputs

The CP-2007 module contains 4 analog outputs AO0 - AO3, which have the same behavior and range from 0 to 10 V. The output is able to generate value up to 105% of the nominal range.

The function of the analog outputs is selected by inserting the jumper on the corresponding tips in the setting field on the front side of the CP-2007 basic module (chap.4, tab.4.2).

Table 5.16 gives an overview of the analog output range limit values.

Tab.5.16 Overview of analog output ranges

Output	Range	Lower limit -5%	Lower limit	Upper limit	Upper limit +5%
AO0 - AO3	0 to +10 V	-	0 V	10,0 V	10,5 V

When the power is turned on, the analog outputs are always set to 0.

The following chart and table show the transmitted values for the analog output range.

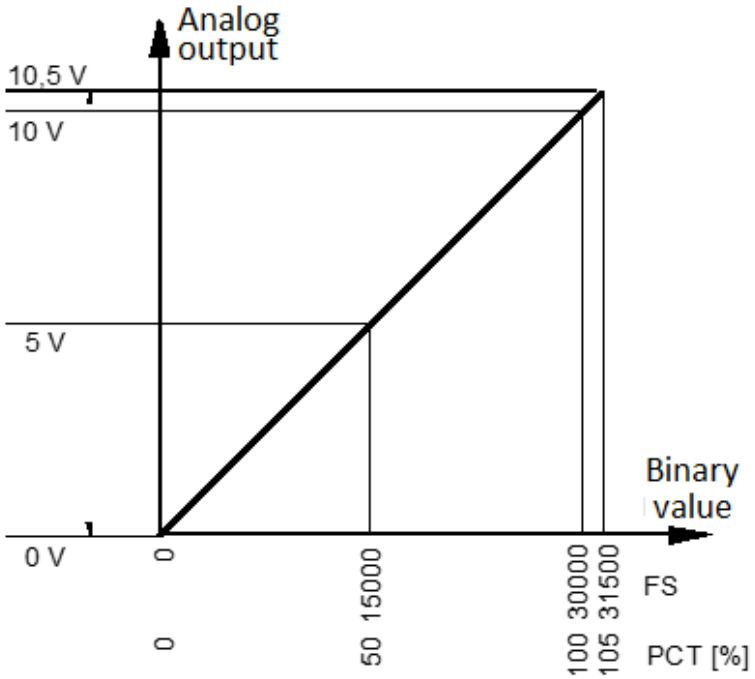


Fig.5.22 Range of analog outputs

Tab.5.17 Output values of analog outputs for range 0 to 10 V

Output value	Variable FS	ENG	PCT	
10,5 V	> 31500	> 10,5	> 105	range overflow
10,5 V	31500	10,5	105	range overrun
:	:	:	:	
10 V	30000	10	100	nominal range
:	:	:	:	
0 V	0	0	0	

5.3.4. Counters

The CP-2007 module contains 4 counter objects that use inputs DI4, DI5, DI8, DI9. All counters can be operated in one-way counter mode, counters 4 and 5 additionally support PWM input mode.

Tab.5.18 Overview of input assignment to counters

Counter	Counter object signals DI4	DI5	DI8	DI9
counter 4	UP, PWM	-	-	-
counter 5	-	UP, PWM	-	-
counter 8	-	-	UP	-
counter 9	-	-	-	UP

One-way counter

The counter object contains one unidirectional counter of external events (variable VAL), equipped with a counting input UP (corresponding input DI) and a preset (variable SET).

When a leading edge appears at the UP input, the counter increments its content by 1 and a value of 1 appears in the EV bit in the EV bit for one PLC cycle as a leading edge flag at the

input. If the resulting counter content is the same as the SET variable, the SCNT variable in the PS bit displays a value of 1 for one PLC cycle as a preselection flag. If the CC bit is set to 1 in the CCNT variable, the counter content is automatically reset.

You can also use the CCNT variable to control the counter run (EN bit), reset the counter (leading edge of the RES bit), or set its content to a value in the SET variable (leading edge of the SET bit).

