sysWORXX CTR-750

Technical Specifications

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Changes

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1 Introduction

This document includes all device specific information for the sysWORXX CTR-750.

To get more general information on how to operate the device, please refer to the System Manual of our sysWORXX device series L-2782 (see Table 1).

2 Overview

Table 1 lists up all relevant manuals for the device.

Table 1: Overview of relevant manuals

Information about…	In which manual?
Specific technical information about the device	In this manual
Basic information about the device (configuration, administration, process image, connection assignment, firmware update, reference designs et cetera)	System Manual sysWORXX series – L-2782

3 Product Description

The sysWORXX CTR-750 extends the SYS TEC electronic AG product range within the field of IoT and control applications. It is an innovative, Linux-based compact controller for universal processing purposes of standard industrial signals. The controller module provides to the user numerous local in- and outputs as well as versatile communication interfaces.

The most significant features of the device are listed below:

- Linux-based compact PLC for industrial controls
- High-capacity CPU kernel (Freescale i.MX7 series Dual ARM Cortex-A7 Core 1GHz, Real-time Core Cortex-M4 200MHz)
- Up to 1024 MiB RAM, 8GiB eMMC FLASH Memory
- 1x USB 2.0 Host interface
- 2x 10/100/1000 Mbps Ethernet LAN interface
- LTE modem
- SIM-Card connector
- 1x asynchronous serial port (UART), usable as RS-232 or RS-485
- 10x digital input 24VDC, galvanic isolated
    - Alternate function: 1 high-speed counter input, galvanic isolated
    - Alternate function: 1 A/B-Encoder
- 2x relay output (2x normally open)
- 8x analog input 0-10VDC or 0-20mA with 12-Bit resolution
- 4x analog output 0-10VDC or 0-20mA with 12-Bit resolution
- 6x RTD 4-wire connector for PT100/PT1000 connections
- 4x thermocouple inputs (K-type)
- RTC (with buffer capacitor)
- On-board software: Linux, PLC firmware
- Programmable according to IEC 61131-3, C/C++ and Java
- Function block libraries for communication (Ethernet and UART)

- Function block libraries for hardware components (RTC, Counter, PWM/PTO)
- Linux-based (other user programs are executable in parallel)
- Remote login via SSH
- Dimensions: 162 x 91 x 60mm
- Temperature -20° … 60°C
- Suitable for DIN top hat rail mounting

Order no.: **23031000**: sysWORXX CTR-750 with basic Debian/GNU Linux installation, including microUSB cable for serial terminal via SERVICE plug

4 Interface of the sysWORXX CTR-750

4.1 Pin assignment

Figure 1: Interface and connector assignment of the device

Figure 1 shows the positioning of connectors on the device as an overview. Table 1 lists all connectors in detail.

