ANALOG MODULES TC700

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1. INTRODUCTION

Analog modules (Table 1.1) serve for connection of input and output analog signals of the object being controlled to the programmable logic controller (PLC) TECOMAT TC700. The modules ensure conversion of the analog voltage or current input level to the level of internal logic signals of the PLC and filtering off of faults and vice versa, conversion of logic signals of the PLC to output analog levels of current or voltage.

The information on module type and their basic parameters can be found on the front plate and module sides. The assignment of signals on the terminals of the module connectors is illustrated on the inside of the door.

Modules in the PLC are unequivocally identified by their position in the rack and by rack address. Analog modules can be fitted at any arbitrary position of both the main and expansion racks.

Table 1.1 List of modules with order numbers

Module type	Modification	Order number
IT-7601	8 analog inputs, standard signals (10 V, 20 mA)	TXN 176 01
IT-7604	8 analog inputs, standard signals, Pt100, Ni1000	TXN 176 04
OT-7652	8 analog outputs, standard signals (10 V, 20 mA)	TXN 176 52

2. MECHANICAL DESIGN

Each module has a plastic protective case 30 mm wide. After opening the door you can access the connectors for signal connection. At the bottom of the unit there is a hole for cables connected to the technology being controlled.

The modules are fitted with connectors, plug-in counterparts of which have screw-type or screwless (spring) terminals. Taking out of each connector is facilitated by means of locking levers. By moving the locking lever round a slight amount, the terminal becomes loose. When fitting the connector on, the locking lever has to be moved round a slight amount in reverse direction and, for connectors TXN 102 3x, the locking levers serve also to secure the connector against disconnecting.

The connectors are ordered separately and are ready for mechanical encoding. For each module type, a different code is used, so that it is ensured that the user does not interchange the cables by mistake with another connections and does not possibly destroy the module by a higher voltage. Encoding is carried out by means of plastic pins into the connector (according to the instructions for use, which are part of each connector set). The modules are supplied with counterparts of connectors already encoded according to fig. 2.2.

Fixation of the module on the rack is easy and done by means of a screw located at the top part of the case.

When fixing the module on the rack, the module has to be put with its two lugs at the rear bottom part of the case into the holes at the bottom edge of the metal frame in required position and by swinging movement press the module down onto the connector of the bus and secure it by the screw located at the top side of the case.

When you want to take the module out off the rack, loose the screw at the top part of the case and by swinging movement towards you and down, tilt the module from the rack and take it carefully out of the rack.

Configuration jumpers (current input ranges) on the module are accessible after taking away the door on the right side of the case. The door can be loosen by a screwdriver inserted behind the catch on the right side of the module case.

ATTENTION! The modules contain parts sensitive to static charge, therefore, it is necessary to follow the safety rules when working with these circuits! Any handling must be done on the module taken out from the rack!

Table 2.1 Module dimensions and weights

Dimensions	- height	198 mm
	- width	30 mm
	- depth	137 mm
Weight		0.3 to 0.4 kg (according to type)

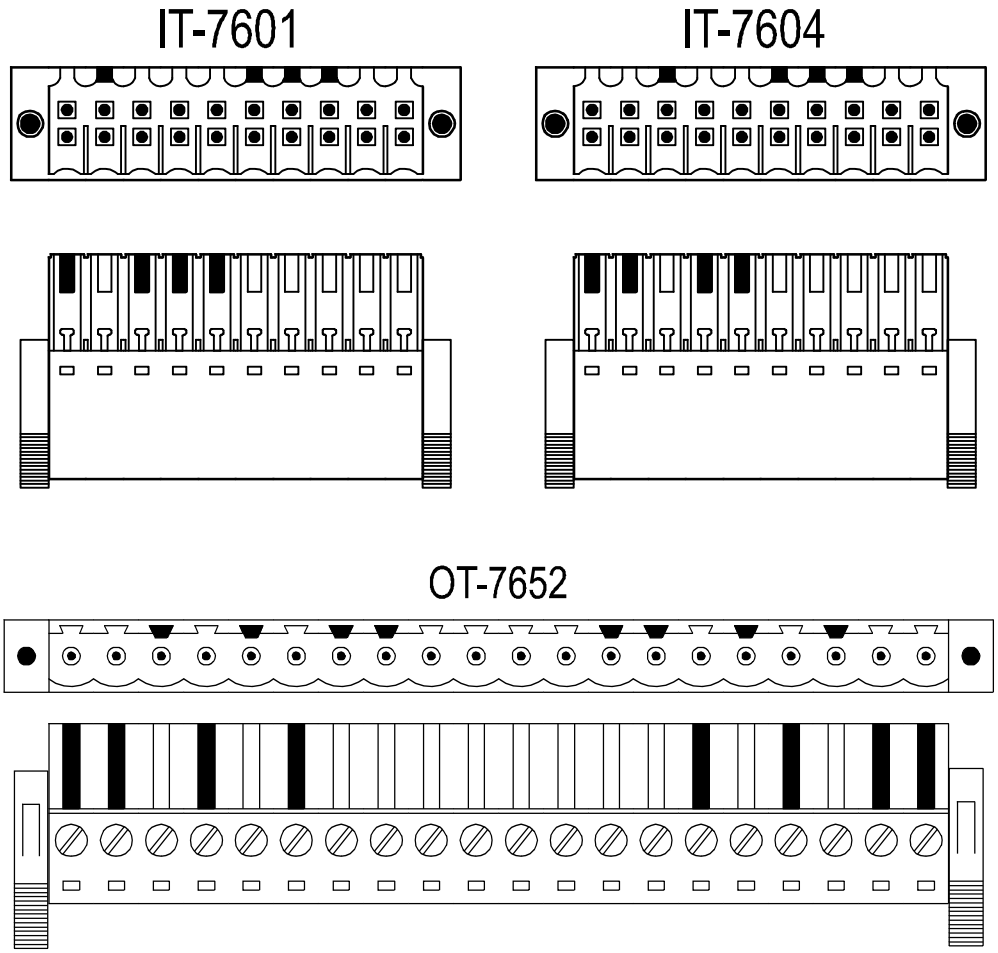


Fig. 2.2 Encoding of module connectors (view of connector counterparts from pins, i.e. through open door of the module)

3. ANALOG INPUT MODULE IT-7601

The IT-7601 module is designed for measuring and processing of signals from 8 analog sensors at the most. Each module input can be set individually to one of the ranges (see chapter 3.3). The model processes the measured values to be used further in the user program (conversion to engineering units, etc.).

3.1 BASIC PARAMETERS

Product standard	ČSN EN 61131-2
Protection class of electrical object ČSN 33 0600	III
Connection	Screwless terminals, max. 1.0 mm^2 conductor per terminal
Coverage (after installation into rack)	IP20 ČSN EN 60529
Type of equipment	built-in
Supply voltage	from internal system source
Input power	max. 3 W
Maximum weight	0.3 kg
Dimensions	137 x 30 x 198 mm

3.2 OPERATIONAL CONDITIONS

Class of ambient influence – ČSN 33 2000-3	Normal
Operating temperatures range	0 °C to + 55 °C
Permissible temperatures during transport	-25 °C to +70 °C
Relative humidity	10 % to 95 % without condensation
Atmospheric pressure	min. 70 kPa (< 3000 m above see level)
Degree of pollution - ČSN EN 61131-2	2
Overvoltage category of installation - ČSN 33 0420-1	II
Working position	Vertical
Type of operation	Continuous
Electromagnetic compatibility	
Emissions - ČSN EN 55022*	class A
Immunity	table 16, ČSN EN 61131-2
Vibration resistance (sinusoidal vibrations) Fc according to ČSN EN 60068-2-6	10 Hz to 57 Hz amplitude 0.075 mm, 57 Hz to 150 Hz acceleration 1G

* This is a product of class A. In indoor conditions (i.e. such conditions, where using of radio and TV sets can be supposed in a distance of 10 m from the mentioned equipment), the product can cause radio disturbances. It might be required in such cases that the user takes necessary measures to avoid this.

3.3 ELECTRICAL PARAMETERS

Number of inputs	8
Organization and type of inputs	8 differential
Galvanic isolation from internal circuits	yes, 8 inputs together
Diagnostics	yes, signalisation on module panel and in the status
Conversion method	Multiplex sigma-delta modulation
Operation modes	Periodical scanning of inputs
Type of protection	Integrated overvoltage protections
Insulation potentials under normal operating conditions	500 V DC between input and internal circuits
Filtering	lowpass filter, digital comb filter 50/60 Hz,
Internal calibration	auto-calibration always after switching on the module
Input ranges:	
Voltage	±10 V ±5 V ±2 V ±1 V ±0.5 V ±0.2 V ±0.1 V
Current	0÷5 mA ±5 mA 0÷20 mA 4÷20 mA ±20 mA
External power supply	no
Common points between channels, if any	yes, terminal AGND
Type of cable, length, recommended conditions	see TXV 001 08.01
Installation to ensure noise resistance	see TXV 001 08.01
Calibration or verification to keep nominal accuracy	2 years
Terminal arrangement	see chapter 3.5
Typical example(s) of external connections	see TXV 001 08.01
Influence of incorrect connection of input terminals	None, if max. overload of all input terminals is followed

Voltage input ranges	
Input impedance within signal ranges	> 10 MΩ
Error of analog input - Max. error at 25 °C - Temperature coefficient	 ± 0,2 % of full range ± 0,02 % of full range/K
Non-linearity	±0,07 % of full range
Repeatability under steady conditions	0,05 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 3.11
Least significant bit value (LSB)	see chapter 3.11
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes, indication by range overflow (out of range 10 V)
Total time of system input transfer (TAID + TAIT)	typ. 65 ms [1)]
Sample repeating period	typ. 520 ms [1)]

Current input ranges	
Input impedance within signal ranges	25.2 Ω
Error of analog input - Max. error at 25 °C - Temperature coefficient - Non-linearity - Repeatability under steady conditions	 ± 0.3 % of full range ± 0.03 % of full range/K ±0.07 % of full range 0.05 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 3.11
Least significant bit value (LSB)	see chapter 3.11
Max. permitted continuous overload (without damage)	± 50 mA terminals AI against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes (only for a range of 4÷20 mA)
Total time of system input transfer (TAID + TAIT)	typ. 65 ms [1)]
Sample repeating period	typ. 520 ms [1)]

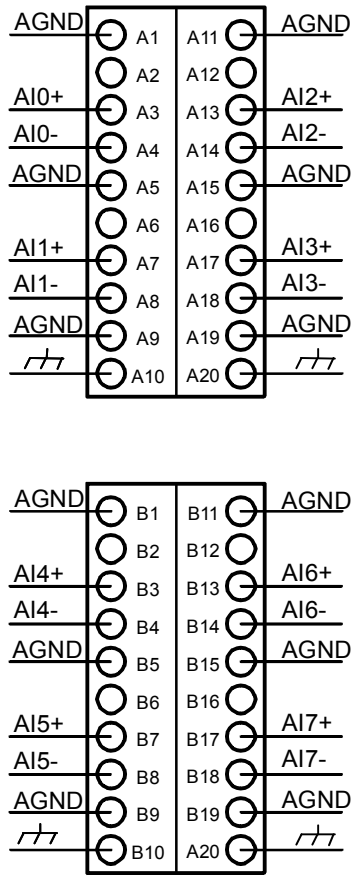
[1)] The time of transfer and data update period of each channel is dependant on module configuration - i.e. on the number of measured channels and set ranges of the individual channels.

3.4 POWER SUPPLY

The module is fed from a power supply, which is part of the TC700 system assembly.

3.5 CONNECTION

The module is fitted with two identical screwless connectors (order number of the connectors set TXN 102 40).



- The module is fitted with two identical screwless connectors (A and B). 4 inputs are led to each connector.
- Signals on both connectors are connected identically.

AGND	analog ground signal terminal
AIx+	analog positive input terminal
AIx–	analog negative input terminal
⏚	terminal interconnected with protective terminal on the rack of TC700

Fig. 3.1 Terminal connection of module IT-7601

Detailed information on connection, proper installation procedure, examples of module connection and principles for increasing resistance and reliability can be found in the handbook for designing TXV 001 08.01.

3.6 OPERATION

3.6.1 Module HW configuration

The module is operated, set and diagnosed from the MOSAIC development environment. On the module only the jumpers for connection of nominal resistance for measuring of current signals are set. Location of the jumpers is illustrated on figure 3.2.

For measuring of current signals, the corresponding jumper at the corresponding input must be short-circuited (always marked with the number of the corresponding analog input - be careful, the jumpers are not located in the same order as the channels). For measuring voltage signals, signals from passive sensors and thermocouples, the jumper must be removed.

As per standard manufacturer's setting, all jumpers are slid on and the inputs are configured as current ones.

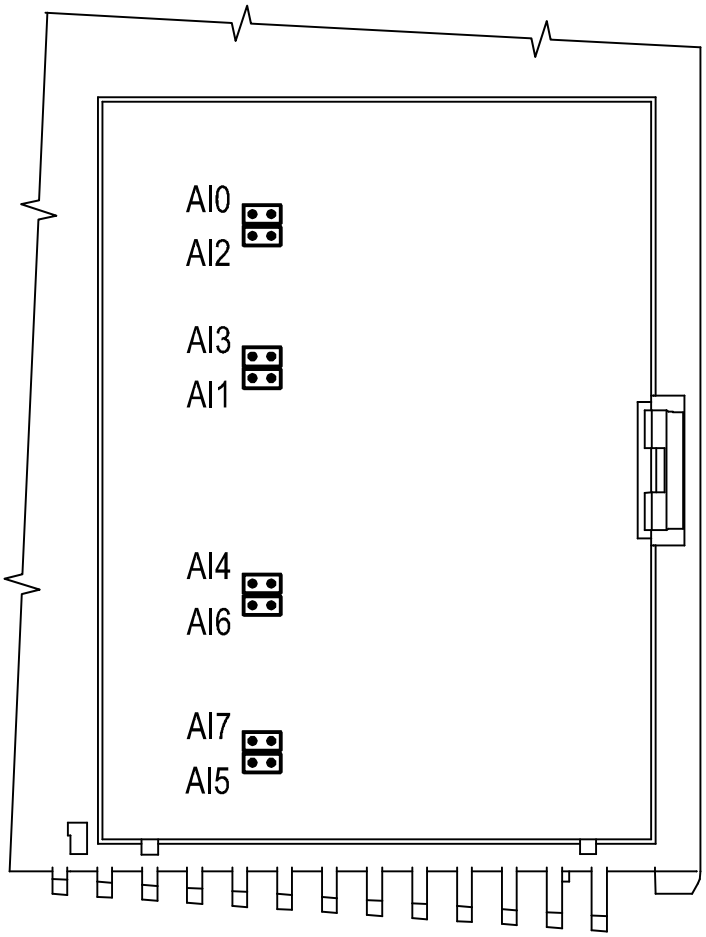


Fig. 3.2 Location of jumpers of the IT-7601 module

3.6.2 Putting in operation

After putting the module into the rack and switching power supply on, the module is fully ready for operation and does not require any other settings of its elements.

3.7 DIAGNOSTICS

The basic diagnostic system of the module is part of the standard module software. The diagnostic system becomes active after module power supply is on, and works independently from the user. The error states of the module being diagnosed are passed on the central module of the assembly and displayed by combined error messages individually for each channel - see the following chapter.

3.8 INDICATION

On the front panel of the module, two indication LEDs are assigned to each input analog channel. The green LED indicates active operation of the concrete channel, the red ERR LED indicates an error of the concrete channel (see chapter 3.10 Input data structure, variable STAT). Further, there is a green RUN LED on the front panel. If the RUN LED is on, the module is in the HALT mode, if the RUN LED flashes, the module is in the RUN mode.

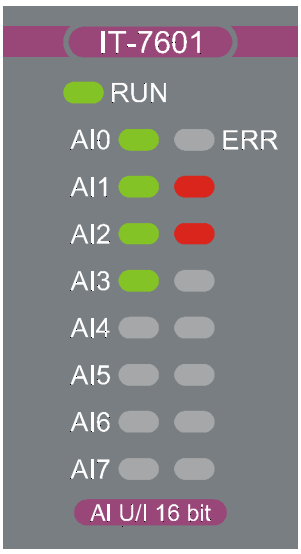


Fig. 3.3 Indication panel of the IT-7601 module

3.9 CONTROL BUTTONS

Under the front door there are 2 buttons serving for manual control of the input analog multiplex (inputs are multiplexed (switched over) to one common A/D converter of the module. This manual mode serves primarily for servicing interventions. It enables permanent operation (measurement) of the just selected channel.

By pressing of the upper button for a longer time (approx. 1.5 s), multiplex control is switched to the manual mode. Switching to the manual mode is indicated by all indication LEDs of the module going out (with the exception of the RUN LED). After releasing the upper button, the multiplex can be switched to next measured channel by pressing the bottom button. The channel measurement is indicated by flashing of the corresponding green LED, or by the corresponding red ERR LED being on (in case of channel measurement failure).

By pressing the upper button, multiplex control is switched back to the automatic mode. This switching is indicated by the green LEDs of all permitted channels going on. After switching module power supply on, the automatic mode is always set.

3.10 MODULE SETUP

For trouble-free module operation it is necessary to perform its SW setup within the frame of module declaration. For each channel, it is specified the type of input analog signal, information on which variables will be transferred from the module and whether the input signal will be numeral-filtered. Module setup is carried out within the MOSAIC development environment by means of the dialog given below. Together with module SW setup, module HW is set, too (see chapter 3.6.1 Module HW configuration).

