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[RSD product category A]

Real-time Digital Oscilloscopes

TP22_028



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	Position	Name
Responsible person	Research Assistant	Stanislav Stanček
Prepared by	Research Assistant, Engineer	Stanislav Stanček, Francesco Schillaci

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<i>Reviewed By</i>			
Name (Reviewer)	Position	Date	Signature
Daniele Margarone	Head of department of Ion Acceleration and Application of High Energy Particles	<u>NOTICE (RSD product category A)</u>	
Luboš Nims	Electrical Engineering Group leader		
Jiří Kubricht	Lawyer		
Roman Kuřátko	Head of Department of Building Infrastructure and IT		
Veronika Olšovcová	Group Leader of Safety		
Viktor Fedosov	Group Leader of Quality and Planning		

<i>Approved by</i>			
Name (Approver)	Position	Date	Signature
Daniele Margarone	Head of department of Ion Acceleration and Application of High Energy Particles	10.06.2022	<u>via TC</u>

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1. Introduction

1.1. Purpose

This Requirements Specification Document (RSD) lists the technical requirements and constraints on the product being purchased for department 87 of the ELI Beamlines project.

1.2. Scope

The RSD contains all of the technical requirements: functional, performance and delivery, safety and quality requirements for the following product (*tender code TP22_028*): **Real-time Digital Oscilloscopes** (further “**Oscilloscopes**”).

The Oscilloscopes are considered to be the standalone technology and will be placed at the ELI Beamlines facility in the E4 hall. These Oscilloscopes are registered in the PBS software under the following PBS code: *E.E4.ELMA.ION.7.1*.

This product is a product **Category A** according to the ELI Beamlines RSD categories of products. The Category A is an Off-the-shelf Product without the necessity of modifications and the necessity to be subjected to a verification program (review of design, inspection and testing) for ELI applications by the actual project specifications. All verification activities performed by a supplier shall be executed in accordance with the supplier’s plan of outgoing inspection and tests. Internal Acceptance Procedure of the product Category A shall be established and applied before the product implementation (operation phase).

1.3. Terms, Definitions and Abbreviations

For the purpose of this document, the following abbreviated terms are applied:

Abbreviation	Meaning
AC	Alternating Current
CA	Contracting Authority (Institute of Physics CAS)
CPU	Central Processing Unit
DC	Direct Current
ELI	Extreme Light Infrastructure
GPIB	General Purpose Interface Bus
pts	points
RSD	Requirements Specification Document
USB	Universal Serial Bus
WXGA	Wide eXtended Graphics Array

1.4. References to standards

If this document includes references to standards or standardized/ standardizing technical documents the CA allows/permits also another equivalent solution to be offered.

2. Functional, Performance and Design requirements

2.1. General technical requirements

REQ-034435/A

Each of the Oscilloscopes shall provide real-time signal registration of at least 4 analogue channels.

REQ-034436/A

The Oscilloscopes shall be provided with a WXGA Color Display, at least 12.1" Touch Screen and a Multi-tab Display Option with at least 4 channels simultaneous display of real-time signal.

REQ-034627/A

The operating system of the Oscilloscopes shall be fully compatible with CA's operating and control systems.

NOTE: The Microsoft Windows® 10 is used by the CA to interface with devices and the acquisition system.

REQ-034437/A

The Oscilloscopes shall have a power supply compatible with the input voltage in minimal ranges of 100-240 V AC $\pm 10\%$ at 50/60 Hz $\pm 5\%$; 110-120 V AC $\pm 10\%$ at 400 Hz $\pm 5\%$ (Automatic AC Voltage Selection).

REQ-034438/A

Each of the Oscilloscopes shall have the following maximum power consumption:

- Nominal Power Consumption 415 W / 415 VA
- Max. Power Consumption 500 W / 500 VA (with all PC peripherals and active probes connected to 4 channels).

REQ-034439/A

The performance parameters of the Oscilloscopes shall correspond to the requirements given in table 1 below.

