1.0 OBJECTIVE

This specification provides information and requirements regarding customer application of PwrBlade ULTRA® Connector System. This specification is intended to provide general guidance for application process development. It is recognized that no single application process will work under all customer scenarios and that customers will develop their own application processes to meet their needs. However, if these application processes differ greatly from the one recommended, AFCI cannot guarantee results.

2.0 SCOPE

This specification provides information and requirements regarding customer application of PwrBlade ULTRA® Connector System.

- **Right Angle Receptacles, Press-Fit and Solder-to-board**
- **Right Angle Plugs, Press-Fit and Solder-to-Board**
- **Vertical Receptacles, Press-Fit and Solder-to-Board**

3.0 GENERAL

This document is meant to be an application guide. If there is a conflict between the product drawings and specifications, the drawings take precedence.

PwrBlade ULTRA® has two options for connection to Printed Circuit Boards: Press Fit and Solder to Board. The press fit and solder tail configuration are available for all plugs and receptacles. The PwrBlade ULTRA® Solder-to-Board Power and Signal Contacts are compatible with several soldering processes, including wave soldering. They are versatile with many configurations to fit the individual needs of the client and are less expensive than press fit. The Press Fit connection eliminates the need for soldering, achieving a connection to the board through the normal forces between the press fit tail and the plated through hole. The number of signal and power contacts is customer dependent with multiple choices of pitches between power contacts. PwrBlade ULTRA® has high current carrying capabilities ideal for data communications and data processing and is well suited for a wide variety of applications, such as SSI server power supplies, Fault-tolerant computers, Modular and hot-swap redundant N+1 power distribution systems and uninterruptible power systems (UPS).

Modules are available with contact centerline spacing and related voltage rating listed in the following table:

MODULE TYPE	CONFIGURATION INDICATION	CONTACT	
		CENTERLINE SPACING (mm / inch)	VOLTAGE RATING (V_{AC})
High Power	HVP	7.25[.285"]	407
		7.00[.276"]	382
	HP	5.00[.197"]	182
Low Power	LP	5.50[.217"]	400
		3.50[.138"]	200
Signal	S	2.54[.100"]	39

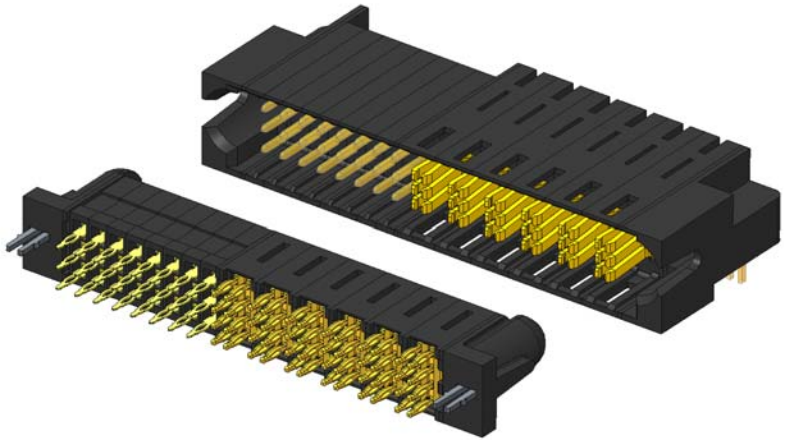


Figure 1 – Exploded view of a Right Angle Plug mating with a Vertical Receptacle.

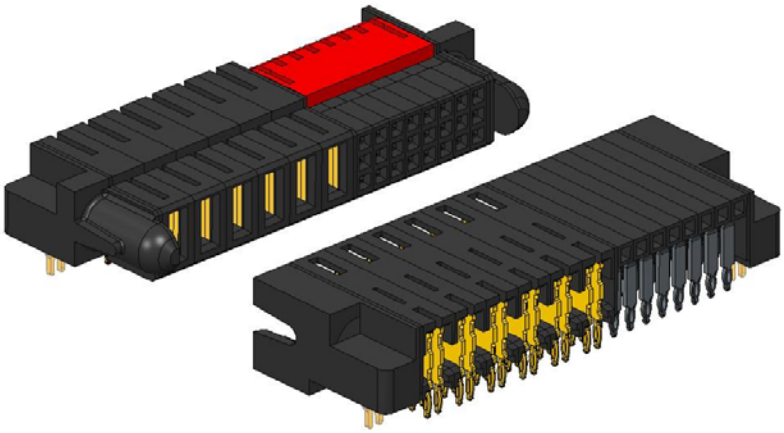


Figure 2 – Exploded view of a Right Angle Plug mating with a Right Angle Receptacle.

The maximum overall length allowed for the connector is 203.2[8.00”]. Combinations of up to 36 power contacts and 148 signal contacts can be used-provided the maximum allowable length is not exceeded.

End modules are available with features that provide blind mating, misalignment, and polarization. End modules contain a guide post or guide hole with key slot and a retention clip, and/or mounting hole. Guides (posts on receptacle and holes in plug) have rounded edges for ease of mating and are offset to prevent improper mating of connectors. The retention clips help to align the connector to the pc board for installation then secure the connector for soldering. The connectors are supplied in tray form for manual placement.

The connectors feature standoffs (one located at each contact) to facilitate pc board cleaning after soldering. Convection windows and cored lances located on the housing provide air flow for power modules.

4.0 DRAWINGS AND APPLICABLE DOCUMENTS

- AFCI PRODUCT SPECIFICATION GS-12-1176
- AFCI PRODUCT DRAWINGS
- APPLICATION MANUALS/INSTRUCTION SHEETS (IF NOT INCLUDED IN THIS DOCUMENT)

Product drawings and AFCI's GS-12-1176 Product Specification are available at www.FCI.com In the event of a conflict between this application specification and the drawing, the drawing will take precedence. Customers are advised to refer to the latest revision level of AFCI product drawings for appropriate details.

5.0 APPLICATION REQUIREMENTS

5.1 Safety

The connectors are designed to operate in a temperature range of -40°C to 125°C [-40°F to 257°F]. Voltage ratings for these connectors are related to the Minium Creepage Distances when the connector is installed in the pc board. Voltage ratings are based upon UL 60950 -1 Second Edition Tale 2N. Voltage ratings according to Minimum Creep Distance (MCD) are given in Figure 3.

Rated voltage table,

Note: MCD determined using Ø1.02mm finished hole with 0.24mm annular ring (nominal). Resulting in a Ø1.50mm pad (nominal).