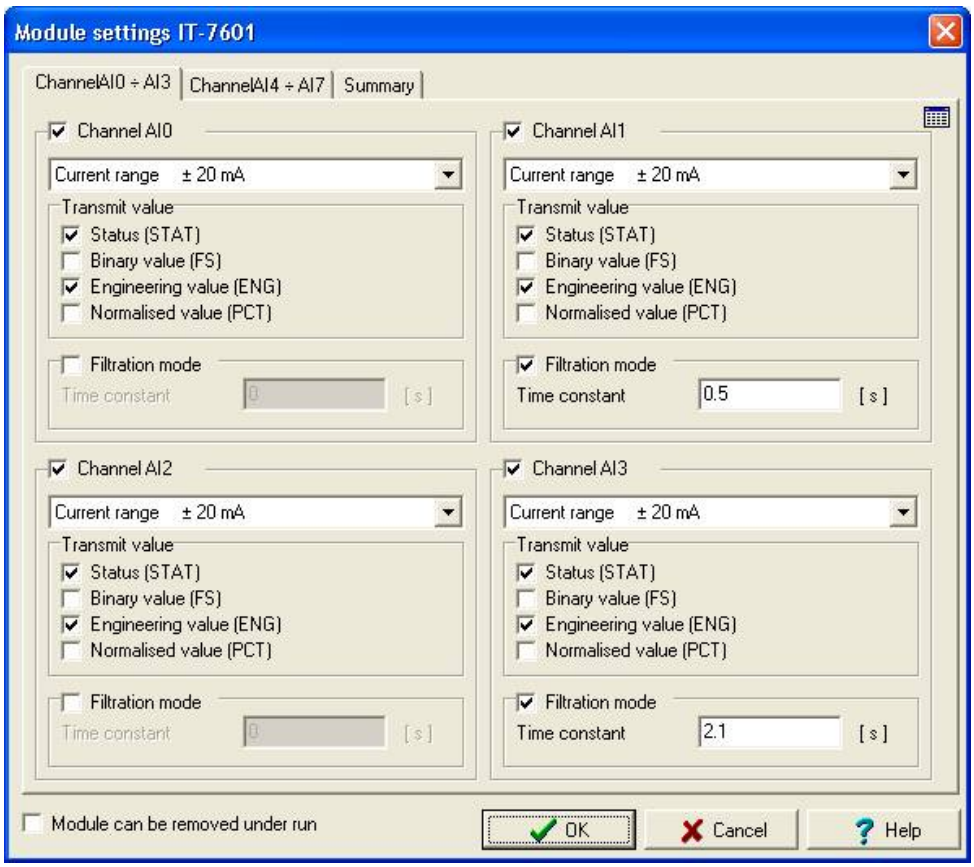


Fig. 3.4 Module SW setup

Based on this dialog, the MOSAIC development environment generates an initialization table T for each declared module. The table contains initialization data, which will be written automatically into the module during each system restart.

AIx channel

Full activation/deactivation of analog channel measurement.

Type of analog channel

Current range
- *0 ÷ 20 mA*
- *4 ÷ 20 mA*
- *± 20 mA*
- *0 ÷ 5 mA*
- *± 5 mA*

Voltage range
- *± 10 V*
- *± 5 V*
- *± 2 V*
- *± 1 V*
- *± 0.5 V*
- *± 0.2 V*
- *± 0.1 V*

Passing of value

Status (STAT)	- activation of passing of variable STAT
Binary value (FS)	- activation of passing of variable FS
Engineering value (ENG)	- activation of passing of variable ENG
Normalised value (PCT)	- activation of passing of variable PCT

Filtering mode

Activation/deactivation of numerical filtering of the measured signal.

Time constant - time constant of numerical filtering of 1st order. The filter is given by the following relation:

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

x - analog input current value
y_t - output
y_{t-1} - recent output
τ - time constant of 1st order filter (TAU)

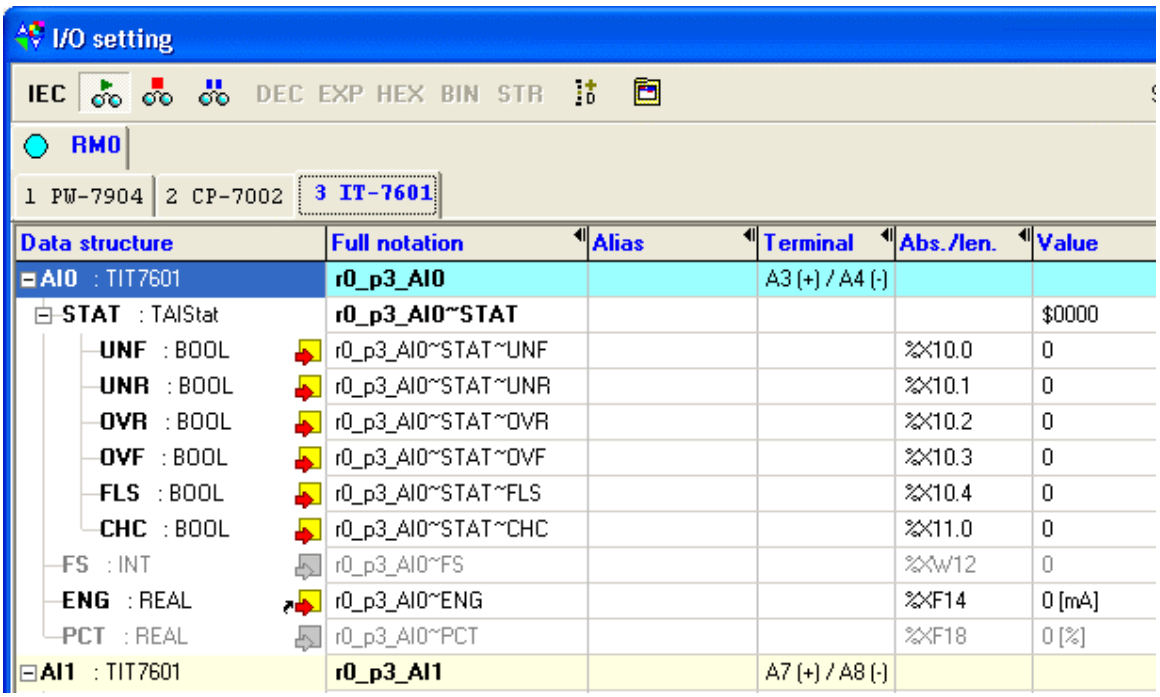
The value of the constant is specified within a range of 0.1÷25.5 and represents the time constant within a range of 100 ms ÷ 25.5 s. Filtering applies to all data formats of the given channel (FS, ENG and PCT).

3.11 INPUT DATA STRUCTURE

The analog input module IT-7061 has 8 input 16-bit channels. Each channel provides information status STAT and data in several optional data formats, namely FS data format (Full Scale), ENG (engineering) format and PCT data format (percentual). Each channel enables to measure the analog value up to a range of 105% (±105%) of the nominal range (except for the range of ±10V, which allows measuring only in a nominal range of ±100%).

The structure items of the analog module have symbolic names assigned, beginning with the rack number and position number in the rack.

In the column *Full Notation*, concrete symbolic name is specified for the given item. If you want to use the data in the user program, you will use either this symbolic name or you will write your symbolic name in the column *Alias*, that can be used later. Do not use absolute operands in any case, since they can change after a new compilation of the user program. The structure of passed data is obvious from the panel *I/O Setting* in the MOSAIC development environment (fig. 3.5) (icon ).



Data structure	Full notation	Alias	Terminal	Abs./len.	Value
AI0 : TIT7601	r0_p3_AI0		A3 (+) / A4 (-)		
STAT : TAIStat	r0_p3_AI0~STAT				$0000
UNF : BOOL	r0_p3_AI0~STAT~UNF			%X10.0	0
UNR : BOOL	r0_p3_AI0~STAT~UNR			%X10.1	0
OVR : BOOL	r0_p3_AI0~STAT~OVR			%X10.2	0
OVF : BOOL	r0_p3_AI0~STAT~OVF			%X10.3	0
FLS : BOOL	r0_p3_AI0~STAT~FLS			%X10.4	0
CHC : BOOL	r0_p3_AI0~STAT~CHC			%X11.0	0
FS : INT	r0_p3_AI0~FS			%W12	0
ENG : REAL	r0_p3_AI0~ENG			%F14	0 [mA]
PCT : REAL	r0_p3_AI0~PCT			%F18	0 [%]
AI1 : TIT7601	r0_p3_AI1		A7 (+) / A8 (-)		

Fig. 3.5 Data structure of analog module IT-7601

The module data structure is automatically generated by the Mosaic application (according to panel *I/O Setting* into file HWconfig.ST.

```
TYPE
  TAIStat    : STRUCT
    UNF      : BOOL;
    UNR      : BOOL;
    OVR      : BOOL;
    OVF      : BOOL;
    FLS      : BOOL;
    dummy5   : BOOL;
    dummy6   : BOOL;
    dummy7   : BOOL;
    CHC      : BOOL;
    dummy9   : BOOL;
    dummy10  : BOOL;
    dummy11  : BOOL;
    dummy12  : BOOL;
    dummy13  : BOOL;
    dummy14  : BOOL;
    dummy15  : BOOL;

  END_STRUCT;


  TIT7601  : STRUCT
    Stat   : TAIStat;
    FS     : INT;
    ENG    : REAL;
    PCT    : REAL;
  END_STRUCT;
END_TYPE
```

```
VAR_GLOBAL
  r0_p3_AI0            AT %X10   : TIT7601;
  r0_p3_AI1            AT %X22   : TIT7601;
  r0_p3_AI2            AT %X34   : TIT7601;
  r0_p3_AI3            AT %X46   : TIT7601;
  r0_p3_AI4            AT %X58   : TIT7601;
  r0_p3_AI5            AT %X70   : TIT7601;
  r0_p3_AI6            AT %X82   : TIT7601;
  r0_p3_AI7            AT %X94   : TIT7601;
END_VAR
```

Variable STAT

The passed value in the variable STAT contains 16 items of bool type. The status provides basic information on the measured analog value with the following meaning:

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

	upper byte							
	-	-	-	-	-	-	-	CHC
bit	.7	.6	.5	.4	.3	.2	.1	.0

STAT.FLS - invalid measured value (during module startup after switching on)
STAT.OVF - range overflow (the input variable exceeded the nominal range by 5%)
STAT.OVR - overrange (the input variable exceeded the nominal range)
STAT.UNR - underrange (the input value exceeded the nominal range)
STAT.UNF - range underflow (the input value exceeded the nominal range by 5%)
STAT.CHC - calibrated channel (0 – default settings, 1 – range calibrated)

Together with the activation of range overflow flags (OVF), or range underflow (UNF), the corresponding red ERR LED on the front panel of the module goes on.

Variable FS

The value being passed in the variable FS is a variable of the int type. The zero value corresponds to the minimum value of the input unipolar value, the value of 31500 corresponds to the maximum value. The value of -31500 corresponds to the minimum value of the input bipolar value, the value of 31500 corresponds to the maximum value, with the relation that 100% (±100%) of the nominal range of the analog input corresponds to the FS value of 30000 (±30000).

Variable ENG

The value being passed in the variable ENG is a variable of the real type and depends on the type of the signal source connected (configured). When measuring voltage signals, it represents voltage in V and during measuring of current ranges, it represents directly current in mA.

Variable PCT

The value being passed in the variable is a variables of the real type and expresses a percentage relation between the measured and nominal values of the analog input. The variable PCT is related to the variable FS, with the relation that for the value of FS=0 is PCT=0 [%] and for the value of FS=±30000 is PCT=±100 [%]. The variable PCT can assume the value of ±105% as the maximum, which corresponds to the FS value of ±31500.

The following tables and diagrams illustrate individual ranges with their corresponding values passed from the module.

3.11.1 Voltage and current ranges

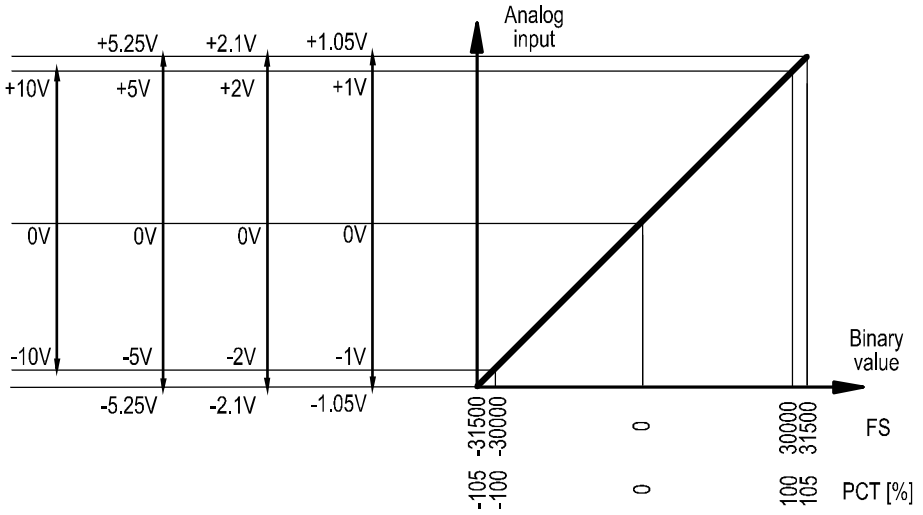


Fig. 3.6 Voltage ranges of module IT-7601 ±10V, ±5V, ±2V, ±1V

Table 3.1 Voltage range of module IT-7601 ±10V

Range	**Variable**			
±10V*	**FS**	**ENG**	**PCT**	
				range overflow
				overrange
10V	30000	10	100	
333µV	1	0.000333	0.00333	
0V	0	0	0	nominal range
-10V	-30000	-10	-100	
				underrange
				range underflow

*) Overflow and overrange (underflow and underrange) of the range is signalized at the same time.

Table 3.2 Voltage range of module IT-7601 ±5V

Range	**Variable**			
±5V	**FS**	**ENG**	**PCT**	
				range overflow
5.25V	31500	5.25	105	
				overrange
5V	30000	5	100	
166µV	1	0.000166	0.00333	
0V	0	0	0	nominal range
-5V	-30000	-5	-100	
				underrange
-5.25V	-31500	-5.25	-105	
				range underflow

Table 3.3 Voltage range of module IT-7601 ±2V

Range	Variable			
±2V	**FS**	**ENG**	**PCT**	
				range overflow
2.1V	31500	2.1	105	
				overrange
2V	30000	2	100	
66µV	1	0.000066	0.00333	
0V	0	0	0	nominal range
-2V	-30000	-2	-100	
				underrange
-2.1V	-31500	-2.1	-105	
				range underflow

Table 3.3 Voltage range of module IT-7601 ±1V

Range	Variable			
±1V	**FS**	**ENG**	**PCT**	
				range overflow
1.05V	31500	1.05	105	
				overrange
1V	30000	1	100	
33µV	1	0.000033	0.00333	
0V	0	0	0	nominal range
-1V	-30000	-1	-100	
				underrange
-1.05V	-31500	-1.05	-105	
				range underflow

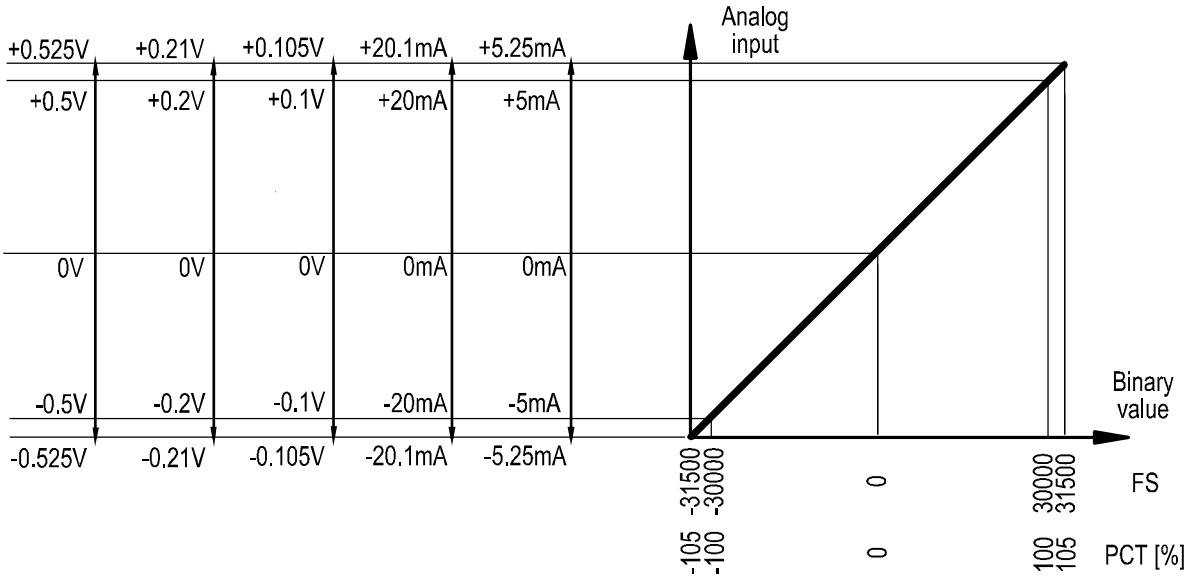


Fig. 3.7 Voltage and current ranges of module IT-7601 ±0.5V, ±0.2V, ±0.1V,±20mA,±5mA

Table 3.4 Voltage range of module IT-7601 ±0.5V

Range	Variable			
±0.5V	**FS**	**ENG**	**PCT**	
				range overflow
0.525V	31500	0.525	105	
				overrange
0.5V	30000	0.5	100	
16µV	1	0.000016	0.00333	
0V	0	0	0	nominal range
-0.5V	-30000	-0.5	-100	
				underrange
-0.525V	-31500	-0.525	-105	
				range underflow

Table 3.5 Voltage range of module IT-7601 ±0.2V

Range	Variable			
±0.2V	**FS**	**ENG**	**PCT**	
				range overflow
0.21V	31500	0.21	105	
				overrange
0.2V	30000	0.2	100	
6.6µV	1	0.0000066	0.00333	
0V	0	0	0	nominal range
-0.2V	-30000	-0.2	-100	
				underrange
-0.21V	-31500	-0.21	-105	
				range underflow

Table 3.6 Voltage range of module IT-7601 ±0.1V

Range	Variable			
±0.1V	**FS**	**ENG**	**PCT**	
				range overflow
0.105V	31500	0.105	105	
				overrange
0.1V	30000	0.1	100	
3.3µV	1	0.0000033	0.00333	
0V	0	0	0	nominal range
-0.1V	-30000	-0.1	-100	
				underrange
-0.105V	-31500	-0.105	-105	
				range underflow

Table 3.7 Voltage range of module IT-7601 ±20mA

Range	Variable			
±20mA	**FS**	**ENG**	**PCT**	
				range overflow
21mA	31500	21	105	
				overrange
20mA	30000	20	100	
0.66µA	1	0.00066	0.00333	
0mA	0	0	0	nominal range
-20mA	-30000	-20	-100	
				underrange
-21mA	-31500	-21	-105	
				range underflow

Table 3.8 Voltage range of module IT-7601 ±5mA

Range	Variable			
±5mA	**FS**	**ENG**	**PCT**	
				range overflow
5.25mA	31500	5.25	105	
				overrange
5mA	30000	5	100	
0.16µA	1	0.00016	0.00333	
0mA	0	0	0	nominal range
-5mA	-30000	-5	-100	
				underrange
-5.25mA	-31500	-5.25	-105	
				range underflow

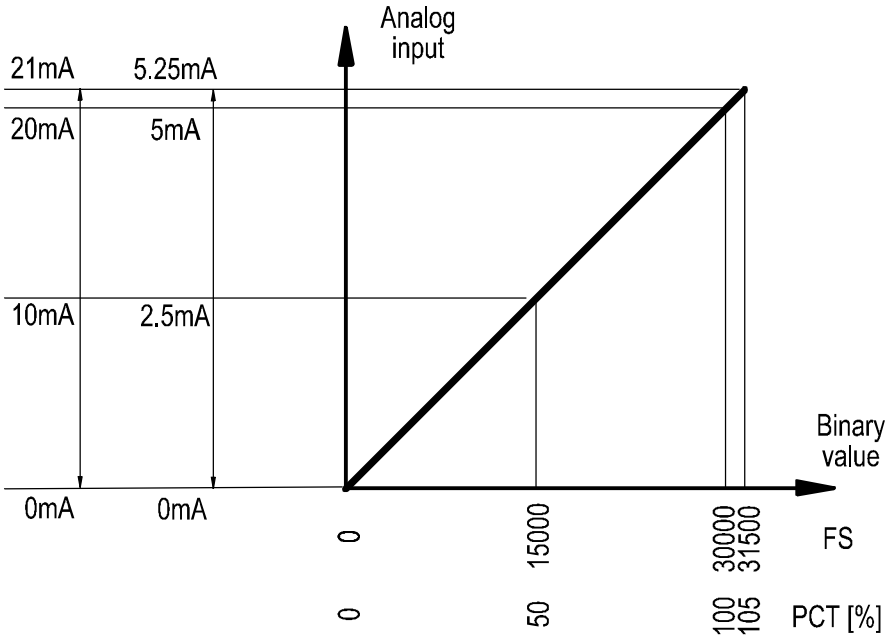


Fig. 3.8 Current ranges of module IT-7601 0÷20mA, 0÷5mA

Table 3.9 Current range of module IT-7601 0÷20mA

Range	**Variable**			
0÷20mA*	**FS**	**ENG**	**PCT**	
				range overflow
21mA	31500	21	105	
				overrange
20mA	30000	20	100	
0.66µA	1	0.00066	0.00333	nominal range
0mA	0	0	0	

*) This range does not indicate any underrange or range underflow.

