1.0 OBJECTIVE:

This specification defines the performance, test, quality and reliability requirements of the HPC product.

2.0 SCOPE:

This specification is applicable to the termination characteristics of the HPC II family of products which provide mechanical and electrical interconnection of a daughter PCB to a mother PCB.

3.0 GENERAL:

This document is composed of the following sections:

3.1 Banned/Restricted Substances

All product where the part number ends in “LF” meet the European Union directives and other country regulations as described in GS-22-008. The part numbers that do not end in “LF” meet all regulations except for Pb in SnPb plating.

3.2 Manufacturing Processability

All products covered by this specification will withstand exposure to 260°C peak temperature for 10-30 seconds in a convection, infra-red or vapor phase reflow oven.

4.0 APPLICABLE DOCUMENTS:

4.1 Specifications

4.1.1 Engineering drawings
4.1.2 Process drawings

4.2 Military Standards

4.2.1 MIL-STD-202F: Test Methods for Electronic and Electrical Component Parts.
4.2.2 MIL-STD-1344A: Test Methods for Electrical Connectors
4.2.3 MIL-STD-2166: Connectors, Electrical, Compliant Pin
4.2.4 MIL-G-45204: Gold Plating (Electrodeposited)
4.2.5 MIL-P-81728: SnPb Plating
4.2.6 MIL-P-45209: Palladium Alloy Plating

4.3 Federal Specifications

4.3.1 QQ-N-290 - Nickel Plating
QQ-C-533 - Beryllium Copper Alloy Copper Strip

4.4 Other Standards and Specifications

4.4.1 UL94-VO: Flammability
4.4.2 UL-STD-498

4.5 FCI Specifications

4.5.1 BUS-03-114
4.5.2 BUS-03-113
4.5.3 BUS-03-108
4.5.4 BUS-03-404
4.5.5 BUS-03-405
4.5.6 BUS-03-111
4.5.7 BUS-03-110

4.6 Lab Reports - Supporting Data

4.6.1 EL-93-07-045 (Qualification Test Matrix)
4.6.2 EL-94-04-055 (Compliant Pin)
4.6.3 EL-94-05-053 (Compliant Pin)
4.6.4 EL-94-08-006 (Solderability)
4.6.5 EL-94-08-028 and -028A (Pin Torque Strength)
4.6.6 EL-94-09-025 (FCI Environmental Sequence and Bellcore 3-Gas IMFG, Central Office)
4.6.7 EL-99-08-003CR (Berg Environmental sequence)
4.6.8 EL-95-02-053 (Normal Force)
4.6.9 EL-99-08-003CR (Resistance to Solder Heat)

5.0 REQUIREMENTS:

5.1 Qualification

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

5.2 Material

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

5.2.1 Receptacle Terminal. The receptacle terminal shall be Beryllium Copper Alloy, or other copper alloy as specified on the product drawing.

5.2.2 Header Pin. The pin shall be Phosphor Bronze Alloy UNS C51000 in accordance with ASTM B-159 or other copper alloy as specified on the product drawing.

5.2.3 Housing. Housings shall be molded using glass and mineral filled LCP. The material shall be rated V-O in accordance with UL-94.

5.3 Finish

The finish for applicable components shall be as specified herein or equivalent.

5.3.1 Gold Plating. When gold plating is specified, the receptacle terminals and header pins shall be plated with the specified minimum thickness (as shown on the product drawings) of gold over 50 microinches, minimum, of nickel. The gold deposit shall meet the requirements of MIL-G-45204, Type II, Grade C and the nickel deposit shall meet the requirements of QQ-N-290, Class 2.

5.3.2 GXT Plating. When GXT plating is specified, the terminals and pins shall be plated with a thin gold flash over the specified minimum thickness (as shown on the product drawings) of palladium alloy over 50 microinches, minimum, of nickel. The palladium allow deposit shall meet the requirements of MIL-P-45209 and the nickel deposit shall meet the requirements of QQ-N-290, Class 2.

5.3.3 Sn-Pb Plating. Receptacle tails shall be plated with a minimum of 100 microinches of Sn-Pb over a minimum of 50 microinches of nickel. The plating shall meet requirements of MIL-P-81728.

5.4 Design and Construction

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

6.0 ELECTRICAL CHARACTERISTICS

6.1 Contact Resistance, Low Level (LLCR) - The low level contact resistance shall not exceed 15 milliohms (20 milliohms after environmental exposure) when measured in accordance with MIL-STD-1344A, Method 3002.1. The following details shall apply:

a. Method of Connection - Attach current and voltage leads as shown in Figure 1.
b. Test Voltage - 20 millivolts DC max open circuit.
c. Test Current - Not to exceed 100 milliamperes.

6.2 Insulation Resistance - The insulation resistance of unmated connectors shall not be less than 500 megohms when measured in accordance with MIL-STD-202F, Method 302. The following details shall apply:

a. Test Voltage - 500 volts DC.
b. Electrification Time - 2 minutes, unless otherwise specified.
c. Points of Measurement - Between adjacent contacts.

