ISH® HYBRID CONNECTOR

Product Specification

Qualification Test Report No. STR-23005,23015

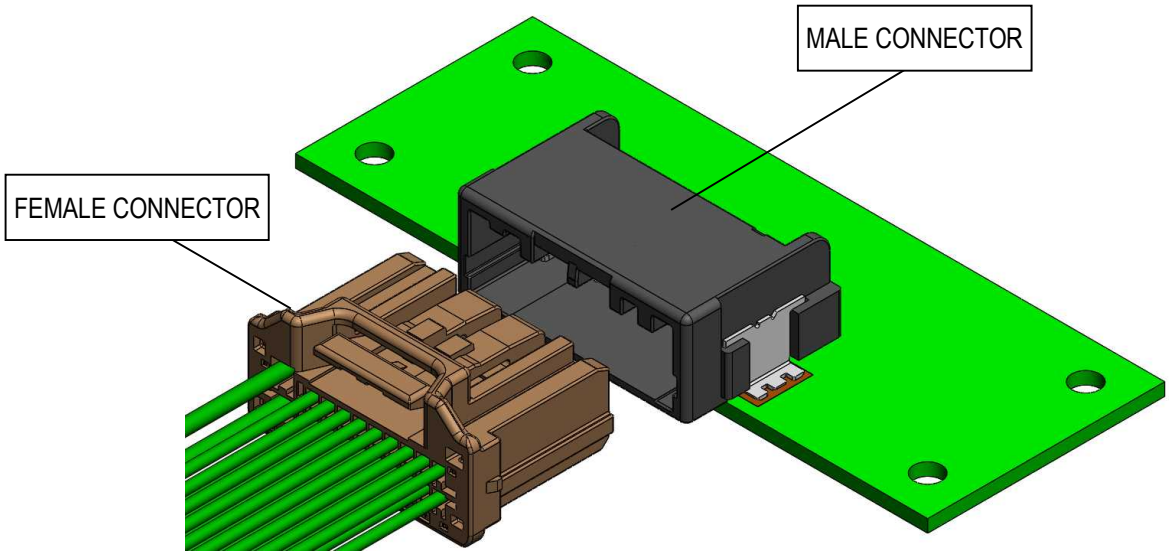
1	RS0960	August 29, 2023	Y. Nishimura	J. Mukunoki	J. Tateishi
0	RS0942	June 14, 2023	Y. Nishimura	J. Mukunoki	J. Tateishi
Rev.	ECN	Date	Prepared by	Checked by	Approved by

1. Scope： This CONNECTOR is Hybrid miniature SMT connector for 0.5mm and 1.5mm terminal.

2. Purpose：This specification covers the requirements for product performance and test methods of ISH HYBRID CONNECTOR.

3. Application items

This specification is applicable to the items listed below



ISH HYBRID CONNECTOR HORIZONTAL TYPE

Table 1. Product Line

Poles	TYPE		PARTS No.		
	KEY CODING	Lock	FEMALE TERMINNAL	MALE ASS'Y	FEMALE SUB ASS'Y
20	A	INERTIA LOCK	0.5mm : VT009-** ×18Pin 1.5mm : VT011-** ×2Pin	V0123-020E-01	V0124-020B-01
	B			V0123-020E-11	V0124-020B-11
28	-	STANDARD	0.5mm : VT009-** ×26Pin 1.5mm : VT011-** ×2Pin	V0123-028E-01	V0124-028B-02

4. Operating Condition

Temperature ：-40～125℃ (including temperature rise)

5. Construction, Materials and Finish

5.1 ISH CONNECTOR

(1)MALE HOUSING・・・・・Material：Glass-filled LCP, Flame retardance：UL94V-0, Color：BLACK or NATURAL

(2)MALE TERMINAL・・・・・Material：BRASS, Plating：Sn(Reflow)

(3)PEG・・・・・Material：BRASS, Plating：Sn(Reflow)

(4)FEMALE HOUSING・・・・・Material：PBT, Flame retardance：UL94HB, Color：BLACK or NATURAL

(5) FEMALE RETAINER・・・・・Material：PBT, Flame retardance：UL94HB, Color：BLACK

(6)0.5mm FEMALE TERMINAL・・・・・BOX Material：BRASS, Plating：Sn(Reflow)

Spring Material：Copper alloy, Plating：Sn(Reflow)

(7)1.5mm FEMALE TERMINAL・・・・・BOX Material：BRASS, Plating：Sn(Reflow)

Spring Material：Copper alloy, Plating：Sn(Reflow)

(8) Applicable cable size for 0.5mm FEMALE TERMINAL・・・・・Cross section：0.3mm^2、0.5mm^2, Outer diameter：1.60mm MAX.

(9) Applicable cable size for 1.5mm FEMALE TERMINAL・・・・・Cross section：0.5 mm^2, Outer diameter：1.93mm MAX.