Table 3.10 Current range of module IT-7601 0÷5mA

Range	**Variable**			
0÷5mA*	**FS**	**ENG**	**PCT**	
				range overflow
5.25mA	31500	5.25	105	
				overrange
5mA	30000	5	100	
0.16µA	1	0.00016	0.00333	nominal range
0mA	0	0	0	

*) This range does not indicate any underrange or range underflow.

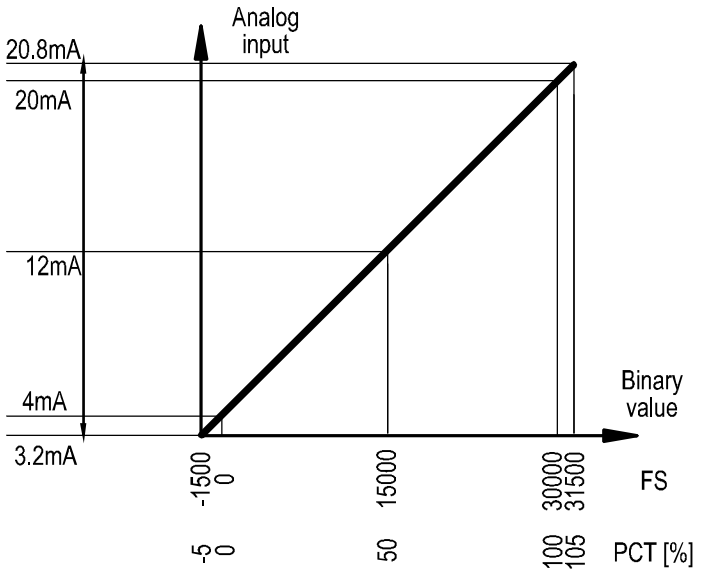


Fig. 3.9 Current range of module IT-7601 4÷20mA

Table 3.11 Current range of module IT-7601 4÷20mA

Range	Variable			
4÷20mA	**FS**	**ENG**	**PCT**	
				range overflow
20.8mA	31500	20.8	105	
				overrange
20mA	30000	20	100	
4.00053mA	1	4.00053	0.00333	nominal range
4mA	0	4	0	
				underrange
3.2mA	-1500	3.2	-5	
				range underflow

3.12 APPENDIX FOR ADVANCED USERS

The structures given below are typically automatically generated by the MOSAIC development environment (into file *.HWC) and it is not recommended to alter them. If the programmer does not use automatic configuration generation, the description below serves as a sample for manual module configuration.

3.12.1 Initialization data structure

The module requires an initialization table, this is represented in the declaration file of the MOSAIC development environment (*.HWC) by the following description:

```
#struct _TTS_Head               ;module heading structure
        UINT  ModulID,          ;identification code of module type
        USINT Stat0,            ;data exchange status
        USINT Stat1             ;data exchange status
```

```
#struct _TTS_EnbCHAI  ;activation structure of channel variables being passed
        USINT ESTAT,  ;variable STAT passing activation
        USINT EFS,    ;variable FS passing activation
        USINT EENG,   ;variable ENG passing activation
        USINT EPCT    ;variable PCT passing activation

#struct _TTS_IniCHAI  ;structure of channel initialization data
        USINT TypAI,  ;sensor class and type
        USINT TAU     ;numeric filtering constant

#struct _TTS_IT7601              ;module initialization table structure
        _TTS_Head Head,          ;table heading
        _TTS_EnbCHAI[8] EnableCH,;variable activation of particular channels
        _TTS_IniCHAI[8] InitCH   ;initialization data of particular channels
```

Example of initialization table declaration :

```
#table _TTS_IT7601 _r0_p3_Table = 7601,$00,$00,     ;table heading
                                  $80,$80,$80,$80,  ;variable activation
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $40,00,           ;initialization data
                                  $40,05,
                                  $41,00,
                                  $41,21,
                                  $40,00,
                                  $40,00,
                                  $40,00,
                                  $40,00
```

Example of module declaration :

```
#struct TModulE1                 ;module declaration structure
        USINT version,           ;description version
        USINT rack,              ;rack address
        USINT address,           ;module address in the rack
        UINT  LogAddress,        ;logic address
        UINT  LenInputs,         ;length of input data zone
        UINT  LenOutputs,        ;length of output data zone
        DINT  OffsetInputs,      ;position of input data zone
        DINT  OffsetOutputs,     ;position of output data zone
        UINT  InitTable          ;initialisation table index

#module TModulE1 1, 0, 3, 0, 96, 0, __offset(r0_p3_AI0), 0, __indx
(_r0_p3_Table)
```

The meaning of the items of the initialization table is as follows :

ESTAT - variable STAT passing activation
EFS - variable FS passing activation
EENG - variable ENG passing activation
EPCT - variable PCT passing activation
= $80 - the variable will be passed from the module
= $00 - the variable will not be passed from the module
TypAI - sensor class and type

Bit	SN3	SN2	SN1	SN0	TP3	TP2	TP1	TP0
	7	6	5	4	3	2	1	0

SN3 ÷ SN0 - selection of class of connected sensor (signal)
TP3 ÷ TP0 - selection of sensor type

Group	SN3÷SN0	TP3÷TP0	Range, sensor type
Current ranges:	$40		0 ÷ 20 mA
	$41		4 ÷ 20 mA
	$42		± 20 mA
	$43		0 ÷ 5 mA
	$44		± 5 mA
Voltage ranges:	$80		± 10 V
	$81		± 5 V
	$82		± 2 V
	$83		± 1 V
	$84		± 0.5 V
	$85		± 0.2 V
	$86		± 0.1 V

TAU - Time constant of numerical filtering of 1st order. By non-zero setting of this value, the function of input numerical filtering by the 1st order filter is activated. The filter is given by the following relation:

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

x - analog input passed value
y_t - output
y_{t-1} - recent output
τ - time constant of 1st order filter (TAU)

The value of the constant TAU is specified within a range of 1÷255 and represents the time constant within a range of 100 ms ÷ 25.5 s. For the value of TAU=0, the filtering function is not activated. Filtering applies to all data formats of the given format (FS, ENG and PCT).

3.13 EXAMPLES OF CONNECTION OF MODULE IT-7601

Example 1 To the module IT-7601, the following signals are connected:

- 2 signals against ground 0÷10 V
- 2 signals against ground 4÷20 mA

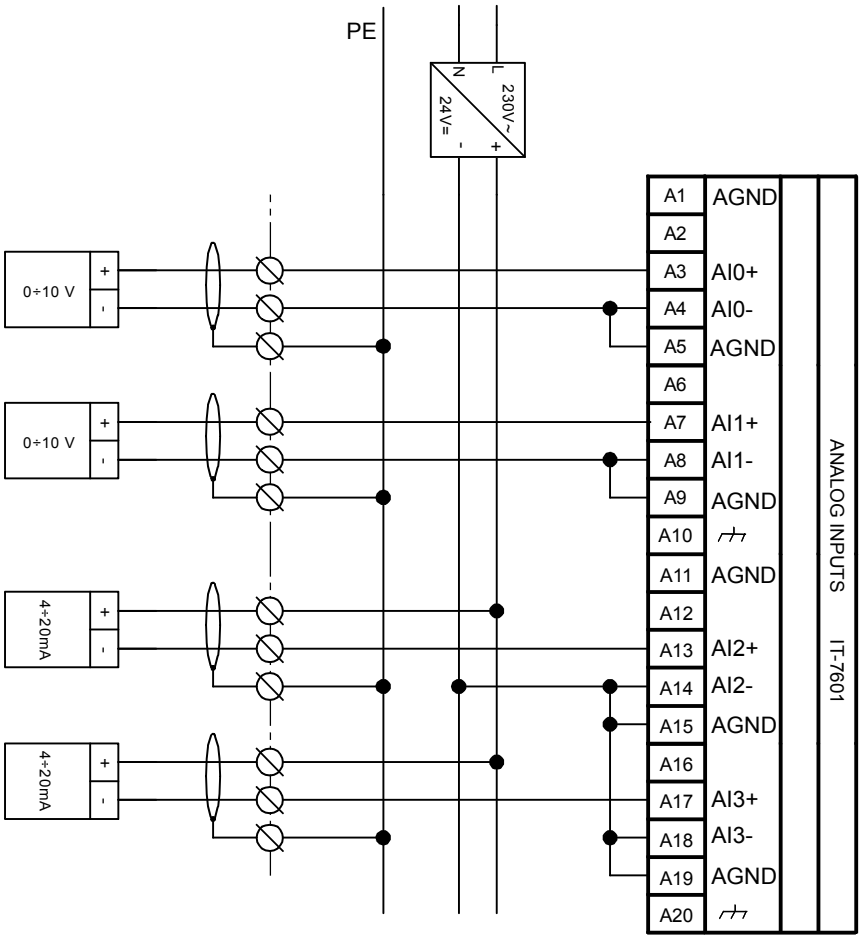


Fig. 3.10 Connection of connector A of module IT-7601 according to example Nr. 1

Notes:

1. *When measuring voltage or current (differential measurement of the signal floating source), we always connect one input of each of such used channel (usually AI-) to the terminal of the analog ground of the unit AGND (a short-circuiting conductor or a resistance of up to 2kΩ can be used).*
2. *Cable shielding is usually connected to the terminal of the working ground (on the unit or in the switchgear on the terminal board).*
3. *Current lops are fed by an external source, there can be more current loops connected parallel to the source (detailed information see TXV 001 08).*
4. *For small voltage signals, a shielded inlet conductor can be fitted (JYTY, etc., shielding of which is connected according to general rules (see TXV 001 08).*
5. *Identical connection is valid also for the B connector (second half of the module).*

4. ANALOG INPUT MODULE IT-7604

The IT-7604 module is designed for measuring and processing of signals from 8 analog sensors at the most. Each module input can be set individually to one of the ranges (see chapter 4.3). The model processes the measured values to be used further in the user program (linearization, conversion to engineering units, etc.).

4.1 BASIC PARAMETERS

Product standard	ČSN EN 61131-2
Protection class of electrical object ČSN 33 0600	III
Connection	screwless terminals, max. 1.0 mm^2 conductor per terminal
Coverage (after installation into rack)	IP20 ČSN EN 60529
Type of equipment	built-in
Supply voltage	from internal system source
Input power	max. 3 W
Maximum weight	0.3 kg
Dimensions	137 x 30 x 198 mm

4.2 OPERATIONAL CONDITIONS

Class of ambient influence – ČSN 33 2000-3	normal
Operating temperature range	0 °C to + 55 °C
Permissible temperatures during transport	-25 °C to +70 °C
Relative humidity	10 % to 95 % without condensation
Atmospheric pressure	min. 70 kPa (< 3000 m above see level)
Degree of pollution - ČSN EN 61131-2	2
Overvoltage category of installation - ČSN 33 0420-1	II
Working position	vertical
Type of operation	continuous
Electromagnetic compatibility	
Emissions - ČSN EN 55022*	class A
Immunity	table 16, ČSN EN 61131-2
Vibration resistance (sinusoidal vibrations) Fc according to ČSN EN 60068-2-6	10 HZ to 57 Hz amplitude 0.075 mm, 57 Hz to 150 Hz acceleration 1G

* This is a product of class A. In indoor conditions (i.e. such conditions, where using of radio and TV sets can be supposed in a distance of 10 m from the mentioned equipment), the product can cause radio disturbances. It might be required in such cases that the user takes necessary measures to avoid this.

4.3 ELECTRICAL PARAMETERS

Number of inputs	8
Organization and type of inputs	8 differential
Galvanic isolation from internal circuits	yes, 8 inputs together
Diagnostics	yes, signalisation on module panel and in the status
Conversion method	multiplex sigma-delta modulation
Operation modes	periodical scanning of inputs
Type of protection	integrated overvoltage protections
Insulation potentials under normal operating conditions	500 V DC between input and internal circuits
Filtering	lowpass filter, digital comb filter 50/60 Hz,
Internal calibration	auto-calibration always after switching on the module
Input ranges:	
Voltage	±10 V ±5 V ±2 V ±1 V ±0.5 V ±0.2 V ±0.1 V
Current	0÷5 mA ±5 mA 0÷20 mA 4÷20 mA ±20 mA
Passive sensors	Pt100 1.385 (-90/+550°C) Pt100 1.391 (-90/+550°C) Pt1000 1.385 (-90/+550°C) Pt1000 1.391 (-90/+550°C) Ni1000 1.617 (-60/+200°C) Ni1000 1.500 (-60/+200°C) OV100 OV1000
Thermocouples	J (-210/+1200°C) K (-200/+1372°C) R (-50/+1768.1°C) S (-50/+1768.1°C) T (-200/+400°C) B (+250/+1820°C) N (-200/+1300°C)
External power supply	no
Common points between channels, if any	yes, terminal AGND
Type of cable, length, recommended conditions	see TXV 001 08.01
Installation to ensure noise resistance	see TXV 001 08.01
Calibration or verification to keep nominal accuracy	2 years
Terminal arrangement	see chapter 4.5
Typical example(s) of external connections	see TXV 001 08.01

Influence of incorrect connection of input terminals	none, if max. overload of all input terminals is followed

Voltage input ranges	
Input impedance within signal ranges	> 10 MΩ
Error of analog input - Max. error at 25 °C - Temperature coefficient	 ± 0.2 % of full range ± 0,02 % of full range/K
Non-linearity	±0,07 % of full range
Repeatability under steady conditions	0,05 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 4.11
Least significant bit value (LSB)	see chapter 4.11
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes, indication by range overflow(out of range 10V)
Total time of system input transfer (TAID + TAIT)	typ. 65 ms [1)]
Sample repeating period	typ. 520 ms [1)]

Current input ranges	
Input impedance within signal ranges	25.2 Ω
Error of analog input - Max. error at 25 °C - Temperature coefficient - Non-linearity - Repeatability under steady conditions	 ± 0,3 % of full range ± 0,03 % of full range/K ±0,07 % of full range 0,05 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 4.11
Least significant bit value (LSB)	see chapter 4.11
Max. permitted continuous overload (without damage)	± 50 mA terminals AI against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes (only for a range of 4÷20mA)
Total time of system input transfer (TAID + TAIT)	typ. 65 ms [1)]
Sample repeating period	typ. 520 ms [1)]

Passive resistance sensors	
Input impedance within signal ranges	> 10 MΩ
Error of analog input - Max. error at 25 °C - Temperature coefficient	 ± 0,25 % of full range ± 0,025% of full range/K
Non-linearity	±0,07 % of full range
Repeatability under steady conditions	0,05 % of full range
Numerical resolution	16 bits

Format of data returned to application program	see chapter 4.11
Least significant bit value (LSB)	see chapter 4.11
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes, signalization by content overflow
Total time of system input transfer (TAID + TAIT)	Typ. 65 ms [1)]
Sample repeating period	Typ. 520 ms [1)]

Thermocouples	
Input impedance within signal ranges	> 10 MΩ
Error of analog input - Max. error at 25 °C - Temperature coefficient	 ± 1 % of full range ± 0,05 % of full range/K
Non-linearity	±0,1 % of full range
Repeatability under steady conditions	0,5% of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 4.11
Least significant bit value (LSB)	see chapter 4.11
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	yes, on module panel and in module status word
Input type	differential
Detection of open input	yes, indication by range overflow(out of range 10V)
Total time of system input transfer (TAID + TAIT)	Typ. 400 ms [1)]
Sample repeating period	Typ. 3260 ms [1)]

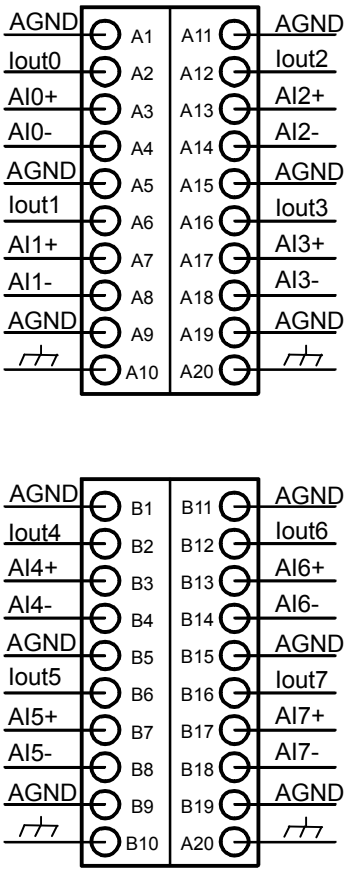
[1)] The time of transfer and data update period of each channel is dependant on module configuration - i.e. on the number of measured channels and set ranges of the individual channels.

