ADQ3x-FIBER Datasheet



The ADQ3 series digitizers are available in a stand-alone enclosure with PCIe-over-cable connection. The PCIe-over-cable version of the ADQ3 series features:

- **PCIe connection to a PC with up to 14 Gbyte/s data transfer rate**
- **Up to 100 m separation between PC and digitizer using active optical cable**
- **Galvanic isolation between PC and digitizer using active optical cable**
- **Extended GPIO**
- **12 V power supply**
- **Fan-less operation for OEM assembly (requires external air flow)**
- **Multiple digitizers can be connected via the same cable in daisy-chain mode**
- **Hot-plugging of digitizers is supported**

1 ADQ3X-FIBER INTRODUCTION

1.1 Features

- Stand-alone box version of ADQ3-series digitizers
- Copper cable or active optical cable (AOC) for PCIe-extension
- Up to 100 m separation between PC and digitizer using AOC
- Galvanic isolation between PC and digitizer using AOC
- PCIe connection to a PC with up to 14 Gbyte/s sustained data throughput
- Extended GPIO
- 12 V power supply
- Fan-less operation for OEM assembly (requires external air flow)
- Multiple digitizers can be connected via the same cable in daisy-chain mode
- Hot-plugging of digitizers is supported

1.2 Applications

- Time-of-flight mass spectrometry
- Distributed fiber optical sensing
- LIDAR
- Scientific instruments
- ATE
- Test and measurement
- RF

1.3 Advantages

- A space-saving, compact stand-alone box with high data transfer rate to the host PC
- The digitizer can be located close to the detector for optimized analog performance
- Galvanic isolation
- Real-time processing and high data throughput of the ADQ3 series digitizers
- Fan-less option for systems integration reduces the cost of ownership
- Teledyne SP Devices design services are available for fast integration to reduce time to market

2 ORDERING INFORMATION

2.1 System components

An ADQ3x-FIBER unit contains an ADQ3-series digitizer with a PCIe-over-cable interface. To connect it to a host PC, the following auxiliary equipment is also required and can be ordered from SP Devices:

- One or two copper cables or active optical cables (AOC) for PCIe communication.
- A host adapter installed in the host PC.

The host PC must be selected to fulfil the data processing needs of the system. Both Linux and Windows are supported.

Figure 1 shows a typical connection with two PCIe cables.



Figure 1 ADQ35-S5G0-WB-FIBER-FAN connected to MXH918 using 2 active optical cables

2.2 Available digitizer models

Table 1 lists the digitizer models that are available with the PCIe-over-cable interface. See the datasheet of the respective digitizer model for details about its features. The PCIe-over-cable interface is indicated in the product name by the tag “-FIBER”.

Table 1 ADQ3 series digitizer with PCIe-over-cable extension.

Order code	Sampling rate	Channels	Transfer rate
ADQ33-S1G0-BW1G0-FIBER	1 GSPS	2	7 Gbyte/s
ADQ33-S1G0-PDRX-FIBER	1 GSPS	1	7 Gbyte/ss
ADQ32-S2G5-BW2G5-FIBER	5 / 2.5 GSPS	1 / 2	7 Gbyte/s
ADQ32-S2G5-PDRX-FIBER	2.5 GSPS	1	7 Gbyte/s
ADQ35-S5G0-BW2G5-FIBER	10 / 5 GSPS	1 / 2	14 Gbyte/s
ADQ35-S5G0-PDRX-FIBER	5 GSPS	1	14 Gbyte/s
ADQ35-S5G0-WB-FIBER	10 / 5 GSPS	1 / 2	14 Gbyte/s

2.3 Cooling

The default configuration is fan-less for OEM design-in. The cooling relies on air flow from the system where it is installed, Figure 2. For desktop use, or for other cases where no external airflow can be relied upon, the products are available with a top-side fan, Figure 3. This option is indicated by the tag "-FAN" in the product name, see Table 2.

Table 2 ADQ3 series digitizer with PCIe-over-cable extension with fan for cooling.