5.2 Terminal crimp specification

Terminal crimp specification is based on Handling Manual【HDM-0021】

6. Reflow Temperature Profile

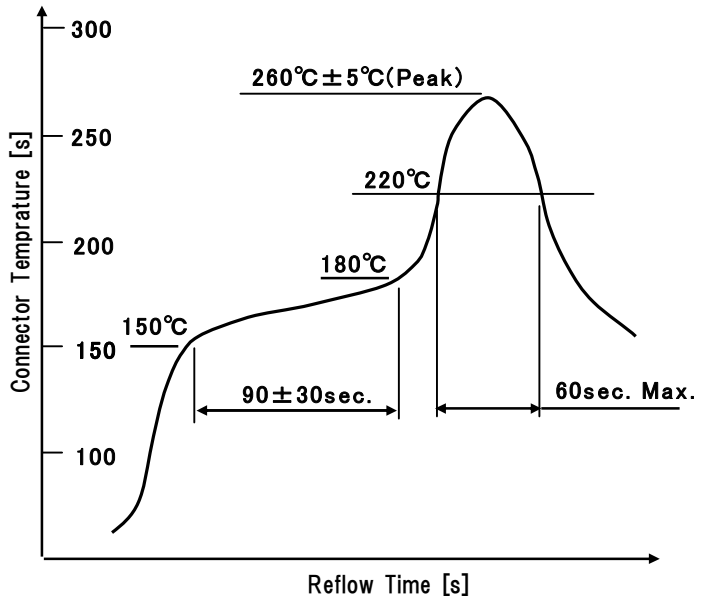


Fig.1.Reflow Temperature Profile

※Use Metal Mask which has a thickness of 0.15mm MIN. when the male connector is mounted on the PCB.

7. Test Methods and Performances

7.1 Initial characteristics

Test method is described in 8.1 Initial characteristics Test Method.

Table 2. Initial characteristics

Item	Measurement		Requirements	
1	Terminal appearance		No detrimental deformation	
2	Terminal outer dimension		Satisfy drawing dimension	
3	Housing appearance		No detrimental deformation	
4	Housing outer dimension		Satisfy drawing dimension	
5	Feeling(insertion/removal)		No discomfort	
6	Connector mating force		20P	70N Max.
			28P	71.2N Max.
7	Connector unmating force		20P	55N Max.
			28P	66.2N Max.
8	Connector retention force		100N Min.	
9	Unlocking force		50N Max.	
10	Insulation resistance		100MΩ Min.	
11	Withstanding voltage		No insulation breakdown or errosion	
12	Temperature rise	Single pole	ΔT=50°CMax.	
		All poles	ΔT=50°CMax.	
13	Leak current		1mA Max.	
14	Coplanarity		0.1mm Max.	
15	Peg strength		100N Min.	
16	Audible click		60dB(A) Min.	
17	Terminal crimp strength		0.5mm FEMALE TERMINAL：70N Min. 1.5mm FEMALE TERMINAL：90N Min.	
18	Terminal insertion force		0.5mm FEMALE TERMINAL：0.5N Min. ～ 3N Max. 1.5mm FEMALE TERMINAL：3.5N Min.～4.5N Max.	
19	Terminal removal force		0.5mm FEMALE TERMINAL：0.5N Min. ～ 3N Max. 1.5mm / FEMALE TERMINAL：3.5N Min.～4.5N Max.	
20	Terminal contact force		0.5mm terminal	3N Min.
			1.5mm terminal	4N Min.
21	Terminal bend strength		a	Must not bend more than 1mm
			b	Terminal bending 30°MAX
22	Voltage drop		Initial	10mV/A Max.
			After test	20mV/A Max.
23	Dry circuit resistance		Initial	10mΩ Max.
			After test	20mΩMax.
24	Microcut monitoring		Not exceed 7Ωfor 1μs Min.	
25	Terminal retention force		With secondary lock	0.5mm FEMALE TERMINAL：49N Min. 1.5mm FEMALE TERMINAL：100N Min.
			Without secondary lock	0.5mm FEMALE TERMINAL：20N Min. 1.5mm FEMALE TERMINAL：60N Min.
26	Terminal to housing insertion force		10N Max.	
27	Retainer insertion/removal force		Insertion force	29.4N Max.
			Removal force	14.7N Min.
28	Housing lock strength without terminals		49N Min.	
29	Sn whisker		125μm Max.	

7.2 Environmental Performances

Test method is described in 8.2 Environmental Performances Test Method.

