ULAD 32 - User Guide

PiKRON s.r.o. (http://www.pikron.com)

March 25, 2014

Contents

1 ULAD 32 Converter Features

Technical Specifications of ULAD 32 :

Quantity	Value	Units
External supply voltage	5 to 12	VDC
Max. single unit supply current	100	mA
Max. supply current in power distribution mode	500	mA
Absolute max. analog input voltage	± 15	V
Number of analog inputs (continuous acquisition)	1	
Analog inputs	2	ch.
Sampling frequency - basic rate – optional selectable frequencies	10 5, 10, 20, 40, 80, 160, 320	Hz
Basic input voltage range (gain $\times 1$)	± 10	V
Software selectable gain and range reduction	$\times 1, \times 2, \times 4, \cdots, \times 64, \times 128$	
AD converter resolution for basic rate	≥ 20	bit
Width of input software filter	from 1 to 64 samples	
Number of digital inputs/outputs	4 / 4	
Maximal switched/input voltage	30	VDC
Maximal switched current (one output only)	100 (500)	mA
Active high level output voltage (0.5 mA load)	4.0	VDC
Active source current for TTL high (3.0 VDC)	5.0	mA
Sample valve position/mark detection	Yes	
Communication interface	RS-485	
Protocol	uLan	
Communication baud rate	19200	Baud

2 Setup

ULAD 32 device can be connected to control/acquisition computer by USB cable or through uLan network. To connect ULAD 32 to computer by means of uLan network another ULAD 32, uLan to USB converter or uLan RS-485 card is required to interface uLan RS-485 link to the PC. In the case of direct USB connection, ULAD 32 is powered by computer over USB cable. If multiple ULAD 32 should be connected to one PC then they should be interconnected by uLan cable and only one device connected to the PC. Up to 3 more interconnected devices can be powered through that ULAD 32 device which is connected to the PC if power distributed mode is selected and cables for power distribution is used (typically white cables). If long distance or more devices are used then the power supply adapter has to be used to provide power for other devices. Device can be even switched to USB device disable mode to use USB connection only for power up. Independed power adapter with USB terminal can be used to provide power supply for distant units.

2.1 Configuration switches

ULAD 32 is equipped by two switches. SW1 enables USB device interface. If disabled, computer does not see the device but device can be powered through USB. The SW2 select high current USB mode to receive enough power to distribute it to other interconnected devices.

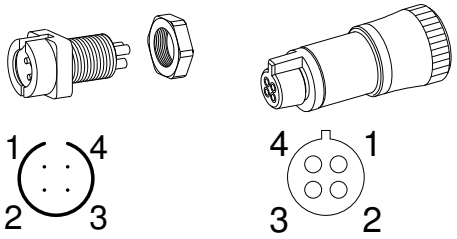
2.2 Device connectors and terminals

The next connectors can be found on the **ULAD 32** device

USB connector used to connect device to a computer or to power device by power adapter with USB terminal

2× uLan connectors these connectors allows to interconnect/daisy-chain multiple devices togeter, allows use device as interface to control other uLan equipped HPLC instruments etc. Binder 719 series connectors are used (09 9765 2004 on ULAD 32, 09 9764 7004 on cable)

1. not connected or optional ground (GND)
2. D- connected to the cable inner wire
3. not connected or optional power supply (VCC)
4. D+ connected to the cable shielding



Screw terminal connector analog input terminals and digital configurable input/output signals

Terminal	Signal	description
1	IN1+	Analog positive signal input
2	IN1-	Analog negative/reference/ground signal input
3	IN2+	Auxiliary analog input positive terminal
4	IN2-	Auxiliary analog input negative terminal
5	GND	Prefered use use analog input ground or shielding
6	I/O3	Digital signal 3 used for input or output
7	I/O2	Digital signal 2
8	I/O1	Digital signal 1
9	I/O0	Digital signal 0 (MARK input for default configuration)
10	GND	Ground terminal for digital inputs and outputs

3 Control and Communication over uLan RS-485 Line

3.1 Accessible Dictionary Variables

3.1.1 Actual AD Converter Input Voltage Values

The ULAD converters provide single or multiple channels providing converted digital value for input analog signal. The channels are labeled CHA, CHB etc. The CH*X* label is used for any of the channels. As for ULAD32 there is only one continually sampled channel - channel CHA.

