LABOR – ASTER

INDUSTRIAL AUTOMATION

CONVERTER OF INPUTS/OUTPUTS TO MODBUS-RTU
type As703

- **Standard MODBUS-RTU communication**
- **8 galvanically separated channels:**
  - **measurement inputs (0/4…20mA, 0…10V, RTD, thermocouple)**
  - **analog outputs (0/4…20mA, 0…10V)**
  - **triple binary inputs**
  - **triple binary outputs**
- **High measurement accuracy**
- **Automatic recognition of connected modules**
- **Transmission speed 2400….115 200 bd**

APPLICATION:

Converter **As703** is designed to cooperate with controllers or other devices with MODBUS-RTU communication standard. This module is device type SLAVE (it answers on requests).

The converter allows to gather analog or bistate signals and also control analog or bistate signals.

The converter consists of baseboard which is responsible for separated transmission, main controller and 4 two-channel mini-boards which are responsible for input/output signals configuration. Different mini-boards can be ordered. The following channel types are available (there are two the same separated channels per one mini-board):

- three-wire input RTD (Pt100, Ni100, …)
- four-wire input RTD (Pt100, Ni100, …)
- thermocouple input (K, J, N, L, S, …)
- universal input U/I/Z (0/4…20mA, 0…10V, two-wire 4…20mA)
- two bistate inputs (0/10…60 Vac/dc)
- three bistate inputs with one common terminal (contact, 0/10…60 Vac/dc)
- current or voltage output (0…20mA, 0…10V)
- two bistate outputs type OC (60V/0,5A)
- three bistate outputs with one common terminal type OC (60V/0,5A)

The converter is designed to be installed in control closets on rail TS35. Green LED indicates power supply and proper main controller operation and yellow LED indicates correct transmission.

BASIC TECHNIAL PARAMETERS:

Power supply	-	24Vdc (20...36Vdc)/250mA
Input/output signals	-	specified for each mini-board
Communication interface:	-	RS485
Protocol	-	Modus-RTU
Transmission speed	-	2400, 4800, 9600, 19200, 38400, 57600, 115200 bd
Settings		8N1
Max amount of devices on line	-	254
Max length of transmission cable	-	1200 m

Galvanic separation of transmission line		2 kV
Galvanic separation between channels and power supply		1 kV
Housing	-	width 110 x height 125 x depth 57.5 [mm]
Mounting	-	on rail TS35
Operation condition		
a. ambient temperature	-	0 ÷+55°C
b. relative humidity	-	up to 90%
Safety requirements	-	**PN-EN 61010-1:2002**
EMC requirements	-	**PN-EN 61000-6-1**
	-	**PN-EN 61000-6-3**

TECHNICAL DESCRIPTION

Each of the converter has individual address so 254 devices can operate in one line. The converter has SLAVE function (it answers on requests) and uses MODBUS-RTU transmission protocol.

Each char has 1 star bit, 8 data bits and 1 stop bit.

Shorting RES switch turns on factory-set operation of the converter, which enables changing device's address and transmission speed.

Inputs/outputs, transmission and power supply circuits are mutually separated from each other

Factory-set settings of the converter:
- device address = **127 (Ø7F hex)**
- transmission speed = **2 (9600b/s)**

To program transmission parameters:
- set **RES** jumper to "ON" (it switches transmission parameters to factor-set parameters)
- program desired device's address and transmission speed
- set **RES** jumper to "OFF"

Factory-new converter without RES jumper has transmission speed set to 19200bd and address = 01.

Setting switcher RS-TER to "ON" causes closing transmission line with terminator 300 Ω.

List of transmission messages:

[01] – read state of bistate outputs
[02] – read bistate inputs
[03] – read configure registers
[04] – read measuring inputs
[05] – clear one bistate output
[06] – write configure register

Negative responses:
The converter response negatively on MASTER's request when:
- Illegal register address – error code **02**
- Illegal data value – error code **03**

Device does not answer when CRC error or illegal function code.

REGISTERS DECRIPTION
The converter has per each channel: 8 registers of bistate outputs, 8 registers on bistate inputs, 4 registers of measuring analog inputs and 4 main configure registers, 4 configure registers and 2 small adjusting registers.

