1.0 OBJECTIVE

This specification defines the performance, test, quality and reliability requirements of the HPCE& HP2 Receptacle Cable connector system.

2.0 SCOPE

This specification is applicable to the termination characteristics of the HPCE& HP2 Receptacle Cable System which provides a separable interface for power to board and power to edge card applications.

3.0 GENERAL

This document is composed of the following sections:

Paragraph	Title	Page
1.0	**OBJECTIVE**	**1**
2.0	**SCOPE**	**1**
3.0	**GENERAL**	**1**
4.0	**APPLICABLE DOCUMENTS**	**3**
4.1	FCI Specification	
4.2	Others Standards and Specification	
4.3	FCI Lab Reports – Supporting Data	
4.4	UL/CSA/TUV Certification	
5.0	**REQUIREMENTS**	**3**
5.1	Current Ratings	
5.2	Materials	
5.3	Qualification	
5.4	Design and Construction	
5.5	Visual	
6.0	**ELECTRICAL CHARACTERISTICS**	**5**
6.1	Signal contact resistance at LLCR	
6.2	Power Contact resistance at Specified Current	
6.3	Insulation Resistance	
6.4	Dielectric Withstanding Voltage	
6.5	Current Rating.	
6.6	Crimp Resistance Low Level	
7.0	**MECHANICAL CHARACTERISTICS**	**8**
7.1	Mating/Un-mating Force	
7.2	Contact Retention	
7.3	Crimp Tensile Strength	
7.4	Crimp Acceptance Criteria	
7.5	Cross-Section Acceptance	
7.6	Bending Radius	

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8.0 ENVIRONMENTAL CONDITIONS 10
- 8.1 Thermal Shock
- 8.2 Humidity and Temperature
- 8.3 High Temperature Life
- 8.4 High Temperature Life (Preconditioning)
- 8.5 Industrial Mixed Flowing Gas
- 8.6 Random Vibration
- 8.7 Mechanical Shock
- 8.8 Durability
- 8.9 Durability (preconditioning)
- 8.10 Thermal Disturbance
- 8.11 Dust Contamination

9.0 QUALITY ASSURANCE PROVISIONS 12
- 9.1 Equipment Calibration
- 9.2 Inspection Conditions
- 9.3 Sample Quantity and Description
- 9.4 Acceptance
- 9.5 Qualification Testing
- 9.6 Re-qualification Testing

10.0 TABLE 1: QUALIFICATION TEST MATRIX 13

11.0 REVISION RECORD 14

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4.0 APPLICABLE DOCUMENTS

4.1 FCI Specifications:

Applicable FCI product drawings
GS-20-0338: Application Specification, HPCE &HP2 Receptacle Cable System.

4.2 Other Standards and Specifications

- UL94-V0: Tests for Flammability of Plastic Materials in Devices and Appliances
- EIA 364: Electrical connector/Socket test procedures include environmental classification.
- EIA 364-1000: Environmental test methodology for assessing the performance of electrical connectors and sockets used in business office applications.
- GR-1217-CORE: Telcordia Specification “Generic Requirements for Separable Electrical Connectors”

4.3 FCI Lab Reports - Supporting Data

GS-XX-XXX (Customer Test Report)

4.4 UL/CSA Certifications

- UL xxxxxx (TBD)
- TUV xxxxxxx (TBD)

5.0 REQUIREMENTS

5.1 Current Rating

Maximum operating temperature: -40°C --+105°C

Maximum operating voltage: (Reference GS-20-0338)

The temperature rise above ambient shall not exceed 30ºC at any point in the system when all contacts are powered.

a) Starting at ambient: 25ºC – Still Air
b) Reference – FCI Test Specification BUS-03-601

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Product Application	Current Rating/Contact (AMPs)		Number Energized contact								Test Board	Starting Temp.	Forced/Still Air	T-Rise
			POWER - Wire Size (AWG)					SIGNAL Wire Size (AWG)						
			HP (High Power)			LP (Low Power)		1x1 beam						
sMates To	**Power**	**Signal**	10	12	14	14	16	22	24	26				
EDGE CARD	23	2	-	9	-	-	-	-	-	24	2 oz. Multi Layers	25°C Ambient	Still	30° C
	33	5	9	-	-	-	-	24	-	-				
	17	5	-	-	9	-	-	24	-	-				
	33	5	4	-	-	-	-	24	-	-				
	17	5	-	-	-	12	-	24	-	-				
	13	5	-	-	-	-	12	24	-	-				
	17	2	-	-	-	12	-	-	-	24				
	17	5	-	-	-	4	-	24	-	-				
	33	3	9	-	-	-	-	-	24	-				
HEADER ON BOARD														

TABLE I

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5.2 Materials

The material for each component shall be as specified herein or equivalent.

