

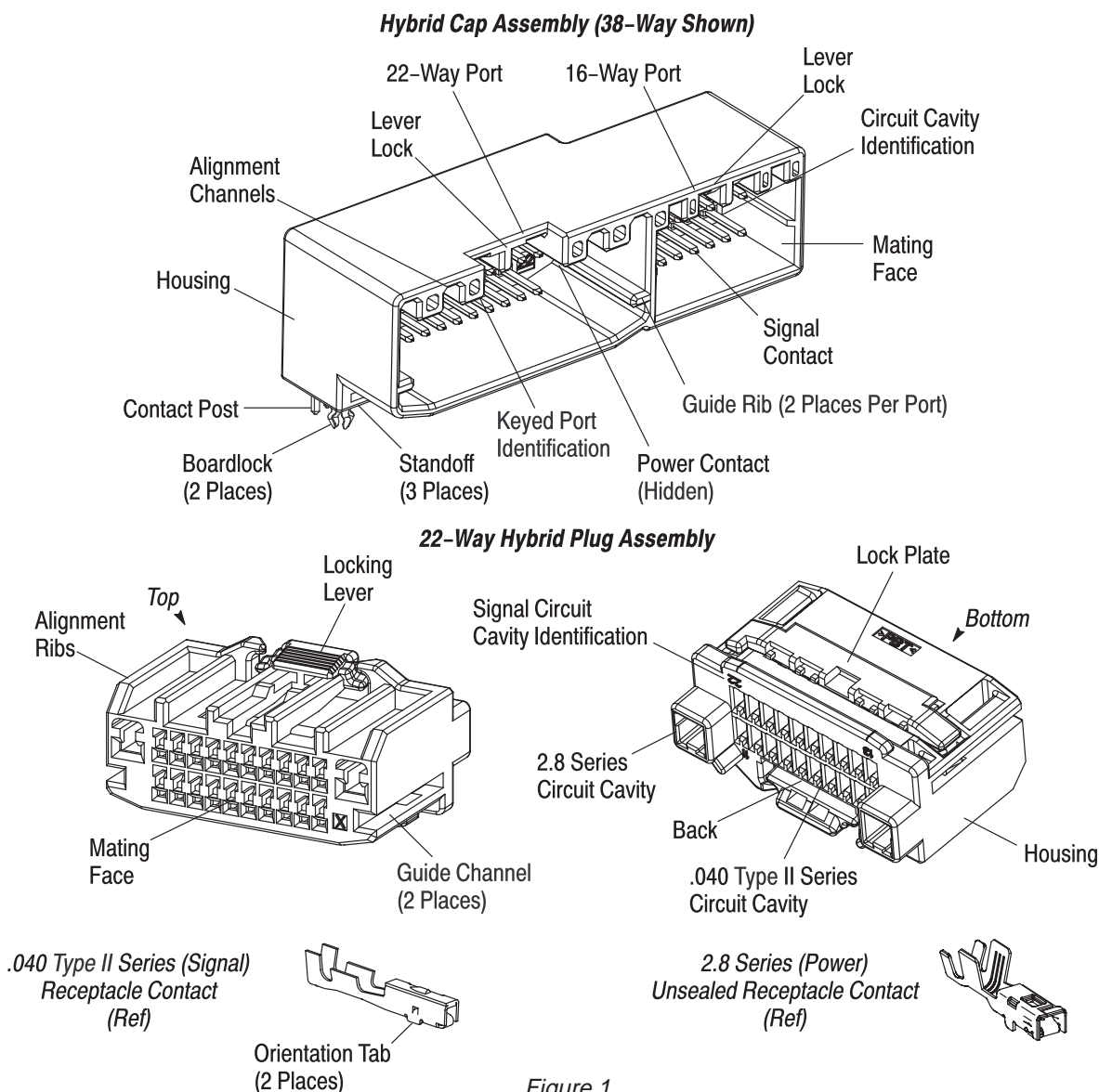
**MULTILOCK\* .040/2.8 Hybrid Connectors**
**NOTE**


All numerical values are in metric units [with U.S. customary units in brackets]. Dimensions are in millimeters [and inches]. Unless otherwise specified, dimensions have a tolerance of  $\pm 0.13$  [ $\pm .005$ ] and angles have a tolerance of  $\pm 2^\circ$ . Figures and illustrations are for identification only and are not drawn to scale.

**1. INTRODUCTION**

This specification covers the requirements for application of MULTILOCK .040/2.8 hybrid connectors used in the automotive industry. The hybrid connectors consist of 38- and 54-way (position) horizontal printed circuit (pc) board-mount hybrid cap assemblies and 22-way wire-termination hybrid plug assembly. The cap assembly is pre-loaded with right-angle solder post (signal and power) contacts with signal contact centerline spacing of 2.5 [.098]. The plug assembly accepts 2.8 series unsealed (power) receptacle contacts in circuit cavities 1 and 12 and .040 Type II series (signal) receptacle contacts in the remaining circuit cavities.

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.


**Figure 1**

The hybrid plug assembly consists of a housing and a side-type lock plate. End signal circuit cavities are marked on the back of the housing for identification. Each contact is held in the circuit cavity when the internal locking mechanism engages the locking surface of the contact. When engaged (in the “latched” position), the lock plate ensures that all contacts are seated and provides a secondary lock to secure them in place.

