

Generating Fiber Characterization Reports

By Gregory Lietaert

High-speed and high-quality transmission systems require verification of network fiber infrastructure performance to ensure reliable equipment operation and to meet rigorous performance standards. At 10 G and 40 G line rates, dense wavelength division multiplexing (DWDM) and optical transport network (OTN) technologies require a detailed conventional measurement suite and additional tests to measure dispersion.

The number of optical tests needed to comprehensively characterize fiber can generate a large amount of data that must then be delivered to the network operator. However, compiling and formatting the test results into a comprehensive, professional report quickly with minimal risk for errors can be challenging.

Why is a Fiber Characterization Report Essential?

Failure to characterize the fiber before installing system components can substantially delay service provisioning or increase repair times. It can also potentially postpone projects or cause providers to miss turn-up commitments. Detailed records must be generated for the test parameters that can affect transmission quality, and network managers must know the system's limitations for future provisioning. Fiber characterization reports serve as a contractual document that installers or third-party fiber characterization companies must provide to all service providers.

If the network fails to perform as contracted and reported, the network provider must be able to test the network to pinpoint the trouble source. Comprehensive, complete fiber characterization reports provide key information for troubleshooting because it lets providers quickly compare measurements recorded during fiber installation against current test results. They can then use this information to isolate and sectionalize problems or to assign responsibility to fix the issue.

Furthermore, verifying fiber performance and comparing it to commissioning/acceptance test values becomes useful for ongoing network analysis and to spot trends. A complete and comprehensive fiber characterization report helps providers investigate fiber behavior or degradation.

Professional, Optimized Test Reports

Professional, optimized fiber characterization test reports provide critical information used throughout the network life cycle, therefore, quality reports are a necessity. Generated reports must be professional-looking and must provide all relevant link information including detailed measurements. Furthermore, reports must meet the end-customer's content and format requirements.

Managing Multiple Test Results

As transmission system performance increases, the number of test parameters becomes increasingly important. Conventional tests, the core of the fiber characterization report, include insertion loss (IL), optical return loss (ORL), and bidirectional OTDR measurements for 1310/1550/1625 nm wavelengths. The OTDR provides loss, distance, and reflectance values for each of the in-line components on the link, such as splices and connectors. Reporting these conventional measurements already produces an extensive, complex report.

In addition, the final report must include dispersion tests because they assure the link's or DWDM transmission systems' ability to run at very high bit rates. Dispersion tests measure both polarization mode dispersion (PMD) and chromatic dispersion (CD) end to end. However, the CD measurement's wavelength-dependent characteristics can generate a large table of data for the entire 1250 to 1650 nm wavelength band, such as those in a CWDM transmission system.

DWDM systems require factoring in the attenuation profile (AP), which provides the fiber attenuation according to the wavelength over the entire link, resulting in additional test results and an additional table in the final acceptance report.

Software currently available helps to compile a partial report using some of these individual parameters. However, only Viavi Solutions Optical FiberCable2 software simultaneously provides all of these capabilities and manages the test results so that one technician can generate professional cable acceptance test reports with OTDR, PMD, AP, IL, and ORL results simultaneously.