Table 3. Environmental Performances

Item	Test name	Measurement			Requirements
1	Repeated insertion/removal	Connector mating force		After 5 repeat	See table2-Item6(Sheet 4/19)
				After test	
		Connector unmating force		After 5 repeat	See table2-Item7(Sheet 4/19)
				After test	
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
2	Resistance to forced mating (with 98N in 4 directions)	Connector mating force		After test	See table2-Item6(Sheet 4/19)
		Connector unmating force		After test	See table2-Item7(Sheet 4/19)
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
3	Fretting corrosion	Dry circuit resistance		Monitor dry circuit resistance during test.	20mΩ Max.
4	Thermal aging	Housing appearance			No detrimental deformation
		Feeling(insetrion/removal)			No discomfort
		Connector retention force		Direction 1	100N Min.
		Terminal crimp strength		0.5mm terminal	70N Min.
				1.5mm terminal	90N Min.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Terminal retention force	0.5mm terminal	With secondary lock	49N Min.
				Without secondary lock	20N Min.
			1.5mm terminal	With secondary lock	100N Min.
				Without secondary lock	60N Min.
		Housing lock strength without terminals			49N Min.
5	Low temperature aging	Housing appearance			No detrimental deformation
		Feeling(insetrion/removal)			No discomfort
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Terminal retention force	0.5mm terminal	With secondary lock	49N Min.
				Without secondary lock	20N Min.
			1.5mm terminal	With secondary lock	100N Min.
				Without secondary lock	60N Min.
		Housing lock strength without terminals			49N Min.
6	Thermal shock	Housing appearance			No detrimental deformation
		Feeling(insetrion/removal)			No discomfort
		Connector retention force		Direction 1	100N Min.
		Terminal crimp strength		0.5mm terminal	70N Min.
				1.5mm terminal	90N Min.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Terminal retention force	0.5mm terminal	With secondary lock	49N Min.
				Without secondary lock	20N Min.
			1.5mm terminal	With secondary lock	100N Min.
				Without secondary lock	60N Min.

Table 4.Environmental Performances

Item	Test name	Measurement			Requirements
7	Temperature/humidity cycle	Housing appearance			No detrimental deformation
		Feeling(insetrion/removal)			No discomfort
		Insulation resistance			100MΩ Min.
		Withstand voltage			No insulation breakdown or errosion
		Leak current			1mA Max.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Terminal retention force	0.5mm terminal	With secondary lock	49N Min.
				Without secondary lock	20N Min.
			1.5mm terminal	With secondary lock	100N Min.
				Without secondary lock	60N Min.
8	Resistance to humidity	Housing appearance			No detrimental deformation
		Connector retention force		Direction 1	100N Min.
		Insulation resistance			100MΩ Min.
		Withstand voltage			No insulation breakdown or errosion
		Leak current			1mA Max.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Terminal retention force	0.5mm terminal	With secondary lock	49N Min.
				Without secondary lock	20N Min.
			1.5mm terminal	With secondary lock	100N Min.
				Without secondary lock	60N Min.
9	Resistance to abrasion	Terminal appearance			No detrimental deformation
		Housing appearance			No detrimental deformation
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
10	Corrosion gas	Terminal appearance			No detrimental deformation
		Housing appearance			No detrimental deformation
		Terminal crimp strength		0.5mm terminal	70N Min.
				1.5mm terminal	90N Min.
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
11	Resistance to stress corrosion	Terminal appearance			No detrimental deformation
		Terminal crimp strength		0.5mm terminal	70N Min.
				1.5mm terminal	90N Min.
12	Condensation	Terminal appearance			No detrimental deformation
		Housing appearance			No detrimental deformation
		Insulation resistance			100MΩ Min.
		Withstand voltage			No insulation breakdown or errosion
		Leak current			1mA Max.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.

Table 5. Environmental Performances

Item	Test name	Measurement			Requirements
13	Dump heat cycle	Housing appearance			No detrimental deformation
		Leak current			1mA Max.
		Insulation resistance		250h	100MΩ Min.
				500h	100MΩ Min.
				750h	100MΩ Min.
				1000h	100MΩ Min.
		Migration			No migration
14	Current cycle	temperature rise			ΔT=50°C Max.
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
15	Shock	Voltage drop		Initial	10mV/A Max.
				After test	20mV/A Max.
		Microcut			Not exceed 7Ωfor 1μs Min.
16	Vibration	temperature rise			ΔT=50°C Max.
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Microcut			Not exceed 7Ωfor 1μs Min.
17	Vibration with temperature change	Terminal appearance			No detrimental deformation
		Housing appearance			No detrimental deformation
		Terminal contact force		0.5mm terminal	3N Min.
				1.5mm terminal	4N Min.
		Voltage drop	0.5mm terminal	Initial	10mV/A Max.
				fter test	20mV/A Max.
			1.5mm terminal	Initial	10mV/A Max.
				After test	20mV/A Max.
		Dry circuit resistance	0.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
			1.5mm terminal	Initial	10mΩ Max.
				After test	20mΩ Max.
		Microcut			Not exceed 7Ωfor 1μs Min.

