

# MHF<sup>®</sup> 4L Connector

Plug Part No. 20565-001R-13, 20572-001R-08  
 Receptacle Part No. 20579-001E, 20579-001E-01

## Product Specification

Qualification Test Report No. TR-14097

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7	S21510	October 22, 2021	K. Ikeshita		M. Takemoto
6	S21315	July 2, 2021	N. Miyashiro	K. Ikeshita	M. Takemoto
Rev.	ECN	Date	Prepared by	Checked by	Approved by

## 1. Scope

This Product Specification defines the test conditions and the performances of the MHF 4L Connector  
Test method is complied with "PCI Express® M.2 Electromechanical Specification DRAFT Revision 1.0".

## 2. Product Name and Parts No.

### 2.1 Product Name

MHF 4L Connector

### 2.2 Parts No.

Plug: 20565-001R-13, 20572-001R-08

Receptacle: 20579-001E, 20579-001E-01

## 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 0.70(±0.05)mm

Outer conductor : Braid of 0.05mm, diameter0.93(±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±2Ω 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±3Ω 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	Frequency	0.1~3GHz	3~6GHz	6~9GHz	9~12GHz
	Plug:20565-001R-13, 20572-001R-08	1.30 MAX.	1.45 MAX.	1.60 MAX.	1.90 MAX.
	Receptacle: 20579-001E	1.30 MAX.	1.40 MAX.	1.50 MAX.	1.65 MAX.

**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**

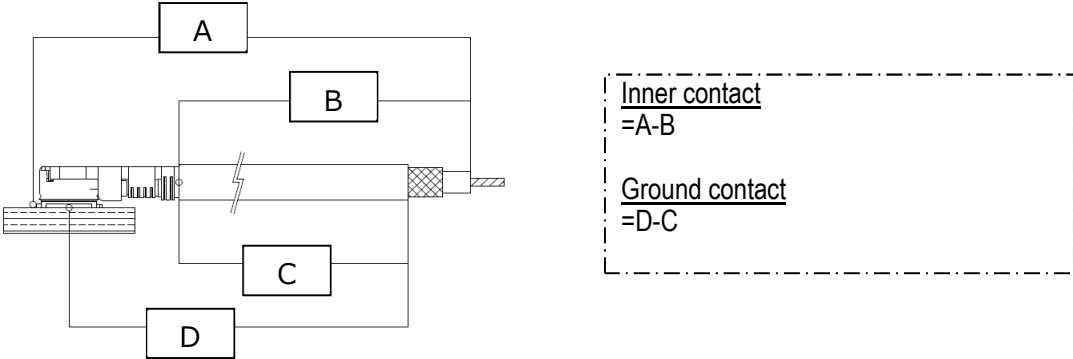
This initial test is equal to it's at shipping condition and unless otherwise specified, all tests and measurements shall be performed under the following conditions in accordance with MIL-STD-202.

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 : 0.1GHz ~ 12GHz					
Fig. 2 VSWR					
Pass criteria:	Frequency	0.1~3GHz	3~6GHz	6~9GHz	9~12GHz
	Plug:20565-001R-13, 20572-001R-08	1.30 MAX.	1.45 MAX.	1.60 MAX.	1.90 MAX.
	Receptacle: 20579-001E, 20579-001E-01	1.30 MAX.	1.40 MAX.	1.50 MAX.	1.65 MAX.

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:	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..

4.2. Mechanical Performance

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 10cycles toward arrowhead direction. (Fig. 3)
Fig. 3 Cable retention force at 30 degree	
Pass criteria:	Appearance: No abnormality adversely affecting the performance shall occur. Electrical discontinuity: No electrical discontinuity greater than 1 $\mu$ s.

3. Cable retention force at 0 degree	
Reference standard:	-
Test conditions:	Mate Plug with Receptacle and pull the $\phi$ 1.13, $\phi$ 1.37 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 $\mu$ 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:	Contact Resistance: Shall meet 4.1.1. Appearance: No abnormality adversely affecting the performance shall occur

## 4.2. Mechanical Performance

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: 20N MIN.

6. Vibration	
Reference standard:	-
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 <sup>2</sup> (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, Condition A.
Test conditions:	Solder the receptacle connector to the test board and then apply the following shock to the mating connector. During the testing, run 100mA DC to check electrical discontinuity. MAX.G: 50G Duration: 11msec Wave Form: Half Sinusoidal Directions: 6 mutually perpendicular direction Cycle: 3 cycles about 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

## 4.3. Environmental Performance

1. Thermal shock	
Reference standard:	MIL-STD-202-107, 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, Condition B.
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

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. Saltwater 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



## 4.3. Environmental Performance

5. H <sub>2</sub> 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 <sub>2</sub> S 3±1ppm Duration: 48 hours
Pass criteria:	Contact resistance: Shall meet 4.1.1. Appearance: No abnormality 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±5K (245±5°C) for 5±0.5seconds 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:	MIL-STD-202-101, Condition B.
Test conditions:	Reflow temperature profile as shown in Fig. 6. The number of times of reflow is within 2.
Fig. 6 Reflow Temperature Profile	
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	1,5	1,3	1,3			
Insulation resistance										2,6		2,6					
Dielectric withstanding voltage	1									3,7		3,7					
VSWR		1															
Mating force Un-mating force			1														
Cable retention force at 30 degree				1													
Cable retention force at 0 degree					1												
Durability						2											
Shearing strength							1										
Vibration								2									
Shock									2								
Thermal shock										4							
High temperature life											2						
Humidity (Steady State)												4					
Saltwater spray													2				
H <sub>2</sub> 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.