Verizon NEBS™ Compliance: Generic Requirements for Passive Optical Component

Verizon Technical Purchasing Requirements

VZ.TPR.9427

Issue 6, December 2011

CHANGE CONTROL RECORD:

Version	Date	Action*	Reason for Revision
1	*07/31/2007*	New	New Document
2	*10/04/2007*	Add	Added temperature requirements for optical characterization
3	*10/28/2007*	Change	Changed the During test measurement requirement
	10/28/2007	Delete	"Hermetic Product Only" from Section 5.4.2.3
	10/28/2007	Add	Added note for providing additional test data
4	*2/1/2008*	Change	Removed RL requirement during testing.
	2/1/2008	Add	Added notes for clarity on some of the testing.
5	*08/24/2011*	Change	Plug and Play Splitter Qualification – Added Clarification
	08/24/2011	Change	Added Clarifications to Splitter Component & Splitter Module Re-Qualification Guidelines
	08/24/2011	Add	Proven Technology and Product Family Qualification Test Program
6	*12/09/2011*	Change	Modification to Proven technology and product Family Qualification Test Program
	12/09/2011	Add	Defined ports tested for 1x64, 2x64 splitters

* **New, Add, Delete, Change, Reissue**

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Table of Contents

1.0 PURPOSE 5
2.0 SCOPE 5
3.0 REFERENCES 5
4.0 ACRONYMS 5
5.0 TEST REQUIREMENTS FOR PASSIVE OPTICAL COMPONENTS 6

1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to provide FOC testing Requirements for Passive Optical Components.

2.0 SCOPE

FOC Products

3.0 REFERENCES

Verizon ITL Memo #26, June 30 2005	Notes and Information – Various GR's
Verizon FOC Memo #27, Rev 1 – July 27, 2005	GRs: 1209 and 1221 Splitters and other Passive Optical Components, Complete Program Test Punch Lists and Modified Test Programs/Punch Lists for Specific Scenarios
Verizon FOC Memo #40, June 26, 2006	Summary Notes
GR-1209-CORE; Issue 3, March 2001	Generic Requirements for Passive Optical Components

4.0 ACRONYMS

FOC	Fiber Optic Components
ITL	Independent Testing Laboratory
FDH	Fiber Distribution Hub
IL	Insertion Loss
RL	Return Loss
nm	Nano-meter
N/A	Not Applicable
B	Before
D	During
A	After

5.0 TEST REQUIREMENTS FOR PASSIVE OPTICAL COMPONENTS

Verizon is considering using Passive Optical Components for all applications as required. The following are the test requirements for qualifying Passive Optical Components. All the testing must be completed by a Verizon approved ITL.

M x N Splitter Module FOC TPR.9427 (GR-1209) Qualification Test Program		
Task Name	**Optical Measurements**	**Test Conditions**
Prepare Test Samples & Materials		Room Temp unless noted otherwise
3. General and Design Criteria		
3.1.1 General Documentation		Per GR-1209
3.1.2 Workcenter Information Package		Per GR-1209
3.2 Marking, Packaging, and Shipping		Per GR-1209
3.3 Physical Design Criteria		Per GR-1209
3.3.1 General Physical Design Criteria		Per GR-1209
3.3.2 Optical Fiber		Per GR-1209
3.3.3 Optical Connectors		Per GR-1209
3.3.4 Materials		Per GR-1209
3.3.4.1 Toxicity		Per GR-1209
3.3.4.2 Corrosion Resistance		Per GR-1209
3.3.4.3 Dissimilar Metals		Per GR-1209
3.3.4.4 Fungus Resistance		Per GR-1209
3.3.4.5 Flammability		Per GR-1209
3.3.5 Safety		Per GR-1209
3.3.6 Mounting		Per GR-1209
3.4 Passive Optical Component Qualification		Per GR-1209
3.5 Reliability Assurance		Per GR-1209
3.6 Quality Technology Program		Per GR-1209
4.0 Optical Performance Criteria (Characterization)		
4.1 Optical Bandpass		Measured from 1260nm thru 1635nm
4.2 Insertion Loss		Reported at 1310/1490/1550/1625
4.3 Uniformity		
4.4 Isolation		**N/A Splitters**
4.5 Directivity		Measurements on Adjacent ports (output)
4.6 Return Loss		Measured on all Output ports
4.7 Polarization-Dependent Loss		
4.8 Polarization Dependent Wavelength		**N/A Splitters**
4.9 Polarization-Mode Dispersion		Measured @ 1550nm only
4.10 Temperature Effects on DWDM Components		**N/A Splitters**

