


NUMBER GS-20-0362	TYPE <b>Application Specification</b>		
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 1 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

## 1. OBJECTIVE

This specification provides information and requirements regarding customer application of PwrLoPro 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, FCI cannot guarantee results.

## 2. SCOPE

This specification provides information and requirements regarding customer application of PwrLoPro Connector System. The product possibilities for configuration including:

- Right angle headers
- Right angle receptacles
- Vertical receptacles


## 3. GENERAL

- 3.1. This document is meant to be an application guide. If there is a conflict between the product drawings and specifications, the drawings take precedence.
- 3.2. All numerical values are in metric units. Dimensions are in millimeters. Unless otherwise specified, dimensions have a tolerance of  $\pm 0.13\text{mm}$  and angles have a tolerance of  $\pm 2^\circ$ . Figures and illustrations are for identification only and are not drawn to scale.

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 2 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

3.3. This document covers the following sections:

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1.	Objective	1
2.	Scope	1
3.	General	1
4.	Drawings and Applicable documents	3
5.	Introduction	3
6.	Requirements	4
6.1	Safety	5
6.2	Limitations	5
6.3	Material	6
6.4	Storage	6
6.5	PCB Board	6
6.6	Connector Placement	8
6.7	Mounting Hardware	8
6.8	Soldering	9
6.9	Connector Mating	10
6.10	Checking Installed Connector	12
6.11	Connector Mating	13
6.12	Circuit Testing	17
6.13	Connector Removal	18
6.14	Repair	18
7.	Qualification	18
8.	Tooling	18
9.	Visual Aid	19
10.	Product Part Number Assignments	20
11.	Record Retention	21

NUMBER GS-20-0362	TYPE <b>Application Specification</b>		
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 3 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

#### 4. DRAWINGS AND APPLICABLE DOCUMENTS

- FCI PRODUCT SPECIFICATION GS-12-1064
- FCI PRODUCT DRAWINGS

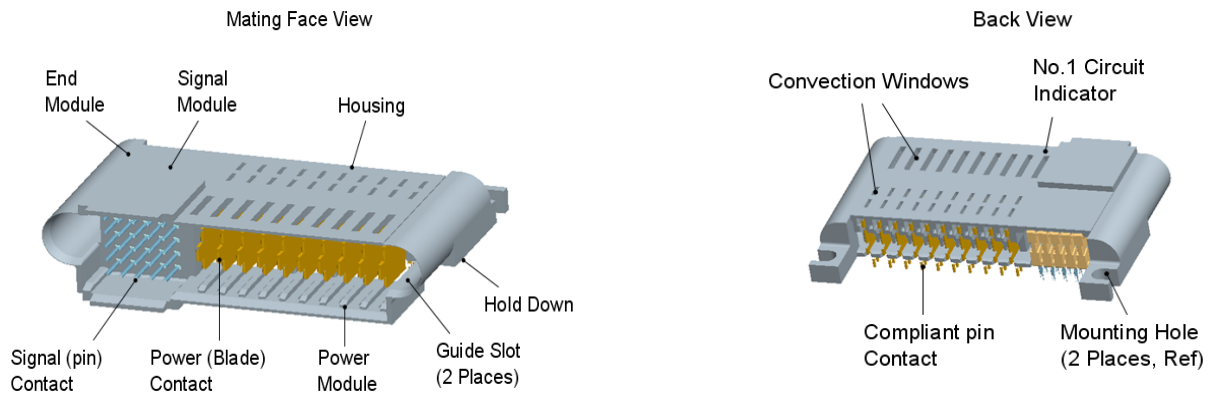
Product drawings and **FCI's GS-12-1064** Product Specification are available at [www.fci.com](http://www.fci.com). In the event of a conflict between this application specification and the drawing, the drawing will take precedence. Customers are advised to refer to the latest revision level of FCI product drawings for appropriate details.

#### 5. INTRODUCTION

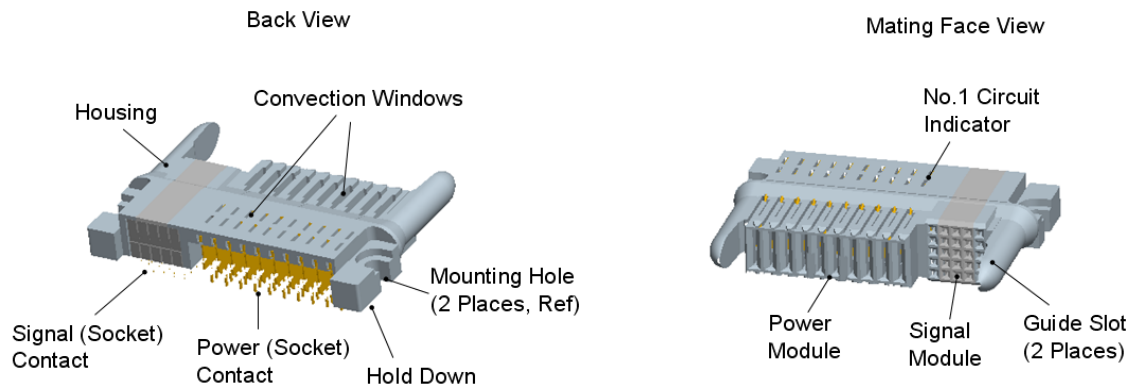
- 5.1. This specification covers the requirements for PwrLoPro connectors onto printed circuit (pc) boards specifically designed for module hot-swappable power distribution systems. These connectors consist of right-angle header assemblies, right-angle-receptacle assemblies and vertical-receptacle assemblies. PwrLoPro have precision formed compliant pin contacts that can be used either for press-fit application or wave soldering application. Each connector consists of one housing with power modules containing one row of power (either header or receptacle) contacts and signal modules containing 5 rows of signal (either header or receptacle) contacts. When corresponding with personnel, use the terminology provided in this specification to facilitate your inquiries for information. Basic terms and features of this product are provided in Figure 1.