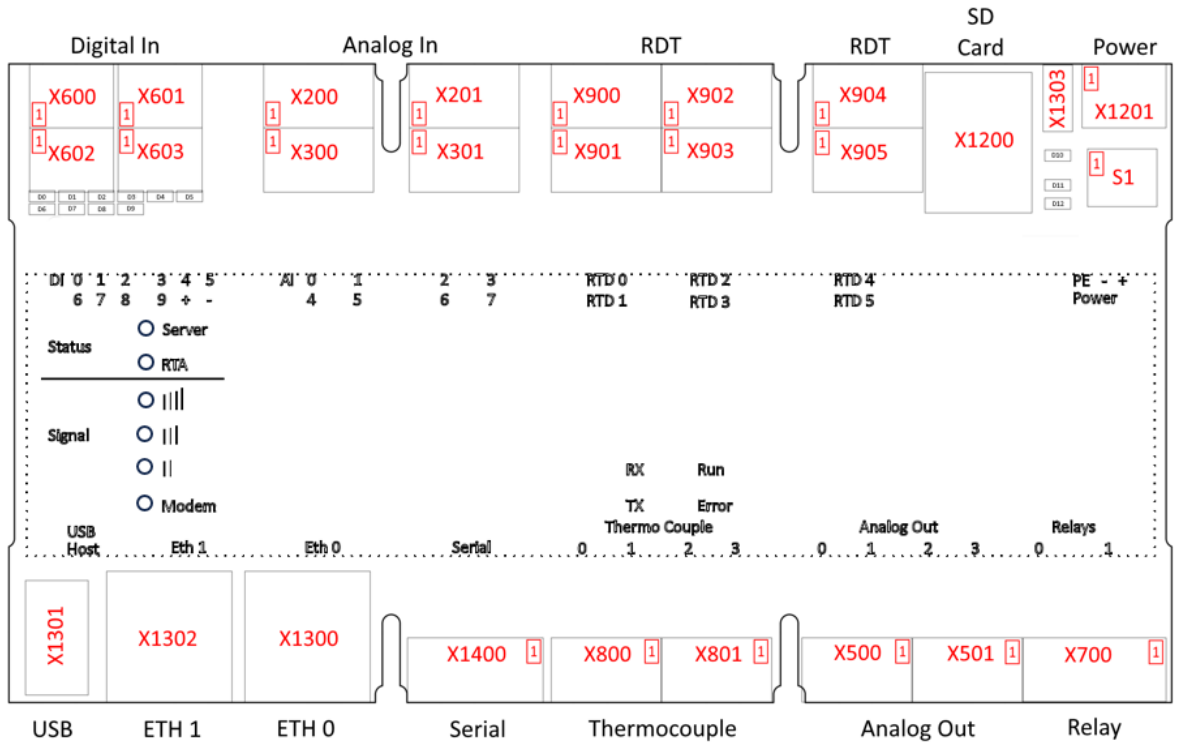

Figure 2: Interface and connector assignment

Table 2: Pin assignment

Terminal	Pins	Signal name	Remark
Digital Inputs X600	1 …3	DI0 … DI2	24V
Digital Inputs X601	1 … 3	DI3 … DI5	
Digital Inputs X602	1 … 3	DI6 … DI8	
Digital Inputs X603	1	DI9	
	2	24V	
	3	DI_GND	

Terminal	Pins	Signal name	Remark
Relay X700	1	REL1_COM	230V
	2	REL1_NO	
	3	REL0_COM	
	4	REL0_NO	
Analog Inputs X200	1	AI0+	0 … 10V/0 … 20mA
	2	AI0- (GND)	
	3	AI1+	
	4	AI1- (GND)	
Analog Inputs X201	1	AI2+	
	2	AI2- (GND)	
	3	AI3+	
	4	AI3- (GND)	
Analog Inputs X300	1	AI4+	
	2	AI4- (GND)	
	3	AI5+	
	4	AI5- (GND)	
Analog Inputs X301	1	AI6+	
	2	AI6- (GND)	
	3	AI7+	
	4	AI7- (GND)	
µSD/SIM-Card-Holder X1200	-	-	-
µUSB (console) X1303	-	-	-
Power X1201	1	PE	24V
	2	GND	
	3	24VDC	
USB-Host X1301	-	-	-
Ethernet 0 X1300	-	-	-
Ethernet 1 X1302	-	-	-
RTD 0 X900	1	0.1	PT100/PT1000
	2	0.2	

Terminal	Pins	Signal name	Remark
	3	0.3	
	4	0.4	
RTD 1 X901	1	1.4	PT100/PT1000
	2	1.3	
	3	1.2	
	4	1.1	
RTD 2 X902	1	2.1	PT100/PT1000
	2	2.2	
	3	2.3	
	4	2.4	
RTD 3 X903	1	3.4	PT100/PT1000
	2	3.3	
	3	3.2	
	4	3.1	
RTD 4 X904	1	4.1	PT100/PT1000
	2	4.2	
	3	4.3	
	4	4.4	
RTD 5 X905	1	5.4	PT100/PT1000
	2	5.3	
	3	5.2	
	4	5.1	
Analog Output X500	1	GND	0 … 10V
	2	AO1	
	3	GND	
	4	AO0	
Analog Output X501	1	GND	0 … 20mA
	2	AO3	
	3	GND	
	4	AO2	
Thermocouple X800	1	TC1+	K-Type
	2	TC1-	
	3	TC0+	
	4	TC0-	
Thermocouple	1	TC3+	K-Type
	2	TC3-	

Terminal	Pins	Signal name	Remark
X801	3	TC2+	
	4	TC2-	
Serial Interface X1400	1	GND	RS-232
	2	RTS	
	3	TX	
	4	CTS	
	5	RX	
	1	GND	RS-485/Modbus RTU (full-duplex, HW Rev1 only)
	2	Z+ = TX+	
	3	Y- = TX-	
	4	B+ = RX+	
	5	A- = RX-	
	1	GND	RS-485/Modbus RTU (half-duplex, HW Rev0)
	2	Not connected	
	3	Not connected	
	4	B+ = RX+/TX+	
	5	A- = RX-/TX-	

4.2 User interface

Table 3: Description Switches

Switch	Port	OFF	ON
S1	1	-	-
	2	-	-
	3	**SERIAL**: RS-485: Bus termination off RS-232: Must be set!	**SERIAL:** RS-485: Bus termination on RS-232: Do not set!
	4	-	**/CONFIG** Reserved (low active)
	5	-	-
	6	Boot mode: SD-Card	Boot mode: eMMC

Table 4: Description LEDs

LED	Color	Feature
D0 … D9	Yellow	Signal status of the DI's (on = high)
D10	Green	Status of the power supply for the device
D11	Yellow	Relay 0 status LED (enabled = high)
D12	Yellow	Relay 1 status LED (enabled = high)
D13	Red	Server status
D14	Green	RTA operational status
D15	Green	Signal strength I
D16	Green	Signal strength II
D17	Green	Signal strength III
D18	Green	Serial RX
D19	Green	Serial TX
D20	Green	Modem network status
D21	Green	PLC Run Status
D22	Red	PLC Error

The LEDs D0 to D12 cannot be controlled from a device's software directly. The others are accessible from a PLC application or via the SYSWORXX IO driver. Please refer to section L-2782 for more details.

The LEDs D0 to D12 are mounted on the ground plane, while the LEDs D13 to D22 are placed on the upper power plane. This plane is not shown in Figure 3.