M x N Splitter Module FOC TPR.9427 (GR-1209) Qualification Test Program		
Task Name	**Optical Measurements**	**Test Conditions**
4.11 Other Fiber Optic Filter Specific Criteria		**N/A Splitters**
Initial Optical Performance Measurements	All	Complete set of initial optical characterization measurements at four wavelengths @-40°C, 23°C, 85°C
5.0 Environmental and Mechanical Performance Test Sequence		
5.4.1 Transportation and Handling		
5.4.1.1 Temperature-Humidity Aging *	IL - B/D/A, RL - B	75º C/ 90% RH, 7 days
5.4.1.5 Temperature Cycling *	IL - B/D/A,	−40°C to +70°C; 10 cycles; Dwell Time: ≥15 minutes; Ramp Rate: 1°C/min.
5.4.2 Operational Performance		
5.4.2.2 Temperature-Humidity Cycle: Uncontrolled Environment *	IL - B/D/A	Between -40°C and +85°C; humidity from 20% RH to 85% RH
5.4.2.3 Water Immersion *	IL - B/D/A, RL - A	+43°C, pH 5.5, 168 hrs.
5.4.1 Transportation and Handling		
5.4.1.2 Vibration	IL - B/A	10-55 Hz, 1.52 mm amplitude, 3 axes (20 minutes/axis) for 1 hour if only testing toVZ.TPR.9427 or GR-1221 Section 6.2.2.1 Vibration Test - Condition A, 20 G maximum, 20-2000 Hz, 4 minutes per cycle and 4 cycles per axis if testing to both VZ.TPR.9427 and VZ.TPR.9405
5.4.1.4 Module Impact - Mechanical Shock	IL - B/A	50 G (based on module mass), 3 axes, 2 impacts/direction, (12 impacts total), Nominal 1ms, Half Sine Pulse / GR-1221 Mechanical Shock Test
5.4.3 Fiber Integrity Criteria		
5.4.3.1 Fiber Flex	IL - B/A	Loose Buffered Fiber: 0.45 kg, 30 cycles Reinforced Cable: 0.45 kg, 30 cycles *There is a conditional cycling require of 300 cycles for the product.*
5.4.3.2 Fiber Twist	IL - B/A	Loose Buffered Fiber: 0.45 kg, 10 cycles Reinforced Cable: 0.45 kg, 10 cycles
5.4.3.3 Fiber Side Pull	IL - B/A	Coated Fiber: 0.23 kg, 90°, 5 sec, 2 dir. Tight Buffered Fiber: 0.23 kg, 90°, 5 sec, 2 dir. Loose Buffered: 0.45 kg, 90°, 5 sec Reinforced Cable: 0.45 kg, 90°, 5 sec
5.4.3.4 Fiber and Cable Retention (Straight Pull)	IL - B/A	Coated Fiber: 0.45 kg, 60 sec,1x, or 5 sec, 3x Tight Buffered Fiber: 0.45 kg, 60 sec,1x, or 5 sec, 3x Loose Buffered Fiber: 1.0 kg, 60 sec,1x, or 5 sec, 3x Reinforced cable: 1.0 kg, 60 sec,1x, or 5 sec, 3x
6.0 Optical Performance Criteria (As Specified During Environmental and Mechanical Performance Test		

M x N Splitter Module FOC TPR.9427 (GR-1209) Qualification Test Program		
Task Name	**Optical Measurements**	**Test Conditions**
Sequence)		
4.2 Insertion Loss		
4.6 Return Loss		
7.0 Final Optical Performance Measurements	All	Complete set of optical characterization measurements[1] at four wavelengths @ 23°C, as defined in section 4.0.

