ACQ1001/ACQ1002 Installation Guide

High Performance Simultaneous Data Acquisition

ACQ1001/ACQ1002
1 and 2-Site D-TACQ ELF/FMC Carriers

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1 Overview

1.1 Product Description

ACQ1001 is a compact carrier designed to accommodate a single D-TACQ ELF or FMC module, allowing up to 32 simultaneous analog data acquisition channels in one enclosure.

ACQ1002 is designed to accommodate up to two D-TACQ ELF modules, or a D-TACQ ELF module and an FMC module, allowing up to 64 simultaneous analog data acquisition channels in one enclosure.

Both systems use a Xilinx Zynq-7000 All Programmable SoC Z-7020 running Linux. Connectivity is provided by Gigabit Ethernet. External Clock and Trigger inputs are also provided, and multiple units may be synchronised together.

Expansion options are provided on ACQ1002 and include internal and external USB 2.0 connections, external SD Card allowing for storage expansion and PMOD connectivity, for custom user modules such as GPS sync inputs.

ACQ1001 and ACQ1002 are designed to fit up to 5 units within a 1U, 19” rack. ACQ1002 also ships in a compact configuration for use in PIGs or other space-restricted applications. Please see Section 9 for rack-mount options and Section 10 for dimensions.

1.2 Variations and Options

ACQ1001 and ACQ1002 comes in several standard configurations.

Product Name	Compatibility		
	VITA 57 LPC FMC	D-TACQ ELF	Form Factor
ACQ1001Q-ELF		1x	Single
ACQ1001Q-FMC	1x		Single
ACQ1002R-ELF		2x	Rack
ACQ1002R-FMC	1x	1x	Rack
ACQ1002S-ELF		2x	Stack
ACQ1002S-FMC	1x	1x	Stack

Table 1: ACQ1001/2 Configurations

The ACQ1001/2 provides on-board Analog Power for D-TACQ ELF modules which are configured to suit the Module payload, please contact support@d-tacq.com for alternatives.

Third-party FMC modules must only be used in sites that are designated for FMC.
D-TACQ FMC modules can be used in either FMC or ELF sites.
D-TACQ ELF modules must only be used in ELF Sites
Contact support@d-tacq.com for details on compatibility.

1.3 Glossary

- FMC : VITA57.1 FPGA Mezzanine Card
- ELF : Electrically Extended FMC, implies ULPC or DULPC (only compatible with D-TACQ carriers)
- LPC : FMC Low Pin Count standard as per VITA57.1
- ULPC : Subset by D-TACQ, Ultra Low Pin Count
- DULPC : Subset by D-TACQ, Differential Ultra Low Pin Count (ULPC with extra differential signalling)
- Xilinx ZYNQ System on Chip (SoC)
- FPGA : Field Programmable Gate Array

2 Front Panels

The three standard front panels are shown below. Other front panels are available covering a range of Single, Rack and Stack configurations please contact support@d-tacq.com for more details.