MEASUREMENT REGISTERS channel 1:

Address	Index	Variable type	Description
00H	01	integer (2 bytes)	**AI** – measurement from A/C converter
01H	02	integer (2 bytes)	**AIF** – filtered measurement
02H	03	integer (2 bytes)	**AIFL** – linearizes measurement
03H	04	integer (2 bytes)	**AIFLS** – scaled measurement

Address and indexes of next channels:

	Address	Index
Channel 2	04H	05
Channel 3	08H	09
Channel 4	0CH	13
Channel 5	10H	17
Channel 6	14H	21
Channel 7	18H	25
Channel 8	1CH	29

Format of the measurements for registers 1, 2, 3 (integer 14 bits) is as follows:

Measurement value		Representation	
		DEC	HEX
0 V	0mA	0	0H
2 V	4mA	3 276	C CCH
10 V	20mA	16 384	40 00H
max 11 V	max 22mA	18 022	46 66H

Similarly for other ranges.

CONFIGURE REGISTERS:

Address	Index	Description	Range
00H	01	**NRS** – address of the converter	1 … 254
01H	02	**BAUD** – transmission speed	0 … 6
02H	03	Device identifier	0703H
03H	04	Device version	
04…07H	05…08	Parameters of channel 1*	
08…0BH	09…12	Parameters of channel 2*	
0C…0FH	13…16	Parameters of channel 3*	
10…13H	17…20	Parameters of channel 4*	
14…17H	21…24	Parameters of channel 5*	
18…1BH	25…28	Parameters of channel 6*	
1C…1FH	29…32	Parameters of channel 7*	
20…23H	33…36	Parameters of channel 8*	
100H..101H	257..258	Small adjust for channel 1	
104H..105H	261..262	Small adjust for channel 2	
…	…	…	
11C...11DH	285..286	Small adjust for channel 8	

* specified for each small-board

NRS – specify address of the slave.

Transmission speed code **BAUD:**	
code	**speed**
0	2400 bd
1	4800 bd
2	9600 bd
3	19200 bd
4	38400 bd
5	57600 bd
6	115 200 bd

Device identifier and version are read-only values.

HOW TO ORDER:
Converter
 As 703 - channel 1, 2 - mini-board type (range) - channel 3, 4 - mini-board type (range) - channel 5, 6 - mini-board type (range) - channel 7, 8 - mini-board type (range)
Order example:
1). Converter **As 703 – channels 1…8 inputs Pt100 three-wire 0…200 °C**
2). Converter **As 703 – channels 1,2 inputs Pt100 three-wire 0…100ºC – channels 3,4 Pt100 three-wire 0…200ºC - channels 5,6 inputs 4…20mA – channels 7,8 4…20mA**

CONVERTER type As703:
MINI-BOARD input Pt100 three- and four-wire
MINI-BOARD input 0…10V
MINI-BOARD input 4…20mA / two-wire transmitter

ADDITION OF BASIC TECHNICAL PARAMETERS:

Input signals:	-	voltage 0...10V / 100kΩ
		current 0..20mA,4..20mA/50Ω
		sensor Pt100, Ni100
		or other as requested
Supply for two-wire transmitters	-	24V/22mA
Class	-	0,1 %
Resolution	-	(14 bits) 0,006 %
Temperature drift	-	0,006 %/°C

REGISTER DESCRIPTION OF THE MINI-BOARD

MEASUREMENT REGISTERS:
The same as in the main datasheet.

Address	Index	Variable type	Description
4*N+00H	4*N+01	integer (2 bytes)	AI – measurement from A/C converter
4*N+01H	4*N+02	integer (2 bytes)	AIF – filtered measurement
4*N+02H	4*N+03	integer (2 bytes)	AIFL – linearizes measurement
4*N+03H	4*N+04	integer (2 bytes)	AIFLS – scaled measurement

N = channel number [0…7]

CONFIGURE REGISTERS
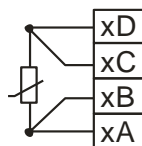4 configure registers and 2 registers for small adjusting.

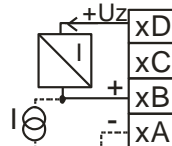| Address	Index	Variable type	Description
4*N+04H	4*N+05	word (2 bytes)	TYPE – type of mini-board
4*N+05H	4*N+06	integer (2 bytes)	Z0 – lower range of scaled measurement
4*N+06H	4*N+07	integer (2 bytes)	Z100 – upper range of scaled measurement
4*N+07H	4*N+08	integer (2 bytes)	WF – filtration coefficient
4*N+100H	4*N+257	integer (2 bytes)	FtZ0 – bottom of the range small adjust
4*N+101H	4*N+258	integer (2 bytes)	FtZ100 – top of the range small adjust

N = channel number [0…7]

TYPE – code of mini-boards:
0101H – 4…20 mA and two-wire transmitter
0201H – 0…10 V
03xxH - Pt100 three-wire
04xxH - Pt100 four-wire
  xx = 01 for 0…100 °C
  xx = 02 for 0…200 °C
  xx = 03 for 0…300 °C
  xx = 04 for 0…400 °C
  xx = 05 for 0…50 °C
  xx = 06 for -50…+50 ºC

Z0 and Z100:
- bottom and top range of signal recalculation AIFLS.