4.3 Power Supply

The devices feature power supply inputs (24VDC ±20%). and has reverse polarity protection. If the device experiences a power fail, there is a short time window to act accordingly, for example to safe your data. During this time frame, the device will work normally then shuts down. To access the power fail signal, one must use the driver library in a separate program (see L-2782, Section 6). The exact values for power fail and the delay time are documented in section 7.

4.4 Galvanic Isolation

Figure 3 shows the galvanic isolation of the different interfaces and system components of the device.

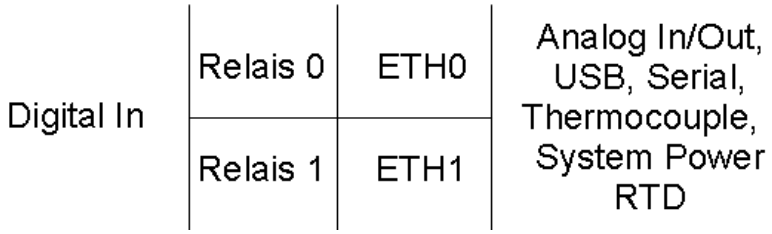

Figure 3: Galvanic isolation

- Analog In, USB, serial interfaces, Thermocouple and RTD's have **no isolation**.
- Digital in have **functional isolation** of 50 VDC
- Interfaces ETH0 and ETH1 have a **basic isolation** of 230 VAC
- Relays 0 and 1 have **reinforced isolation** of 230 VAC

4.5 Device Status/Control Signals

The device consists of status and control signals, listed, and descripted in

Table 5.

Table 5: List of user device status / control signals

Status Signal	Description
/CONFIG (S1) (see section 4.2)	Reserved
SER_MODE	Control serial interface modus: *TRUE* = RS485, *FALSE* = RS323
AOUT_EN	Turn analog out put on (*TRUE*) / off (*FALSE*).
MODEM_/RST	Triggers the reset of the modem if *FALSE*.
WDG_EN	Enable (*TRUE*) watchdog (works only wants and cannot being disabled again).
MODEM_EN	Enable/disable modem Enable = *TRUE*, Disable = *FALSE*
/PF	Power Fail signal (active low)
/DI_ERR	Digital input error (active low)
USB_/OC	USB over current (X1301) (active low)
AOUT0_/ERR	Failure at analog output 0 (X500:4) (active low)
AOUT1_/ERR	Failure at analog output 1 (X500:2) (active low)
AOUT2_/ERR	Failure at analog output 2 (X501:4) (active low)
AOUT3_/ERR	Failure at analog output 3 (X501:2) (active low)

The status and control signals in a PLC program are accessible via the process image or more general via the SYSWORXX IO driver as described in L-2782.

4.6 Cable types and maximum cable lengths

The following table shows, which cable types are recommended for the different interfaces:

Table 6: Recommended cable lengths, types and wire cross section

Interface	Cable length	Recommended cable types	Wire cross section
Digital outputs	<30m	Any cable suitable to the specific usage.	0,2 - 1,5mm² or AWG24 – 16
Digital inputs			
Analog inputs			
Analog outputs			
Relay Output			
RTD			
Thermocouple			
CAN	<30m	Shielded twisted pair	
SERIAL	RS232: <15m Modbus RTU: <30m	Shielded twisted pair	
Ethernet	<30m	S/FTP Cat 6	-
USB, Service	<3m	USB standard cable	-
MESHNET	-	-	
WLAN	-	-	
POWER	<30m	Any cable suitable to the specific usage.	1mm² - 1,5mm² or AWG17 - 16

4.7 Analog Inputs

To get the real value for the voltage or current measurement, the LSB must be multiplied by the measured digits. The specific values and calculation are as follows:

Example for voltage measurement:

U = 1 LSB * DIGIT
U = 311.76µV * 28145 = 8.774V

Example for current measurement:

I = 1 LSB * DIGIT
I = 820.39nA * 16384 = 13.441mA

4.8 Analog Outputs

To get the real value for the voltage or current output, use one of the following formulas:

Voltage:

V_{out} = (28kΩ/2*5.6Ω)*V_{in}
LSB = ((FSR/4095)*1000)*(V_{out}/V_{in})
RAW = (V_{out}/(LSB/1000)

Current:

I_{out} = (10/2kΩ)*V_{in}
LSB = ((FSR/4095)*1000)*(I_{out}/V_{in})
RAW = I_{out}/LSB

4.9 Serial Interfaces

The following table shows the list of serial interfaces and the corresponding Linux-Devices:

Table 7: Serial interface to Linux device node path

Interface	Linux-Device (*INTERFACE*)
SERIAL0	/dev/ttymxc1
SERVICE [1]	/dev/ttymxc0

[1] The **SERVICE** interface is used as the default Linux console for serial access to the device. Do not use this for custom applications unless you really know how to handle this without any conflicts.

4.10 Shared Process Image

Compared to other SYS TEC compact control systems, this device obtains a process image with identical addresses. All supported in- and outputs listed in Table 8.

