

MHF® 4 / 4L Connector

Part No. MHF 4L Plug: 20565-001R-13, 20572-001R-08 MHF 4 Receptacle: 20449-001E-**

Product Specification

Qualification Test Report No. TR-13011

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13	S21509	October 22, 2021	K. Ikeshita		M. Takemoto
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Rev.	ECN	Date	Prepared by	Checked by	Approved by

1. Scope

This Product Specification defines the test conditions and the performances of the MHF 4 / 4L Connector
Test method is complied with "PCI Express® M.2 Electromechanical Specification DRAFT Revision 0.9".

2. Product Name and Parts No.

2.1 Product Name

MHF 4 / 4L Connector

2.2 Parts No.

MHF 4L Plug: 20565-001R-13, 20572-001R-08

MHF 4 Receptacle: 20449-001E-**

3. Rating

3.1 Applicable cable

3.1.1 Part No. 20565-001R-13

(1) Description

Inner conductor: AWG#32(7/0.08) , Silver plating copper wire

Dielectric core: Fluoro-plastics, diameter 0.68(+0.04,-0.02)mm

Outer conductor: Braid of 0.05mm, diameter 0.93(±0.09)mm, silver plating copper wire
or tin plating copper wire

Jacket: Fluoro-plastics, diameter 1.13(+0.08,-0.05)mm

(2) Requirements

Characteristic impedance: $50 \pm 2 \Omega$ by TDR method

Nominal capacitance(Reference value): 97 pF/m

Dielectric withstand voltage: no breakdown at AC 500V for 1 minutes.

3.1.2 Part No. 20572-001R-08

(1) Description

Inner conductor : AWG#36(7/0.05) ,Silver plating copper wire

Dielectric core : Fluoro-plastics ,diameter 0.40(+0.04,-0.02)mm

Outer conductor : Braid of 0.05mm, diameter 0.65(±0.1)mm , silver plating copper wire or tin plating copper wire

Jacket : Fluoro-plastics , diameter 0.81(+0.04,-0.03)mm

(2) Requirements

Characteristic impedance : $50 \pm 3 \Omega$ by TDR method

Nominal capacitance(Reference value): 96 pF/m

Dielectric withstand voltage : no breakdown at AC 1,000V for 1 minutes.

3.2 Conditions

Voltage: 60 Vr.m.s AC

Operating Temperature: 233~363K(-40°C~+90°C)

(Containing temperature rise by current)

Nominal characteristic impedance: 50Ω

Frequency: DC~12 GHz

VSWR: [Plug] 1.30 MAX at 0.1~3 GHz

1.45 MAX at 3~6 GHz

1.60MAX at 6~9 GHz

1.90MAX at 9~12 GHz

[Receptacle] 1.30 MAX at 0.1~3 GHz

1.40 MAX at 3~6 GHz

1.55 MAX at 6~9 GHz

3.3 Storage Conditions

Storage temperature: 248 to 333K(-25°C to 60°C)

Storage humidity: 85% max. (Non-condensing)

4. Test and Performance

Test Condition

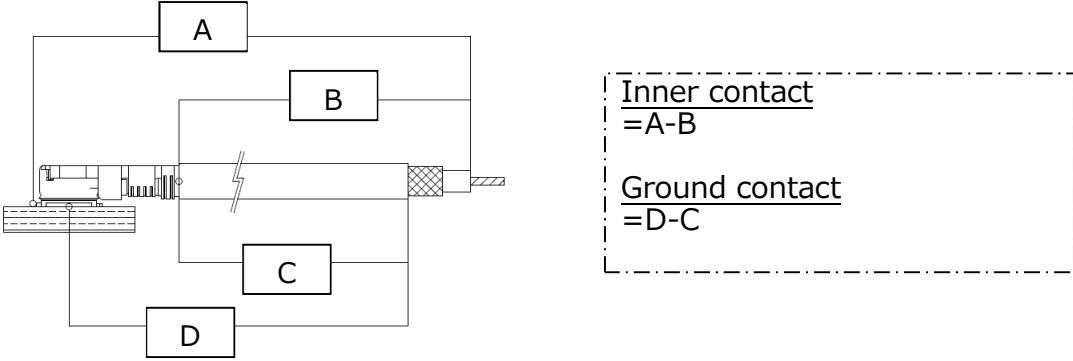
This initial test is equal to it's at shipping condition and unless otherwise specified, all tests and measurements shall be performed under the following conditions in accordance with MIL-STD-202.