**NOTE**

*Application requirements for the contacts are covered in 114-5159 for the .040 Type II series and 114-13013 for the unsealed 2.8 series.*

Each hybrid cap assembly features boardlocks to provide stability for placement on the pc board and standoffs to facilitate pc board cleaning after soldering. The hybrid cap assemblies can be placed on the pc board manually or by using an automatic machine.

The 38-way hybrid cap assembly has one 22-way port and one 16-way port. The 54-way hybrid cap assembly has two 22-way ports and one 10-way port. Each port accepts a plug assembly having the same number of circuit cavities. Each port features alignment channels that accept the alignment ribs of the plug assembly for proper mating. The guide ribs and guide channels help to guide the plug assembly into the port of the hybrid cap assembly. The connectors have locking features for harness retention.

**NOTE**

*Application requirements for the 10-way plug assembly is covered in 411-5763, and application requirements for the 16-way plug assembly is covered in 412-5475.*

*The 38-way and 54-way hybrid cap assemblies and 22-way hybrid plug assembly are covered in this application specification.*

Keying is provided for the 22-way ports of the 54-way hybrid cap assembly. These ports have keyed alignment channels that accept the keyed alignment ribs of a 22-way hybrid plug assembly for proper port selection when mating. These ports are embossed with a letter (A or B) for key identification, and the housings are color-coded corresponding to the key for visual identification.

## 2. REFERENCE MATERIAL

### 2.1. Revision Summary

- Updated application specification to corporate requirements
- Changed base part number in Paragraph 2.2

### 2.2. Customer Assistance

Reference Product Base Part Number 1438789 and Product Code 0417 are representative of MULTILOCK .040/2.8 hybrid connectors. Use of these numbers will identify the product line and expedite your inquiries through a service network established to help you obtain product and tooling information. Such information can be obtained through a local Representative (Field Service Engineer, Field Applications Engineer, etc.) or, after purchase, by calling PRODUCT INFORMATION at the number at the bottom of page 1.

### 2.3. Drawings

Customer Drawings for product part numbers are available from the service network. If there is a conflict between the information contained in the Customer Drawings and this specification or with any other technical documentation supplied, the information contained in the Customer Drawings takes priority.

### 2.4. Manuals

Manual 402-40 can be used as a guide to soldering. This manual provides information on various flux types and characteristics with the commercial designation and flux removal procedures. A checklist is included in the manual as a guide for information on soldering problems.

### 2.5. Specifications

Product Specifications (108-series) provides product performance and test information, and Application Specifications (114- and 412-series) provides product description and application requirements. Documents available which pertain to this product are:

108-2217 .040 II/2.8 Unsealed Hybrid MULTILOCK Connector System

- 108-5342 .040 II/.070 II Hybrid I/O MK-II Connector for Wire-to-Board Termination
- 114-5159 Crimping .040 II Series Tab and Receptacle Contact
- 114-13013 2.8mm Terminal System (Sealed and Unsealed)

## 2.6. Instructional Material

Instruction Sheets (408- and 411-series) provide product assembly instructions or tooling setup and operation procedures. Documents available which pertain to this product are:

- 408-9817 Handling of Reeled Products
- 408-10027 Disengaging the Lock Plate of 22-Way .040/2.8 Hybrid Plug Assemblies
- 411-5763 .040 III High Density Connector
- 411-5287 Extraction Tool 755430-2 for Extracting .070 Series Contact
- 411-5288 Extraction Tool 755430-1 for Extracting .040 Series Contact

## 3. REQUIREMENTS

### 3.1. Safety

Do not stack product shipping containers so high that the containers buckle or deform.

### 3.2. Storage

#### A. Reeled Products

Coil wound reels should be stored horizontally and traverse wound reels should be stored vertically.

#### B. Ultraviolet Light

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

#### C. 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.

#### D. Chemical Exposure

Do not 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

#### NOTE

Where the above environmental condition exists, it is recommended using phosphor-bronze contacts.



### 3.3. Contact Loading

#### A. Disengage Lock Plate

The lock plate of the hybrid plug assembly must be disengaged (in the pre-latch position) before any contacts can be inserted. The lock plate is disengaged when both ends are raised slightly (approximately 1.3 [.051]) and evenly from the housing. See Figure 2.

#### NOTE

408-10027 provides instruction for disengaging and engaging the lock plate.



#### B. Insert Contact

The contact must be inserted into the contact cavity at the back of the hybrid plug assembly. The contact must be oriented so that the orientation tabs face the locking lever as shown in Figure 2, Detail A.