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 4 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

### Right-Angle Header Assembly (25S X 10P, Ref)

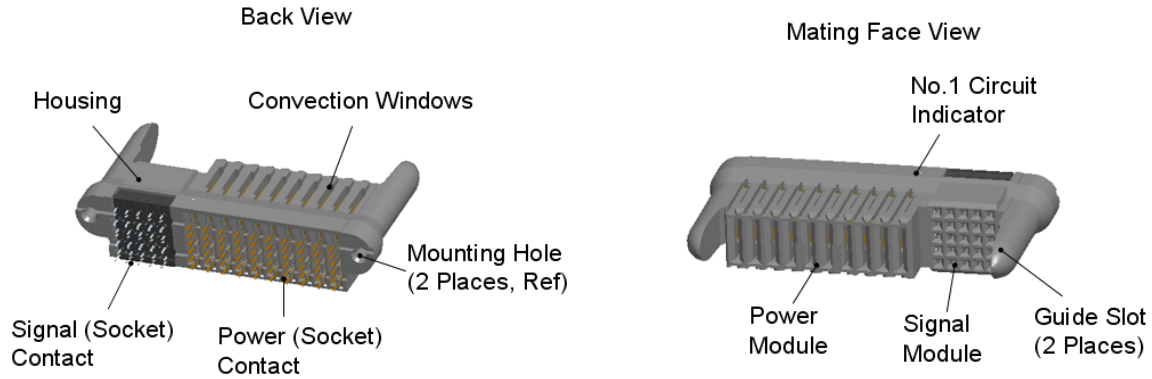


### Right-Angle Receptacle Assembly (25S X 10P, Ref)



### Vertical Receptacle Assembly (25S X 10P, Ref)

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 5 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
		CLASSIFICATION <b>UNRESTRICTED</b>	

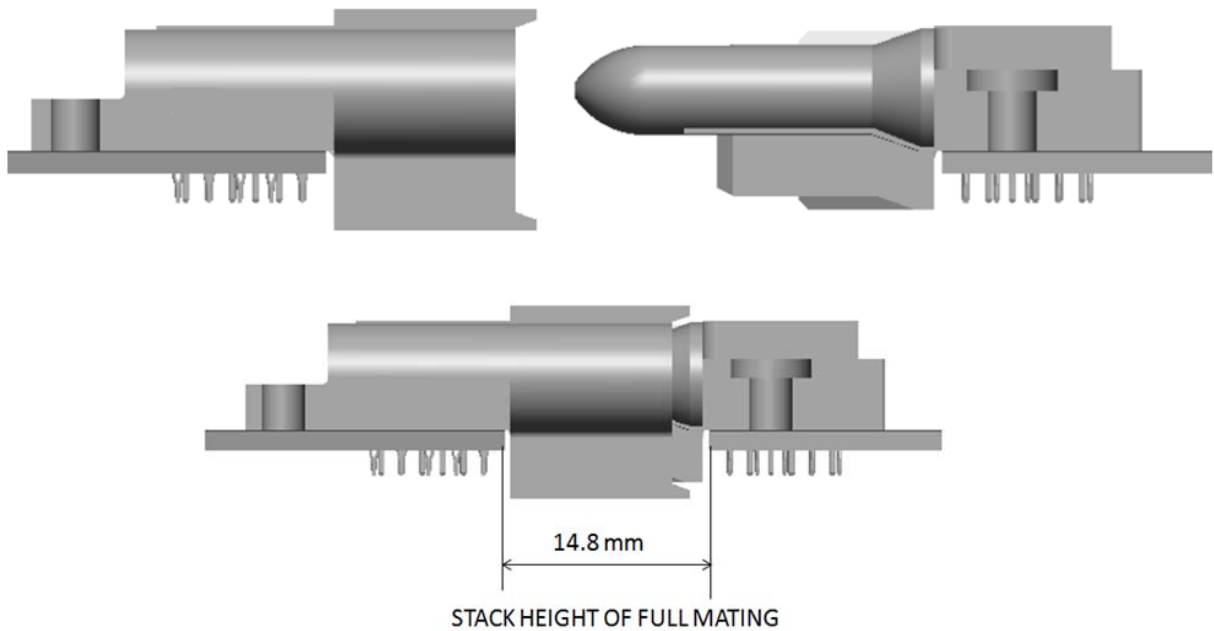


Restriction of Hazardous Substances (ROHS) Compliant

**Figure 1**

## 5.2. PCB Alignment

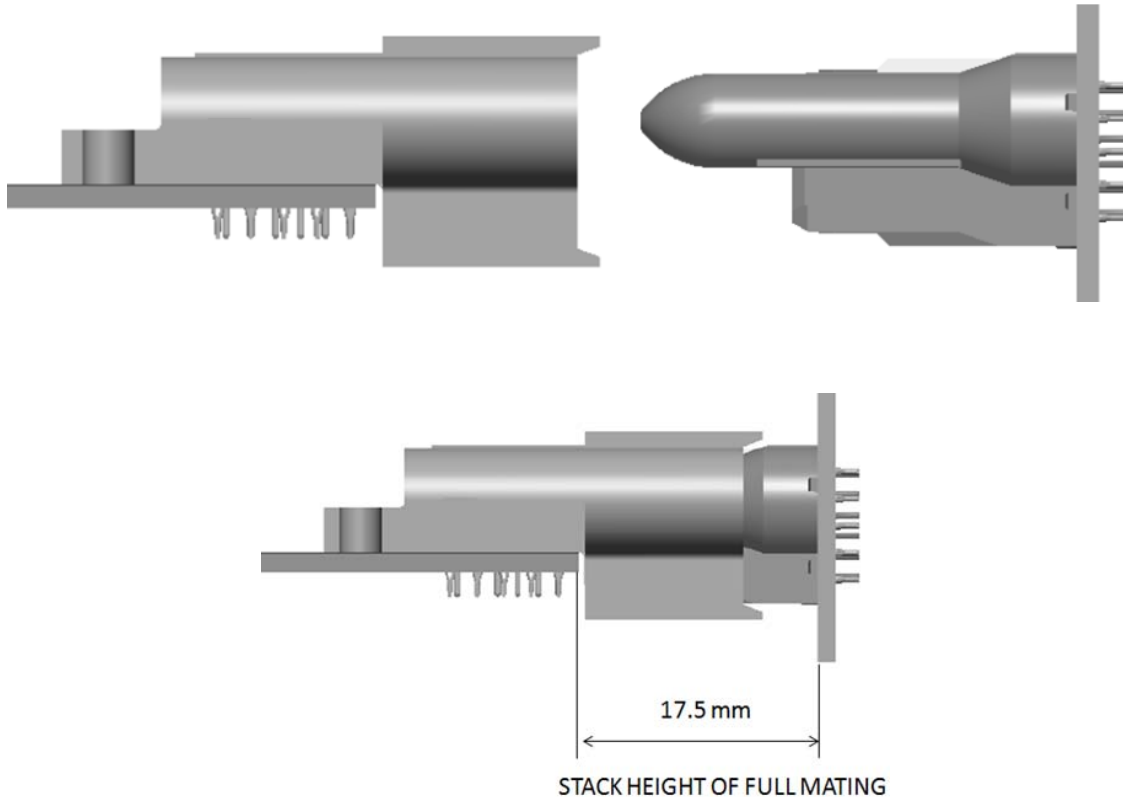
### 5.2.1. Right Angle Receptacle to Right Angle Header