Optical Measurements:

Characterization	100% of devices and channels unless other wise specified
B & A - Before and After	IL Optical Testing @ (1310, 1490, 1550 and 1625nm) - 100% of channels, unless otherwise stated in this TPR
D - During	IL Optical Testing @ (1310, 1490, 1550 and 1625nm) - 100% of channels, unless otherwise stated in this TPR
IL - Insertion Loss, RL - Return Loss	
Sample Configurations:	
1 product	11 samples / 3 hot spares
2 or more products	7samples/7samples/x…. 2 hot spares/2 hot spares/x….
* - Environmental Testing to be preformed sequentially	(Temp Humidity Aging, Temp Cycling, Temp/Humidity Cycling, Water Immersion)
Number of Ports Tested	Sample ports tested. For all full evaluations of 1x64 or higher count splitter modules (including 2x64), the number of ports tested is reduced to 50%. Ports are to selected for testing in the following manner: Sample 1 – All even numbered ports Sample 2- All odd numbered ports Sample 3 – All even numbered ports Sample 4- All odd numbered ports • • •

Notes:

[1] The final optical measurements are reduced to IL/RL if all samples meet the mechanical and environmental criteria of this document.

Optical Bandpass: is specified at a max range of 1635nm rather than 1625nm to allow for a +/- 10nm variance in the source as in most of the other standards.

RL on all Output Ports: This method was advised as a means of making the measurement easier to perform and more accurate. While using a mandrel deading method for RL, measuring RL from output to input will provide a return loss of a specific channel. Measuring from the input to the outputs provides for the maximum return loss of all of the channels in the device. Although this seems simpler due to the need to only perform one measurement, utilizing a wrapping measurement method can be very difficult to ensure you properly deadened all connections. If you can accurately read the product from the input to the output, this would be acceptable providing utilization of a Verizon approved methodology.

*Plug and Play Splitters:

Must be tested in a configuration that uses the actual complete FDH or a fixture that simulates the FDH receptacle shelf for the splitter. When performing the GR-1209 Temperature and Humidity Cycle the following procedural steps are required:

At 23 C, perform 10 insert/remove cycles of the plug/play splitter modules. Measure IL/RL, then subject the samples to 42 cycles of Temp/Hum per GR-1209. At the conclusion of the 42 cycles measure IL/RL. Raise the chamber temperature to 40 C and allow the temperature to stabilize. Subject the samples to 25 insert/remove cycles, measure IL/RL. Lower the chamber temperature to -18 C and allow the temperature to stabilize. Subject the samples to 25 insert/remove cycles. Measure IL/RL. Raise the chamber temperature to 23 C. Perform 10 insert/remove cycles and measure IL/RL.

Splitter Component & Splitter Module Re-Qualification Guidelines (Due to Design Changes):

Note: Test results for all the requirements that need testing per Section 3 of GR-1209 and Section 3 & 4 of GR-1221 must be provided with option A & B below.

- Option A – Splitter Component not Qualified/Module remains the same:
  (i.e. - qualified splitter module that you intend on replacing the splitter with a new, unqualified splitter component within the module)
  - Perform splitter component qualification to both TPR.9427 and TPR.9405 criteria.
  - Complete set of initial optical characterization measurements at four wavelengths @-40°C, 23°C, 85°C, as stated in the TPRs
  - Fiber integrity testing not required if module already qualified
  - No module level testing required
  - Complete set of final optical characterization measurements at four wavelengths @ 23°C, as stated in the TPRs.

- Option B – Splitter Component Qualified/Module not Qualified
    - Complete set of initial optical characterization measurements at four wavelengths @-40°C, 23°C, 85°C: as stated in the TPR's.
    - Perform Module Qualification per TPR.9427 (GR-1209-CORE) criteria.
    - Substitute Vibration and Physical Shock from 1221 with that of 1209
    - Complete set of final optical characterization measurements at four wavelengths @ 23°C, as stated in the TPR.

Splitter Proven Technology Product Family Qualification Test Program

This section defines a "Proven Technology Product Family Qualification Test Program" that is intended to provide necessary performance criteria for qualifying new splitter products using a reduced set of TPR.9405 and TPR.9427 criteria based on proven technology and the existence of previously qualified high splitter count Splitter products. The set of criteria is intended to provide sufficient assurance of product performance and quality while reducing substantially the product qualification testing cycle.

