



RTU analog input module TELEM-AI12-T

User Manual

Martem AS
2017

Preface

This document, User Manual for RTU Analog Input Module TELEM-AI12-T, provides a general technical description of the module, its configuration and use. Current version of this manual is applicable to the RTU versions marked as AI-D-xxx.

Although we have carefully checked the contents of this publication for conformity with the hardware and software described, we cannot guarantee complete conformity since errors cannot be excluded. The information provided in this manual is checked at regular intervals and any corrections that might become necessary are included in the next releases. Any suggestions for improvement are welcome.

The RTU Digital Input Module TELEM-AI12-T has been designed and manufactured according to the quality principles of ISO 9001.

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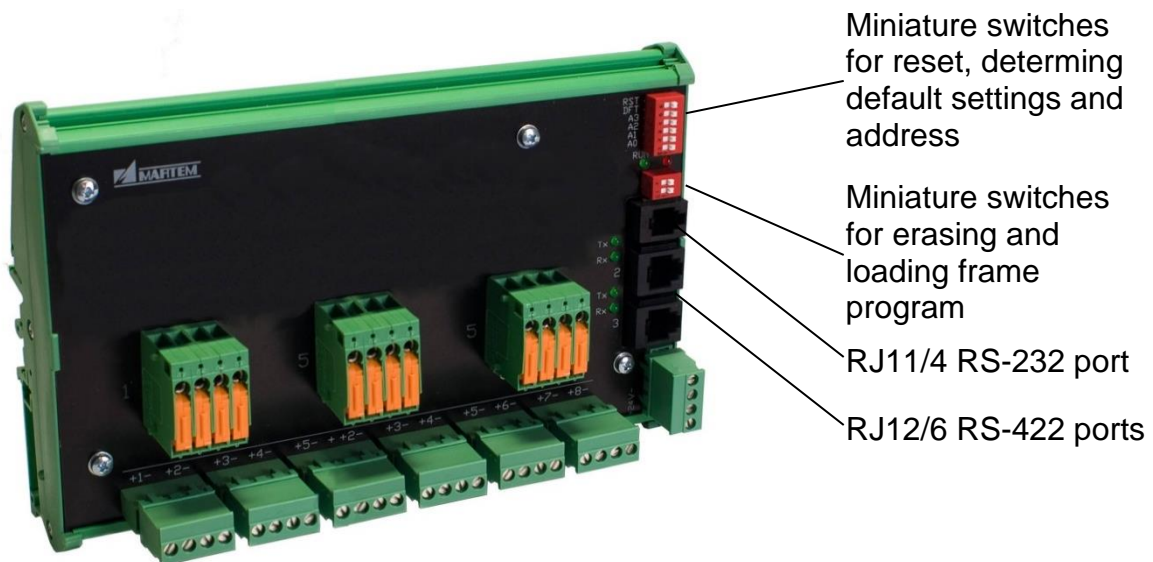
1. Application

TELEM-AI12-T analog input module is used for analog info acquisition and data exchange with higher level devices or systems. Its functionality allows it to be flexibly used for distributed process automation in systems to measure analog values using different transducers, data processing and acquisition where excellent noise immunity with respect to environmental and electromagnetic influences is important. It may be used as a standalone device or in a daisy chain connection with other modules.

2. Construction

The mechanical design is based on a plastic box that can be readily mounted on 35-mm rails.

The module is based on 32 ARM CPU. Interfaces to other equipment are RS-232 or RS-422. Data exchange protocol IEC 60870-5-1-101



3. Features

- Two level input filters
- Binary signals are recorded with a time resolution of 1 ms
- Measurements are periodically saved
- Online leased line or offline dial-up mode operation, data GSM communication request by an event in substation or by the remote control center
- Configuration / parameterization with IEC protocol at the same line with data communication
- Daisy chain master – slave connection for up to 15 modules using RS 422 interface
- Self diagnostics and supervision simultaneously with data acquisition
- Quick value changes can be registered with time tags (min and max value)
- Periodical time-tagged measurements
- Onboard knife disconnectors for inputs