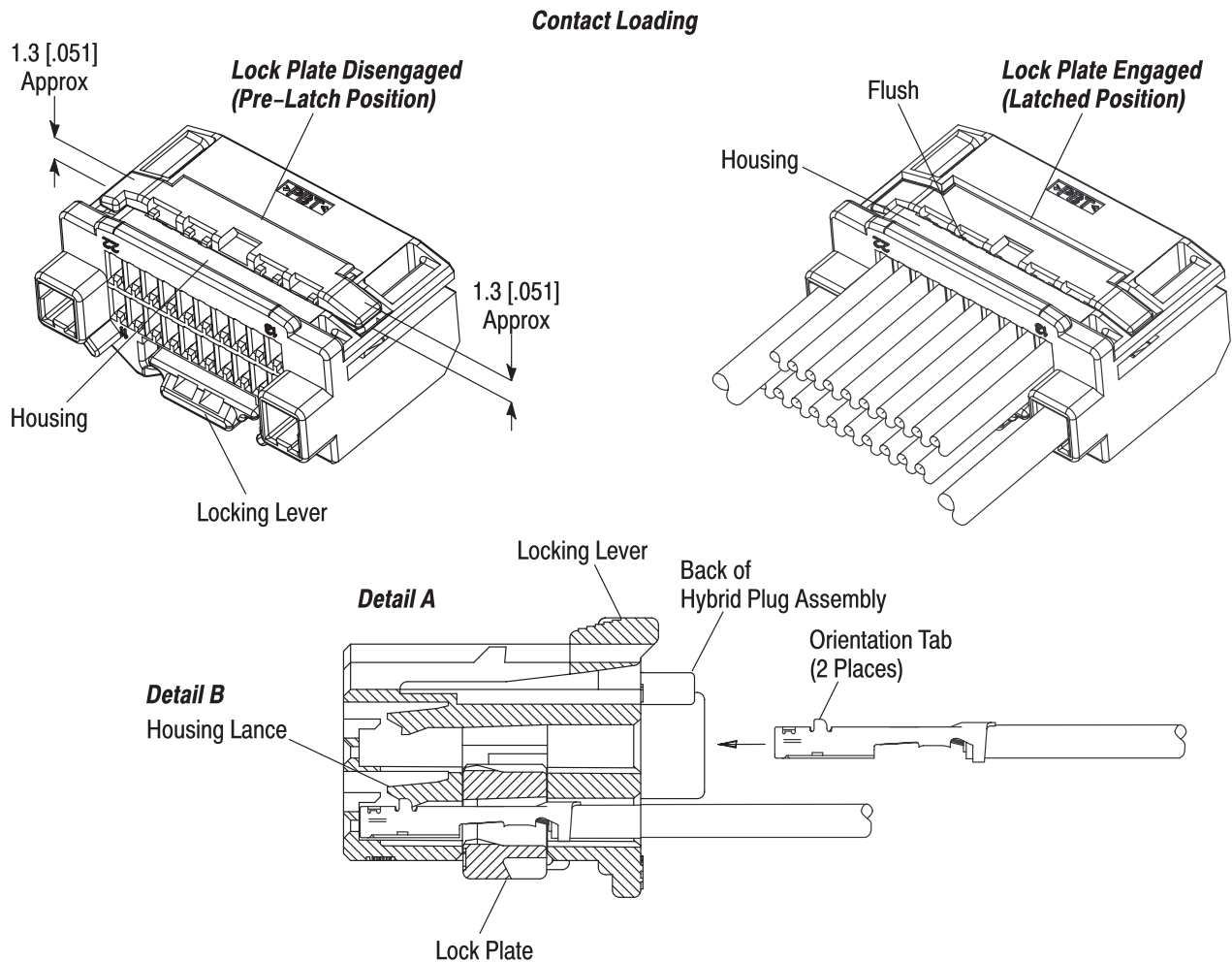


Figure 2

**NOTE**

The contact cavities and contacts have polarization features that prevent the contact from being inserted upside-down.

When the contact is fully inserted (there should be an audible click), the locking surface of the contact (located between the orientation tabs) will engage the housing lance of the hybrid plug assembly and prevent backing out during mating of the connectors. After insertion, it is recommended to pull back lightly on the wire to ensure that the contact is seated. See Figure 2, Detail B.

**CAUTION**

Contacts must not be forced to be seated.

**C. Engage Lock Plate**

After all contacts are seated, the lock plate of the hybrid plug assembly must be engaged (in the “latched” position). The lock plate is engaged when it is flush with the housing. If the lock plate does not engage, this indicates that all contacts are not seated. See Figure 2.

**3.4. Contact Extraction**

The lock plate of the hybrid plug assembly must be disengaged (in the pre-latch position) before removing any contacts. The lock plate is disengaged when both ends are raised slightly (approximately 1.3 [.051]) and evenly from the housing as shown in Figure 2.

An extraction tool (refer to Section 5) must be used to extract a contact from the housing.

**NOTE**

408-10027 provides instruction for disengaging and engaging the lock plate. The instruction sheet packaged with the tool provides instruction for extracting the contacts.

### 3.5. PC Board

#### A. Material and Thickness

The pc board material shall be glass epoxy (FR-4 or G-10). Recommended pc board thickness is 1.57 [.062]. Board thickness may vary; however, it is recommended that a minimum of 1.02 [.040] of the contact post protrude from the pc board.

**NOTE**

Contact **PRODUCT INFORMATION** at the number listed at the bottom of page 1 for suitability of other board materials and thicknesses.

#### B. Tolerance

Maximum allowable bow of the pc board shall be 0.03 [.001] over the length of the hybrid cap assembly.

#### C. Pads

The pc board circuit pads must be solderable in accordance with Test Specification 109-11.

#### D. Hole Dimensions

The contact holes must be drilled to specific dimensions to prevent stubbing during placement of the hybrid cap assembly on the pc board and to ensure optimum continuity for circuits. The contact holes can be used with or without plating. The plating type and thickness and finished hole size must be as stated in Figure 3.