No	Parameters	Minimum Requirements
1	Analog Bandwidth (max)	4 GHz
2	Analog Bandwidth @ 50 Ω (-3 dB)	4 GHz (≥ 5 mV/div)
3	Analog Bandwidth @ 1 M Ω (-3 dB)	500 MHz (typical)
4	Rise Time (10-90%, 50 Ω)	100 ps (typical)
5	Rise Time (20-80%, 50 Ω)	75 ps (typical)
6	Input Channels	4
7	Vertical Resolution	8 bits
8	Vertical Noise Floor (1 mV/div)	165 μ Vms
9	Vertical Noise Floor (2 mV/div)	165 μ Vms
10	Vertical Noise Floor (5 mV/div)	368 μ Vrms
11	Vertical Noise Floor (10 mV/div)	420 μ Vrms
12	Vertical Noise Floor (20 mV/div)	657 μ Vrms
13	Vertical Noise Floor (50 mV/div)	1.21 mVrms
14	Vertical Noise Floor (100 mV/div)	2.25 mVrms

No	Parameters	Minimum Requirements
15	Vertical Noise Floor (200 mV/div)	6.35 mVrms
16	Vertical Noise Floor (500 mV/div)	11.57 mVrms
17	Vertical Noise Floor (1 V/div)	21.74 mVrms
18	Sensitivity @ 50 Ω	1 mV-1 V/div, fully variable
19	Sensitivity @ 1 M Ω	1 mV-10 V/div, fully variable
20	DC Vertical Gain Accuracy (Gain Component of DC Accuracy)	\pm (1%) F.S, offset at 0 V
21	DC Vertical Offset Accuracy	\pm (1.5% of offset setting +1% of full scale + 1 mV) (test limit)
22	Channel-Channel Isolation (for any two ProBus input channels, same v/div settings, typical)	DC-2.5 GHz: 40 dB (>100:1), 2.5 GHz to rated BW: 31.6 dB (>30:1)
23	Offset Range @ 50 Ω	BWL \leq 1 GHz: \pm 1.6 V @ 1 mV - 4.95 mV/div \pm 4 V @ 5 mV - 9.9 mV/div \pm 8 V @ 10 mV - 19.8 mV/div \pm 10 V @ 20 mV - 1V/div BWL > 1 GHz: \pm 1.4V @ 5 mV - 100 mV/div \pm 10V @ 102 mV - 1 V/div
24	Offset Range @ 1 M Ω	\pm 1.6 V @ 1 mV - 4.95 mV/div \pm 4 V @ 5 mV - 9.9 mV/div \pm 8 V @ 10 mV - 19.8 mV/div \pm 16 V @ 20 mV - 100 mV/div \pm 80 V @ 102 mV - 1.0 V/div \pm 160 V @ 1.02 V - 10 V/div
25	Maximum Input Voltage @ 50 Ω	5 V RMS \pm 10 V peak
26	Maximum Input Voltage @ 1 M Ω	400 V max. (DC + peak AC < 10 kHz)
27	Sample Rate (Single-shot)	20 GS/s on 4 Ch, 40 GS/s on 2 Ch
28	Sample Rate (Repetitive)	200 GS/s for repetitive signals (20 ps/div to 10 ns/div)
29	Memory Length (4 Ch / 2 Ch / 1Ch)	64M / 128M / 128M
30	Number of Segments	15000
31	Intersegment Time	1 μ s
32	Input Coupling @ 1 M Ω	AC, DC, GND
33	Input Coupling @ 50 Ω	DC, GND
34	CPU Passmark	2553 score or better according to CPU Mark on the www.cpubenchmark.net
35	Processor Memory	16 GB standard
36	Enhanced Resolution	From 8.5 to 11 bits vertical resolution
37	Ethernet Port	Supports 10/100/1000BaseT Ethernet interface (RJ45 port)

No	Parameters	Minimum Requirements
38	USB Host Ports	4 side USB 3.1 Gen1 ports and 1 front USB 2.0 port support Windows compatible devices
39	USB Device Port	1 port - USBTMC over USB 3.1 Gen1
40	GPIB Port (optional)	Supports IEEE - 488.2 (External)
41	Remote Control	Via Windows Automation, or via Remote Desktop
42	Network Communication Standard	Compliant with VXI-11 or VICP, LXI Class C (v1.2)
43	Local language user interface (language preferences)	English

Table 1: Performance parameters of the Oscilloscopes.