**Figure 1a**

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 6 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

### 5.2.2. Vertical Receptacle to Right Angle Header



**Figure 1b**

- 5.3. The connectors are available in two contact mating lengths to provide 2 levels of mating sequence : the power contact Level 1: mate-first break-last(MFBL) and LEVEL 2: standard, and the signal contacts have Level 2 : standard and Level 3 : mate-last break-first (MLBF). Each power module has a contact centerline spacing of 2.75mm. Each signal module has a contact centerline spacing of 2.00mm.
- 5.4. Each housing has an embossed dot to indicate the NO.1 circuit. The maximum overall length allowed for the connector is 101mm. Thirty power contact (without signal contacts) or combinations of up to 24power Contacts and 40 signal contacts can be used – provided the maximum allowable length is not exceeded.
- 5.5. The connector configuration is described by reading left to right on the header.
- 5.6. End modules are available with feature that providing blind mating, alignment, and polarization. End modules contain a guide post (for receptacles only) guide slot (for headers only) and a hold down (for wave soldering application), and/or mounting hole (for press fit application). Guides have rounded edges for ease of mating and positioned to prevent improper mating of connectors. The hold down and mounting hole (which accept commercially – available standard screws) help to align the connector to the pc board for installation then secure the connector to the pc board. Convection windows located on the housing provide air flow for power modules.

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>			
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 7 of 22	REVISION C		
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016		
CLASSIFICATION <b>UNRESTRICTED</b>					

5.7. The connectors are supplied in tray form for manual placement.

## 6. APPLICATION REQUIREMENTS

### 6.1. Safety

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

### 6.2. Limitations

The connectors are designed to operate in a temperature range of -40° to 125°C [-40° to 257°F].

Voltage ratings for these connectors are based upon UL – 60950 -1 Second Edition Tale 2N. Voltage ratings according to Minimum Creep Distance (MCD) are given in Figure 2.

The voltage rating are based on normal circuit pad diameters of 1.12mm for press-fit application and 1.41mm for solder application and Underwriters Laboratories Inc. (UL), Pollution Group II, Material Group IIIb. That material group has a comparative tracking index (CTI) of  $100 \leq CTI \leq 175$ .

CONTACT			MAXIMUM VOLTAGE RATING IN AC (RMS) OR DC			
TYPE	FUNCTION	PITCH	Within Primary Circuits	Primary to Secondary Circuits	Primary to Ground Circuits	Within Secondary Circuits
Press-Fit	Signal	2.00 [.0787]	—	—	—	60●
	Power	2.75 [.1083]	150	150	150	150
		5.50 [.2165]	400	—	400	400
Solder	Signal	2.00 [.0787]	—	—	—	60●
	Power	2.75 [.1083]	100	100	100	100
		5.50 [.2165]	400	—	400	400

● Safety Extra Low Voltage (SELV) Circuits

Figure 2

### 6.3. Material

The housing is made of glass filled high temperature nylon, UL 94V-0, with an oxygen index of 49%. The contacts are made of high-conductivity copper alloy under plated with nickel and plated with gold or palladium nickel; solder tines are plated with tin over nickel. Retention clips are made of plated copper alloy.

### 6.4. Storage

#### 6.4.1. Ultraviolet Light

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

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 8 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

#### 6.4.2. 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.

#### 6.4.3. 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

#### 6.5. PC Board

##### 6.5.1. 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 3.

PC BOARD THICKNESS	
CONNECTOR WITH PRESS-FIT CONTACTS	CONNECTOR WITH SOLDER TYPE CONTACTS
1.40 Min	1.40~2.62mm

**Figure 3**

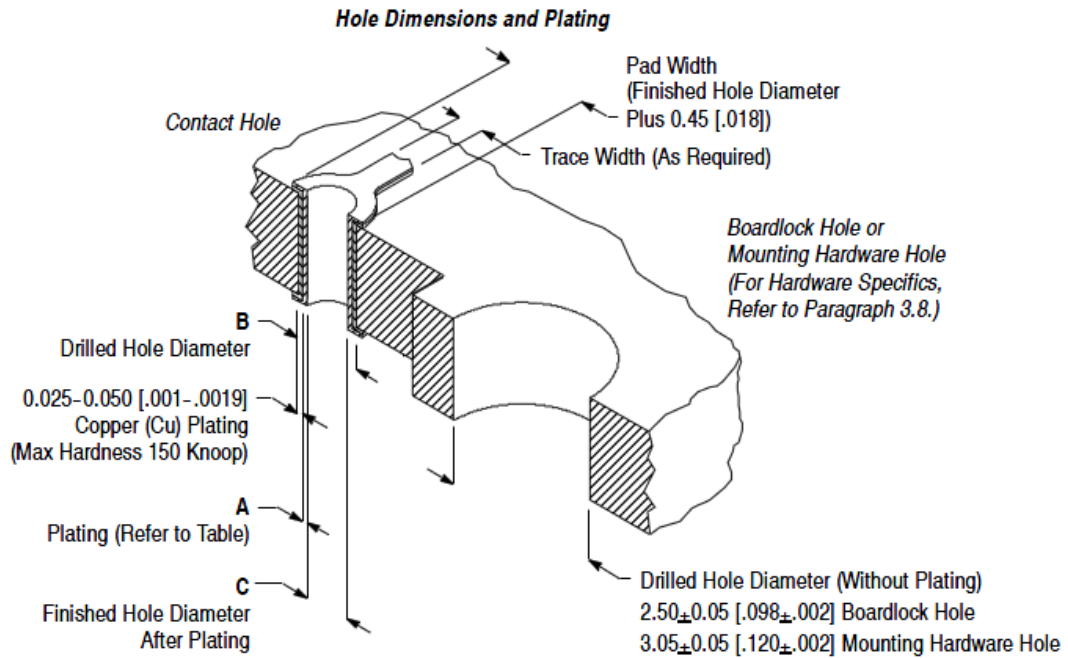
##### 6.5.2. Hole Dimensions, Plating, and Durability