The boardlock holes must be drilled to the dimensions given in Figure 3.

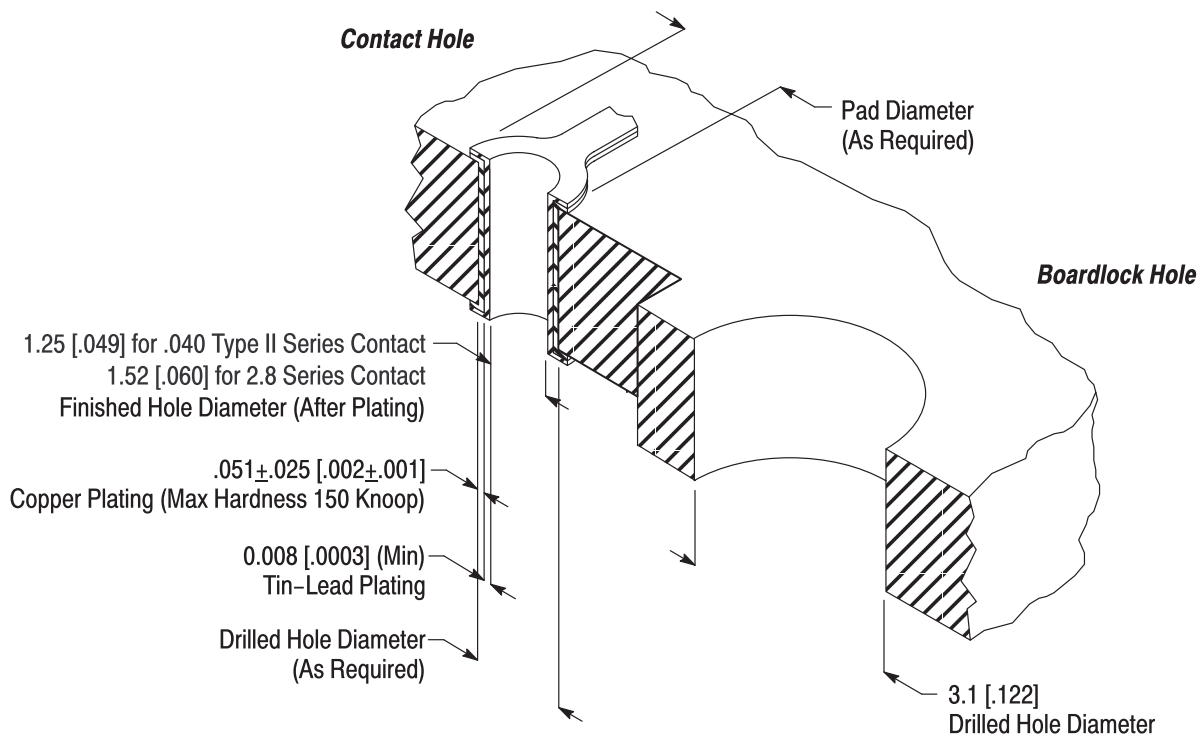


Figure 3

## E. Layout

The boardlock holes and contact holes in the pc board must be precisely located to ensure proper placement and optimum performance of the hybrid cap assembly. The pc board layout must be designed using the dimensions provided on the customer drawing for the specific hybrid cap assembly. Reference *samples* of the recommended pc board layout are shown in Figure 4.