Power Receptacle Contacts: Copper alloy
Signal Receptacle contacts: Copper alloy
Housings: High temperature thermoplastic, UL 94V-0 compliant ,color:black.

Finish:

- Contact Area (Power & Signal):

  Performance-base plating, qualified to meet the requirements of this specification

- Tails (Power & Signal):

  Sn - Tin plated over Nickel (Standard)
  or
  SnPb - Tin-lead plated over Nickel (special)

5.3 Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

5.4 Design and Construction

Connectors shall be of the design, construction and physical dimensions specified on the applicable product drawings.

5.5 Visual

Visual examinations shall be performed using 10X magnification. Parts should be free from blistering, cracks, discoloration, etc.

6.0 ELECTRICAL CHARACTERISTICS

6.1 Low Level Contact Resistance (LLCR) – Signal only tested at Low Level (LLCR) – The low level contact resistance shall not exceed 15 milliohm initial and 25 milliohms after environmental exposure when measured in accordance with EIA 364 TP06. Crimped terminal samples not to be inserted into housings when tested. The following shall apply: See figure 1

- Test Voltage Open Circuit – 20 millivolts DC max.
- Test Current – 100 milliampere DC.

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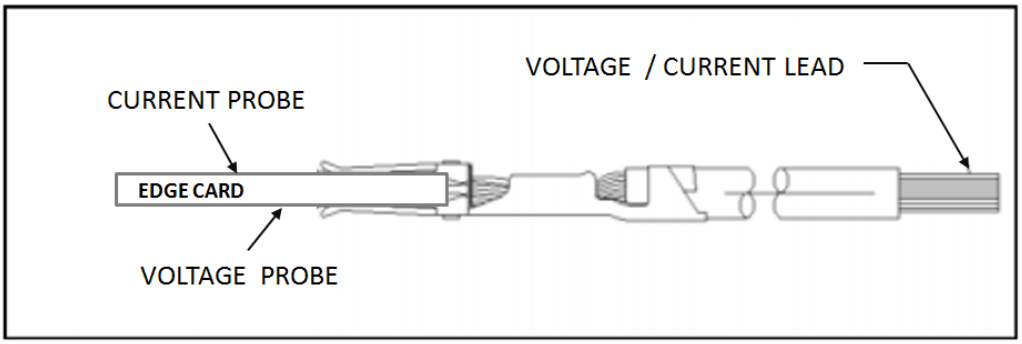

FIGURE 1

6.2 Power contact resistance tested at specified Current:

The contact resistance at a specified current shall not exceed **1.0** mΩ (milliohms) initially or after mating cycles and environmental exposure when measured in accordance with EIA 364-TP06. See Table II and Figure 2

Contact Beam	Contact Resistance at Rated Current For Power Cable Only	
	Wire Size (AWG)	Test Current (Amps DC)
High Power	10	33
	12	23
	14	17
Low Power	14	17
	16	13

TABLE II

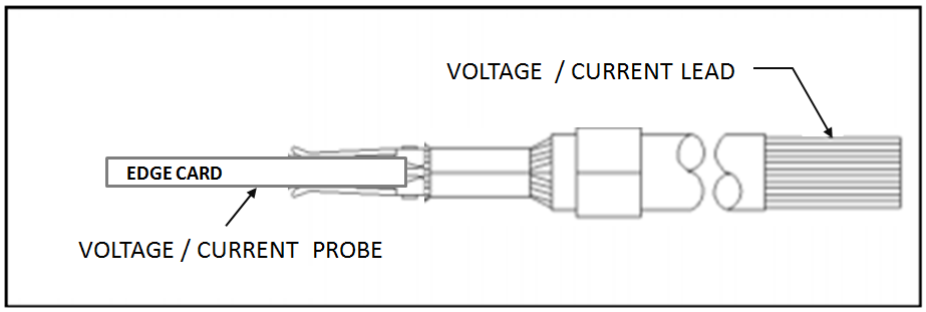

FIGURE 2

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6.3. Insulation Resistance:

- Test condition: per IEC 60512-3-1 or EIA 364-21. Apply with a test voltage 500 VDC between the closest adjacent contacts.
- Requirement: the insulation resistance shall be exceed 5,000MΩ (mega ohms) minimum for power contact and 500MΩ minimum for signal contact.

