731 Enterprise Drive
Lexington, KY 40510

Telephone: 859-226-1000
Facsimile: 859-226-1040
www.intertek.com

AMENDED FINAL REPORT FOR:

CUSTOMER NAME: **Schneider Electric India Pvt. Ltd.**
 # 12A, Attibele Industrial Area
Hosur Road, Neralur Post, Bangalore – 562107 Karnataka, India

PRODUCT NAME: **LC-SC OS2 Fiber Channel**

Tested To:

ANSI/TIA-568.3-D-2016
Optical Fiber Cabling and Components Standard
October 2016

Annex E (Informative) Guidelines for Field-Testing Length, Loss & Polarity Of Optical Fiber Cabling, Section 5.1.4 Singlemode.

Date: November 15, 2017
Project: G103024698
Report: 103024698LEX-001.1

Responsible Engineer: _____ **Date:** 11/15/2017

Paul Alt, Senior Project Engineer

Approved By: Richard Proctor **Date:** 11/15/2017

Richard Proctor, Operations Manager

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

Table 1: History of Revision

Revision	Date	Section #	Description of Revision
Original	October 6, 2017	All	Original Document Issued
1	November 15, 2017	1.1.1.4 Test Configurations and Conditions, Table 3	The following statement was added below Table 3: "*Actassi Fiber Cables are also available in different configurations and different fiber count."

Declaration of Compliance

The LC-SC OS2 Fiber Channel was evaluated and found to be **compliant** with all applicable criteria of ANSI/TIA-568.3-D Optical Fiber Cabling and Components Standard, October 2016, Annex E (Informative) Guidelines for Field-Testing Length, Loss & Polarity of Optical Fiber Cabling, Section 5.1.4.

Sample Condition and Receive Date

Schneider Electric India Pvt. Ltd. selected and provided the test samples for evaluation to the criteria of ANSI/TIA-568.3-D. The samples arrived on 9/8/2017 in used condition. The equipment tested was the two fiber Singlemode LC-SC OS2 Fiber Channel link system.

1 ANSI/TIA 568.3-D-2016 Optical Fiber Cabling and Components Standard

1.1 Annex E (Informative) Guidelines for Field-Testing Length, Loss & Polarity of Optical Fiber Cabling, Section 5.1 Optical Cabling Attenuation

1.1.1 Annex E Section 5.1.4 Singlemode

1.1.1.1 Conformance Criteria

The cable link system shall not exhibit a change greater than the value determined in Section 7.3.7 Channel attenuation allowance calculation. The calculation is as follows:

Channel Attenuation Allowance (dB) = Cabled Fiber Attenuation Allowance (dB) + Connections Attenuation Allowance (dB) + Fiber Splices Attenuation Allowance (dB) + Optical Branching Components Attenuation Allowance (dB)

The calculation was determined with the values noted in Table 2:

Table 2: Section 7.3.7 Channel Attenuation Allowance Calculation Component Values

Calculation Formula Requirement	Component of LC-SC OS2 Fiber Channel	Maximum dB Allowed	Calculation
Cabled Fiber Attenuation Allowance	0.423 km spool of cabled fiber	1.0 dB/km	0.42 dB
Fiber Splices Attenuation Allowance	2 fusion splices from spool to pigtail	0.3 dB per splice	0.6 dB
Connections Attenuation Allowance	0.5 dB per connection	1 dB	1 dB
Optical Branching Components Attenuation Allowance	NA	NA	NA
Total Maximum loss allowed per channel			2.02 dB

NA: Not Applicable

1.1.1.2 Sample Size

One LC-SC OS2 Fiber Channel was tested for compliance to ANSI/TIA 568.3-D-2016, Annex E, Section 5.1.4 Singlemode.

