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Environmental Simulation & Laser Safety Testing

Report of Compliance

for the

sm130 Swept Laser Interrogator

Tests and Calculations Derived From:

NEBS GR-63-CORE, Issue 1, October 1995;
FDA Classification 21 CFR 1040.10 and IEC 60825-1

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I. Environmental Testing

1. Executive Summary

A. Thermal Testing

The operating and storage temperature ranges are dictated by the limits of the major components and subsystems. A complete summary of these parts can be seen in table 1.

Platform Environmental Specification: Major Components and Subsystems

Subsystem or Component	Operating Temp Low	Operating Temp High	Storage Temp Low	Storage Temp High	Relative Humidity
Single Board Computer – Optical Acquisition Module	0	60	n/s	n/s	0 to 90%, non-condensing
Fiber Fabry-Perot Tunable Filter	0	65	-20	80	0 to 95% @ 40 degrees C max
Fabry Perot Optical Reference	0	70	-40	85	0 to 95% @ 40 degrees C max
Optical Gain Medium	0	70	-40	85	hermetically sealed
TEC Controller	-20	100	-65	150	not specified
Optical BPF	0	65	-40	85	GR-1221
Optical Isolator	-20	70	-40	85	Na
Optical fiber couplers	-40	85	-40	85	Na

Table 1. Thermal Specifications for major components and subsystems.

i. Storage Temperature

a. **Requirement 1.1.1** Low Temperature Shock: the EUT will be held at a constant temperature of –20 °C for 72 hours, transferred to room temperature, and evaluated for performance. The transition from RT to –20 will take place at a rate of ~30°C/hour. Transition from –20 to RT will take 5 minutes or less.

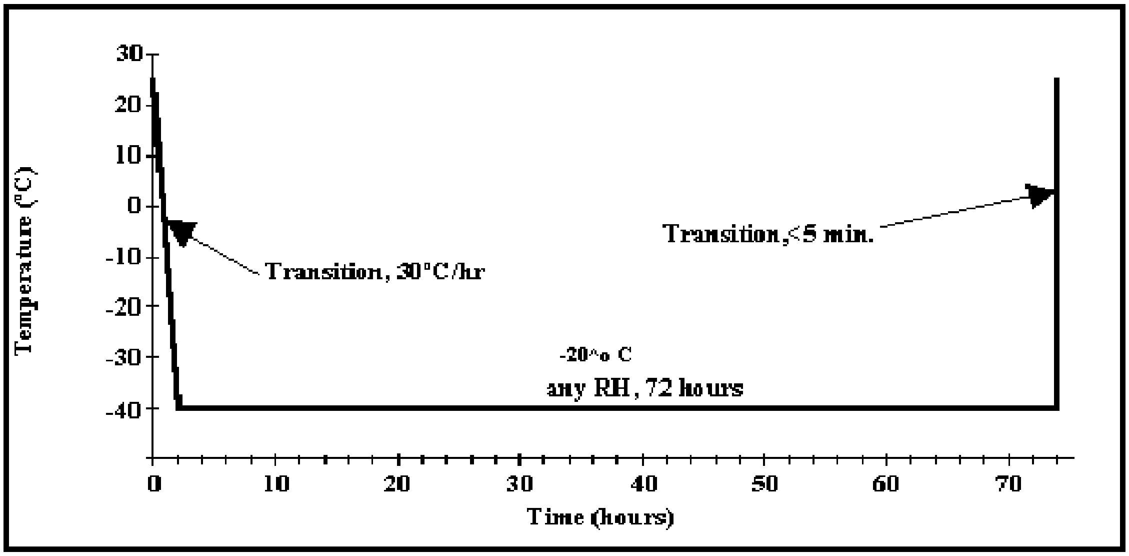

Figure 1. Low Temperature Thermal Shock

b. **Requirement 1.1.2** High Temperature Shock: the EUT will be held at a constant temperature of –70 °C for 72 hours, transferred to room temperature, and evaluated for performance. The transition from RT to +70 will take place at a rate of ~30°C/hour. Transition from +70 to RT will take 5 minutes or less.