4. Technical Data

Number of differential independently configurable analog inputs	12
Input ranges	0...5; 0...10; 0...20; 4...20; +/-5; +/-10; +/-20 mA
Measurement accuracy	0.1% (automatically scaled)
Resolution	16 bit
Scanning period	1 ms
Form of transfer measured values	normalized
Buffer size for each input	126 values

Power requirements

Supply voltage	20-72 (Optional 12-32) V DC, 1W
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Installation, terminals and environment

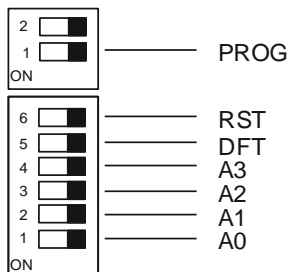
Enclosure (wxhxd)	250 x 120 x 60
Weight	500 g
Mountable	DIN 35
Cross section of wires for signal	Max. 2,5 mm ²
Cross section of wires for power	Max. 2,5 mm ²
Plug connector for communication	RJ10; RJ12
Over voltage protection	IEC-60255-4, 5 kV pulse protection IEC-60255-5, 2 kV DC
Ambient temperature in operation	-30...+70°C

Disturbance

Emission	EN-55022A
Static discharge	EN-61000-4-2
Fast transients	EN-61000-4-4
Surge	EN-6100-4-5
Conducted HF field	EN-61000-4-6
Emitted HF field	EN-61000-4-3

5. Mode Switches and Indication Led

5.1. Mode Switches



PROG – ON – load a new frame program

RST – ON – reset the device

DFT – ON – restores default setup

A0 – A3 – determines the address of the module

5.2. Indication LED

Indication LEDs display the state of the device:

ALERT – fired, error state or no connection with upper level device

RUN – blinking fire/unfired 1/1, normal operation and synchronized by an internal clock,

RUN – blinking fired/unfired 1/9, normal operation and synchronized by a gateway.

SIGNAL STATE – green fired, signal is activated, internal power supply

SIGNAL STATE – red fired, signal is activated, external power supply

5.3. Setting an address

A0	A1	A2	A3	Address
on	off	off	off	1
off	on	off	off	2
on	on	off	off	3
off	off	on	off	4
on	off	on	off	5
off	on	on	off	6
on	on	on	off	7
off	off	off	on	8
on	off	off	on	9
off	on	off	on	10
on	on	off	on	11
off	off	on	on	12
on	off	on	on	13
off	on	on	on	14
on	on	on	on	15
off	off	off	off	16

6. Configuration

TELEM-AI12-T is configured using **configuration tool TELEM-GWS**. All 12 analog inputs are configured independently.

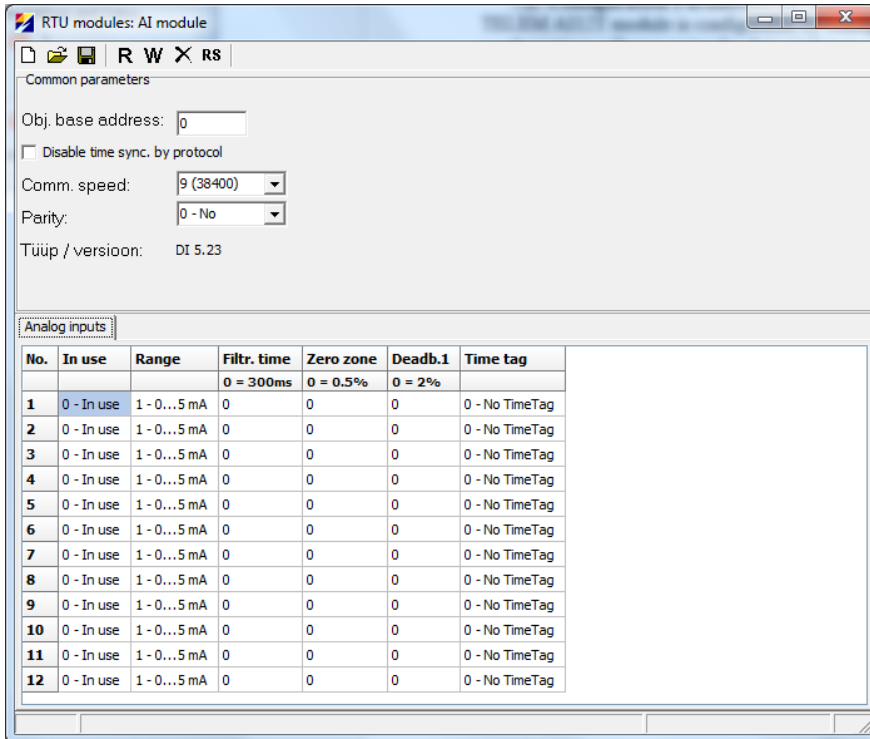
6.1. Configurable Parameters and General Settings of Communication Ports