6.3 Dielectric Withstanding Voltage - There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (> 1 milliampere) when unmated connectors are tested in accordance with MIL-STD-1344A, Method 3001.1. The following details shall apply:

a. Test Voltage - 1000 volts (DC, 60Hz).
b. Test Duration - 60 seconds.
c. Test Condition - 1 (760 Torr - sea level).
d. Points of Measurement - Between adjacent contacts.

6.4 Current Rating - The temperature rise above ambient shall not exceed 30 degrees C at any point in the system when all contacts are powered at 1 ampere or one contact is powered at 2.25 amperes. The following details shall apply:

a. Ambient Conditions - Still air at 25 degrees C.
b. Reference - EIA-364-70.

6.5 Capacitance - The specification requirements shall be satisfied when evaluated in accordance with EIA 364-30 and the following details.

Testing is to be performed using the impedance test method with a frequency of 1 mhz and a test voltage of 1 volt. The capacitance measurements are to be taken between two signal pins with no ground reference, therefore, testing at various signal to ground ratios is not required. Measurements are to be made between two adjacent pins in the same row with all other pins isolated from ground.

The following Pin Out & Point of Measurement was utilized to obtain the given results.

PIN OUT & POINT OF MEASUREMENT

	Row		
Long Pin	4	o M M o o	M = Point of Measurement
	3	o M M o o	o = Unused Signal Pin
	2	o M M o o	
Short Pin	1	o M M o o	

NOTE: **Layout pattern represents 5 columns of a 4 row connector which is repeated for the length of the connector.**

The average results found are listed below:

Row 1	Row 2	Row 3	Row 4
0.87 pF	1.06 pF	1.15pF	1.24 pF

6.6 Inductance - The specification requirements shall be satisfied when evaluated in accordance with EIA 364-33 and the following details.

Testing is to be performed using the TDR Test Method with a risetime of 1000 Pico-seconds. The inductance measurements are to be taken for each signal to ground ratio and pin length [row] in the connector. Four signal to ground ratios are tested. The 7/1 S/G ratio is tested under two conditions in order to represent the two worst case 7/1 ratio possibilities.

The following Pin Out & Point of Measurement was utilized to obtain the given results.

PIN OUT & POINT OF MEASUREMENT

	Row	7/1 S/G Condition 1	7/1 S/G Condition 2	3/1 S/G	2/1 S/G
Long	4	G M G o G	o M o o o	G M G o G	G o M G o
	3	o M o o o	o M o o o	o M o o o	o G M o G
	2	o M o o o	o M o o o	o M o o o	o M G o o
Short	1	o M o o o	G M G o G	o G M G o	G M o G o

M = Point of Measurement
o = Unused Signal Pin Terminated in 50 ohms
G = Grounded Pin

NOTE: **Layout pattern represents 20 columns of a 4 row connector which is repeated for the length of the connector.**

The average results found are listed below:

S/G Ratio	Row 1	Row 2	Row 3	Row 4
7/1 Condition 1	15.6 nH	14.1 nH	11.8 nH	9.4 nH
7/1 Condition 2	4.9 nH	8.5 nH	14.5 nH	19.8 nH
3/1	5.5 nH	9.0 nH	10.8 nH	9.2 nH
2/1	5.3 nH	6.0 nH	7.5 nH	10.5 nH

6.7 Propagation Delay - The specification requirements shall be satisfied when evaluated in accordance with EIA 364-103 and the following details.

Testing is to be performed using the through pulse test method with risetime of 35 Pico-Seconds. The propagation measurements are to be taken for each of the signal to ground ratios and pin length [row] in the connector. Four signal to ground ratios are tested. The 7/1 S/G ratio is tested under two conditions in order to represent the two worst case 7/1 ratio possibilities.

The following Pin Out & Point of Measurement was utilized to obtain the given results:

PIN OUT & POINT OF MEASUREMENT

	Row	7/1 S/G Condition 1	7/1 S/G Condition 2	3/1 S/G	2/1 S/G
Long	4	G M G o G	o M o o o	G M G o G	G o M G o
	3	o M o o o	o M o o o	o M o o o	o G M o G
	2	o M o o o	o M o o o	o M o o o	o M G o o
Short	1	o M o o o	G M G o G	o G M G o	G M o G o

M = Point of Measurement
o = Unused Signal Pin Terminated in 50 ohms
G = Grounded Pin

NOTE: **Layout pattern represents 20 columns of a 4 row connector which is repeated for the length of the connector.**

Maximum propagation delay values are listed below:

S/G Ratio	Row 1	Row 2	Row 3	Row 4
7/1 Condition 1	137 pS	157 pS	184 pS	197 pS
7/1 Condition 2	136 pS	156 pS	176 pS	192 pS
3/1	141 pS	162 pS	183 pS	203 pS
2/1	137 pS	152 pS	174 pS	193 pS

6.8 Characteristic Impedance - The specification requirements shall be satisfied when evaluated in accordance with EIA 364-108 and the following details.

Testing is to be performed using the TDR Test Method with risetimes of 200, 500, and 1000 Pico-Seconds. The impedance measurements are to be taken for each signal to ground ratio and pin length [row] in the connector. Four signal to ground ratios are tested. The 7/1 S/G ratio is tested under two conditions in order to represent the two worst case 7/1 ratio possibilities.

