DAQ Modules
UDAQ-1408A/E/CA/CE/DA/DE
UDAQ-1416CA/CE
User Guide
Manufacturing, sales office, service center, technical support and headquarters:
address: TEDIA® spol. s r. o.
Zábělská 12
31211 Plzeň
Czech Republic
website: http://www.tedia.eu
phone/e-mail: https://www.tedia.eu/contacts
tech. support: https://www.tedia.eu/support

Trademarks:
TEDIA is a registered trademark of TEDIA® spol. s r. o. All other trademarks or registered marks in this manual belong to their respective owners.

Disclaimer:
This manual has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, TEDIA® reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition.
TEDIA® provides this document “as is,” without warranty of any kind, either expressed or implied, including, but not limited to, its particular purpose. TEDIA® reserves the right to make improvements and/or changes to this manual, or to the products and/or the programs described in this manual, at any time.
Information provided in this manual is intended to be accurate and reliable. The reader should contact TEDIA®, if errors are suspected. In no event shall TEDIA® be held liable for any form of damage arising out of or related to this document or the information contained in it.

Copyright © 1994-2013 TEDIA® spol. s r. o., All rights reserved.
Table of Contents

CE Declaration of Conformity, WEEE

1. Introduction
   1.1 Description ............................................................... 1-1
   1.2 Available versions ..................................................... 1-1
   1.3 General instructions for use ......................................... 1-1
   1.4 Note on the contents of the manual ................................. 1-1

2. Specifications
   2.1 Analog inputs ............................................................. 1-2
   2.2 Trigger logic ............................................................... 1-2
   2.3 Counters ................................................................. 1-3
   2.4 Digital ports ............................................................... 1-3
   2.5 General data ............................................................... 1-3

3. Installation
   3.1 Introduction ............................................................... 1-4
   3.2 Hardware configuration ................................................ 1-4
   3.3 Installation ............................................................... 1-4
   3.4 Connector placement and pin assignment ........................... 1-4

4. Basic features of the module
   4.1 Analog inputs ............................................................. 1-5
   4.2 Digital inputs ............................................................... 1-5
   4.3 Digital outputs .............................................................. 1-5
   4.4 Counters ................................................................. 1-5
   4.5 Operating modes ......................................................... 1-5
   4.6 Creating your own program ............................................ 1-5

5. Calibration of A/D converter
   5.1 Introduction ............................................................... 1-6
   5.2 Calibration procedure ................................................ 1-6

Appendix - Tables and Figures

Notes

rev. 02.2013
CE Declaration of Conformity

All TEDIA® products described in this user guide comply with the essential requirements of the following applicable European Directives:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU

The CE Declaration of Conformity original document is stored at the manufacturer and its copy may be provided on request.

Waste Electrical and Electronic Equipment (WEEE)

This symbol indicates that waste products should be disposed of separately from municipal household waste according to WEEE Directive 2012/19/EU of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources.
1. Introduction

1.1 Description
The modules UDAQ-1408A/E/CA/CE/DA/DE a UDAQ-1416CA/CE are products of a modern concept intended especially for laboratory and mobile measuring systems. The advantages include simple installation and programmable configurability of all parameters; no hardware configuration need to be set during installation or use. General view of the modules is shown in the Figures 1 and 2 in the Appendix.