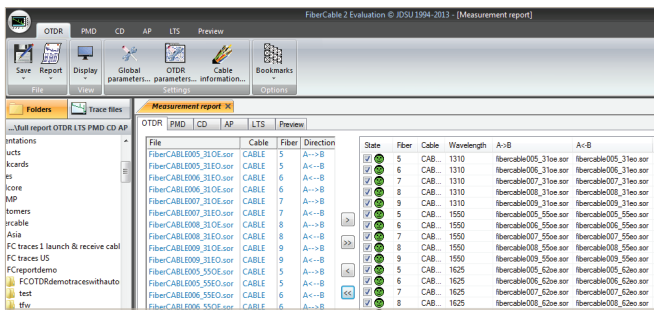


Figure 1. The complete set of test results Viavi FiberCable2 software manages

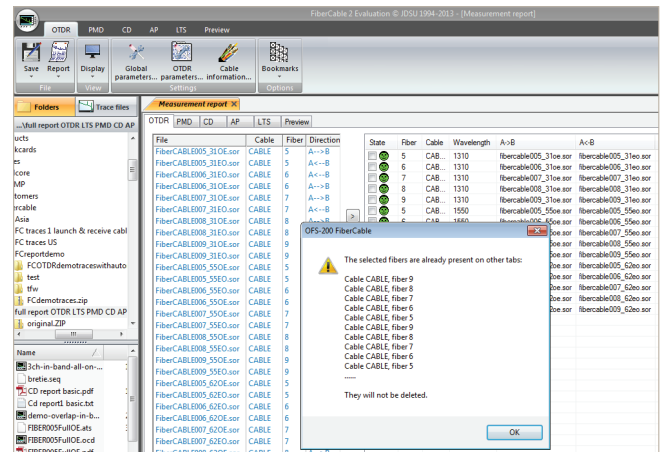


Figure 2. Viavi FiberCable2 software tests for consistency during report generation

Achieving Consistent Measurement Results

Several test results must be compiled and certified which requires extracting thousands of values, sorting them, and then organizing them into dedicated tables. Each value defines the network's ability to transmit at a certain rate; therefore, report consistency is critical for reducing the risk of manipulation errors. Dealing with large amounts of data can cause OTDR traces from cable A to mix with PMD values from cable B, and so on. This new reporting software reliably compiles all of the data into a single-staged process, with step-by-step check points for consistently permanent results. Viavi FiberCable2 software not only compiles all the data together, but it also screens results to verify compatibility between related fiber cables and then creates an error-free report.

Generate Reports Quickly to Improve Productivity

Nowadays, fiber installers and test contractors cannot afford to have technicians spending hours generating reports when characterizing fiber. Nor can they postpone job completion to wait for an acceptance report. So providers build in “time to report” as part of the overall fiber characterization process. The contract is complete once the end contractor receives the final report.

Viavi FiberCable2 software can combine information from several independent reports into a single document and independently manages results, which cuts the reporting process considerably over other available solutions.

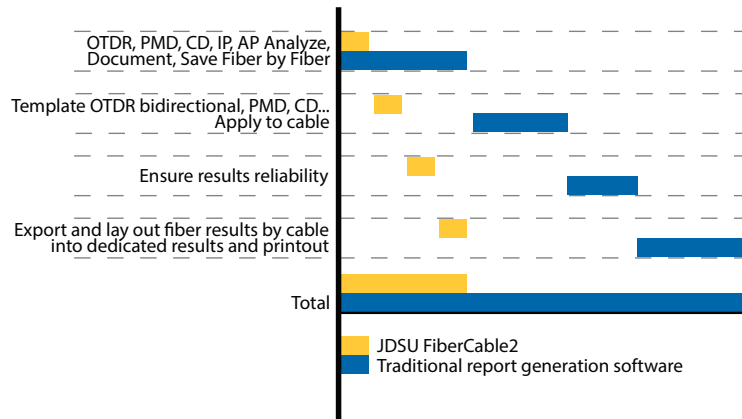


Figure 3. Viavi FiberCable2 software saves time generating fiber characterization reports

Error-Free Fiber Characterization Reports

Generating error-free reports quickly is important but requires monitoring and verifying the automated software process step-by-step. Whereas FiberCable2 software uses dialog boxes and pop-up windows to warn technicians of potential problems during report generation.

In addition to the various check points, technicians can set thresholds and define other criteria to get more information about report quality. Corresponding pass/fail information shown in results tables display necessary warnings.

ID Cable	ID Fibre	Wavelength	Average	Total loss			1			2			3			4			
				A->B	A<-B	Average	A->B	A<-B	Average	A->B	A<-B	Average	A->B	A<-B	Average	A->B	A<-B	Average	
CA...	5	1310	0,226	12,925	13,104	13,015	0,157	0,019	0,088	0,004	0,001	0,003	-0,003	0,003	0,000	0,000	-0,003	-0,001	
CA...	6	1310	0,261	12,825	13,105	12,967	0,151	-0,004	0,073	0,003	-0,007	-0,002	-0,001	-0,003	-0,002			-0,003	⚠
CA...	7	1310	0,227	12,906	13,085	12,996	0,157	0,022	0,090	0,004	0,000	0,002	-0,004	0,000	-0,002	-0,001	-0,003	-0,002	
CA...	8	1310	0,225	12,942	13,060	13,001	0,157	0,019	0,088	0,003	-0,003	0,000	-0,004	0,000	-0,002	-0,001	-0,001	-0,001	
CA...	9	1310	0,224	12,947	13,050	12,998	0,157	0,003	0,080	0,003	-0,010	-0,004	-0,001	-0,001	-0,001	0,001	-0,003	-0,001	
CA...	5	1550	0,195	8,431	8,602	8,517	0,171	0,028	0,099	0,000	-0,003	-0,001	-0,003	-0,001	-0,002	0,000	-0,001	-0,001	
CA...	6	1550	0,194	8,415	8,602	8,509	0,168	0,021	0,094	0,000	-0,003	-0,001	0,001	-0,001	0,000	0,003	-0,004	-0,001	
CA...	7	1550	0,195	8,424	8,587	8,506	0,169	0,025	0,097	-0,001	0,000	-0,001	-0,001	0,003	0,001	0,000	-0,001	-0,001	