The following Pin Out & Point of Measurement was utilized to obtain the given results:

PIN OUT & POINT OF MEASUREMENT

	Row	7/1 S/G Condition 1	7/1 S/G Condition 2	3/1 S/G	2/1 S/G
Long	4	G M G o G	o M o o o	G M G o G	G o M G o
	3	o M o o o	o M o o o	o M o o o	o G M o G
	2	o M o o o	o M o o o	o M o o o	o M G o o
Short	1	o M o o o	G M G o G	o G M G o	G M o G o

M = Point of Measurement
o = Unused Signal Pin Terminated in 50 ohms
G = Grounded Pin

NOTE: **Layout pattern represents 20 columns of a 4 row connector which is repeated for the length of the connector.**

Characteristic impedance values (Ohms) are within +/-15% of quantities listed below:

S/G Ratio	Risetime	Row 1	Row 2	Row 3	Row 4
7/1 Condition 1	200 pS	76.1	77.2	76.3	74.2
	500 pS	72.0	69.3	66.1	63.4
	1000 pS	64.3	62.7	60.4	58.1
7/1 Condition 2	200 pS	58.7	68.1	82.3	93.0
	500 pS	56.5	61.5	70.6	81.6
	1000 pS	54.1	57.3	63.1	68.8
3/1	200 pS	61.1	70.8	80.2	74.2
	500 pS	57.5	63.1	66.7	63.4
	1000 pS	54.6	57.8	59.5	57.9
2/1	200 pS	62.1	64.9	70.2	78.2
	500 pS	57.6	59.2	61.1	65.6
	1000 pS	54.4	55.0	56.4	59.2

6.9 Cross Talk (Single Active) - The specification requirements shall be satisfied when evaluated in accordance with EIA 364-90 and the following details.

Testing is to be performed using the Matching Pad Test Method with risetimes of 200, 500, and 1000 Pico-Seconds. The points of measurement are picked to give worst case conditions [i.e. greatest distance from the ground pins].

The following Pin Out & Point of Measurement was utilized to obtain the given results:

PIN OUT & POINT OF MEASUREMENT

Row		7/1 S/G Condition 1	7/1 S/G Condition 2	3/1 S/G	2/1 S/G
Long	4	G o G o G	o A Q o o	G o G o G	G A Q G o
	3	o o o o o	o o o o o	o o Q A o	o G o o G
	2	o o o o o	o o o o o	o o o o o	o o G o o
Short	1	o A Q o o	G o G o G	o G o G o	G o o G o

M = Point of Measurement
o = Unused Signal Pin Terminated in 50 ohms
G = Grounded Pin
Q = Quiet Pin

NOTE: **Layout pattern represents 20 columns of a 4 row connector which is repeated for the length of the connector.**

Maximum cross talk (single active) values are listed below:

S/G Ratio	Risetime	Near End Cross Talk	Far End Cross Talk
7/1 Condition 1	200 pS	13.8%	8.8%
	500 pS	9.9%	7.2%
	1000 pS	7.4%	7.5%
7/1 Condition 2	200 pS	16.0%	9.6%
	500 pS	11.7%	8.2%
	1000 pS	8.5%	5.8%
3/1	200 pS	11.4%	4.9%
	500 pS	7.6%	3.6%
	1000 pS	4.8%	2.6%
2/1	200 pS	14.4%	4.8%
	500 pS	10.0%	3.8%
	1000 pS	6.7%	2.4%

7.0 MECHANICAL CHARACTERISTICS

7.1 Mating/Unmating Force - The force to mate a receptacle connector and compatible header shall not exceed 99 grams (3.5 ounces) per contact. The unmating force shall not be less than 18 grams (.64 ounces) per contact. The following details shall apply:

a. Cross Head Speed - 1 inch per minute
b. Lubrication - None
c. Utilize free floating fixtures
d. Reference - MIL-STD-1344A, Method 2013.1

7.2 Normal Force - The contact normal force shall not be less than 50 grams (nor greater than 120 grams) when tested in accordance with Test Specification BUS-03-404.

7.3 Individual Contact Insertion/Withdrawal Force - The insertion force shall not exceed 100 grams (3.5 ounces) when a maximum gauge is inserted. After three insertions with a maximum gauge, the withdrawal force shall not be less than 14 grams (.49 ounces) when measured using a minimum gauge. See Figure 2 for gauge descriptions. Gauges shall be lubricated with a solution of 10% Nye Oil in Isopar H. Testing shall be in accordance with Test Specification BUS-03-405.

7.4 Contact Retention - Individual contacts shall withstand an axial load of 3 pounds minimum applied at a rate of 0.5 inches/minute without dislodging from the housing cavity. Reference MIL-STD-1344A, Method 2007.1.

7.5 Individual Pin Insertion/Retention Force - The force required to insert an individual compliant pin into a plated through hole in a printed circuit board at a rate of 0.2 inches/minute shall not exceed 40 pounds. The retention force in an axial direction opposite that of insertion shall not be less than 7.5 pounds.

