



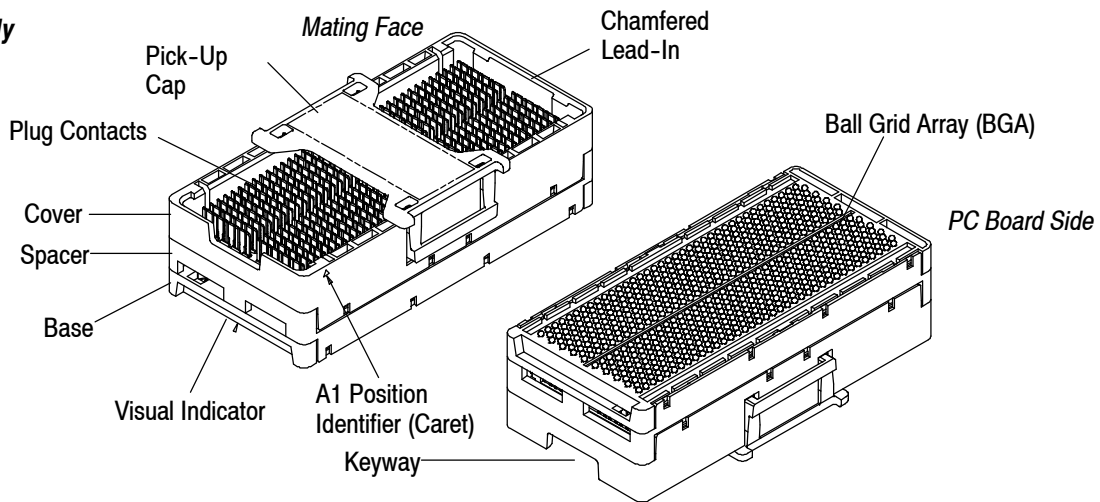
All numerical values are in metric units [with U.S. customary units in brackets]. Dimensions are in millimeters. Unless otherwise specified, dimensions have a tolerance of ± 0.13 and angles have a tolerance of $\pm 2^\circ$. Figures and illustrations are for identification only and are not drawn to scale.

1. INTRODUCTION

This specification covers the requirements for application of STEP-Z PC Board Connectors used to provide high bandwidth with low crosstalk for high-speed differential and single-ended electrical connection between two parallel pc boards. The connectors are available in a plug assembly and receptacle assembly.

When corresponding with TE Connectivity 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.