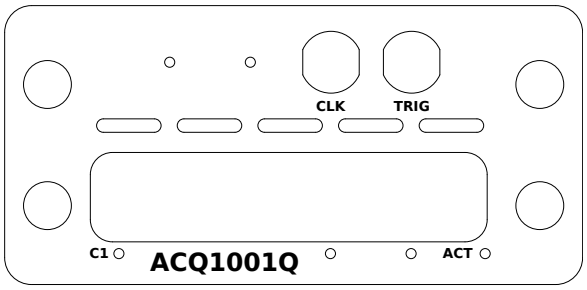

Figure 1: ACQ1001Q Front Panel

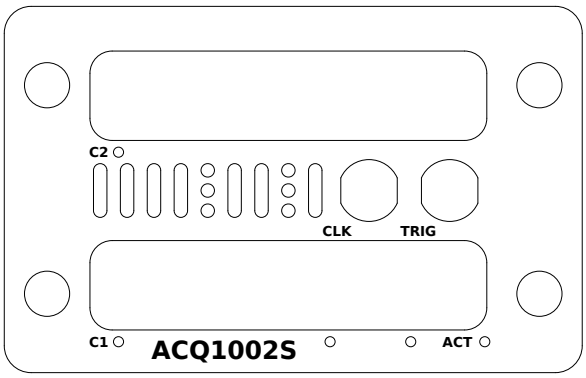

Figure 2: ACQ1002S Front Panel Stack

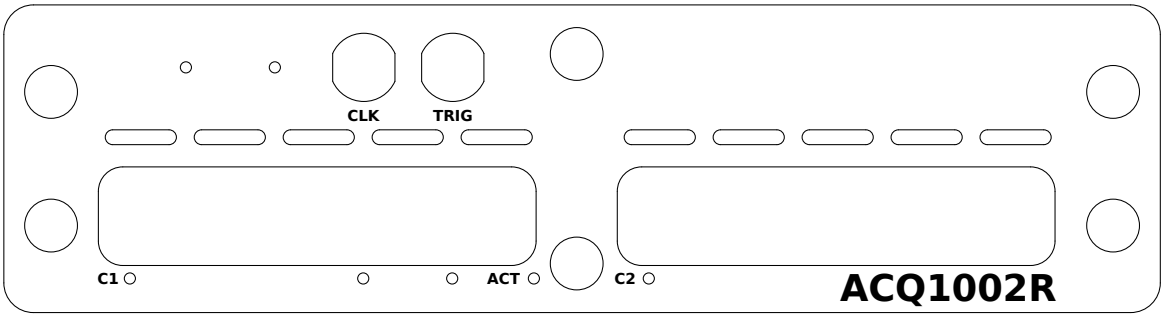

Figure 3: ACQ1002R Front Panel Rack

2.1 D-TACQ ELF/FMC Sites

ACQ1001 has space for 1 D-TACQ ELF/FMC module and ACQ1002 has space for 2 D-TACQ ELF/FMC module. Only FMC sites can be used for third-party FMC modules see Section 1.2 for ACQ1001 FMC support . Please contact support@d-tacq.com for details on our range of data acquisition modules, see Section 7 for details on field replacement.

2.2 LEDs

Upon power-up, the POWER LED (on the rear panel) should light, followed 20s later by LOADED (also on the rear panel) to indicate successful FPGA load. When Linux boots, an LED test sequence will be shown, displaying red and green on each LED.

LED		Description
C1-C2	Green Red	Card present, valid configuration. Analog power enabled if all cards are valid. Card present, invalid configuration. Analog Power disabled if any card is invalid.
CLK	Green Red	Lit when a valid clock signal is in use. Unused at present.
TRIG	Green Red	Lit when a valid trigger signal is being received. Unused at present.
ACT	Green	Heartbeat – flashes to indicate Linux activity.

Table 2: Front Panel LEDs

3 Front Panel Features

3.1 Clock [CLK]

The ACQ1001 accepts a clock input signal via a centre-positive single-pin LEMO 00 Series Mini Coax connector (part EPL.00.250.NTN). Mating plugs should be compatible with this part.

3.2 Trigger [TRG]

The ACQ1001 accepts a trigger input signal via a centre-positive single-pin LEMO 00 Series Mini Coax connector (part EPL.00.250.NTN). Mating plugs should be compatible with this part.

3.3 Optional LEMO connections

ACQ1001 and ACQ1002 can be fitted with up to two extra front panel LEMO connectors on request. These are bidirectional and may be used for both inputs or outputs. Please contact support@d-tacq.com for more details.

3.4 TTL or Opto-Coupled Signals Rev C ACQ1001 only

The Front Panel LEMO input signals can be configured as either 5V TTL inputs or Opto-Coupled inputs. The Opto-Coupled inputs are of type TLP2367. See Table 5 below for the Opto-Coupler characteristics; if higher input voltages are required a user in-line resistor may be used to reduce the input voltage at the connector. Contact support@d-tacq.com to verify any setup.

The factory shipping settings on the Top Deck Switches are as follows

Signal	Default Setting
Clock	Opto-Coupled Input
Trigger	Opto-Coupled Input
AUX1	TTL Input/Output
AUX2	TTL Input/Output

Table 3: Front Panel I/O Default Switch Positions

When configured as TTL inputs or outputs the signals have the following electrical specification. Note Clock and Trigger are input only

Parameter	Value
TTL Input Low Voltage	< 1.5V [1]
TTL Input High Voltage	> 3.5V [1]
Minimum Input Voltage	-0.5V [2]
Maximum Input Voltage	5.5V [2]
TTL Output Low Voltage	< 0.55V [3]
TTL Output High Voltage	> 3.8V [3]
TTL Max Output Current	24 mA

[1] Trigger Input has a guaranteed hysteresis of 700mV
[2] Inputs have under/over voltage protection up to 100mA
[3] Output Voltages at specified Max Current

Table 4: TTL Input and Output Characteristics

When configured as Opto-Coupled inputs the signals have the following electrical specification

Parameter	Value
Input Low Voltage	< 0.6V
Input High Voltage	> 4V
Minimum Input Voltage	-5V
Maximum Input Voltage	9V
Min ON LED Current	4 mA
Max LED Current	15 mA

Table 5: Opto-Coupled Input Characteristics

Each signal is independently selected for TTL or Opto-coupled using individual switches on the ACQ1001 mainboard. This board is accessed by removing the top cover of the ACQ1001/2 and is located on the front left of the mainboard with the front panel towards the user.