8. Test method

8.1 Initial characteristics Test Method

(1) Terminal appearance

Test method Visual(e.g. magnifier) and tactile verification.

(2) Terminal outer dimensions

Test method Measure dimensions using caliper, micrometer, projector.

(3) Housing appearance

Test method Visual(e.g. magnifier) and tactile verification.

(4) Housing outer dimensions

Test method Measure dimensions using caliper, micrometer, projector.

(5) Feelinng (insertion/ extraction)

Test method Verification of feeling by insertion/ extraction of connector and single terminal.

(6) Connector mating force

Test method Measure the force required to mate female and male connectors at a rate of 100 mm/min. (terminals must be fully populated)

(7) Connector unmating Force

Test method Measure the force to pull the connectors apart at a rate of 100 mm/min. without the locking feature.

(8) Connector Retention Force

Test method Measure the maximum force to pull out female connector from mated state (Fig.2). Pull in four directions at a speed of 50mm/min. (terminals must be fully populated)

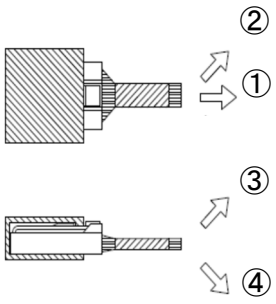


Fig 2.Measurement of connector retention force

(9) Unlocking force

Test method Measure the force to disengage the lock.

(10) Insulation resistance

Test method Supply DC500V insulation resistance between (a) terminals (b) terminal and ground on mated connectors.

(11) Insulation resistance

Test method Supply AC1000V between (a) terminals (b) terminal and ground on mated connectors for 1minute.
Same connection as for insulation resistance test.

(12) Temperature rise

Test method Supply current to mated connectors, measure the temperature rise at crimp area, when temperature is saturated. Female connector wire length: 300mm

Single pin ： Apply current to 1 terminal.(1.5mm terminal : 11A, 0.5mm terminal : 7A)

All pins ： Connect 1.5 mm terminals and 0.5 mm terminals in series, and apply the current value that is calculated by the above current value (7A) multiplied by the coefficient in Table 6.

Table 6. Coefficient

Poles	Coefficient
1	1
2～3	0.75
4～5	0.6
6～8	0.55
9～12	0.5
13～20	0.4

(13) Leak current

Test method Supply 16±0.1V to mated connector terminals. Measure maximum leak current.

(14) Coplanarity

Test method Measure coplanarity of male connector lead and peg at initial and 5 points specified in Fig. 3 during the reflow.