### Sample Recommended PC Board Layout (Connector Side)

**Note:** Not to scale. Dimensions are in millimeters.

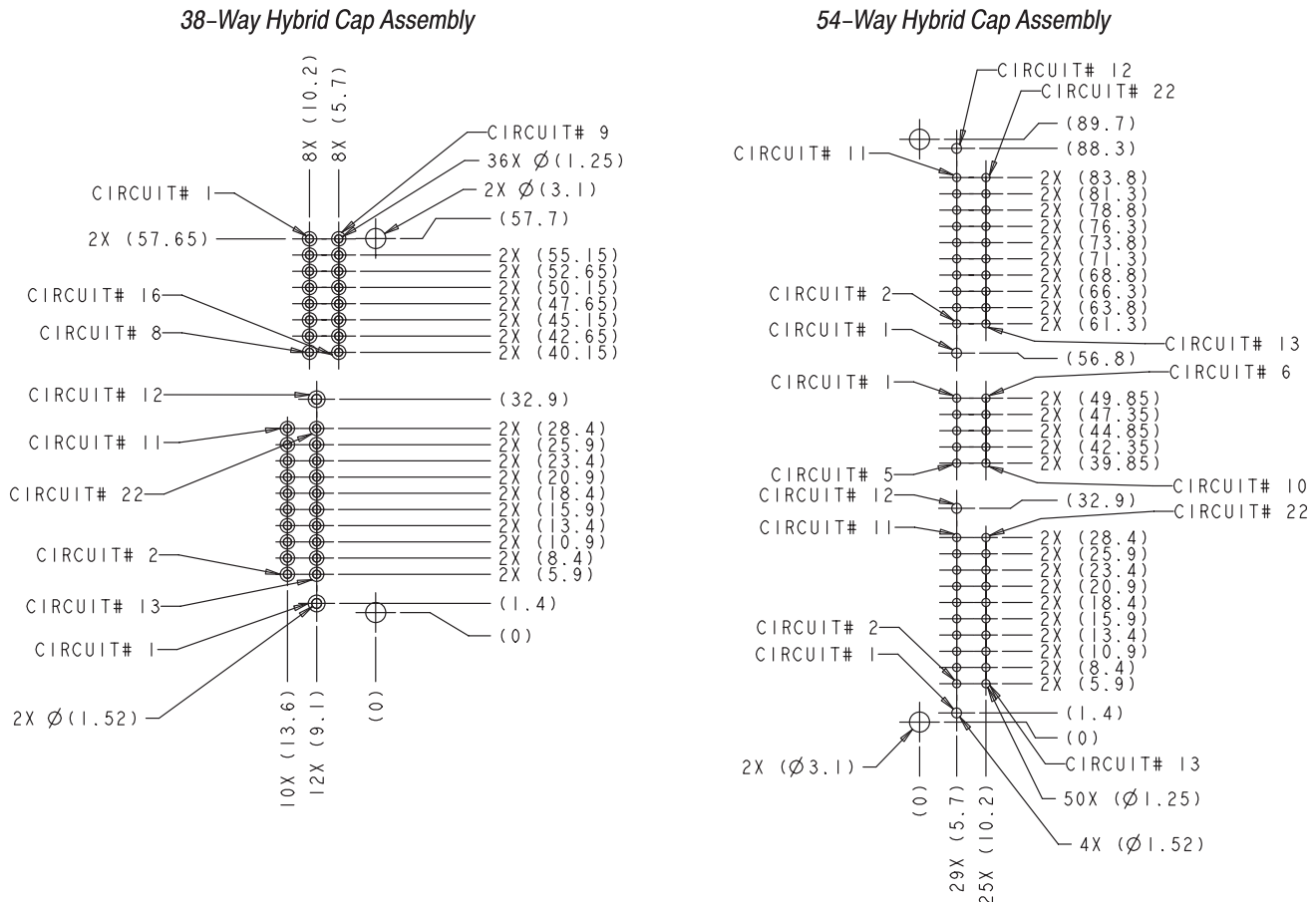


Figure 4

## 3.6. Cap Assembly Placement



Hybrid cap assemblies should be handled only by the housing to avoid deformation, contamination, or damage to the contact posts or boardlocks.

### A. Registration

The hybrid cap assembly number one contact position must be aligned with the number one circuit hole on the pc board. When placing hybrid cap assemblies on the pc board, make sure that the contact posts and boardlocks are aligned with matching holes before seating the cap assembly onto the pc board. Refer to Figure 5.

### B. Seating

The hybrid cap assembly standoffs must be fully seated on the pc board as shown in Figure 5.



Placement of Hybrid Cap Assembly

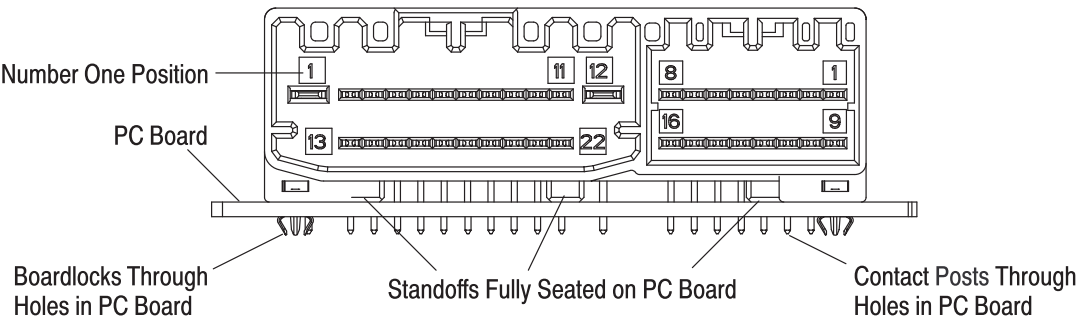


Figure 5

C. Insertion Force

The maximum force required to seat the cap assembly onto the pc board is 41.15 N [9.25 lb–force] per hybrid cap assembly.

3.7. Soldering

A. Flux Selection

The contact posts and boardlocks 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. Call PRODUCT INFORMATION at the number at the bottom of page 1 for consideration of other types of flux. Flux that is compatible with the hybrid cap assemblies is provided in Figure 6.

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

Figure 6

B. Process

The hybrid cap assemblies can be soldered using wave soldering, vapor phase (VPR), double–sided non–focused infrared reflow (IR), or equivalent soldering techniques. It is recommended using SN60 or SN62 solder. The temperatures and exposure time shall be as specified in Figure 7.

SOLDERING PROCESS	TEMPERATURE (Max)	TIME
Wave	260° C [500° F]	5 Seconds
VPR	215° C [419° F]	5 Minutes
IR	260° C [500° F]	40 Seconds

Figure 7

C. 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 with times and temperatures that will not affect these connectors is specified in Figure 8.



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.

**DANGER**

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).

CLEANER		TIME (Minutes)	TEMPERATURE (Maximum)
NAME	TYPE		
ALPHA 2110	Aqueous	1	132° C [270° F]
BIOACT EC-7	Solvent	5	100° C [212° F]
Butyl CARBITOL	Solvent	1	Ambient Room
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 8

**NOTE**

If you have a particular cleaning solvent that is not listed, contact **PRODUCT INFORMATION** at the number at the bottom of page 1.