Figure 4. Alarms help technicians locate reporting errors

Compiling data into spreadsheets can be tedious; therefore, technicians should review results prior to starting the final stage. FiberCable2 software lets technicians preview the report and it highlights missing information and inconsistencies. This capability eliminates technicians compiling multiple results unnecessarily which can add significant time to the final report-generation process.

Measurement report																		
OTDR PMD CD AP LTS Preview																		
Information ID Cable ID Fibre Wavelength Average	Losses (dB)	Stops (dB/km)	Reflectances (dB)			Spans (m)	Bend evaluation	OTDR Alarms			PMD	CD	AP	LTS				
			A->B	A<-B	Average			A->B	A<-B	Average					A->B	A<-B	Average	
CA...	5	1310	0.226	12.925	13.104	13.015	0.157	0.019	0.088	0.004	0.001	0.003	-0.003	0.003	0.000	0.000	-0.003	-0.001
CA...	6	1310	0.223	12.825	13.105	12.967	0.151	-0.004	0.073	0.003	-0.007	-0.002	-0.001	-0.003	-0.002	-0.003	-0.003	-0.003
CA...	7	1310	0.227	12.906	13.085	12.996	0.157	0.022	0.090	0.004	0.000	0.002	-0.004	0.000	-0.002	-0.001	-0.003	-0.002
CA...	8	1310	0.225	12.942	13.060	13.001	0.157	0.019	0.088	0.003	-0.003	0.000	-0.004	0.000	-0.002	-0.001	-0.001	-0.001
CA...	9	1310	0.224	12.947	13.050	12.998	0.157	0.003	0.080	0.003	-0.010	-0.004	-0.001	-0.001	-0.001	0.001	-0.003	-0.001
CA...	5	1550	0.195	8.431	8.602	8.517	0.171	0.028	0.099	0.000	-0.003	-0.001	-0.003	-0.001	-0.002	0.000	-0.001	-0.001
CA...	6	1550	0.194	8.415	8.602	8.509	0.168	0.021	0.094	0.000	-0.003	-0.001	-0.001	-0.001	0.000	0.003	-0.004	-0.001
CA...	7	1550	0.195	8.424	8.587	8.506	0.169	0.025	0.097	-0.001	0.000	-0.001	-0.001	0.003	0.001	0.000	-0.001	-0.001
CA...	8	1550	0.195	8.439	8.577	8.508	0.172	0.018	0.095	0.000	-0.001	-0.001	0.001	0.000	0.001	0.001	-0.004	-0.001
CA...	9	1550	0.194	8.441	8.571	8.507	0.169	0.024	0.096	0.000	-0.001	-0.001	-0.001	0.000	-0.001	0.000	-0.003	-0.001
CA...	5	1625	0.191	8.741	8.899	8.821	0.193	0.040	0.116	0.000	-0.001	-0.001	0.001	-0.001	0.000	0.000	-0.003	-0.001
CA...	6	1625	0.191	8.772	8.900	8.837	0.191	0.040	0.115	-0.001	-0.004	-0.003	0.003	-0.001	-0.001	-0.001	-0.003	-0.002
CA...	7	1625	0.191	8.747	8.896	8.822	0.191	0.040	0.115	-0.003	-0.003	-0.003	0.000	-0.001	-0.001	0.000	-0.003	-0.001
CA...	8	1625	0.191	8.743	8.894	8.819	0.193	0.041	0.117	-0.003	-0.004	-0.004	0.000	-0.003	-0.001	0.000	-0.003	-0.001
CA...	9	1625	0.191	8.744	8.894	8.820	0.191	0.044	0.118	-0.003	-0.003	-0.003	0.000	-0.003	-0.001	0.000	-0.001	-0.001

Figure 5. Complete fiber characterization report preview

Conclusion

Professional, legible fiber characterization reports combine all the tests results, alarms, and other pertinent information providing end-users with complete information about the fiber installed. These reports complete the installation process and serve as reference tools for managers and technicians during fiber manipulations or future system upgrades. Viavi created its FiberCable2 software to meet the increased demand for reporting efficiency and document quality needed by technicians and managers who characterize fiber.