4.4 POWER SUPPLY

The module is fed from a power supply, which is part of the TC700 system assembly.

4.5 CONNECTION

The module is fitted with two identical screwless connectors (order number of the connectors set TXN 102 40). The connection of connectors is on fig. 4.1.



AGND analog ground signal terminal
AIx+ analog positive input terminal

AIx– analog negative input terminal
Ioutx nominal current output (1 mA)

terminal interconnected with protective terminal on the rack of TC700

Fig. 4.1 Terminal connection of module IT-7604

Detailed information on connection, proper installation procedure, examples of module connection and principles for increasing resistance and reliability can be found in the Handbook for designing TXV 001 08.01.

4.6 OPERATION

4.6.1 Module HW configuration

The module is operated, set and diagnosed from the MOSAIC development environment. On the module only the jumpers for connection of nominal resistance for measuring of current signals are set. Location of the jumpers is illustrated on figure 4.2.

For measuring of current signals, the corresponding jumper at the corresponding input must be short-circuited (always marked with the number of the corresponding analog input - be careful, the jumpers are not located in the same order as the channels). For measuring voltage signals, signals from passive sensors and thermocouples, the jumper must be removed.

As per standard manufacturer's setting, all jumpers are slid on (the inputs are configured as current ones).

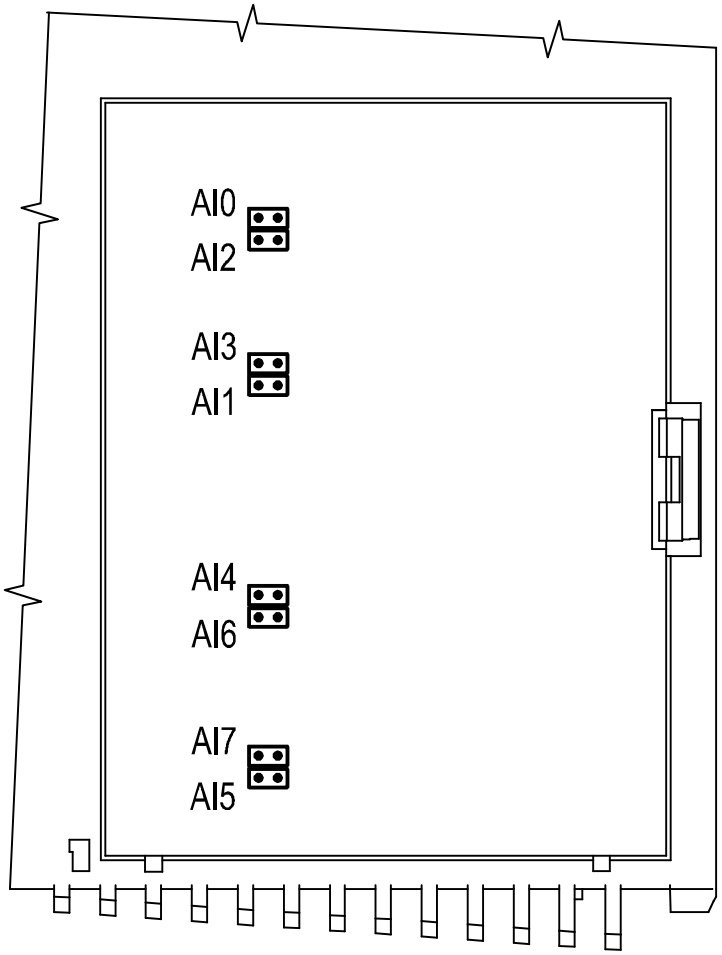


Fig. 4.2 Location of jumpers of the IT-7604 module

4.6.2 Putting in operation

After putting the module into the rack and switching power supply on, the module is fully ready for operation and does not require any other settings of its elements.

4.7 DIAGNOSTICS

The basic diagnostic system of the module is part of the standard module software. The diagnostic system becomes active after module power supply is on, and works independently from the user. The error states of the module being diagnosed are passed on the central module of the assembly and displayed by combined error messages individually for each channel - see the following chapter.

4.8 INDICATION

On the front panel of the module, two indication LEDs are assigned to each input analog channel. The green LED indicates active operation of the concrete channel, the red ERR LED indicates an error of the concrete channel (see chapter 4.10 Input data structure, variable STAT). Further, there is a green RUN LED on the front panel. If the RUN LED is on, the module is in the HALT mode, if the RUN LED flashes, the module is in the RUN mode.

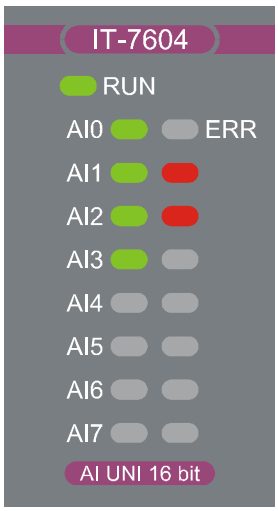


Fig. 4.3 Indication panel of the IT-7604 module

4.9 CONTROL BUTTONS

Under the front door there are 2 buttons serving for manual control of the input analog multiplex (inputs are multiplexed (switched over) to one common A/D converter of the module. This manual mode serves primarily for servicing interventions. It enables permanent operation (measurement) of the just selected channel (in the normal module run, the specific current of 1 mA is continually switched over according to the channel being just measured and on the sensor itself and lines, it is not possible to measure with standard equipment).

By pressing of the upper button for a longer time (approx. 1.5 s), multiplex control is switched to the manual mode. Switching to the manual mode is indicated by all indication LEDs of the module going out (with the exception of the RUN LED). After releasing the upper button, the multiplex can be switched to next measured channel by pressing the bottom button. The channel measurement is indicated by flashing of the corresponding green LED, or by the corresponding red ERR LED being on (in case of channel measurement failure).

When measuring the cold junction of the module (used for measurement of thermocouples), all green LEDs are flashing (or all red ERR LEDs are on, as the case may be).

By pressing the upper button, multiplex control is switched back to the automatic mode. This switching is indicated by the green LEDs of all permitted channels going on. After switching module power supply on, the automatic mode is always set.

4.10 MODULE SETUP

For trouble-free module operation it is necessary to perform its SW setup within the frame of module declaration. For each channel, it is specified the type of input analog signal, information on which variables will be transferred from the module and whether the input signal will be numeral-filtered. Module setup is carried out within the MOSAIC development environment by means of the dialog given below. Together with module SW setup, module HW is set, too (see chapter 4.6.1 Module HW configuration).

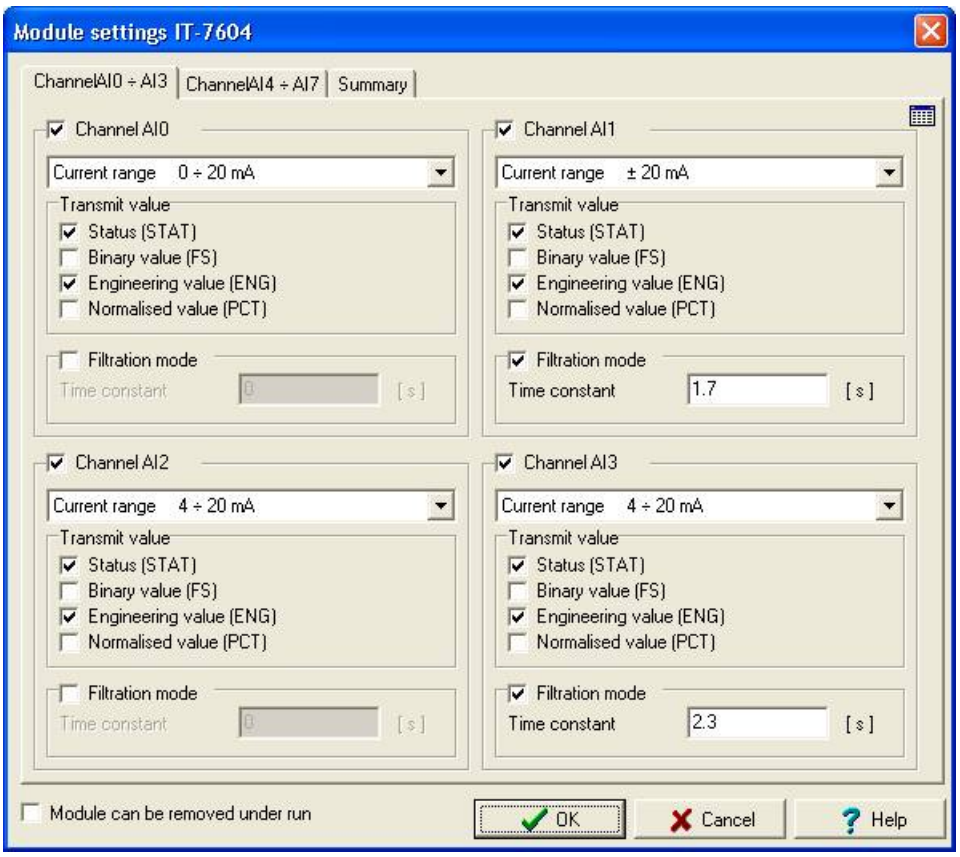


Fig. 4.4 Module SW setup

Based on this dialog, the MOSAIC development environment generates an initialization table T for each declared module. The table contains initialization data, which will be written automatically into the module during each system restart.

AIx channel

Full activation/deactivation of analog channel measurement.

Type of analog channel

Current range
- *0 ÷ 20 mA*
- *4 ÷ 20 mA*
- *± 20 mA*
- *0 ÷ 5 mA*
- *± 5 mA*

Voltage range
- *± 10 V*
- *± 5 V*
- *± 2 V*
- *± 1 V*
- *± 0.5 V*
- *± 0.2 V*
- *± 0.1 V*

Resistance sensor
- *Pt100, W_{100}=1.385*
- *Pt100, W_{100}=1.391*
- *Pt1000, W_{100}=1.385*
- *Pt1000, W_{100}=1.391*

- *Ni1000, W_{100}=1.617*
- *Ni1000, W_{100}=1.500*
- *OV100*
- *OV1000*

Thermocouple
- *type J*
- *type K*
- *type R*
- *type S*
- *type T*
- *type B*
- *type N*

*External cold junction**
- *Pt100, W_{100}=1.385*
- *Pt100, W_{100}=1.391*
- *Pt1000, W_{100}=1.385*
- *Pt1000, W_{100}=1.391*
- *Ni1000, W_{100}=1.617*
- *Ni1000, W_{100}=1.500*

*) External cold junction can be set only for input AI7. When measuring thermocouples the value of this external cold junction is considered instead of internal sensor of cold junction.

Passing of value

Status (STAT) - variable STAT passing activation
Binary value (FS) - variable FS passing activation
Engineering value (ENG) - variable ENG passing activation
Normalised value (PCT) - variable PCT passing activation

Filtering mode

Activation/deactivation of numerical filtering of the measured signal.

Time constant - time constant of numerical filtering of 1st order. The filter is given by the following relation:

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

x - analog input current value
y_t - output
y_{t-1} - recent output
τ - time constant of 1st order filter (TAU)

The value of the constant is specified within a range of 0.1÷25.5 and represents the time constant within a range of 100 ms ÷ 25.5 s. Filtering applies to all data formats of the given channel (FS, ENG and PCT).

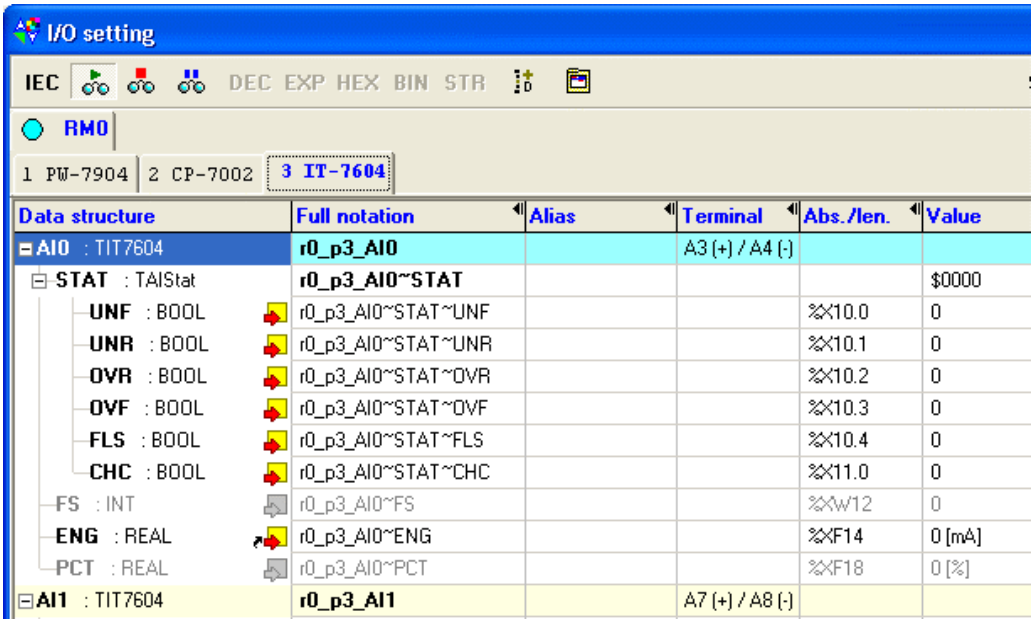
4.11 INPUT DATA STRUCTURE

The analog input module IT-7604 has 8 input 16-bit channels. Each channel provides information status STAT and data in several optional data formats, namely FS data format (Full

Scale), ENG (engineering) format and PCT data format (percent). Each channel enables to measure the analog value up to a range of 105% (±105%) of the nominal range (except for the range of ±10V, which allows measuring only in a nominal range of ±100%).

The structure items of the analog module have symbolic names assigned, beginning with the rack number and position number in the rack.

In the column *Full Notation*, concrete symbolic name is specified for the given item. If you want to use the data in the user program, you will use either this symbolic name or you will write your symbolic name in the column *Alias*, that can be used later. Do not use absolute operands in any case, since they can change after a new compilation of the user program. The structure of passed data is obvious from the panel *I/O Setting* in the MOSAIC development environment (fig. 4.5) (icon).



Data structure	Full notation	Alias	Terminal	Abs./len.	Value
AI0 : TIT7604	r0_p3_AI0		A3 (+) / A4 (-)		
STAT : TAIStat	r0_p3_AI0~STAT				$0000
UNF : BOOL	r0_p3_AI0~STAT~UNF			%X10.0	0
UNR : BOOL	r0_p3_AI0~STAT~UNR			%X10.1	0
OVR : BOOL	r0_p3_AI0~STAT~OVR			%X10.2	0
OVF : BOOL	r0_p3_AI0~STAT~OVF			%X10.3	0
FLS : BOOL	r0_p3_AI0~STAT~FLS			%X10.4	0
CHC : BOOL	r0_p3_AI0~STAT~CHC			%X11.0	0
FS : INT	r0_p3_AI0~FS			%XW12	0
ENG : REAL	r0_p3_AI0~ENG			%XF14	0 [mA]
PCT : REAL	r0_p3_AI0~PCT			%XF18	0 [%]
AI1 : TIT7604	r0_p3_AI1		A7 (+) / A8 (-)		

Fig. 4.5 Data structure of analog module IT-7604

The module data structure is automaticaly generated by the Mosaic application (according to panel *I/O Setting*) into file HWconfig.ST.

```
TYPE
  TAIStat    : STRUCT
    UNF      : BOOL;
    UNR      : BOOL;
    OVR      : BOOL;
    OVF      : BOOL;
    FLS      : BOOL;
    dummy5   : BOOL;
    dummy6   : BOOL;
    dummy7   : BOOL;
    CHC      : BOOL;
    dummy9   : BOOL;
    dummy10  : BOOL;
    dummy11  : BOOL;
    dummy12  : BOOL;
    dummy13  : BOOL;
    dummy14  : BOOL;
    dummy15  : BOOL;
  END_STRUCT;
```

```
  TIT7604 : STRUCT
    Stat  : TAIStat;
    FS    : INT;
    ENG   : REAL;
    PCT   : REAL;
  END_STRUCT;
END_TYPE


VAR_GLOBAL
  r0_p3_AI0            AT %X10  : TIT7604;
  r0_p3_AI1            AT %X22  : TIT7604;
  r0_p3_AI2            AT %X34  : TIT7604;
  r0_p3_AI3            AT %X46  : TIT7604;
  r0_p3_AI4            AT %X58  : TIT7604;
  r0_p3_AI5            AT %X70  : TIT7604;
  r0_p3_AI6            AT %X82  : TIT7604;
  r0_p3_AI7            AT %X94  : TIT7604;
END_VAR
```

Variable STAT

The passed value in the variable STAT contains 16 items of bool type. The status provides basic information on the measured analog value with the following meaning:

	lower byte									upper byte							
	-	-	-	FLS	OVF	OVR	UNR	UNF		-	-	-	-	-	-	-	CHC
bit	.7	.6	.5	.4	.3	.2	.1	.0	bit	.7	.6	.5	.4	.3	.2	.1	.0

STAT.FLS - invalid measured value (during module startup after switching on)
STAT.OVF - range overflow (the input variable exceeded the nominal range by 5%)
STAT.OVR - overrange (the input variable exceeded the nominal range)
STAT.UNR - underrange (the input value exceeded the nominal range)
STAT.UNF - range underflow (the input value exceeded the nominal range by 5%)
STAT.CHC - calibrated channel (0 – default settings, 1 – range calibrated)

Together with the activation of range overflow flags (OVF), or range underflow (UNF), the corresponding red ERR LED on the front panel of the module goes on.

Variable FS

The value being passed in the variable FS is a variable of the int type. The zero value corresponds to the minimum value of the input unipolar value, the value of 31500 corresponds to the maximum value. The value of -31500 corresponds to the minimum value of the input bipolar value, the value of 31500 corresponds to the maximum value, with the relation that 100% (±100%) of the nominal range of the analog input corresponds to the FS value of 30000 (±30000).

Variable ENG

The value being passed in the variable ENG is a variable of the real type and depends on the type of the signal source connected (configured). When measuring thermoelectric and passive

temperature sensors, it represents the temperature value in °C, when measuring resistance devices, it represents the resistance value in Ω, for voltage signals, it represents voltage in V and during measuring of current ranges, it represents directly current in mA.