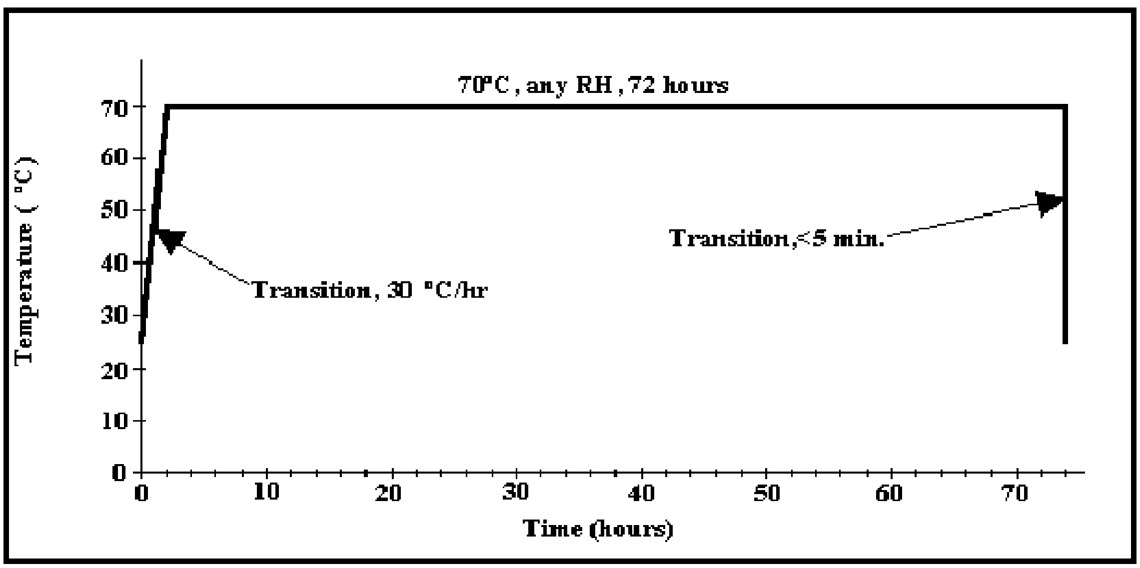

Figure 2. High Temperature Thermal Shock

c. **Requirement 1.1.3** High Relative Humidity Exposure: the EUT will be held at 40°C and 95% RH for 96 hours, transferred to room temperature and humidity, and evaluated for performance. The transition from RT to 40°C will take place at ~30°C per hour. The RH will increase to 95% over a four-hour period. Following the 96 hour soak, the temperature and RH will return to ambient at a rate of ~30°C/hour.

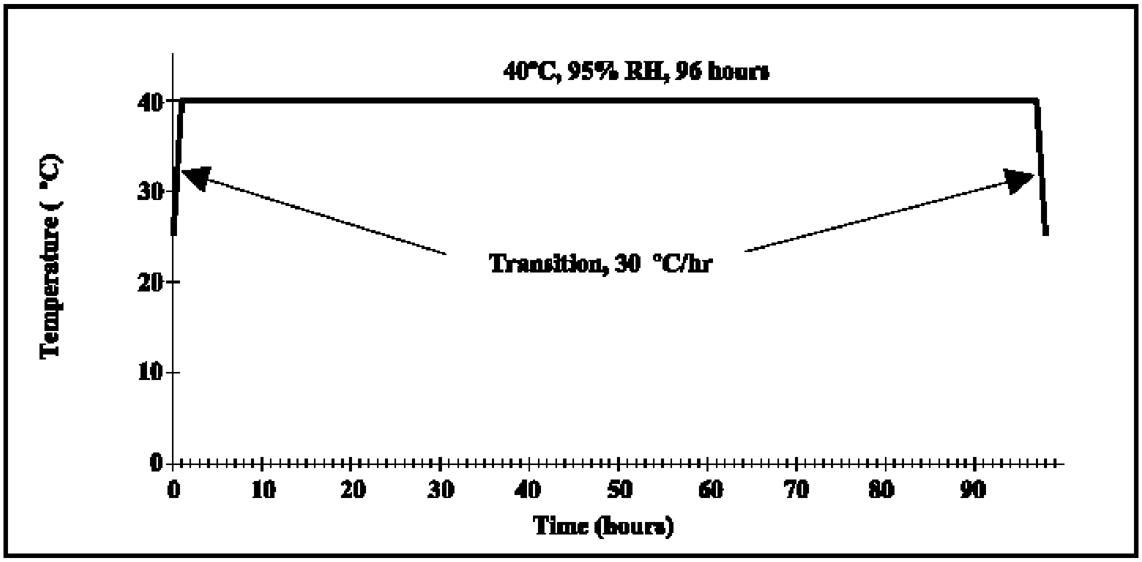

Figure 3. High Relative Humidity Exposure

ii. Operating Temperature

Requirement 1.2 Operating Temperature testing will take place according to the sequence described in Figure 4.