Selecting the signalling type for each signal requires two switches to be set as follows

Setting	SWAn	SWBn
Opto-Coupled Input	B	B
Bypass/TTL Input/Output	A	A

Table 6: Front Panel TTL / Opto Switch Positions

The Switches are shown in the picture below

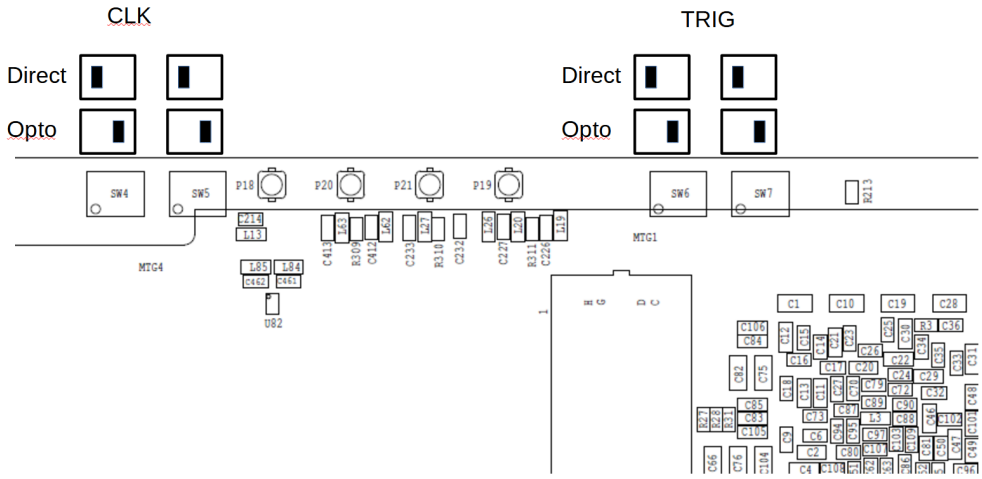

Figure 4: Opto-Coupler Switches

3.5 Air Inlets

The row of slots on the front panel allow air to enter ACQ1001 and ACQ1002. Air is drawn across the cards by fans at the rear of the box. Do not cover the air inlets.
ACQ1001/2 dissipates some heat through the baseplate and therefore should not be placed on a hot or thermally insulating surface. A steel shelf in normal airflow is ideal.

4 Rear Panels

The ACQ1001 rear panels are shown below.

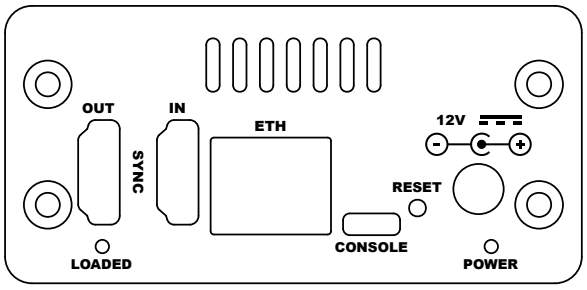

Figure 5: ACQ1001Q Rear Panel

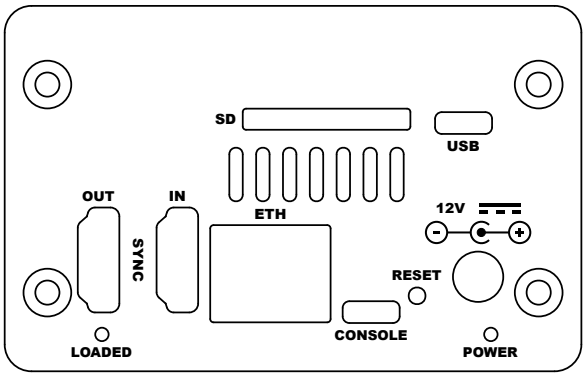

Figure 6: ACQ1002S Rear Panel Stack

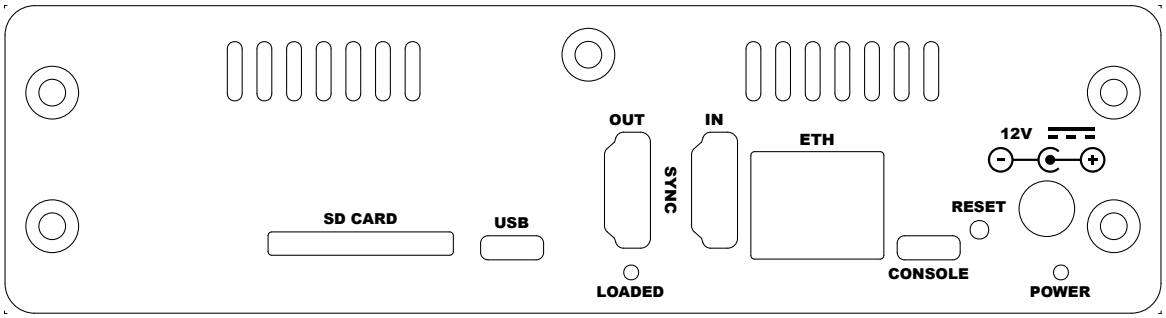

Figure 7: ACQ1002R Rear Panel

5 Rear Panel Features of both ACQ1001 and ACQ1002

5.1 Power

Power is provided to ACQ1001/2 by an external 12V regulated DC supply capable of outputting approximately 45W, although a supply capable of a minimum of 20W may be used depending on payload. The socket accepts a standard DC barrel connector, centre-positive, 2.5mm internal diameter, 5.5mm external diameter, with a minimum length of 10.5mm. The power supply's input earth should be connected to the output 0V.