6.4. Dielectric Withstanding Voltage:

- Test condition: per IEC 60512-4-1 or EIA 364-20. Apply with test voltage 1800 VDC for power contact and 500 VDC for signal contact.
- Requirement: there shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (>1 mA).

6.5 Current Rating:

- Test condition: Energize the series of the power contacts of both upper and lower row, including signal contacts.
  a) Ambient conditions: still air at Lab ambient
  b) Reference: IEC 60512-5-1 or IEC 60512-5-2 or EIA 364-70 specification
  c) Copper trace weight: 2 external layers copper trace and 5 oz. test boards
  d) Feed wire size: (Reference. EIA 364-70 specification)
  e) Maximum 30°C temperature rise.

- Requirement:

  Develop temperature rise versus current curves for 36 total Power pins on upper and lower line and 24 Signal pins. Increase current level to **X (Table 1) Amp power pin and Y (Table 1) Amp for each signal pin** until all contacts have exceeded 30°C temperature rise. The current rating is to be determined by the current level at which the first contact exceeds 30°C temperature rise.

6.6 Crimp Resistance Low Level:

- When properly crimped, the change in crimp resistance shall not exceed 1.0 milliohms for wire sizes 22 – 26 AWG for Signal and 10 - 16 AWG for Power. Crimp resistance shall be measured in accordance with EIA-364-23. The following conditions shall apply:

  a. Method of connection
     - For Signals attach current and voltage leads as shown in Figure 3
     - For Power attach current and voltage leads as shown in Figure 3A
  b. Test Voltage – 20 millivolts DC max. open circuit
  c Test Current – Not to exceed 100 milliamperes

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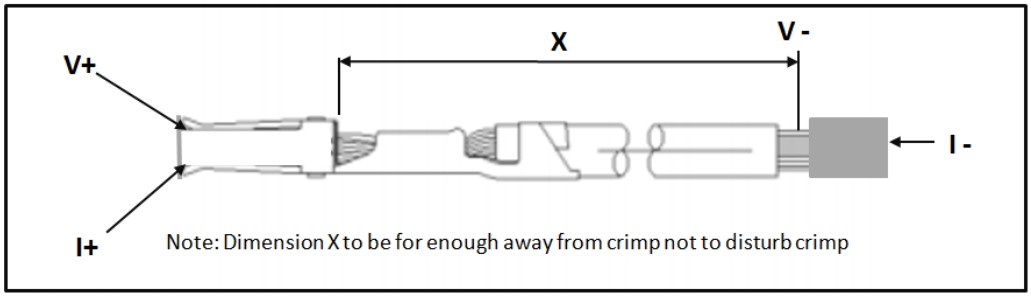

FIGURE 3

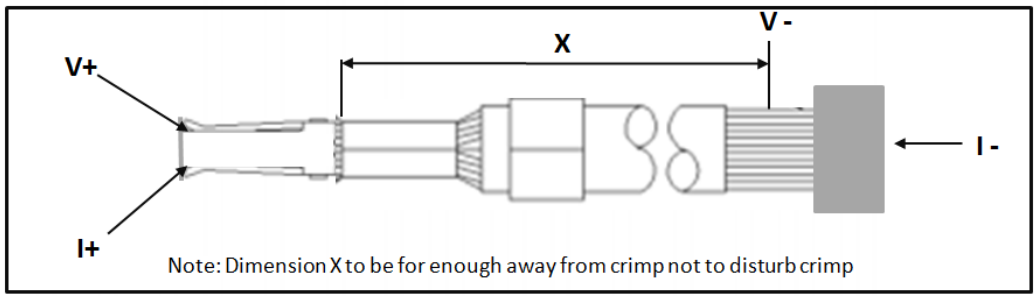

FIGURE 3A

7.0 MECHANICAL CHARACTERISTICS

7.1 Mating/Un-mating forces:

- Test condition:
  a) Cross head speed: 25.4mm (1 inch) per minute
  b) Utilize floating fixtures
  c) Reference: IEC 60512-13-2 or EIA 364-13
  d) Test with 1.57 +/- 0.13mm thickness of Edge card (2 Oz / Multi layers).

Configuration	Mating Force (N) (Max. Allowance)	Un-Mating Force (N) (Min. Allowance)
36P+24S	**46.08**	**17.61**
4 BEAM POWER Contact	**3.68**	**0.89**
2 BEAM POWER Contact	**2.6**	**0.6**
Single SIGNAL Contact Beam	**0.54**	**0.4**

TABLE III

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7.2 Contact Retention:

- Test condition: Ref EIA 364-29;
- Requirement:

Signal Pin

During mating, Individual Receptacle Signal Pin shall withstand an axial retention load of **4.5** N.