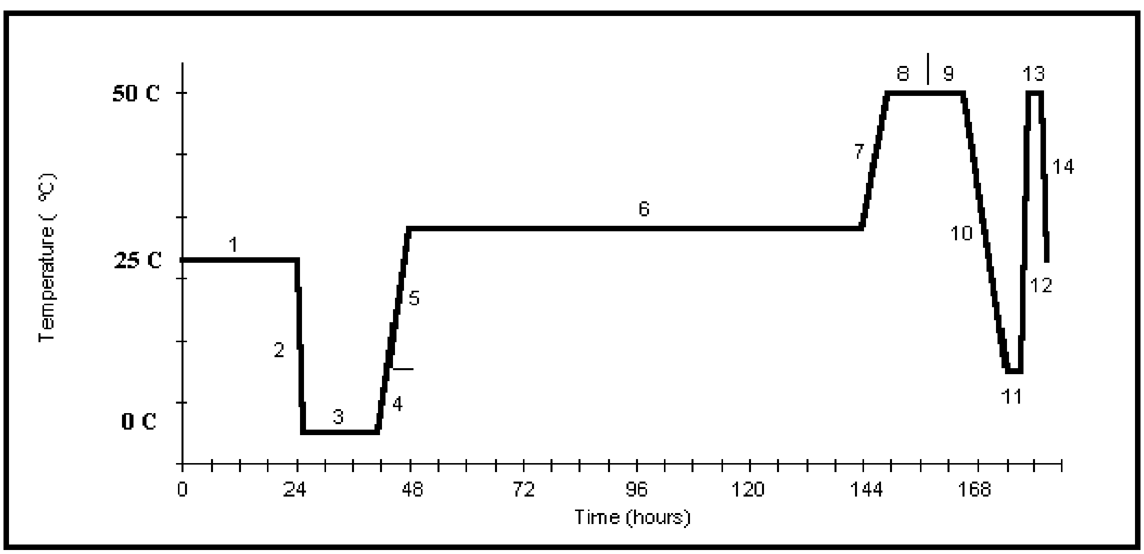

Figure 4. Operating Temperature and Humidity Test

a. The EUT is installed in the temperature chamber and conditioned for 24 hours, at 23°C (+/-2°C) and 50% RH. **(Figure 4, step 1)**
b. Following the 24 hour period, the EUT is functionally evaluated.
c. The chamber temperature is decreased to 0°C as measured by the chamber controller. The RH is not controlled. **(Figure 4, step 2)**
d. The 0°C test condition is held for 16 hours. **(Figure 4, step 3)**
e. The chamber temperature is increased to 10°C as measured by the chamber controller. The RH is not controlled. **(Figure 4, step 4)**
f. The chamber temperature is increased to 25° C (+/- 2°C) at a uniform rate of ~5°C per hour (or faster), as measured by the chamber controller while the humidity is increased to 90% RH. **(Figure 4, step 5)**
g. The test temperature is maintained at 25°C, 90% RH for 96 hours. The EUT functionality is measured throughout this period. **(Figure 4, step 6)**
h. The chamber temperature is increased to 50°C, at a uniform rate of ~5°C per hour (or faster). The humidity is decreased to 32%RH. **(Figure 4, step 7)**
i. The test temperature is maintained at 50°C for 12 hours. **(Figure 4, step 8)**
j. The test temperature is maintained at 50°C for an additional 4 hours while the humidity is decreased to less than 15%. **(Figure 4, step 9)**
k. The chamber temperature is decreased to 10°C (+/- 2°C) at a uniform rate of ~5°C per hour (or faster) while maintaining the humidity to less than 15%. **(Figure 4, step 10)**
l. The test temperature is maintained at 10°C, <15% RH for 3 hours. **(Figure 4, step 11)**
m. The chamber temperature is increased to 50°C at a uniform rate of ~30°C per hour (or faster). The RH is not controlled. **(Figure 4, step 12)**
n. The test temperature is maintained at 50°C for 3 hours. **(Figure 8, step 13)**
o. The chamber temperature is decreased to 25°C at a uniform rate of ~30°C per hour (or faster). The RH is not controlled. **(Figure 4, step 14)**
p. The 25° C test condition is held until the EUT average internal air temperature changes at a rate of less than 2°C per hour.
q. The EUT functionality is evaluated after the EUT temperature stabilizes.

Note: To evaluate operation, a single stabilized sensor value will be used as the test artifact for the EUT. For informational purposes, the data will be collected throughout the operational test.

B. Handling Tests

1. Handling Drop Tests – Packaged Equipment, Requirement 3.1

a. The EUT is subjected to drops from a height of 750mm (~29.5 inches).
b. The EUT is dropped on each of the following (see Figure 5).

Surface	S1, S2, S3
Edge	E1, E2, E3
Corner	C1, C2, C3, C4

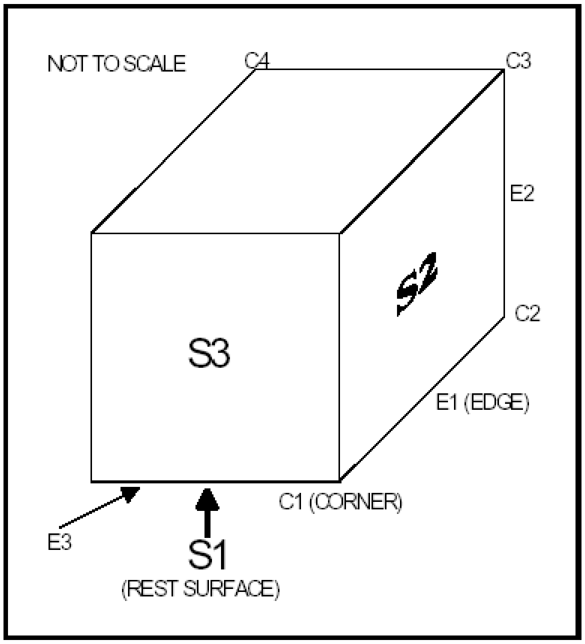

Figure 5. Drop Surfaces for Handling Test - Packaged Container

c. The test is performed on a smooth concrete floor.
d. The package is dropped from a hand-held position. Care is taken to ensure that rotational or sideways forces are not imparted to the EUT package upon release.
e. The packaged EUT is raise to the height specified (750mm). The EUT is dropped once on each impact surface, from the specified height. For corner drops, the EUT is oriented such that a straight line drawn through the struck corner and the package's geometric center is approximately perpendicular to the impact surface.
f. One minute between drops is allowed for the cushioning to recover its shape.

2. Unpackaged Equipment Drop Tests, Requirement 3.2

a. The test is performed on an unpackaged EUT. The EUT is subjected to the following drops from a height of 100mm (~3.9 inches).
b. The EUT is dropped once on each of the following sides. (see Figure 6)

Surface	S1
Edge	E1, E3
Corner	C1, C2

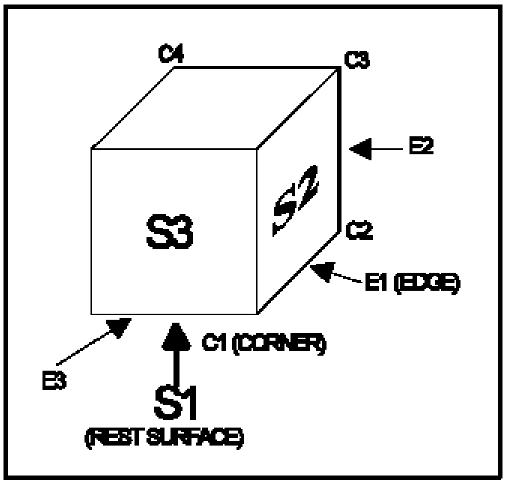

Figure 6. Drop Surfaces for Unpackaged Equipment

c. The test is performed on a smooth, concrete floor.
d. The package is dropped from a hand-held position. Care is taken to ensure that rotational or sideways forces are not imparted to the EUT package upon release.
e. The packaged EUT is raise to the height specified (100mm). The EUT is dropped once on each impact surface, from the specified height. For corner drops, the EUT is oriented such that a straight line drawn through the struck corner and the package's geometric center is approximately perpendicular to the impact surface.