Table 8: Assignment of in- and outputs to the process image

I/O of the device	Address and Data type in the Process Image	
DI0 ... DI7	**%IB0.0** %IX0.0 … %IX0.7	as Byte with DI0 … DI7 as single Bit for each input
DI8 ... DI9	**%IB1.0** %IX1.0 … %IX1.1	as Byte with DI8 … DI9 as single Bit for each input
AI0	**%IW8.0**	15Bit + sign (0 … +32767)
AI1	**%IW10.0**	15Bit + sign (0 … +32767)
AI2	**%IW12.0**	15Bit + sign (0 … +32767)
AI3	**%IW14.0**	15Bit + sign (0 … +32767)
AI4	**%IW16.0**	15Bit + sign (0 … +32767)
AI5	**%IW18.0**	15Bit + sign (0 … +32767)
AI6	**%IW20.0**	15Bit + sign (0 … +32767)
AI7	**%IW22.0**	15Bit + sign (0 … +32767)
C0	**%ID40.0** counter input: DI8 (%IX1.0), direction: DI9 (%IX1.1)	31Bit + sign (-2^{31} - 2^{31} -1)
CPU Temperature Sensor	**%ID72.0**	31Bit + sign as 1/10000 °C
System Temperature Sensor	**%ID76.0**	31Bit + sign as 1/10000 °C
Temperature RTD0	**%ID80.0**	31Bit + sign as 1/10000 °C
Temperature RTD1	**%ID84.0**	31Bit + sign as 1/10000 °C
Temperature RTD2	**%ID88.0**	31Bit + sign as 1/10000 °C
Temperature RTD3	**%ID92.0**	31Bit + sign as 1/10000 °C
Temperature RTD4	**%ID96.0**	31Bit + sign as 1/10000 °C
Temperature RTD5	**%ID100.0**	31Bit + sign as 1/10000 °C
Temperature Thermo Couple 0	**%ID104.0**	31Bit + sign as 1/10000 °C
Temperature Thermo Couple 1	**%ID108.0**	31Bit + sign as 1/10000 °C
Temperature Thermo Couple 2	**%ID112.0**	31Bit + sign as 1/10000 °C
Temperature Thermo Couple 3	**%ID116.0**	31Bit + sign as 1/10000 °C

REL0 and REL1	**%QB0.0** as Byte with REL0 and REL1 %QX0.0 … %QX0.1 as single Bit for each Relay
REL0 and REL1 Mask	**%QB1984.0** as Byte with REL0 and REL1 %QX1984.0 … %QX1984.1 as single Bit for each Relay 0: relay isn't controlled by PLC, 1: PLC controls relay
AI0 Configuration	**%QB1928.0** Configuration of AI0 0: keep configuration, 1: set to voltage measurement, 2: set to current measurement
AI1 Configuration	**%QB1929.0** Configuration of AI1 see AI0 Configuration
AI2 Configuration	**%QB1930.0** Configuration of AI2 see AI0 Configuration
AI3 Configuration	**%QB1931.0** Configuration of AI3 see AI0 Configuration
AI4 Configuration	**%QB1932.0** Configuration of AI4 see AI0 Configuration
AI5 Configuration	**%QB1933.0** Configuration of AI5 see AI0 Configuration
AI6 Configuration	**%QB1934.0** Configuration of AI6 see AI0 Configuration
AI7 Configuration	**%QB1935.0** Configuration of AI7 see AI0 Configuration

RTD0 Configuration	**%QB1946.0** Configuration of RTD0 00_h: keep configuration, 11_h: Two-Wire PT100, 21_h: Three-Wire PT100, 31_h: Four-Wire PT100, 12_h: Two-Wire PT1000, 22_h: Three-Wire PT1000, 32_h: Four-Wire PT1000
RTD1 Configuration	**%QB1947.0** Configuration of RTD1 see RTD0 configuration
RTD2 Configuration	**%QB1948.0** Configuration of RTD2 see RTD0 configuration
RTD3 Configuration	**%QB1949.0** Configuration of RTD3 see RTD0 configuration
RTD4 Configuration	**%QB1950.0** Configuration of RTD4 see RTD0 configuration
RTD5 Configuration	**%QB1951.0** Configuration of RTD5 see RTD0 configuration
Serial Mode	**%QX4.0** 0: RS-232, 1: RS-485
Serial Mode Mask	**%QX1988.0** 0: output isn't controlled by PLC, 1: PLC controls output via %QX4.0
General Analog Out Enable	**%QX4.1** 0: disable, 1: enable
General Analog Out Enable Mask	**%QX1988.1** 0: output isn't controlled by PLC, 1: PLC controls output via %QX4.1
Modem Reset Signal	**%QX4.2** 0: no reset, 1: reset
Modem Reset Signal Mask	**%QX1988.2** 0: output isn't controlled by PLC, 1: PLC controls output via %QX4.2
LED Server Status	**%QX5.0** active high
LED Server Status Mask	**%QX1989.0** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.0
LED Signal Strength 0	**%QX5.1** active high
LED Signal Strength 0 Mask	**%QX1989.1** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.1
LED Signal Strength 1	**%QX5.2** active high
LED Signal Strength 1 Mask	**%QX1989.2** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.2
LED Signal Strength 2	**%QX5.3** active high
LED Signal Strength 2 Mask	**%QX1989.3** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.3
LED RTA Operational	**%QX5.4** active high
LED RTA Operational Mask	**%QX1989.4** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.4
LED Serial RX	**%QX5.5** active high
LED Serial RX Mask	**%QX1989.5** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.5
LED Serial TX	**%QX5.6** active high

LED Serial TX Mask	**%QX1989.6** 0: output isn't controlled by PLC, 1: PLC controls output via %QX5.6
Analog Out0	**%QW8.0** 15Bit + sign (0 … +32767) DAC Voltage
Analog Out1	**%QW10.0** 15Bit + sign (0 … +32767) DAC Voltage
Analog Out2	**%QW12.0** 15Bit + sign (0 … +32767) DAC Current
Analog Out3	**%QW14.0** 15Bit + sign (0 … +32767) DAC Current
AO Mask 0	**%QB1992.0** as Byte Each bit from that byte controls an analog output.