Power Contact

During mating, the individual Receptacle Power Pin shall withstand an axial retention load of **50** N.

7.3 Crimp Tensile Strength:

The force required to pull the properly crimped wire from the terminal shall not be less than the value specified in Table" IV "for Power Cables and Table" V" for Signal Cables when tested per SAE/USCAR 21 section 4.4.5. If terminals are equipped with an insulation barrel, they should not be crimped to have an effect on this test.

Cable Size (AWG)	10	12	14	16
Crimping Pull Force (N) min.	290	240	180	115

TABLE IV (POWER ONLY)

Cable Size (AWG)	22	24	26
Crimping Pull Force (Lbs) min.	16	11	6.5

TABLE V (SIGNAL ONLY)

7.4 Crimp Acceptance Criteria:

General Appearance as defined by SAE/USCAR21section 4.2.5.

7.5 Cross Section Acceptance:

Cross section acceptance as defined by SAE/USCAR21section 4.3.4 and 4.3.5

7.6 Bending Radius:

Cable shall accept a bending radius of 8 times its outer diameter without any cracking to the outer cable jacket or breaking of strands of copper wires.

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8.0 ENVIRONMENTAL CONDITIONS

After exposure to the following environmental conditions in accordance with the specified test procedure and / or details, the product shall show no physical damage and shall meet the applicable electrical and mechanical requirements of sections 6.0 and 7.0 as detailed in Table 1. Unless otherwise specified, assemblies shall be mated during exposure.

8.1 Thermal Shock:

- Test condition: Per IEC 60512-11-4 or EIA 364-32, Test condition 1. Cycle the connector -55ºC to +85ºC. Dwell time of 30 minutes at extreme temperature. Transfer time 5 minutes max.
- Requirement: No physical damages and meets sequenced tests.
  Test duration : 5 cycles

8.2 Humidity and Temperature:

- Test condition: Per IEC 60512-11-3 or EIA 364-31, method II. Exposes the connector to 40ºC±2 ºC at humidity of 90% to 95%. The test condition A will be used and the test duration is 96 hours.
- Requirement: No physical damages and meets sequenced tests

8.3 High Temperature Life:

- Test condition: Per IEC 60512-9-2 or EIA 364-17, Test method A, 240 hours at temperature 105± 2Cº, pertaining to 65ºC for 10 years per EIA-364-1000.
- Requirement: No physical damages and meets sequenced tests.

8.4 High Temperature Life (preconditioning)

- Test condition: Per EIA 364-17, Test method A, 120 hours at temperature 105± 2Cº pertaining to 65ºC for 10 years per EIA-364-1000.
- Requirement: No physical damages and meets sequenced tests.

8.5 Industrial Mixed Flowing:

- Test condition: Per IEC 60512-11-7 or EIA 364-65,Class IIA. Perform 10 days mated.
- Requirement: No physical damages and meets sequenced tests.

8.6 Random Vibration:

- Test condition: Per IEC 60512-6-4 or EIA 364-28. Test condition VII, Condition E with overall 4.90 rms g between 10-500 Hz. This test shall be performed for a total of 1 ½ hours in each axis.
- Requirement: No physical damages and no electrical discontinuity more than 1µ second.

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8.7 Mechanical Shock:

- Test condition: per IEC 60512-6-3 or EIA 364-27, Test condition A. Half-Sine pulse, 50G, 11ms, 3 shocks, 6 directions (18 shocks totally)
- Requirement: No physical damages and no electrical discontinuity more than 1µ second.

8.8 Durability:

- Test condition: per IEC 60512-9-1 or EIA 364-09

  a) Number of cycles: 200
  b) Cycling rate: 127 mm/minute (5 inches/minute)
  c) Mating and unmating force to be measured on the first and last cycle using floating fixture.

- Requirement: There shall be no damage to the housing or contacts after 200 cycles.

8.9 Durability (preconditioning)

- Test condition: per EIA 364-09
  a) Number of cycles: 20
  b) Cycling rate: 127 mm/minute (5 inches/minute)
  c) Mating and un-mating force to be measured on the first and last cycle
- Requirement: There shall be no damage to the housing or contacts after 20 cycles.

8.10 Thermal Disturbance:

- Test condition: Per EIA-364-1000, Test group 4. Cycle the connector between 15ºC ±3ºC and 85ºC ±3ºC, as measured on the part. Ramps should be a minimum of 2 ºC per minute, and dwell times should insure that the contacts reach the temperature extremes (a minimum of 5 minutes) Humidity is not controlled. Perform 10 such cycles.
- Requirement: No physical damages and meets sequenced tests.