Order code	Sampling rate	Channels	Transfer rate
ADQ33-S1G0-BW1G0-FIBER-FAN	1 GSPS	2	7 Gbyte/s
ADQ33-S1G0-PDRX-FIBER-FAN	1 GSPS	1	7 Gbyte/s
ADQ32-S2G5-BW2G5-FIBER-FAN	5 / 2.5 GSPS	1 / 2	7 Gbyte/s
ADQ32-S2G5-PDRX-FIBER-FAN	2.5 GSPS	1	7 Gbyte/s
ADQ35-S5G0-BW2G5-FIBER-FAN	10 / 5 GSPS	1 / 2	14 Gbyte/s
ADQ35-S5G0-PDRX-FIBER-FAN	5 GSPS	1	14 Gbyte/s
ADQ35-S5G0-WB-FIBER-FAN	10 / 5 GSPS	1 / 2	14 Gbyte/s



Figure 2 ADQ35-S5G0-WB-FIBER



Figure 3 ADQ35-S5G0-WB-FIBER-FAN

2.4 Accessories

2.4.1 Standard accessories

Digitizers with the PCIe-over-cable interface are delivered with the following standard accessories:

- Selected digitizer model, with or without fan
- Power supply
- Software development kit (SDK)
- Digitizer Studio graphical interface
- FWDAQ – firmware for data acquisition

Additional accessories to build a system are defined in section 2.4.2 to 2.5.1.

2.4.2 Cables

The connection to the PC is done via one or more copper cables or active optical cables (AOC). Each cable supports PCIe Gen4 x4, with a transfer rate of up to 7 Gbyte/s. To reach 14 Gbyte/s, two cables in parallel are needed. The recommended cables are listed in Table 3.

Table 3 Recommended cables.

Order number	Length	PCIe link	Cable type
108-007-000	0.5 m	Gen4 x4	Copper
108-007-001	10 m	Gen4 x4	Active optical cable
108-007-002	100 m	Gen4 x4	Active optical cable

2.5 Host adapters

A host adapter is required on the PC side for the cables to plug into. Available options are listed in Table 4. The host adapters must be configured differently for Window or Linux and depending on whether the links should be 4 or 8 lanes wide. See section 2.5.1 details.

Table 4 Host adapters.

Order number	Name	Cable connections	Maximum data rate[1]
109-008-001	MXH914	Gen4 x4	7 Gbyte/s
109-008-002	MXH918	Gen4 x4	14 Gbyte/s
109-008-003	MXH930	Gen4 x4	28 Gbyte/s

2.5.1 Configurations

Various topologies of the PCIe network are enabled by configurations of the host and target adapters. The configurations are:

- The digitizers can be configured in a star configuration where multiple units connect directly to the host, Figure 4, or in a daisy-chain where multiple units are connected in a chain, Figure 5.
- The host adapter supports non-transparent bridge to enable hot-plugging of the digitizers. The non-transparent bridge requires different configurations depending on the operating system.

These configurations can retro fit in the field, but it is recommended to install the correct combination at the factory. The order codes for the host adapter are in Table 5 and for the digitizer in Table 6.

[1] This is the maximum effective sustained data rate for payload when using the host adapter with ADQ3 series digitizer.

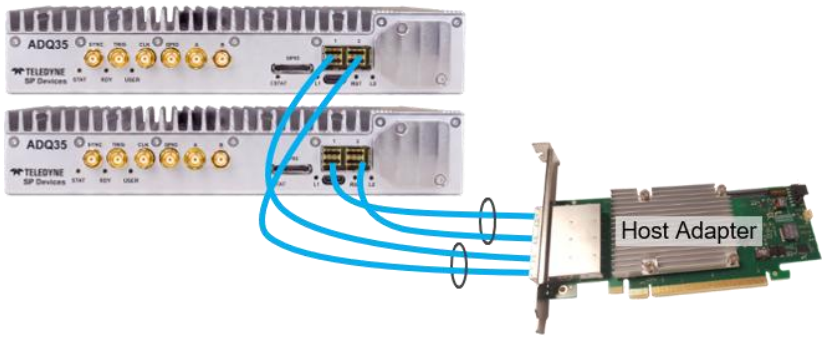


Figure 4 Star connection, MXH930 to two ADQ35-FIBER. Two active optical cables to each digitizer enable 14 Gbyte/s per digitizer.