SCNT

0	0	0	PS	0	0	0	EV
.7	.6	.5	.4	.3	.2	.1	.0

EV - 1 - leading edge flag at UP input
PS - 1 - preset achievement flag

SCNTB

0	0	0	0	0	0	0	0
.7	.6	.5	.4	.3	.2	.1	.0

VAL - current counter value

VALB - 0

CCNT

0	0	0	0	FC	SET	RES	EN
.7	.6	.5	.4	.3	.2	.1	.0

EN - 0 - counter stands
1 - counter counts
RES - 1 - reset the counter and reset it
SET - 1 - setting the counter to the value of the SET variable
FC - 0 - free running counters
1 - resetting the counter when the SET variable value is reached

CCNTB

0	0	0	0	0	0	0	0
.7	.6	.5	.4	.3	.2	.1	.0

SET - preset counters

SETB - 0

PWM output

The counter object in this mode captures the PWM signal at input DI4, respectively. DI5 and calculates the ratio of pulse width at log.1 level to the signal period. It also calculates the period and frequency of the PWM signal.

In the variable VAL, it is possible to display either the ratio of the pulse width at log.1 level to the PWM signal period in thousandths (per mille) or the approximate value of the counter. The information switches depending on the value of the INFCA bit in the CCNTB variable (0 - pulse width, 1 - counter value).

In the VALB variable, either the PWM signal period in microseconds or the PWM signal frequency in Hz can be displayed. The information switches depending on the value of the INFCB bit in the CCNTB variable (0 - period, 1 - frequency).

The currently transmitted information is indicated by the INFSA and INFSB bits in the SCNTB variable. Response to INFCA and INFCB change takes one PLC cycle. This means that after writing the request to these bits, the original information will be transferred in the next PLC cycle immediately (the INFSA and INFSB bits have the original value). When the request is accepted in the next cycle, the VAL and VALB variables display the requested information and the INFSA and INFSB bits have the same value as the INFCA and INFCB bits.

When a rising edge appears at the PWM input, a value of 1 appears in the status bit in the EV bit for one PLC cycle as a rising edge flag at the input. This flag can be used to indicate the presence of a PWM signal at the input. If the signal period is shorter than the PLC cycle time, then the EV bit can serve directly as an indication of the presence of a PWM signal at the input.

If the signal period is longer than the PLC cycle time, a value of 1 periodically appears in the EV bit for one PLC cycle each time a rising edge occurs at the input. An indication of the presence of the PWM signal at the input can then be created using the TON timer, on which the EV bit content is input. The timer preset value must be greater than the sum of the PWM signal period and PLC cycle time.

SCNT

0	0	0	0	0	0	0	EV
.7	.6	.5	.4	.3	.2	.1	.0

EV - 1 - leading edge flag at PWM input

SCNTB

INFSB	INFSA	0	0	0	0	0	0
.7	.6	.5	.4	.3	.2	.1	.0

INFSA - information transmitted in the variable VAL
- 0 - ratio of pulse width of log.1 level to PWM signal period [‰]
- 1 - PWM leading edge counter

INFSB - information transmitted in the variable VALB
- 0 - PWM signal period [µs]
- 1 - PWM signal frequency [Hz]

VAL - ratio of pulse width of log.1 level to signal period [‰] (CCNTB.INFCA = 0)
- PWM signal leading edge counter (CCNTB.INFCA = 1)

VALB - PWM signal period [µs] (CCNTB.INFCB = 0)
- PWM signal frequency [Hz] (CCNTB.INFCB = 1)

CCNT

0	0	0	0	0	0	0	0
.7	.6	.5	.4	.3	.2	.1	.0

CCNTB

INFCB	INFCA	0	0	0	0	0	0
.7	.6	.5	.4	.3	.2	.1	.0

INFCA - setting the information transmitted in the variable VAL
- 0 - ratio of pulse width at log.1 level to PWM signal period [‰]
- 1 - PWM leading edge counter

INFCB - setting the information transmitted in the variable VALB
- 0 - PWM signal period [µs]
- 1 - PWM signal frequency [Hz]

SET - 0

SETB - 0

5.3.5. PWM outputs

The CP-2007 module contains 2 PWMs that use DO11 and DO12 transistor outputs.

PWM outputs can operate in three modes - fixed frequency, variable frequency and as a pulse generator.

PWM output with constant frequency

In this mode, the period value is entered once in the PWM Permanent Period [µs] configuration. Pulse width can be varied from 0 to 100% on the fly using the real-time PCTP variable, which is a percentage of the pulse width to the period value.

As shown in Fig. 5.23, the leading edge of the pulse is repeated in a fixed time pattern according to a specified period, while the trailing edge of the pulse moves according to a set value of the control variable. If the control variable is 0, the output remains idle, no pulses are

generated. As the value of the control variable increases, more and more pulses are generated, which at the moment of reaching 100%, and the output remains permanently active.