8.11 Dust Contamination:

- Perform in accordance with EIA 364-91 Dust contamination 1 (benign), unmated receptacle connectors.

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9.0 QUALITY ASSURANCE PROVISIONS

9.1 Equipment Calibration:

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with ISO 9000.

9.2 Inspection conditions:

Unless otherwise specified, all inspections shall be performed under the following conditions:

a) Temperature: $25 \pm 5^{o}C$
b) Relative humidity: 30 to 80%
c) Barometric Pressure: Local ambient

9.3 Sample Quantity and Description:

The sample size and description is listed for each test in the appropriate section of this document.

9.4 Acceptance:

Electrical and mechanical requirements placed on test samples as indicated in the sections of this specification shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with the product specification shall meet the stated requirements.

Failures attributed to equipment, test set-up or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification.

9.5 Qualification Testing:

Qualification testing shall be performed on sample units with equipment and procedures normally used in production. Test sequence is as shown in Table 1.

9.6 Re-qualification Testing:

If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of the applicable parts of the test matrix, Table 1.

a) A significant design change is made to the existing product that impacts the product form, fit or function. Examples of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, contact force or contact surface geometry, insulator design, contact base material or contact lubrication requirements.
b) A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.
c) A significant change is made to the manufacturing process that impacts the product form, fit or function.

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10. Table VI: Qualification Test Matrix

TEST GROUP ID:		1	2	3	4	5	6	7	8	9
TEST DESCRIPTION	**SECTION**	Mixed Flowing Gas	Temp Life	Dielectric	Thermal Shock & Humidity	Mech. Shock & Vibration	Durability	Initial Current Rating	Terminal	Crimp LLCR
VISUAL EXAMINATION	5.5	1, 20	1,16	1,10	1,22	1,14	1,7	1,7	1	1
REASTING RECEPTACLE & EDGE CARD		2, 17	2,13		2,19	2	2,9	2		9
ELECTRICAL:										
CONTACT RESISTANCE AT LOW LEVEL (Signal)	6.1	3,9,12, 15,18	3,8,11, 14		3,8,11, 14,17,20	3,6,9, ,12,	3,10			
CONTACT RESISTANCE AT SPEC CURRENT (Power)	6.2	4,10,13, 16,19	4,9,12, 15		4,9,12, 15,18,21	4,7, , ,10,13	4,11			
INSULATION RESISTANCE	6.3			2,5,8						
DIELECTRIC WITHSTANDING VOLTAGE	6.4			3,6,9						
CURRENT RATING (Power)	6.5							3		
CURRENT RATING (Signal)	6.5							4		
CRIMP CONTACT RESISTANE (LLCR) (Power/Signal)	6.6									2
MECHANICAL:										
MATING / UNMATING FORCE	7.1	5,7	5,7		5,7		5,8			
CONTACT RETENTION (Power & Signal)	7.2								2	
CRIMP TENSIL STRENGTH	7.3								3	
CRIMP CROSS SECTION ACCEPTANCE	7.5							6		
ENVIRONMENTAL:										
THERMAL SHOCK	8.1			4	10					3,4,6,8
HUMIDITY & TEMP.	8.2			7	16					5
HIGH TEMPERATURE LIFE	8.3		10							7
HIGH TEMPERATURE LIFE (Preconditioning)	8.4	8				5				5
MFG - 10 days (EIA-364-65 Class IIA, table 4.1)	8.5	11								
RANDOM VIBRATION	8.6					8				
MECHANICAL SHOCK	8.7					11				
DURABILITY, 200 Cycles	8.8						6			
DURABILITY, 20 CYCLES (Preconditioning)	8.9	6	6		6					
THERMAL DISTURBANCE	8.11	14								
DUST CONTAMINATION	8.12				13					
SAMPLE NUMBER(PCS)		5	5	5	7	5	3	5	5	5

SAMPLES NEEDED:	
FIRST TIME SAMPLE	
SECOND TIME SAMPLE	
THIRD TIME SAMPLE	

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11. REVISION RECORD

REV	PAGE	DESCRIPTION	EC#	DATE
1	ALL	Preliminary product spec	Rev.1	1/04/2012
2	ALL	Preliminary product spec	Rev. 2	2/08/2012
3	ALL	Preliminary product spec	Rev. 3	5/24/2012
4	ALL	Preliminary product spec	Rev. 4	7/13/2012
A				
B				

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