Advice: The device works with Little-Endian format ("Intel-Notation). Consequently, and on the contrary to controls using Big-Endian ("Motorola-Notation), it is **possible** to sum up several BYTE variables of the process image to one WORD or DWORD and to access Bits above Bit7. The following example shows issue described:

```
bInByte0  AT %IB0.0 : BYTE;
bInByte1  AT %IB1.0 : BYTE;
wInWord0  AT %IW0.0 : WORD;

wInWord0.0 == bInByte0.0  due to Little-Endian: wInWord0.0 <> bInByte1.0
wInWord0.8 == bInByte1.0  due to Little-Endian: wInWord0.8 <> bInByte0.0
```

In- and outputs are not negated in the process image. Hence, the H-level at one input leads to value "1" at the corresponding address in the process image. Contrariwise, value "1" in the process image leads to an H-level at the appropriate output.

5 Firmware Function Scope

Table 9 lists all firmware functions and function blocks available on the device.

Sign explanation:

FB	Function block
FUN	Function
Online Help	*OpenPCS* online help
L-1054	Manual *"SYS TEC-specific extensions for OpenPCS / IEC 61131-3"*, Manual no.: L-1054)
PARAM:={0,1,2}	values 0, 1 and 2 are valid for the given parameter

Table 9: Firmware functions and function blocks

Name	Type	Reference	Remark
PLC standard Functions and Function Blocks			
SR	FB	Online Help	
RS	FB	Online Help	
R_TRIG	FB	Online Help	
F_TRIG	FB	Online Help	
CTU	FB	Online Help	
CTD	FB	Online Help	
CTUD	FB	Online Help	
TP	FB	Online Help	
TON	FB	Online Help	
TOF	FB	Online Help	

Functions and Function Blocks for string manipulation			
ETRC	FB	L-1054	
PTRC	FB	L-1054	
GETVARPOINTER	FB	L-1054	
BIN_TO_STR	FUN	L-1054	
STR_TO_BIN	FUN	L-1054	
OBJ_TO_STR	FB	L-1054	
GETSTRINFO	FB	L-1054	
CHR	FUN	L-1054	
ASC	FUN	L-1054	
STR	FUN	L-1054	
VAL	FUN	L-1054	
LEN	FUN	L-1054	
LEFT	FUN	L-1054	
RIGHT	FUN	L-1054	
MID	FUN	L-1054	
CONCAT	FUN	L-1054	
INSERT	FUN	L-1054	
DELETE	FUN	L-1054	
REPLACE	FUN	L-1054	
FIND	FUN	L-1054	
STR_UPPER	FUN		
STR_LOWER	FUN		
STR_TRIM	FUN		
Functions and Function Blocks for OpenPCS specific task controlling			
GETVARDATA	FB	Online Help	
GETVARFLATADDRESS	FB	Online Help	
GETTASKINFO	FB	Online Help	
Functions and Function Blocks for handling of non-volatile data			
NVDATA_BIT	FB	L-1054	DEVICE:={0} see (1)
NVDATA_INT	FB	L-1054	DEVICE:={0} see (1)
NVDATA_STR	FB	L-1054	DEVICE:={0} see (1)
NVDATA_BIN	FB	L-1054	DEVICE:={0} see (1)
Functions and Function Blocks for handling of time			
GETTIME	FUN	Online Help	
GETTIMECS	FUN	Online Help	
TIME_TO_DINT	FUN		
DINT_TO_TIME	FUN		
DT_CLOCK	FB	L-1054	
DT_ABS_TO_REL	FB	L-1054	
DT_REL_TO_ABS	FB	L-1054	
DT_REL_TO_DT			
Functions and Function Blocks for counter inputs and pulse outputs			
CNT_FUD	FB	L-1054	CHANNEL:={0,1,2}
PTO_PWM	FB	L-1054	***Not Supported***
PTO_TAB	FB	L-1054	***Not Supported***
Function Block for PID regulator			
PID1	FB	L-1054	