7.6 Pin Torque Strength - There shall be no damage to the pin, and the LLCR shall not exceed 0.5 milliohms, when tested in accordance with MIL-STD-202F, Method 211A. The following details shall apply:

a. Test Method - E
b. Torque - 2 1/2 in-oz

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 electrical and mechanical requirements per paragraphs 6.0 and 7.0 as specified in the Table 1 Test Sequences. Unless specified otherwise, assemblies shall be mated during exposure.

8.1 Thermal Shock - MIL-STD-202F, Method 107G.

a. Test Condition - A (25, 1-hour cycles)
b. Temperature Range - Between -55 and +125 degrees C
c. Time at Each Temperature - 30 minutes
d. Transfer Time - 5 minutes, maximum

8.2 Humidity, Steady State - MIL-STD-202F, Method 103B.

a. Relative Humidity - 95%
b. Temperature - +40 degrees C
c. Test Condition - B (96 hours)

8.3 Environmental Sequence: (Samples exposed mated)

Phase I - Thermal Shock, EIA 364-32, Condition 1.

a. Test Duration - 100, 1-hour cycles
b. Temperature Range - Between -55 and +85 degrees C
c. Time at Each Temperature - 30 minutes
d. Transfer Time - 5 minutes, maximum

Phase II - Humidity, EIA 364-31, Method III (omit step 7b.

a. Test Duration - 240 hours
b. Temperature - +25 to 65 degrees C

Phase III - High Temperature Life, EIA 364-17, Method A, Condition 3.

a. Test Duration - 500 hours
b Temperature - 85 degrees C

8.4 Industrial Mixed Flowing Gas (IMFG) - Battelle Procedure.

a. Class - IIA
b. Duration - 20 days mated

8.5 Vibration - MIL-STD-202F, Method 204D.

a. Condition - B
b. Vibration Amplitude - 0.06" DA or +/-15G
c. Frequency Range - 10 to 2000 to 10 hertz
d. Cycle Time and Duration - 20 minutes per cycle, 4 hours along each of three orthogonal axes (12 hours total).
e. Mounting - Rigidly mount assemblies
f. No discontinuities greater than 10 nano seconds

8.6 Mechanical Shock – EIA364 TP 27.

a. Condition - I (100G, 6 millisecond half sine wave)
b. Shocks - 3 shocks in both directions along each of three orthogonal axes (18 total).
c. Mounting - Rigidly mount assemblies
d. No discontinuities greater than 10 nano seconds

8.7 Durability - Standard laboratory procedure as applicable to the specific product.

a. Number Cycles - 250 cycles
b. Cycling Rate - 5 inches per minute

8.8 Solderability - MIL-STD-202F, Method 208F.

a. Steam aging - 4 hours
b. Contact areas evaluated shall meet the Method 208 requirements.

8.9 Resistance to Solder Heat - MIL-STD-202F, Method 210B.

a. Test Condition - E
b. There shall be no evidence of physical or mechanical damage.

8.10 Sequential Industrial Mixed Flowing Gas - Battelle Procedure.

Step 1 - Perform 100 durability cycles
Step 2 - Subject header only to 10 days, Class IIA
Step 3 - Subject mated header and receptacle to 10 days, Class IIA
Step 4 - Perform 100 durability cycles

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 MIL-C-45662 and ISO 9000.

9.2 Inspection Conditions

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

a. Temperature: 25 +/- 5 degrees C
b. Relative Humidity: 30% to 60%
c. Barometric Pressure: Local ambient

9.3 Sample Quantity and Description

Each test group consist of (3) assemblies as described on drawing Figure 3 and 4. The HPC II Header to Test Board Assembly is further described on drawing Figure 5. The HPC II Receptacle to Test Board Assembly is further described on drawing Figure 6. Additional graphic and dimensional detail is available on supporting component drawings which are identified on drawings 50240 and 50241.

9.4 Acceptance

9.4.1 Electrical and mechanical requirements placed on test samples as indicated in paragraphs 6.0 and 7.0 shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with this product specification shall meet the stated requirements.

9.4.2 Failures attributed to equipment, test setup, 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 produced with equipment and procedures normally used in production. The test sequence shall be as shown in Table 1.

9.6 Re-qualification Testing

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

9.6.1 A significant design change is made to the existing product which 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, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.