The ACQ1001/1002 must be powered from the D-TACQ supplied Power Supply.

5.2 LEDs

The rear panel provides extra LEDs for system information.

LED		Description
LOADED	Green	Lights approximately 20s after power-up to indicate FPGA loaded. If unlit after this, check the validity of the SD card image or check the console for error messages.
POWER	Green	Lit when digital power supplies are all valid.

Table 7: Rear Panel LEDs

5.3 Console [CONSOLE]

ACQ1001 uses an FTDI FT232R USB-Serial converter for console access via a Micro USB port. Please see the FTDI website for drivers. Serial Console settings are as follows.

Name	Setting
Baud Rate	115200
Data Bits	8
Parity	No
Stop Bits	1
Flow Control	None

Table 8: Serial Console Settings

5.4 Ethernet [ETH]

A single Gigabit Ethernet port is provided that accepts standard RJ45 connectors.

5.5 Reset [RESET]

The Reset push button is recessed. Use a paper clip or pin to push the reset button if required.

5.6 Sync Bus [SYNC OUT] [SYNC IN]

ACQ1001 provides 2 Sync Bus connectors allowing multiple units to be chained together. The bus uses standard HDMI cables (typically provided by the customer) and has one input port and one output port. These are labelled SYNC IN and SYNC OUT.

The Sync Bus uses +3.3V CMOS logic and is compatible with other D-TACQ carriers. Breakout modules (TERM05, TERM10, TERM11; see Termination Modules) providing various connector and signal options are also available.

The sync ports may also be used for digital I/O in some customer applications. Please contact support@d-tacq.com for details.
Please note the system is not capable of video output - do not connect to a monitor – the ports may only be used for digital I/O.

The pinouts and functionality are described as follows.

Pin	Name	Description	
		Output Connector	**Input Connector**
1	Sync	Synchronisation Output	Synchronisation Input
4	Trigger	Trigger Output	Trigger Input
7	GPIO	General Purpose Output	General Purpose Input
10	CLK	Clock Output	Clock Input
19	Cable Detect	Allows master to detect the presence of a slave device.	Ground (0VD)
18	+3.3V	+3.3V input from slave to power output signals	+3.3V output to master to power output signals
13,14,15, 16	NC	Not connected	
2,3,5,6,8, 9,11,12,17	GND	Ground (0VD)	

Table 9: HDMI Connector Pin Out

5.7 Fan Outlets

Fan outlets help keep ACQ1001 and ACQ1002 cool, drawing air across the modules from front to back. Do not cover the fan outlets.

6 ACQ1002

ACQ1001 functionality is extended to make the ACQ1002 with the addition of a daughterboard (also known as a CELF). Additional features are described below.

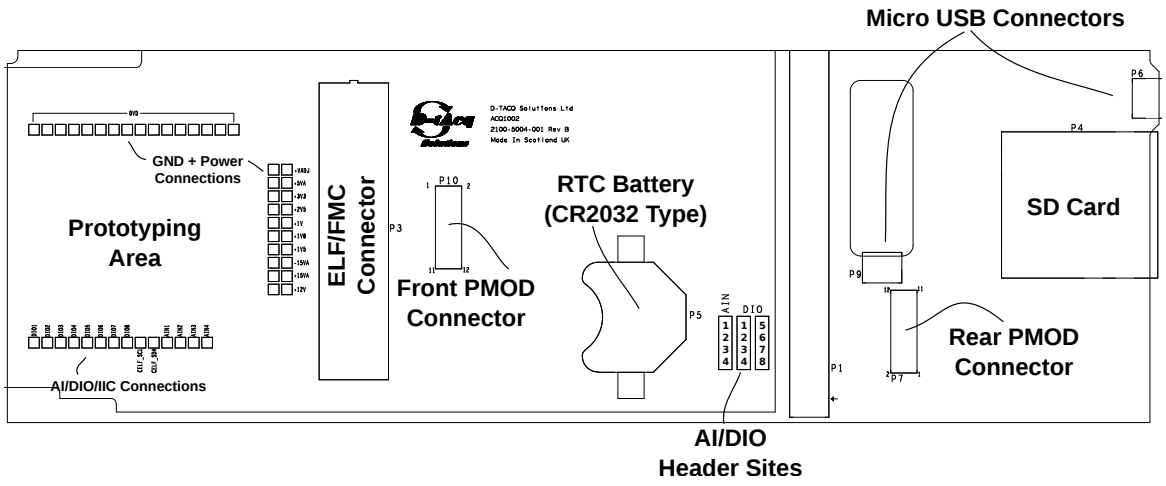

Figure 8: ACQ1002/CELF Daughterboard Functionality

6.1 PMOD

A custom rear panel may be produced along with PMOD modules allowing the user to extend the functionality of ACQ1002. For example, some customers use a GPS module to provide a synchronisation signal.