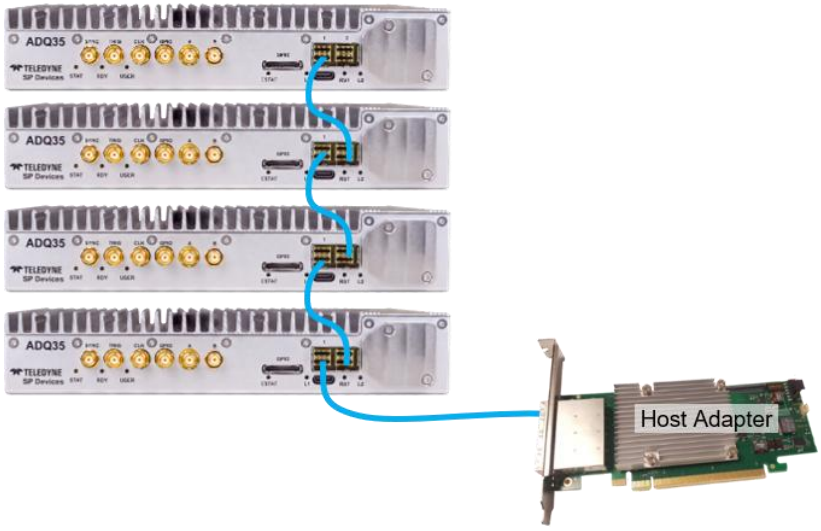


Figure 5 Daisy-chain connection of four ADQ35-FIBER units

Table 5 Options for configuring the host adapter. Select one per host adapter.

Order number	Cable configuration	PCIe link	Operating system
700-002-000	Single	Gen4 x4	Windows
700-002-001	Dual	Gen4 x8	Windows
700-002-002	Single	Gen4 x4	Linux
700-002-003	Dual	Gen4 x8	Linux

Table 6 Options for configuring the ADQ3 series digitizer. Select one per digitizer.

Order number	Cable configuration	PCIe link	Operating system
700-002-004[2]	Single	Gen4 x4	Windows
700-002-005	Dual	Gen4 x8	Windows

[2] This configuration is required for enabling daisy-chain of digitizers.

3 SYSTEM DESIGN

3.1 Mechanical assembly

The PCIe-over-cable versions of the ADQ3 series digitizers offer several features facilitate the mechanical robustness of systems built around them:

- There are four bottom-plate M3 screw holes that enable mounting the unit to a base plate. It is important that the screws do not stick in more than 6 mm into the digitizer. See Figure 7 for hole locations.
- SMA connectors provide secure connections for analog signals.
- PCIe cable connections, power supply, and GPIO connectors feature snap-lock cable retention.
- The box itself is based on a robust aluminum extrusion.

3.2 Software interface

The PCIe-over-cable versions of the ADQ3 series digitizers operate with the same API as the native PCIe versions. Additionally, a driver is needed for the host adapter. The driver can be downloaded from Dolphin ICs' web site. See 21-2539 ADQ3 series user guide for further instructions.

3.3 Power supply

The digitizer is powered by 12 V from the supplied power adapter. The power connector is a 3-pin XLR connector with a latch. Warranty coverage and compliance testing are valid only when using the supplied adapter. For alternative power sources, please consult a Teledyne SP Devices representative.

3.4 Copper cable and active optical cable selection

Use the active optical cable for longer distances and for galvanic isolation. For short, local connections, copper cable offers a lower cost alternative.

4 TECHNICAL DATA

See the datasheet for each respective digitizer model for additional information.

Table 7 Environmental and mechanical parameters

Parameter	Condition	Min	Typical	Max	Unit
Power and temperature					
Power consumption	ADQ35		70		W
Power consumption	ADQ32 / ADQ33		50		W
Power supply		10.8	12	13.2	V
Operating temperature	Fan-less[3]	0		55	°C
Operating temperature	Fan option[4]	0		35	°C
Size[5]					
Width			215		mm
Length			235		mm
Height			40		mm
Weight			1930		g
Compliances					
RoHS3		Yes			
CE		Yes			
FCC	Exclusion according to CFR 47, part 15, paragraph 15.103(c).				

[3] These are typical operating conditions with air flow. The digitizer has to be installed where it cannot be touched if the fan-less mode is selected and there is a risk the airflow could in some situation be insufficient to keep the surface temperature below 50 °C.
[4] This temperature range is valid when the unit is installed where it may be touched by the operator.
[5] See Figure 7 for a dimensioned drawing.