Table 2	PwrBlade ULTRA® Maximum Working Voltage Vs. Minimum Creep Distance (Reference UL 60950-1 Second Edition Table 2N)					
Type	Contact Pitch (mm / inch)	Pollution Degree (office Environment)	Material Group (Base on UL Rating)	MCD Of PCB (mm)	Maximum Working Voltage (AC RMS)	Maximum Working Voltage (DC/AC Peak)
Signal	2.54 [.100"]	2	II	1.04	120	170
High Power	5.00 [.197"]			1.82	253	358
	7.00 [.276"]			3.82	531	751
	7.25 [.285"]			4.07	567	802
Low Power	3.50 [.138"]			2.00	285	403
	5.50 [.217"]			4.00	557	788
Signal	2.54 [.100"]	2	IIIb	1.04	39	55
High Power	5.00 [.197"]			1.82	182	257
	7.00 [.276"]			3.82	382	540
	7.25 [.285"]			4.07	407	575
Low Power	3.50 [.138"]			2.00	200	282
	5.50 [.217"]			4.00	400	565

Figure 3

5.2 PC Board

5.2.1 Material and Thickness

The pc board material shall be glass epoxy (FR-4 or G-10).The pc board thickness shall be as stated in Figure 4.

PC BOARD THICKNESS		
CONNECTOR WITH PRESS-FIT CONTACTS	CONNECTOR WITH SOLDER TYPE CONTACTS	
	2.34 ± 0.40mm TAIL LENGTH (NOT TOOLED FOR RECEPTACLE)	3.43 ± 0.40mm TAIL LENGTH
1.35mm [.053''] Min	1.40~1.75mm [.055''~.069'']	2.11~2.62mm [.083''~.103'']

Figure 4

5.2.2 Hole Dimensions and Durability

The contact holes must be drilled and plated through to specific dimensions to prevent stubbing during placement of the connector on the pc board and to ensure optimum continuity for circuits after soldering. If applicable, holes for the retention clips or mounting hardware may be used with or without plated through holes. The drilled hole size, plating types, plating thickness, and finished hole size must be as stated to provide unrestricted insertion. See Figure 5.

For connectors with press-fit contacts, the pc board holes can't withstand connector removal more than threes. The radius of any board hole must not increase more than 0.038mm [.0015''] or decrease less than 0.0508mm [.002''].

5.2.3 Land/pad size and lay-out

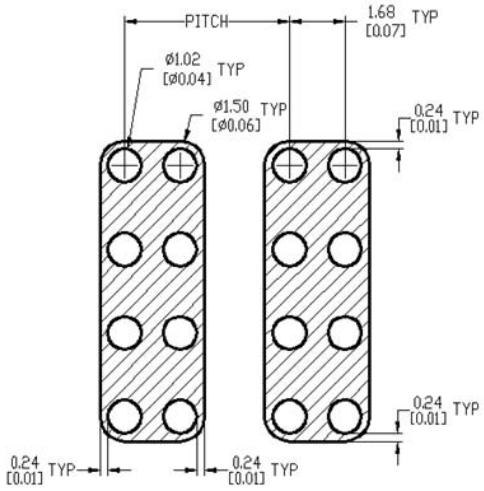
The pc board land/pad size is given in Figure 5.

	mm	inch
Drilled hole diameter	1.150 +/- 0.025	0.0453 +/- 0.001
Plated hole diameter	1.02+/- 0.07	0.040+/- 0.003
Copper plating	0.051 +/- 0.025	0.002 +/- 0.001
Tin/Lead plating	0.007	0.0003
Signal Land/Pad size	1.500 +/- 0.064	0.060 +/- 0.0025
Power Land/Pad size	1.500 +/- 0.064	0.060 +/- 0.0025