Variable PCT

The value being passed in the variable PCT is a variable of the real type and expresses a percentage relation between the measured and nominal values of the analog input. The variable PCT is related to the variable FS, with the relation that for the value of FS=0 is PCT=0 [%] and for the value of FS=±30000 is PCT=±100 [%]. The variable PCT can assume the value of ±105% as the maximum, which corresponds to the FS value of ±31500.

The following tables and diagrams illustrate individual ranges with their corresponding values passed from the module.

4.11.1 Voltage and current ranges

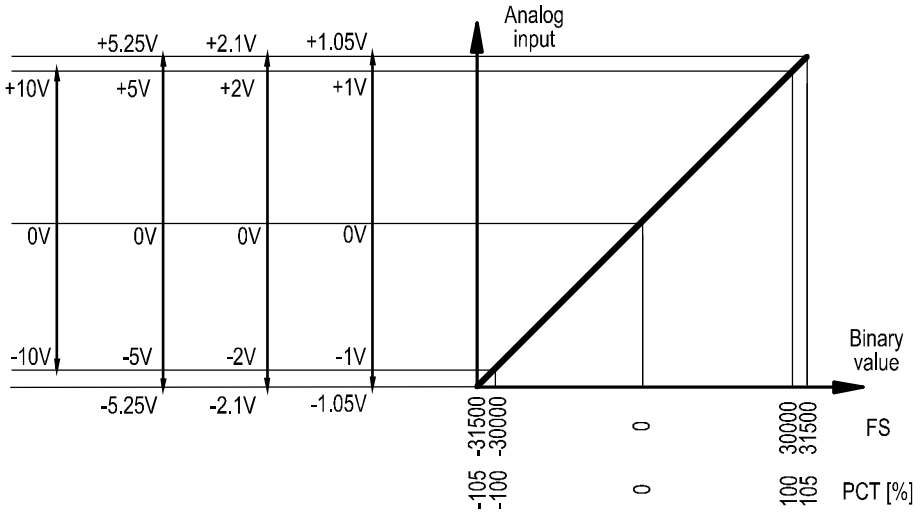


Fig. 4.6 Voltage ranges of module IT-7604 ±10V, ±5V, ±2V, ±1V

Table 4.1 Voltage range of module IT-7604 ±10V

Range	Variable			
±10V*	**FS**	**ENG**	**PCT**	
				range overflow
				overrange
10V	30000	10	100	
333µV	1	0.000333	0.00333	
0V	0	0	0	nominal range
-10V	-30000	-10	-100	
				underrange
				range underflow

*) Overflow and overrange (underflow and underrange) of the range is signalized at the same time.

Table 4.2 Voltage range of module IT-7604 ±5V

Range	Variable			
±5V	**FS**	**ENG**	**PCT**	
				range overflow
5.25V	31500	5.25	105	
				overrange
5V	30000	5	100	
166µV	1	0.000166	0.00333	
0V	0	0	0	nominal range
-5V	-30000	-5	-100	
				underrange
-5.25V	-31500	-5.25	-105	
				range underflow

Table 4.3 Voltage range of module IT-7604 ±2V

Range	Variable			
±2V	**FS**	**ENG**	**PCT**	
				range overflow
2.1V	31500	2.1	105	
				overrange
2V	30000	2	100	
66µV	1	0.000066	0.00333	
0V	0	0	0	nominal range
-2V	-30000	-2	-100	
				underrange
-2.1V	-31500	-2.1	-105	
				range underflow

Table 4.4 Voltage range of module IT-7604 ±1V

Range	Variable			
±1V	**FS**	**ENG**	**PCT**	
				range overflow
1.05V	31500	1.05	105	
				overrange
1V	30000	1	100	
33µV	1	0.000033	0.00333	
0V	0	0	0	nominal range
-1V	-30000	-1	-100	
				underrange
-1.05V	-31500	-1.05	-105	
				range underflow

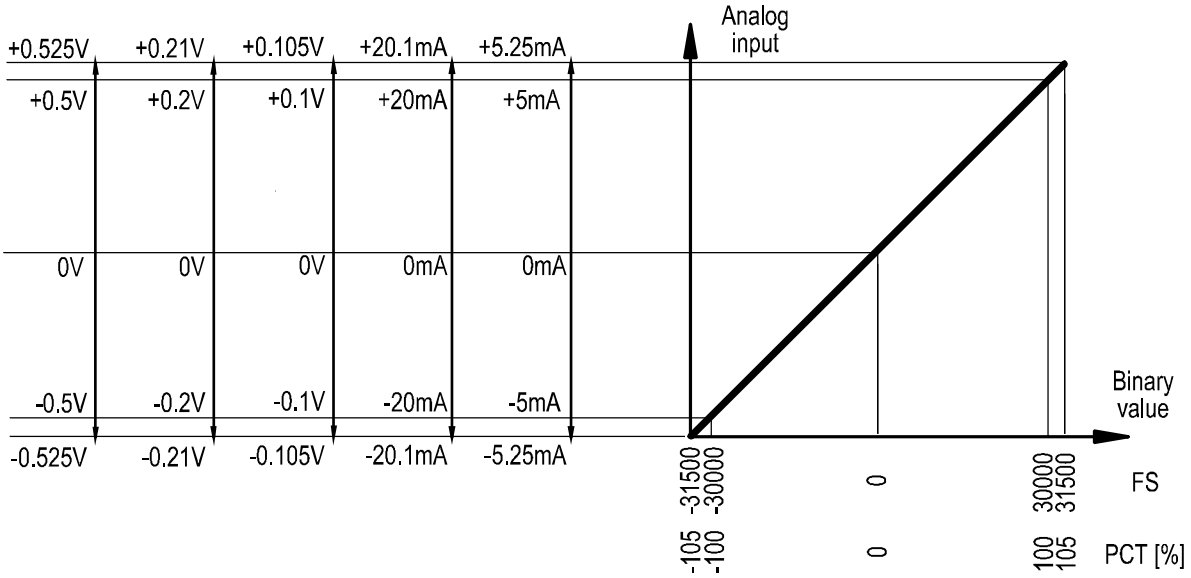


Fig. 4.7 Voltage and current ranges of module IT-7604 ±0.5V, ±0.2V, ±0.1V,±20mA,±5mA

Table 4.5 Voltage range of module IT-7604 ±0.5V

Range	**Variable**			
±0.5V	**FS**	**ENG**	**PCT**	
				range overflow
0.525V	31500	0.525	105	
				overrange
0.5V	30000	0.5	100	
16µV	1	0.000016	0.00333	
0V	0	0	0	nominal range
-0.5V	-30000	-0.5	-100	
				underrange
-0.525V	-31500	-0.525	-105	
				range underflow

Table 4.6 Voltage range of module IT-7604 ±0.2V

Range	**Variable**			
±0.2V	**FS**	**ENG**	**PCT**	
				range overflow
0.21V	31500	0.21	105	
				overrange
0.2V	30000	0.2	100	
6.6µV	1	0.0000066	0.00333	
0V	0	0	0	nominal range
-0.2V	-30000	-0.2	-100	
				underrange
-0.21V	-31500	-0.21	-105	
				range underflow

Table 4.7 Voltage range of module IT-7604 ±0.1V

Range	Variable			
±0.1V	**FS**	**ENG**	**PCT**	
				range overflow
0.105V	31500	0.105	105	
				overrange
0.1V	30000	0.1	100	
3.3µV	1	0.0000033	0.00333	
0V	0	0	0	nominal range
-0.1V	-30000	-0.1	-100	
				underrange
-0.105V	-31500	-0.105	-105	
				range underflow

Table 4.8 Voltage range of module IT-7604 ±20mA

Range	Variable			
±20mA	**FS**	**ENG**	**PCT**	
				range overflow
21mA	31500	21	105	
				overrange
20mA	30000	20	100	
0.66µA	1	0.00066	0.00333	
0mA	0	0	0	nominal range
-20mA	-30000	-20	-100	
				underrange
-21mA	-31500	-21	-105	
				range underflow

Table 4.9 Voltage range of module IT-7604 ±5mA

Range	Variable			
±5mA	**FS**	**ENG**	**PCT**	
				range overflow
5.25mA	31500	5.25	105	
				overrange
5mA	30000	5	100	
0.16µA	1	0.00016	0.00333	
0mA	0	0	0	nominal range
-5mA	-30000	-5	-100	
				underrange
-5.25mA	-31500	-5.25	-105	
				range underflow

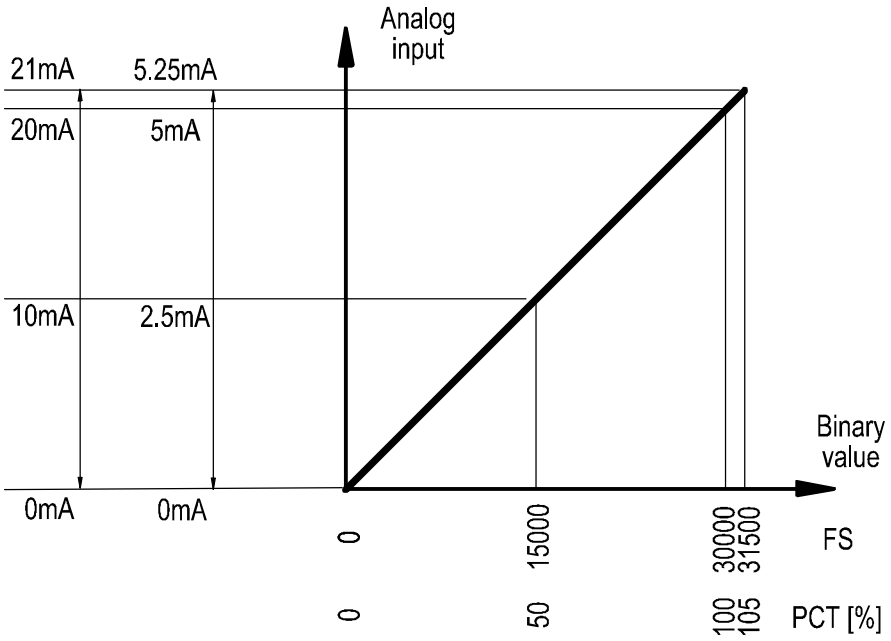


Fig. 4.8 Current ranges of module IT-7604 0÷20mA, 0÷5mA

Table 4.10 Current range of module IT-7604 0÷20mA

Range	**Variable**			
0÷20mA*	**FS**	**ENG**	**PCT**	
				range overflow
21mA	31500	21	105	
				overrange
20mA	30000	20	100	
0.66µA	1	0.00066	0.00333	nominal range
0mA	0	0	0	

*) This range does not indicate any underrange or range underflow.

Table 4.11 Current range of module IT-7604 0÷5mA

Range	**Variable**			
0÷5mA*	**FS**	**ENG**	**PCT**	
				range overflow
5.25mA	31500	5.25	105	
				overrange
5mA	30000	5	100	
0.16µA	1	0.00016	0.00333	nominal range
0mA	0	0	0	

*) This range does not indicate any underrange or range underflow.

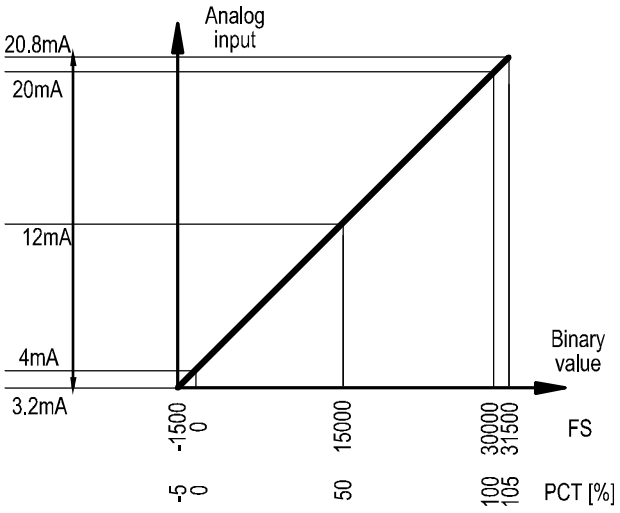


Fig. 4.9 Current range of module IT-7604 4÷20mA

Table 4.12 Current range of module IT-7604 4÷20mA

Range	Variable			
4÷20mA	**FS**	**ENG**	**PCT**	
				range overflow
20.8mA	31500	20.8	105	
				overrange
20mA	30000	20	100	
4.00053mA	1	4.00053	0.00333	nominal range
4mA	0	4	0	
				underrange
3.2mA	-1500	3.2	-5	
				range underflow

4.11.2 Passive temperature sensors

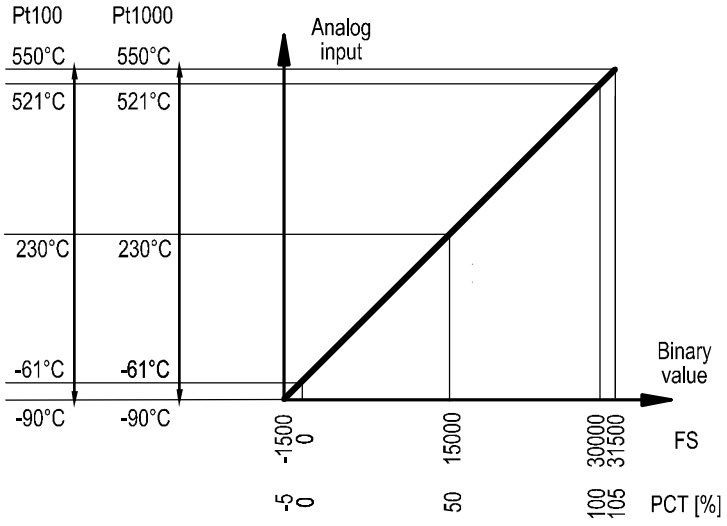


Fig. 4.10 Passive temperature sensors of module IT-7604 Pt100, Pt1000

Table 4.13 Passive temperature sensors of module IT-7604 Pt100, Pt1000

Pt100, Pt1000 W_{100}		**Variable**			
1.385	**1.391**	**FS**	**ENG**	**PCT**	
					range overflow
550°C	550°C	31500	550	105	
					overrange
521°C	521°C	30000	521	100	
					nominal range
		1	-61+0.0194	0.00333	
-61°C	-61°C	0	-61	0	
					underrange
-90°C	-90°C	-1500	-90	-5	
					range underflow

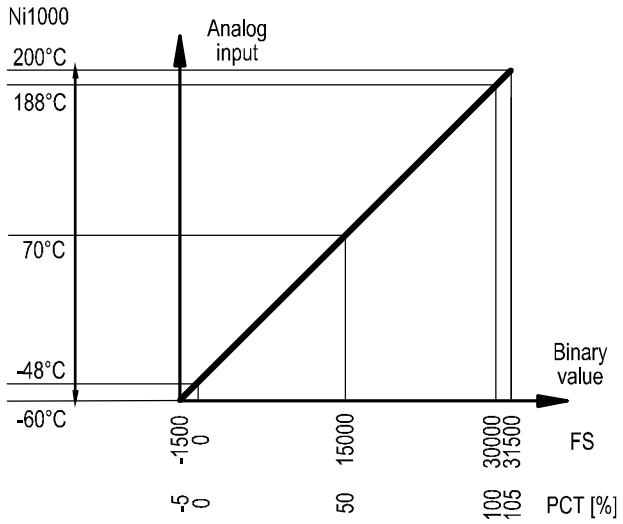


Fig. 4.11 Passive temperature sensors of module IT-7604 Ni1000

Table 4.14 Passive temperature sensors of module IT-7604 Ni1000

Ni1000 W_{100}		**Variable**			
1.617	**1.500**	**FS**	**ENG**	**PCT**	
					range overflow
200°C	200°C	31500	200	105	
					overrange
188°C	188°C	30000	188	100	
					Nominal range
		1	-48+0.0078	0.00333	
-48°C	-48°C	0	-48	0	
					underrange
-60°C	-60°C	-1500	-60	-5	
					Range underflow

4.11.3 Resistance devices

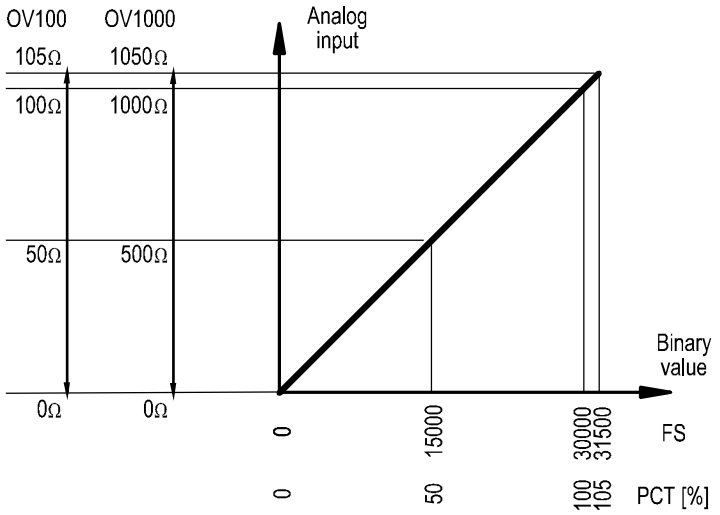


Fig. 4.12 Resistance devices of module IT-7604 OV100, OV1000

Table 4.15 Resistance devices of module IT-7604 OV100

Range	**Variable**			
OV100*	**FS**	**ENG**	**PCT**	
				range overflow
105 Ω	31500	105	105	
				overrange
100 Ω	30000	100	100	
0.00333 Ω	1	0.00333	0.00333	nominal range
0 Ω	0	0	0	

*) This range does not indicate any underrange or range underflow.

Table 4.16 Resistance devices of module IT-7604 OV1000

Range	**Variable**			
OV1000*	**FS**	**ENG**	**PCT**	
				range overflow
1050 Ω	31500	1050	105	
				overrange
1000 Ω	30000	1000	100	
0.03333 Ω	1	0.03333	0.00333	nominal range
0 Ω	0	0	0	

*) This range does not indicate any underrange or range underflow.