9.6.2 A significant change is made to the manufacturing process which impacts the product form, fit or function.

9.6.3 A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

TABLE 1 – QUALIFICATION TESTING

Test Description	PAR	Test Group 1	2	3	4	5	6	7	8	9	10	11
		Test Sequence										
Examination of Product	5.4	1 3	1 10	1 5	1 3	1 5	1 16	1 9	1 3	1 6	1 11	1 3
Contact Resistance Low Level	6.1						3 5 7 11 13	3 5 8		2 5	2 4 6 8 10	
Insulation Resistance	6.2		3 7									
Dielectric Withstanding Voltage	6.3		4 8									
Current Rating	6.4								2			
Propagation Delay	6.7					2						
Characteristic Impedance	6.8					3						
Crosstalk	6.9					4						
Mating/Unmating Force	7.1						2 8 10 14	2 6				
Normal Force	7.2	2					15					
Insertion / Withdrawal	7.3				2							
Contact Retention	7.4		2 9	2 4								
Thermal Shock	8.1		5									
Humidity, Steady State	8.2		6									
Environmental Sequence Phase I Phase II Phase III	8.3						 4 6 12					
Ind. Mixed Flowing Gas	8.4							7				
Vibration	8.5									3		
Mechanical Shock	8.6									4		
Durability (250 cycles)	8.7						9	4				
Solderability	8.8											2
Res. To Soldering Heat	8.9			3								
Sequential - IMFG Step 1 - Durability Step 2 - IMFG, Unmated Step 3 - IMFG, Mated Step 4 - Durability	8.10										 3 5 7 9	

FIGURE 1 - LOW-LEVEL CIRCUIT RESISTANCE

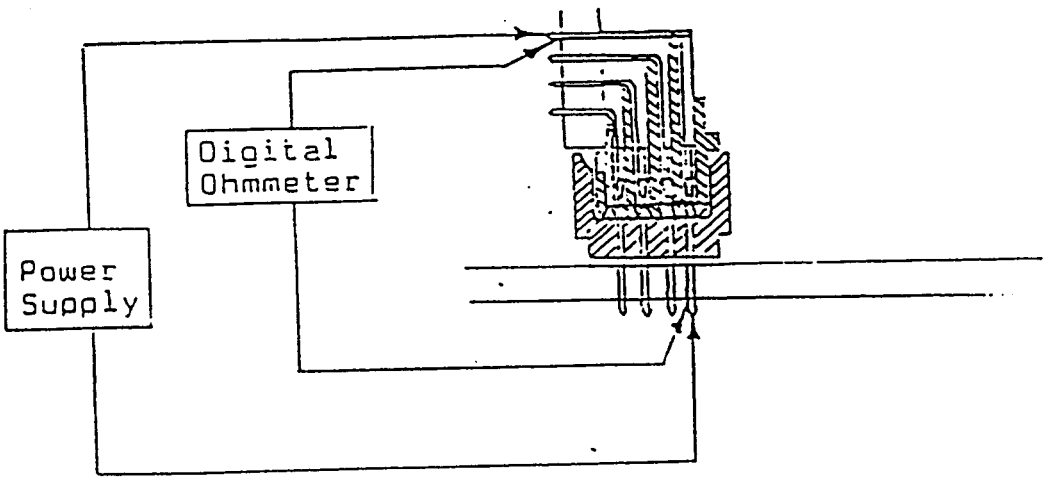
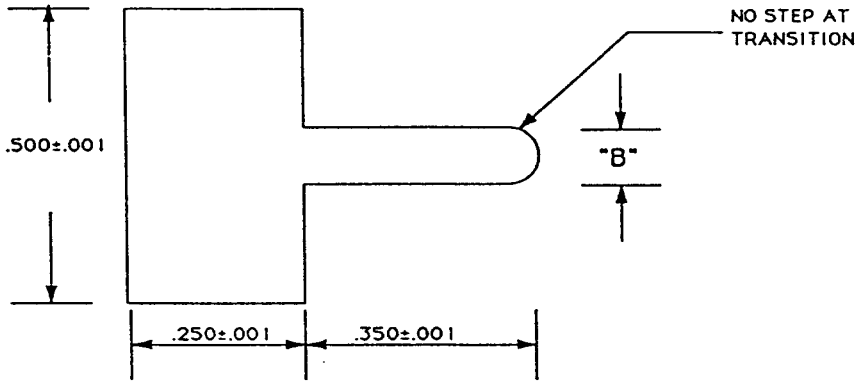
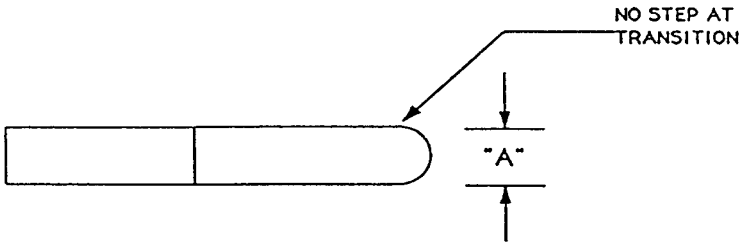