WF:

Time constant of digital filters:	
WF code	Time constant
0	no filtration
1	0,2 sec.
2	0,5 sec.
3	1 sec.
4	2 sec.
5	4 sec.
6	8 sec.
7	16 sec.

FtZ0 and FtZ100
Entering value from range +/-500 will cause adjusting bottom and top of the range of +/-5% (one unit is about 0.01%). Exceeding range of +/-511 is considered as error and value of 0 is taken.

HOW TO CONNECT INPUT SIGNALS

Pt100 trzyprzewodowe   Pt100 czteroprzewodowe   4...20mA   0...10V
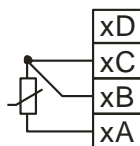
x - numer kanału

CONVERTER type As703:
MINI-BOARD input thermocouple

ADDITION OF BASIC TECHNICAL PARAMETERS:

Input signal:	-	Voltage 0…20 mV
		0…60 mV
	Thermocouple:	
		K, J, N, L, S and others
		ranges acc. to the order
Class	-	0,2 %
Cold endings compensation	-	±2 °C
Resolution	-	(14 bits) 0,006 %
Temperature drift		0,006 %/°C

REGISTER DESCRIPTION OF THE MINI-BOARD

MEASUREMENT REGISTERS:
Not the same as in the main datasheet.

Address	Index	Variable type	Description
4*N+00H	**4*N**+01	integer (2 bytes)	**AI** – thermocouple voltage measurement from A/C converter (14 bits)
4*N+01H	**4*N**+02	integer (2 bytes)	**To** – cold endings voltage compensation in AI scale
4*N+02H	**4*N**+03	integer (2 bytes)	**AIFL** – measurement with cold endings compensation, filtration and linearization included
4*N+03H	**4*N**+04	integer (2 bytes)	**AIFLS** – scaled measurement

N = channel number [0…7]

HOW TO CONNECT INPUT SIGNALS
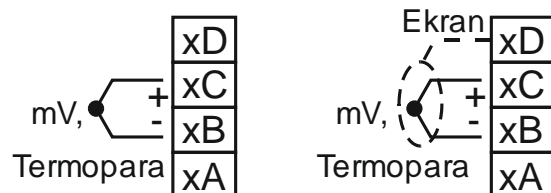
x - numer kanału

CONFIGURE REGISTERS
4 configure registers and 2 registers for small adjusting.

Address	Index	Variable type	Description
4*N+04H	**4*N**+05	word (2 bytes)	**TYPE** – type of mini-board
4*N+05H	**4*N**+06	integer (2 bytes)	**Z0** – lower range of scaled measurement
4*N+06H	**4*N**+07	integer (2 bytes)	**Z100** – upper range of scaled measurement
4*N+07H	**4*N**+08	integer (2 bytes)	**WF** – filtration coefficient
4*N+100H	**4*N**+257	integer (2 bytes)	**FtZ0** – bottom of the range small adjust
4*N+101H	**4*N**+258	integer (2 bytes)	**FtZ100** – top of the range small adjust

N = channel number [0…7]

TYP – code of mini-boards:
05xxH – thermocouple
    xx = 01 for K 0…1000 °C
    xx = 02 for K 0…650 °C
    xx = 03 for other range
Z0 and **Z100**:
- bottom and top range of signal recalculation **AIFLS.**

WF:

Time constant of digital filters:	
WF code	**Time constant**
0	no filtration
1	0,2 sec.
2	0,5 sec.
3	1 sec.
4	2 sec.
5	4 sec.
6	8 sec.
7	16 sec.

FtZ0 and FtZ100
Entering value from range **+/-500** will cause adjusting bottom and top of the range of **+/-5%** (one unit is about 0.01%). Exceeding range of +/-511 is considered as error and value of 0 is taken.

CONVERTER   type As703:
MINI-BOARD input binary

ADDITION OF BASIC TECHNICAL PARAMETERS:

Input parameters   logic "1" for U> 8 Vdc
                               logic "0" for U< 4 Vdc

REGISTER DESCRIPTION OF THE MINI-BOARD

MEASUREMENT REGISTERS:
Not the same as in the main datasheet.
   Reading with message [02].