4.11.4 Thermocouples

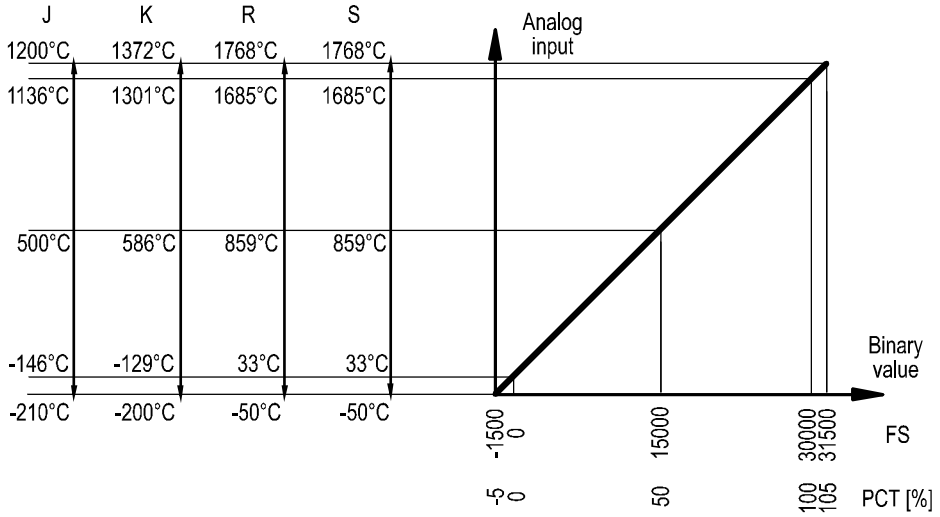


Fig. 4.13 Thermocouples of module IT-7604 J, K, R, S

Table 4.17 Thermocouple J of module IT-7604

Range	**Variable**			
Thermocouple J	**FS**	**ENG**	**PCT**	
				range overflow
1200°C	31500	1200	105	
				overrange
1136°C	30000	1136	100	
				nominal range
	1	-146+0.0427	0.00333	
-146°C	0	-146	0	
				underrange
-210°C	-1500	-210	-5	
				range underflow

Table 4.18 Thermocouple to the module IT-7604

Range	**Variable**			
Thermocouple K	**FS**	**ENG**	**PCT**	
				range overflow
1372°C	31500	1372	105	
				overrange
1301°C	30000	1301	100	
				nominal range
	1	-129+0.0476	0.00333	
-129°C	0	-129	0	
				underrange
-200°C	-1500	-200	-5	
				range underflow

Table 4.19 Thermocouple R of module IT-7604

Range	Variable			
Thermocouple R	**FS**	**ENG**	**PCT**	
				range overflow
1768°C	31500	1768	105	
				overrange
1685°C	30000	1685	100	
				nominal range
	1	33+0.0572	0.00333	
33°C	0	33	0	
				underrange
-50°C	-1500	-50	-5	
				range underflow

Table 4.20 Thermocouple S of module IT-7604

Range	Variable			
Thermocouple S	**FS**	**ENG**	**PCT**	
				range overflow
1768°C	31500	1768	105	
				overrange
1685°C	30000	1685	100	
				nominal range
	1	33+0.0572	0.00333	
33°C	0	33	0	
				underrange
-50°C	-1500	-50	-5	
				range underflow

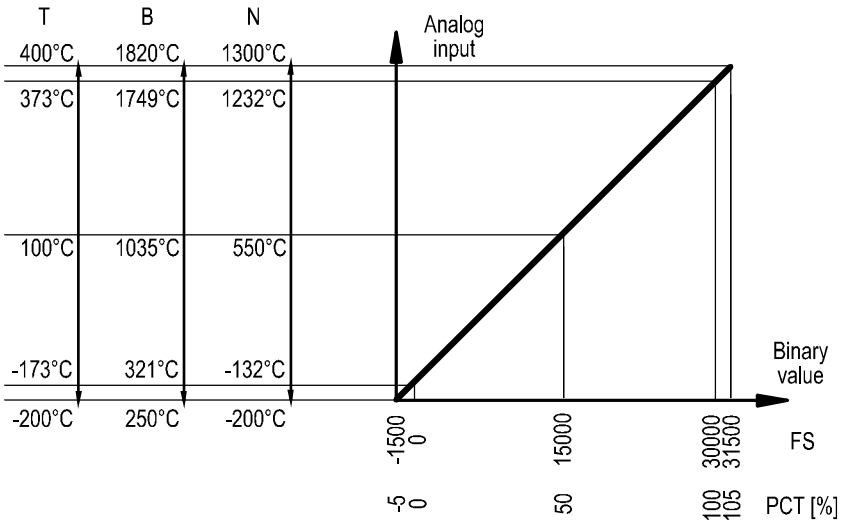


Fig. 4.14 Thermocouples of module IT-7604 T, B, N

Table 4.21 Thermocouple T of module IT-7604

Range	Variable			
Thermocouple T	**FS**	**ENG**	**PCT**	
				range overflow
400°C	31500	400	105	
				overrange
373°C	30000	373	100	
				nominal range
	1	-173+0.0182	0.00333	
-173°C	0	-173	0	
				underrange
-200°C	-1500	-200	-5	
				range underflow

Table 4.22 Thermocouple B of module IT-7604

Range	Variable			
Thermocouple B	**FS**	**ENG**	**PCT**	
				range overflow
1820°C	31500	1820	105	
				overrange
1749°C	30000	1749	100	
				nominal range
	1	321+0.0476	0.00333	
321°C	0	321	0	
				underrange
250°C	-1500	250	-5	
				range underflow

Table 4.23 Thermocouple N of module IT-7604

Range	Variable			
Thermocouple N	**FS**	**ENG**	**PCT**	
				range overflow
1300°C	31500	1300	105	
				overrange
1232°C	30000	1232	100	
				nominal range
	1	-132+0.0454	0.00333	
-132°C	0	-132	0	
				underrange
-200°C	-1500	-200	-5	
				range underflow

4.12 APPENDIX FOR ADVANCED USERS

The structures given below are typically automatically generated by the MOSAIC development environment (into file *.HWC) and it is not recommended to alter them. If the programmer does not use automatic configuration generation, the description below serves as a sample for manual module configuration.

4.12.1 Initialization data structure

The module requires declaration of an initialization table, this is represented in the declaration file of the MOSAIC development environment (*.HWC) by the following description:

```
#struct _TTS_Head                ;module heading structure
        UINT  ModulID,           ;identification code of module type
        USINT Stat0,             ;data exchange status
        USINT Stat1              ;data exchange status

#struct _TTS_EnbCHAI  ;activation structure of channel variables being passed
        USINT ESTAT,  ;variable STAT passing activation
        USINT EFS,    ;variable FS passing activation
        USINT EENG,   ;variable ENG passing activation
        USINT EPCT    ;variable PCT passing activation

#struct _TTS_IniCHAI  ;structure of channel initialization data
        USINT TypAI,  ;sensor class and type
        USINT TAU     ;numeric filtering constant

#struct _TTS_IT7604              ;module initialization table structure
        _TTS_Head Head,          ;table heading
        _TTS_EnbCHAI[8] EnableCH,;variable activation of particular channels
        _TTS_IniCHAI[8] InitCH   ;initialization data of particular channels
```

Example of initialization table declaration :

```
#table _TTS_IT7604 _r0_p3_Table = 7604,$00,$00,     ;table heading
                                  $80,$80,$80,$80,  ;variable activation
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $80,$80,$80,$80,
                                  $40,00,           ;initialization data
                                  $40,17,
                                  $41,00,
                                  $41,23,
                                  $40,00,
                                  $40,00,
                                  $40,00,
                                  $40,00
```

Example of module declaration :

```
#struct TModulE1                 ;module declaration structure
```

```
        USINT version,          ;description version
        USINT rack,             ;rack address
        USINT address,          ;module address in the rack
        UINT  LogAddress,       ;logic address
        UINT  LenInputs,        ;length of input data zone
        UINT  LenOutputs,       ;length of output data zone
        DINT  OffsetInputs,     ;position of input data zone
        DINT  OffsetOutputs,    ;position of output data zone
        UINT  InitTable         ;initialisation table index


#module TModulE1 1, 0, 3, 0, 96, 0, __offset(r0_p3_AI0), 0, __indx
(_r0_p3_Table)
```

The meaning of the items of the initialization table is as follows :

ESTAT - variable STAT passing activation
EFS - variable FS passing activation
EENG - variable ENG passing activation
EPCT - variable PCT passing activation
= $80 - the variable will be passed from the module
= $00 - the variable will not be passed from the module
TypAI - sensor class and type

Bit	SN3	SN2	SN1	SN0	TP3	TP2	TP1	TP0
	7	6	5	4	3	2	1	0

SN3 ÷ SN0 - selection of class of connected sensor (signal)
TP3 ÷ TP0 - selection of sensor type

Group	SN3÷SN0	TP3÷TP0	Range, sensor type	
Thermocouples:	$00		type J	
	$01		type K	
	$02		type R	
	$03		type S	
	$04		type T	
	$05		type B	
	$06		type N	
Resistance sensors:	$20		Pt100	W_{100} = 1,385
	$21		Pt100	W_{100} = 1,391
	$22		Pt1000	W_{100} = 1,385
	$23		Pt1000	W_{100} = 1,391
	$24		Ni1000	W_{100} = 1,617
	$25		Ni1000	W_{100} = 1,500
	$26		OV100	
	$27		OV1000	

Current ranges:	$40	0 ÷ 20 mA	
	$41	4 ÷ 20 mA	
	$42	± 20 mA	
	$43	0 ÷ 5 mA	
	$44	± 5 mA	
Voltage ranges:	$80	± 10 V	
	$81	± 5 V	
	$82	± 2 V	
	$83	± 1 V	
	$84	± 0.5 V	
	$85	± 0.2 V	
	$86	± 0.1 V	
External cold junction *:	$30	Pt100	W_{100} = 1.385
	$31	Pt100	W_{100} = 1.391
	$32	Pt1000	W_{100} = 1.385
	$33	Pt1000	W_{100} = 1.391
	$34	Ni1000	W_{100} = 1.617
	$35	Ni1000	W_{100} = 1.500

*) External cold junction can be set only for input AI7. When measuring thermocouples the value of this external cold junction is considered instead of internal sensor of cold junction.

TAU - Time constant of numerical filtering of 1st order. By non-zero setting of this value, the function of input numerical filtering by the 1st order filter is activated. The filter is given by the following relation:

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

x - analog input passed value
y_t - output
y_{t-1} - recent output
τ - time constant of 1st order filter (TAU)

The value of the constant TAU is specified within a range of 1÷255 and represents the time constant within a range of 100 ms ÷ 25.5 s. For the value of TAU=0, the filtering function is not activated. Filtering applies to all data formats of the given format (FS, ENG and PCT).

4.13 EXAMPLES OF CONNECTION OF MODULE IT-7604

Example 1 To the module IT-7604 the following signals are connected:

- 1 sensor Pt100 four-wire
- 1 sensor Ni1000 two-wire
- 2 signals against ground 4÷20mA

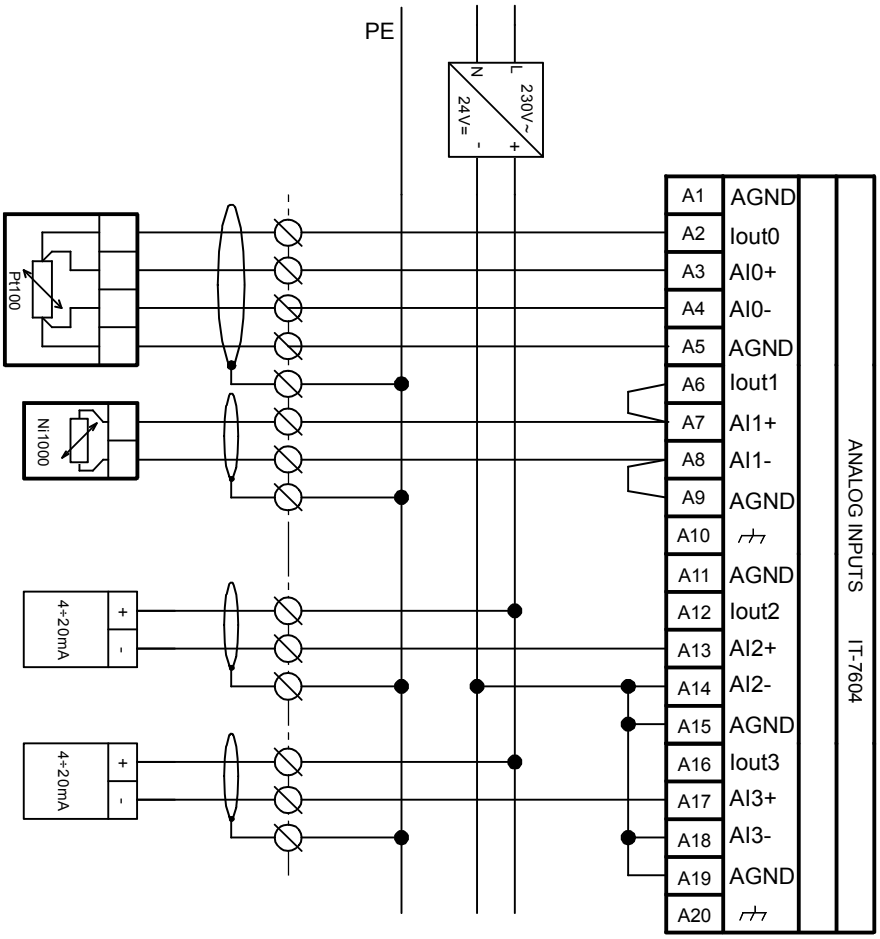


Fig. 4.15 Connection of connector A of module IT-7604 according to example Nr. 1

Notes:

1. *When measuring voltage or current (differential measurement of the signal floating source), we always connect one input of each of such used channel (usually AI-) to the terminal of the analog ground of the unit AGND (a short-circuiting conductor or a resistance of up to 2 kΩ can be used).*
2. *Cable shielding is usually connected to the terminal of the working ground (on the unit or in the switchgear on the terminal board).*
3. *Current lops are fed by an external source, there can be more current loops connected parallel to the source (detailed information see TXV 001 08).*
4. *For small voltage signals, a shielded inlet conductor can be fitted (JYTY, etc., shielding of which is connected according to general rules (see TXV 001 08).*
5. *Identical connection is valid also for the B connector (second half of the module).*

5. ANALOG OUTPUT MODULE OT-7652

The OT-7652 module generates 8 analog output signals. Each module output can be set individually to one of the ranges (see chapter 5.3). The model ensures the conversion of the value specified in the user program. Each output is led to individual terminals as voltage and current passive one.

5.1 BASIC PARAMETERS

Product standard	ČSN EN 61131-2
Protection class of electrical object ČSN 33 0600	III
Connection	screwless terminals, max. 1.0 mm^2 conductor per terminal
Coverage (after installation into rack)	IP20 ČSN EN 60529
Type of equipment	built-in
Supply voltage	from internal system source
Input power	max. 4.2 W
Maximum weight	0.3 kg
Dimensions	137 x 30 x 198 mm

5.2 OPERATIONAL CONDITIONS

Class of ambient influence – ČSN 33 2000-3	normal
Operating temperatures range	0 °C to + 55 °C
Permissible temperatures during transport	-25 °C to +70 °C
Relative humidity	10 % to 95 % without condensation
Atmospheric pressure	min. 70 kPa (< 3000 m above see level)
Degree of pollution - ČSN EN 61131-2	2
Overvoltage category of installation - ČSN 33 0420-1	II
Working position	vertical
Type of operation	continuous
Electromagnetic compatibility	
Emissions - ČSN EN 55022*	class A
Immunity	table 16, ČSN EN 61131-2
Vibration resistance (sinusoidal vibrations) Fc according to ČSN EN 60068-2-6	10 Hz to 57 Hz amplitude 0,075 mm, 57 Hz to 150 Hz acceleration 1G

* This is a product of class A. In indoor conditions (i.e. such conditions, where using of radio and TV sets can be supposed in a distance of 10 m from the mentioned equipment), the product can cause radio disturbances. It might be required in such cases that the user takes necessary measures to avoid this.

5.3 ELECTRICAL PARAMETERS

Number of outputs	8
Organization and type of outputs	8 with common terminal
Galvanic isolation from internal circuits	yes, 8 inputs together
Diagnostics	no
Conversion method	multiplexed A/D converter
Operation modes	periodical setting of outputs
Type of protection	integrated overvoltage protections
Insulation potentials under normal operating conditions	500 V DC between input and internal circuits
Filtering	-
Internal calibration	-
Output ranges:	
Voltage	± 10 V ± 5 V 0 ÷ 10 V
Current	0 ÷ 20 mA 4 ÷ 20 mA
External power supply	yes (for current outputs)
Common points between channels, if any	yes, terminal AGND
Type of cable, length, recommended conditions	see TXV 001 08.01
Installation to ensure noise resistance	see TXV 001 08.01
Calibration or verification to keep nominal accuracy	2 years
Terminal arrangement	see chapter 5.5
Typical example(s) of external connections	see TXV 001 08.01
Influence of incorrect connection of output terminals	none, if max. overload of all output terminals is followed

Voltage output ranges	
Maximum output current	10 mA
Analog output error - Max. error at 25 °C - Temperature coefficient	 ± 0,3 % of full range ± 0,03 % of full range/K
Non-linearity	±0,07 % of full range
Repeatability under steady conditions	0,05 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 5.10
Least significant bit value (LSB)	see chapter 5.10
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	no
Output type	active voltage output
Detection of open output	no
Total time of system input transfer (TAID + TAIT)	typ. 20 ms [1)]
Sample repeating period	typ. 160 ms [1)]

Current output ranges	
Maximum external voltage of loop	32 V DC
Error of analog output - Max. error at 25 °C - Temperature coefficient - Non-linearity - Repeatability under steady conditions	 ± 0,5 % of full range ± 0,04 % of full range/K ±0,07 % of full range 0,5 % of full range
Numerical resolution	16 bits
Format of data returned to application program	see chapter 5.10
Least significant bit value (LSB)	see chapter 5.10
Max. permitted continuous overload (without damage)	± 35 V each terminal against AGND
Overload indication	no
Type of output	passive current output
Detection of open input	no
Total time of system input transfer (TAID + TAIT)	typ. 20 ms [1)]
Sample repeating period	typ. 160 ms [1)]

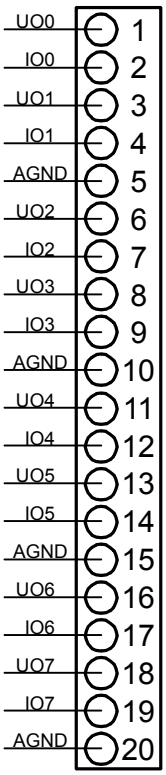
[1)] The time of transfer and data update period of each channel is dependant on module configuration - i.e. on the number of set channels.

5.4 POWER SUPPLY

The module is fed from a power supply, which is part of the TC700 system assembly.

