

OptiTIMTM Reliability Report for Mechanical Durability

The purpose of this test is to characterize:

1. The durability of the OptiTIMTM solution after 1000 hrs of reliability tests (baking at 125°C, hast conditions of 85°C and 85% humidity, and thermal shock cycles from -40°C to 125°C) .
2. Using QSFP-DD module preform 100 mechanical insertions after 1000 hrs to reach exposure outlined above.
3. We evaluated two different lot numbers of adhesive (18115 and 19124)

Test Equipment:

Description	Manufacturer
Environmental HAST Chamber 1	BlueM Electric
Environmental Bake Chamber	Yamato
Thermal Cycle Chamber 2	ESPEC
QSFP-DD Heatsinks (12)	Molex P/N
QSFP-DD Optical Module	Multilane
Insert test setup	"In house"

Test Procedure:

Prepare 12 heat sinks for testing

1. Scribe identification numbers on each of the 12 heatsinks.
2. Prepare 6 heat sink samples with OptiTIMTM with adhesive lot #18115.
3. Prepare 6 heat sink samples with OptiTIMTM with adhesive lot #19124.



6 heat sink samples, DX4, DX5, DX6, DX10, DX11, DX12 with adhesive lot #18115



6 heat sink samples, DX16, DX17, DX18, DX22, DX23, DX24 with adhesive lot #19124

Isothermal Bake

1. Select 2 samples of each adhesive lot number for the Thermal Baking test, record the identification numbers.
2. Subject the samples to Isothermal Bake at 125°C for 500 hours.
3. Remove the samples and allow time for them to return to ambient room temperature.
4. Run Insertion Test (100x)
5. Record observations (Pass or Fail)

HAST Test

1. Select 2 samples of each adhesive lot number for the HAST test, record the identification numbers.
2. Subject the samples to 85°C and 85% relative humidity for 1000 hours.
3. Remove the samples and allow time for them to return to ambient room temperature.
4. Run Insertion Test (100x)
5. Record observations (Pass or Fail)

Thermal Shock

1. Select 2 samples of each adhesive lot number for the thermal shock test, record the identification numbers
2. Subject the samples to thermal shock at -40°C to 125°C for 1000 hours.
3. Remove the samples and allow time for them to return to ambient room temperature.
4. Run Insertion Test (100x)

5. Record observations (Pass or Fail)

Test Results:

Isothermal Bake, Heat Sinks DX4 and DX5 with adhesive lot # 18115 and DX16 and DX17 with adhesive lot # 19124 after 1000 hours at a constant temperature of 125°C.



DX4



DX5



DX16



DX17

Observations:

1. After 1000 hours of baking testing for the samples with adhesive lot # 18115, there is no delamination.
2. After 1000 hours of bake testing for the samples with adhesive lot # 19124, both DX16 and DX17 show the slight delaminations. However, the minor delaminations don't affect the overall adhesion of the samples.

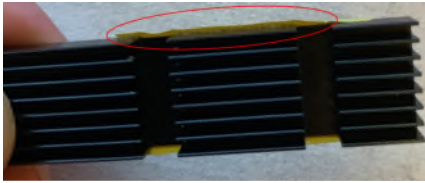
Thermal Shock Heat Sinks DX6 and DX10 with adhesive lot # 19124 and DX18 and DX22 with adhesive lot # 19124 after 1000 hrs at -40°C to 125°C at ½ hour increments



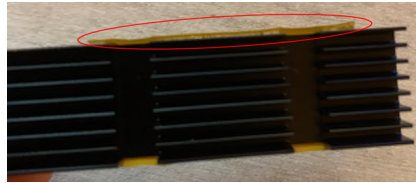
DX6



DX10



DX18

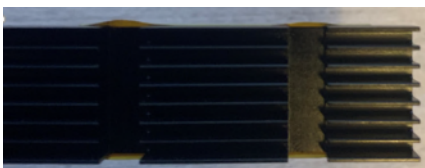


DX22

Observations:

1. After 1000 hours of thermal shock testing for the samples with adhesive lot # 18115, there is slight delamination on the edge of DX10 but this doesn't affect the overall adhesion of the solution.
2. After 1000 hours of thermal shock testing for the samples with adhesive lot # 19124, both DX18 and DX22 show the some delaminations on the edge. However, the minor delaminations don't affect the overall adhesion of the samples.

Hast Testing - Heat Sinks DX11 and DX12 with adhesive lot # 18115 and DX23 and DX24 with adhesive lot # 19124 after 1000 hours at 85°C and 85% Relative Humidity.



DX11



DX12



DX23



DX24

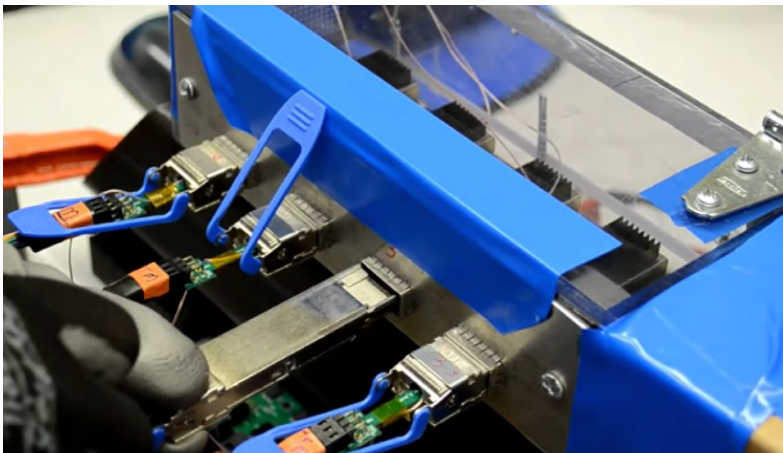
Observations:

1. After 1000 hours of hast testing for the samples with adhesive lot # 18115, DX12 shows slight delaminations on the edge. However, the delaminations doesn't affect the overall adhesion of the samples
2. After 1000 hours of hast testing for the samples with adhesive lot # 19124, both DX23 and DX24 show the slight delaminations on the edge. However, the minor delaminations doesn't affect the overall adhesion of the samples.

