RTU513 Remote Terminal Unit Datasheet
Analog Input 513AIR01

Application

The 513AIR01 board records up to eight analog measured values.

The module 513AIR01 is able to process the following types of signals:

- Analog measured values (AMI)

- Measured floating point information (MFI)

Following measurement ranges can be configured:

- ±2mA

- ± 5 mA

- ±10mA

- ±20mA

- ± 40 mA

- ± 2 V DC

- 0... 20 V DC

Other effective ranges and live zero signals become generated out of these ranges through conversion of the communication unit (CMU).

Characteristic

Analog inputs

Basic signal checks and cyclic processing functions are already be done locally in order to unburden the communication unit. The module transmits relevant changes as event via the RTU I/O bus.

The 8 differential inputs are not galvanic isolated against the power supply.

The differential inputs are protected against static and dynamic over-voltages by a protection circuit. A low-pass filter suppresses unwanted frequency components.

The internal high resolution of the AD converter allows to scan all measuring ranges with the same resolution. An additional measurement channel is used for automatic zero calibration. This compensates the longterm drift of the components.

Characteristic

For elimination of tolerances a calibration is done during production. The synchronization of the scan cycle with the line frequency is used to increase the line frequency interference suppression of the DC input signal.

Frequency	Conversion time per channel	Scan cycle time (same for all channels)
60Hz	54 ms	486 ms
50Hz	54 ms	486 ms
16.7Hz	155 ms	1395 ms

Power supply input

The required power for the module is supplied via the RTU513 backplane.

Figure 1: Block diagram Analog input board 513AIR01

I/O controller (IOC)

The micro-controller on the module processes all time critical tasks of the parameterized processing functions. Moreover it carries out the interactive communication with the RTU I/O bus. All configuration data and processing parameters are loaded by the communication unit via the RTU I/O bus. The module is equipped with a serial interface to the RTU513 I/O bus on the backplane.

The analog input unit can execute the following processing functions on the measured values:

• Scan cycle and line frequency interference suppression

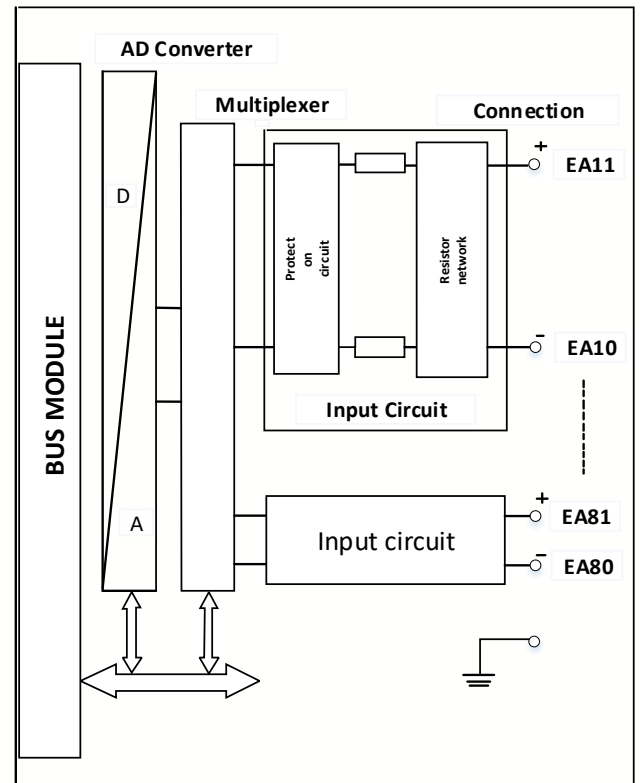• Zero value supervision and switching detection

• Smoothing

Characteristic

• Threshold value monitoring on absolute value or with accumulation

• Periodic transmission and background cycles

During initialization and operation the module carries out a number of tests. If a fault occurs it is reported to the communication unit. All fault conditions impairing the function of the module are displayed as common fault signal by a red LED. A failure of the module is detected by the communication unit.

Processing functions

The micro controller EAP (Ein-/ Ausgabe -Prozessor / Input- output processor) controls the A/D converter and reads the digitized analog measured value. The configuration parameters are loaded by the CMU (communication unit). The used processing functions of the 513AIR01 are defined by the RTU513.