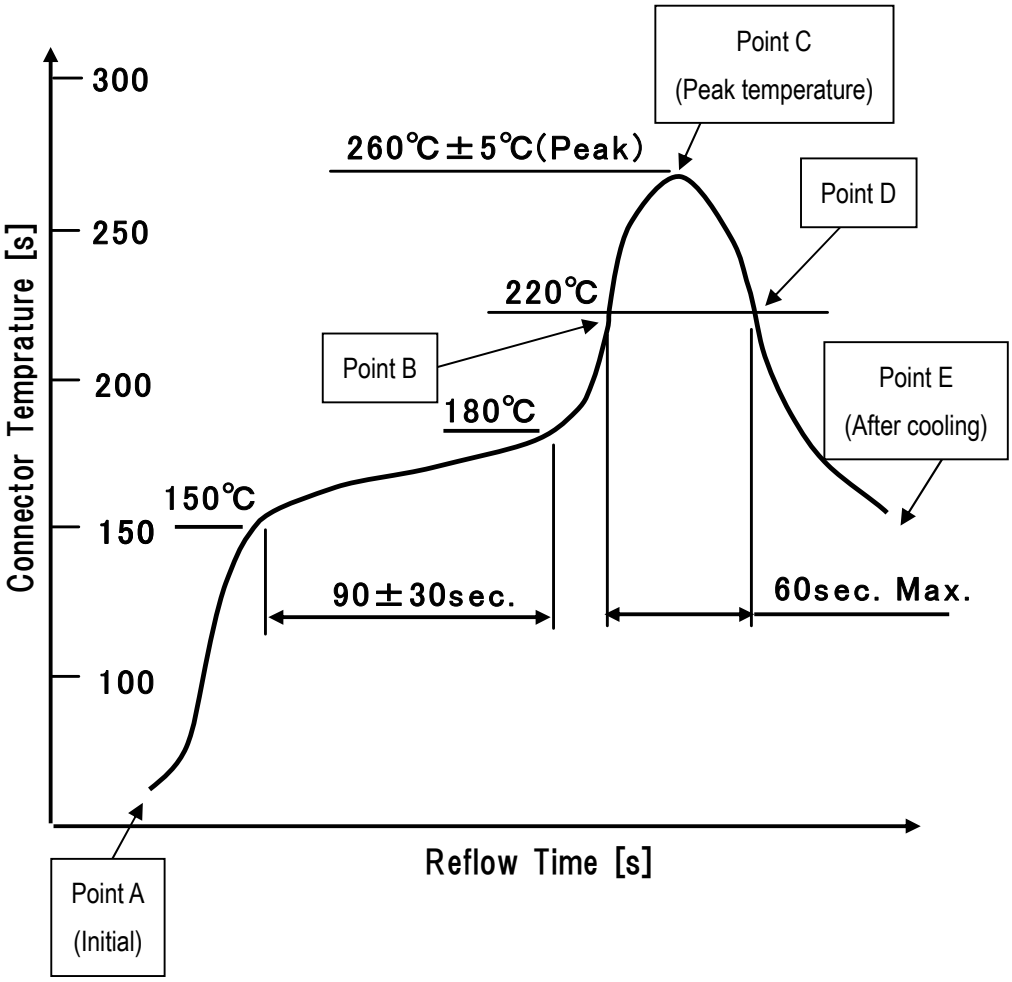
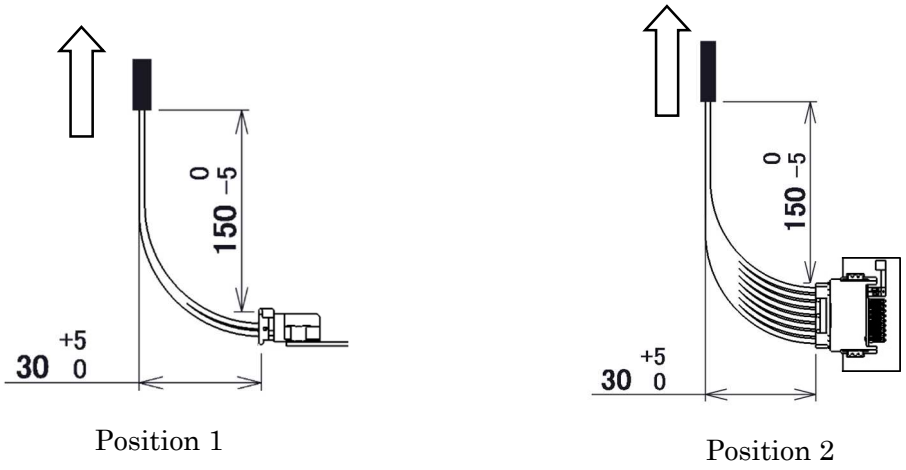


Fig 3.Coplanarity Measurement points

(15) Peg strength

Test method Mate a wired female connector to the soldered male connector, and pull the wire at a rate of 100mm/min. Measure the force when the peg comes out from the PCB.
If mating portion has some breakage, it is needed to reinforce them.
Fix the connector in the following 3 positions, and pull towards the arrowed direction.



Position 1

Position 2

Position 3

Fig.4.Peg strength measuring method

(16) Audible click

Test method Horizontally insert fully populated female connector to male connector which is soldered onto PCB.
Measure by the sound with sound level meter, and analyze the frequency analyzer (FFT).
Measurement range:10kHz～20kHz
Background noise: 5kHz MIN, Peak: 50dB MAX
Measurement must be done in a room.
Keep the position of the connector lock 600mm away from sound level meter.
Fix PCB and measure the lock sound without any touches.

(17) Terminal crimp strength

Test method Crimp wire of 100mm approx. to female terminal and pull the wire at the speed of 50-100mm/min. Measure the force when the wire breaks or the wire comes out from the terminal. Do not use insulation barrel.

(18) Terminal insertion force

Test method Measure the force to insert female terminal into fixed male connector at a speed of 100 mm/min.

(19) Terminal removal force

Test method Measure the force to pull out female terminal from male connector at a speed of 100 mm/min.

(20) Terminal contact force

Test method Calculate a contact force of female terminal and male terminal.
Measure female terminal spring displacement-force characteristics, and calculate a contact force from displacement upon male terminal insertion.
(accuracy 0.01mm MAX)

(21) Terminal bend strength

Test method (a) Push a male terminal to mating direction from housing entrance at a speed of 50mm/min with the load (maximum of connector insertion force).
(b) Remove housing walls around male terminals. Push a terminals at a speed of 50mm/min to the perpendicular direction to mating axis (4 directions: up, down, left, right)with the force.
1.5mm terminal : 12N (only up , down) , 0.5mm terminal : 3N (4 directions) applies a load.

(22) Voltage drop

Test method Open: 12V, Short circuit: 1A

Measure the voltage drop between male connector lead and temp. measurement point after where is 75mm for from the crimp area of female terminal.

temperature reached saturation at 75mm from female terminal crimp.