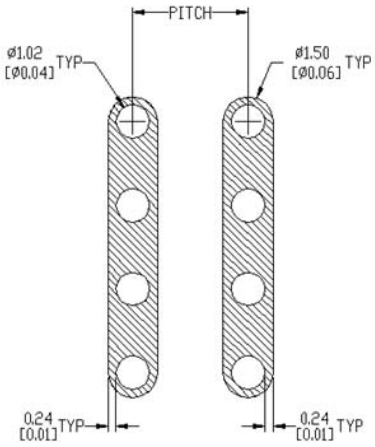
Figure 5

Typical PC Board Land/Pad Lay-out For Reference Only

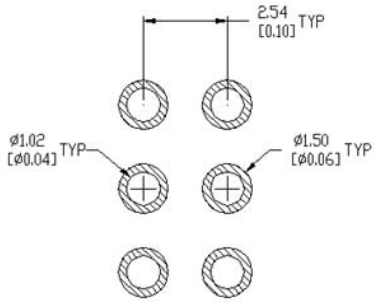
Dimensions are mm/inch



Land/Pad Lay-out For High Power Modules



Land/Pad Lay-out For Low Power Modules



Land/Pad Lay-out For Signal Modules

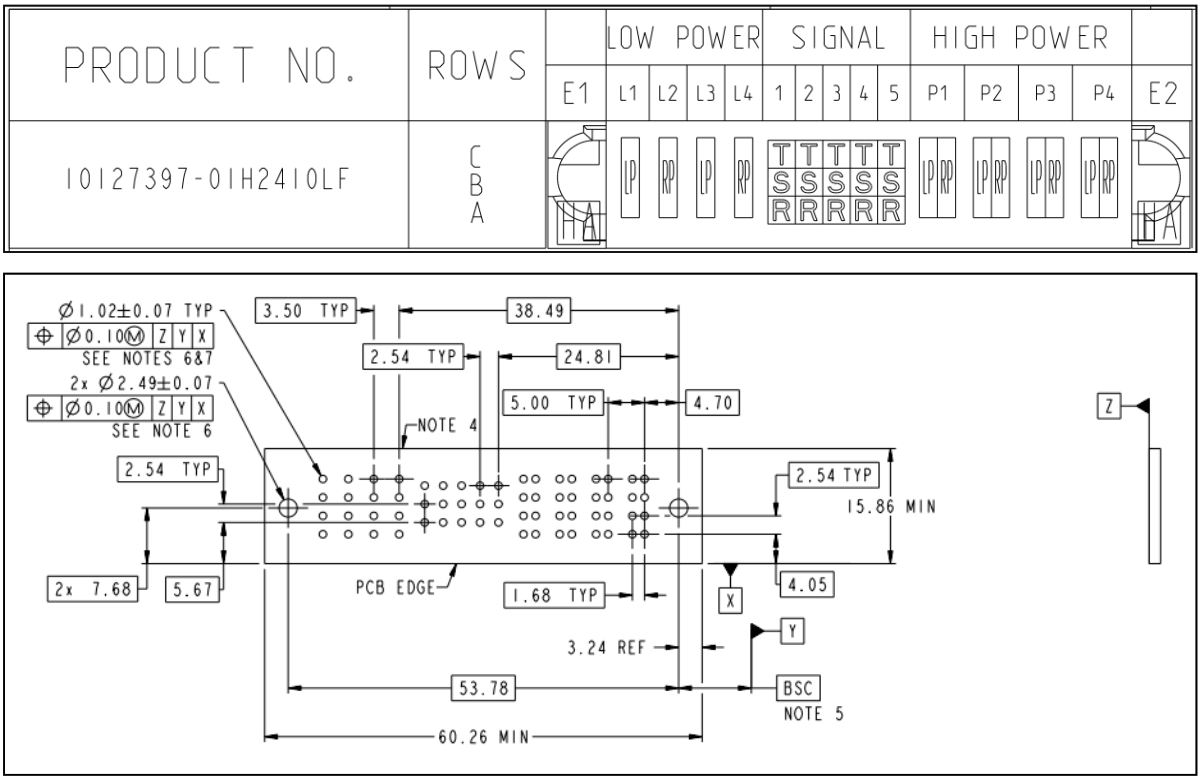
Figure 6

5.2.4 PC Board Layout

The holes in the pc board must be precisely located to ensure proper placement and optimum performance of the connector. The pc board layout must be designed using the dimensions provided on the customer drawing for the specific connector. A sample of the recommended pc board layout is shown in Figure 7.

Sample Recommended PC Board Layout

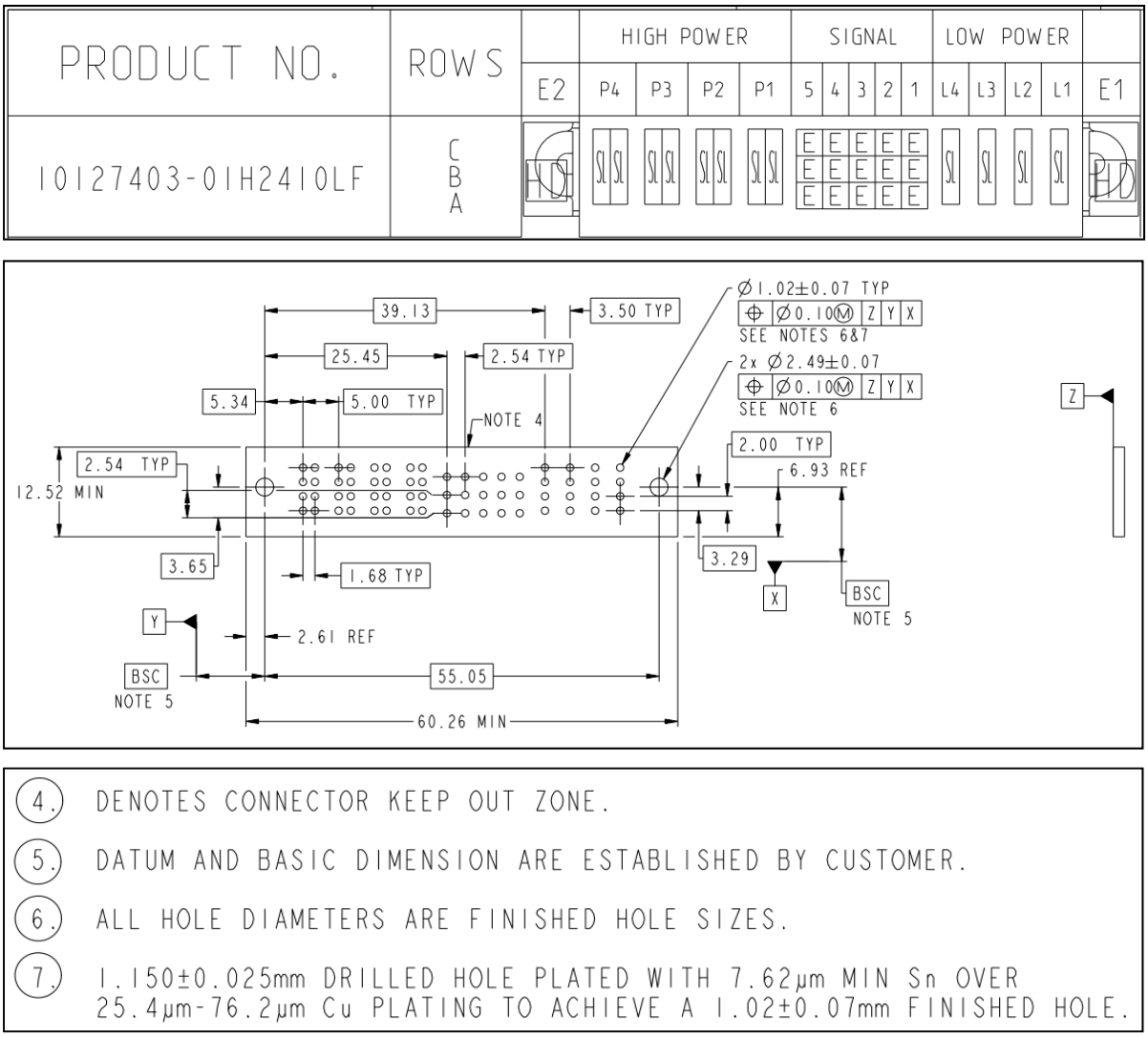
Right Angle Plug (With Retention Clips)



4. DENOTES CONNECTOR KEEP OUT ZONE.
5. DATUM AND BASIC DIMENSION ARE ESTABLISHED BY CUSTOMER.
6. ALL HOLE DIAMETERS ARE FINISHED HOLE SIZES.
7. 1.150±0.025mm DRILLED HOLE PLATED WITH 7.62µm MIN Sn OVER 25.4µm-76.2µm Cu PLATING TO ACHIEVE A 1.02±0.07mm FINISHED HOLE.

Sample Recommended PC Board Layout

Vertical Receptacle (With Retention Clips)



4. DENOTES CONNECTOR KEEP OUT ZONE.
5. DATUM AND BASIC DIMENSION ARE ESTABLISHED BY CUSTOMER.
6. ALL HOLE DIAMETERS ARE FINISHED HOLE SIZES.
7. 1.150±0.025mm DRILLED HOLE PLATED WITH 7.62µm MIN Sn OVER 25.4µm-76.2µm Cu PLATING TO ACHIEVE A 1.02±0.07mm FINISHED HOLE.