Functions and Function Blocks for Serial interfaces			
SIO_INIT	FB	L-1054	PORT:={0,1} see (2)
SIO_STATE	FB	L-1054	PORT:={0,1} see (2)
SIO_READ_CHR	FB	L-1054	PORT:={0,1} see (2)
SIO_WRITE_CHR	FB	L-1054	PORT:={0,1} see (2)
SIO_READ_STR	FB	L-1054	PORT:={0,1} see (2)
SIO_WRITE_STR	FB	L-1054	PORT:={0,1} see (2)
SIO_READ_BIN	FB	L-1054	PORT:={0,1} see (2)
SIO_WRITE_BIN	FB	L-1054	PORT:={0,1} see (2)
Functions and Function Blocks for Ethernet interfaces / UDP			
LAN_GET_HOST_CONFIG	FB	L-1054	NETNUMBER:={0}
LAN_ASCII_TO_INET	FB	L-1054	NETNUMBER:={0}
LAN_INET_TO_ASCII	FB	L-1054	NETNUMBER:={0}
LAN_GET_HOST_BY_NAME	FB	L-1054	NETNUMBER:={0}
LAN_GET_HOST_BY_ADDR	FB	L-1054	NETNUMBER:={0}
LAN_UDP_CREATE_SOCKET	FB	L-1054	NETNUMBER:={0}
LAN_UDP_CLOSE_SOCKET	FB	L-1054	NETNUMBER:={0}
LAN_UDP_RECVFROM_STR	FB	L-1054	NETNUMBER:={0}
LAN_UDP_SENDTO_STR	FB	L-1054	NETNUMBER:={0}
LAN_UDP_RECVFROM_BIN	FB	L-1054	NETNUMBER:={0}
LAN_UDP_SENDTO_BIN	FB	L-1054	NETNUMBER:={0}
Functions and Function Blocks for file access			
FILE_OPEN	FB	L-1828	
FILE_CLOSE	FB	L-1828	
FILE_READ	FB	L-1828	
FILE_READ_LINE	FB	L-1828	
FILE_WRITE	FB	L-1828	
FILE_SEEK	FB	L-1828	
FILE_SYNC	FB	L-1828	
FILE_STAT	FB	L-1828	
FILE_CHMOD	FB	L-1828	
FILE_TOUCH	FB	L-1828	
FILE_DELETE	FB	L-1828	
FILE_RENAME	FB	L-1828	
FILE_COPY	FB	L-1828	
FILE_SPLIT_PATH	FB	L-1828	
FILE_DIR_OPEN	FB	L-1828	
FILE_DIR_CLOSE	FB	L-1828	
FILE_DIR_READ	FB	L-1828	
FILE_GET_DIR	FB	L-1828	
FILE_SET_DIR	FB	L-1828	
FILE_MKDIR	FB	L-1828	
FILE_RMDIR	FB	L-1828	
FILE_MKFIFO	FB	L-1828	
FILE_EXEC_SYS_CMD	FB	L-1828	
FTYPE_TO_UINT	FUN	L-1828	
FSEEK_TO_UINT	FUN	L-1828	
FPERM_TO_STRING	FUN	L-1828	
SYSERR_TO_STRING	FUN	L-1828	

Functions and Function Blocks for Modbus communication			
MODBUS_OPEN_INSTANCE	FB	L-1829	
MODBUS_CLOSE_INSTANCE	FB	L-1829	
MODBUS_REGISTER_VAR_LIST	FB	L-1829	
MODBUS_READ_REGS	FB	L-1829	
MODBUS_WRITE_SINGLE_REG	FB	L-1829	
MODBUS_WRITE_MULTI_REGS	FB	L-1829	
MODBUS_READ_WRITE_REGS	FB	L-1829	
MODBUS_READ_INPUT_REGS	FB	L-1829	
MODBUS_READ_DISCR_INPUTS	FB	L-1829	
MODBUS_READ_COILS	FB	L-1829	
MODBUS_WRITE_SINGLE_COIL	FB	L-1829	
MODBUS_WRITE_MULTI_COILS	FB	L-1829	
MODBUS_RAW_PDU_REQUEST	FB	L-1829	
Functions and Function Blocks for MQTT communication			
MQTT_GET_CAPABILITIES	FB	Demo	
MQTT_CONNECT	FB	Demo	
MQTT_DISCONNECT	FB	Demo	
MQTT_GET_CONNECT_STATE	FUN	Demo	
MQTT_SUBSCRIBE	FB	Demo	
MQTT_UNSUBSCRIBE	FB	Demo	
MQTT_GET_ARRIVED_MESSAGE	FB	Demo	
MQTT_PUBLISH	FB	Demo	

(1) All nonvolatile data is filed into directory *"/home/plc/plcdata/PlcPData.bin"*. This file has a fix size of 32 KiB. By calling function blocks of type *NVDATA_Xxx* in a writing mode, the modified data is directly stored into file *"/home/plc/plcdata/PlcPData.bin"* ("*flush*"). Thus, unsecured data is not getting lost in case of power interruption.

(2) Interface SERVICE primarily serves as service interface to administer the device. Hence, this interface should only be used for sign output. The module always tries to interpret and execute sign inputs as Linux commands.

6 Library sysWORXX IO

This section describes the usage of the sysWORXX IO library that enables access to the different inputs and outputs of the device as well as additional device information. The header file with the public interface is located at "**/usr/include/sysworxx_io.h**". The driver is managed via a systemd service "*iodaemon.service*" that is enabled by default and located at "**/lib/systemd/system**".