**D. Drying**

When drying cleaned assemblies and pc boards, temperature limitations must not be exceeded: -55° to 105° C [-68° to 221° F]. Excessive temperatures may cause housing degradation.

**3.8. Connector Spacing**

Care must be used to avoid interference between adjacent connectors and other components. The minimum distance between cap assemblies to ensure proper placement (side-to-side) and ability of mating (face-to-face) is provided in Figure 9.

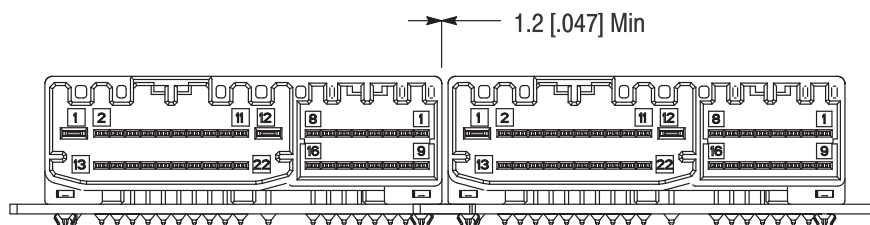
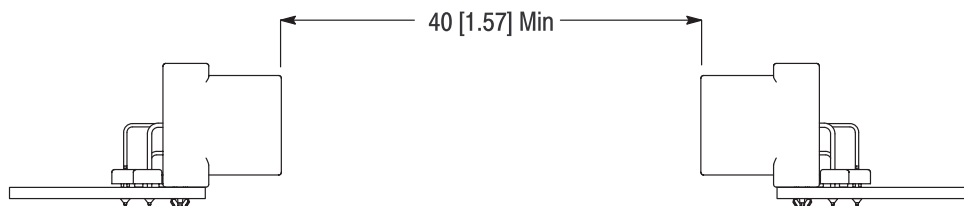
**Side-to-Side Recommended Distance****Face-to-Face Recommended Distance**

Figure 9



**NOTE**

If robotic equipment is used for placement of the cap assemblies, space must be allowed for the grippers.



### 3.9. Checking Installed Hybrid Cap Assembly

All solder joints should conform to those specified in Workmanship Specification 101-21 and all other requirements specified in this document. The standoffs must be seated on the pc board not exceeding the dimension shown in Figure 10.

The installed hybrid cap assembly must have solder fillets evenly formed around each contact post, and the standoffs must be seated on the pc board to the dimensions shown in Figure 10.

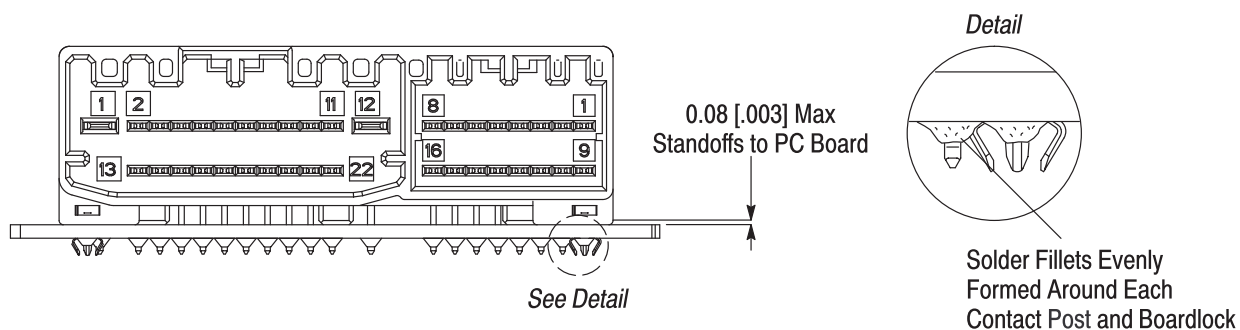


Figure 10

### 3.10. Keying (54-Way Hybrid Cap Assembly Only)

The keyed alignment ribs of 22-position hybrid plug assemblies match the keyed alignment channels of the corresponding 22-way port. The embossed letters (A and B) can be used for visual identification before aligning the connectors for mating. The 10-way port is not keyed. See Figure 11.

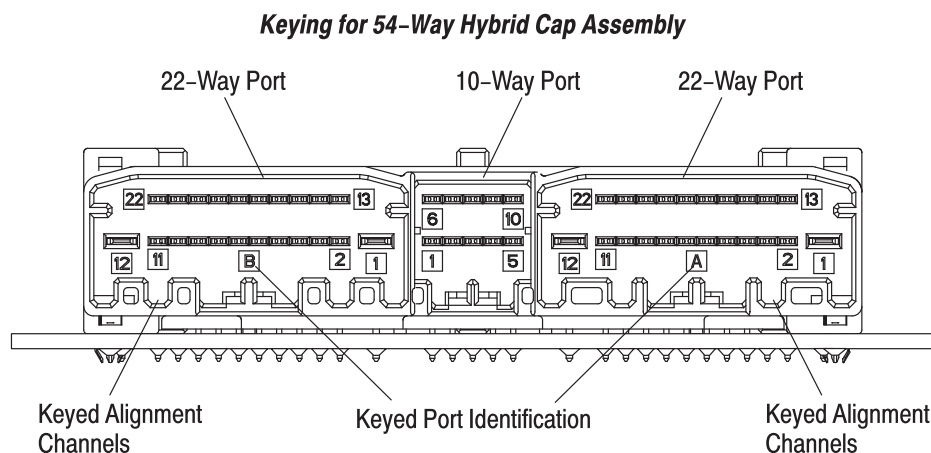


Figure 11

### 3.11. Mating Connectors

**CAUTION**

Hybrid plug assemblies should be handled only by the housing to avoid damage to the contacts or wires.