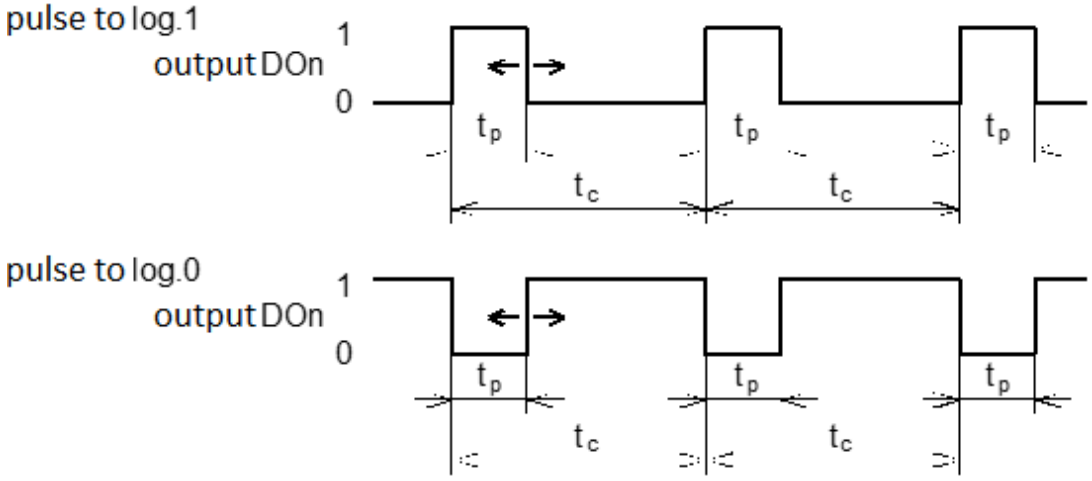


Fig.5.23 PWM output
t_p - pulse width, t_c = period

PWM output with variable frequency

In this mode, the output signal period is determined by the value of the udint PERP variable, which is interpreted either as a period in µs or as a frequency in Hz. The way of interpretation is selected in the configuration in Method of input of pulse frequency. Thus, the output signal period can be varied on the fly as well as the pulse width, which can be varied using a real-type PCTP variable between 0 and 100%, which is a percentage of the pulse width to the period value..

As shown in Fig. 5.23, the leading edge of the pulse is repeated in a time pattern given by the current value of the PERP variable, while the trailing edge of the pulse moves according to the entered value of the PCTP control variable. If the control variable is 0, the output remains idle, no pulses are generated. As the value of the control variable increases, more and more pulses are generated, which at the moment the value reaches 100%, and the output remains permanently active.

If the PERP variable is zero, no pulses are generated.

Individual pulses

This mode allows to generate individual pulses of defined width.

The CNTP variable is used to trigger pulse generation. Changing the value of bit 0 of this variable from 0 to 1 results in a single pulse of a width defined by the current value of the udint PERP variable in microseconds. Pulse polarity is given by configuration.

As shown in Fig. 5.24, the leading edge of the generated pulse always follows immediately after setting the CNTP.0 variable to 1 (more precisely, immediately after transfer of this change to the peripheral processor, which always takes place in the PLC cycle turn). In order to generate a new pulse, we must return CNTP.0 back to 0 in the next PLC cycle. This operation has no effect on the width of the generated pulse, which is clearly defined by the value of the PERP variable. It is thus possible to return the CNTP.0 value back to 0 even before the generated pulse is terminated.