In general the 513AIR01 board can process the following functions per input channel:

- Zero value supervision

- Switching detection

- Smoothing

- Cyclic transmission to the CMU independent from threshold supervision

- Threshold supervision

Input signal conversion

The A/D converter operates by the sigma-delta method. The sigma-delta method allows a high suppression of line-frequency and line-harmonics interference voltages. This is still specified by a deviation from the nominal line-frequency of up to ±10 %. On this occasion the suppression is still > 45 dB.

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Input signal conversion

The 513AIR01 transmits the measured value with 12 bit plus sign to the CMU. The scaling to the telecontrol transmission protocol

With a ninth internal measuring channel the 513AIR01 does an automatic zero calibration at each cycle. The A/D converter uses the result as a rating factor.

Settings

Input signal range

A measuring range can be differently configured for each of the eight channels. Therefore the configuration has to be done for all eight channels.

For each channel:

- the switch registers S1 to S3 AND

- the jumper X5x1

should be configured to the same measuring range. Only if jumper and switch register setting corresponds the 513AIR01 scans and converts the measuring value correct.

The configuration of jumper X5x1 is shown in Table 1. Hereby is x the channel to be configured. Table 2 shows the corresponding settings for switch register S1 to S3 and the corresponding position of jumper X5x1.For channel 5 = 20 mA as an example it should be set:

- X5x1 jumper 5 = position 1-2
- S3-5 = OFF
- S2-5 = ON
- S1-5 = ON

The firmware of the 513AIR01 uses the position of switch register S1 to S3 for the scaling and calculation to the nominal measuring range. In addition it identifies by the position which rating value it should use.

Settings

| Pos.	Xx1	Measuring range
1	1 2 3	20 mA 40 mA 10 mA
2	1 2 3	2 mA 5 mA
3	1 2 3	2 V 20 V
x = 1 to 8 for the respective channel		

Table 1: configuration jumper Xx1
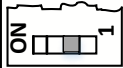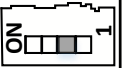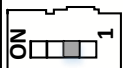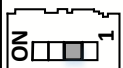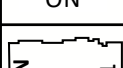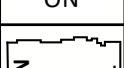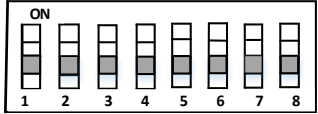
Measuring range	S3-x	S2-x	S1-x	X5x1
±2mA	OFF	OFF	OFF	1 2 3
±5mA	OFF	OFF	ON	1 2 3
±10mA	OFF	ON	OFF	1 2 3
±20mA	OFF	ON	ON	1 2 3
±40mA	ON	OFF	OFF	1 2 3
±2V	ON	OFF	ON	1 2 3
0...20V	ON	ON	OFF	1 2 3
Not used	ON	ON	ON	1 2 3

S1
S2
S3
ON
OFF

ON
1 2 3 4 5 6 7 8

X5x1
1 2 3

X=1 to 8= input channel

The Configuration of S1-X to S3-X and X5x1 should Correspond to each other

Table 2: configuration S1 to S3 and X5x1

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Settings

Configuration of line-frequency

Beside the information about the configured measuring range the information about the line-frequency is requested for the A/ D-conversion. The configured line-frequency is valid for all eight channels. Therefore jumper X401 has to be configured.

Frequency	Conversion time per channel	Scan cycle time (same for all channels)
60Hz	54 ms	486 ms
50Hz	54 ms	486 ms
16.7Hz	155 ms	1395 ms
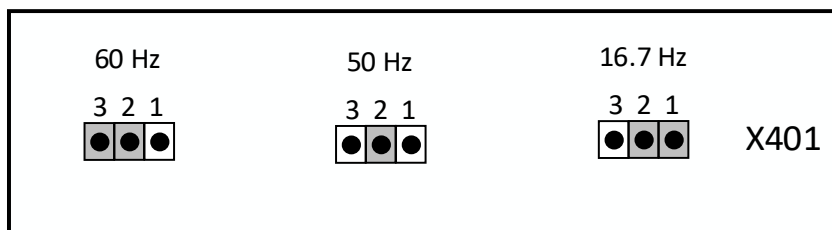
Figure 3: Configuration of line-frequency

Factory calibration

An on-site calibration of the A/D converter is not necessary. The 513AIR01 will be calibrated for all channels and measuring ranges at the factory. During the calibration the firmware calculates a rating value per measuring range and channel and stores this rating value in an EEPROM. The rating values are protected by a checksum.