Qualifications Requirements

Splitter Type and/or Manufacturer Experience	Qualification Program Required
New Manufacturer (no previously FOC qualified splitters)	Full TPR.9405 and Full TPR.9427 FOC test
New Splitter Technology (manufacturer has not qualified any identical technology type splitters)	Full TPR.9405 and Full TPR.9427 FOC test
New Family member (Supplier seeks to qualify a smaller port count splitter) (Large port count splitter previously qualified.)	TPR.9405 and TPR.9427 Waiver Program

Conditions for a PLC Based Optical Splitter and Modules Faimly Test Qualification Waiver

A Splitter component chip or module may qualify for a TPR.9405 and TPR.9427 test program waiver if the following conditions are met.

A. The highest port count (such as a 1x64 or 2x64) of the Vendor's splitter/module family has been FOC tested and qualified/certified via the Verizon FOC program.
B. Then the full FOC testing for any lower count modules can be waived (such as the 1x32 or 2x32) provided that the following criteria are met:

    a. A complete FOC test report (TPR.9405 and TPR.9427) for the highest count port exists and that the report shows that the highest port count splitters (for example, the 1x64 and 2x64) are compliant.
    b. The Vendor must provide proof that the lower port count splitter chip uses the same technology and that the chip component is manufactured by the same supplier utilizing the same manufacturing processes and acceptance criteria.
    c. The splitter module design is exactly the same* as the originally qualified highest port count splitter

OR

In the lower count module, minor design changes have been made to improve the product. Vendor must supply change details and all applicable in-house test data showing that the changes have not resulted in a decrease in module performance. (Verizon will review the design changes and data and decide if the design changes are "minor" and if the data is sufficient to show that the changes are non-performance affecting.)

d. All Incoming lots of the splitter component are 100% screen tested and inspected. One hundred percent of all outgoing final products (including 100% of the ports) are tested for IL, RL, PDL, and Uniformity. Comprehensive records are kept of the testing results/activities. One hundred percent (100%) of shipped product must comply with the Verizon RFQ criteria.
e. The technical criteria of IL uniformity, RL and PDL for the smaller port count modules lower port spec on IL Uniformity, RL, and PDL are no worse than the higher end splitter/module,
f. A random sample selection and verification is required for the lower port count splitter/module. (See the following definition of the verification criteria).
    A. Factory Audit per Verizon TPR.9445 (Process audit only 1-2 day)
    B. Test Eleven (11) samples (from factory audit) to the complete set of optical characterization criteria Per TPR.9427 at 23C followed by;
    C. Seven (7) days of temperature-humidity aging per TPR.9427 section 5.4.1.1.
    D. Twenty One Cycles, Seven (7) days of temperature cycling per TPR.9427, section 5.4.2.2[2].
    E. Optical monitoring of IL/RL Before, IL during, and IL/RL after.

***A lower count splitter module is the same as the original higher count splitter module if the following conditions are met:**

Chip:

1. The lower port count splitter chip utilizes the same splitter technology and manufacturer as the high port count splitter chips.
2. The lower port count chip utilizes the same input fiber array and adhesive.
3. The lower port count chip utilizes the same output fiber array and adhesive
4. The lower port count chip uses the same component case style and materials (but case size may vary)
5. The lower port count chip uses the same fiber type

Module:

1. The lower port count module chip meets the chip criteria 1 through 5 above.

[2] Controlled Environment (section 5.4.2.1) Temperature Humidity cycling (with the modification of reducing testing to 168 hrs) is applicable for those splitters intended for controlled environment only.

2. The lower port count module utilizes the same materials and basic module physical design (shape, material thickness, component layout, etc.)
3. The lower port count module utilizes the same terminating method and parts (Including cables and connectors)
4. Basic manufacturing assembly procedures are the same as the larger port splitter module.
5. Module is assembled at the same factory location as the larger port splitter modules.

Definitions:

Splitter Component Product Family – A MxN splitter component is a member of a product family if the splitter component has the following characteristics:

- Utilizes the same splitter technology and manufacturer (as the other members of the family), such as PLC
- Uses the same input fiber array and adhesive
- Uses the same adhesive and interface type on the output
- Uses the same component case style and materials (but case size may vary)
- Utilizes the same fiber type

The largest size component family member has been successfully FOC tested.