- Transmission rate 200...38400 bit/s
- Communication mode asynchronous, data bits 8, parity N, stop bits 1
- Communication protocol IEC60870-5-101 slave/master, unbalanced
- Link address length 1 byte
- ASDU address length 2 byte
- Object address length 2 byte
- Time synchronization protocol ASCII (Motorola), device TLM-
- Communication interface selectable RS-232, RS-422
- Communication interface isolation optically to 2,5kV RMS

6.2. Configuration Parameters for Analog inputs

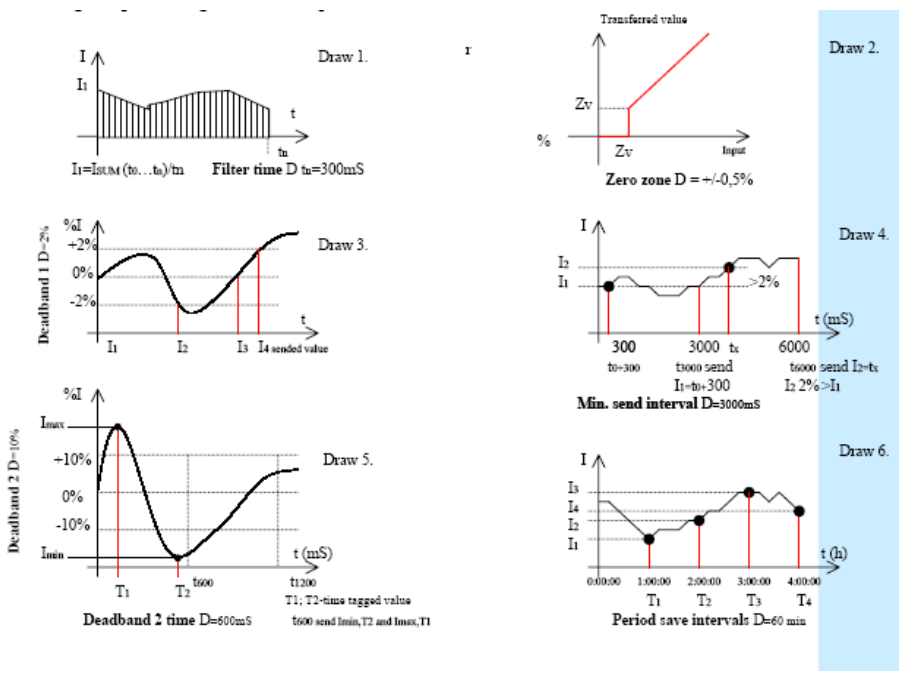
TELEM AI12T module is configurable by **configuration tool TELEM-GWS** or by other configuration software using the data exchange protocol IEC60870-5-101. Telem-2000 RTU configuration software runs under Windows 95 or later operating systems on any standard PC, communicates via COM interface and performs the following principal functions:

- Configuration / parameterization of RTU
- Back up of RTU configuration data

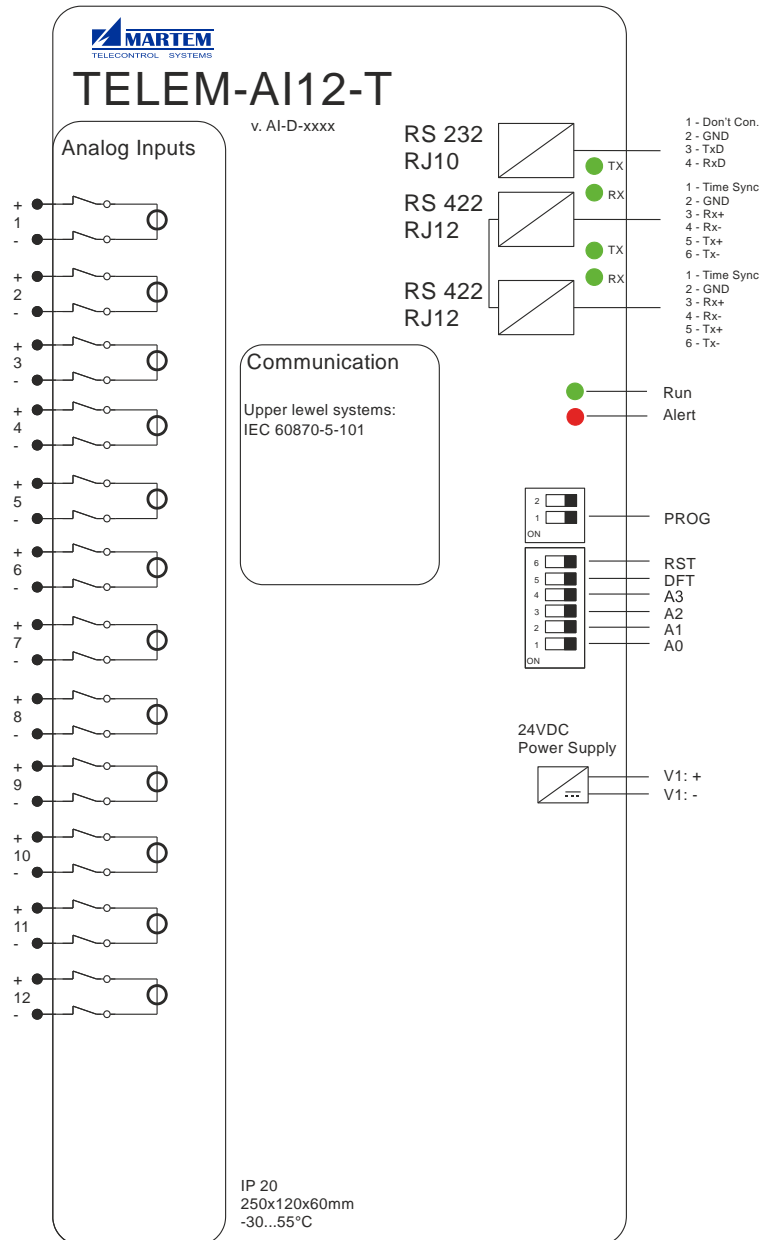


Parameter	Value	Default value
1. Communication speed	200 – 38400 bps	9600
2. Link Address	1-15	1
3. ASDU address	1-15	1
4. Object's base address	0-65500	0
5. Communication mode	Online	Online
6. Type of periodical analog measurements [On Spont. per. sends time-tagged values after specified interval (7.2.9). On Request per. collects the time-tagged measurements and sends them only on request.]	Spont. per. Request per.	Spont.per.
8. Buffer depth for each time-tagged input [Increases if some inputs are not in use , 12 I/O- depth is 20]		20
9. Referents voltage correction [factory setting ex. -40 ‰]		0
10. Type/version [Loaded module program version (ex. A30.4)]		