5.5 CONNECTION

The module is fitted with a connector (order number of the connector TXN 102 3x according to customer's choice). Connection of the connector is illustrated on figure 5.1.



AGND analog ground signal terminal

UOx analog voltage output terminal

IOx analog current output terminal

Fig. 5.1 Terminal connection of module OT-7652

Detailed information on connection, proper installation procedure, examples of module connection and principles for increasing resistance and reliability can be found in the handbook for designing TXV 001 08.01.

5.6 OPERATION

5.6.1 Module HW configuration

The module is operated, set and diagnosed from the MOSAIC development environment.

5.6.2 Putting in operation

After putting the module into the rack and switching power supply on, the module is fully ready for operation and does not require any other settings of its elements.

5.7 DIAGNOSTICS

The basic diagnostic system of the module is part of the standard module software. The diagnostic system becomes active after module power supply is on, and works independently from the user. The error states of the module being diagnosed are passed on the central module.

5.8 INDICATION

On the front panel of the module, one green indication LED is assigned to each output analog channel. If the LED is on, it indicates active operation of the concrete channel.

Further, there is a green RUN LED on the front panel. If the RUN LED is on, the module is in the HALT mode, if the RUN LED flashes, the module is in the RUN mode. Additionally, there is a yellow OFF LED on the panel and when it is on, blocking of analog outputs is indicated.

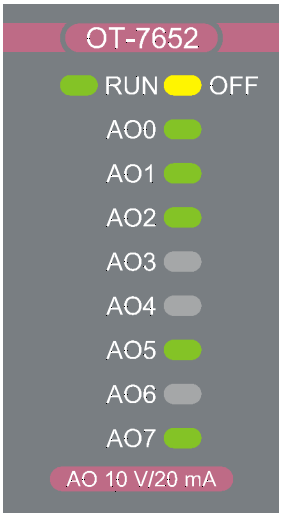


Fig. 5.2 Indication panel of the OT-7652 module

5.9 MODULE SETUP

For trouble-free module operation it is necessary to perform its SW setup within the frame of module declaration. For each channel, it is specified the type of output analog signal, information whether the channel will accept the specified value from the variables FS or PCT

and information how the channel will behave during output blocking. Module setup is performed within the MOSAIC development environment by means of the dialog given below.

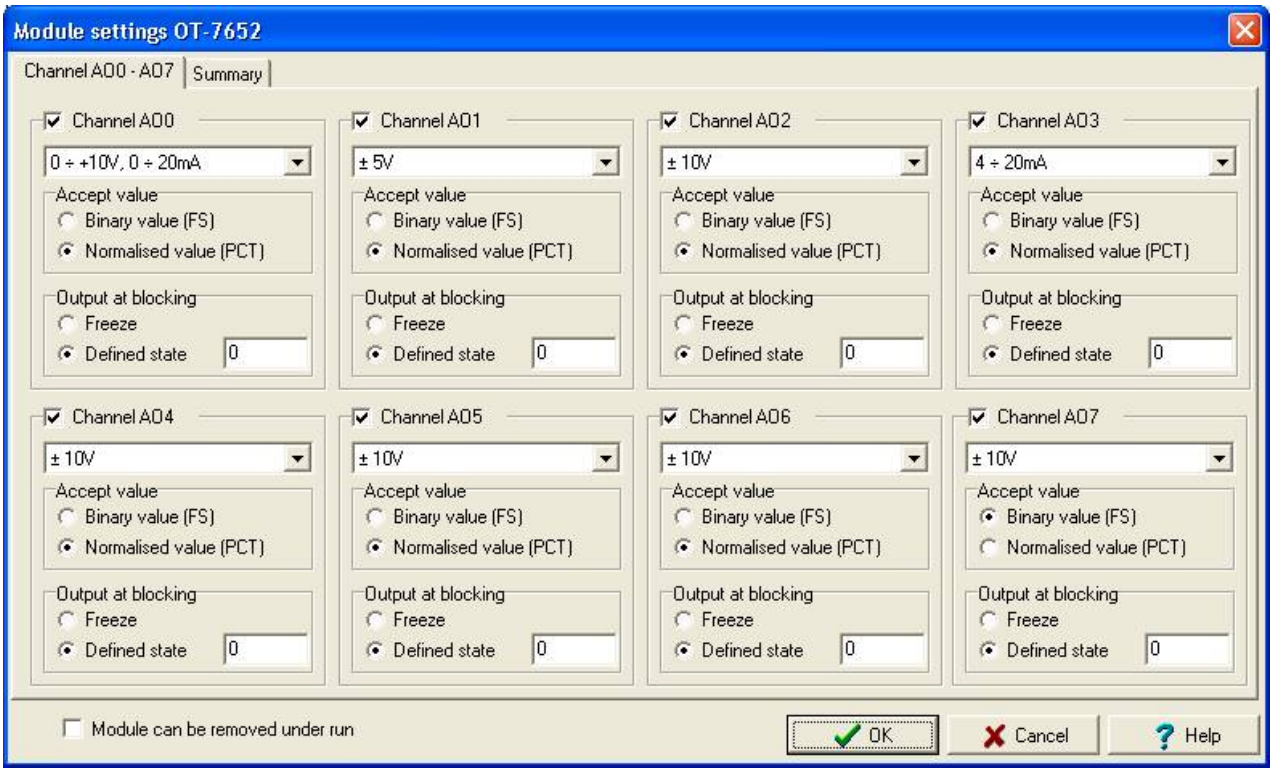


Fig. 5.3 Module SW setup

Channel AOx

Full activation/deactivation of analog channel operation

Type of analog channel

0 ÷ +10 V, 0 ÷ 20 mA	- unipolar range setup 10 V, or current 20 mA
±5V	- bipolar range setup 5 V
±10V	- bipolar range setup 10 V
4 ÷ 20mA	- current range setup 4 ÷ 20 mA

Accept value

Binary value (FS)	- the channel will be processing the value passed in the variable FS
Normalised value (PCT)	- the channel will be processing the value passed in the variable PCT

Output during blocking

Freeze	- during switching to the HALT mode, the analog output status will be frozen
Defined status	- during switching to the HALT mode, the output will be set to the defined status

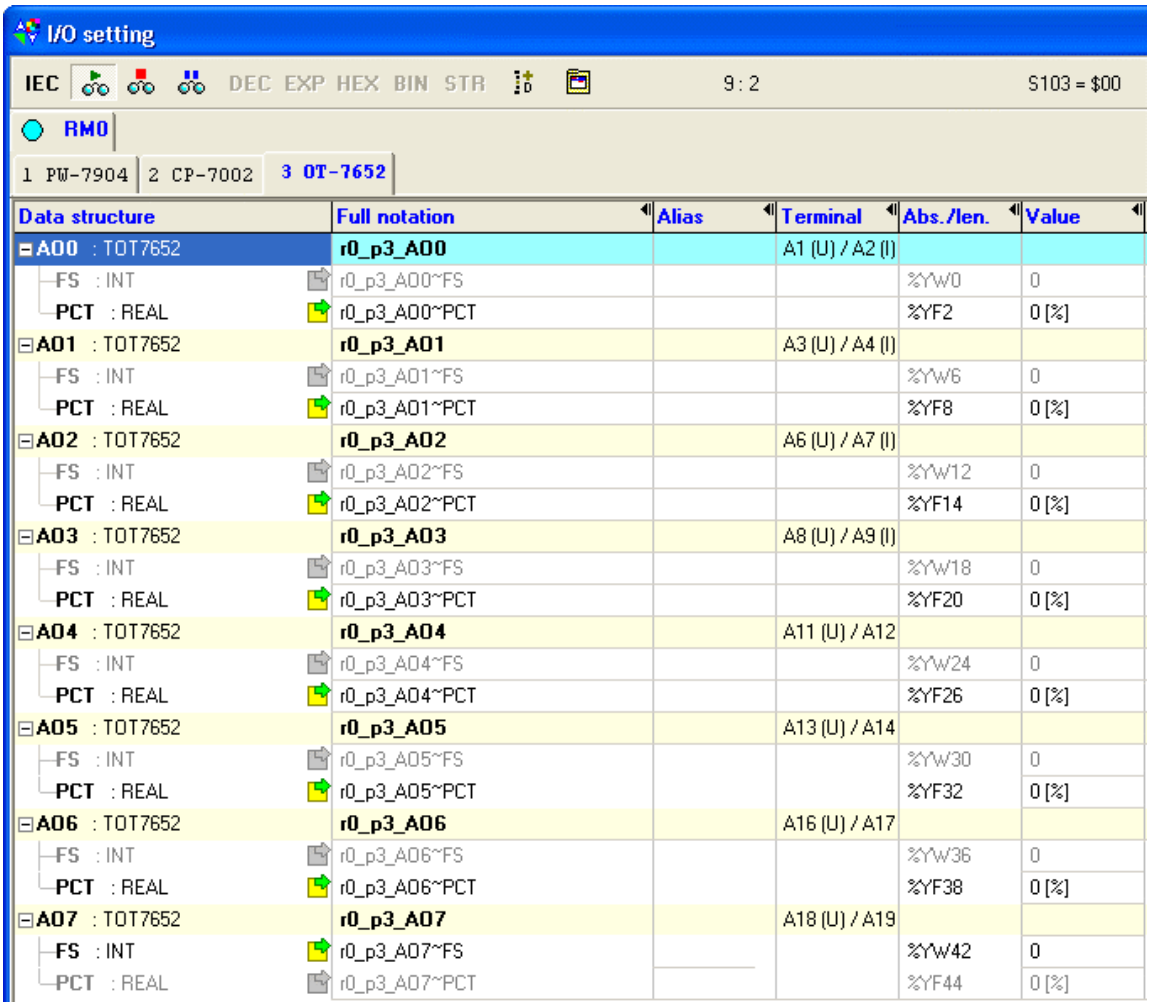
Defined status

If the output is set to the defined status during blocking (see above), this value is written to the analog output, when the peripheral module is switched to the HALT mode i.e. during a hard error signalised by the central module, or during switching to the HALT mode from the programming environment).

Note: The specified value of the defined status will be understood as a value of the int type within a range of ±31500 when the channel value from the variable FS is accepted, or as a value of the real type within a range ±105% when the channel value from the variable PCT is accepted.

5.10 OUTPUT DATA STRUCTURE

The analog output module OT-7652 has 8 output 16-bit channels. Each channel can process a value in FS (Full Scale) format, or PCT format (percent). The structure items of the analog module have symbolic names assigned, beginning with the rack number and position number in the rack. In the column *Full Notation*, a concrete symbolic name is always specified for the given item. If you want to use the data in the user program, you will use either this symbolic name or you will write your symbolic name in the column *Alias*, that can be used later. Do not use absolute operands in any case, since they can change after a new compilation of the user program. The structure of passed data is obvious from the panel *I/O Setting* in the MOSAIC development environment (fig. 5.4) (icon).



Data structure	Full notation	Alias	Terminal	Abs./len.	Value
A00 : TOT7652	r0_p3_A00		A1 (U) / A2 (I)		
FS : INT	r0_p3_A00~FS			%YW0	0
PCT : REAL	r0_p3_A00~PCT			%YF2	0 [%]
A01 : TOT7652	r0_p3_A01		A3 (U) / A4 (I)		
FS : INT	r0_p3_A01~FS			%YW6	0
PCT : REAL	r0_p3_A01~PCT			%YF8	0 [%]
A02 : TOT7652	r0_p3_A02		A6 (U) / A7 (I)		
FS : INT	r0_p3_A02~FS			%YW12	0
PCT : REAL	r0_p3_A02~PCT			%YF14	0 [%]
A03 : TOT7652	r0_p3_A03		A8 (U) / A9 (I)		
FS : INT	r0_p3_A03~FS			%YW18	0
PCT : REAL	r0_p3_A03~PCT			%YF20	0 [%]
A04 : TOT7652	r0_p3_A04		A11 (U) / A12		
FS : INT	r0_p3_A04~FS			%YW24	0
PCT : REAL	r0_p3_A04~PCT			%YF26	0 [%]
A05 : TOT7652	r0_p3_A05		A13 (U) / A14		
FS : INT	r0_p3_A05~FS			%YW30	0
PCT : REAL	r0_p3_A05~PCT			%YF32	0 [%]
A06 : TOT7652	r0_p3_A06		A16 (U) / A17		
FS : INT	r0_p3_A06~FS			%YW36	0
PCT : REAL	r0_p3_A06~PCT			%YF38	0 [%]
A07 : TOT7652	r0_p3_A07		A18 (U) / A19		
FS : INT	r0_p3_A07~FS			%YW42	0
PCT : REAL	r0_p3_A07~PCT			%YF44	0 [%]

Fig. 5.4 Data structure of analog module OT-7652

The module data structure is automaticaly generated by the Mosaic application (according to panel *I/O Setting*) into file HWconfig.ST.

```
TYPE
  TOT7652 : STRUCT
    FS    : INT;
    PCT   : REAL;
  END_STRUCT;
END_TYPE

VAR_GLOBAL
  r0_p3_AO0            AT %Y0   : TOT7652;
  r0_p3_AO1            AT %Y6   : TOT7652;
  r0_p3_AO2            AT %Y12  : TOT7652;
  r0_p3_AO3            AT %Y18  : TOT7652;
  r0_p3_AO4            AT %Y24  : TOT7652;
  r0_p3_AO5            AT %Y30  : TOT7652;
  r0_p3_AO6            AT %Y36  : TOT7652;
  r0_p3_AO7            AT %Y42  : TOT7652;
END_VAR
```

Variable FS

The value being passed in the variable FS is a value of the int type. In the OT-7652 module the value is converted to the corresponding output voltage or current. For unipolar ranges of the output values, the zero value corresponds to the minimum value of output voltage or current, the value of 31500 corresponds to the maximum value of output voltage or current. For bipolar ranges of the output values, the value of -31500 corresponds to the minimum value of the output voltage, the value of 31500 corresponds to the maximum value of the output voltage. The FS value of 30000 (-30000) corresponds to the nominal range of the analog output.

Variable PCT

The value being passed in the variable PCT is a variable of the real type and expresses per cent relation between the required and nominal values of the analog output. In the OT-7652 module, the value is converted to the corresponding output voltage or current. For unipolar ranges of the output values, the value of 0% corresponds to the minimum value of output voltage or current, the value of 105% corresponds to the maximum value of output voltage or current. For bipolar ranges of the output values, the value of -105% corresponds to the minimum value of the output voltage, the value of +105% corresponds to the maximum value of the output voltage. The PCT value of 100% (-100%) corresponds to the nominal range of the analog output.

The following tables and diagrams illustrate individual ranges with their corresponding output analog values in relation to the FS and PCT values written into the module.

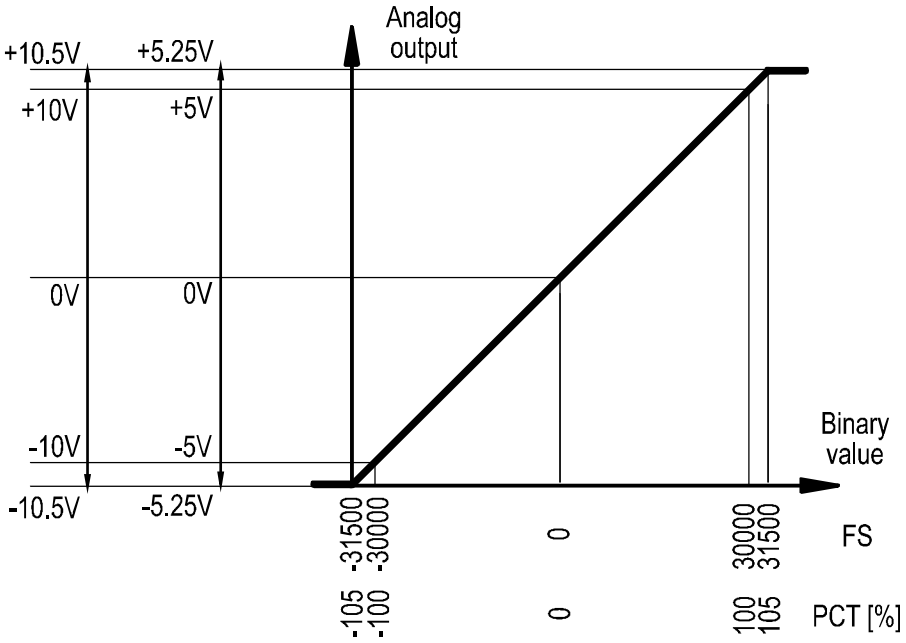


Fig. 5.5 Output value representation for ranges 0÷10V and 0÷20mA

Table 5.1 Output value representation for ranges 0÷10V and 0÷20mA

Variable		**Range**		
PCT	**FS**	**0÷10V**	**0÷20mA**	
109.223%	32767	10.5V	21mA	range overflow
105%	31500	10.5V	21mA	overrange
100%	30000	10V	20mA	nominal range
0.003333%	1	333.3µV	666.6nA	
0%	0	0V	0mA	
				range underflow
-109.226%	-32768	0V	0mA	

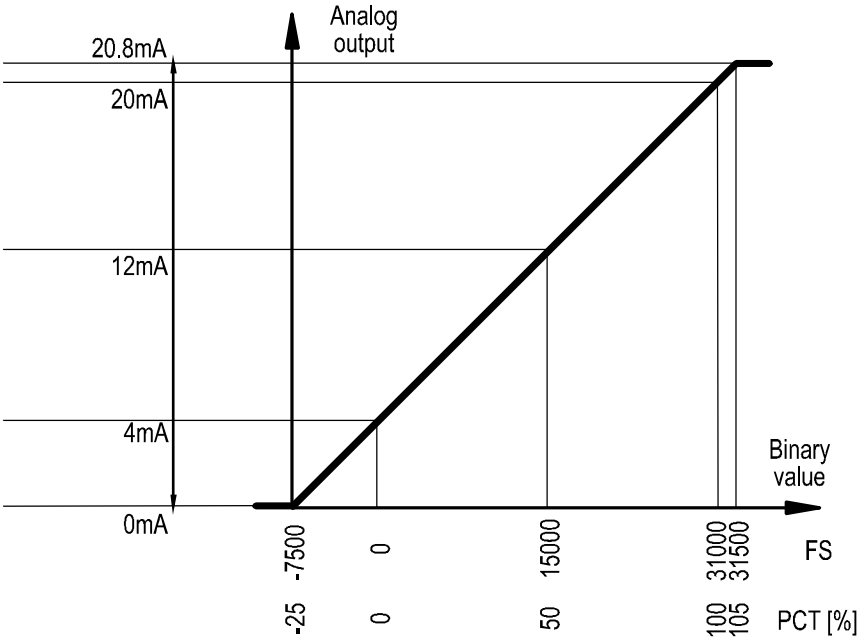


Fig. 5.6 Output value representation for range 4÷20mA

Table 5.2 Output value representation for range 4÷20mA

Variable		**Range**	
PCT	**FS**	**4÷20mA**	
109.223%	32767	20.8mA	range overflow
105%	31500	20.8mA	overrange
100%	30000	20mA	nominal range
0.003333%	1	4mA+533.3nA	
0%	0	4mA	
			underrange
-25%	-7500	0mA	
			range underflow
-109.226%	-32768	0mA	

