MHF® 4L Connector

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

Product Specification

Qualification Test Report No. TR-14097

Rev.	ECN	Date	Prepared by	Checked by	Approved by
11	S25292	July 14, 2025	M. Toida	H. Takao	K. Yufu
10	S25269	June 17, 2025	Y. Kuribayashi	H. Takao	K. Yufu
9	S22252	June 16, 2022	H. Lu		M. Takemoto
8	S22215	May 31, 2022	Y. Imaji	K. Yufu	Y. Hashimoto

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, 20565-001R-13-P, 20572-001R-08
Receptacle: 20579-001E, 20579-001E-01

3. Rating

3.1 Applicable Cable

3.1.1 Part No. 20565-001R-13, 20565-001R-13-P

(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 Operating Conditions

Voltage: 60Vr.m.s AC (per contact)
Operating temperature: 233 to 363K(-40℃ to +90℃) (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	1.30 MAX.	1.45 MAX.	1.60 MAX	1.90 MAX
	Receptacle	1.30 MAX.	1.40 MAX.	1.50 MAX.	1.65 MAX.

3.3 Storage Conditions

Storage temperature: 248 to 333K(-25℃ to 60℃)
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 to 308K(15℃ to 35℃)
Pressure: 866hPa to 1066hPa (650mmHg to 800mmHg)
Relative humidity: 45 to 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.

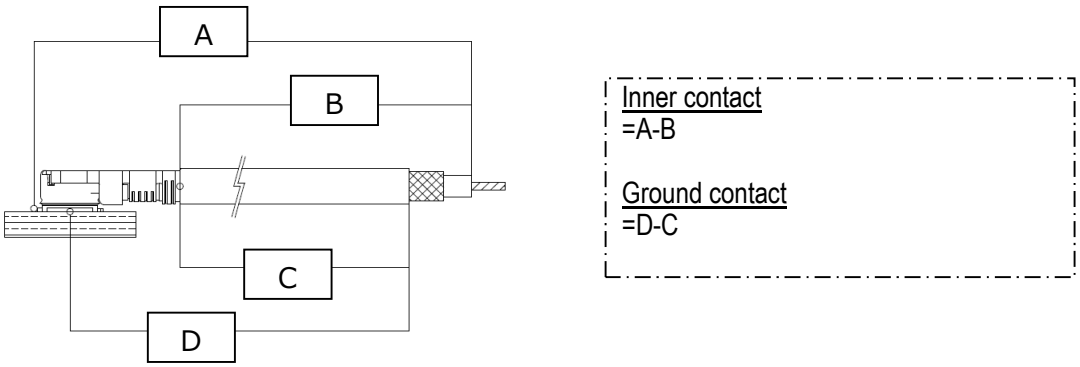


Fig. 1 Contact resistance

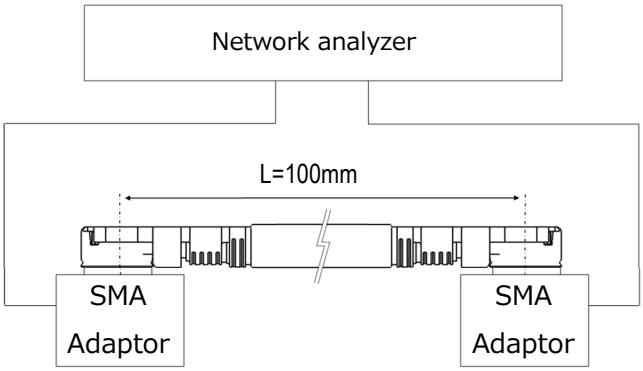
Pass criteria:	Contact Initial: 20 mΩMAX. After testing: ⊿R20 mΩ MAX. Ground contact Initial: 20 mΩ MAX. After testing: ⊿R20 mΩ MAX.

2. Insulation resistance	
Reference standard:	MIL-STD-202-302, Test condition A
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 abnormalities such as creeping discharge, flashover, insulator breakdown 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				
Pass criteria:	Frequency	0.1～3GHz	3～6GHz	6～9GHz	9～12GHz
	Plug	1.30 MAX.	1.45 MAX.	1.60 MAX	1.90 MAX
	Receptacle	1.30 MAX.	1.40 MAX.	1.50 MAX.	1.65 MAX.