The second version of the CELF board provides a front-facing PMOD connector for further custom applications. The connector is not fitted by default to allow for the installation of full-size ELF cards, however, if required, the connector part is a Sullins NPPC062KFMS-RC.

Function	Pin	Pin	Function
GPIO	1	2	GPIO
GPIO (SCL) [1]	3	4	GPIO
GPIO (SCL/SDA) [1]	5	6	GPIO
GPIO (SDA) [1]	7	8	GPIO
GND	9	10	GND
+3V3	11	12	+3V3

[1] GPIO by default, I2C is resistor jumper selectable.

Table 10: PMOD Connector Pin Out

Contact support@d-tacq.com for more information on PMOD settings

6.2 USB

ACQ1002 contains internal and external USB 2.0 ports, allowing use of external storage or additional serial ports, for example.

The Rack and Stack cases allow for the internal mounting of standard 2.5" USB hard drives. ACQ1002R allows two modules and a hard drive. ACQ1002S allows one module and a hard drive. Please contact support@d-tacq.com for more details on this feature.

6.3 Real-Time Clock

ACQ1002 also contains an internal RTC for use in time stamping remote data acquisition. The RTC takes a CR2032 type battery.

6.4 Digital IO

An 8-channel I^{2}C GPIO device (Texas Instruments PCA9534) is provided for slow IO use. The first two of these are used for the site indicator LED by default, but may be disconnected by removing R21 and R22. On the second version of the CELF, all pins are connected to a header at the rear of the board, as well as the prototyping area at the front. I/O voltage is 3.3V max. Please see the device data-sheet for input thresholds.

6.5 Analog Inputs

A 4-channel I^{2}C temperature and voltage monitoring device (Analog Devices AD7417) is installed on the second version of the CELF to allow for slow analog measurements. Access the inputs either at the side of the prototyping area or the header connection near the RTC battery holder.

WARNING

The analog inputs are capable of 0V to 2.5V input only. Care should be taken to ensure these limits are not exceeded. See the device datasheet for more information.

6.6 Prototyping Area

ACQ1002 has a standard 2.54mm/0.1" pitch prototyping area provided for custom applications. Test points are provided for multiple ground connections, every power rail, and all AI, DIO and I2C connections. See Figure 9 for a diagram showing each connections. Modifications are performed at the customer's own risk – D-TACQ are not responsible for failures resulting from customer modifications.

Analog Supplies
Please contact support@d-tacq.com for available current on each supply rail as this is customer specific.
Two connections are provided for each supply.
Note that +VADJ is typically connected to +1V8 but this may be customer-specific so please measure to confirm voltage before use.
Analog power rails (shown as ±VA below but marked ±15VA on the PCB) are customer specific and may be different. Please measure to confirm voltage before use.
Multiple ground connections are provided to 0VD.

Digital IO
See the above Section 6.4 for details on the eight DIO[1-8] connections. Note that DIO1 and DIO2 are also used for the front panel LED (active low). If necessary these may be disconnected by removing R21 and R22 on the underside of the board. Please also note the 3.3V input voltage limit.

I^{2}C Connections
Connections to the CELF's I^{2}C bus (running at 3.3V) are shared with some of the on-board devices. Reserved addresses are as follows:

Address	Device	Description
0x20	TCA9534	Bus Expander Digital I/O
0x28	AD7417	Temperature Sensor and Analog Inputs
0x6F	MCP7940N	Real-time Clock

Table 11: I^{2}C Reserved Devices

The prototyping area is shown in Figure 9, below.

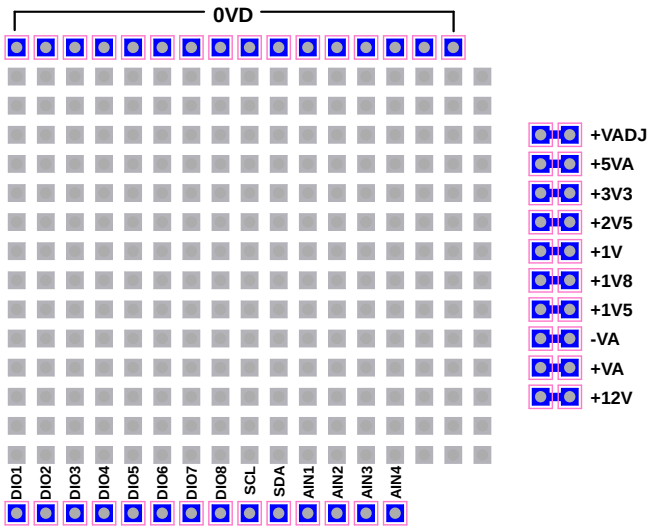

Figure 9: ACQ1002/CELF Prototyping Area

7 D-TACQ ELF/FMC Module Replacement

The ELF or FMC modules may be replaced by the user. Contact support@d-tacq.com for more detailed instructions.