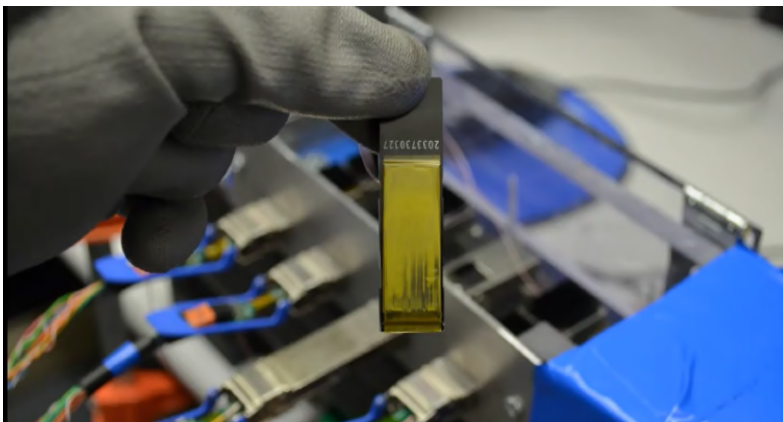
Insertion Test Setup:



QSFP-DD, 4 position test setup using Molex cage and heatsinks.

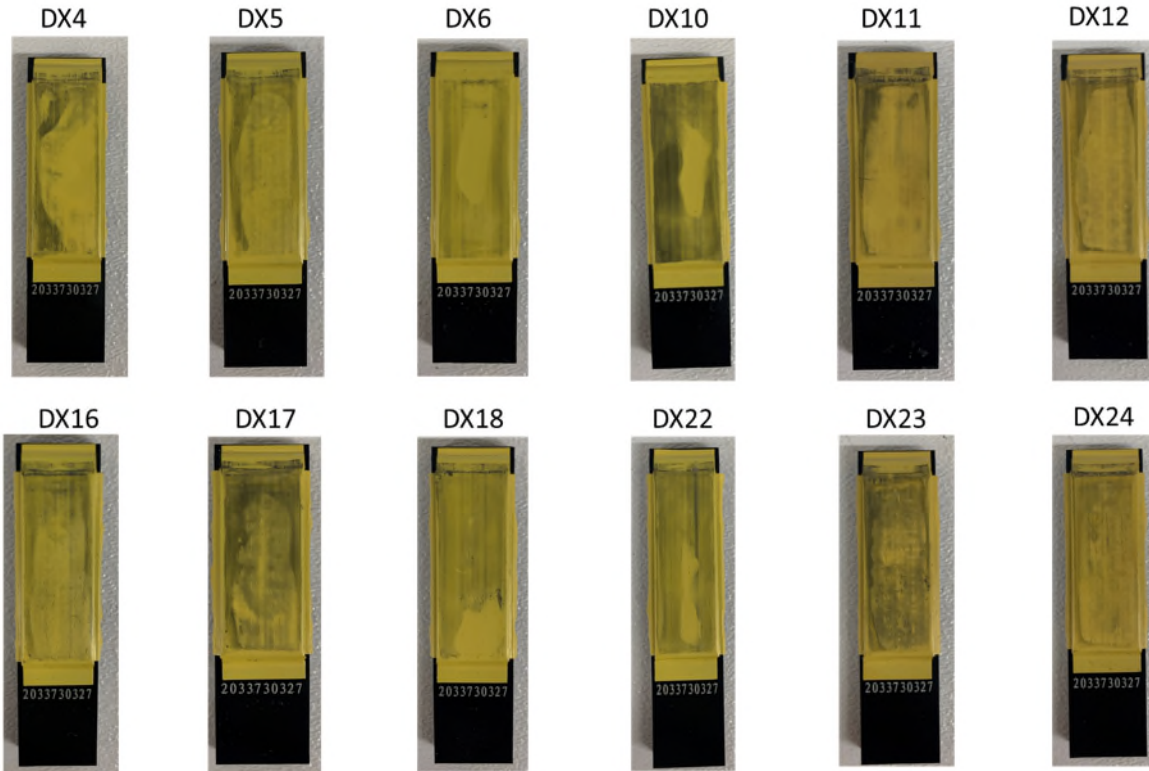


Insertion test run while module is operating (heated)



Results after 100 insertions

Insertion Test Results:



All 12 samples passed the 100 insertions test.

Adhesive lot #	Reliability Condition	HS #	50 Insertions Result	100 Insertions Result
18115	Bake (125°C)	DX 4	pass	pass
		DX 5	pass	pass
	Thermal Shock (-40°C to 125°C)	DX 6	pass	pass
		DX 10	pass	pass
	Hast (85°C, 85% Humidity)	DX 11	pass	pass
		DX 12	pass	pass
19124	Bake (125°C)	DX 16	pass	pass
		DX 17	pass	pass
	Thermal Shock (-40°C to 125°C)	DX 18	pass	pass
		DX 22	pass	pass

	Hast (85°C, 85% Humidity)	DX 23	pass	pass
		DX 24	pass	pass

Conclusion:

Although there was some minor delaminations on the edge of some of the heatsinks, the overall adhesion of the OptiTIM pad was not compromised. All OptiTIM[™] pads passed 100 insertions in all three test parameters: Thermal Bake, Thermal Cycling, and HAST.