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 4.

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 or decrease less than 0.0508mm.



NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 9 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
		CLASSIFICATION <b>UNRESTRICTED</b>	



APPLICATION	DIMENSION			
	A		B	C (Nominal, Ref)
	Surface Finish	Thickness		
Press-Fit	Immersion Gold (Au) Over Nickel (Ni)	0.00127 [.00005] Min	0.71-0.75 [.028-.0295]	0.65 [.0255]
	Hot Air Solder Leveling (HASL) Tin (Sn) Tin-Lead (Sn Pb)	0.004-0.015 [.00016-.0006]	0.68-0.72 [.0267-.0283]	0.61 [.0240]
	Immersion Sn	0.0005 [.00002] Min		
	Organic Solderability Preservative (OSP)	0.0002-0.0005 [.000008-.00002]		
	Immersion Silver (Ag)	0.0001 [.000004] Min		
Solder	Sn Pb	0.008 [.0003] Min	0.97-1.01 [.0382-0.398]	0.90 [.0354]
	Immersion Sn	0.0005-0.004 [.00002-.0015]		
	Organic Solderability Preservative (OSP)	0.0002-0.0005 [.000008-.00002]		
	Immersion Silver (Ag)	0.0001 [.000004] Min		

**Figure 4**

NUMBER GS-20-0362	TYPE Application Specification	Amphenol FCI	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 10 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

### 6.5.3. Land/pad size

The pc board land/pad size is given in Figure 4.

### 6.5.4. 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 5.

### Sample Recommended PC Board Layout

As Viewed from Connector Side

(25S X 10P Plug Assembly Shown)

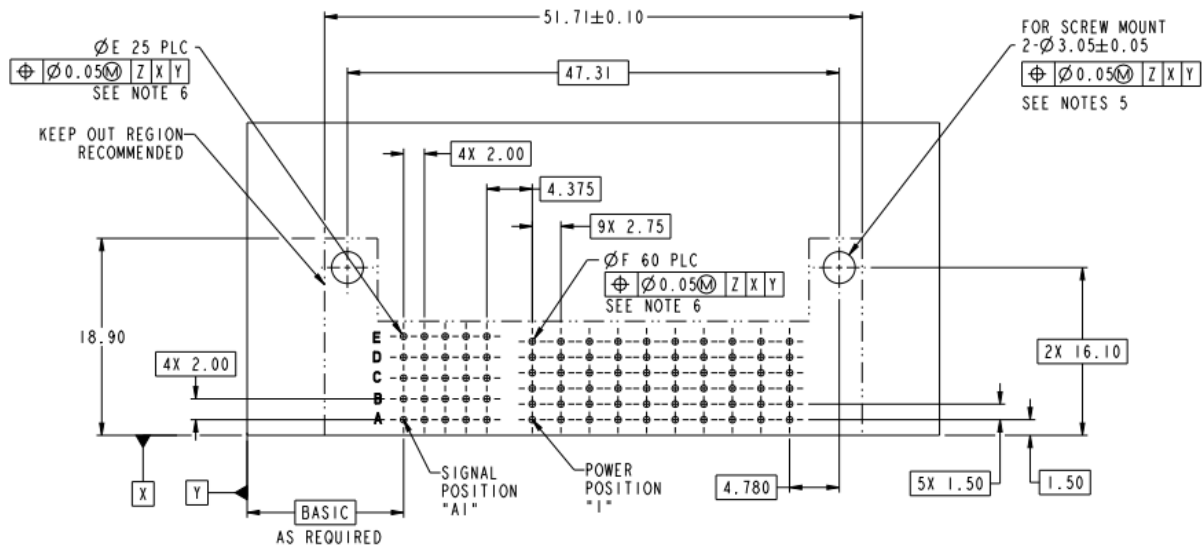


Figure 5 (Not to Scale)

### 6.6 Connector Spacing

Care must be used to avoid interference between adjacent connectors and other components.

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 11 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

## 6.7 Connector Placement

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

### 6.7.1 Registration

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

### 6.7.2 Insertion force of press fit application

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 power contacts X maximum insertion force per power contact N [lbs.]

Insertion force N [lbs.] =

Number of signal contacts X maximum insertion force per signal contact N [lbs.]

Insertion force N [lbs.] =

Number of hold downs X maximum insertion force per hold down N [lbs.]

The maximum amount of insertion force per press-fit contact and retention clips is given in Figure 6.

MAXIMUM INSERTION FORCE (N [lb])		
PER POWER CONTACT	PER SIGNAL CONTACT	PER BOARD-LOCK (If Applicable)
267 [60]	44.5 [10]	27 [6]

**Figure 6**

## 6.8 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 7.

Typically, this method of mounting (or hold-down) serves connectors with solder type contacts and without hold down. The hardware must be installed BEFORE soldering.