Hybrid plug assemblies must be aligned with the proper port (port with the same number of positions) of the hybrid cap assembly. When mating, the alignment ribs of the hybrid plug assembly must align with the alignment channels of the hybrid cap assembly, then the hybrid plug assembly must be pushed straight into the port. For the 54-way cap assembly, the keyed alignment ribs of a 22-way hybrid plug assembly must align with the keyed alignment ribs of the 22-way port.

After mating, the locking lever of the hybrid plug assembly must be fully seated and latched to the lever lock of the hybrid cap assembly (there will be an audible click) as shown in Figure 12.

When unmating connectors, the locking lever must be depressed while pulling the connectors straight apart.

**CAUTION**

The connectors must not be pulled by the wires.

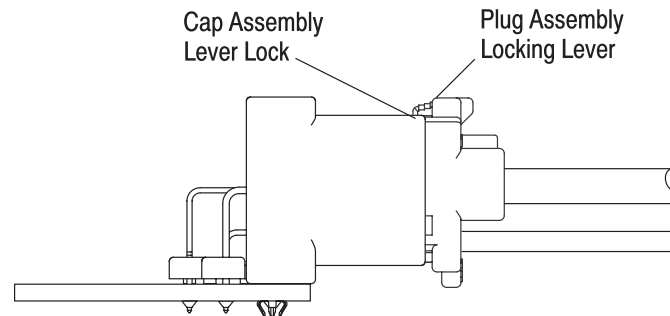


Figure 12

### 3.12. Strain Relief

Wires can be bundled together and supported with cable ties. Wires must not be stretched or confined in any way that would restrict the floating action of the contacts inside the circuit cavities. Therefore, the wires must remain perpendicular to the connectors and avoid an excessively sharp bend radius. The minimum distance for the cable tie, measured from the back of the hybrid plug assembly to the cable tie should be 25.4 [1.0], and the minimum bend radius of a wire bundle should be ten times the diameter of the largest wire.

When bending or forming wires, the wire bundle must be held at least 30 [1.181] beyond the back of the hybrid plug assembly before bending in any direction. If the installation is to be subject to bending forces, strain relief should be provided on the wire bundle approximately 25.4 [1.0] from the back of the hybrid plug assembly.

**CAUTION**

Unsupported wires must not be bent as this may cause strain on the contacts.



### 3.13. Replacement and Repair

Contacts can be removed from the hybrid plug assembly for replacement or relocation using an extraction tool (refer to Section 5). Damaged or worn contacts can be replaced provided there is sufficient slack after re-stripping the wire to insert a new contact into the hybrid plug assembly.

The lock plate of the hybrid plug assembly can be removed and replaced.

The hybrid cap assembly can be removed from the pc board by standard de-soldering methods and replaced with a new one. Defective or damaged connectors **MUST NOT** be used.

## 4. QUALIFICATION

MULTILOCK .040/2.8 hybrid connectors do not require agency approval.

## 5. TOOLING

Tooling part numbers and instructional material packaged with the tooling are given in Figure 13.

### 5.1. Robotic Equipment

For automatic machine placement, a pc board support must be used to prevent bowing of the pc board during the placement of hybrid cap assemblies on the board. It should have flat surfaces with holes or a channel large enough and deep enough to receive any protruding components. The robotic equipment must have a true position accuracy tolerance to properly locate the hybrid cap assembly. This includes gripper and fixture tolerances as well as equipment repeatability.

### 5.2. Screwdriver

A standard insulated screwdriver having a 3.2 [.125] maximum flat blade must be used to disengage the lock plate of the hybrid plug assembly.

### 5.3. Extraction Tool

The extraction tool is designed to remove a contact from the hybrid plug assembly by releasing the housing lance from the locking surface of the contact without overstressing the contact.