2. Requirements and Objectives Matrices

EUT Serial Number	**EUT 1**			
Requirements/Summary	**Conformance**			
	YES	NO	N/A	Comments
<u>Storage Environment</u>				
1.1.1 Low Temp Shock	•			None
1.1.2 High Temp Shock	•			None
1.1.3 High RH Exposure	•			None
<u>Operating Environment</u>				
1.2 Operating Temp	•			None
<u>Handling Tests</u>				
2.1 Packaged Drop Testing	•			None
2.2 Unpackaged Drop Testing	•			None

EUT Serial Number	**EUT 2**			
Requirements/Summary	**Conformance**			
	YES	NO	N/A	Comments
<u>Storage Environment</u>				
1.1.1 Low Temp Shock	•			none
1.1.2 High Temp Shock	•			None
1.1.3 High RH Exposure	•			None
<u>Operating Environment</u>				
1.2 Operating Temp	•			None

3. General

A. Overview – Environmental Testing Plan for the sm130, Optical Sensing Interrogator

The environmental qualification test plan for the sm130 was based largely on the requirements set forth for the General Requirements for telecom equipment in Telcordia GR-63. Those items which either do not apply to the sm130, have not been requested by any customer, or are not feasible for MOI to test locally have be omitted for this round of testing.

The general areas for testing are as follows are thermal shock testing, operating environmental testing, and drop/shock testing (both packaged and unpackaged), and office/transportation vibration. The items from GR-63 that will not be tested are: Altitude testing, heat dissipation, fire testing, and airborne contaminants.

Each of two units has been subjected to the complete battery of thermal tests. Two of the units were subjected to the drop/shock testing, while one unit underwent office/transportation vibration testing. Successful completion of each test has been decided by the outcome of a total performance qualification following each test. The optical performance testing procedures will be laid out in a later part of this document.

B. Test Sites

Low and high temperature thermal shock, high humidity exposure, and operating temperature tests were all performed on site at Micron Optics, Inc., 1852 Century Place, Atlanta, GA 30043.

Office and Transportation vibration tests were performed by Motorola Product Testing Services, 1700 Belle Meade Court, Lawrenceville, GA 30043.

All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology as is applicable to determining the performance of the EUT.

C. Description of Test Sample

Micron Optics Swept Wavelength Interrogators facilitate a wide variety of rapid, accurate optical sensor measurements. Drawing from the strengths of proprietary swept wavelength laser technology, MOI Interrogators offer a combination of measurement speed, accuracy, dynamic range, environmental performance and measurement capacity that cannot be duplicated with any other technology.

MOI interrogators share common optical, mechanical, and computing platforms, and can be customized for bench top or OEM applications. Most all models are available with front panel LCD displays and controls, or can be simplified for industrial OEM applications.

For testing purposes, units with full graphical and user interfaces have been tested, including front panel keypads and LCD displays.

D. Test Configuration

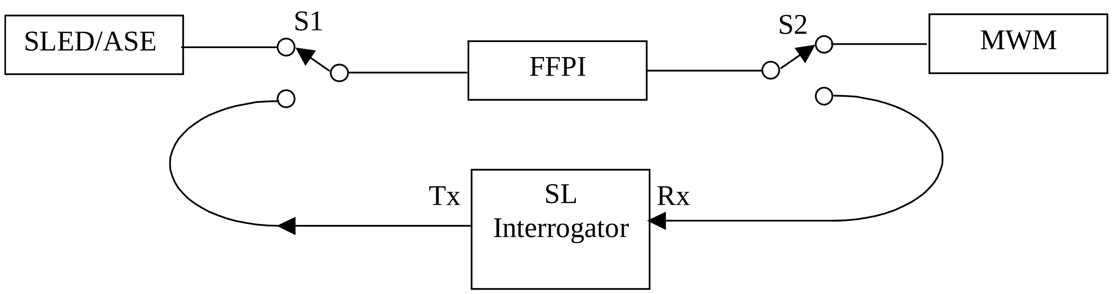

Figure 7: Block Diagram of Test Configuration

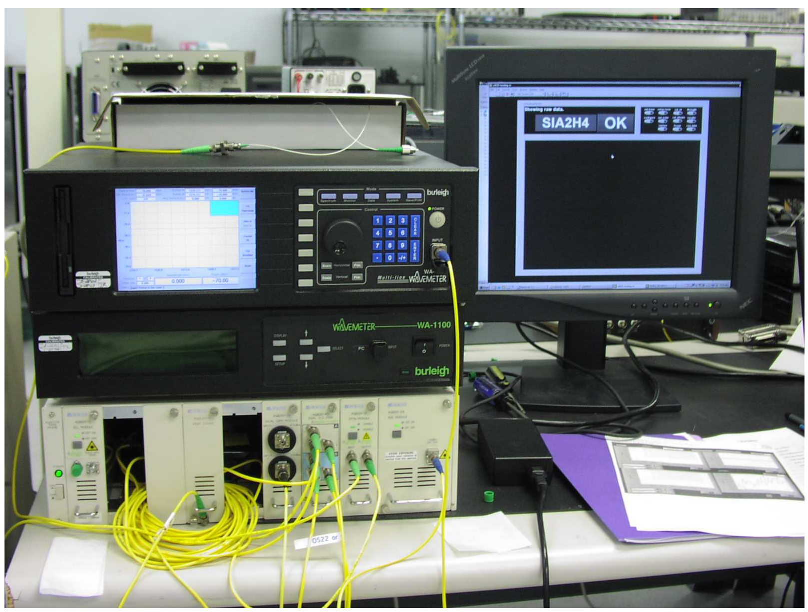

Figure 8. Test equipment used for performance measurements.