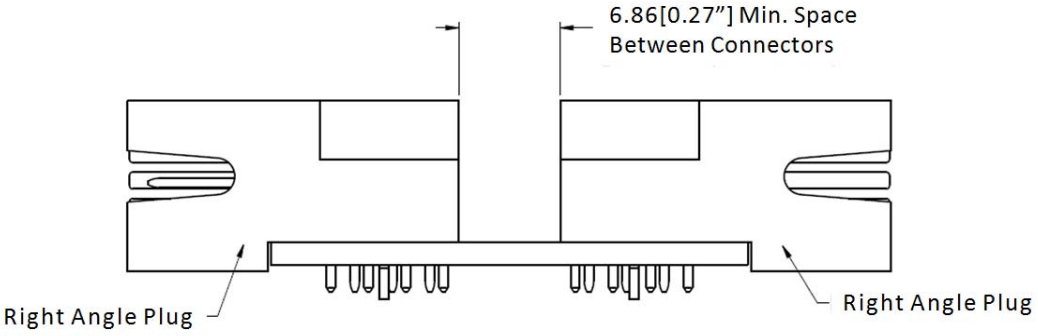
Figure 7

("Power and Signal traces inside the connector zone seen in Figure 7 need to be coated or under solder mask to protect against oxidation and minimize wear or damage during assembly and handling.")

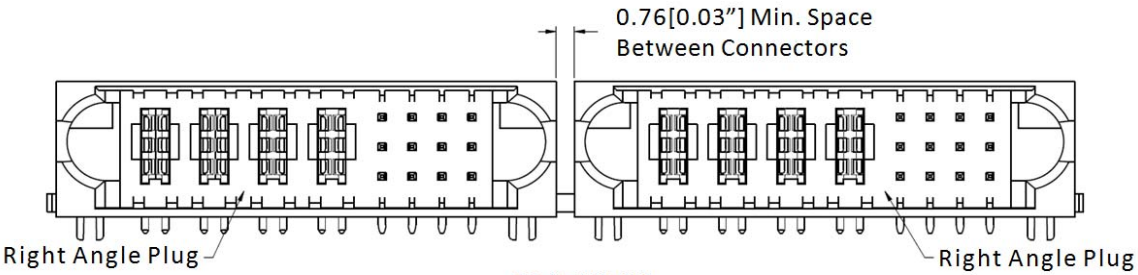
5.2.5 Spacing

Care must be used to avoid interference between adjacent connectors and other components. In addition, space allowed between pc boards for mating of connectors must be considered when determining distance between pc boards. The minimum allowable distance needed between connector to ensure full mating of connectors and the allowable distance between pc boards with connectors fully mated is provided in Figure 8.

Allowable Distance Between Connectors



END VIEW

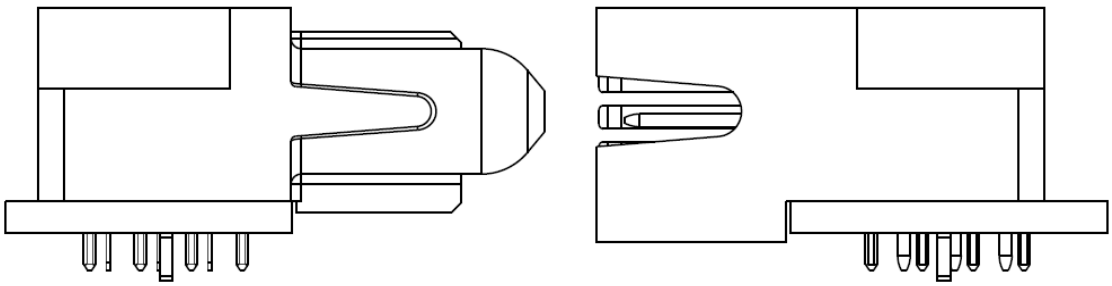


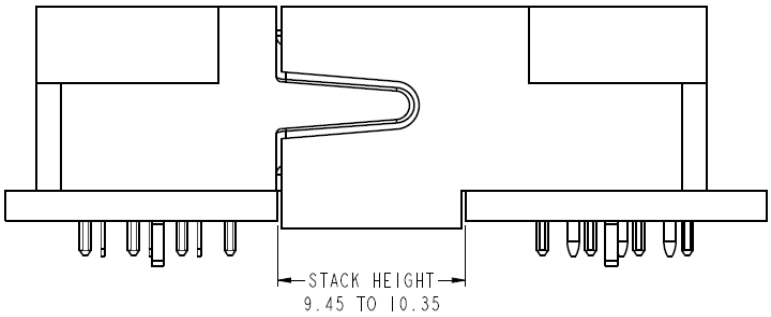
SIDE VIEW

Allowable Distance Between PC Boards

Note: Connectors must be fully mated

A.) Right Angle Receptacle to Right Angle Plug





B.) Vertical Receptacle to Right Angle Plug

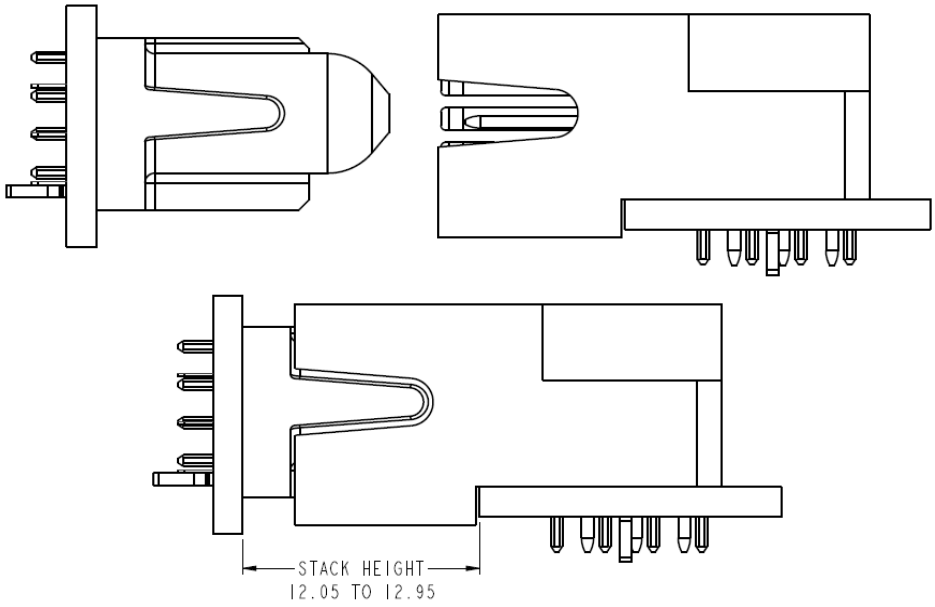


Figure 8

6.0 APPLICATION TOOLING

6.1 Connectors with Solder Type Contacts

No tooling is required for placement of the connectors with solder type contacts onto the pc board.