1.1.1.3 Test Method

I. Test Methodology and Setup

1. The RIFOCS test system was setup and allowed to stabilize for one hour prior to testing.
2. One ST/SC LC 1.6 mm jacketed cable launch lead was connected to the RIFOCS 1310 nm source.
3. One ST/SC LC 1.6 mm jacketed cable launch lead was connected to the RIFOCS detector.
4. Per ANSI/TIA-568.3-D, Section E, the following test method steps were established. All references from this test method to clause and sub-clause refer directly back to this standard and section for development of the procedures used.
5. The basic steps taken to measure and calculate singlemode cabling attenuation include:
    a. Verifying cord quality (once before testing; see clause E.5.1.4.1)
    b. Setting the reference (once before testing; see clause E.5.1.4.2)
    c. Verifying the reference (once before testing; see clause E.5.1.4.3)
    d. Measuring cabling attenuation (each link; see clause E.5.1.4.4)
    e. Calculating attenuation (each link; see clause E.5.1.5).

II. Setting the Reference

1. The following procedure verified that test jumpers are in acceptable condition for singlemode cabling. All jumper cables selected were verified to have the proper cord quality for test leads per ANSI/TIA-568.3-D, Section E, clause 5.1.4.1.
2. The first jumper (J1) having one non-overlapping 30 mm (1.2 inches) wrap of singlemode fiber on a mandrel was connected to the 1300 nm source.
3. To verify that the test jumper was in acceptable condition, the light source was referenced to the optical power meter with the launch (see Figure 1).
4. The resulting measurements recorded as the initial, or P1, measurements.

III. Verifying the Reference

1. The first jumper (J1) having one non-overlapping 30 mm (1.2 inches) wrap of singlemode fiber on a mandrel was connected to the 1310 nm source.
2. The test jumper (J1) was disconnected from the power meter (only) and a second test jumper (J2) was inserted by connecting it to (J1) with a mating adapter and then to the power meter to record the measurement (see Figure 2).
3. Both ends of J2 were disconnected. The ends were then interchanged, reconnected and the measurement was read again.
4. All resulting measurements were within the appropriate connector loss specification for reference quality test jumpers ≤ 0.2 dB.

IV. Measuring Cabling Attenuation

1. TIA-526-7-A, Method A-1 was used to test singlemode cabling attenuation.
2. The LC-SC OS2 Fiber Channel was setup per the manufacturer's instructions. All connections were cleaned, mated and verified to be functional prior to the beginning of testing.
3. The reference measurements were established prior to each connection to verify there was no change or drift from the initial reference measurements.
4. The link measurement was then performed on the first channel by disconnecting this test jumper from the optical meter (only), placing a second jumper (J2) previously verified as reference quality on the optical meter, and then measuring the link attenuation by connecting the test jumper of the source to one end of the cabling link and the test jumper of the meter to the other end of the cabling link.
5. The resulting measurements recorded as the final, or P2, measurements in the forward direction.
6. Both ends of the cabling link were disconnected. The ends were then interchanged, reconnected and the measurement was read again.
7. The resulting measurements recorded as the final, or P2, measurements in the reverse direction.

V. Calculating Cabling Attenuation

1. The flowing formula is used to calculate the loss on each channel:
   a. Initial measurements of launch lead (P1) minus Final measurements of individual link channel (P2) = Loss of link channel in dB.
2. The loss for each channel is calculated in the forward and reverse directions, as well as an averaging of these losses for complete channel loss calculations.
3. The loss for each channel, as well as the measurement direction the loss was calculated in, was reported individually in the **Test Results** section of this report.

1.1.1.4 Test Configurations and Conditions

The test was conducted at lab ambient atmospheric conditions; 23 ± 2°C, ~75% RH.

Optical measurements were taken at 1300 nm ± 20 nm.

The launch lead used was verified to be reference quality per the standard.

The test condition setup and referencing is demonstrated in Figure 1.

The test measurement configuration is demonstrated in Figure 2.

The customer's equipment individual part identification numbers are listed in Table 3.

The LC pigtails were fully populated in the 48 port LIU Blank ACTFMD1URS48_E.

The SC pigtails were fully populated in the 24 port LIU Blank ACTFMD1URS24_E.

For this project only 24 channels were monitored.