Table 8 GPIO expansion

Parameter	Value
Connector type	Hirose, ST60-24P(30)
Number of differential LVDS input signals	2
Number of differential LVDS output signals	2
Number of single-ended 3.3-V LVCMOS I/O signals	4
Control bus	I2C, 3.3 V with internal pull-ups
Power supply	3.3 V, max 0.5 A

Table 9 GPIO expansion pinout, see also Figure 6

Pin	Function
1, 4, 7, 10, 13, 16, 19, 22, shield	GND
2	I2C SDA
3	I2C SCL
5	LVDS output, positive, Port B, Signal B0
6	LVDS output, negative, Port B, Signal B0
8	GPIO, Port C, Signal C0
9	GPIO, Port C, Signal C1
11	LVDS output, positive, Port B, Signal B1
12	LVDS output, negative, Port B, Signal B1
14	GPIO, Port C, Signal C2
15	GPIO, Port C, Signal C3
17	LVDS input, positive, Port B, Signal B2
18	LVDS input, negative, Port B, Signal B2
20, 21	Power 3.3 V, max 0.5 A, switchable Port D
23	LVDS input, positive, Port B, Signal B3
24	LVDS input, negative, Port B, Signal B3

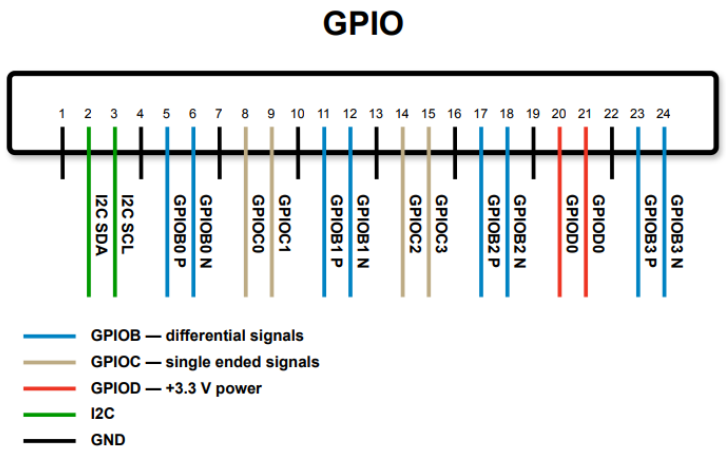


Figure 6 Pin-out GPIO port

Table 10 Software support

Parameter	Value
Operating system [6]	Windows / Linux
GUI	Digitizer Studio
Example code	C, Python
API	C / C++ / Python
High-level API	LabVIEW / MATLAB / C#

Table 11 Data transfer[7]

Parameter	Condition	Value	Unit
Connector type		SFF-8644	
PCIe data transfer standard to PC	Per cable connection	Gen4x4	
Sustained data rate to PC	1 copper cable 0.5 m	Up to 7	Gbyte/s
Sustained data rate to PC	2 active optical cables, 10 m	Up to 14	Gbyte/s
Sustained data rate to PC	2 active optical cables, 100 m	Up to 12.5[8]	Gbyte/s
Sustained data rate to PC	1 active optical cable, 100 m	Up to 7	Gbyte/s
Daisy chain depth		4	units

5 ABSOLUTE MAXIMUM RATINGS

Table 12 Absolute maximum ratings[9]

Parameter	Condition	Min	Max	Unit
Power supply to GND		-0.4	14	V
Operating ambient temperature[10]		0	55	°C
Storage temperature		-40	70	°C

[6] See 15-1494 Operating system support for a detailed listing of supported distributions.
[7] This is the data rate supported by the PCIe-extension implementation. Other parts of the system may limit the performance. Also consider the data rate from the selected digitizer model.
[8] For host adapter MXH930 only. Host adapter MXH918 limits performance to 11 Gbyte/s
[9] See the datasheet for the respective ADQ3 series digitizer for additional limits.
[10] The maximum ambient temperature depends on the air flow and the load on the FPGA. The digitizer has an overheat protection feature that shuts down the board to protect it from overheating.