Then, subtract voltage drops of wire and male connector lead

Wire resistance: Table 7 or actual measurement.

Table 7.Wire resistance (20℃, 75mm)

Cable Size (mm^2)	Resistance (mΩ)
0.3	3.77
0.5(JIS)	2.45
0.5(ISO)	2.8
0.75	1.77
1.0	1.4
1.25	1.07

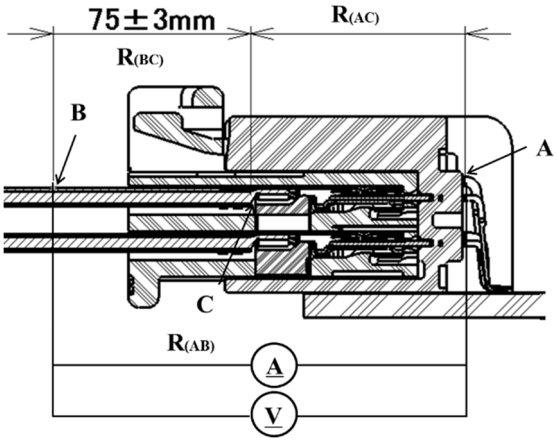


Fig 5.In-line Circuit Test Lead Location

(23) Dry circuit resistance

Test method Open: 20±5mV, Short circuit: 10±0.5mA

Measure resistance of point where is 75mm for from the crimp area of female terminal and male connector lead.

Then, subtract resistance of wire and male connector lead.

Wire resistance: Table 7 or actual measurement

(24) Microcut monitoring

Test method Measure dry circuit resistance.

(25) Terminal retention force

Test method Measure the force to pull out female terminal from female connector housing at a speed of 100mm/min. Test with and without retainer.

(26) Terminal insertion force to housing

Test method Measure the force to fully insert female terminal into female connector housing at a speed of 100mm/min

(27) Retainer insertion/removal force

Test method Fully populate female connector housing with the female terminals.
Measure the force to insert and remove the retainer at a speed of 100mm/min.
Measure the forces for each of the two locking positions.

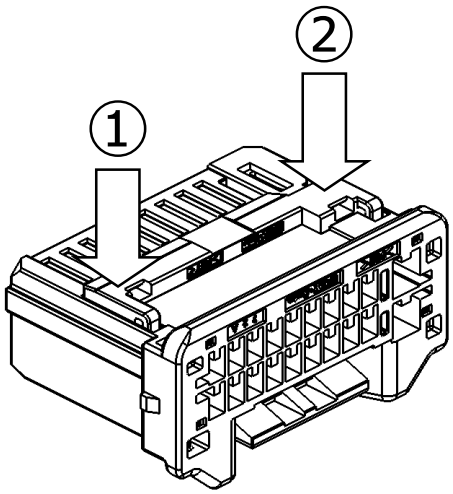


図 6.測定箇所 / Fig 6.Measurement point

(28) Housing lock strength without terminals

Test method Measure the maximum force to pull out unpopulated female connector housing from mated status at a speed of 100mm/min.

(29) Sn whisker

Test method Check the surface of connector's metal portions(terminals, lead) with microscope, etc. to find Sn whisker. Use microscope with magnification of X100 MIN.
Check closely not to lose sight of whisker with different magnifications.

8.2 Environmental Performances Test Method

(1) Repeated insertion/removal

Test method Measure the force to insert/extraction populated female connector into/from fixed male connector at a speed of 100mm/min. Repeat 10 times. Lock must be disengaged.

(2) Resistance to forced mating (with 98N in 4 directions)

Test method Insert populated female connector into male connector. Apply force of 98N from 4 directions perpendicular to insertion axes.
Apply force twice per direction. Repeat 10 times.
Female connector insertion depths: 1)depth at which terminals start to touch and 2) depth of maximum insertion

(3) Fretting corrosion

Test method Insert female terminals into male connector and subject them to micro motion.
Frictional distance: 0.23mm, Cycle time: 1-2 Hz, No. of cycles: 5,000
Monitor dry circuit resistance during test.

(4) Thermal Aging

Test method Place mated connectors in thermal chamber at 125±3℃ for 120h.
Remove the connectors from the chamber and leave it to ambient temperature to recover.

(5) Low temperature aging

Test method Place mated connectors in thermal chamber at －40±3℃ for 120h.
Repeat insert/extraction for 5 times immediately after removing from the chamber, then leave it to ambient temperature to recover.

(6) Thermal shock

Test method Place mated connectors in thermal chamber and subject them to heat /cold cycle (100±3℃/-40±3℃). No of cycles: 3000
Duration (0.5h) may be shortened if sample's temperature reaches test temperature requirement early.
Monitor resistance during test, open circuit 20±5mV, short circuit 10±0.5mA.