Table 3: Part Numbers and Quantities

Item	Schneider Electric India Pvt. Ltd. Part Number	Description	Qty
1	ACTFMD1URS24_E	24 port LIU Blank (SC)	1
2	ACTFMD1URS48_E	48 port LIU Blank (LC)	1
3	ACTFT1C1S19S10_E	SC Pigtail	24
4	ACTFMD1PSC6PSM_E	SM SC Adaptor Panel	4
5	ACTFT1L1S19S10_E	LC Pigtail	24
6	ACTFMD2PLC6PSM_E	LC Adaptor Panel	4
7	ACTUDGST48SM9_E	48-FIBER, OS2, 0.423KM SPOOL, Armoured GST Fiber Cable	1

*Actassi Fiber Cables are also available in different configurations and different fiber count.

Figure 1: Launch Lead Reference and Verification

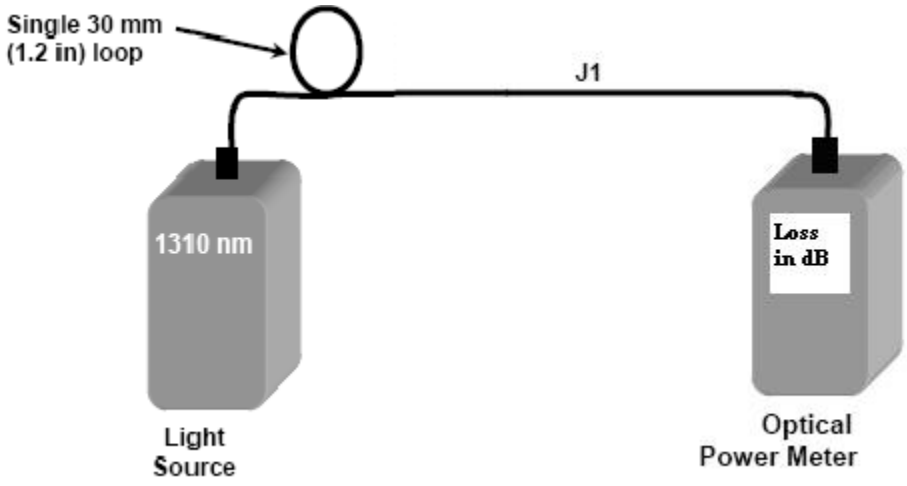
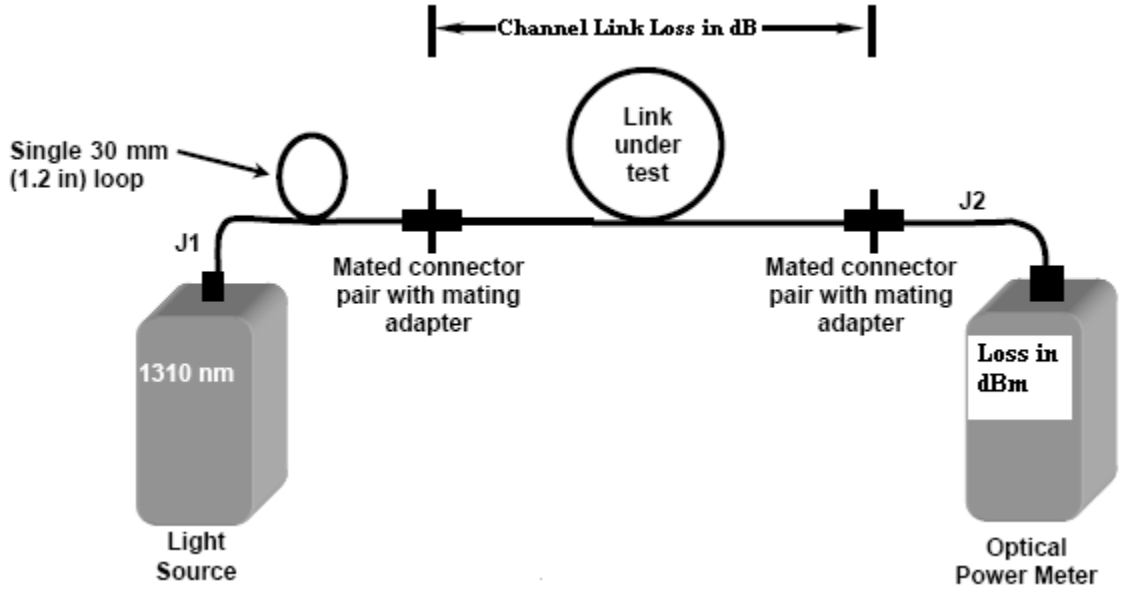