1.2 Available versions

<table>
<thead>
<tr>
<th>module type</th>
<th>number of analog inputs</th>
<th>type of analog inputs connector</th>
<th>analog inputs isolation</th>
<th>other inputs and outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>UDAQ-1408A</td>
<td>8x S.E.</td>
<td>screw terminals</td>
<td>no</td>
<td>1 digital output</td>
</tr>
<tr>
<td>UDAQ-1408E</td>
<td>8x S.E.</td>
<td>screw terminals</td>
<td>yes</td>
<td>2 digital inputs</td>
</tr>
<tr>
<td>UDAQ-1408CA</td>
<td>8x S.E.</td>
<td>D-Sub 25</td>
<td>no</td>
<td>2 counters</td>
</tr>
<tr>
<td>UDAQ-1408CE</td>
<td>8x S.E.</td>
<td>D-Sub 25</td>
<td>yes</td>
<td>(all digital I/O on screw terminals)</td>
</tr>
<tr>
<td>UDAQ-1408DA</td>
<td>8x DIF.</td>
<td>D-Sub 25</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>UDAQ-1408DE</td>
<td>8x DIF.</td>
<td>D-Sub 25</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>UDAQ-1416CA</td>
<td>16x S.E.</td>
<td>D-Sub 25</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>UDAQ-1416CE</td>
<td>16x S.E.</td>
<td>D-Sub 25</td>
<td>yes</td>
<td></td>
</tr>
</tbody>
</table>

1.3 General instructions for use
The modules are compatible with USB 1.1 / 2.0 computers in office, industrial or portable environments and are designed for signal processing. All measured signals (analogue as well as digital) can be connected with a suitable shielded cable with a maximum length of 2 m.

Caution:
The modules are designed for data transmission and may be used only according to the manufacturer’s recommendations and precautions given in this manual and other general standards and terms and may be used only such a way, that its failure caused by any reason will not be dangerous to any person or property.

1.4 Note on the contents of the manual
This manual contains all information related to module features, I/O connectors etc., but does not include a description of installing and using drivers.
For information about drivers see the dedicated documentation attached to the installation files.
2. Specifications

2.1 Analog inputs

Number and type of inputs: 8x S.E. (UDAQ-1408A/E/CA/CE)
8x DIF. (UDAQ-1408DA/DE)
16x S.E. (UDAQ-1416CA/CE)

ADC resolution: 14-bit

General input range: ±10 V

General input range gain: ±0.1% of range max. (after calibration)

General input range offset: ±0.2% of range max. (±0.1% typ., cannot be adjusted)

Programmable gain: 1x, 2x, 5x, 10x, 20x, 50x

(i.e. ranges ±10 V, ±5 V, ±2 V, … , ±0.2 V)

Gain error 2x ÷ 50x: ±0.15% of range max. (±0.05% typ.)

Input impedance: >10 MOhm

Maximum input voltage: ±24 V (permanently; max. 5 inputs)
±50 V (10 ms max.)

Isolation voltage: 1 kVDC (types E, CE and DE only)

Note: Although the analog inputs have high impedance characteristics, it should be taken into account that the output impedance of the source of the measured signal fundamentally affects the function of the input signal multiplexer (i.e. it increases the time needed to stabilize the measured signal after switching the analog input). When using a signal source with output impedance greater than 1 kOhm, it is necessary to set a longer delay to stabilize the amplifier; the module allows to set up to 255 μs separately for each input range and thus adjust the properties to a signal source with an impedance of tens of kOhms. Insufficient settling time results in an unstable measured value usually affected by signals from other inputs.

2.2 Trigger logic

Trigger sources: internal timer (pacer), software start

Scanning logic sources: all physical inputs (AIN, CNT, DIO)

Pacer trigger mode range: 30.5 Hz ÷ 40 kHz

Software trigger mode range: single measurement up to dozens of Hz

Conversion time of ADC: 12 μs (independent of selected gain)

Settling time range: 0÷255 μs (gain 1x÷10x)
3÷255 μs (gain 20x)
8÷255 μs (gain 50x)

Minimum sampling period: (number of measured AIN+CNT+DIO) * 25 μs
+ sum of the configured settling time for all AINs

Note: The maximum sampling rate for is equal to the reciprocal value of the minimum sampling period.
2.3 Counters
Number and resolution: 2x 16-bit
Operating frequency: 2 MHz max. (duty cycle signal 1:1)
Type of inputs and levels: see section 2.4 Digital ports
Data transfer mode: asynchronously and synchronously with AIN data

Note: Counter inputs are shared with digital inputs.