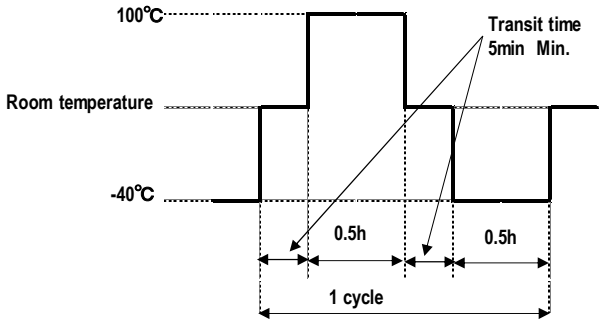


Fig.7 .Thermal shock

(7) Temperature/humidity cycle

Test method Place mated connectors in climatic chamber and subject them to the cycle pattern specified in Fig. 8. Duration 24h, No. of cycles: 10, Temperature: 85±3℃

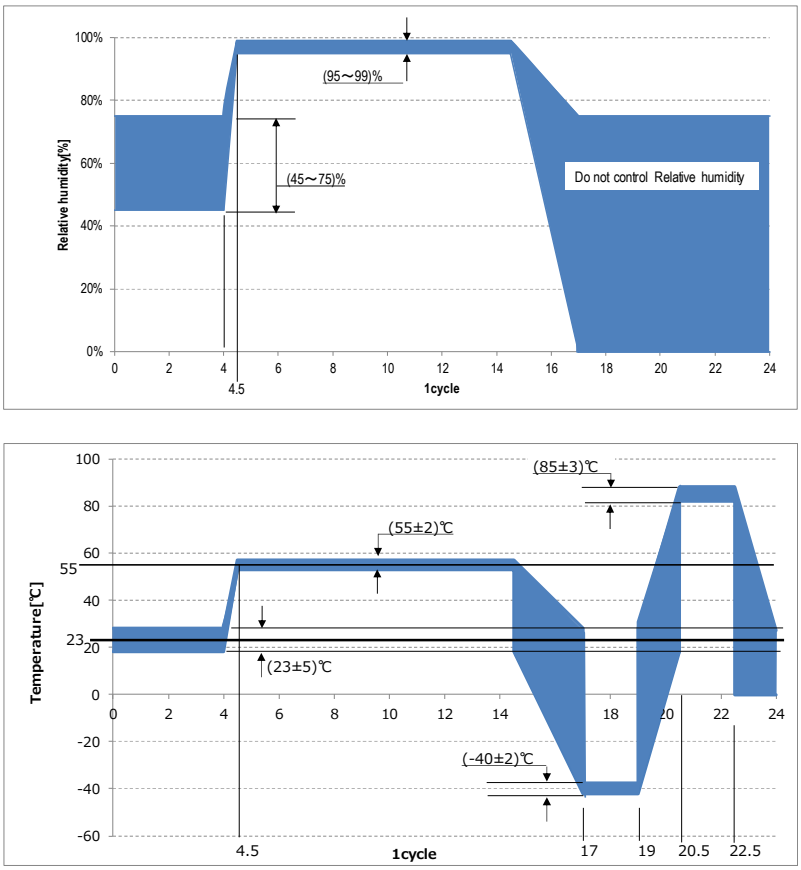


Fig8.Temperature / humidity cycle

(8) Resistance to humidity

Test method Place mated connectors in climatic chamber and subject them to 60℃±5℃, 90～95%RH for 96h.

Hang connectors to prevent any drips the connectors.

(9) Resistance to dust

Test method Suspend mated connectors in the chamber and spray dust for 10s every 15 min.

Insert/extraction connectors every other cycle.

No. of cycles: 8

Chamber length must be 900-1200mm. Use approx. 1.5kg of dust particles of Kanto Loam layer or Portland cement (JIS R5210).

(10) Corrosion gas

Test method Place male and female connectors (not mated) in 25±5ppm, 40±2℃, 90-98%RH, SO2 gas for 96h.

(11) Resistance to stress corrosion

Test method Degrease female terminals, cleanse with 10%H2SO4, rinse under water and dry.
Submerge in solution of free ammonia 6N, copper 10.2g/L for 3h, then remove.
Making test solution:
Mix, ammonia (28%～30%): Purified water = 1:1.6, to make 6N ammonia water.
Mix copper powder (10.2g) with 6N ammonia solution (1L).