6.2 Receptacle and Right-Angle Plugs with Press-Fit Contacts

6.2.1 Application Tooling

The application tooling (such as an arbor press) used to seat these connectors must provide sufficient amount of downward force to insert the contacts into the pc board holes.

6.2.2 PC Board Support

A pc board support must be used to prevent bowing of the pc board during the placement of these connectors on the board. The board support must have a flat surface with holes or a channel large

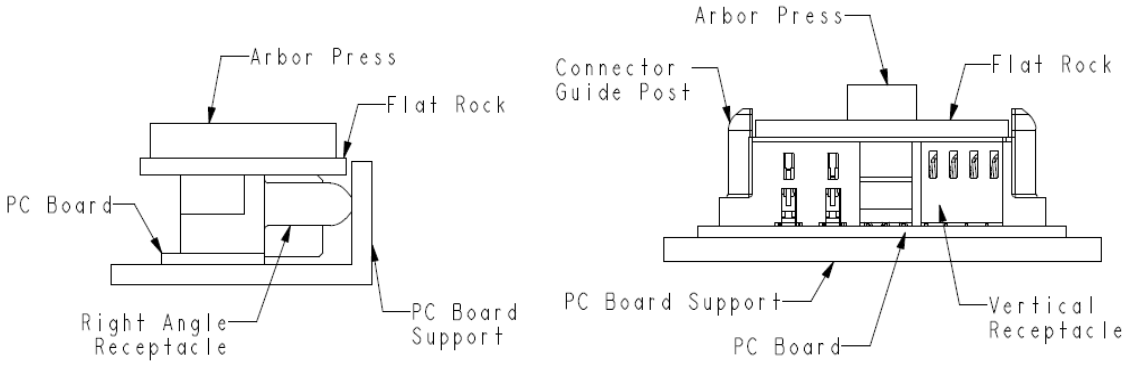
enough and deep enough to receive any protruding components. The pc board must be secured to the board support to prevent movement of the board during seating. Refer to Figure 9.

The board support must also be used when removing these connectors from the pc board.

6.2.3 Flat Rock Tooling

Commercially available bar stock (flat rock tooling) with a flat surface large enough to cover all contacts and any protruding components must be used with the application tooling to seat these connectors. For vertical receptacle with guides, the flat rock tooling must be sized to fit between the guides.

For removing these connectors from the pc board, it is suggested that the pc board be supported from the connector side and that the connector be removed using flat rock tooling.



Seating Receptacles and Right-Angle Plug with Press-Fit Contacts

Figure 9

7.0 APPLICATION PROCEDURE

7.1 Connector Placement

7.1.1 Registration

When placing connectors on the pc board, contacts and, if applicable, retention clips or mounting holes must be aligned and started into the matching holes before seating the connector onto the board.

7.1.2 Insertion Force

The force required to seat the connector with press-fit contacts or retention clips onto the pc board can be calculated by:

Insertion force N [lbs.] = Number of connector press-fit contacts X maximum insertion force per contact

Insertion force N [lbs.] = Number of connector retention clips X maximum insertion force per retention clips

The maximum amount of insertion force per press-fit contact and retention clips is given in Figure 10.

MAXIMUM INSERTION FORCE (N [lbs.])				
PER PRESS-FIT HIGH POWER CONTACT	PER PRESS-FIT LOW POWER CONTACT	PER PRESS-FIT SIGNAL CONTACT		PER RETENTION CLIP
720 [161.8]	360 [80.9]	Plug	93.4 [21]	27 [6]
		Receptacle	27 [6]	

Figure 10

7.2 Mounting Hardware

Connectors with mounting holes can be secured to the pc board before soldering using commercially-available standard screws. The screw size and maximum torque (applied to the mating face of the connector) is provided in Figure 11.

Typically, this method of mounting (or hold-down) serves connectors with solder type contacts and without retention clips.

MOUNTING HOLE DIAMETER	SCREW		MAXIMUM TORQUE N-m [lb- in.] (Applied to Mating Face)
	SIZE	HEAD DIAMETER (Maximum)	
3.05 [.120]	No. 4	6.35 [.250]	0.57 [5]

Figure 11

7.3 Soldering

Observe guidelines and procedures when soldering contacts. Contact solder tines must be soldered, cleaned, and dried according to the following:

7.3.1 Flux Selection

Contact solder tines must be fluxed prior to soldering with a mildly active, rosin base flux. Selection of the flux will depend on the type of pc board and other components mounted on the board. Additionally, the flux must be compatible with the wave solder line, manufacturing, health, and safety requirements. Flux that is compatible with these connectors are provided in Figure 12.

FLUX TYPE	ACTIVITY	RESIDUE	COMMERCIAL DESIGNATION	
			KESTER	ALPHA
RMA	Mild	Noncorrosive	186	611

Figure 12

7.3.2 Process

The connectors can be soldered using wave soldering or equivalent soldering techniques. It is recommended using tin or tin-lead solder for these connectors. The temperatures and exposure time shall be as specified in Figure 13.

SOLDERING PROCESS	WAVE TEMPERATURE	TIME (At Maximum Temperature)
Wave	265°C [509˚F]	10 Seconds

Figure 13

7.3.3 Cleaning

After soldering, removal of fluxes, residues, and activators is necessary. Consult with the supplier of the solder and flux for recommended cleaning solvents. Cleaners must be free of dissolved flux and other contaminants. Common cleaning solvents that will not the affect connectors for the time and temperature specified are list in Figure 14.

Consideration must be given to toxicity and other safety requirements recommended by the solvent manufacturer. Refer to the manufacture's Material Safety Data Sheet (MSDS) for characteristics and handling of cleaners. Trichloroethylene and Methylene Chloride is not recommended because of harmful occupational and environmental effects. Both are carcinogenic (cancer-causing).

Even when using "no clean" solder paste, it is imperative that the contact interface be kept clean of flux and residue, since it acts as an insulator. Flux may migrate under certain conditions with elevated temperatures and therefore, cleaning is necessary.

CLEANER		TIME (Minutes)	TEMPERATURE (Maximum)
NAME	TYPE		132°C [270˚F]
ALPHA 2110	Aqueous	1	100°C [212˚F]
BIOACT EC-7	Solvent	5	100°C [212˚F]
BIOACT EC-7	Solvent	5	Ambient Room
Butyl CARBITOL	Solvent	1	100°C [212˚F]
Isopropyl Alcohol	Solvent	5	100°C [212˚F]
KESTER 5778	Aqueous	5	100°C [212˚F]
KESTER 5779	Aqueous	5	100°C [212˚F]
LONCOTERGE 520	Aqueous	5	100°C [212˚F]
LONCOTERGE 530	Aqueous	5	100°C [212˚F]
Terpene Solvent	Solvent	5	100°C [212˚F]

(ALPHA is a trademark of Cookson Group, Inc. CARBITOL and LONCOTERGE are trademarks of Union Carbide Corp.