6 MECHANICAL DRAWINGS

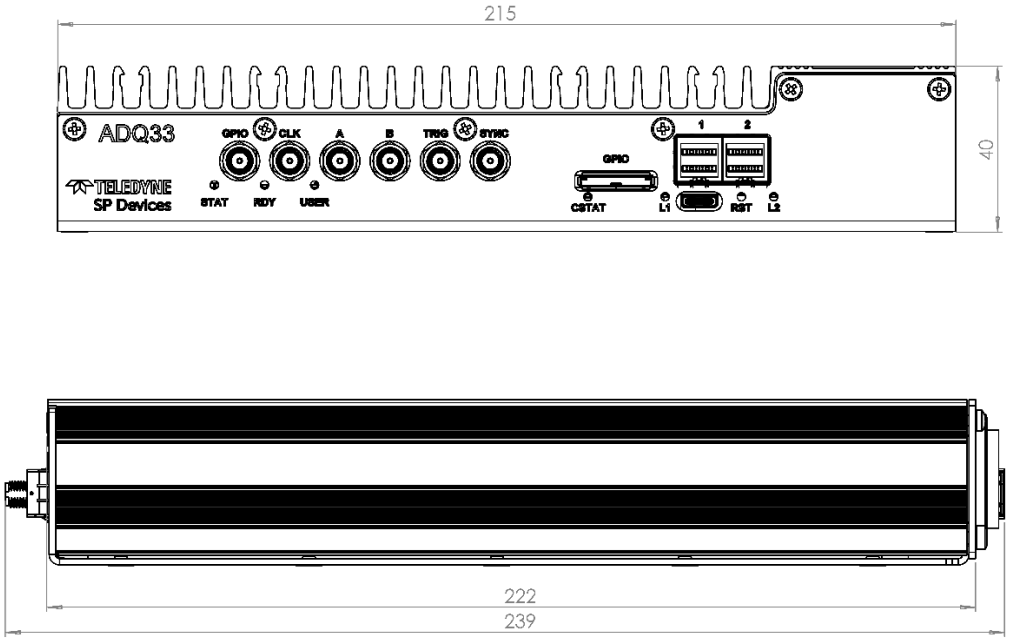


Figure 7 ADQ3x-FIBER outer dimensions

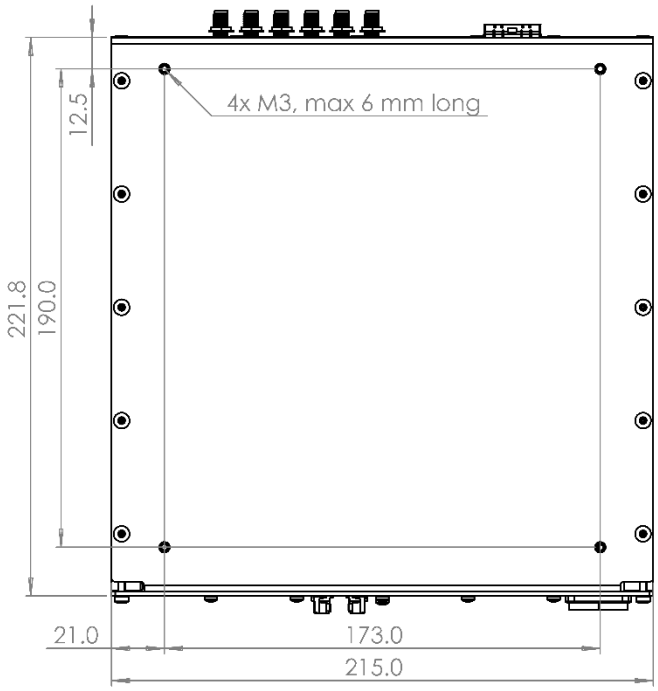


Figure 8 Location of holes for screw attachment of ADQ3x-FIBER

7 REFERENCES

Refer to Teledyne SP Devices' website, www.spdevices.com, for the latest version of supplementary documents.

15-1494 Supported operating systems

18-2059 ADQUpdater user guide

20-2378 ADQ32 datasheet

20-2451 ADQ33 datasheet

20-2507 ADQ3 series development kit user guide

20-2509 ADQ35-WB datasheet

20-2521 ADQAssist user guide

21-2539 ADQ3 series user guide

22-2797 ADQ32-PDRX datasheet

22-2918 ADQ35 datasheet

22-2919 ADQ35-PDRX datasheet

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