Temperature... 288K~308K (15°C~35°C)

Pressure... 866hPa~1066hPa (650mmHg~800mmHg)

Relative humidity... 45~75%R.H.

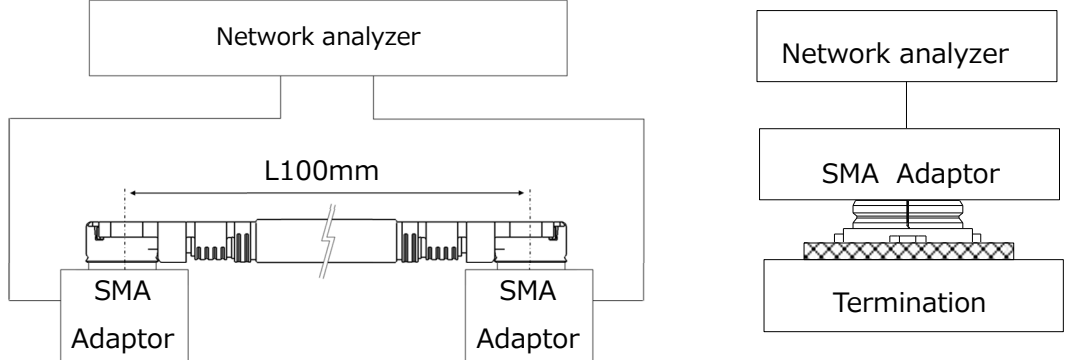
4.1. Electrical Performance

1. Contact resistance	
Reference standard:	MIL-STD-202-307
Test conditions:	Solder the receptacle connector to the test board and mate the plug connector together, then measure the contact resistance as shown in Fig.1 by the four terminal methods. Apply the low level condition of 20mV MAX. DC for the open circuit voltage and 10mA MAX. DC for the closed circuit current.
	
Fig. 1 Contact resistance	
Pass criteria:	Contact Initial: 20 mΩ MAX. After testing: \triangleleft R20 mΩ MAX. Ground contact Initial: 20 mΩ MAX. After testing: \triangleleft R20 mΩ MAX.

2. Insulation resistance	
Reference standard:	MIL-STD-202-302
Test conditions:	Mate the plug and receptacle connector together, and then apply DC 100 V between the inner contact and the ground contact.
Pass criteria:	Initial: 500 MΩ MIN. After testing: 100 MΩ MIN.

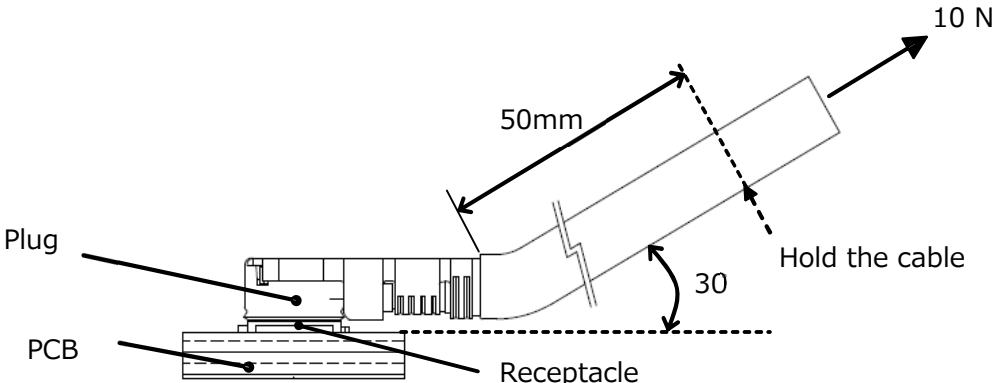
3. Dielectric withstanding voltage	
Reference standard:	MIL-STD-202-301
Test conditions:	Mate the receptacle and plug connector together, then apply AC 200V(rms) between the neighboring contacts for a minute.
Pass criteria:	No creeping discharge, flashover, no insulator breakdown shall occur.