SCREW		MAXIMUM TORQUE Nm [in.-lb] (Applied to Mating Face)
SIZE	HEAD DIAMETER (Maximum)	
No. 4	7.37 [.290]	0.57 [5]

**Figure 7**

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 12 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

## 6.9 Soldering

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

### 6.9.1 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 8.

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

**Figure 8**

### 6.9.2 Solder Mask

A solder mask is **MUST** be applied over the trace of any connector component hanging below the bottom of the pc board to prevent bridging and wicking of solder away from the contact solder tines.

A heat-resistant solder mask is recommended.

If bridging or wicking occurs, the trace must be repaired.

### 6.9.3 Process

The connectors must be soldered using lead-free wave soldering or equivalent soldering techniques. The temperatures and exposure time shall be as specified in Figure 9.

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

**Figure 9**

### 6.9.4 Cleaning

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 13 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

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 affect connectors for the time and temperature specified are listed in Figure 10.

Consideration must be given to toxicity and other safety requirements recommended by the solvent manufacturer. Refer to the manufacturer'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.

***The cleaning process must be accomplished by hand.***

***Lubricant at the mating interface MUST NOT be removed.***

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]

**Figure 10**

(ALPHA is a trademark of Alpha Metals, Inc.

CARBITOL is a trademark of Union Carbide Corporation

BIOACT is a trademark of Petroferm, Inc.

KESTER is a trademark of Kester, Inc.

LONCOTERGE is a trademark of London Chemical Company, Inc.)

### 6.9.5 Drying

When drying cleaned connectors and pc boards, make certain that temperature limitations are not exceeded: -40°C to 125°C [-104°F to 257°F]. Excessive temperatures may cause housing degradation.

### 6.10 Checking Installed Connector

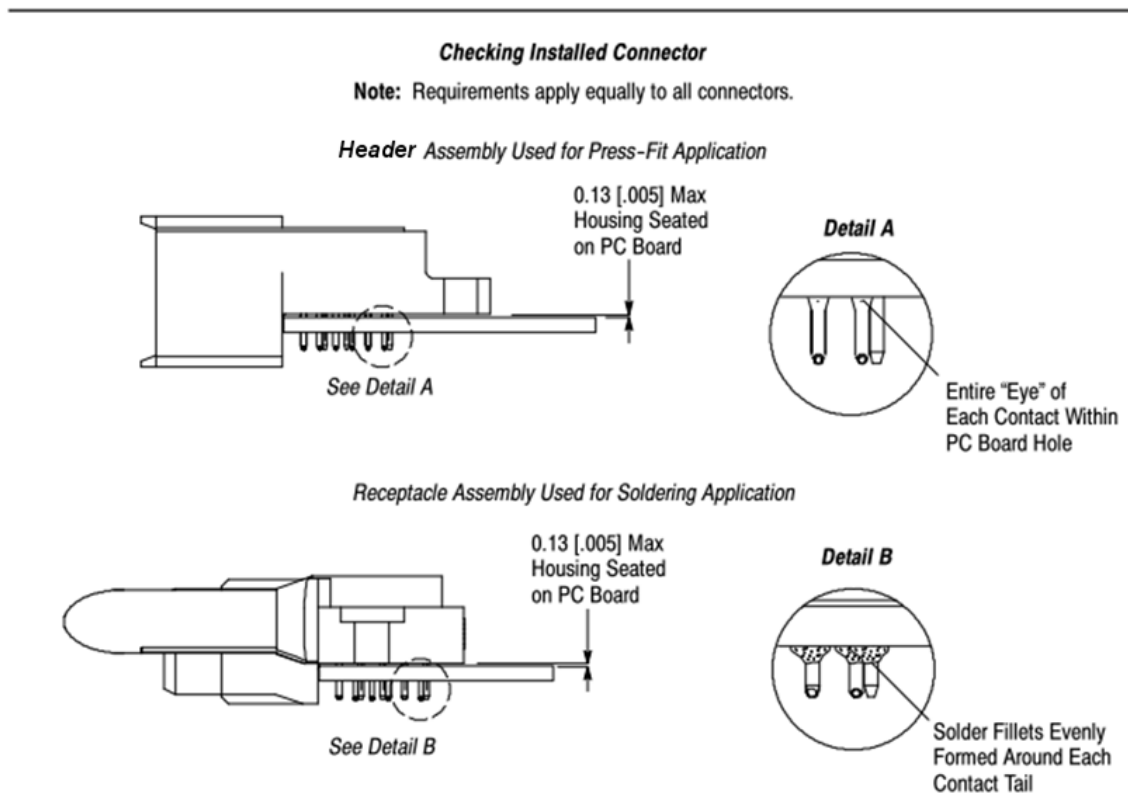
NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 14 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

### 6.10.1 Using contacts for press-fit application

The entire “eye” of each contact must be within the pc board hole. The housing must be seated on the pc board within the dimension provided in Figure 11, Detail A.

### 6.10.2 Using contacts for soldering application

Solder fillets must be evenly formed around each contact solder tail. There must be no visible skips or void. The housing must be seated on the pc board within the dimension provided in Figure 11, Detail B.



**Figure 11**

## 6.11 Connector Mating

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 15 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
		CLASSIFICATION <b>UNRESTRICTED</b>	

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

### 6.11.1 Polarization

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

### 6.11.2 Mating Force

The maximum amount of mating force per contact is given in Figure 12.

CONTACT	MAXIMUM MATING FORCE PER CONTACT ( N [oz] )
Power	3.00 [ 10.8 ]
Signal	1.65 [ 5.9 ]