Channel	Address	Variable type	Description
1	**01**	binary (3 bits)	01 - input 1 02 - input 2 03 - input 3
2	**09**	binary (3 bits)	09 - input 1 10 - input 2 11 - input 3
3	**17**	binary (3 bits)	17 - input 1 18 - input 2 19 - input 3
4	**25**	binary (3 bits)	25 - input 1 26 - input 2 27 - input 3
5	**33**	binary (3 bits)	33 - input 1 34 - input 2 35 - input 3
6	**41**	binary (3 bits)	41 - input 1 42 - input 2 43 - input 3
7	**49**	binary (3 bits)	49 - input 1 50 - input 2 51 - input 3
8	**57**	binary (3 bits)	57 - input 1 58 - input 2 59 - input 3

Input states can also be read with message [04].
Registers are accessible with address:
(01), (05) (09) (13) (17) (21) (25) (29)

In the order please specify:
   - 2 binary passive inputs, galvanically separated
   - 3 binary passive inputs, without separation
   - 3 binary active input (OC can be connected to
         the inputs), without separation

a).
 2 passive inputs with galvanic separation (active voltage signal is necessary)
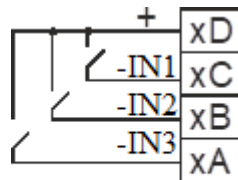
IN1 + xD
    - xC
IN3 + xB
    - xA
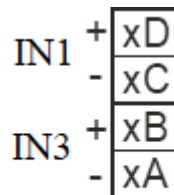
x - channel number

b).
3 inputs without galvanic separation
(common "-" terminal, active voltage signal is necessary)

+IN1 xD
+IN2 xC
+IN3 xB
  - xA
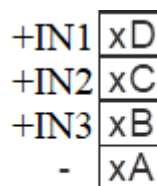
x - channel number

c).
3 inputs without galvanic separation type closing contact
(common "+" terminal, signal type OC or contact is expected)

+   xD
-IN1 xC
-IN2 xB
-IN3 xA

x - channel number

HOW TO CONNECT INPUT SIGNALS

CONVERTER type As703:
MINI-BOARD output binary

ADDITION OF BASIC TECHNICAL PARAMETERS:

Output signals:	-	2 or 3 outputs type OC or other if requested
Output OC parameters	-	Umax <60Vdc Imax < 100mA

In the order please specify:
- **2 binary outputs with galvanic separation**
- **3 binary outputs without separation**

REGISTER DESCRIPTION OF THE MINI-BOARD

MEASUREMENT REGISTERS:
Not the same as in the main datasheet.
Reading with message [01].

Channel	Address	Variable type	Description
1	**01**	binary (3 bits)	**01 - output 1** **02 - output 2** **03 - output 3**
2	**09**	binary (3 bits)	**09 - output 1** **10 - output 2** **11 - output 3**
3	**17**	binary (3 bits)	**17 - output 1** **18 - output 2** **19 - output 3**
4	**25**	binary (3 bits)	**25 - output 1** **26 - output 2** **27 - output 3**
5	**33**	binary (3 bits)	**33 - output 1** **34 - output 2** **35 - output 3**
6	**41**	binary (3 bits)	**41 - output 1** **42 - output 2** **43 - output 3**
7	**49**	binary (3 bits)	**19 - output 1** **50 - output 2** **51 - output 3**
8	**57**	binary (3 bits)	**57 - output 1** **58 - output 2** **59 - output 3**

HOW TO CONNECT OUTPUT SIGNALS

3 output without separation (common "-" terminal)   **2 outputs with galvanic separation**
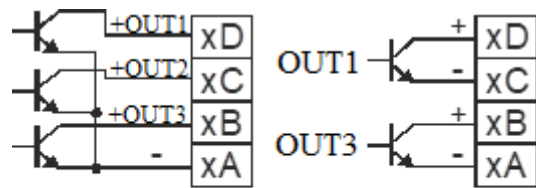
x - channel number

Writing is done with message [05].

Address	Index	Variable type	Description
8*N+01H	**8*N+01**	bit	**output 1**
8*N+02H	**8*N+02**	bit	**output 2**
8*N+03H	**8*N+03**	bit	**output 3**

N = channel number [0…7]

Output states can also be read with message [03] and change with message [06].
Registers are accessible with address:
(06), (10) (14) (18) (22) (26) (30) (34)