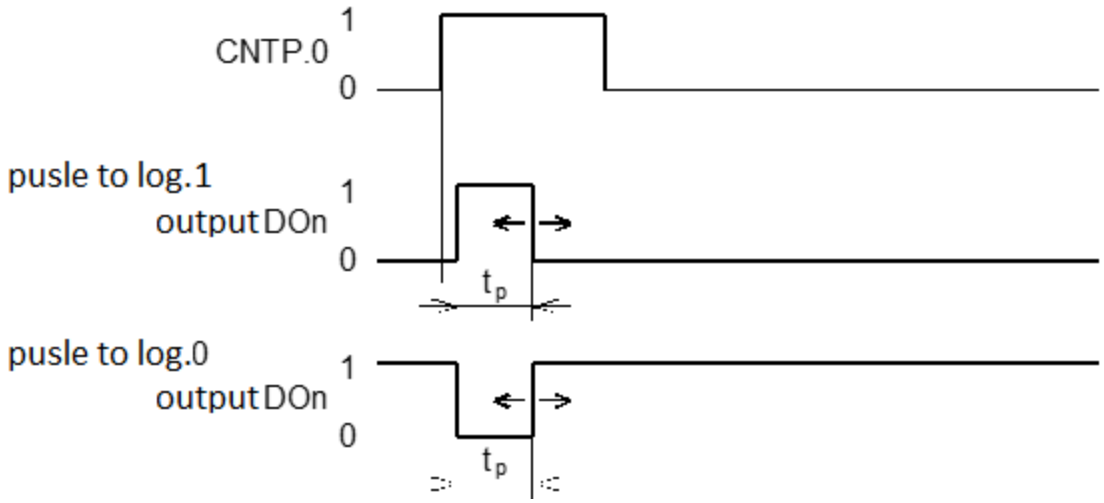


Fig.5.24 Individual pulses
t_p - pulse width

5.3.6. Integrated display

The CP-2007 includes an integrated 4 x 20 character OLED display and 6 user buttons.

The display is active 60 minutes from the start of the user program or the last press of any button. Then it goes out. Activate it for another 60 minutes by pressing any button or by switching the PLC to another mode (HALT, RUN). The display is also activated when a serious PLC fault occurs.

The time of 60 minutes is the default value and can be changed within the display configuration in the user program (chapter 5.1.).

Display character set

The display serves both for displaying system information and for application use by the user as a conventional operating panel. If the display is operated by the user program, then in the RUN mode it works in the user mode - ie. it displays characters generated by the user program. It can be switched to system mode with the MODE button to display the system status. The behavior of the display in system mode is described in the TECOMAT FOXTROT 2 programmable logic controllers (TXV 004 50.01) documentation.

The display is operated in character mode. Allows you to display the 256 characters of the character set selected when initializing the user program. The following Windows character sets are available:

CP1250 (WinLatin2 - Centraleuropean)
CP1251 (WinCyrillic - Cyrillic)
CP1252 (WinLatin1 - Westeeuropean)
CP1253 (WinGreek - Greek)

All of these character sets have the same encoding of the first 128 characters. Codes 0 - 31 contain graphical characters for creating lines and bargraphs and displaying key characters. Codes 32 - 127 correspond to standard ASCII encoding. Codes 128 - 255 vary according to the selected code page and contain national alphabet characters and other characters.

Individual characters and their encoding are listed in the following tables.

Tab.5.19 ASCII code table of characters 0 - 127 ($00 - $7F)

code	$0x	$1x	$2x	$3x	$4x	$5x	$6x	$7x
$x0		│		0	@	P	`	p
$x1	═	┤	!	1	A	Q	a	q
$x2	╒	┐	“	2	B	R	b	r
$x3	╓	└	#	3	C	S	c	s
$x4	╔	┴	$	4	D	T	d	t
$x5	╕	┬	%	5	E	U	e	u
$x6	╖	├	&	6	F	V	f	v
$x7	╗	─	’	7	G	W	g	w
$x8	╘	↑	(	8	H	X	h	x
$x9	╙	↓	)	9	I	Y	i	y
$xA	╚	→	*	:	J	Z	j	z
$xB	╛	←	+	;	K	[	k	{
$xC	╜	┼	,	<	L	\	l	|
$xD	✓	┘	–	=	M	]	m	}
$xE	-1	┌	.	>	N	^	n	~
$xF	∞		/	?	O	_	o	■

Tab.5.20 ASCII character code table 128 - 255 ($ 80 - $ FF) for code page CP1250 (Central European)

code	$8x	$9x	$Ax	$Bx	$Cx	$Dx	$Ex	$Fx
$x0	€			°	Ŕ	Đ	ŕ	đ
$x1		‘		±	Á	Ń	á	ń
$x2	‚	‘			Â	Ň	â	ň
$x3		“	Ł	ł	Ă	Ó	ă	ó
$x4	„	“	¤		Ä	Ô	ä	ô
$x5	…	•	Ą	µ	Ĺ	Ő	Í	ő
$x6	†	-	¦	¶	Ć	Ö	ć	ö
$x7	‡	–	§	·	Ç	x	ç	÷
$x8	^	~			Č	Ř	č	ř
$x9	‰			ą	É	Ů	é	ů
$xA	Š	š	Ş	ş	Ę	Ú	ę	ú
$xB	<	>	«	»	Ë	Ű	ë	ű
$xC	Ś	ś	¬	Ľ	Ě	Ü	ě	ü
$xD	Ť	ť	–		Í	Ý	í	ý
$xE	Ž	ž		ľ	Î	Ţ	î	ţ
$xF	Ź	ź	Ż	ż	Ď	ß	ď	■