**Figure 12**

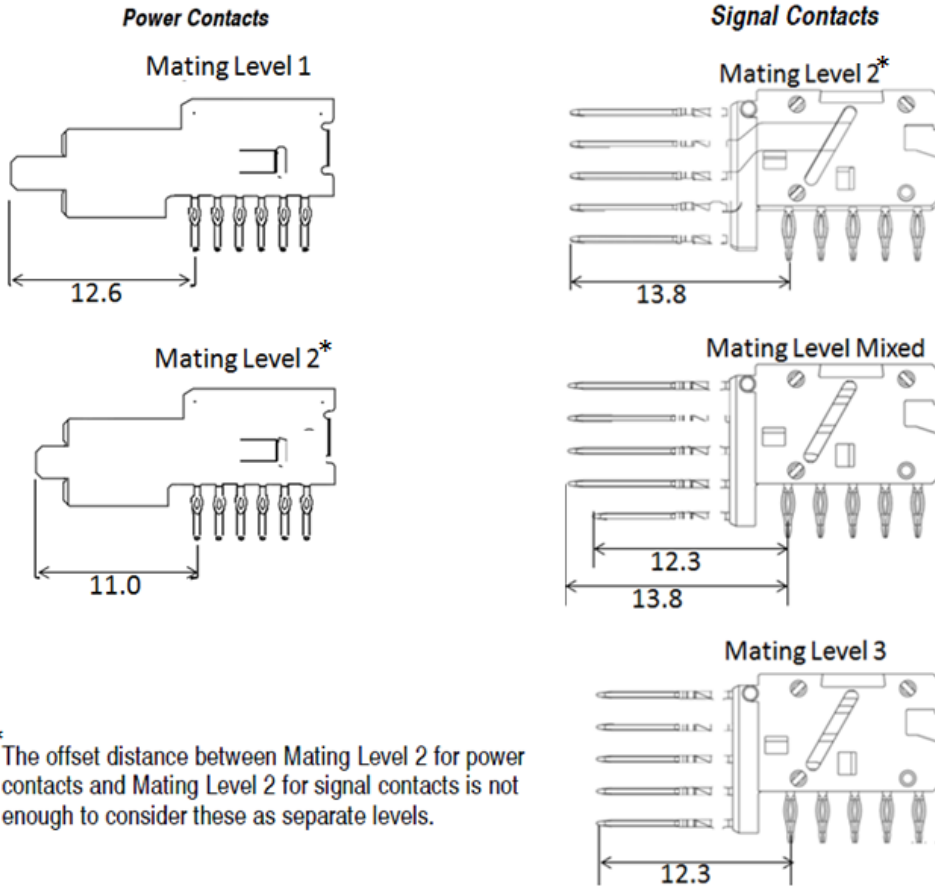
### 6.11.3 Mating Length

Contact mating lengths available for the connectors are listed in Figure 13.

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NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 16 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
		CLASSIFICATION <b>UNRESTRICTED</b>	

**Mating Length**



CONTACT TYPE	MATING LENGTH	MATING LEVEL
Power	MFBL (Pre-Mate)	1
	Standard	2
Signal	Standard	2
	MLBF (Post-Mate)	3

**Figure 13**



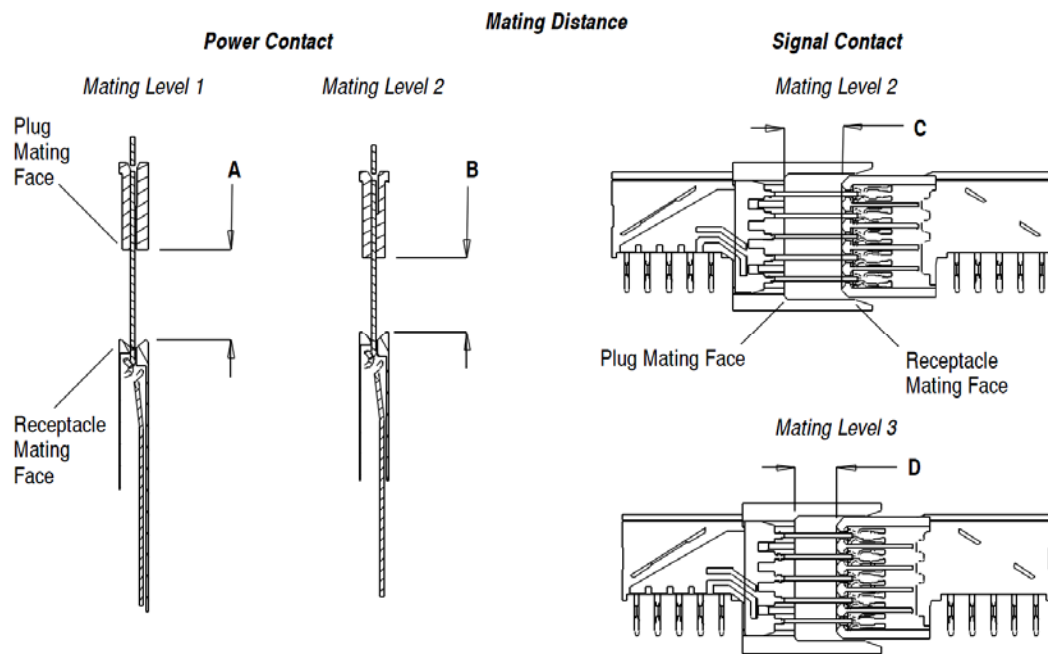
NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 17 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

#### 6.11.4 Mating distance and wipe length

The connectors provide sequencing among contacts with 3 mating levels. The mating distance, measured from the receptacle mating face to the header 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.

Wiping length for these connectors is defined as that portion (length) of the mating contacts that touches (wipes) from the point of engagement to the point of being fully mated. The wipe length depends on the contact (power or signal) and mating length (standard, MFBL, or MLBF) of each *individual* contact.

The mating distance and minimum wipe length at the mating level for power and signal contacts is listed in Figure 14.