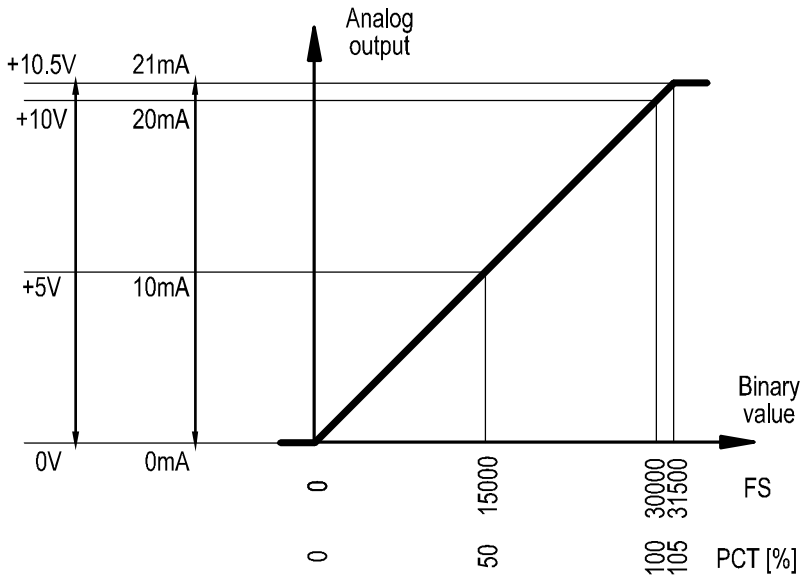


Fig. 5.7 Output value representation for ranges ±10V and ±5V

Table 5.3 Output value representation for ranges ±10V and ±5V

Variable		**Range**		
PCT	**FS**	**±10V**	**±5V**	
109.223%	32767	10.5V	5.25V	range overflow
105%	31500	10.5V	5.25V	overrange
100%	30000	10V	5V	nominal range
0.003333%	1	333.3µV	166.6µV	
0%	0	0V	0V	
-100%	-30000	-10V	-5V	
				underrange
-105%	-31500	-10.5V	-5.25V	
				range underflow
-109.226%	-32768	-10.5V	-5.25V	

5.11 APPENDIX FOR ADVANCED USERS

The structures given below are typically automatically generated by the MOSAIC development environment (into the file *.HWC) and it is not recommended to alter them. If the programmer does not use automatic configuration generation, the description below serves as a sample for manual module configuration.

5.11.1 Initialization data structure

The module requires declaration of an initialization table, this is represented in the declaration file of the MOSAIC development environment (*.HWC) by the following description:

```
#struct _TTS_Head                ;module heading structure
        UINT  ModulID,           ;identification code of module type
        USINT Stat0,             ;data exchange status
        USINT Stat1              ;data exchange status

#struct _TTS_EnableCH_OT7652 ;structure of activation of passed variables
        USINT EFS,            ;variable FS passing activation
        USINT EPCT            ;variable PCT passing activation

#struct _TTS_InitCH_OT7652  ;structure of channel initialization data
        USINT TypeAO,       ;type of analog output
        USINT BlcCont,      ;output control during blocking
        REAL  BlcState      ;output value during blocking

#struct _TTS_OT7652         ;module initialization table structure
        _TTS_Head Head,     ;table heading
        _TTS_EnableCH_OT7652[8] EnableCH, ;activation of channel variables
        _TTS_InitCH_OT7652[8] InitCH      ;channel initialization data
```

Example of initialization table declaration :

```
#table _TTS_OT7652 _r0_p3_Table = 7652,$00,$00,     ;table heading
                                  $00,$80,$00,$80,  ;variable activation
                                  $00,$80,$00,$80,
                                  $00,$80,$00,$80,
                                  $00,$80,$00,$80,
                                  0,1,0,            ;initialization data
                                  1,1,0,
                                  2,1,0,
                                  3,1,0,
                                  2,1,0,
                                  2,1,0,
                                  2,1,0,
                                  2,1,0
```

Example of module declaration :

```
#struct TModulE1                ;module declaration structure
        USINT version,          ;description version
        USINT rack,             ;rack address
        USINT address,          ;module address in the rack
        UINT  LogAddress,       ;logic address
        UINT  LenInputs,        ;length of input data zone
```

```
        UINT  LenOutputs,        ;length of output data zone
        DINT  OffsetInputs,      ;position of input data zone
        DINT  OffsetOutputs,     ;position of output data zone
        UINT  InitTable          ;initialisation table index

#module TModulE1 1, 0, 3, 0, 0, 48, 0, __offset(r0_p3_AO0), __indx
(_r0_p3_Table)
```

The meaning of the items of the initialization table is as follows:

EFS - activation of passing of variable to periphery in FS format
EPCT - activation of passing of variable to periphery in PCT format
= $80 - the variable will be passed to the module
= $00 - the variable will not be passed to the module

Note : For each channel, it is possible to pass the value only in one type of format (i.e. either in the format FS or PCT format).

TypA0 - analog output range
= 0 – 0 ÷ +10V, 0 ÷ 20mA
= 1 – ±5V
= 2 – ±10V
= 3 – 4 ÷ 20mA

BlkCont - output behaviour control during blocking
= 0 – freezing of current value
= 1 – acceptation of BlkState value

BlkState - the value, which will be written into the analog output, after switching the peripheral module to the HALT mode (i.e. during a hard error signalised by the central module, or during switching to the HALT mode from the programming environment).

Note : A value in the variable BlkState will be understood as a value of the int type within a range of ±31500, when the channel value in the FS format is accepted, or as a value of the real type within a range of ±105%, when the channel value in the PCT format is accepted.

5.12 EXAMPLES OF CONNECTION OF MODULE OT-7652

Example 1 To the module OT-7652 the following signals are connected:

- 1 drive with control 0÷10V
- 1 output 4÷20 mA

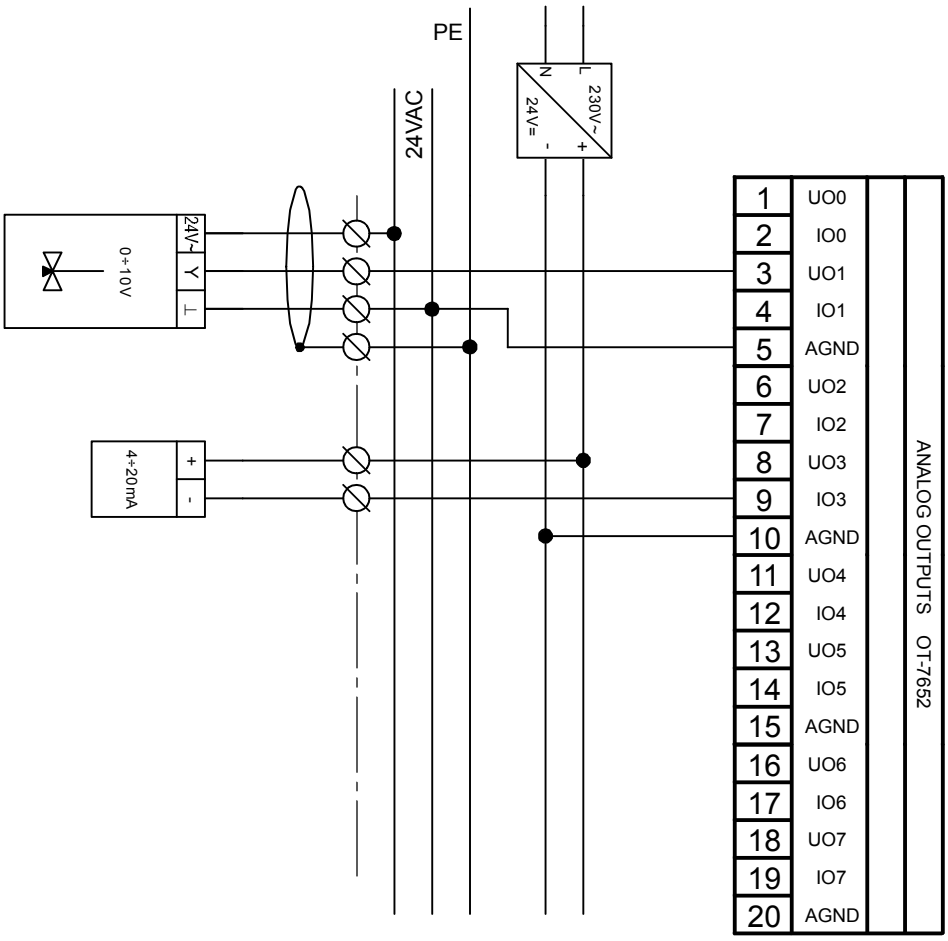


Fig. 5.8 Connection of module OT-7652 according to example Nr. 1

Notes:

1. *For long distances or environments with a high level of interference it is advantageous to use a shielded inlet conductor (JYTY etc.), shielding of which is connected according to general rules (see TXV 001 08).*
2. *Current outputs are fed from an external source of direct voltage, typically 24VDC, maximum is 35VDC (recommended types of sources are PS25/24 or PS50/24 based on the number of the branches being fed).*
3. *Due to interference transmission, it is not recommended to use the source for loop feeding for other circuits in the technology than for the analog ones.*

6. PACKAGING, TRANSPORT, STORAGE

The modules are packed according to internal packing instructions into a cardboard box.

The external packaging is done according to the quantity and way of transportation into a shipping container being labelled and containing all the necessary data for transportation.

The goods is transported from the manufacture's facilities as agreed when placing an order. Transportation of the goods by the customer must be pursued by covered transport means and in the position as indicated on the packaging. The shipping containers must be fixed in such a way to avoid accidental spontaneous movement and damage of the external container during transport.

During transportation and storage, the products must be protected from direct influence of atmospheric actions. Transportation of the products is permitted within a temperature range of -25 °C to 70 °C, relative humidity of 10 % to 95 % (without condensation) and minimum atmospheric pressure higher than 70 kPa (pressure corresponding to 3000 metres above see level). The products must be stored only in clean spaces free from conductive dust, aggressive gases and vapours. The optimum storage temperature is 20 °C.

7. INSTALLATION

Installation of the modules into the rack of the TC700 system shall be carried out according to TXV 004 02. Mechanical dimensions are specified in documentation TXV 004 02.

8. MAINTENANCE AND CLEANING

When following general instructions for installation, the modules do not require any other maintenance. Should dismantling of some part of the module be necessary, supply voltage must always be OFF.

Since the modules contain semiconductor components, it is necessary to follow the principles for working with components sensitive to electrostatic charges when handling the cover taken off. It is strictly prohibited to touch printed circuits directly without protective measures!!!

9. GLOSSARY

A/D converter

The circuit of the analog input unit responsible for conversion from the analog input value (from technology) to a numerical value, further being processed in the *PLC* user program.

AGND

Analog ground signal terminal. For analog units, it represents the common terminal for input and output circuits occupied on the unit. For differential measurement, it is usually connected through a resistor to one terminal of the differential input due to potential reduction between this terminal and differential input. For the NS-950 units, it usually represents analog signal ground for galvanically isolated units (i.e. it is not connected with the PLC internal circuits - see *0V*). It is not identical with mechanical ground (PLC frame)!

AI+

Positive input analog terminal. Together with the terminal *IN-* it represents the *differential input* (differential channel), designated for connection of the analog signal source from technology. If the positive pole of voltage source is led to this terminal (negative pole to the terminal IN-), the unit then returns the measured value with positive polarity.

AI-

Negative input analog terminal. Together with the terminal *IN+* it represents the *differential input* (differential channel) designated for connection of the analog signal source from technology. If the positive pole of voltage source is led to this terminal (positive pole to the terminal *IN+*) the unit then returns the measured value with positive polarity.

D/A converter

The circuit of the analog output unit responsible for conversion from the numerical value (received in the *PLC* user program) to the analog output value passed to the technology being controlled.

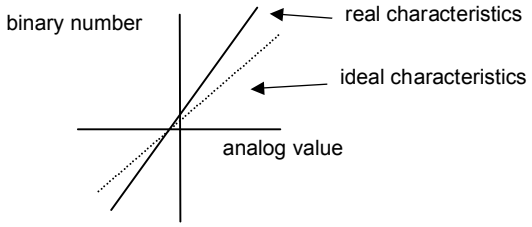
Differential input

The unit analog input (also differential channel) having separately led out its positive and negative terminals (*IN+* a *IN-*) where none of these terminals is grouped through internal circuits with the analog ground terminal of the unit (*AGND* or *0V*).

Another configuration possibility is "against ground", i.e. instead of one input terminal (*IN-*), the analog ground terminal is directly used (*0V* or *AGND*). This type of connection is also called as configuration with common terminal.

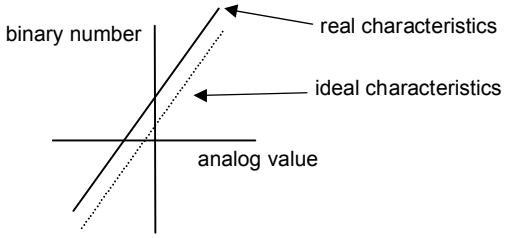
Amplification error

A numerical value specifying the change of inclination of the real conversion characteristics of the converter against the ideal one. The absolute size of the error is proportional to the size of the value being measured. It is defined in per cent of the input or output value.



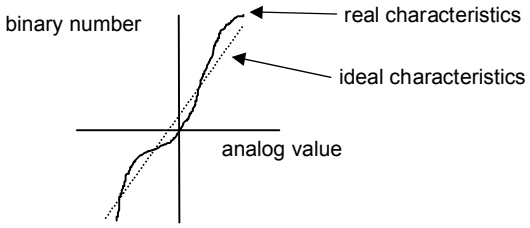
Zero error

A numerical value specifying the shift of the real conversion characteristics of the converter against the ideal one. The absolute size of the error is a value given by the input unit at zero voltage on its input and vice versa, for the output unit it represents a value, which has to be written to the unit to get zero voltage on its output. It is defined in bits (*LSB*).



Linearity error

A numerical value specifying the maximum deviation of the real conversion characteristics from the ideal one (the zero and amplification error are not taken into account). A straight line characteristics is the ideal one, the real characteristics shows an error for each combination of binary data read from the converter (A/D converter) or for the data written to the converter. The absolute size of the error is the greatest one of these values. It is defined in bits (*LSB*).



Value error

A numerical value specifying the change of inclination of the real conversion characteristics of the converter against the ideal one. The absolute value of the error is proportional to the size of the value being measured. It is defined in per cent of the input or output value.

Range error

A numerical value specifying the shift of the real conversion characteristics of the converter against the ideal one. It is defined in per cent of the maximum input or output value.

Iout

Output of specific current of the analog input unit used for feeding of *passive resistance sensors*. The output is active, the current loop is closed through the resistance being sensed, to the analog ground terminal *(0V* or *AGND*). For the output analog units, it means the current output of the *D/A converter* (usually realized by the conversion from the voltage output of identical sequence - for example *Uout* 3 with corresponding *Iout* 3). Current outputs are realized as active ones (i.e. they directly generate current against the analog ground terminal), or as passive outputs (they absorb current, the current source itself of the loop is realized outside the output unit).

LSB

For definition of unit parameters, it represents one bit (for example at the input range of 10 V, conversion with resolution is 1/4096, the total number of bits is 4096 for the range of 10 V, the result of which is LSB=10/4096=2.44 mV). The LSB term means "least significant bit", this represents the bit with the lowest significance for binary representation (the bit with the highest significance is called "most significant bit" - MSB).

Multiplexer

The circuit of the analog unit responsible for switching over of the input channels to one circuit for processing (*A/D converter*). It usually performs the function of the electronic switch (for example 8 inputs to 1 output).

Passive resistance sensors

The sensor reacting to the change of the value being sensed by changing its real resistance, but it does not generate actively any signal. The main representatives of these are passive resistance temperature (Pt100, Ni1000 etc.). In the TECOMAT systems, the drop in voltage on the sensor when feeding the sensor by a constant known current is usually measured by *differential input* (the units have outputs *Iout* of the specific current).

PLC

Programmable Logic Controller - in this case TECOMAT TC700.

Resolution

The smallest value of voltage or current, by which the output value can be changed (*D/A converter*) or the smallest change of input voltage that the input unit (*D/A converter*) is able to process (*corresponds to the value of LSB*).

Temperature drift

Change of a certain value, depending on the unit ambient temperature. It is expressed numerically for a change by 1 °C.

Temperature coefficient

An additional value, which takes into account the range of temperatures defined (to determine the corresponding unit parameter within the full range of temperatures, it is added to the main value defined for the nominal temperature). It is expressed in the format corresponding to the nominal value of the parameter, to which it is added.

Uout

For the analog output unit, it means voltage output of the *D/A converter*. With some units, also current outputs to the voltage outputs are available (see *Iout*).

Input impedance

It mostly represents the input resistance of the unit terminals (for differential input between terminals *IN+* and *IN-*, for the input with common analog ground terminal for the terminal and the input terminal).

Input channel

Another name for the input of the analog unit without differentiation whether it is a differential input or an input configured against analog ground.

W_{100}

Coefficient (specified by standards or another regulations) that for passive resistance temperature sensors specifies the relation between sensor resistance at 100 °C and resistance at 0 °C.

0V

Analog signal ground terminal. For analog units, it represents the common terminal of input and output circuits fitted in the module. For differential measurement, it is usually connected through a resistor to one terminal of the differential input due to potential reduction between this terminal and differential input. For the TC700 modules, it usually represents analog signal ground for galvanically not isolated units (i.e. it is connected with the PLC internal circuits - for example with another identically marked terminals of the analog units in the rack). It is not identical with mechanical ground (PLC frame)!

Notes

Order and information:
Teco a.s., Havlíčkova 260, 280 58 Kolín 4, Czech Republic, tel.: +420 321 737 611,
fax: +420 321 737 633, e-mail: teco@tecomat.cz, http://www.tecomat.com

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