4.1. Electrical Performance

4.VSWR							
Reference standard:	-						
Test conditions:	Measure the VSWR as shown in Fig. 2 by the network analyzer. Frequency : 100MHz ~ 12GHz						
							
Fig. 2 VSWR							
Pass criteria:	<table border="0"> <tr> <td>PLUG:</td> <td>1.30 MAX. at 0.1~3GHz, 1.45 MAX. at 3~6GHz</td> </tr> <tr> <td></td> <td>1.60 MAX. at 6~9GHz, 1.90 MAX. at 9~12GHz</td> </tr> <tr> <td>RECEPTACLE:</td> <td>1.30 MAX. at 0.1~3GHz, 1.40 MAX. at 3~6GHz, 1.55MAX. at 6~9GHz</td> </tr> </table>	PLUG:	1.30 MAX. at 0.1~3GHz, 1.45 MAX. at 3~6GHz		1.60 MAX. at 6~9GHz, 1.90 MAX. at 9~12GHz	RECEPTACLE:	1.30 MAX. at 0.1~3GHz, 1.40 MAX. at 3~6GHz, 1.55MAX. at 6~9GHz
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	1.60 MAX. at 6~9GHz, 1.90 MAX. at 9~12GHz						
RECEPTACLE:	1.30 MAX. at 0.1~3GHz, 1.40 MAX. at 3~6GHz, 1.55MAX. at 6~9GHz						

4.2. Mechanical Performance

1. Mating force and Un-mating force									
Reference standard:	-								
Test conditions:	Solder the receptacle connector to the test board, then place the board and plug on push-on/pull-off machine, measure of initial and mating/unmating 30 cycles at a speed 25±3mm/min. along the mating axis.								
Pass criteria:	<table border="0"> <tr> <td>Mating force</td> <td></td> </tr> <tr> <td>Initial:</td> <td>30 N MAX. 30cycles: 30 N MAX.</td> </tr> <tr> <td>Unmating force</td> <td></td> </tr> <tr> <td>Initial:</td> <td>20 N MAX. , 5 N MIN. 30cycles: 20 N MAX. , 3 N MIN..</td> </tr> </table>	Mating force		Initial:	30 N MAX. 30cycles: 30 N MAX.	Unmating force		Initial:	20 N MAX. , 5 N MIN. 30cycles: 20 N MAX. , 3 N MIN..
Mating force									
Initial:	30 N MAX. 30cycles: 30 N MAX.								
Unmating force									
Initial:	20 N MAX. , 5 N MIN. 30cycles: 20 N MAX. , 3 N MIN..								

2. Cable retention force at 30 degree					
Reference standard:	-				
Test conditions:	Mate plug with receptacle and tilt cable by 30 degree and pull the cable by 10N force with 10 cycles toward arrowhead direction. (Fig. 3)				
					
Fig. 3 Cable retention force at 30 degree					
Pass criteria:	<table border="0"> <tr> <td>Appearance :</td> <td>No abnormality adversely affecting the performance shall occur</td> </tr> <tr> <td>Electrical discontinuity:</td> <td>No electrical discontinuity greater than 1µs.</td> </tr> </table>	Appearance :	No abnormality adversely affecting the performance shall occur	Electrical discontinuity:	No electrical discontinuity greater than 1µs.
Appearance :	No abnormality adversely affecting the performance shall occur				
Electrical discontinuity:	No electrical discontinuity greater than 1µs.				

4.2. Mechanical Performance

3. Cable retention force at 0 degree

Reference standard: -

Test conditions: Mate Plug with Receptacle and pull the $\phi 1.13$ cable by 20N force toward horizontal direction. (Fig. 4) In case of $\phi 0.81$ cable strength should have more than 10N.

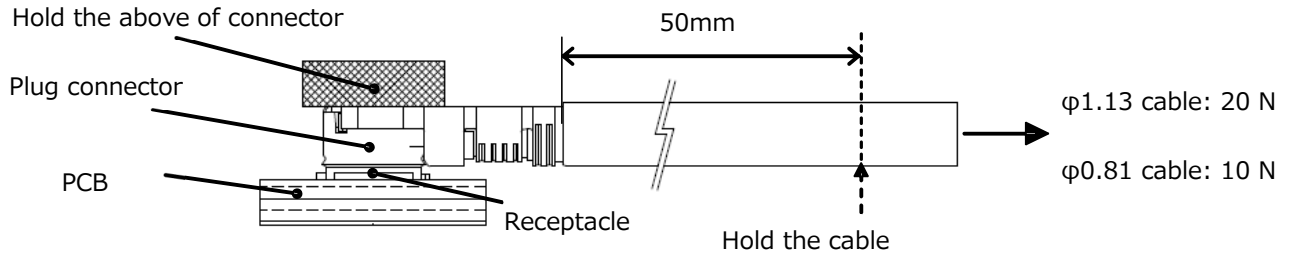


Fig. 4 Cable retention force at 0 degree

Pass criteria:

Appearance : No abnormality adversely affecting the performance shall occur
Electrical discontinuity: No electrical discontinuity greater than 1 μ s.