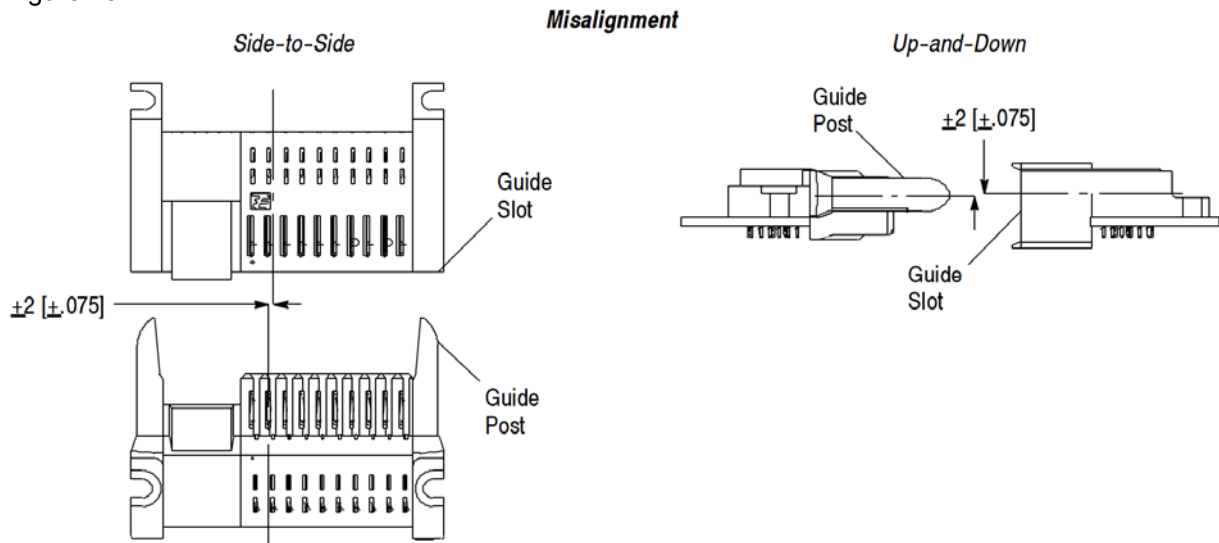
CONTACT	MATING LENGTH	MATING LEVEL	MATING DISTANCE			WIPE LENGTH (Min)
			DIMENSION	First Mate	Reliable Mate	
Power	MFBL (Pre-Mate)	1	A	8.52 [.3354]	6.68 [.263]	6 [.235]
	Standard	2	B	6.92 [.2724]	5.08 [.200]	4.4 [.173]
Signal	Standard	2	C	5.42 [.2134]	5.01 [.197]	3.75 [.148]
	MLBF (Post Mate)	3	D	3.92 [.1543]	3.51 [.138]	2.25 [.089]

**Figure 14**

#### 6.11.5 Misalignment

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 18 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

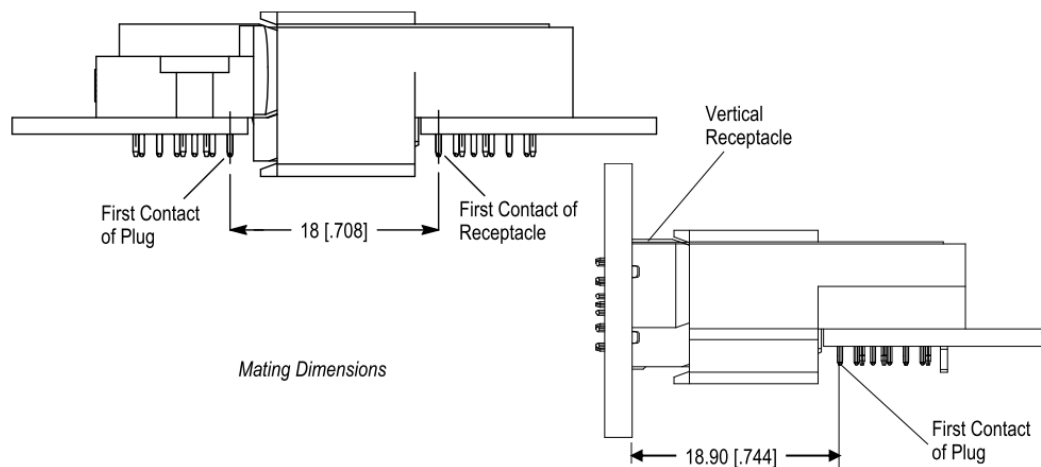
When mating connectors, side-to-side and up-and-down misalignment is allowed to the dimensions given in Figure 15.



**Figure 15**

### 6.11.6 Mating dimension

When fully engaged, the dimension between the first contact of the receptacle and the first contact of the header meet the dimension given in Figure 16.



**Figure 16**

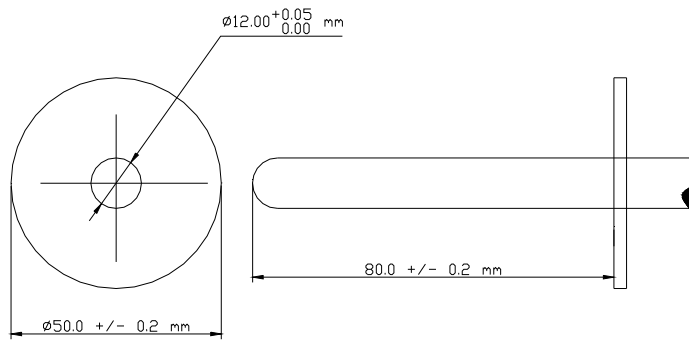
### 6.11.7 Durability

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 19 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
		CLASSIFICATION <b>UNRESTRICTED</b>	

The connectors can withstand 250 mating cycles.

### 6.12 Circuit Testing

Unmated receptacles and mated headers must be tested against hazardous voltages using the test probe specified in UL 1950. Specific area of the connector must be tested as indicated in Figure 17.