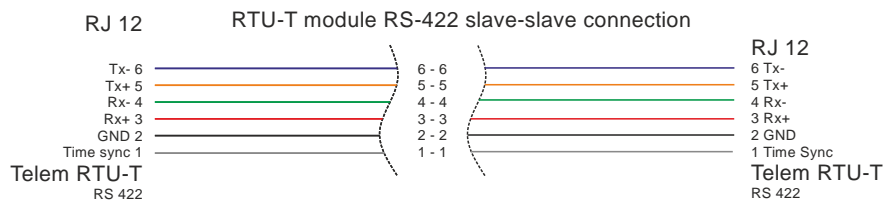
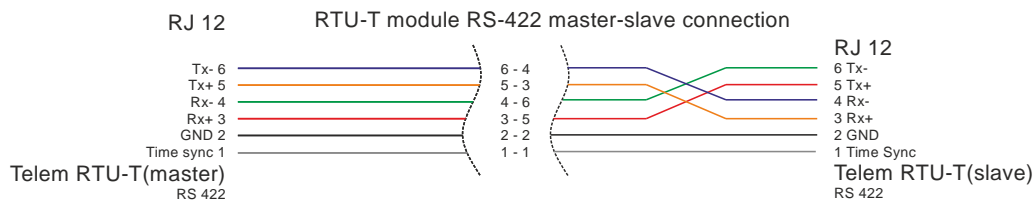
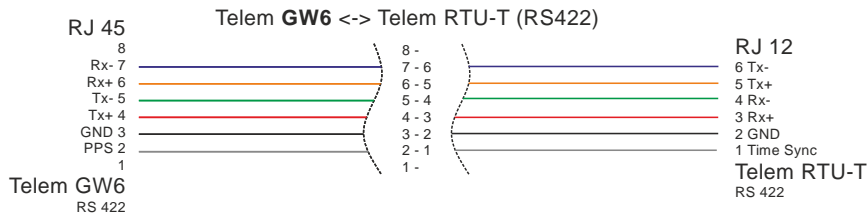
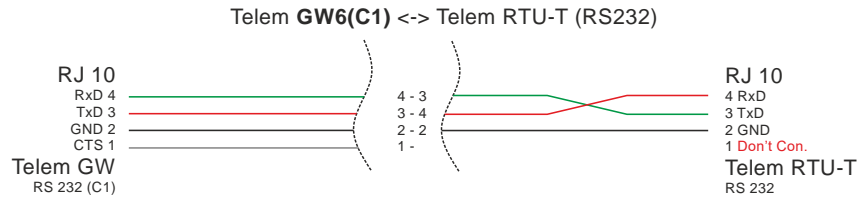
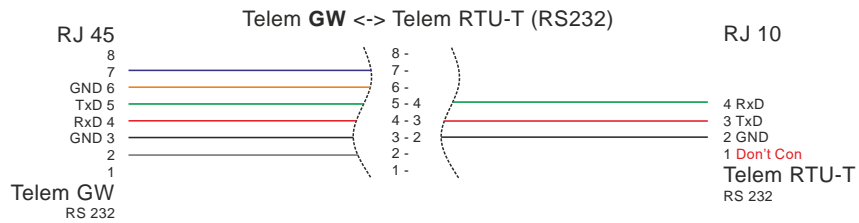
Parameter	Value	Default value
1. In use	Yes No	Yes
2. Input signal range	0...5	0...10; 0...20; +/-5 mA; +/-5; +/-10; +/-20; 4...20mA
3. Filtration time [Determines the averaging time. Samples are taken with 1 ms time resolution. Drawing 1]	1- 65535 ms	300 ms (0)
4. Zero zone [If the value in this range is around zero then it is transferred as zero. Drawing 2.]	0,01- 100%	0,5 % (0)
5. Dead Band 1 [for events without a time tag. Drawing 3]	0,01- 100%	2 % (0)
6. Min. interval [Min. interval for events. Drawing 4]		
7. Time interval for a periodical time-tagged event and the tagged values (p. 7.1.6) [Drawing 6]	1- 65535 sec.	3600 sec.(0)



7. Connection to signal lines



8. Communication Cables



9. Loading Frame program

For loading new frame program two files:

- AI_SerialDownload_Firmware.bat
- ai_XXX.bin

and a program:

- sflash

are needed.

Place those files in a folder

All of those files are provided by Martem AS, when needed.

Step 1

Modify contents of AI_SerialDownload_Firmware.bat

```
@echo off
```

```
sflash.exe ai_XXX.bin -s 16 -p 0x2800 -c 8 -b 115200 -d
```

```
pause
```

Define **ai_XXX**.bin file to be used in the new program and set **com port** used by PC.