TEST/SUPPORT EQUIPMENT USED			
Quantity	**Type**	**Manufacturer**	**Model Number**
1	Laptop Computer	Sony	VGN-FE790P
1	Flat Panel Monitor	NEC	
1	PCMCIA GPIB Card	National Instruments	NI-GPIB-USB-HS
1	Scanning Michelson Interferometer	Burleigh	WA-7600
1	Equipment Mainframe	ANDO	AQ-8201
1	Dual Power Meter	ANDO	AQ-8201-22
1	Dual 1x2 Switch	ANDO	AQ-8201-212
1	Attenuator	ANDO	AQ-8201-31
1	ASE Source	ANDO	AQ8201-12
1	Environmental Chamber	Espec	PL-1FPH

Table 2. Test and support equipment used during qualification testing.

Figure 9. Espec environmental chamber used for testing.

Figure 10. EUT inside test chamber.

E. Modifications

No modifications were made to the EUT prior to testing.

F. General Test Setup

The EUT was configured according to the procedures defined by Micron Optics, Inc. and was operated in a manner representative of the typical usage of the equipment.

Operational verifications were performed using standard Micron Optics test limits and procedures, and are identical to those used during standard manufacturing.

G. Method of Monitoring EUT Operation

Each sm130 unit is goes through a fully automated calibration and testing procedure to validate operation over time, temperature and wavelength. In order to test a complete spectrum of sensor measurements, a fixed Fabry-Perot Interferometer (FFPI) is used to emulate a series of sensors with bandwidths of 0.08nm. This test artifact is first illuminated with an ASE source and measured by a reference instrument with 0.3 pm calibrated accuracy. The FFPI is then optically switched into the path of the sm130, which then measures the same optical peaks. A comparison between the two instruments is made, and the difference is assessed to be the error of the sm130. These measurements are repeated over time and temperature to ensure accurate, reliable measurements over the specified conditions for the instrument.