2.4 Digital ports
Number of inputs: 2 (see Figures 1 and 2)
Operating levels: TTL/HC
Maximum input voltage: -10 V / +15 V (permanently)
-15 V / +24 V (10 ms max.)
Number of outputs: 1
Type of outputs: C type relay (see Figures 1 and 2)
Operating levels: 30 V$_{DC}$ / 0.5 A, resp. 100 V$_{RMS}$ / 0.5 A
Isolation voltage of outputs: 200 V$_{DC}$
Data transfer mode: asynchronously and synchronously with AIN data

2.5 General data
USB bus standard: USB 1.1/2.0
Power voltage: +5 V (from the USB bus)
Current consumption: 240 mA max. (A, CA and DA types)
300 mA max. (E, CE ans DE types)
Dimensions: cca 140 x 110 x 35 mm
Connectors - analog inputs: plug-in screw terminals (A and E types)
D-Sub 25 male (CA, CE, DA and DE types)
Connectors - digital ports: plug-in screw terminals
Connectors - USB: USB-B type
Operating temperature: 0° ÷ 55° C
Storage temperature: -10° ÷ 60° C
Relative humidity: 10% ÷ 90%, noncondensing
Recommended cable length: shielded cables, 2 m max.

Note: The current consumption is suitable for connecting the module directly to the USB port of the computer or to a powered USB hub (so-called active hub), but it exceeds the allowed value for connection to a passive USB hub, ie. hubs without their own power supply.
3. **Installation**

3.1 **Introduction**

Attention has been focused on achieving a high quality and reliability during the manufacturing process and attention was also paid to an inspection of the module before being shipped to you. Detailed reading of this guide and following the instructions precisely are highly recommended for achieving full quality and to prevent any damage during installation. For further information see manufacturer’s website http://www.tedia.eu.

3.2 **Hardware configuration**

Modules do not contain any configuration elements except of the calibration potentiometer located on the back of the module. Calibration process is described in Chapter 5.

3.3 **Installation**

Connect the module with included USB cable to your computer with a functional USB interface (it does not matter whether it is on or off).

The system driver is installed differently depending on your version of Windows, see the installation manual (included in this driver's installation package).

The TEDIA_DAQ01 application driver is installed by a separate setup program; for more information about installation and use, refer to its documentation.

*Note:* The Windows 8, Windows 7, Windows Vista, Windows XP (Windows 2000 and Windows 98/Me supported without warranty) are supported at the time of document release. You can find the current status and detailed information in the documentation attached to the installation files.

Server operating systems are only supported by the system driver.

3.4 **Connectors location and pin assignment**

The connector pin and plug-in screw terminals assignments and location are shown in Figure 1, Figure 2, Table 1 and Table 2 in Appendix of this manual.
4. Basic features of the module

4.1 Analog inputs
The UDAQ-1408A/E/CA/CE/DA/DE modules contain 8 high-impedance analog inputs; all inputs are available on plug-in screw terminals, resp. on the D-Sub 25 connector located on the front of the module.
The UDAQ-1416CA/CE modules contain 16 high-impedance analog inputs; all inputs are available on the D-Sub 25 connector located on the front of the module.
Details on connecting analog inputs and screw/connector pin assignments can be found in Figure 1, Figure 2, Table 1 and Table 2 in Appendix of this manual.
All types of modules allow selection of working range independently for each input.

4.2 Digital inputs
All types of modules include two digital inputs for TTL/HC signals. For details refer to the Figure 1 in Appendix of this manual.

4.3 Digital outputs
All types of modules include one digital output (C type relay). For details refer to the Figure 1 in Appendix of this manual.

4.4 Counters
All types of modules include two 16-bit counters connected to the digital input signals.

4.5 Operating modes
All types of modules supported two operating modes - software trigger mode and pacer timer mode.
Software trigger mode is only suitable for the lowest sampling rates; all measurement requirements are controlled by the application program and the module transmits all currently measured values (ie. the status of analog inputs, digital inputs and counters) at one batch. In this mode can be also controlled the digital output, preset the working ranges of the individual analog inputs, and set the counter value.
Pacer timer mode is suitable for measuring the sampling frequencies defined by the module’s internal timer; the application program only starts the measurement and then processes the data transmitted by the module to the computer. In this mode it is no longer possible to modify the setting of analog input ranges or counter contents, but digital output can be still controlled.