(12) Condensation

Test method Place mated connectors in climatic chamber and subject them to the following cycle.
1 cycle: 1h at -30±3℃, then 1h at 25±3℃ and 90±5%RH
No. of cycles: 48

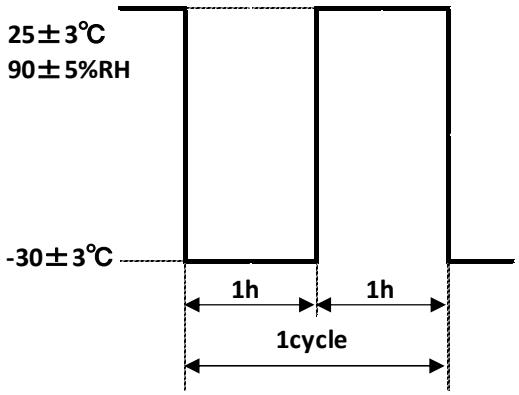


Fig.9. Condensation

(13) Dump heat cycle

Test method Place mated connectors in the chamber and apply current for 1000h at 85±3℃、
85±5%RH. Measure the leak current during the test.

(14) Current cycle

Test method Place the mated connectors in thermal chamber at 70℃±3℃. Energize 1.5mm terminals and 0.5mm terminals in series, and apply the current value (1.5mm terminal : 7A , 0.5mm terminal : 3A) for 45min, then break for 15min.
No. of cycles: 300.

(15) Shock

Test method Fix mated connectors as shown in Fig.10 and subject to impact.

Use impact according to Fig.11 sinusoidal half-wave.

Duration D=6ms, Peak acceleration A=981m/s^2

Directions: 6 directions (top, down, left, right, front back), 3 shocks each direction

Connect all terminals in direct circuit.

Monitor resistance during test, open circuit 20±5mV, short circuit 10±0.5mA.

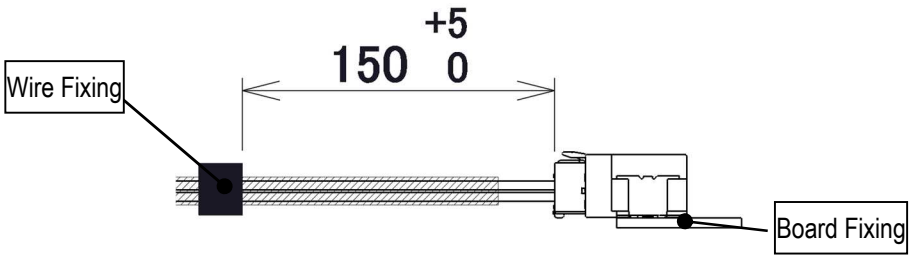


Fig10. Fixing method

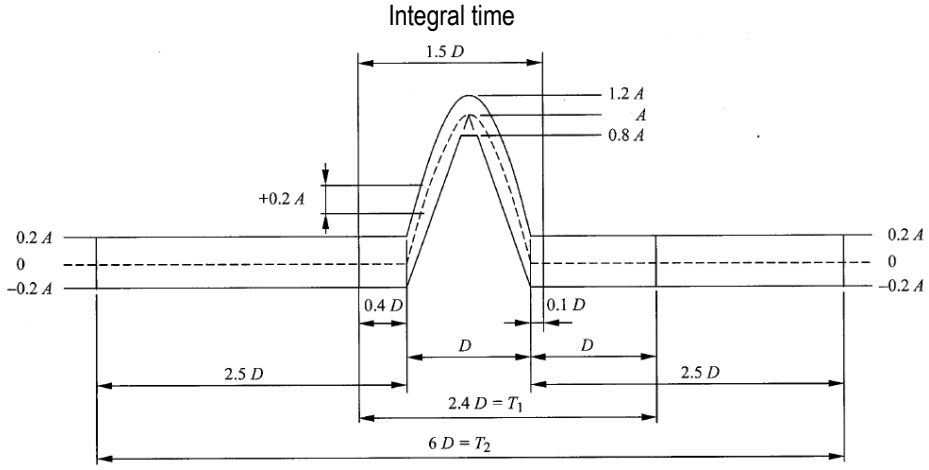


Fig11. Sinusoidal half-wave

(15) Vibration

Test method Fix mated connectors in same way as the shock test (shown in Fig.10) on fixture and subject them to vibration.

◎Vibration condition

- Direction: 3 (front-back, left-right, top-bottom)
- Acceleration: 66.6m/s^2,
- Duration: 2h(front-back, left-right), 4h(top-bottom)
- Frequency: 10-50Hz
- Sweep time: 8min (per sweep)

Energize all terminals in series with, open 13+1/0V, short circuit 10±0.5mA, continuously during test.

(16) Vibration with temperature change

Test method Fix mated connectors in same way as the shock test (show in Fig.9) on fixture and subject them to vibration at 100±3℃.

◎Vibration condition

- Acceleration: 59.8m/s^2
- Frequency: 20-200Hz
- Sweep time: 3min (per sweep)

Apply the current value(1.5mm terminal : 7A , 0.5mm terminal : 3A) for 45min, break for 15min. No. of cycles: 300

Repeat in other directions.

Monitor resistance during 2.2A current supply.

After test, carry out vibration test on 3 axes, each for 1h. Check for any microcuts.