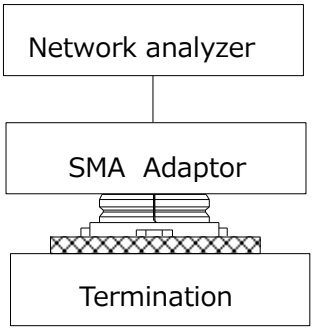
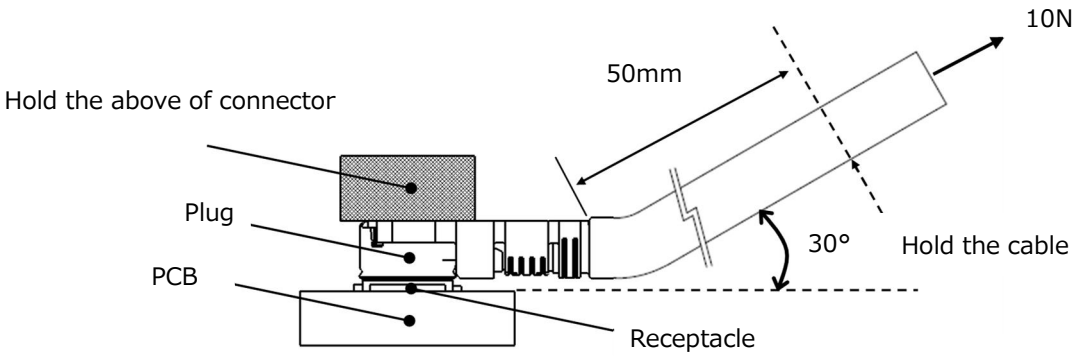


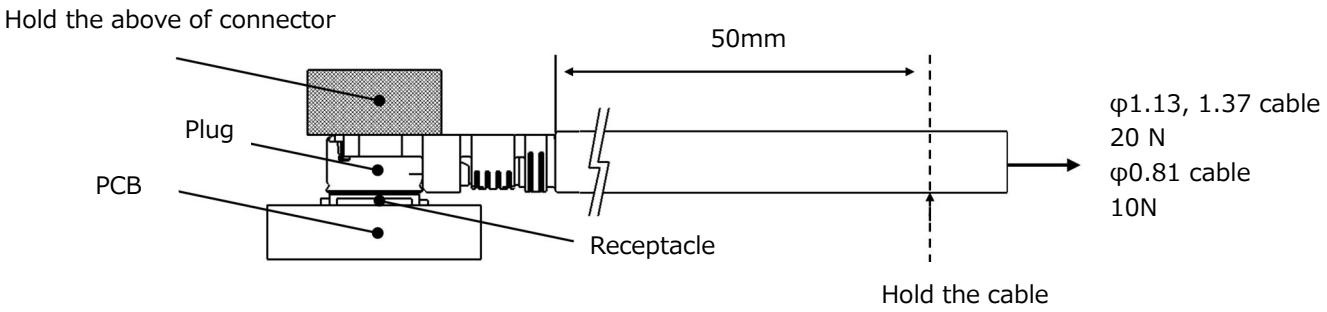
Fig. 2 VSWR

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. Repeat mating/unmating 30 cycles at a speed 25±3mm/min. along the mating axis. Measure the mating and unmating force at the initial and after 30cycles.
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 1μs.

3. Cable retention force at 0 degree	
Reference standard:	-
Test conditions:	Mate Plug with Receptacle and pull the φ1.13, φ1.37 cable by 20N force toward horizontal direction. (Fig. 4) In case of φ0.81 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 1μs.

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±3mm/min. along the mating axis.
Pass criteria:	Contact Resistance: Shall meet4.1.1. 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.