⚠ WARNING

The system should be disconnected from the mains supply and ESD precautions taken before attempting to open the ACQ1001 Assembly.

VITA 57 LPC FMC modules may only be used in the FMC site of ACQ1001. Do not attempt to fit to site 1 on an ACQ1001ELF or to site 2 on an ACQ1002.

ACQ1001 is a complex electronic assembly. Special care should be taken in handling. The cards are susceptible to damage by ESD and improper power connections or FPGA configurations.

1. Ensure the correct FPGA image is available for the new module configuration.
2. Ensure the system is disconnected from the mains.
3. Ensure ESD precautions (chassis and body grounding) are taken before and during the opening of the case.
4. Please be extremely careful to ensure correct module alignment when plugging in the modules to avoid mezzanine module pin damage.

7.1 Case Opening

1. Remove the 6 screws on the top panel
2. On ACQ1002R remove the screw at the top on each of the front and rear panels.
3. Lift the lid off.

7.2 Mezzanine Module Removal

7.2.1 Single

1. Remove the 2 screws on the underside at the front. The 2 on the top at the front may be left attached.
2. Remove the 2 screws on top at the rear of the module. Remove the 2 screws in the centre of D-TACQ Extended Length modules.
3. Carefully lift the card away from the mezzanine connector. Note that limited force is required to do this and the module should not bend.
4. Jog the module out from the front panel.

7.2.2 Rack

Follow the instructions for the Single case for both modules.

7.2.3 Stack

1. Remove the 2 screws on top at the rear of the module. Remove the 2 screws in the centre of D-TACQ Extended Length cards.
2. Carefully lift the card away from the mezzanine connector. Note that limited force is required to do this and the card should not bend.
3. Remove the screws at the rear of the ACQ1002 Extension board. Remove the four stand-offs in the middle of the extension board.

4. Carefully lift the extension board away from the ACQ1001 board, taking great care to keep the backplane and connectors vertical at all times.
5. Follow the instructions for the Single case to remove the remaining module.

7.3 Card replacement and Case Closing

1. Follow the above instructions in reverse order.
2. Ensure the correct FPGA and Software images are installed prior to powering up.

8 Specifications

8.1 Electrical and Environmental

Parameter	Description
Form Factor	Single, Rack and Stack
Power Source	Standard 12V DC power inlet 2.5mm Int Diameter, 5.5mm Ext diameter
Power Consumption	Dependent on payload but typically 15-25W + 10W per site. Maximum 45W
Environmental	0°C - 50°C Operational -10°C - 85°C Non-Operational
Case Dimensions ACQ1001Q	Width 86 mm x 227 mm Depth x 1U High
Case Dimensions ACQ1001R	Width 156 mm x 227 mm Depth x 1U High
Case Dimensions ACQ1001Q	Width 86 mm x 227 mm Depth x 54.5mm High

Table 12: Specifications

8.2 Declaration of Conformity

The ACQ1001 complies with International safety and EMC requirements.
Declarations of Conformity for this product and for other D-TACQ products can be found on the website:

Declarations of Conformity
ACQ400 EC Declaration of Conformity
ACQ400 FCC Declaration of Conformity

See the Product Certification page

8.3 Warranty

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Should D-TACQ and the user have a separate written agreement with warranty terms covering the material in this document that conflict with these terms, the warranty terms in the separate agreement shall control. This equipment is not suitable for use in locations where children are likely to be present.

9 Mounting Options

There are several different mounting options for ACQ1001 and ACQ1002. The cases can be mounted on their own via integrated fixing points – shown in the below images, referenced to the bottom and front panels. Alternatively, different options may be attached to D-TACQ's 19" Mounting Tray.