The 513AIR01 checks the checksum of all rating values during initialization of the board. The 513AIR01 does not start operation if one or more of these checksum are wrong. The 513AIR01 stays passive, that means the CMU does not detect the board and indicates it with "board out of operation". The LED ERR flashes in addition with approx. 3 Hz.

Signaling

The board monitors and checks its functionality as well as the dialog via the peripheral bus.
Detected errors are indicated and/or transmitted by the board:

- by the red LED ERR on the front plate

Settings

- by diagnostic messages

- in the process signal messages (signal status)

The LED ERR indicates board errors, peripheral bus errors and/ or A/D converter failures.

The LED ERR indicates:

- board runs initialization procedure

- board has detected a memory error (RAM or EPROM)

- micro controller faulty

- no dialog via the peripheral bus for at least two minutes. The board is not polled by the PBP (Peripheral Bus Processor) of CMU.

- A/D converter faulty

- flashing with 3 Hz: rating values in the EEPROM faulty

Each configured measuring value will be indicated faulty by the CMU for the listed errors.
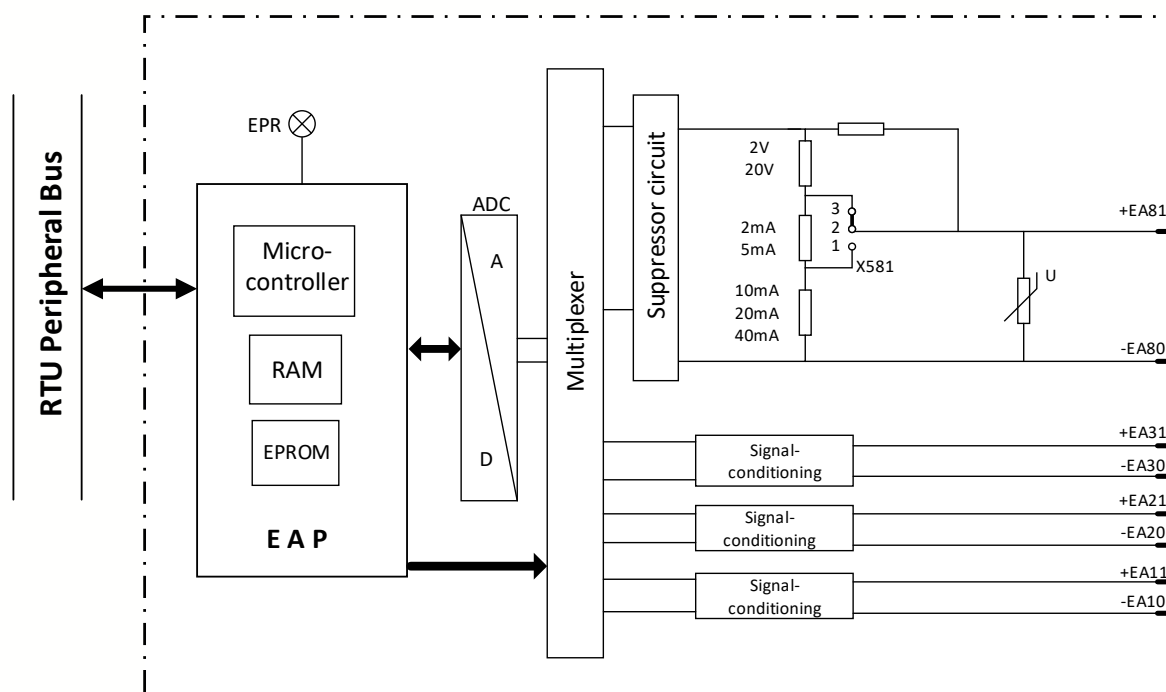
Fig.2: Logic block diagram

