



Technical Specification for the Bidirectional Transceivers, V01

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Abstract

The object of this Technical Specification is describing the requirements of the Bidirectional Transceivers used in the KM3NeT project.

Recipients

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1 Documentation and Acronyms

1.1 Abbreviations/Acronyms

Abbreviation	Description
APD	Avalanche Photo Diode
BER	Bit Error Rate
BOL	Beginning Of Life
DFB	Distributed Feedback laser
DOM	Digital Optical Module
EOL	End Of Life
ESD	Electrostatic discharge
GbE	Gigabit Ethernet
IT	Italy
ITU	International Telecom Union
KM3NeT	Cubic Kilometre Neutrino Telescope
LOS	Loss Of Signal
ODB	Open Data Base
PIN	Positive-Intrinsic-Negative photodiode
PRBS	Pseudo Random Bit Sequence
ROSA	Receiver Optical Sub-Assembly
TBD	To Be Defined
TOSA	Transmitter Optical Sub-Assembly
UPI	Unique Product Identifier

1.2 Reference Documents

	Title	Reference
RD 1.	Guide for Developing System Requirements Specifications	IEEE-STD-1220-1998 (IEEE 1998) IEEE 8



2 Introduction

2.1 Scope

The following specifications are for the tendering procedure of the Bidirectional transceivers to be placed inside the DOM and the DU Base Module for use in KM3NeT.

The supplier is expected to deliver for the tender the following products:

- A. bidirectional transceiver type A for DOM
- B. bidirectional transceiver type B for DU Base Module

2.2 Purpose of Specification

The specification is written to formulate the requirements of the bidirectional transceivers. We can use the following definition of requirement (RD 1):

Requirement: a statement that identifies a product or process operational, functional, or design characteristic or constraint, which is unambiguous, testable or measurable, and necessary for product or process acceptability (by consumers or internal quality assurance guidelines).

2.3 The structure of this document

The document consists of specifications grouped in chapters around the bidirectional transceivers (chapter 3).

3 Specifications for bidirectional transceivers for KM3NeT

The bidirectional transceivers type A and type B will be installed on host boards with a system design life of 15 years without maintenance.

Req.1.	EOL is 15 years
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3.1 General Features

The bidirectional transceivers type A and type B have to meet the following general characteristics:

Req.2.	Data rate: 1.25 Gb/s GbE
Req.3.	Include WDM splitter/combiner for bidirectional operation with a simplex optical interface
Req.4.	Must be delivered with 1 meter long optical pigtail. The bidder is free to adopt any kind of optical interface between the optical pigtail and the transceiver itself, the other end of the optical pigtail should not be connectorized.



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Req.5.	Directly compatible with PCB mount host board connector SAMTEC P/N STH-010-0.50-G-D-A-K-TR (ASP-187092-01)
Req.6.	Footprint: the surface available on the host boards is: 26.2 x 19.1 mm
Req.7.	The maximum allowed height of the transceiver is: 11 mm
Req.8.	Range: 10 km point to point of standard single mode fiber with attenuation of 0.2dB/km and chromatic dispersion of +18 ps/(nm•km)
Req.9.	BER at EOL: better than 10^{-12} measured with a PRBS of 2^7-1 at 1.25 Gb/s GbE data rate, for the following conditions: 10 km of standard single mode fibre with attenuation of 0.2dB/km and chromatic dispersion of +18 ps/(nm•km)
Req.10.	TOSA must be implemented using a DFB Laser light source
Req.11.	ROSA must be implemented using a PIN Photodiode, limiting amplifier and LOS detection circuit

3.2 Compliance with standards

The bidirectional transceivers type A and type B must comply with or exceed the following standards:

Req.12.	SFF-8472
Req.13.	SFF-8074i
Req.14.	SFF-8431 Rev 4.1 for Power Supply Noise (Peak-Peak)
Req.15.	Mechanical Shock: MIL-STD-810, Para. 516.6, proc. I, 650g 0.9 ms operating Mechanical Vibration: MIL-STD-810, Para. 514.6, 40g rms random, operating
Req.16.	MIL-STD-883 for ESD
Req.17.	MIL-STD-1344 for Damp Heat
Req.18.	ROHS
Req.19.	Class 1 Laser Safety

3.3 Functional/Performance Requirements

The bidirectional transceivers type A and type B have to meet the following requirements:

	Parameter	Min	Typ	Max	Unit
	Transmitter				
Req.20.	Average Output Power BOL	-9		-2	dBm
Req.21.	Average Output Power EOL	-9			dBm
Req.22.	Extinction Ratio	7			dB
Req.23.	Transmitted wavelength for Type A		1330		nm
Req.24.	Transmitted wavelength for Type B		1270		nm
Req.25.	Side Mode Suppression Ratio	30			dB
	Receiver				
Req.26.	Receiver sensitivity			-19	dBm
Req.27.	Receiver overload	0			dBm
Req.28.	LOS assert	-30			dBm
Req.29.	LOS hysteresis	0.5	2.0		dBm
	Digital diagnostics	Accuracy			
Req.30.	Transceiver temperature	±3			°C
Req.31.	Transceiver supply voltage	±0.1			V
Req.32.	Transmitter bias current	±10			%
Req.33.	Transmitter average optical output power	±3			dB
Req.34.	Receiver average optical input power	±3			dB