3. Delivery requirements

REQ-034440/A

The transportation to the ELI Beamlines facility in Dolní Břežany of the Oscilloscopes shall be conducted by the Supplier.

NOTE: The bid price will be considered by the CA as the final price, including transportation costs.

4. Safety Requirements

REQ-034441/A

The Supplier shall supply a Declaration of Conformity for each product type if the appropriate legislation determines the Supplier's obligation to have a Declaration of Conformity for the purposes of a Device sale in the Czech Republic. In such a case, the Declaration of Conformity shall comply with:

- Act No. 90/2016 Coll., as amended
- Act No. 22/1997 Coll., as amended
- The equivalent legal regulation of another EU member state so that the conditions for the sale of the product in the Czech Republic are met, and/or
- the relevant EU/EC regulation.

NOTE: The compliance with these obligations will be demonstrated by the (EU) Declaration of conformity, other relevant documents and the CE marking if required by the relevant regulations. If a delivered product is not required to assess conformity according to specific legislation, the supplier declares, in written form, by concluding the contract that the product complies with the general safety requirement of EU Directive 2001/95/EC on general product safety and that the Supplier duly complies their obligations under this Regulation.

5. Quality Requirements

5.1. General Quality Requirements

REQ-034442/A

The Supplier shall provide the Product User Manual as part of the delivered Device. The Manual shall include the instructions and descriptions regarding the following procedures:

- transport, handling, storage and cleaning;
- installation and calibration (see REQ-034444/A);
- safe operation and maintenance procedures;
- user manual for the software /communication protocols.

NOTE: The manual can be supplied in hardcopy or PDF formats.

REQ-034443/A

The Supplier shall provide information on outgoing check of the Product. At least this information shall comprise a report about the execution of outgoing check and fulfilment of the technical requirements defined by the product RSD, and completeness of the product.

NOTE: Alternatively, the Supplier might provide the CA with the information detailed enough to prove meeting all requirements stipulated herein (e.g. catalogue/technical datasheets, product manuals or other similar documentation).

REQ-034444/A

The Supplier shall supply a Calibration Certificate or Test protocol, which shall establish:

- the relation between quantity values with measurement uncertainties provided by measurement standards and the corresponding indications with associated measurement uncertainties;
- the relation for obtaining a measurement result from an indication (if required).

NOTE: The Supplier shall define the calibration interval for the Oscilloscopes.

REQ-034445/A

The Supplier shall establish and maintain a non-conformance control system compatible with ČSN EN ISO 9001 (equivalent to EN ISO 9001).

5.2. Specific Quality requirements

REQ-034446/A

In case of the Oscilloscope repair by the Supplier within the validity of the warranty, the Supplier shall recalibrate and verify the Oscilloscope once the repair is completed. The results of this process shall be provided to the CA.

5.1. Acceptance

Acceptance will be carried out by the CA upon delivery and final verification of the Oscilloscopes and documentation supporting the verification (see REQ-034442/A, REQ-034443/A and REQ-034444/A). The basis for acceptance will be the report about the execution of outgoing check and compliance with technical requirements (see REQ-034443/A).

In case of a successful acceptance phase, the CA will provide the Supplier signed acceptance protocol. In case of an unsuccessful acceptance stage, the CA will provide the Supplier Nonconformity Report (NCR) and a process in accordance with REQ-034445/A will be applied.

REQ-034447/A

The Acceptance phase shall demonstrate the following:

- Final Products have been successfully verified by the Supplier;
- All detected nonconformities have been solved in accordance with REQ-034445/A;
- Final Products are free of fabrication errors and are ready for the intended operational use.