To enable access to the interfaces of the device include the header in a *C/C++* application and use the public interface to program your functionality. Afterwards compile the application with the GCC-compiler and link against the corresponding library located at "**/usr/lib/libsysworxx_io.so**". For the necessary compiler flags and usability of the "GNU Compiler Collection" refer to https://gcc.gnu.org/onlinedocs/gcc-7.3.0/gcc/.

6.1 IoResult Description

Each of the public functions listed in *Table 11* returns a status code that is listed in *Table 10* to indicate the success of the function's behavior.

Table 10: SYSWORXX IO Return Status Codes

Error	Return Status Code
IoResult_Success	0
IoResult_Error	255
IoResult_NotImplemented	254
IoResult_InvalidParameter	253
IoResult_InvalidChannel	252
IoResult_InvalidMode	251
IoResult_InvalidTimebase	250
IoResult_InvalidDelta	249
IoResult_PtoParamTabFull	248
IoResult_DevAccessFailed	247
IoResult_AddressOutOfRange	243
IoResult_WatchdogTimeout	242

6.2 Public Interface Description

The functions listed in *Table 11* are used to access the peripheral as well as status flags of the device. You may us it to read or write digital as well as analog values and setup configurations for e.g., RDT inputs. For details about the parameters of the functions please refer the header file "**sysworxx_io.h**".

Table 11: SYSWORXX IO Public Interface Functions

Function Name	Description
IoInit	Initializes the I/O driver
IoShutdown	De-initialization of the I/O driver
IoGetVersion	Get the version of the I/O driver
IoGetTickCount	Get the tickcount of the system in milliseconds
IoEnableWatchdog	Enable the systems watchdog
IoServiceWatchdog	Service the system watchdog
IoGetHardwareInfo	Get information about device revision and available I/O channels
IoSetRunLed	Set/reset the RUN LED
IoSetErrLed	Set/reset the ERROR LED
IoGetRunSwitch	Get status of the RUN switch
IoGetConfigEnabled	Get status of the config switch

Function Name	Description
IoSetOutput	Set the value of a digital output e.g. REL[0,1]
IoGetInput	Get the value of a digital input e.g., D0…D9
IoRegisterInputCallback	Register a callback to signal changes on a digital input
IoUnregisterInputCallback	Un-register / disable interrupt handling for a digital input
IoAdcGetValue	Get the value of an ADC channel e.g., AI0 … AI7
IoAdcSetMode	Setup an ADC channel for voltage or current measurement
IoDacSetValue	Set DAC output value e.g., AO0 … AO3
IoTmpSetMode	Set mode of a given temperature sensor
IoTmpGetValue	Get the value of a temperature sensor
IoCntEnable	Enable/disable a counter channel
IoCntSetup	Setup the counters mode e.g., mode, trigger, or direction
IoCntSetPreload	Set the initial value of the counter
IoCntGetValue	Get the value of a counter channel

6.3 Device Interface and Signal Channel Mapping

To access status signals or device inputs with the functions listed in *Table 11*, the target of a function is addressed with channel numbers. The following table lists the channels to the corresponding signals or device inputs/outputs. The actual channel names and values can vary depending on the device.

Table 12: Device Interface and Signal Channel Mapping

Name	Channel	Remarks
Digital Inputs		
DI0	0	Access through “IoGetInput” Event notification though “IoRegisterInputCallback” and “IoUnregisterInputCallback”
DI1	1	
DI2	2	
DI3	3	
DI4	4	
DI5	5	
DI6	6	
DI7	7	
DI8	8	
DI9	9	
Relay Outputs		
REL0	0	Access through” IoSetOutput”
REL1	1	
Analog Inputs		
AI0	0	Access though “IoAdcGetValue” Setup though “IoAdcSetMode”
AI1	1	
AI2	2	
AI3	3	
AI4	4	
AI5	5	
AI6	6	
AI7	7	
Analog Output		
AOUT0	0	Access though “IoDacSetValue” Do not forget to enable analog output setting AOUT_EN to *TRUE*.
AOUT1	1	
AOUT2	2	
AOUT3	3	
Temperature Sensors		Default

Name	Channel	Remarks
CPU Temperature Sensor	0	Access through “IoTmpGetValue”
System Temperature Sensor	1	
RTD 0	2	Access through “IoTmpGetValue” Setup through “IoTmpSetMode” All channels are configured as PT100 in two wire mode.
RTD 1	3	
RTD 2	4	
RTD 3	5	
RTD 4	6	
RTD 5	7	
Thermocouple 0	8	Access through “IoTmpGetValue”
Thermocouple 1	9	
Thermocouple 2	10	
Thermocouple 3	11	
Counters		
Counter 0	0	Access through “IoCntGetValue” Enable/Disable through “IoCntEnable” Configure through “IoCntSetPreload” and “IoCntSetup”
Counter 1	1	
LEDs		
LED Server Status	40	Access through” IoSetOutput”
LED Signal Strength 1	41	
LED Signal Strength 2	42	
LED Signal Strength 3	43	
LED RTA operational	44	
LED Serial RX	45	
LED Serial TX	46	
PLC Run Led	-	Access through dedicated function “IoSetRunLed”
PLC Error Led	-	Access through dedicated function “IoSetErrorLed”
Status/Control Signals		
PowerFail24VDC (/PF)	32	Access through “IoGetInput” Event notification though “IoRegisterInputCallback” and “IoUnregisterInputCallback”
DiErr (DI_/ERR)	33	
UsbOc (USB_/OC)	34	
AoutErr0 (AOUT0_/ERR)	35	
AoutErr1 (AOUT1_/ERR)	36	
AoutErr2 (AOUT2_/ERR)	37	
AoutErr3 (AOUT3_/ERR)	38	
/CONFIG	-	Access through dedicated function “IoGetConfigEnabled”
SER_MODE	32	Access through” IoSetOutput”
Analog Out Enable (AOUT_EN)	33	
MODEM_/RST	34	
WDG_EN	35	
MODEM_EN	36	