BIOACT is a trademark of Petroferm, Inc. KESTER is a trademark of Kester, Inc.)

Figure 14

7.3.4 Drying

When drying cleaned connectors and pc boards, make certain that temperature limitations are not exceeded: -40°C to 105°C [-40˚F to 221˚F]. Excessive temperatures may cause housing degradation.

8.0 REPAIR / REMOVAL PROCEDURE

8.1 These connectors are not repairable. Damaged or defective connectors must not be used.

8.2 Solder Type Contacts

Connectors with solder type contacts must be removed from the pc board by standard de-soldering methods. After removal from the board, the connector MUST NOT be re-used.

8.3 Press-Fit Contacts

Connectors with press-fit contacts must be removed from the pc board using a push bar (or flat rock) and pc board support.

(For reparability, the tips of the contacts must extend below the surface of the pc board by at least 1.02mm [.040"]; If not, the connector MUST NOT be removed from the pc board.)

8.4 Retention Force

The force retaining the connector with press-fit contacts or retention clips on the pc board can be calculated by:

Retention Force N [lb] = Number of connector press-fit contacts X minimum retention force per contact

Retention Force N [lb] = Number of connector retention clips X minimum retention force per retention clip

The minimum amount of retention force per press-fit contact and retention clip is given in Figure 15.

MINIMUM RETENTION FORCE (N [lbs.])			
PER PRESS-FIT HIGH POWER CONTACT	PER PRESS-FIT LOW POWER CONTACT	PER PRESS-FIT SIGNAL CONTACT	PER RETENTION CLIP
80 [18]	40 [9]	6.7 [1.5]	13.3 [3]

Figure 15

9.0 OTHER

9.1 Storage Safety

Don't stack product shipping containers so high that the containers buckle or deform.

9.2 Material

The housing is made of glass filled, halogen free polyamide or other high performance resin rated flame retardant 94V-0 in accordance with UL-94. The contacts are made of high-conductivity copper alloy underplated with nickel and plated with GCS® or GXT®; solder tines are plated with tin over nickel. Retention clips are made of copper alloy plated with nickel.

9.3 Storage

9.3.1 Ultraviolet Light

Prolonged exposure to ultraviolet light may deteriorate the chemical composition used in the connector material.

9.3.2 Shelf Life

The connectors should remain in the shipping containers until ready for use to prevent deformation to the contacts. The connectors should be used on a first in, first out basis to avoid storage contamination that could adversely affect performance.

9.3.3 Chemical Exposure

Don't store connectors near any chemical listed below as they may cause stress corrosion cracking in the contacts.

Alkalies	Ammonia	Citrates	Phosphates Citrates	Sulfur Compounds
Amines	Carbonates	Nitrites	Sulfur Nitrites	Tartrates

9.4 Connector Mating

Connectors should be handled only by the housing to avoid deformation, contamination, or damage to the contacts.

9.4.1 Polarization

For connectors with guides, polarization is provided by matching the guides of mating connectors. For connectors with latch receivers or without guides, polarization is provided by matching the mating alignment keys with the key slots of mating connectors.

9.4.2 Mating Force

The maximum amount of mating force per contact is given in Figure 16.

CONTACT	MAXIMUM MATING FORCE PER CONTACT
High Power	7N [25 ounce]
Low power	3.5N [12.5 ounce]
Signal	1N [3.6 ounce]

Figure 16

9.4.3 Mating Length

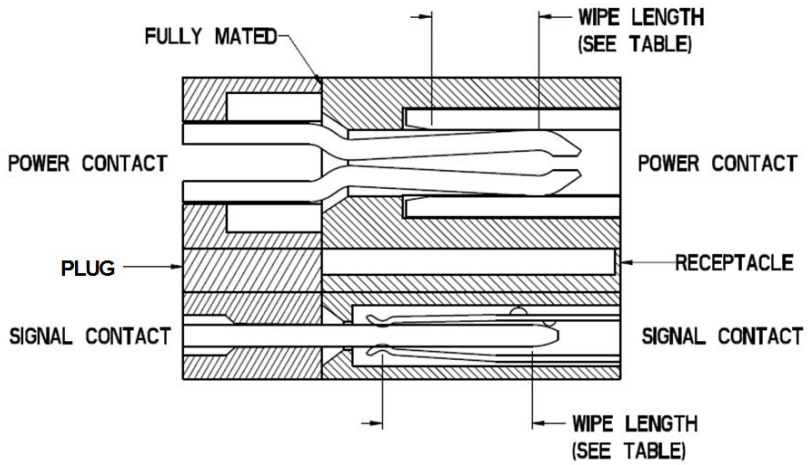
Contact mating lengths available for the connectors are listed in Figure 17.

CONNECTOR	CONTACT MATING LENGTH		
	High Power Contact	Low Power Contact	Signal Contact
Receptacle	MFBL(Pre-Mate) and Standard	MFBL(Pre-Mate) and Standard	Standard
Plug	Standard	Standard	MFBL (Pre-Mate), Standard, and MLBF (Post-Mate)

Figure 17

9.4.4 Wipe Length

The wipe length at the level of mating for power and signal contacts is listed in Figure 18.



CONTACT	MATING LENGTH	MATING LEVEL	WIPE LENGTH	REMARK
High Power	MFBL (Pre-Mate)	1	4.50mm [.177”]	Normal
	Standard	2	3.23mm [.127”]	Normal
Low Power	MFBL (Pre-Mate)	1	4.50mm [.177”]	Normal
	Standard	2	3.23mm [.127”]	Normal
Signal	MFBL2(Pre-Mate)	0	5.79mm [.228”]	Customized
	MFBL (Pre-Mate)	1	4.83mm [.190”]	Normal
	Standard	2	3.56mm [.140”]	Normal
	MLBF (Post-Mate)	3	2.50mm [.098”]	Customized
	MLBF2 (Post-Mate)		2.29mm [.090”]	Normal

Figure 18

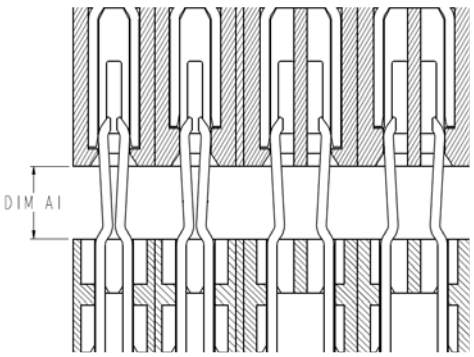
9.4.5 Sequencing

The connectors provide sequencing among contacts with 3 mating levels. The offset distance, measured from the receptacle mating face to the plug mating face at the point of electrical engagement, depends on the contact (power or signal) and mating length (standard, MFBL, or MLBF) of the mating connectors. The offset distance at the level of mating for power and signal contacts is listed in Figure 19.