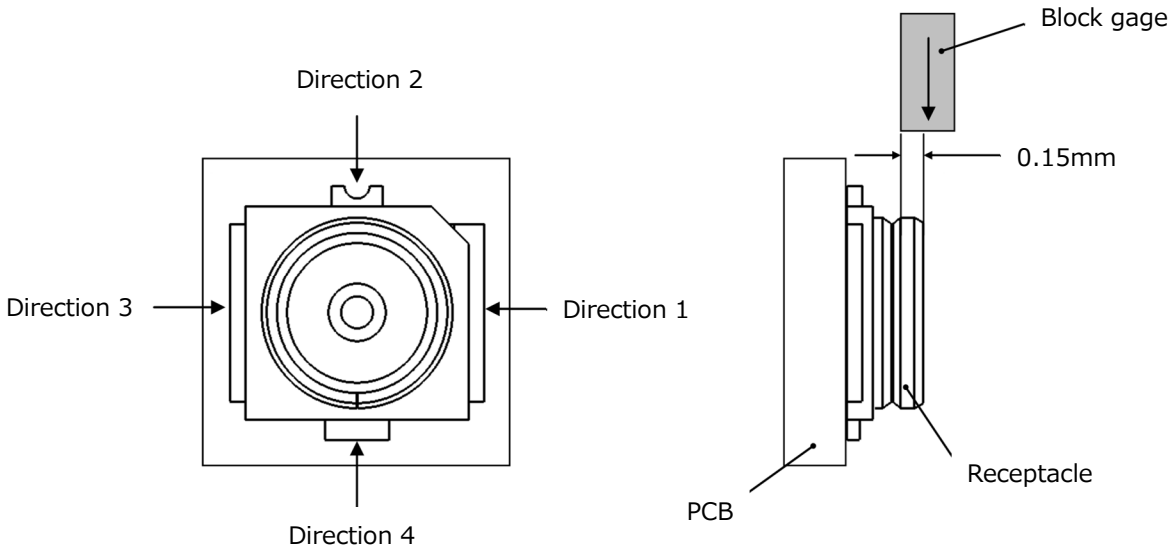


Fig. 5 Receptacle shearing strength

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/s2 (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 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　　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-202-107, Test 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℃),30min.→358K(85℃),30min. Transition time: 5min. MAX. Cycle: 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:	-
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℃) 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, Test condition B.
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℃) 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, Test 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℃) 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_2S 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℃) Relative humidity: 80±5%RH Gas: H_2S 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. Solderability	
Reference standard:	MIL-STD-202-208
Test conditions:	Dip the solder tine of the contact in the solder bath at 518±5K （245±5℃） 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. Resistance to soldering heat	
Reference standard:	MIL-STD-202-101, Test condition B.
Test conditions:	Reflow temperature: See Fig.6. The number of times of reflow is within 2.

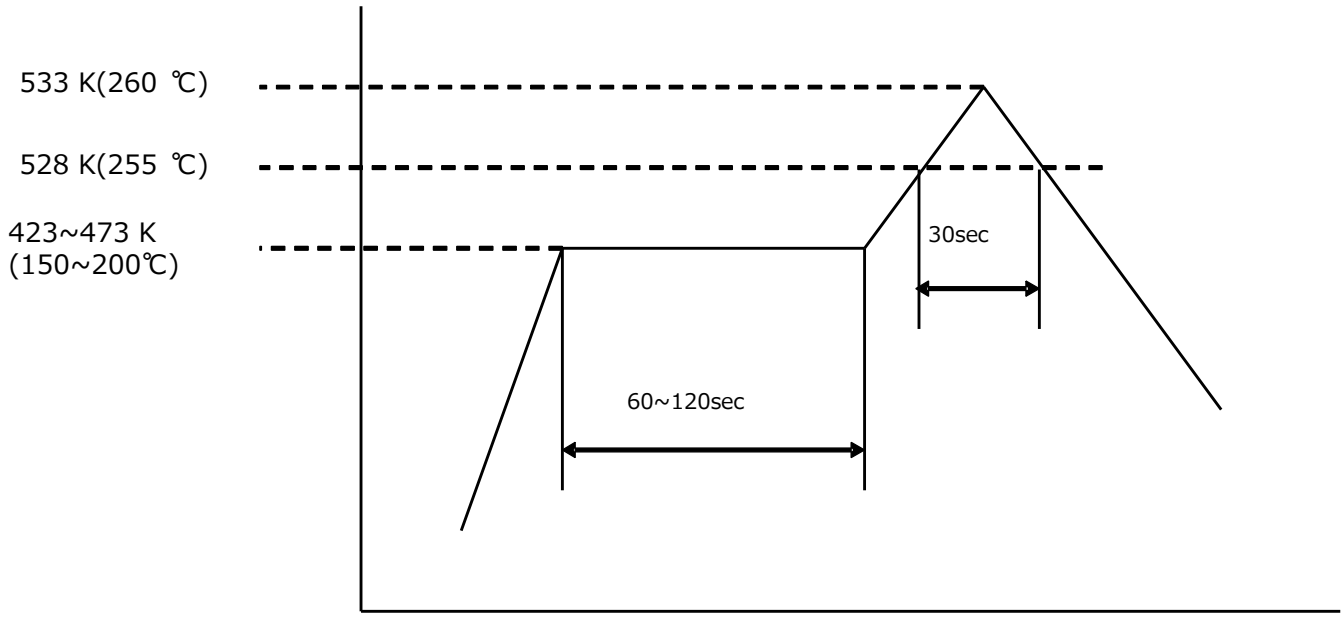


Fig. 6 Reflow Temperature Profile

Pass criteria:	No deformation nor defect adversely affecting the performance occur.

4.5 Test Sequence and Specimen Quantity

Details of the Testing Groups A to R are indicated in test report.

Table.1 Test Sequence and Sample Quantity

No.		Test Item	Testing Groups															
			A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
4.1 Electrical Performance	1	Contact resistance						1,3		1,3	1,3	1,5	1,3	1,5	1,3	1,3		
	2	Insulation resistance										2,6		2,6				
	3	Dielectric withstanding voltage	1									3,7		3,7				
	4	VSWR		1														
4.2 Mechanical Performance	1	Mating force Un-mating force			1													
	2	Cable retention force at 30 degree				1												
	3	Cable retention force at 0 degree					1											
	4	Durability						2										
	5	Shearing strength							1									
	6	Vibration								2								
	7	Shock									2							
4.2 Environmental Performance	1	Thermal shock										4						
	2	High temperature life											2					
	3	Humidity (Steady State)												4				
	4	Saltwater spray													2			
	5	H_2S gas														2		
4.4 Others	1	Solder ability															1	
	2	Soldering heat resistance																1
Specimen quantity		Plug	10	10	10	10	10	10	-	10	10	10	10	10	10	10	-	-
		Receptacle		5					12								10	10

※Numbers indicate test sequences.

5. Recommended Metal Mask

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