Figure 2: Cable Link Channel Testing Configuration



1.1.1.5 Test Equipment Used

Link System Loss Testing					
Equipment Type	**Manufacturer**	**Model Number**	**Local ID Number**	**Last Cal Date**	**Next Cal Date**
Fiber Optic Cleaning Reels	CLETOP	Type A	NA	NA	NA
1310 nm (±20 nm) LED Source	RIFOCS	655R	1999	NA	NA
InGaAs Power Meter	RIFOCS	675RE	1999	7/30/2017	7/30/2018
SuperController	RIFOCS	671	1999	7/30/2017	7/30/2018
Mandrel Size = 18 mm (0.71 inch)	Intertek	NA	NA	NA	NA
Optical Fiber Multi Mode OS2 2mm Jacketed Cable Test Leads (QTY 2)	NA	NA	NA	NA	NA

NA: Not Applicable

1.1.1.6 Summary of Test Results

Conformance/Nonconformance

Criteria	Conforms? C/NC
The cable link system shall not exhibit a change greater than the value determined in Section 7.3.7 Channel attenuation allowance calculation. For this evaluation, the criterion is 2.02 dB per individual fiber channel.	**C**

Actual Sample Size and Test Method Deviations

One LC-SC OS2 Fiber Channel was tested for compliance to this section. There were no deviations from, additions to, or exclusions from, the documented test method here.

Failure History

There was no history of failure for the testing in this section.

Disposition of Nonconformance

There was no failure for the testing in this section.

Test Data

Table 4: Insertion Loss Forward Reading at 1300 nm

Test Performed By:			Test Date		
Paul Alt			9/26/2017		
Test Channel	**Test Configuration**	**Directional Reading**	**Max Value (dB)**	**Loss Criteria**	**Complies? Y/N**
1	**24 Channel SM (OS2)**	**Forward**	-1.38	≤ ±2.02 dB	Y
2	**24 Channel SM (OS2)**	**Forward**	-1.57	≤ ±2.02 dB	Y
3	**24 Channel SM (OS2)**	**Forward**	-1.73	≤ ±2.02 dB	Y
4	**24 Channel SM (OS2)**	**Forward**	-1.27	≤ ±2.02 dB	Y
5	**24 Channel SM (OS2)**	**Forward**	-1.19	≤ ±2.02 dB	Y
6	**24 Channel SM (OS2)**	**Forward**	-1.87	≤ ±2.02 dB	Y
7	**24 Channel SM (OS2)**	**Forward**	-1.65	≤ ±2.02 dB	Y
8	**24 Channel SM (OS2)**	**Forward**	-1.63	≤ ±2.02 dB	Y
9	**24 Channel SM (OS2)**	**Forward**	-1.79	≤ ±2.02 dB	Y
10	**24 Channel SM (OS2)**	**Forward**	-1.53	≤ ±2.02 dB	Y
11	**24 Channel SM (OS2)**	**Forward**	-1.57	≤ ±2.02 dB	Y
12	**24 Channel SM (OS2)**	**Forward**	-1.80	≤ ±2.02 dB	Y
13	**24 Channel SM (OS2)**	**Forward**	-1.64	≤ ±2.02 dB	Y
14	**24 Channel SM (OS2)**	**Forward**	-1.79	≤ ±2.02 dB	Y
15	**24 Channel SM (OS2)**	**Forward**	-1.51	≤ ±2.02 dB	Y
16	**24 Channel SM (OS2)**	**Forward**	-1.51	≤ ±2.02 dB	Y
17	**24 Channel SM (OS2)**	**Forward**	-1.44	≤ ±2.02 dB	Y
18	**24 Channel SM (OS2)**	**Forward**	-1.59	≤ ±2.02 dB	Y
19	**24 Channel SM (OS2)**	**Forward**	-1.91	≤ ±2.02 dB	Y
20	**24 Channel SM (OS2)**	**Forward**	-1.88	≤ ±2.02 dB	Y
21	**24 Channel SM (OS2)**	**Forward**	-1.65	≤ ±2.02 dB	Y
22	**24 Channel SM (OS2)**	**Forward**	-1.54	≤ ±2.02 dB	Y
23	**24 Channel SM (OS2)**	**Forward**	-1.53	≤ ±2.02 dB	Y
24	**24 Channel SM (OS2)**	**Forward**	-1.61	≤ ±2.02 dB	Y