Name	R/W	Type	Function
CHA	R	f4	Actual value of A channel input
CHB	R	f4	Actual value of B channel input
CHAi	R	s2 (/.3)	Channel A as fixed value (unit 10^{-3})
CHBi	R	s2 (/.3)	Channel B as fixed value (unit 10^{-3})
ADCAl	R	s4	Raw A channel ADC value
ADCBl	R	s4	Raw B channel ADC value

Actual reported channel value is obtained as result of more scaling steps applied to the raw ADC output value:

- converter proceeds conversion according to a selected mode CH*X*_MODE, result is raw value ADC*X*l
- value is filtered by moving averaging filter of width CH*X*_FILT samples
- factory preset callibration constants (CH*X*_CM, CH*X*_CA) scales value resulting from previous steps such, that they correspond to voltage value (in Volt units) connected to the **ULAD 32** input (max. range $\pm$10.000 V).
- user can select user defined scaling by constants CH*X*_UM, CH*X*_UA. The default values of these constants are CH*X*_UM = 1 and CH*X*_UA = 0.

The steps are corresponding to the equation

$$CHX = CHX\_UA + CHX\_UM \cdot (CHX\_CA + CHX\_CM \cdot ADCX_{norm})$$

where $ADCX_{norm}$ is given as ratio of input voltage to the basic (jumper selected) input range

3.1.2 User Scaling and Offset for A and B Channels

Name	R/W	Type	Function
CHA_UM (CHB_UM)	R/W	f4	User selectable channel A (B) multiplier
CHA_UA (CHB_UA)	R/W	f4	User selectable channel A (B) additive offset

3.1.3 Channel A and B Voltage Calibration Scaling and Offset

Name	R/W	Type	Function
CHA_CM (CHB_CM)	R/W	f4	Channel A (B) voltage calibration multiplier
CHA_CA (CHB_CA)	R/W	f4	Channel A (B) voltage calibration additive offset

3.1.4 ADC Input Samples Filter

Name	R/W	Type	Function
CHA_FILT (CHB_FILT)	R/W	u2 <1,64>	Channel A (B) averaging filter length in samples

3.1.5 Conversion Mode of AD Converter

Name	R/W	Type	Function
CHA_MODE (CHB_MODE)	R/W	u2	ADC channel A (B) mode

The next table describes possible MODE setting for base range ±10 V

Gain	Mode value	Input voltage range
1×	0	±10 V
2×	1	±5 V
4×	2	±2.5 V
8×	3	±1.25 V
16×	4	±625 mV
32×	5	±300 mV
64×	6	±150 mV
128×	7	±75 mV

3.1.6 Selection of Channel for Continuous Data Acquisition

Name	R/W	Type	Function
CH_SEL	R/W	u2 <1,2>	Selection of analog input terminals

The **ULAD 32** allows to select which of two analog input channels is utilized for continuous data acquisition. If value stored in CH_SEL is one (1) then channel A and corresponding IN1+/- terminals are used for data acquisition. If the value is 2 then channel B and corresponding IN2+/- terminals are used. The channel A (IN1) is the factory default setting.

3.1.7 ADC Sampling Period/Frequency

Name	R/W	Type	Function
ADCSAMPPER	R/W	u2 <10,100>	Sampling period specified in milliseconds

The **ULAD 32** is configured for 10 Hz (i.e. 100 ms) sampling rate which provides best noise immunity to 60 Hz and 50 Hz AC mains frequency as well as other calibration and ADC resolution parameters. The acquisition and control software reads ADC sampling frequency from variable ADCSAMPPER to reflect connected device acquisition timing. The value of the ADCSAMPPER can be modified to allow faster sampling rate if application depends on that. Any value from 10 ms to 100 ms can written but ADC support only frequencies specified in next table. Written value is adjusted to nearest available sampling period.

ADCSAMPPER value	Sampling frequency [Hz]	Sampling period [ms]
200	5	200
100	10	100
50	20	50
25	40	25
12	80	12.5
6	160	6
3	320	3

3.1.8 Digital Inputs Outputs

Name	R/W	Type	Function
AUXUAL	R/W	u2	Actual state on digital inputs and outputs and outputs preset value
AUX_DIR	R/W	u2	Controls selection of input/output function for given I/O*x* terminal, 1- input, 0 - output
MARK_DADR	R/W	u2 <1,100>	The destination uLan address for MARK delivery
MARK_MASK	R/W	u2	Mask of changes producing MARK

ULAD 32 is populated with screw terminal connector. The four digital input/output signals (I/O1, I/O2, I/O3, I/O4) are connected to the connector contacts. Actual state of inputs and last set value of of outputs can be read through AUXUAL dictionary variable. This variable is used for setting of value of output signals as well. Bits corresponding to the inputs are ignored in such case. Read and written value is equal to logical or arithmetic sum of weights corresponding to the signals. The direction of each pin is controlled by AUX_DIR property. If the bit/weight for given signal is set/applied then corresponding I/O terminal is configured for input.