Tab.5.21 ASCII characters code table 128 - 255 ($ 80 - $ FF) for code page CP1251 (Cyrillic)

code	$8x	$9x	$Ax	$Bx	$Cx	$Dx	$Ex	$Fx
$x0	Ђ	ђ		°	А	Р	а	р
$x1	Ѓ	‘	Ў	±	Б	С	б	с
$x2	‚	‘	ў	І	В	Т	в	т
$x3	ѓ	“	Ј	і	Г	У	г	у
$x4	„	“	¤	ґ	Д	Ф	д	ф
$x5	…	•	Ґ	µ	Е	Х	е	х
$x6	†	-	¦	¶	Ж	Ц	ж	ц
$x7	‡	–	§	·	З	Ч	з	ч
$x8	€		Ё	ё	И	Ш	и	ш
$x9	‰			№	Й	Щ	й	щ
$xA	Љ	љ	Є	є	К	Ъ	к	ъ
$xB	<	>	«	»	Л	Ы	л	ы
$xC	Њ	њ	¬	ј	М	Ь	м	ь
$xD	Ќ	ќ	–	S	Н	Э	н	э
$xE	Ћ	ћ		s	О	Ю	о	ю
$xF	Џ	џ	Ї	ї	П	Я	п	я

Tab.5.22 ASCII characters code table 128 - 255 ($ 80 - $ FF) for code page CP1252 (West European)

code	$8x	$9x	$Ax	$Bx	$Cx	$Dx	$Ex	$Fx
$x0	€			°	À	Đ	à	đ
$x1		‘	¡	±	Á	Ñ	á	ñ
$x2	‚	‘	¢	²	Â	Ò	â	ò
$x3	*ƒ*	“	£	³	Ã	Ó	ã	ó
$x4	„	“	¤		Ä	Ô	ä	ô
$x5	…	•	¥	µ	Å	Õ	å	õ
$x6	†	–	¦	¶	Æ	Ö	æ	ö
$x7	‡	–	§	·	Ç	x	ç	÷
$x8	^	˜			È	Ø	è	ø
$x9	‰			¹	É	Ù	é	ù
$xA	Š	š	ª	º	Ê	Ú	ê	ú
$xB	<	>	«	»	Ë	Û	ë	û
$xC	Œ	œ	¬	¼	Ì	Ü	ì	ü
$xD			–	½	Í	Ý	í	ý
$xE	Ž	ž		¾	Î	Þ	î	þ
$xF		Ÿ	¯	¿	Ï	ß	ï	ÿ

Tab.5.23 ASCII character code table 128 - 255 ($ 80 - $ FF) for code page CP1253 (Greek)

code	$8x	$9x	$Ax	$Bx	$Cx	$Dx	$Ex	$Fx
$x0	€			°	ΐ	Π	ΰ	π
$x1		‘		±	Α	Ρ	α	ρ
$x2	‚	‘	Ά	²	Β		β	ς
$x3	ƒ	“	£	³	Γ	Σ	γ	σ
$x4	„	“	¤		Δ	Τ	δ	τ
$x5	…	•	¥	μ	Ε	Υ	ε	υ
$x6	†	–	¦	¶	Ζ	Φ	ζ	φ
$x7	‡	–	§	·	Η	Χ	η	χ
$x8	^	~		Έ	Θ	Ψ	θ	ψ
$x9	‰			Ή	Ι	Ω	ι	ω
$xA				Ί	Κ	Ϊ	κ	ϊ
$xB	<	>	«	»	Λ	Ϋ	λ	ϋ
$xC			¬	Ό	Μ	ά	μ	ό
$xD			–	½	Ν	έ	ν	ύ
$xE				Ύ	Ξ	ή	ξ	ώ
$xF			¯	Ώ	Ο	ί	ο	■

Button coding

There are 6 buttons marked with cursor arrows, označ (enter) and X (cancel) for use in the application. These buttons are coded according to Table 5.24. The system supports the autorepeat function (periodic transmission of the button code when pressed for a long time) and the possibility to switch on the passing of the so-called terminating character generated by releasing the pressed button.

Tab.5.24 Button coding

code	button
$00	no button is pressed
$0D	✓
$18	△
$19	▽
$1A	▷
$1B	◁
$7F	**X**
$FF	Exit character (released button)

The MODE button is used to switch the display between system and user display modes and cannot be used for the application. Conversely, in system display mode, the keys indicated by the cursor arrows are used to scroll through the system screens. The keys pressed are not transferred to the PLC scratchpad in system mode.

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