4. Durability

Reference standard: -

Test conditions: Solder the receptacle connector to the test board, then place the board and plug on the push-on/pull-off machine, and repeat mating and un-mating 30 cycles at a speed 25 \pm 3mm/min. along the mating axis.

Pass criteria:

Appearance : No abnormality adversely affecting the performance shall occur
Contact Resistance: Shall meet 4.1.1.

5. Receptacle shearing strength

Reference standard: -

Test conditions: Solder the receptacle connector to the test board, push the receptacle connector from each directions as Shown in Fig. 5. Measure the strength when the connector is broken.

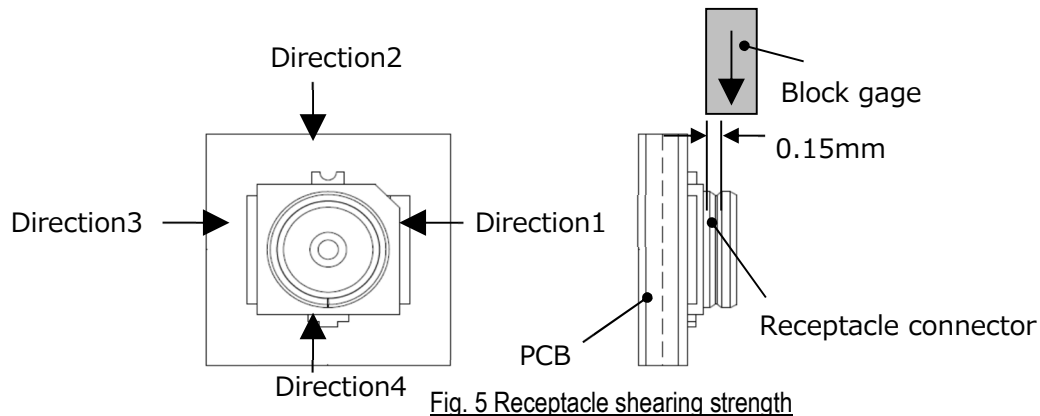


Fig. 5 Receptacle shearing strength

Pass criteria:

Shearing strength: 20 N MIN.

4.2. Mechanical Performance

6. Vibration	
Reference standard:	MIL-STD-202-201.
Test conditions:	Apply the following vibration to the mating connector. During the testing, run 100mA DC to check electrical discontinuity. Frequency: 10Hz → 100Hz → 10Hz / approx 15minutes. Half amplitude, Peak value of acceleration: 1.5mm or 59m/s ² (6G) Directions , cycle: 3 mutually perpendicular direction, 5 cycles (approx 75minutes.) for each direction.
Pass criteria:	Contact resistance: Shall meet 4.1.1. Electrical discontinuity: No electrical discontinuity greater than 1μs shall occur. Appearance : No abnormality adversely affecting the performance shall occur

7. Shock	
Reference standard:	MIL-STD-202-213.
Test conditions:	Apply the following shock to the mating connector. During the testing, run 100mA DC to check electrical discontinuity. MAX.G: 735m/s ² (75G) Directions: 6 mutually perpendicular direction Duration: 11msec Cycle: 3 cycles about each direction Wave Form: Half Sinusoidal
Pass criteria:	Contact resistance: Shall meet 4.1.1. Electrical discontinuity: No electrical discontinuity greater than 1μs shall occur. Appearance : No abnormality adversely affecting the performance shall occur

4.3. Environmental Performance

1. Thermal shock	
Reference standard:	MIL-STD-202, Method 107, Condition A.
Test conditions:	Solder the receptacle connector to the test board, then mate plug connector, and expose them to the following environment. Temperature: 218K(-55°C),30min.→358K(85°C),30min. Transition time: 5min. MAX. No. of cycles: 5 cycles
Pass criteria:	Contact resistance: Shall meet 4.1.1. Insulation resistance: Shall meet 4.1.2. Dielectric withstanding voltage: Shall meet 4.1.3. Appearance : No abnormality adversely affecting the performance shall occur