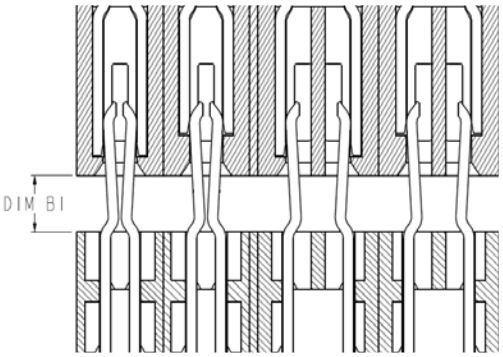
CONTACT	MATING LENGTH	MATING LEVEL	OFFSET DISTANCE		REMARK
			Dimension	Nominal	
High Power	MFBL (Pre-Mate)	1	A1	4.50mm [.177”]	Normal
	Standard	2	B1	3.23mm [.127”]	Normal
Low Power	MFBL (Pre-Mate)	1	A1	4.50mm [.177”]	Normal
	Standard	2	B1	3.23mm [.127”]	Normal
Signal	MFBL2(Pre-Mate)	0	D1	5.79mm [.228”]	Customized
	MFBL (Pre-Mate)	1	A2	4.83mm [.190”]	Normal
	Standard	2	B2	3.56mm [.140”]	Normal
	MLBF (Post-Mate)	3	C1	2.50mm [.098”]	Customized
	MLBF2 (Post-Mate)		C2	2.29mm [.090”]	Normal

High Power/Low Power Contacts

Mating Level 1: MFBL (Note 1)

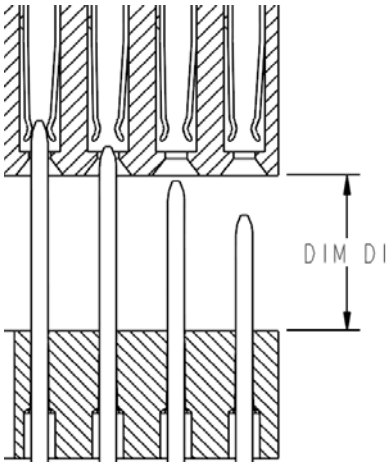


Mating Level 2: STD (Note 2)

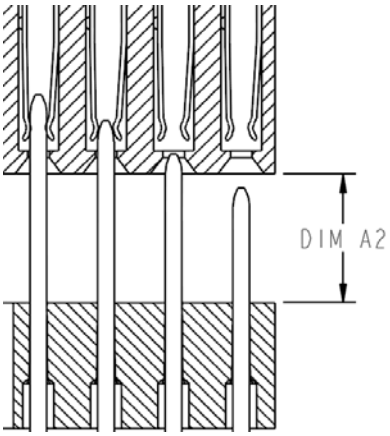


Signal Contacts

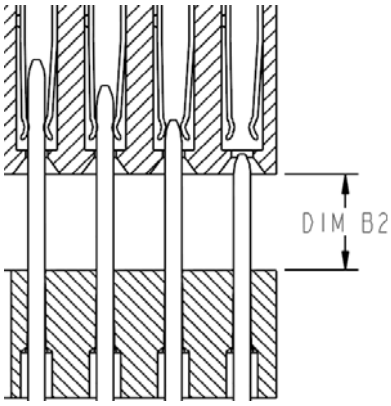
Mating Level 0: MFBL2 (Note 3)



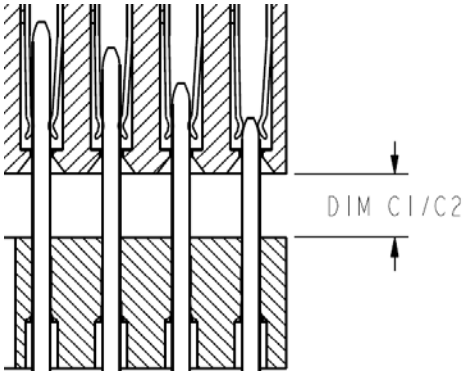
Mating Level 1: MFBL (Note 1)



Mating Level 2: STD (Note 2)



Mating Level 3: MLBF / MLBF2 (Note 4)



Note 1: The offset distance between “A1” and “A2” is not enough to consider these as separate levels.
Note 2: The offset distance between “B1” and “B2” is not enough to consider these as separate levels.
Note 3: This level is a customized special application.
Note 4: This level has 2 options, “MLBF” is a customized special application and “MLBF2” is normal application.

Figure 19

9.4.6 Misalignment

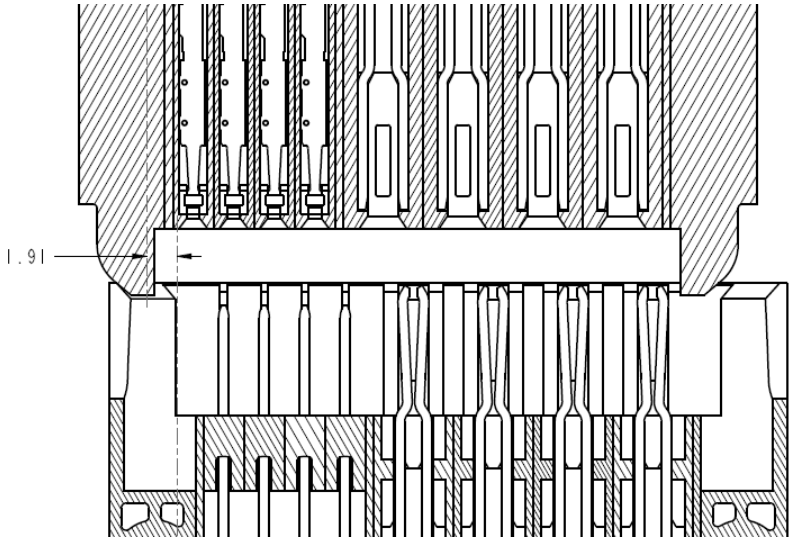
When mating connectors, side-to-side and up-and-down misalignment is allowed to the dimensions given in Figure 20. There is no misalignment for connectors with latch receivers.