4.6 Creating your own program
All types of modules are supported by a comfortable high-level driver TEDIA_DAQ01, which allows to control all functions of the module without knowledge of low-level protocol. For more information about installation and use, refer to its documentation.
5. Calibration of A/D converter

5.1 Introduction
For accurate measurement, all types of modules allow the calibration of A/D converter range with a potentiometer accessible through the rear panel.
To compensate the voltage offset of the input amplifier (ie. the same value for different ranges with zero input voltage) is intended the second potentiometer located inside of the module (it is reserved for calibration at the manufacturer's service workplace only).

5.2 Calibration procedure
Calibration can be performed by any suitable program (such as a test program available from the TEDIA_DAQ01 administrative tool) while maintaining the following:
1) Connect signal with voltage 0 V to the selected input (the easiest way to connect the input to AGND) and to check the measured value at a maximum of ±20 mV (typically less than ±10 mV); the zero voltage deviation is not compensable.
2) Connect signal with voltage 9.0÷9.9 V to the selected input at gain 1x (ie. ±10 V range), change repeatedly signal polarity and set the values closest to the applied voltage for both polarities by the calibration potentiometer. This step should be repeated several times to be set compromise value for both polarities.
3) Subsequently, the accuracy can be verified on all inputs and ranges, ie. apply suitable voltages to the selected input at the selected operating range and compare the measured values with the voltage of input signal.

Note: During manufacturing the module is carefully calibrated and the measurement accuracy is validated on all ranges and inputs.
Figure 1. Location of important points on UDAQ-1408A/1408E module (top view).

- **AIN0**: plug-in screw terminal of analog input AIN0
  the meaning of both signals is shown in the figure
- **AIN1÷AIN7**: plug-in screw terminals of another analog inputs
- **DIN0**: plug-in screw terminal of digital input DIN0
  (TTL/HC signals, inputs contain a 10 kOhm pull-up resistor to the +5 V voltage)
- **DIN1**: plug-in screw terminal of digital input DIN1
- **DOUT0**: plug-in screw terminal of digital output DOUT0
  the meaning of all signals is shown in the figure
- **USB**: USB interface connector (also for powering the module)
- **POT**: potentiometer to calibrate the A/D converter range
- **PWR**: LED indicating the presence of supply voltage
- **status**: signaling data transfer from module to PC

**Note:** The UDAQ-1408E modules contain analog inputs isolated and the AGND signal is floating; the inputs are not isolated from each other.
The UDAQ-1408A modules do not have isolated inputs and the AGND signal is directly connected to the GND USB interface, resp. to the computer case.
The digital inputs are always connected to the GND USB interface, resp. to the computer case.
Figure 2. Location of important points on UDAQ-1408CA/CE/DA/DE and UDAQ-1416CA/CE module (top view).

D-Sub 25 connector for analog input signals
AIN0÷AIN7 signals are available on all types of modules
AIN8÷AIN15 signals are available on UDAQ-1416CA/CE modules only
all other all elements on the rear panel are identical with UDAQ-1408A/E
(see previous page)

Note: The UDAQ-1408CE/DE and UDAQ-1416CE modules contain analog inputs isolated and the AGND signal is floating: the inputs are not isolated from each other.
The UDAQ-1408CA/DA and UDAQ-1416CA modules do not have isolated inputs and the AGND signal is directly connected to the GND USB interface, resp. to the computer case.
The digital inputs are always connected to the GND USB interface, resp. to the computer case.
Table 1. D-Sub 25 (male) connector pin assignment of UDAQ-1408CA/CE modules.