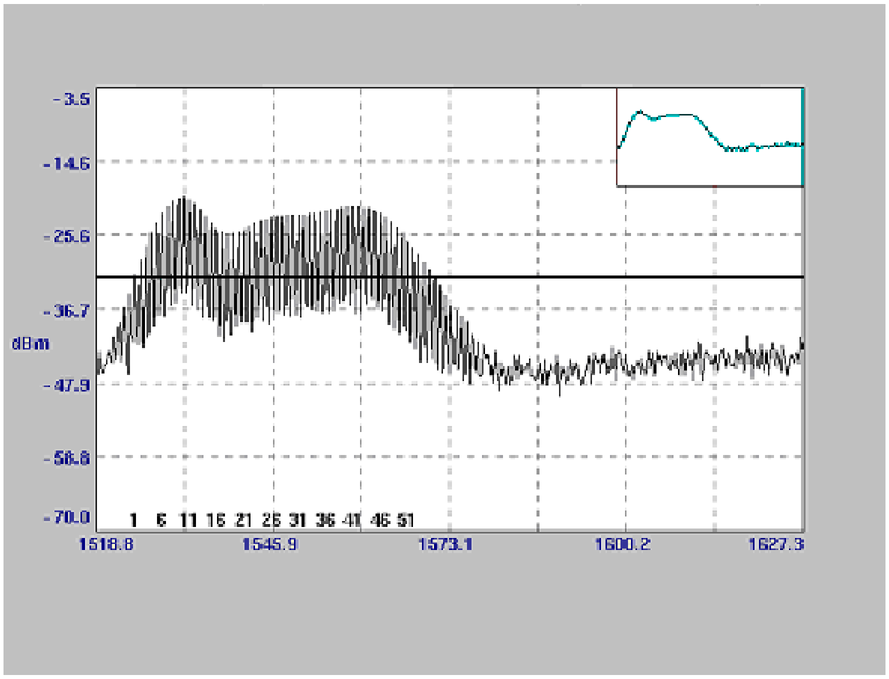

Figure 11. Calibration and test optical artifact as seen by reference instrument

Channel	WL (nm)	P (dBm)	OSNR (dB)	FWHM (pm)	delta Ref (nm)	delta Ch (nm)	delta ITU(nm)
1	1524.6010	−22.858	9.464	78.0	0.0000	0.0000	0.0000
2	1525.3694	−20.320	9.896	77.9	0.7684	−0.7684	0.0000
3	1526.1796	−18.184	10.033	79.4	1.5785	−0.7902	0.0000
4	1526.9686	−16.083	10.343	82.3	2.3675	−0.7890	0.0000
5	1527.7584	−14.198	10.548	81.9	3.1574	−0.7898	0.0000
6	1528.5494	−12.901	10.545	81.7	3.9484	−0.7910	0.0000
7	1529.3412	−11.775	10.675	81.9	4.7402	−0.7918	0.0000
8	1530.1334	−11.008	10.716	82.1	5.5324	−0.7922	0.0000
9	1530.9265	−10.635	10.706	82.7	6.3254	−0.7930	0.0000
10	1531.7210	−10.483	10.697	82.4	7.1200	−0.7946	0.0000
11	1532.5162	−10.833	10.538	82.6	7.9152	−0.7952	0.0000
12	1533.3120	−11.443	10.444	82.1	8.7110	−0.7958	0.0000
13	1534.1088	−12.336	10.314	83.3	9.5077	−0.7967	0.0000
14	1534.9065	−13.268	10.354	83.3	10.3055	−0.7977	0.0000
15	1535.7052	−14.381	10.201	81.4	11.1042	−0.7987	0.0000
16	1536.5045	−15.370	10.068	80.9	11.9035	−0.7994	0.0000
17	1537.3052	−16.073	9.982	84.2	12.7042	−0.8007	0.0000
18	1538.1061	−15.920	10.417	83.1	13.5051	−0.8009	0.0000
19	1538.9085	−16.043	10.272	83.2	14.3075	−0.8024	0.0000
20	1539.7108	−15.869	10.213	82.8	15.1098	−0.8023	0.0000

Figure 12. Calibration data collected by reference instrument

4. Temperature and Humidity Test Results

Test results will be arranged first by test type, then by EUT serial number.

A. 1.1.1 Low Temperature Shock

Test Requirements

The EUT shall not sustain any damage or performance deterioration after it has been exposed to the environment described in Figure 1.

Test Results

EUT 1 – PASS Test unit EUT 1 passed all parameters following section 1.1.1 of the qualification testing.

EUT 2 - PASS. Test unit EUT 2 passed all parameters following section 1.1.1 of the qualification testing.

B. 1.1.2 High Temperature Shock

Test Requirements

The EUT shall not sustain any damage or performance deterioration after it has been exposed to the environment described in Figure 2.

Test Results

EUT 1 – PASS Test unit EUT 1 passes all parameters following section 1.1.2 of the qualification testing.

EUT 2 – PASS Test unit EUT 2 passes all parameters following section 1.1.2 of the qualification testing.

C. 1.1.3 High Relative Humidity Exposure

Test Requirements

The EUT shall not sustain any damage or performance deterioration after it has been exposed to the environment described in Figure 3.

Test Results

EUT 1 – PASS Test unit EUT 1 passes all parameters following section 1.1.3 of the qualification testing.

EUT 2 – PASS Test unit EUT 2 passes all parameters following section 1.1.3 of the qualification testing.

D. 1.1.2 Operating Temperature

Test Requirements

The EUT shall not sustain any damage or performance deterioration during its operating life while within the conditions specified in Figure 4.

Test Results

EUT 1 – PASS Test unit EUT 1 passes all parameters during and after section 1.1.2 of the qualification testing.

EUT 2 – PASS Test unit EUT 2 passes all parameters during and after section 1.1.2 of the qualification testing.

5. Handling Test Results

2.1 Packaged Drop Test

Test Requirements

The EUT shall not sustain any physical damage or performance deterioration after it has been exposed to the shock levels described in Figure 5.

Figure 13 – sm130 handling drop test, packaged equipment, surface S1

Test Results

EUT 1 – PASS. Test unit EUT 1 was dropped on all of the appropriate sides, edges and corners from a height of 750mm above a hard concrete surface. Only slight deformations of the exterior cardboard enclosure were noted. EUT 1 passed all parameters following Section 2.1 of the qualification testing

Figure 14 – sm130 in plastic carrying case

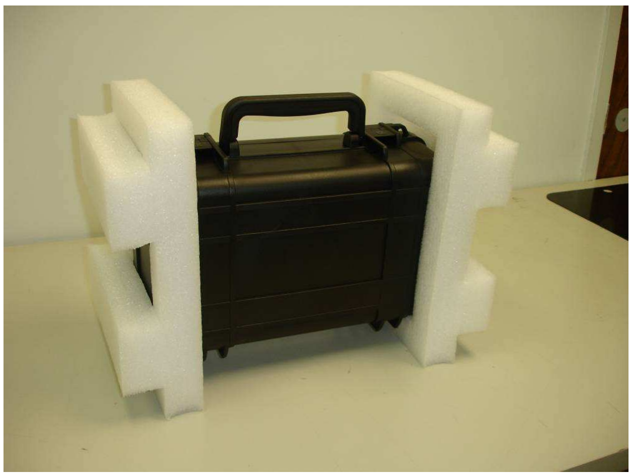

Figure 15 – sm130 plastic carrying case with foam inserts for shipping container

Figure 16 – sm130 plastic carrying case w/inserts placed inside shipping container

Figure 17 – sm130 sealed shipping container

Figure 18 - sm130 handling drop test, packaged equipment, typical damage, edge E2

Figure 19 - sm130 handling drop test, packaged equipment, typical damage, edge E3

Figure 20 - sm130 handling drop test, packaged equipment, typical damage, corner C1

Figure 21 - sm130 handling drop test, packaged equipment, typical damage, corner C2

Figure 22 - sm130 handling drop test, packaged equipment, typical damage, corner C3

Figure 23 – sm130 handling drop test, packaged equipment, at completion of testing

2.2 Unpackaged Drop Test

Test Requirements

The EUT shall not sustain any physical damage or performance deterioration after it has been exposed to the shock levels described in Figure 6.

Test Results

EUT 1 – PASS. Test unit EUT 1 was dropped on all of the appropriate sides, edges and corners from a height of 100mm onto a smooth concrete floor. Following the drops, the unit initialized and performed within spec, with only minor cosmetic blemishes noted on the module enclosure.