Polarization Mode Dispersion													
Fiber number	Delay ps	Coeff ps/km/2	2nd Delay ps/nm	2nd Coeff ps/nm.km									
1	0.193	0.020	0.018	0.003									
2	7.169	0.118	0.619	0.008									
3	0.805	0.081	0.294	0.003									
4	0.346	0.035	0.055	0.001									
5	0.907	0.091	0.365	0.004									
6	0.493	0.050	0.110	0.001									
7	0.473	0.048	0.101	0.001									
8	0.268	0.027	0.033	0.000									
9	0.327	0.033	0.048	0.000									
10	0.198	0.020	0.018	0.000									
11	7.169	0.118	0.619	0.008									
12	0.805	0.081	0.294	0.003									
13	0.349	0.035	0.055	0.001									
14	0.907	0.091	0.365	0.004									
15	0.493	0.050	0.110	0.001									
16	0.473	0.048	0.101	0.001									
17	0.268	0.027	0.033	0.000									
18	0.327	0.033	0.048	0.000									
19	0.198	0.020	0.018	0.000									
20	7.169	0.118	0.619	0.008									
21	0.805	0.081	0.294	0.003									
22	0.349	0.035	0.055	0.001									
23	0.907	0.091	0.365	0.004									
24	0.493	0.050	0.110	0.001									
25	0.473	0.048	0.101	0.001									
26	0.268	0.027	0.033	0.000									
27	0.327	0.033	0.048	0.000									
28	0.198	0.020	0.018	0.000									
29	7.169	0.118	0.619	0.008									
30	0.805	0.081	0.294	0.003									
31	0.349	0.035	0.055	0.001									
32	0.907	0.091	0.365	0.004									
33	0.493	0.050	0.110	0.001									
34	0.473	0.048	0.101	0.001									
35	0.268	0.027	0.033	0.000									
36	0.327	0.033	0.048	0.000									
37	0.198	0.020	0.018	0.000									
38	7.169	0.118	0.619	0.008									
39	0.805	0.081	0.294	0.003									
40	0.349	0.035	0.055	0.001									
41	0.907	0.091	0.365	0.004									
42	0.493	0.050	0.110	0.001									
43	0.473	0.048	0.101	0.001									
44	0.268	0.027	0.033	0.000									
45	0.327	0.033	0.048	0.000									
46	0.198	0.020	0.018	0.000									
47	7.169	0.118	0.619	0.008									
48	0.805	0.081	0.294	0.003									
49	0.349	0.035	0.055	0.001									
50	0.907	0.091	0.365	0.004									
51	0.493	0.050	0.110	0.001									
52	0.473	0.048	0.101	0.001									
53	0.268	0.027	0.033	0.000									
54	0.327	0.033	0.048	0.000									
55	0.198	0.020	0.018	0.000									
56	7.169	0.118	0.619	0.008									
57	0.805	0.081	0.294	0.003									
58	0.349	0.035	0.055	0.001									
59	0.907	0.091	0.365	0.004									
60	0.493	0.050	0.110	0.001									
61	0.473	0.048	0.101	0.001									
62	0.268	0.027	0.033	0.000									
63	0.327	0.033	0.048	0.000									
64	0.198	0.020	0.018	0.000									
65	7.169	0.118	0.619	0.008									
66	0.805	0.081	0.294	0.003									
67	0.349	0.035	0.055	0.001									
68	0.907	0.091	0.365	0.004									
69	0.493	0.050	0.110	0.001									
70	0.473	0.048	0.101	0.001									
71	0.268	0.027	0.033	0.000									
72	0.327	0.033	0.048	0.000									
73	0.198	0.020	0.018	0.000									
74	7.169	0.118	0.619	0.008									
75	0.805	0.081	0.294	0.003									
76	0.349	0.035	0.055	0.001									
77	0.907	0.091	0.365	0.004									
78	0.493	0.050	0.110	0.001									
79	0.473	0.048	0.101	0.001									
80	0.268	0.027	0.033	0.000									
81	0.327	0.033	0.048	0.000									
82	0.198	0.020	0.018	0.000									
83	7.169	0.118	0.619	0.008									
84	0.805	0.081	0.294	0.003									
85	0.349	0.035	0.055	0.001									
86	0.907	0.091	0.365	0.004									
87	0.493	0.050	0.110	0.001									
88	0.473	0.048	0.101	0.001									
89	0.268	0.027	0.033	0.000									
90	0.327	0.033	0.048	0.000									
91	0.198	0.020	0.018	0.000									
92	7.169	0.118	0.619	0.008									
93	0.805	0.081	0.294	0.003									
94	0.349	0.035	0.055	0.001									
95	0.907	0.091	0.365	0.004									
96	0.493	0.050	0.110	0.001									
97	0.473	0.048	0.101	0.001									
98	0.268	0.027	0.033	0.000									
99	0.327	0.033	0.048	0.000									
100	0.198	0.020	0.018	0.000									