7 Technical Specification

Environmental Parameters		Typical	Minimum Maximum
Power Supply	V_{CPU}	24VDC	19.2…30VDC
	V_{IO}	24VDC	19.2…30VDC
	power fail level	18,2V	
	power fail delay time	10ms	
Current Consumption (inactive IOs)	I_{CPU}	100mA	
	I_{IO}	30mA	
Temperature Range	Storage temperature		-40…+85°C
	Operating temperature		-20…+60°C
Protection class	Housing	IP20	
Weight	without any cable and packing	295g	
Dimensions	Width Height Depth		162mm 61mm 91mm
Connector type	Spring type connector		
Lowest cycle time for PLC		5 ms	

I/O-configuration (digital)		Typical	Maximum
Digital Outputs REL0/REL1			
Relay output (N.O.)	Switching Voltage		220VDC 250VAC
	Switching Current		110VDC / 0.3A 30VDC / 2.0A 120VAC / 0.5A 240VAC / 0.25
	Contact rating		60W/62.5VA
	Durability (mechanical.)	$100x10^6$	
	Durability (electrical.) @12V/10mA @60V/500mA @30V/1000mA @30V/2000mA	 $5x10^7$ $5x10^5$ $1x10^6$ $2x10^5$	
	t_{on}	4ms	
	t_{off}	4ms	
	Isolation	1000Vrms	
Digital Inputs DI0 … 09			
24VDC- Inputs, plus switching	U_{IH}	13V	30V
	U_{IL}	-3V	12.3V
	I_{IH} (V_{IN}=6.7V)	1.3mA	
	I_{IH} (V_{IN}=30V)		3.5mA
	Input type according to IEC61131-2	Type 1	
	T_{DLY}		100ns

I/O-configuration (analog)		Typical	Maximum
Analog Inputs AI0 ... 7			
0 ... 10V	Measurement range U_I	0…10.21V	
	Measurement error	-	0.5%[2]
	Destructive voltage U_{I_max}	-	32V
	Input resistance R_I	203.9kΩ ±0.1%	
	Physical Resolution	-	15Bit
	LSB	311.76µV	
	Cut off frequency	4.2Hz	
0 ... 20mA	Measurement range I_I	0…26.882mA[3]	
	Measurement error	-	0.5%[2]
	Input resistance R_I	93Ω ±0.1%	
	Physical Resolution	-	15Bit
	LSB	820.39nA	
	Cut off frequency	4.2Hz	

I/O-configuration (analog)		Typical	Maximum
Analog Outputs AO0 ... 3			
AO0, AO1: 0 ... 10V	Output voltage range U_O	0…10.24V[4]	
	Output voltage error	-	0.5%[6]
	External load impedance	≥ 1kΩ	
	Physical Resolution	-	12Bit
	LSB	2500.611µV	
AO2, AO3: 0 ... 20mA	Output current range I_O	0…20.49mA	
	Output current error	-	0.5%[2]
	External load impedance	≤ 600Ω	
	Physical Resolution	-	12Bit
	LSB	5001.221nA	

I/O-configuration (analog)		Typical	Maximum
Resistance Thermometer Detectors RTD0 ... 7			
RTD0 ... 7	Full Scale Range	-50°C … +250°C	
	Accuracy	-	±0.1%[6 FSR]
	Resolution	≤ 0.16K (PT100)	
	Physical Resolution	-	15Bit
	LSB (R_{RTD})	0.061Ω	
	Wire Mode	2-wire, 3-wire, 4-wire	
	Sensor Type	PT100, PT1000	
Thermocouple TC0 ... 1			
TC0 ... 1 (K-Type)	Full Scale Range	-50°C … +250°C	
	Accuracy	-	±0.5%[6 FSR]
	Resolution	~ 0.22K	
	Physical Resolution	-	15Bit
	LSB (V_{ADC})	7.8125µV	
	Input Impedance	-	710kΩ

Communication Interfaces		Minimum	Maximum
RS-232/RS-485			
SERIAL	Baudrate	1200Baud	230400Baud
SERVICE	Baudrate	1200Baud	230400Baud
Ethernet			
ETH0	Bandwith	10Mbit/s	1000Mbit/s
ETH1	Bandwith	10Mbit/s	1000Mbit/s

[2] Value is defined over temperature range.
[3] Input is protected against overcurrent, max. voltage should not exceed 30V
[4] Output is protected against short circuit.

Standards and approvals		
See the appendix or product folder on the website for the currently valid declaration of conformity		

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