(Connectors with guides should be used in applications requiring blind mating. Connectors with latch receivers and connectors without guides should not be used in applications requiring blind mating.)

Misalignment for Connectors With Guides

The connectors can be misaligned nominally by +/-1.91mm [+/-0.075”] in the X and Y direction.

Side-to-Side



Up-and-Down

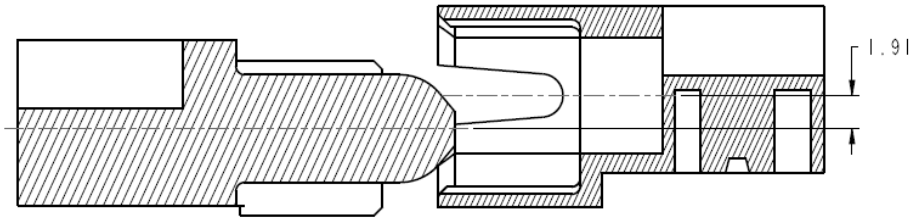
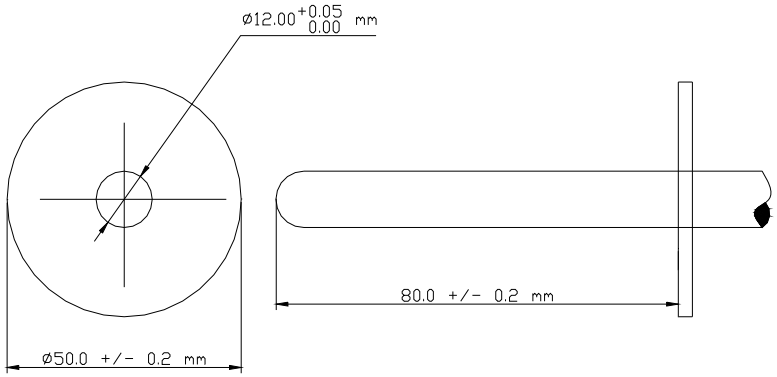


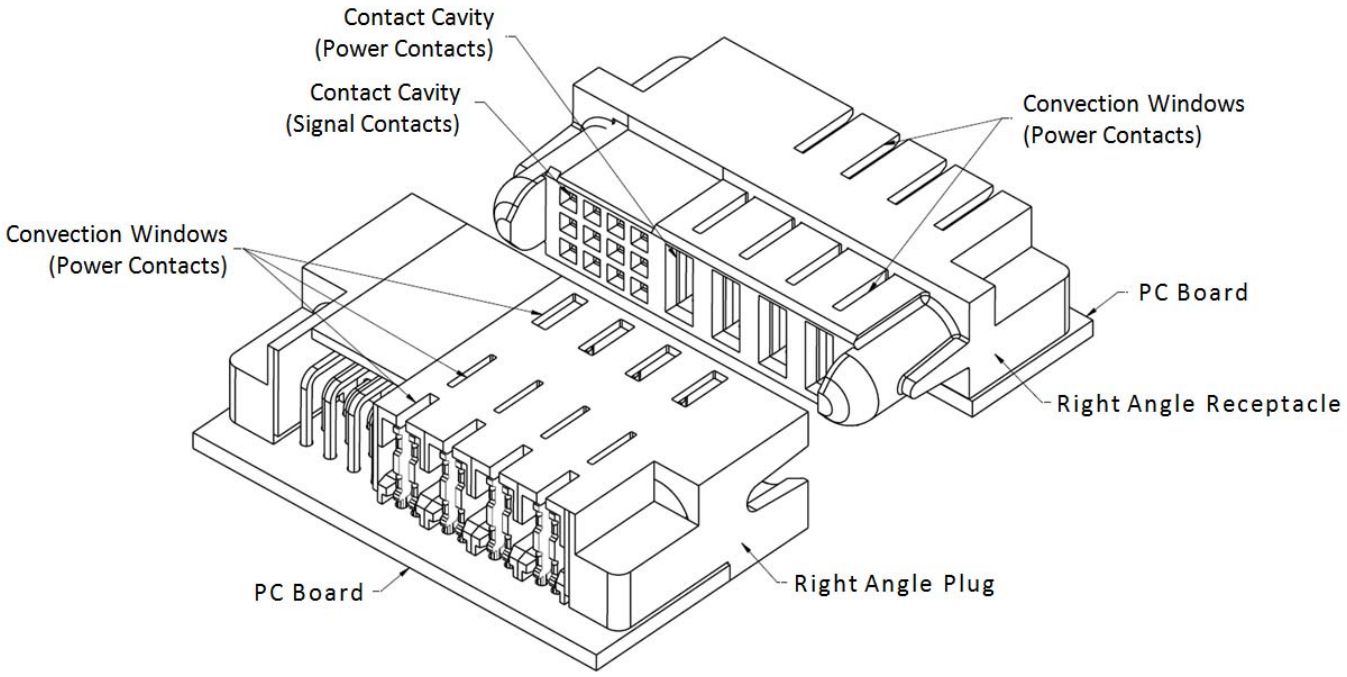
Figure 20

9.5 Circuit Testing

Unmated receptacles and mated plugs must be tested against hazardous voltages using the test probe specified in UL 60950. Specific area of the connector must be tested as indicated in Figure 21.



Dimensions of UL Probe



CONNECTOR	AREA TO BE TESTED			
	Unmated Connectors		Mated Connectors	
	Contact Cavities	Convection Windows	Contact Cavities	Convection Windows
Right Angle Receptacle	Yes	Yes	N/A	Yes
Vertical Receptacle	Yes	Yes	N/A	N/A
Right Angle Plug	N/A	Yes	N/A	Yes

Figure 21

9.6 Connector Unmating

The minimum amount of unmating force per contact is given in Figure 22.

CONTACT	MINIMUM MUMATING FORCE PER CONTACT
High Power	2.2N [8 ounce]
Low Power	1.1N [4 ounce]
Signal	0.2N [0.7 ounce]

Figure 22

10.0 PRODUCT PART NUMBER ASSIGNMENTS

10.1 Base Number: 10127XXX

XXX definition:

XXX	Plug / Receptacle	Right Angle / Vertical	Solder to Board / Press Fit
396	Plug	Right Angle	Press Fit
397			Solder to Board
400	Receptacle	Right Angle	Press Fit
401			Solder to Board
402		Vertical	Press Fit
403			Solder to Board

REVISION RECORD

REV	PAGE	DESCRIPTION	ECN#	DATE
A	ALL	New Release	-	6/17/2016
B	15, 16	Add new signal pin type of “MFBL2” and “MLBF2”	ECN-ELX-DG-25258-1	11/02/2016