Chromatic Dispersion														
Fiber number	λ _c nm	%	Value ps/nm.km	1540nm	1550nm	1560nm	1570nm	1580nm	1590nm	1600nm	1610nm	1620nm	1630nm	1640nm
1	1314.0	0.990	16.500	0.514	16.554	0.526	16.607	0.539	16.660	0.551	16.712	0.563	16.764	0.575
2	1311.6	0.987	16.229	0.554	16.302	0.556	16.376	0.558	16.450	0.560	16.523	0.562	16.596	0.564
3	1312.3	0.987	16.136	0.560	16.194	0.566	16.250	0.569	16.306	0.572	16.362	0.575	16.418	0.578
4	1312.9	0.986	16.364	0.517	16.410	0.517	16.457	0.517	16.504	0.517	16.551	0.517	16.598	0.517
5	1309.6	0.989	16.949	0.577	16.706	0.557	16.762	0.557	16.818	0.557	16.874	0.557	16.930	0.557
6	1322.7	0.991	16.292	0.568	16.381	0.559	16.470	0.550	16.559	0.541	16.648	0.532	16.737	0.523
7	1344.0	0.995	15.747	0.665	15.812	0.665	15.877	0.665	15.942	0.665	16.007	0.665	16.072	0.665
8	1309.9	0.988	16.509	0.558	16.565	0.558	16.621	0.558	16.677	0.558	16.733	0.558	16.789	0.558
9	1309.9	0.988	16.501	0.558	16.527	0.558	16.553	0.558	16.579	0.558	16.605	0.558	16.631	0.558
10	1318.1	0.990	16.326	0.554	16.394	0.558	16.463	0.558	16.532	0.558	16.601	0.558	16.670	0.558
11	1318.1	0.990	16.326	0.554	16.394	0.558	16.463	0.558	16.532	0.558	16.601	0.558	16.670	0.558
12	1309.9	0.989	16.509	0.558	16.565	0.558	16.622	0.558	16.679	0.558	16.736	0.558	16.793	0.558
13	1344.0	0.995	15.747	0.665	15.812	0.665	15.877	0.665	15.942	0.665	16.007	0.665	16.072	0.665
14	1322.7	0.991	16.292	0.559	16.381	0.559	16.470	0.550	16.559	0.541	16.648	0.532	16.737	0.523
15	1309.9	0.989	16.509	0.557	16.706	0.557	16.762	0.557	16.818	0.557	16.874	0.557	16.930	0.557
16	1312.9	0.987	16.364	0.517	16.410	0.517	16.457	0.517	16.504	0.517	16.551	0.517	16.598	0.517
17	1312.3	0.987	16.136	0.568	16.194	0.556	16.250	0.556	16.306	0.556	16.362	0.556	16.418	0.556
18	1311.6	0.987	16.229	0.554	16.302	0.556	16.376	0.556	16.450	0.556	16.523	0.556	16.596	0.556
19	1314.9	0.990	16.500	0.558	16.558	0.558	16.616	0.558	16.673	0.558	16.731	0.557	16.789	0.557
20	1309.9	0.988	16.501	0.558	16.527	0.558	16.553</							