Table 5: Insertion Loss Reverse Reading at 1300 nm

Test Performed By:			Test Date		
Paul Alt			9/26/2017		
Test Channel	**Test Configuration**	**Directional Reading**	**Max Value (dB)**	**Loss Criteria**	**Complies? Y/N**
1	**24 Channel SM (OS2)**	**Reverse**	-1.40	≤ ±2.02 dB	Y
2	**24 Channel SM (OS2)**	**Reverse**	-1.56	≤ ±2.02 dB	Y
3	**24 Channel SM (OS2)**	**Reverse**	-1.74	≤ ±2.02 dB	Y
4	**24 Channel SM (OS2)**	**Reverse**	-1.21	≤ ±2.02 dB	Y
5	**24 Channel SM (OS2)**	**Reverse**	-1.34	≤ ±2.02 dB	Y
6	**24 Channel SM (OS2)**	**Reverse**	-1.87	≤ ±2.02 dB	Y
7	**24 Channel SM (OS2)**	**Reverse**	-1.80	≤ ±2.02 dB	Y
8	**24 Channel SM (OS2)**	**Reverse**	-1.74	≤ ±2.02 dB	Y
9	**24 Channel SM (OS2)**	**Reverse**	-1.57	≤ ±2.02 dB	Y
10	**24 Channel SM (OS2)**	**Reverse**	-1.60	≤ ±2.02 dB	Y
11	**24 Channel SM (OS2)**	**Reverse**	-1.53	≤ ±2.02 dB	Y
12	**24 Channel SM (OS2)**	**Reverse**	-1.89	≤ ±2.02 dB	Y
13	**24 Channel SM (OS2)**	**Reverse**	-1.73	≤ ±2.02 dB	Y
14	**24 Channel SM (OS2)**	**Reverse**	-1.42	≤ ±2.02 dB	Y
15	**24 Channel SM (OS2)**	**Reverse**	-1.45	≤ ±2.02 dB	Y
16	**24 Channel SM (OS2)**	**Reverse**	-1.54	≤ ±2.02 dB	Y
17	**24 Channel SM (OS2)**	**Reverse**	-1.70	≤ ±2.02 dB	Y
18	**24 Channel SM (OS2)**	**Reverse**	-1.54	≤ ±2.02 dB	Y
19	**24 Channel SM (OS2)**	**Reverse**	-1.84	≤ ±2.02 dB	Y
20	**24 Channel SM (OS2)**	**Reverse**	-1.76	≤ ±2.02 dB	Y
21	**24 Channel SM (OS2)**	**Reverse**	-1.44	≤ ±2.02 dB	Y
22	**24 Channel SM (OS2)**	**Reverse**	-1.60	≤ ±2.02 dB	Y
23	**24 Channel SM (OS2)**	**Reverse**	-1.64	≤ ±2.02 dB	Y
24	**24 Channel SM (OS2)**	**Reverse**	-1.58	≤ ±2.02 dB	Y