9.1 Single and Rack

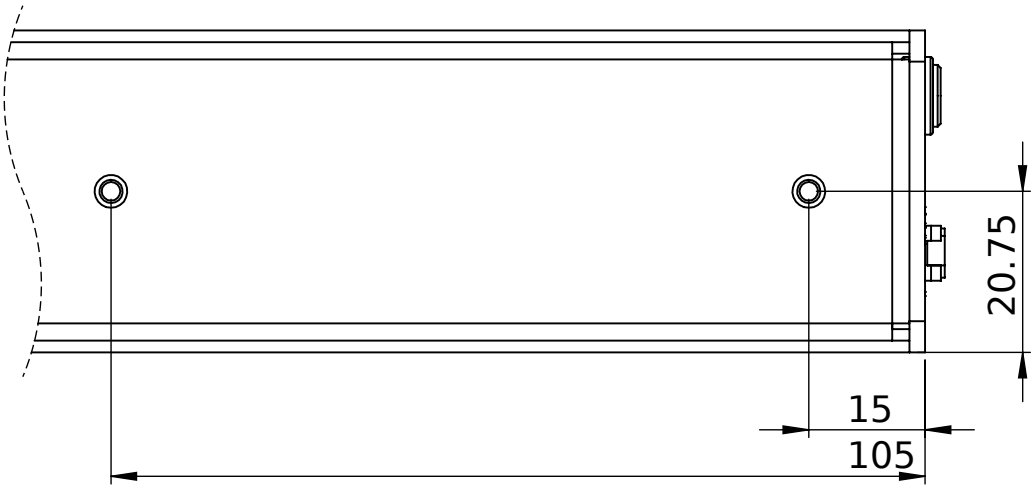

Figure 10: Mounting points for ACQ1001Q (Single) and ACQ1002R (Rack) Cases

9.2 Stack

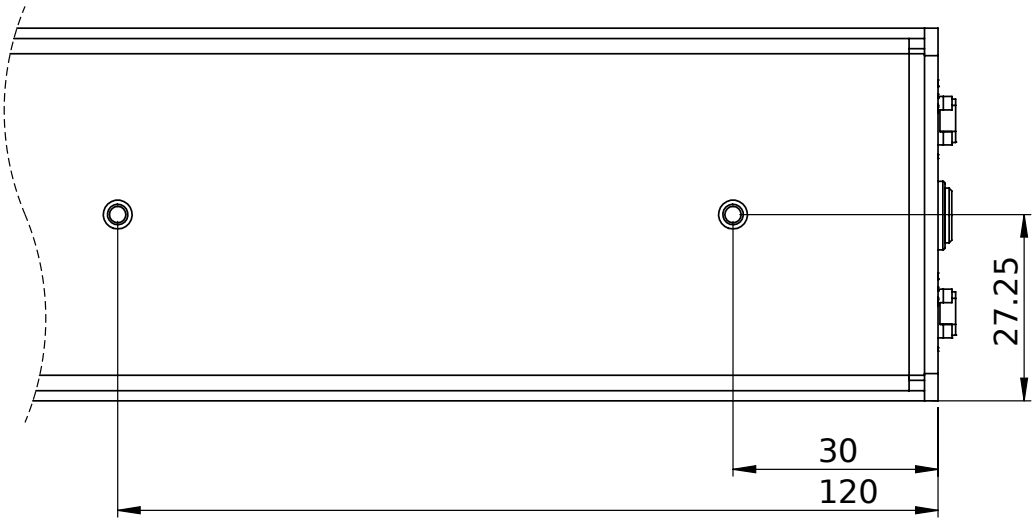

Figure 11: Mounting points for ACQ1002S (Stack) Case

9.3 Mounting Tray

Different examples of configurations using the ACQ1001/ACQ1002 19” Mounting Tray are shown below. Cases may also be arranged vertically. The mounting bracket can be used for many different combinations of both ACQ1001 and ACQ1002, in both horizontal and vertical orientations. Please contact support@d-tacq.com for any specific requirements.