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3.4 Maximum supply current

Req.35.	The maximum supply current of the bidirectional transceiver should be declared and it shall not exceed 300 mA at EOL.
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3.5 Operating Conditions

The Bidirectional transceiver must be capable to operate in the following ranges:

	Parameter	Min	Max	Unit
Req.36.	Operating case temperature	-5	+70	°C
Req.37.	Power supply voltages	3.135	3.465	V

4 Acceptance test sheet provided by producer

The Tenderer must perform tests on the 100% of the parts delivered. This acceptance test sheet must include the measurements of the following parameters:

	Parameter reported in test sheet	Unit
Req.38.	Producer Serial Number	
Req.39.	BER at 1.25 Gb/s with a PRBS of 2^7-1 for the following conditions: 10 km of standard single mode fibre with attenuation of 0.2dB/km and chromatic dispersion of +18 ps/(nm•km)	
Req.40.	Maximum Broadband SMSR: min value	dB
Req.41.	Digital Diagnostic Case Temperature Error: min and max values	°C
Req.42.	Digital Diagnostic Receiver Optical Power Error: min and max values	dB
Req.43.	Digital Diagnostic Transmitter Optical Power Error: min and max values	dB
Req.44.	Firmware Version	
Req.45.	Current consumption: max value	A
Req.46.	Receiver LOS Assert level: min and typ values	dBm
Req.47.	Receiver LOS Hysteresis: min and typ values	dB
Req.48.	Maximum Sensitivity at 1.25 Gb/s with a PRBS of 2^7-1 for the following conditions: 10 km of standard single mode fibre with attenuation of 0.2dB/km and chromatic dispersion of +18 ps/(nm•km)	dBm

Req.49.	Transmitter average Power: min and max values	dBm
Req.50.	Transmitter eye crossing: min and max	%
Req.51.	Transmitter ER: min value	dB
Req.52.	Transmitter Mask Margin: min value	%

5 Labeling

The identification of the components consists of two numbers:

- Bidirectional transceiver UPI; unique number distributed by KM3NeT QA
- Bidirectional transceiver serial number given by producer

All these numbers should be connected in the final product. This should be done by marking the final product and keeping track of the underlying serial/identification numbers in records.

Req.53.	The manufactures shall keep track of all identifications: - Bidirectional transceiver UPI; - Bidirectional transceiver serial number of manufacturer.
Req.54.	The identification numbers shall be delivered in a readable electronic file format
Req.55.	There shall be no label on top side of the Bidirectional transceiver
Req.56.	Each Bidirectional transceiver shall be marked with a unique serial number supplied by the customer (UPI). The UPI is coded in ECC200 data matrix
Req.57.	The marking should be laser engraved on the body of the Bidirectional transceiver

The UPIs expected to be coded in the ECC200 data matrix are:

1. **For Type A: 3.4.3.2.3.1/1330:XXXXX:DOM/1.1**
2. **For Type B: 3.2.2.2.6/1270:XXXXX:BM/1.1**

XXXXX part of the UPI will depend on the manufacturer.

6 Logistics

6.1 Packaging

Req.58.	The Bidirectional transceiver shall be delivered in a box protecting the unit against abuse during transport.
Req.59.	The supplier shall describe the packaging for the transportation of the Bidirectional transceiver
Req.60.	The packaging shall protect the Bidirectional transceiver against mechanical shocks during the transportation
Req.61.	The packaging shall protect the Bidirectional transceiver against ESD
Req.62.	Each box should be accompanied by a printed sheet with the technical characteristics of the Bidirectional transceiver in the box
Req.63.	The format of the electronic file containing the characteristics of each Bidirectional transceiver and the association between the supplier serial number and the KM3NeT UPI will be agreed after the tender completion.
Req.64.	Shock indicators shall be present on the transport box
Req.65.	The contractor shall have full responsibility for the transport including insurance; the delivery must be delivered free of charge at the customer address, and all shipping costs including any customs duties and operations shall be charged to the company.

6.2 Documentation

Req.66.	Each delivery shall contain a printed sheet with the information specified in chapter 4 from Req.38 to Req.52
Req.67.	The format of the electronic file containing the characteristics of each Bidirectional transceiver and the association between the supplier serial number and the KM3NeT UPI will be agreed after the tender completion.

7 Annex

7.1 Annex 1 Tender Documentation

Tender documents for the Bidirectional transceiver are packed in a separate zip file. The documents are:

Req.68.	Calculated Reliability: FIT as predicted by model MIL-HDBK-217F Notice 2. The reliability should be calculated in a temperature range between 10 and 70 °C at 15 years.
Req.69.	Field Reliability as ratio between the Total number of failed units returned to the manufacturer from the field and Total number of units that have been produced. If the product is a new design, data related to similar design could be provided.
Req.70.	Qualification report