Table 6: Insertion Loss Average Reading at 1300 nm

Test Performed By:			Test Date		
Paul Alt			9/26/2017		
Test Channel	**Test Configuration**	**Directional Reading**	**Max Value (dB)**	**Loss Criteria**	**Complies? Y/N**
1	**24 Channel SM (OS2)**	**Average**	-1.39	≤ ±2.02 dB	Y
2	**24 Channel SM (OS2)**	**Average**	-1.57	≤ ±2.02 dB	Y
3	**24 Channel SM (OS2)**	**Average**	-1.74	≤ ±2.02 dB	Y
4	**24 Channel SM (OS2)**	**Average**	-1.24	≤ ±2.02 dB	Y
5	**24 Channel SM (OS2)**	**Average**	-1.27	≤ ±2.02 dB	Y
6	**24 Channel SM (OS2)**	**Average**	-1.87	≤ ±2.02 dB	Y
7	**24 Channel SM (OS2)**	**Average**	-1.73	≤ ±2.02 dB	Y
8	**24 Channel SM (OS2)**	**Average**	-1.69	≤ ±2.02 dB	Y
9	**24 Channel SM (OS2)**	**Average**	-1.68	≤ ±2.02 dB	Y
10	**24 Channel SM (OS2)**	**Average**	-1.57	≤ ±2.02 dB	Y
11	**24 Channel SM (OS2)**	**Average**	-1.55	≤ ±2.02 dB	Y
12	**24 Channel SM (OS2)**	**Average**	-1.85	≤ ±2.02 dB	Y
13	**24 Channel SM (OS2)**	**Average**	-1.69	≤ ±2.02 dB	Y
14	**24 Channel SM (OS2)**	**Average**	-1.61	≤ ±2.02 dB	Y
15	**24 Channel SM (OS2)**	**Average**	-1.48	≤ ±2.02 dB	Y
16	**24 Channel SM (OS2)**	**Average**	-1.53	≤ ±2.02 dB	Y
17	**24 Channel SM (OS2)**	**Average**	-1.57	≤ ±2.02 dB	Y
18	**24 Channel SM (OS2)**	**Average**	-1.57	≤ ±2.02 dB	Y
19	**24 Channel SM (OS2)**	**Average**	-1.88	≤ ±2.02 dB	Y
20	**24 Channel SM (OS2)**	**Average**	-1.82	≤ ±2.02 dB	Y
21	**24 Channel SM (OS2)**	**Average**	-1.55	≤ ±2.02 dB	Y
22	**24 Channel SM (OS2)**	**Average**	-1.57	≤ ±2.02 dB	Y
23	**24 Channel SM (OS2)**	**Average**	-1.59	≤ ±2.02 dB	Y
24	**24 Channel SM (OS2)**	**Average**	-1.60	≤ ±2.02 dB	Y

Photograph:

Figure 3: LC-SC OS2 Fiber Channel Test Setup

References

External Reference Documents

- ANSI Z136.2 ANS For Safe Use Of Optical Fiber Communication Systems Utilizing Laser Diode And LED Sources
- ANSI/TIA-526-7-A, Revision A, July 29, 2015: Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures – Part 4-2: Installed Cable Plant – Single-Mode Attenuation and Optical Return Loss Measurement
- ANSI/TIA-568-C.0-2-2012 General Telecommunications Cabling for Customer Premises
- ANSI/TIA-568.3-D-2016 General Telecommunications Cabling for Customer Premises
- IEC 61918-2007, Industrial Communication Networks - Installation of Communication Networks in Industrial Premises
- TIA-492CAAA, Detail Specification For Class IVA Dispersion-Unshifted Single-Mode Optical Fibers
- TIA-492CAAB, Detail Specification For Class IVA Dispersion-Unshifted Single-Mode Optical Fibers With Low Water Peak
- TIA TSB-31-C, Telephone Terminal Equipment Rationale and Measurement Guidelines for US Network Protection 51

Intertek Documents

- LEX-OE-FIB-179, Fiber Training Program Description
- LEX-OE-FIB-178, General Fiber Safety Policy
- LEX-OE-FIB-185, Fiber Optic Handling Safety Rules and Practices for Optical Fiber Components and Systems Procedures
- LEX-OE-FIB-037, Fiber Optic Insertion Loss and Reflectance Measurements