Step 2

Create connection between PC and Telem AI-12T

Step 3

Make necessary dip switch changes and run **AI_SerialDownload_Firmware.bat** in following order:

1. PROG on
2. RST on
3. RST off
4. run DI_SerialDownload_Firmware.bat
5. wait until firmware update is finished
6. RST on
7. PROG off
8. RST off

10. Calibration

TELEM-AI12-T is calibrated by Martem AS after manufacturing. If there is a necessity of calibration at site, it can be done using **configuration tool TELEM-GWS**. In that case the next steps should be performed:

- TELEM-AI12-T should be powered and connected to the Data Concentrator.
- **To be confident in the correct result of calibration make sure, that all connected analog inputs are unconnected. It can be easily done by unplugging plug-in-connectors.**
- Connect to the AI module with **configuration tool TELEM-GWS** using RS-232 serial connection (direct connection to the device) or RTU-T connection redirection from Data Concentrator via IEC 60870-104 protocol. See **TELEM-GWS** manual for further info. Check if the module firmware version is AI 6.02 or above. If it is not, then update is necessary.
 - Connect to the device, read the configuration by pressing „R“.
 - For the benefit of viewing any small changes the deadband should be changed to smaller value, e.g. 0,01%. Default is 0=2%.
 - Write the configuration by pressing „W“ and close the window.

The screenshot shows the 'RTU modules: AI module' configuration window. It has a toolbar with icons for file operations and buttons labeled 'R', 'W', 'X', and 'RS'. The 'Common parameters' section includes:

- Obj. base address: 0
- Comm. speed: 0 - 9600
- Parity: 0 - No
- Tüüp / versioon: AI 6.02

The 'Analog inputs' section contains a table with 12 rows. The first row shows default values for filter time, zero zone, and deadband. The rest of the rows show that all inputs are currently 'In use' with a range of 0 to +5 mA, a filter time of 0, a zero zone of 0, a deadband of 0,01, and no time tag.

No.	In use	Range	Filtr. time	Zero zone	Deadb.1	Time tag
			0 = 300ms	0 = 0.5%	0 = 2%	
1	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
2	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
3	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
4	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
5	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
6	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
7	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
8	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
9	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
10	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
11	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag
12	0 - In use	0 - +- 5 mA	0	0	0,01	0 - No TimeTag

- Read configuration from Data Concentrator using **configuration tool TELEM-GWS**.
- In Data Concentrator configuration open Objects table and create additional single direct execute control command (DO) into TELEM-AI12-T objects list with downlink address 401. Change the DB also to 0.01%.

Dev. nr.	Obj. nr.	Type	SubType ^	SubType v	Invert	Fn. Code	Info nr.	Index	Obj. Addr. v	61850 DS	61850 v	Obj. Addr. ^	Comment	DB, %Fs
1	1	DI	Single	Normal	No							65	AI12T	
1	2	DO		SN D.Ex INH	No				401			120	AI12T	
1	3	AI	Normalized	0					1			121	AI1	0,01
1	4	AI	Normalized	0					2			122	AI2	0,01
1	5	AI	Normalized	0					3			123	AI3	0,01
1	6	AI	Normalized	0					4			124	AI4	0,01
1	7	AI	Normalized	0					5			125	AI5	0,01
1	8	AI	Normalized	0					6			126	AI6	0,01
1	9	AI	Normalized	0					7			127	AI7	0,01
1	10	AI	Normalized	0					8			128	AI8	0,01
1	11	AI	Normalized	0					9			129	AI9	0,01
1	12	AI	Normalized	0					10			130	AI10	0,01
1	13	AI	Normalized	0					11			131	AI11	0,01
1	14	AI	Normalized	0					12			132	AI12	0,01

- Write the configuration to RTU by pressing „W“
- **To be confident in the correct result of calibration make sure, that all connected analog inputs are unconnected. It can be easily done by unplugging plug-in-connectors.**
- Use the Data Concentrator web interface and perform control „OFF“. Web interface should return positive execution result. Approximate time of calibration is 15s.
- After receiving 0 in all device measurements calibration can be considered as successful.
- Return back to the **configuration tool TELEM-GWS** Data Concentrator configuration and remove additional DO object from TELEM-AI12-T device object list by pressing „-“ button. Also change back the DB values if it is needed both in the device and Data Concentrator configurations.
- Write the configuration into Data Concentrator.

In case of any problem with calibration of TELEM-AI12-T, please, contact Martem AS.

11. Revision History

Rev 5/2015 Manual for TELEM-AI12-T