2. High temperature life	
Reference standard:	MIL-STD-202-108
Test conditions:	Solder the receptacle connector to the test board, then mate plug connector, and expose them to the following environment. Temperature: 363±2K (90±2°C) Duration: 96 hours
Pass criteria:	Contact resistance: Shall meet 4.1.1. Appearance : No abnormality adversely affecting the performance shall occur

4.3. Environmental Performance

3. Humidity(Steady state)	
Reference standard:	MIL-STD-202-103, Condition A.
Test conditions:	Solder the receptacle connector to the test board, then mate plug connector, and expose them to the following environment. Temperature: 313±2K (40±2°C) Humidity: 90~95%RH Duration: 96 hours
Pass criteria:	Contact resistance: Shall meet 4.1.1. Insulation resistance: Shall meet 4.1.2. Dielectric withstanding voltage: Shall meet 4.1.3. Appearance : No abnormality adversely affecting the performance shall occur

4. Salt water spray	
Reference standard:	MIL-STD-202-101, Condition B
Test conditions:	Solder the receptacle connector to the test board, then mate plug connector, and expose them to the following environment. Temperature: 308±2K (35±2°C) Salt water density: 5±1% [by weight] Duration: 48 hours
Pass criteria:	Contact resistance: Shall meet 4.1.1. Appearance : No abnormality adversely affecting the performance shall occur adversely affecting the performance shall occur.

5. H ₂ S gas	
Reference standard:	-
Test conditions:	Solder the receptacle connector to the test board, then mate plug connector, and expose them to the following environment. Temperature: 313±2K (40±2°C) Relative humidity: 80±5%RH Gas: H ₂ S 3±1ppm Duration: 48 hours
Pass criteria:	Contact resistance: Shall meet 4.1.1. Appearance : No abnormality adversely affecting the performance shall occur adversely affecting the performance shall occur.

4.4.Others

1. Solder ability	
Reference standard:	MIL-STD-202-208
Test conditions:	Dip the solder tine of the contact in the solder bath at $518 \pm 5K$ ($245 \pm 5^\circ C$) for 5 ± 0.5 seconds after immersing the tine in the flux of RMA or R type for 5 to 10 seconds.
Pass criteria:	The surface of the dipped contact must become 95% wet and the non-wetted pinholes must not accumulate in one area but be distributed and must be less than 5% of the contact area to be soldered.

2. Soldering heat resistance	
Reference standard:	-
Test conditions:	Reflow temperature profile as shown in Fig. 6. The number of times of reflow is within 2.
<p>The graph shows a reflow temperature profile. The y-axis represents temperature in Kelvin (K) and the x-axis represents time in seconds (sec). The profile consists of several stages: a ramp up to a temperature range of 423~473 K (150~200°C), a horizontal hold for 60~120sec, a second ramp up to 533 K, a horizontal hold for 30sec, and a final ramp down. A secondary peak is indicated at 528 K.</p>	
<p>Fig. 6 Reflow Temperature Profile</p>	
Pass criteria:	No abnormality adversely affecting the performance shall not occur.

4.5 Test Sequence and Specimen Quantity

Table 1 Test Sequence and Sample Quantity

Test Item	Group																
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	
Contact resistance						1,3		1,3	1,3	1,5	1,3	1,3	1,3	1,3			
Insulation resistance										2,6		2,6					
Dielectric withstanding voltage	1									3,7		3,7					
VSWR		1															
Mating force / Unmating force			1														
Cable retention force at 30 degree				1													
Cable retention force at 0 degree					1												
Durability						2											
Receptacle shearing strength							1										
Vibration								2									
Shock									2								
Thermal shock										4							
High temperature life											2						
Humidity (Steady state)												4					
Salt water spray													2				
H ₂ S gas														2			
Solder ability															1		
Soldering heat resistance																1	
Specimen Quantity (pcs.)	Plug	10	10	10	10	10	10	-	10	10	10	10	10	10	10	-	-
	Receptacle	10	5	10	10	10	10	12	10	10	10	10	10	10	10	10	10

※Numbers indicate sequence in which tests are performed.

5. Recommended Metal Mask

Refer to drawing for the recommended metal mask thickness and opening dimension.