Figure 24 – sm130 handling drop test, unpackaged equipment, typical damage, edge E1

Figure 25 – sm130 handling drop test, unpackaged equipment, typical damage, corner C2

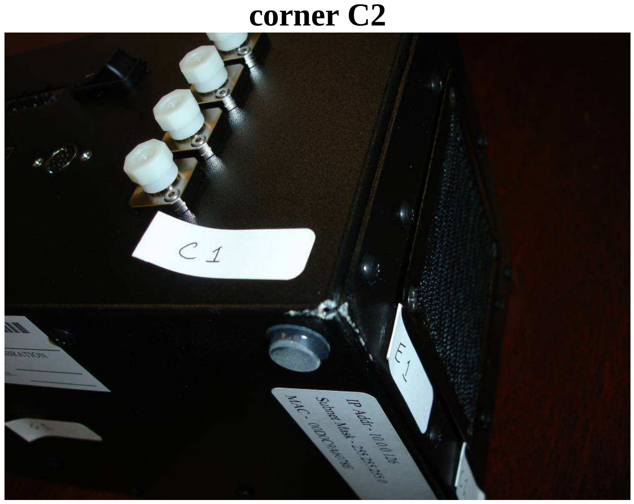

Figure 26 – sm130 handling drop test, unpackaged equipment, typical damage, corner C1

II. Laser Safety Test Report

1. Introduction

Manufacturers of laser products are required to categorize each laser into one of four categories, depending upon the risk of potentially damaging ocular exposure to optical energy. In the United States, requirements are set forth by the Center for Devices and Radiological Health (CDRH), which operates under the Food and Drug Administration (FDA). Internationally, laser safety standards are governed by the International Electrotechnical Commission (IEC). The FDA and IEC qualify laser products in a similar manner. Both methodologies and the resultant FDA and IEC classifications for the MOI Swept Laser Interrogator Platform are covered in this document.

2. FDA Classification, 21 CFR 1040.10

A. Test Procedures and Calculations

For a laser product to be classified as a Class 1 under FDA requirements, the accessible emission level (AEL) must be below a certain level for each of three wavelength ranges. In the case of the MOI Swept Laser, which lases in the 1510nm to 1580nm wavelength range, the following limit applies:

- $AEL_1 = 7.9 \times 10^{-4}$ W for λ = 1400nm to 2500nm

The AEL is measured, according to the FDA standards, at a distance of 20cm through a 7mm aperture. If the AEL for a particular product as measured through the 7mm aperture at a distance of 20cm is below the limit stated above, then the product is Class 1. If the AEL exceeds the above limit, then the product is Class 3b, unless the AEL exceeds 500mW, in which case it is Class 4.

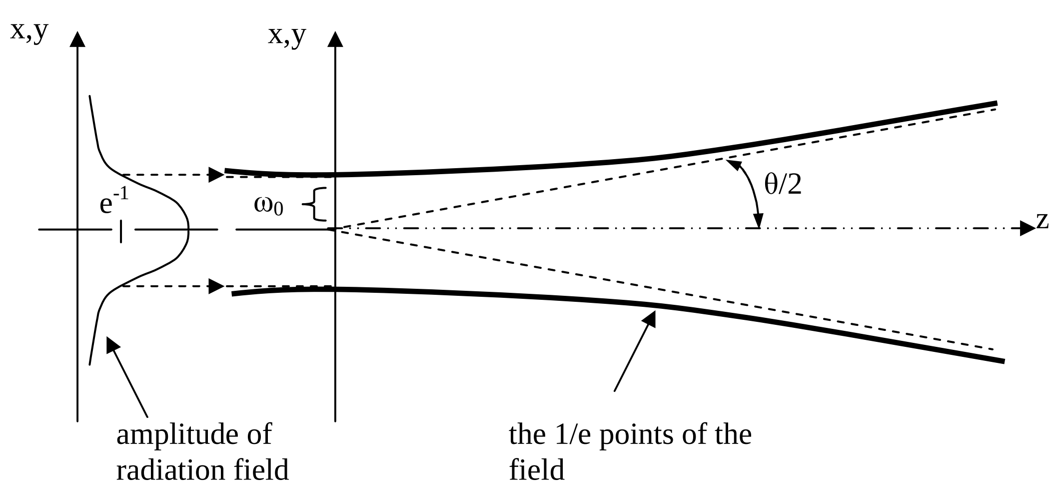

Figure 27. Beam divergence of $TEM_{0,0}$ mode from single mode fiber.

The optical power from a fiber output of a laser that would pass through a 7mm aperture at a distance of 20cm can be calculated using the total optical output power from the fiber, the wavelength of the laser, and the mode field diameter of the optical fiber at the output. For a Gaussian beam, the total power passing through an aperture of diameter D_0 at a distance L can be expressed in terms of a coupling factor.

Equation 1: $$\eta = \left[1 - e^{-\left(\frac{D_0}{D_L}\right)^2}\right],$$

where D_L is the beam diameter at the 1/e points at the aperture distance.

The diameter of the beam emanating from a single mode fiber is a function of the mode field diameter of the fiber, ω_0, and the wavelength of the beam, λ, and is given by the following equation.

Equation 2: $$D_L = \frac{2\mathrm{L}\lambda}{\pi\omega_0}$$

Equation 3 is used to calculate the beam divergence angle, θ, where n is the optical index of refraction.