<table>
<thead>
<tr>
<th>signal</th>
<th>pin</th>
<th>signal</th>
<th>pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>- - -</td>
<td>C1</td>
<td>C14</td>
<td>- - -</td>
</tr>
<tr>
<td>AGND</td>
<td>C2</td>
<td>C15</td>
<td>AGND</td>
</tr>
<tr>
<td>- - -</td>
<td>C3</td>
<td>C16</td>
<td>- - -</td>
</tr>
<tr>
<td>- - -</td>
<td>C4</td>
<td>C17</td>
<td>- - -</td>
</tr>
<tr>
<td>AGND</td>
<td>C5</td>
<td>C18</td>
<td>AIN 7</td>
</tr>
<tr>
<td>AGND</td>
<td>C6</td>
<td>C19</td>
<td>AIN 6</td>
</tr>
<tr>
<td>AGND</td>
<td>C7</td>
<td>C20</td>
<td>AIN 5</td>
</tr>
<tr>
<td>AGND</td>
<td>C8</td>
<td>C21</td>
<td>AIN 4</td>
</tr>
<tr>
<td>AGND</td>
<td>C9</td>
<td>C22</td>
<td>AIN 3</td>
</tr>
<tr>
<td>AGND</td>
<td>C10</td>
<td>C23</td>
<td>AIN 2</td>
</tr>
<tr>
<td>AGND</td>
<td>C11</td>
<td>C24</td>
<td>AIN 1</td>
</tr>
<tr>
<td>AGND</td>
<td>C12</td>
<td>C25</td>
<td>AIN 0</td>
</tr>
<tr>
<td>AGND</td>
<td>C13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. D-Sub 25 (male) connector pin assignment of UDAQ-1408DA/DE modules (label before the slash) and UDAQ-1416CA/CE (label behind slash).

<table>
<thead>
<tr>
<th>signal</th>
<th>pin</th>
<th>signal</th>
<th>pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>- - -</td>
<td>C1</td>
<td>C14</td>
<td>- - -</td>
</tr>
<tr>
<td>AGND / AGND</td>
<td>C2</td>
<td>C15</td>
<td>AGND / AGND</td>
</tr>
<tr>
<td>- - -</td>
<td>C3</td>
<td>C16</td>
<td>- - -</td>
</tr>
<tr>
<td>- - -</td>
<td>C4</td>
<td>C17</td>
<td>- - -</td>
</tr>
<tr>
<td>AIN 7- / AIN 15</td>
<td>C5</td>
<td>C18</td>
<td>AIN 7+ / AIN 7</td>
</tr>
<tr>
<td>AIN 6- / AIN 14</td>
<td>C6</td>
<td>C19</td>
<td>AIN 6+ / AIN 6</td>
</tr>
<tr>
<td>AIN 5- / AIN 13</td>
<td>C7</td>
<td>C20</td>
<td>AIN 5+ / AIN 5</td>
</tr>
<tr>
<td>AIN 4- / AIN 12</td>
<td>C8</td>
<td>C21</td>
<td>AIN 4+ / AIN 4</td>
</tr>
<tr>
<td>AIN 3- / AIN 11</td>
<td>C9</td>
<td>C22</td>
<td>AIN 3+ / AIN 3</td>
</tr>
<tr>
<td>AIN 2- / AIN 10</td>
<td>C10</td>
<td>C23</td>
<td>AIN 2+ / AIN 2</td>
</tr>
<tr>
<td>AIN 1- / AIN 9</td>
<td>C11</td>
<td>C24</td>
<td>AIN 1+ / AIN 1</td>
</tr>
<tr>
<td>AIN 0- / AIN 8</td>
<td>C12</td>
<td>C25</td>
<td>AIN 0+ / AIN 0</td>
</tr>
<tr>
<td>AGND / AGND</td>
<td>C13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Development, manufacturing, sales office, service center, technical support and headquarters:

address: TEDIA® spol. s r. o.
Zábělská 12
31211 Plzeň
Czech Republic

website: https://www.tedia.eu
phone/e-mail: https://www.tedia.eu/contacts
tech. support: https://www.tedia.eu/support