Signal	I/O	Weight
1	I/O	1
2	I/O	2
3	I/O	4
4	I/O	8

The I/O terminals configured for input can be monitored for level change and send MARK packet when change is detected. MARK is sent to the address defined through MARK_DADR variable. The variable MARK_MASK is used to select which I/O terminals are monitored. The low byte of MARK_MASK variable is used to select signals to be monitored for rising edges, high byte (basic weights multiplied by 256) is used for monitoring of falling edges.

Signal	I/O	Weight	
		Falling edge	Rising edge
1	I/O	1	256
2	I/O	2	512
3	I/O	4	1024
4	I/O	8	2048

3.1.9 Miscellaneous Device Properties

Name	R/W	Type	Function
ERRCLR	E		Clear device error state

3.1.10 Configuration Storage to Non-volatile Memory

Name	R/W	Type	Function
SAVECFG	E		Store actual selected configuration into EEPROM memory

Initial values of the most of writable variables are setup according to the values previously stored in EEPROM memory at **ULAD 32** power on. The values of the variables can be written into dictionary and then stored into EEPROM by SAVECFG command invocation.

3.2 Peak Selector/Solvent Recycler Setup

ULAD 32 programmed with the extended firmware version 1.2 can be configured to for classification/detection of baseline and peak interval in the input signal. The input signal is scaled through specified factory and user calibrations and moving filter of the length CHA_FILT is applied. Obtained samples are fed to the peak selector subsystem if it is enabled by PSEL_EN. The history window of PSEL_PWIDTH samples is analyzed and statistical parameters are computed. If the standard deviation of the signal exceeds threshold defined by PSEL_PTRESH then signal is classified as peak area and the digital output(s) selected by PSEL_OUTMASK is/are activated. The output activation/deactivation can be delayed to compensate for the length of tubing between ULAD 32 and peak selector device or solvent recycler valve. The delay on the start of the peak is configured by PSEL_OUTDELAY variable. The output switch off is postponed by PSEL_OUTDUR.

Name	R/W	Type	Function
PSEL_EN	R/W	u2 <0,1>	Value 1 enables peak selector function
PSEL_PWIDTH	R/W	u2	Width of analysis window in number of samples
PSEL_PTRESH	R/W	f4	Threshold of standard deviation to classify signal as peak
PSEL_OUTMASK	R/W	u2	Bit wight mask of the digital output(s) controlled by the classifier
PSEL_OUTDELAY	R/W	u2	Delay in milliseconds to switch on output signal
PSEL_OUTDUR	R/W	u2	Duration in milliseconds to hold output signal after classifier detects flat/baseline signal

The function of the peak selector classifier can be monitored by next two read-only variable.

Name	R/W	Type	Function
PSEL_ISPEAK	R	u2	Immediate/actual output of the peak/baseline classifier
PSEL_VARIANCE	R	f4	Variance value for samples held in the history window

The next procedure to select parameters fitting for given application follow. Check typical half-width of peaks for your separation/analysis from the record of output. Use this value or one half of it to define time window to analyze by peak selector. The value of

PSEL_PWIDTH is computed as time window in seconds $\times 1000$ / ADCSAMPPER which is in milliseconds. The CHA_FILT value should be reasonably/significantly smaller than this value or it has to be 1. Then periodically check value of PSEL_VARIANCE. The maximal value spotted during flat/baseline signal area should be multiplied by 2 or 3 and then square root (standard deviation) is computed. That value is set to PSEL_PTRESH variable.

The value corresponding to the selected digital output signal is programmed to PSEL_OUTMASK. The variables PSEL_OUTDELAY and PSEL_OUTDUR are usually set to zero for initial run.

If optimal parameters are found they can be programmed into control computer system initial set of the command for given analysis or they can be stored in the **ULAD 32** default parameters EEPROM store with use of SAVECFG command.

4 Producer

Company address:

PiKRON s.r.o.
Kankovského 1235
18200 PRAHA 8

Tel.: +420 284684676
Mobile. : +420 603531357

http://www.pikron.com
e-mail: pikron@pikron.com