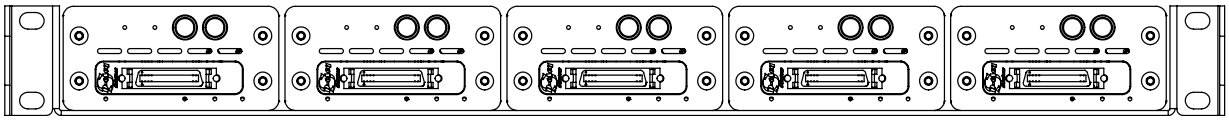

Figure 12: Example of 1U 19” mounting bracket with ACQ1001Q

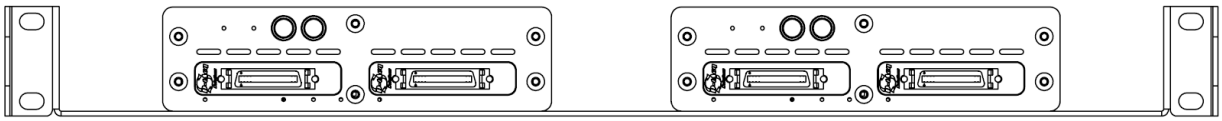

Figure 13: Example of 1U 19” mounting bracket with ACQ1001R

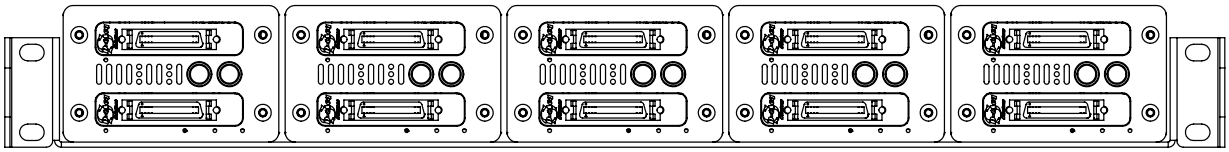

Figure 14: Example of 1U 19” mounting bracket with ACQ1001S

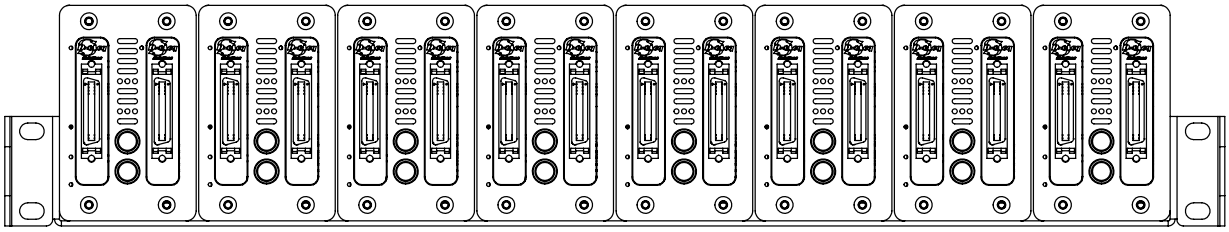

Figure 15: Example of 1U 19” mounting bracket with ACQ1002S

10 Dimensions

The dimensions of the Single, Rack and Stack cases are shown below

10.1 ACQ1001Q (Single)

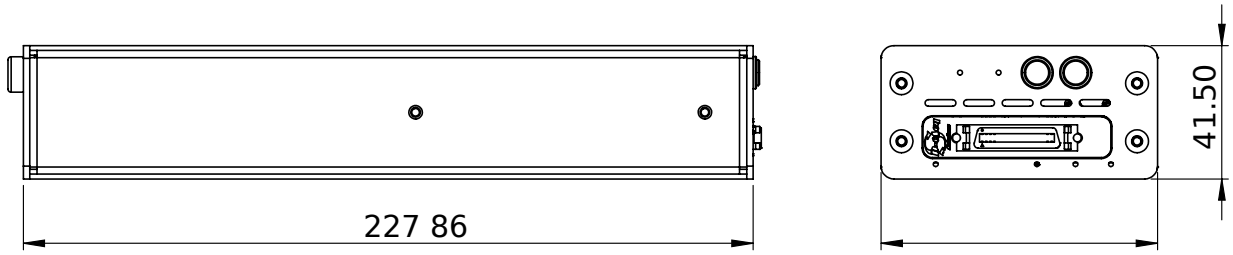

Figure 16: Case Dimensions of ACQ1001Q (Single)

10.2 ACQ1002R (Rack)

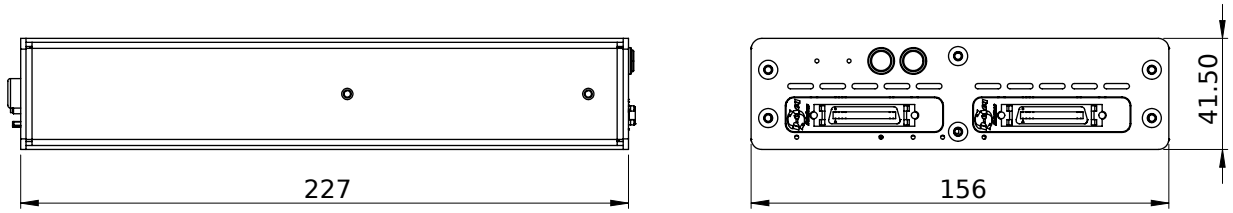

Figure 17: Case Dimensions of ACQ1002R (Rack)

10.3 ACQ1002S (Stack)

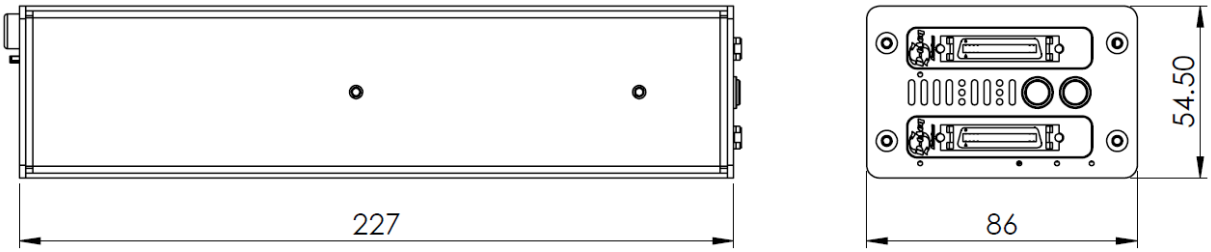

Figure 18: Case Dimensions of ACQ1002S (Stack)

11 Changelog

Revision History

Revision	Date	Author(s)	Description
3	April 2014	PJ	GPIO description. Updates for Rev B ACQ1002/CELF including diagram.
4	November 2014	PJ	More info on Prototyping area.
5	July 2015	PJ	Electrical Specs added.
6	September 2023	JMcL	Updated D-TACQ Format, Rev C ACQ1001 updates
7	February 2025	JMcL	Updated Declaration of Conformity