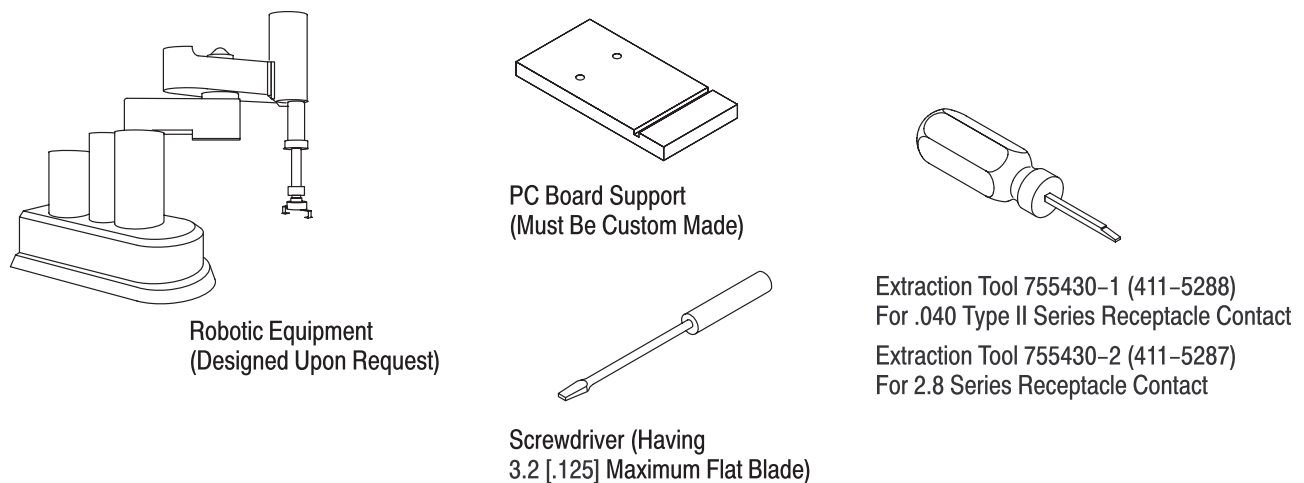
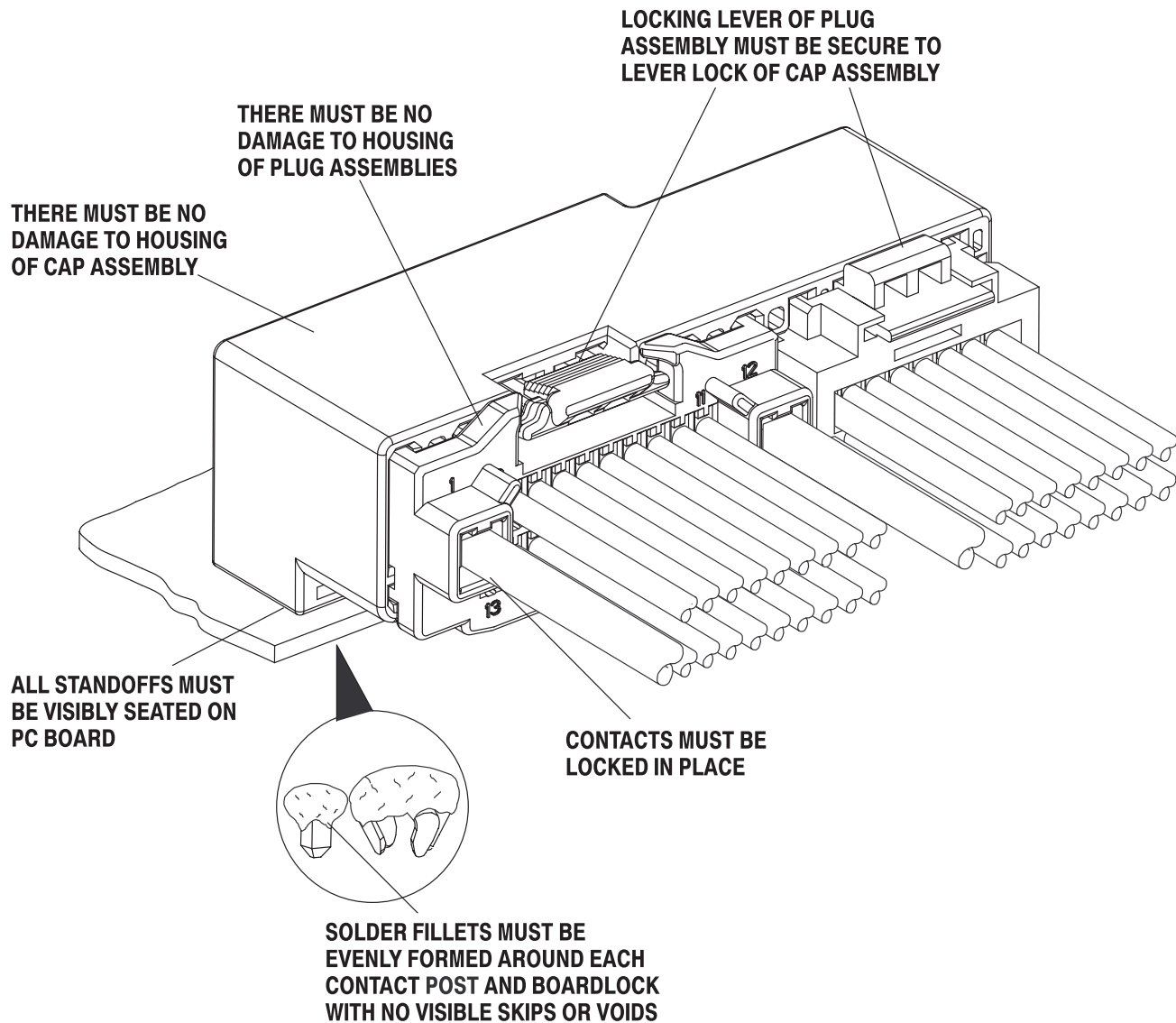


Figure 13

## 6. VISUAL AID

The illustration below shows a typical application of the MULTILOCK .040/2.8 hybrid connectors. This illustration should be used by production personnel to ensure a correctly applied product. Applications 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.



**FIGURE 14. VISUAL AID**