FIGURE 2 - PIN GAUGES





	"A"	"B"
MINIMUM GUAGE:	.0240 $^{+.0000}_{-.0002}$	.025±.0002
MAXIMUM GUAGE:	.0260 $^{+.0002}_{-.0000}$	.025±.0002

MATERIAL: HACKSAW BLADE, M2 MATERIAL, ROCKWELL HARDNESS 63
POLISH TO 4 RMS FINISH IN WORKING AREA

FIGURE 3

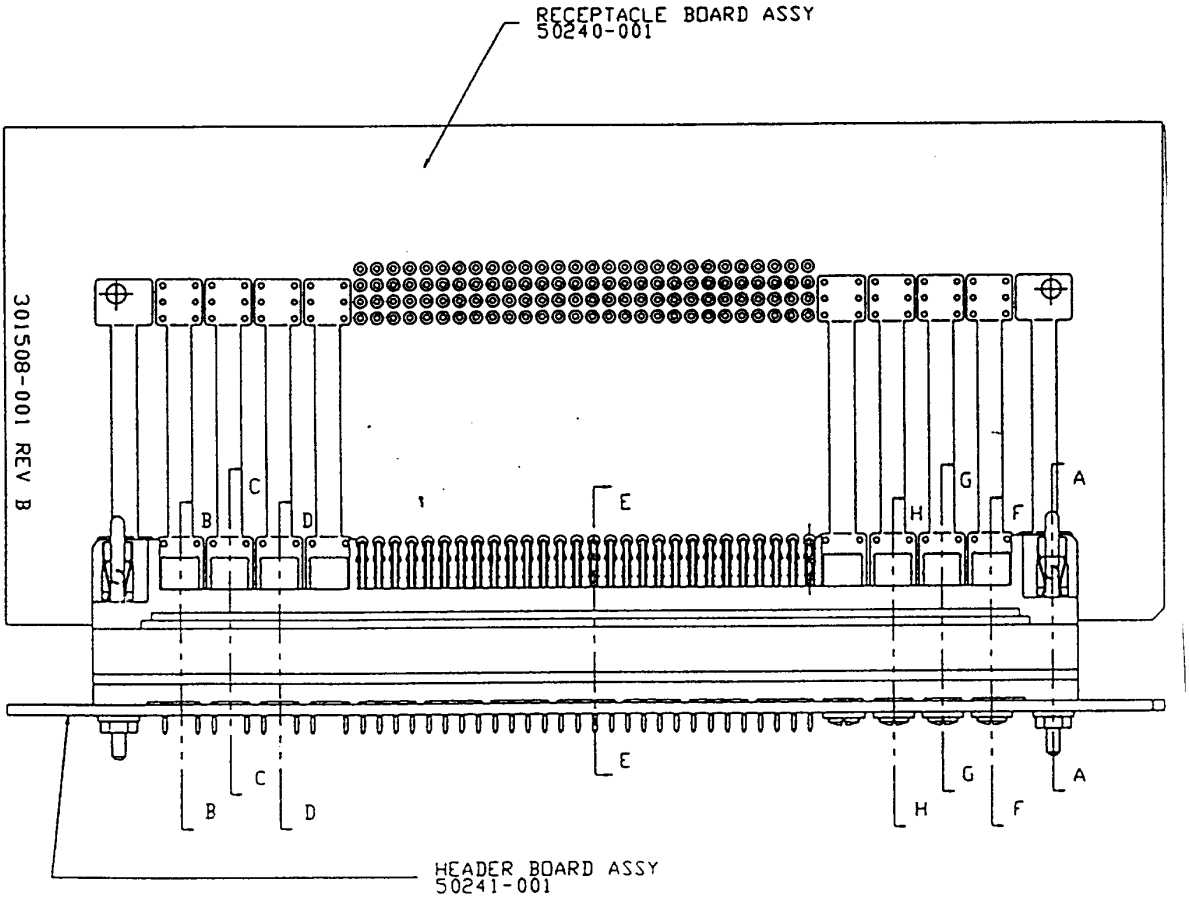


FIGURE 4

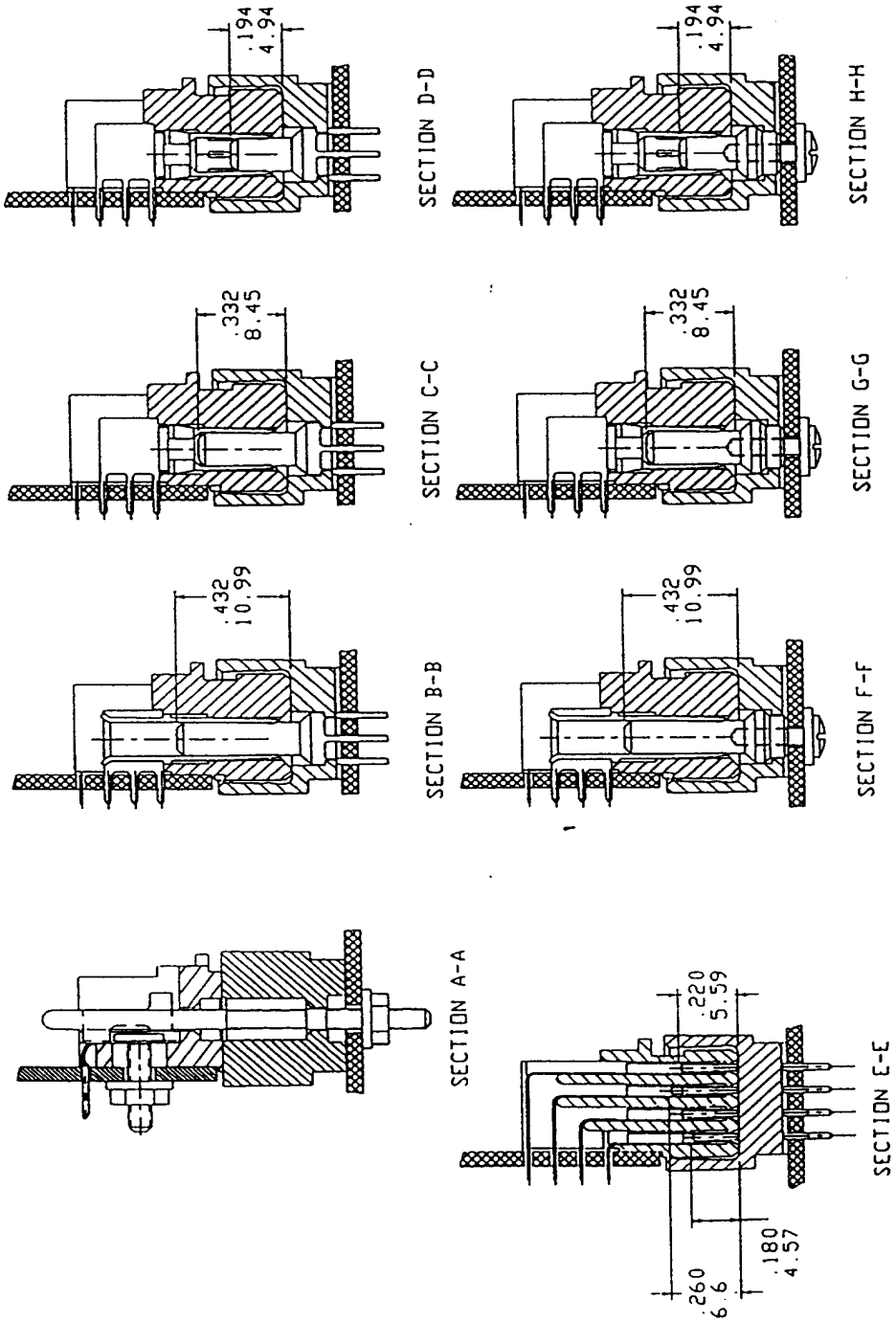

.194
4.94
SECTION D-D
SECTION H-H
.332
8.45
SECTION C-C
SECTION G-G
.432
10.99
SECTION B-B
SECTION F-F
SECTION A-A
.220
5.59
SECTION E-E
.180
4.57
.260
6.6