Dimensions of UL Probe

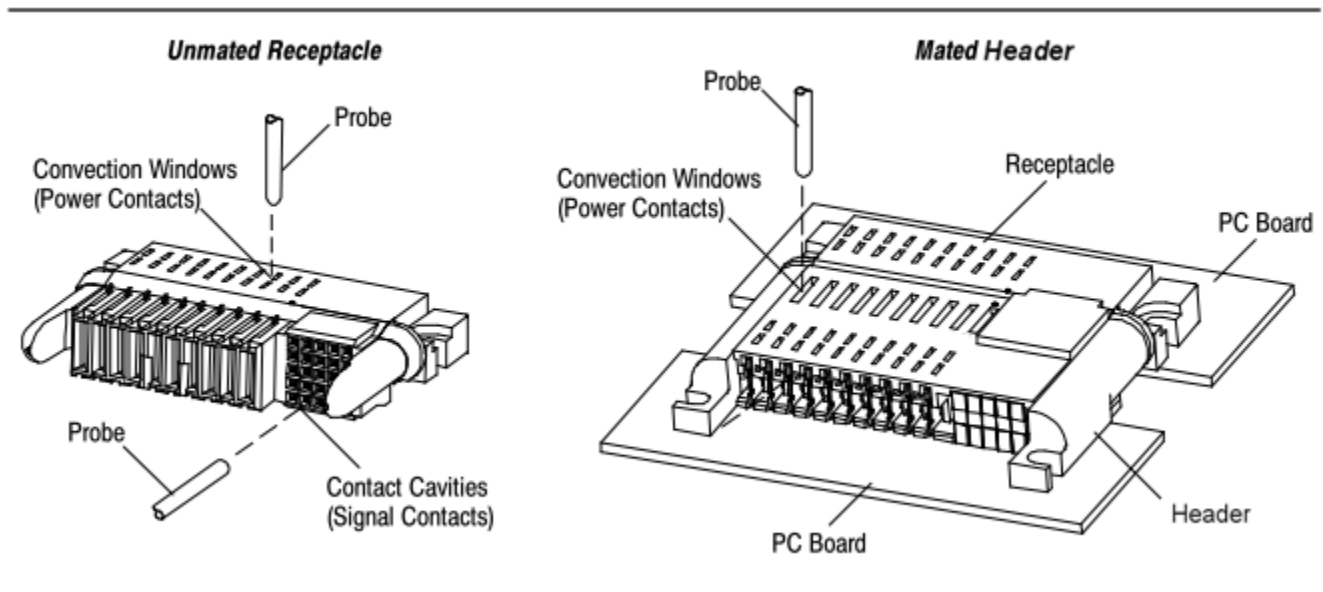


Figure 17

### 6.13 Connector Removal

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 20 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

### 6.13.1 Solder Type Contacts

These connectors must be removed from the pc board by standard de-soldering methods. After removal from the board, the connector **MUST NOT** be re-used.

### 6.13.2 Press-Fit Contacts

These connectors must be removed from the pc board using a push bar (or flat rock) and pc board support.

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

### 6.14 Repair

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

## 7. Qualification

PowLoPro connectors are Recognized by Underwriters Laboratories (UL) in File E66906.

## 8. Tooling

### 8.1 Connectors used for Press-Fit application

Tooling needed to seat connectors with press-fit contacts are shown in Figure 18.

#### 8.1.1 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.

#### 8.1.2 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.

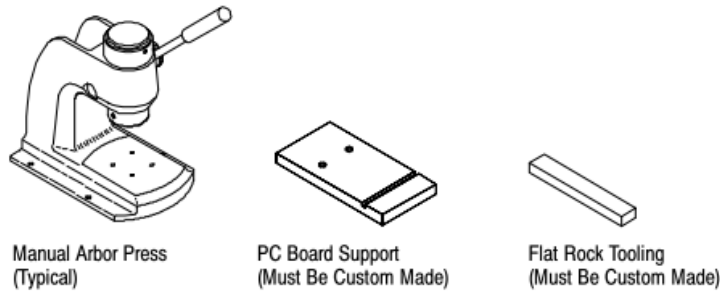
The board support must also be used when removing these connectors from the pc board.

#### 8.1.3 Flat Rock Tooling

Commercially available bar stock (flat rock tooling) with a flat surface large enough to cover all contacts must be used with the application tooling to seat and remove these connectors.

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.

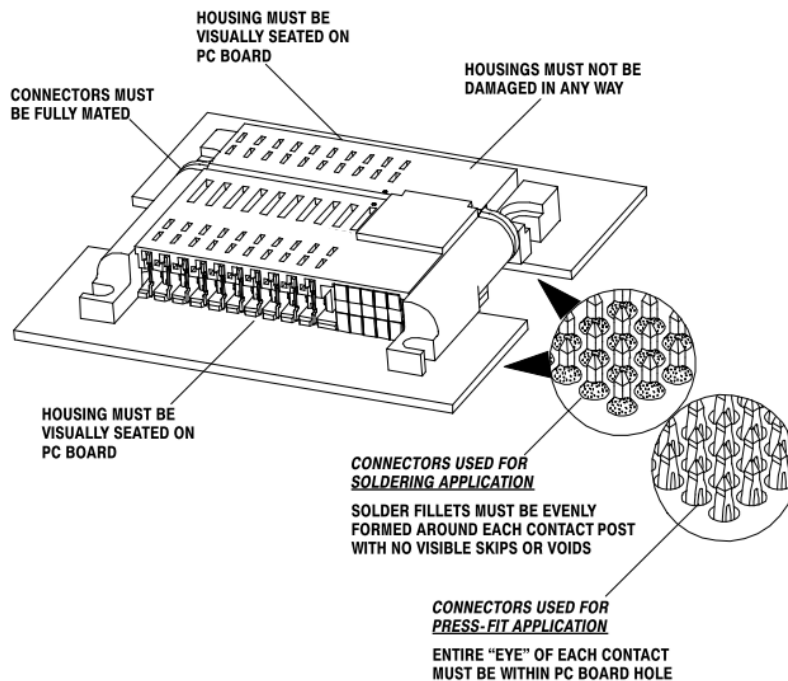
NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 21 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			



**Figure 18**

9. Visual Aid

The illustration below shows a typical application of PwrLoPro connectors. This illustration should be used by production personnel to ensure a correctly applied product. Application which DO NOT appear correct should be inspected using the information in the preceding pages of this specification and in the instructional material shipped with the product or tooling. See Figure 19.



**Figure 19**

NUMBER GS-20-0362	TYPE <b>Application Specification</b>	<b>Amphenol FCI</b>	
TITLE Application Guide for PwrLoPro Headers and Receptacles		PAGE 22 of 22	REVISION C
		AUTHORIZED BY Fancy Zhang	DATE 20- Apr-2016
CLASSIFICATION <b>UNRESTRICTED</b>			

Record Retention

<b>REV</b>	<b>PAGE</b>	<b>DESCRIPTION</b>	<b>EC #</b>	<b>DATE</b>
A	ALL	Rev A Initial		21-Dec-2012
B	ALL	Released to unrestricted classification	ECN-ELX-DG-15580	22-Aug-2013
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