Setting
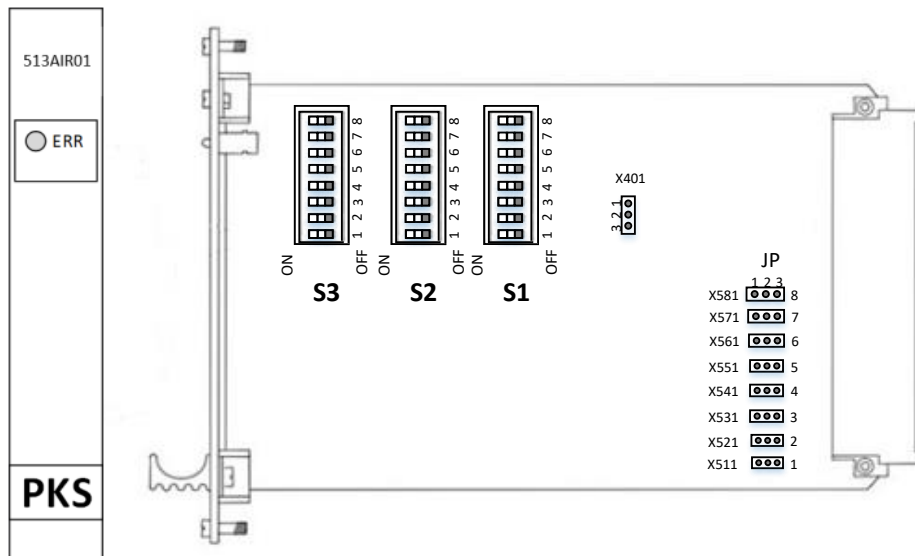
Fig. 3: Board layout with setting positions

WMS10	SMS10 Sub-connector			Signal Identifications	
				Identification	Meaning
1			z32	AI10 –	Analog input 1 -
2		b32		AI11 +	Analog input 1 +
3	d32			AI20 –	Analog input 2 -
4			z30	AI21 +	Analog input 2 +
5		b30		AI30 –	Analog input 3 -
6	d30			AI31 +	Analog input 3 +
7			z28	AI40 –	Analog input 4 -
8		b28		AI41 +	Analog input 4 +
9	d28			AI50 –	Analog input 5 -
10			z26	AI51 +	Analog input 5 +
11		b26		AI60 –	Analog input 6 -
12	d26			AI61 +	Analog input 6 +
13			z24	AI70 –	Analog input 7 -
14		b24		AI71 +	Analog input 7 +
15	d24			AI80 –	Analog input 8 -
16			z22	AI81 +	Analog input 8 +
17					Not used
18		b22			Not used
19	d22				Not used

Table 3: Subrack terminal connection: 513AIR01

Technical data

Analog input channels 513AIR01

Inputs	8 differential inputs
Configurable measuring range	• ± 2 mA • ± 5 mA • ± 10 mA • ± 20 mA • ± 40 mA • ± 2 V DC • 0... 20 V DC
Input impedance	150Ω @ ±2 mA and 5 mA 50Ω @ ±10 to ±40 mA 110 kΩ @ ±2 and 20 V DC
Max. load	80 mA continuous @ ±10 to ±40 mA 40 mA continuous @ ±2 and ±5 mA 38 V/ 0.5 mA @ ±2 and 20V DC
Resolution	12 bit + sign 11 bit + sign @ ±2 V DC
AD converter resolution	16 bit
Accuracy at 25 °C	≤ 0.1 % ≤ 0.2 % @ ±2 V DC
Linearity error at 25 °C	≤ 0.1 %
Temperature drift	≤ 100 ppm/K (0... 70 °C)
Max. common mode input voltage	±150 V DC (electrical limit) ±8 V DC (functional limit)
Max. differential input voltage	± 4 V DC (current input) ± 38 V DC (voltage input)
Common mode rejection	> 70 dB @ 25 °C
Configurable line frequency fN	• 16.7 Hz • 50 Hz • 60 Hz
Line frequency interference suppression	> 100dB @ fN ±2 % > 45 dB @ fN ±10 %

Current consumption for power supplied via RTU513 backplane

5 VDC	75 mA
24 VDC	-

Signaling by LEDs

ERR (red)	Common fault information for the module

Connection type

RTU513 backplane connector	48 pole type F DIN 41612

Environmental conditions

Nominal operating	-25°C... 70°C
temperature range	-40 °C
Start up	+85 °C
Max. operating temperature, max. 96h	EN 60068-2-1, -2-2, -2-14

EN 60068-2-1, -2-2, -2-14

Relative humidity EN 60068-2-30	5 ... 95 % (non condensing)

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Technical data

Immunity test

Electrostatic discharge IEC 61000-4-2	8 kV air / 6 kV contact (level 3) Performance criteria A
Radiated Radio-Frequency Electromagnetic Field IEC 61000-4-3	10 V/m (level 3) Performance criteria A
Electrical Fast Transient Burst IEC 61000-4-4	2 kV (level 3) Performance criteria A
Surge IEC 61000-4-5	2 kV (level 3) Performance criteria A
Conducted Disturbances, induced by Radio-Frequency Fields IEC 61000-4-6	10 V (level 3) Performance criteria A