FIGURE 5

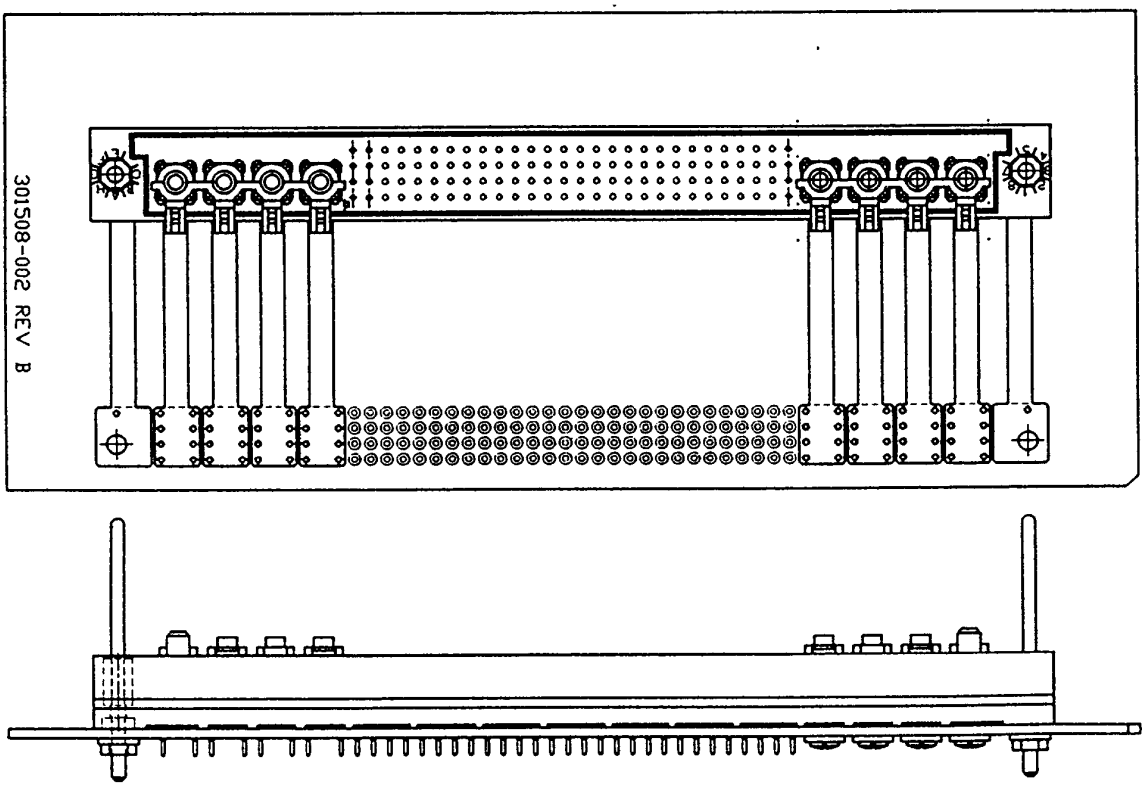
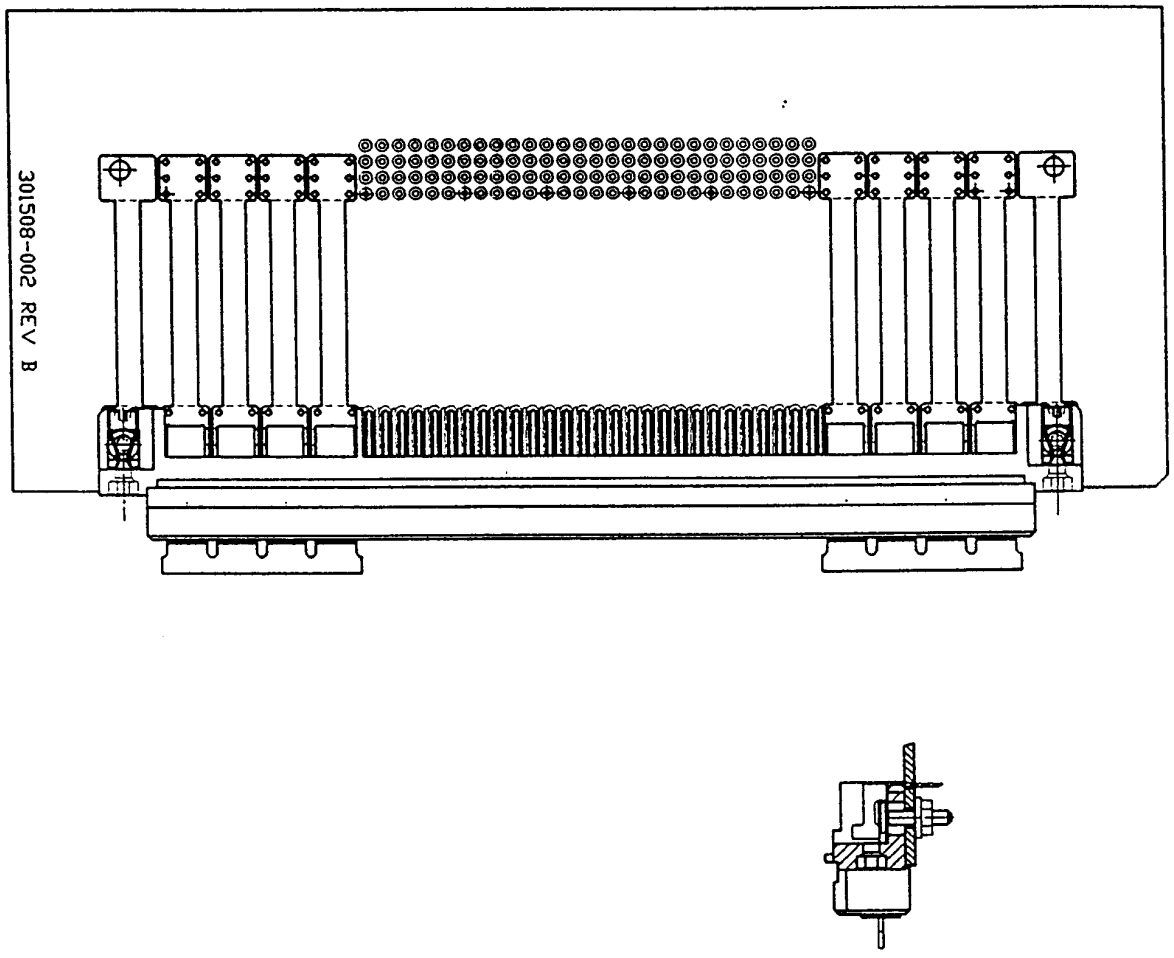


FIGURE 6



REVISION RECORD

REV	PAGE	DESCRIPTION	EC#	DATE
A	ALL	New Release	V50667	05/18/95
B	ALL	Revised format to be consistent with GS-01-001, and change BERG, Dupont, etc. references to FCI.	V01904	08/01/00
C	2,3,5,6, 7,8,9,1 0,11,14	Deleted references to FCI on various pages.. Added new 4.6.7. Changed Resistance to Solder heat report to EL-99-08-003CR in 4.6. Changed “glass-filled Polyphenylene Sulfide” to “glass and mineral filled LCP” in 5.2.3.. Changed grams and ounces in 7.1, 7.2, & 7.3	V00768	02/01/01
D	3,13,14	In 5.2.1 remove C17410. Changed from Class II to Class IIA in section 8.4a. Changed sweep to cycle in 8.5d. In section 8.10 changed Class II to Class IIA. In 8.6 changed sawtooth to half sine wave.	V11504	04/25/01
E	6,7,8	Sections 6.6, 6.7, 6.8, 6.9.	V11577	5/24/01
F	8	Update Section 6.8	V11695	6/15/01
G	1	Add section 3.1 and 3.2	V05-1103	12/6/05