Equation 3: $$\theta = \frac{2\lambda}{\pi n \omega_0}$$

In the case of the MOI Swept Laser, the wavelength selected for analysis is 1510nm. This wavelength, which is the shortest emitted from the SL, has a larger coupling factor than would the higher wavelength extreme of 1580nm, and as such represents a worst case condition for emitted laser radiation through the fixed 7mm aperture at 20cm distance.

Evaluating Equations 1 and 2 for λ = 1510nm, ω_0 = 10.5µm, L = 20cm, and D_0 = 20cm,

from (2), $$D_L = \frac{2(20cm)(1.51um)}{\pi(10.5um)} = 1.83cm$$

from (1), $$\eta = \left[1 - e^{-\left(\frac{0.7}{1.83}\right)^2}\right] = 0.136$$

Given that the max AEL_1 for FDA Class 1 is 7.9 x 10^{-4} W for λ = 1400nm to 2500nm passing through the 7mm aperture at 20cm, the total allowable output power from the fiber can be calculated as follows:

$$\frac{AEL_1}{\eta} = \frac{0.790mW}{0.136} = 5.81mW = 7.6dBm$$

Thus, if the maximum output power from the fiber as measured for 10^4 seconds does not exceed 7.6 dBm, then the MOI Swept Laser can be classified as a Class 1 laser product under FDA guidelines.

Evaluating Equation 3 for λ = 1580nm, ω_0 = 10.5μm, and n = 1, gives the divergence angle θ.

from (3), $$\theta = \frac{2(1550nm)}{\pi(1)(10.5um)} = 0.093 \text{ radians} = 5.38°$$

B. Measurement Results

As measured with an optical power meter, the MOI sm130 Swept Laser output measures to be -6dBm at worst case, over 10 units. This output power is well below the 7.6dBm limit for Class 1. As such the sm130 is an FDA Class 1 laser product. These results carry over to si225 and sm420 instruments, by design.

As measured with an optical power meter, the MOI si720 Swept Laser output measures to be +2.0 dBm at worst case, over 10 units. This output power is well below the 7.6dBm limit for Class 1. As such, the si720 is an FDA Class 1 laser product. These results carry over to the CTS, HR-SLI, si125, si725, and si730, by design.

3. IEC 60825-1 Classification

A. Test Procedures and Calculations

For a laser product to be classified as a Class 1 under IEC requirements, the accessible emission level (AEL) must be below a certain level for each of five wavelength ranges. In the case of the MOI Swept Laser, which lases in the 1510nm to 1580nm wavelength range, the following limit applies:

- AEL = 10mW for λ = 1400nm to 4000nm

IEC standards call for a test condition at L = 50mm with an aperture of 50mm, with a measurement time of 100 seconds. As with the FDA standards, we can back calculate the total allowable output power from the fiber from the aperture limited AEL.

Evaluating Equations 1 and 2 for λ = 1510nm, ω_0 = 10.5μm, L = 100mm, and D_0 = 50mm,

from (2),

$$D_L = \frac{2(100mm)(1.51um)}{\pi(10.5um)} = 9.15mm$$

from (1), $$\eta = \left[1 - e^{-\left(\frac{50}{9.15}\right)^2}\right] \cong 1$$

Since at a distance of 100mm, the 9mm beam diameter is much smaller than the 50mm aperture, all of the light would pass through that aperture, thus leading to a coupling factor of 1.

Given that the max AEL_1 for IEC Class 1 is 10mW for λ = 1400nm to 4000nm passing through the 50mm aperture at 100mm, the total allowable output power from the fiber can be calculated as follows:

$$\frac{AEL_1}{\eta} = \frac{10mW}{1} = 10mW = 10dBm$$

Thus, if the maximum output power from the fiber as measured for 100 seconds does not exceed 10 dBm, then the MOI Swept Laser can be classified as a Class 1 laser product under IEC guidelines.

Under no circumstances, including single faults, can the circuit supply sufficient current to cause the sm130 laser to emit more than –6dBm. Even under single fault conditions, the sm130 output power is always within IEC 60825 Class 1 AEL limits. These results carry over to si225 and sm420 instruments, by design.

Under no circumstances, including single faults, can the circuit supply sufficient current to cause the si720 laser to emit more than +2dBm. Even under single fault conditions, the sm130 output power is always within IEC 60825 Class 1 AEL limits. These results carry over to the CTS, HR-SLI, si125, si725, and si730, by design.

B. Measurement Results

As measured with an optical power meter, the MOI sm130 Swept Laser output measures to be -6dBm at worst case, over 10 units. This output power is well below the 10dBm limit for Class 1. As such the sm130 is an IEC Class 1 laser product. These results carry over to si225 and sm420 instruments, by design.

As measured with an optical power meter, the MOI si720 Swept Laser output measures to be +2.0 dBm at worst case. This output power is well below the 10dBm limit for Class 1. As such, the si720 is an IEC Class 1 laser product. These results carry over to the CTS, HR-SLI, si125, si725, and si730 by design.

4. Conclusions

Under the stipulations of both the FDA 21 CFR 1040.10 and IEC 60825-1, the sm130 qualifies as a Class 1 laser product. As such, the FDA requires no warning labels or control measures. Under IEC guidelines, Class 1 laser products should have fixed an explanatory label bearing the words: CLASS 1 LASER PRODUCT. An example is seen below, in Figure 28.

Figure 28. Explanatory label required by IEC 60825-1.

Micron Optics will also label APC connectors with the emblem seen in Figure 29 or a similar emblem, indicating the apparent source of laser radiation.

Figure 29. Emblem warning of laser radiation.