Plug Assembly



Receptacle Assembly

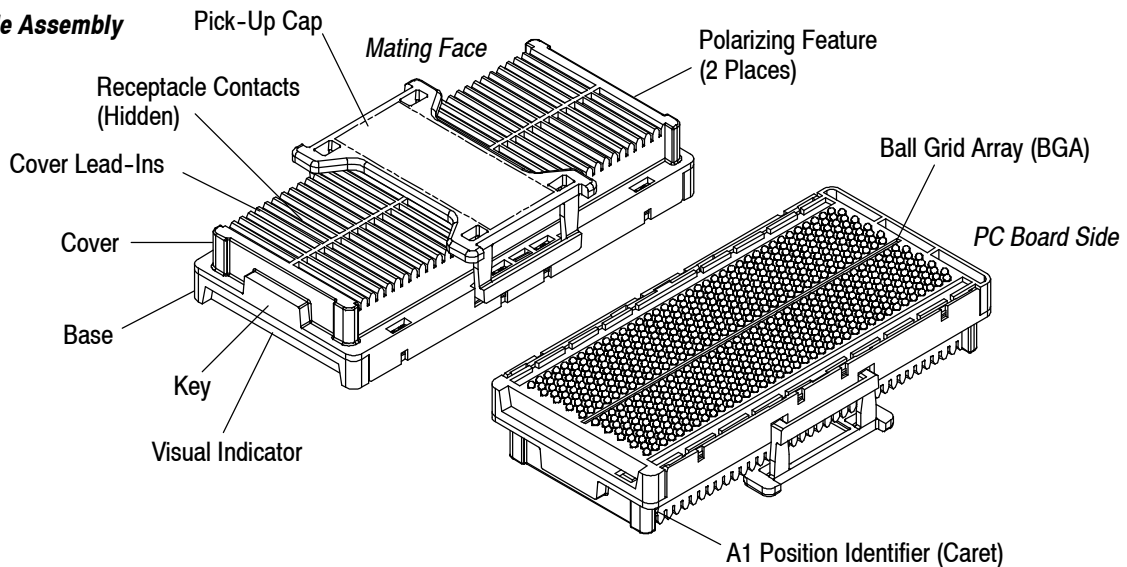


Figure 1

The connectors are available with 104, 200, and 296 positions (size). See Figure 2. The plugs are available with a nominal height of 10, 12, 13, 15, 20, and 25 mm, and the receptacle is available with a nominal height of 5, 11, and 15 mm. These connectors use dedicated ground contacts to provide impedance matching and low cross-talk. This frees the signal contacts so that they can be configured to the application requirements while limiting any impact on performance.



Not all connectors are tooled. Call PRODUCT INFORMATION at the number at the bottom of page 1 for availability.

Each connector consists of a cover, spacer (except plug assemblies with a nominal height of 10, 12, and 13 mm, and receptacle assembly with a nominal height of 5 mm), and base. The cover is on the mating face of the connector and contains contacts; and the base is on the pc board side of the connector and contains solder balls. The connectors use a ball grid array (BGA) for solder attachment to the pc board.

The connectors are supplied in anti-static plastic packaging trays. The pick-up cap, attached to the connector, is used for placement by automated equipment with vacuum pick-up; however, the cap is not used for placement by hand or when using mechanical grippers that grip the outside of the connector or straddle the gull wings of the cap.

Position A1 is identified with a caret located at the same end of the connector having the visual indicators. To assure proper mating orientation, the connectors are keyed at the Position A1 end. For initial alignment during mating, the chamfered lead-in around the perimeter of the plug assembly captures and guides the cover of the receptacle assembly. This lead-in also allows for blind mating.

1.1. Specifics

CONNECTOR SPECIFIC	CONNECTOR SIZE		
	104	200	296
Connector Length	22.55	38.15	53.75
Contact Length	15.60	31.20	46.80
Quantity of: Signal Contacts	104	200	296
Ground Contacts	130	250	370
Shielded Differential Pairs	32	64	96
Cascaded Differential Pairs	48	96	144

Figure 2

1.2. Electrical Performance

These connectors are designed with close edge coupling to dedicated ground contacts on each side of the signal contacts, matching the impedance between contact pairs. Typical electrical performance is given in Figure 3.

TEST	1:1 DIFFERENTIAL PAIR	1:1 SINGLE-ENDED CONNECTION
Impedance at 100 ps (10% to 90%)	85-110 Ohms	50-60 Ohms
Bandwidth (3 dB)	5+ GHz	5 GHz
Multi-Active NEXT at 100 ps (10% to 90%)	< 3%	< 3%

Figure 3

2. REFERENCE MATERIAL

2.1. Revision Summary

Revisions to this application specification include:

- Updated document to corporate requirements
- Added new Paragraph 3.2.B and renumbered
- Added new text to callout in Figure 5

2.2. Customer Assistance

Reference Product Base Part Numbers 1761614 and 1761615 and Product Codes K179 and K180 are representative of STEP-Z PC Board 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 TE Representative 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 Customer Drawing takes precedence.

2.4. Specifications

Product Specification 108-2143 provides product performance and test information.

3. REQUIREMENTS

3.1. Safety

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

3.2. PC Board

NOTE

The design of the pc board affects connector reliability and performance.



A. Solder Pads

The pc board solder pads must be solderable in accordance with Electronic Industries Alliance (EIA) 364-52. The pad diameter shall be 0.55 ± 0.05 mm with a true position of diameter of 0.10 mm regardless of feature size (RFS). The pad shall be copper defined with organic solderability preservative (OSP) or hot air solder leveling (HASL).

When designing pc boards for multiple connector applications, the solder pad patterns shall be within 0.10 mm diameter true position relative to each other.

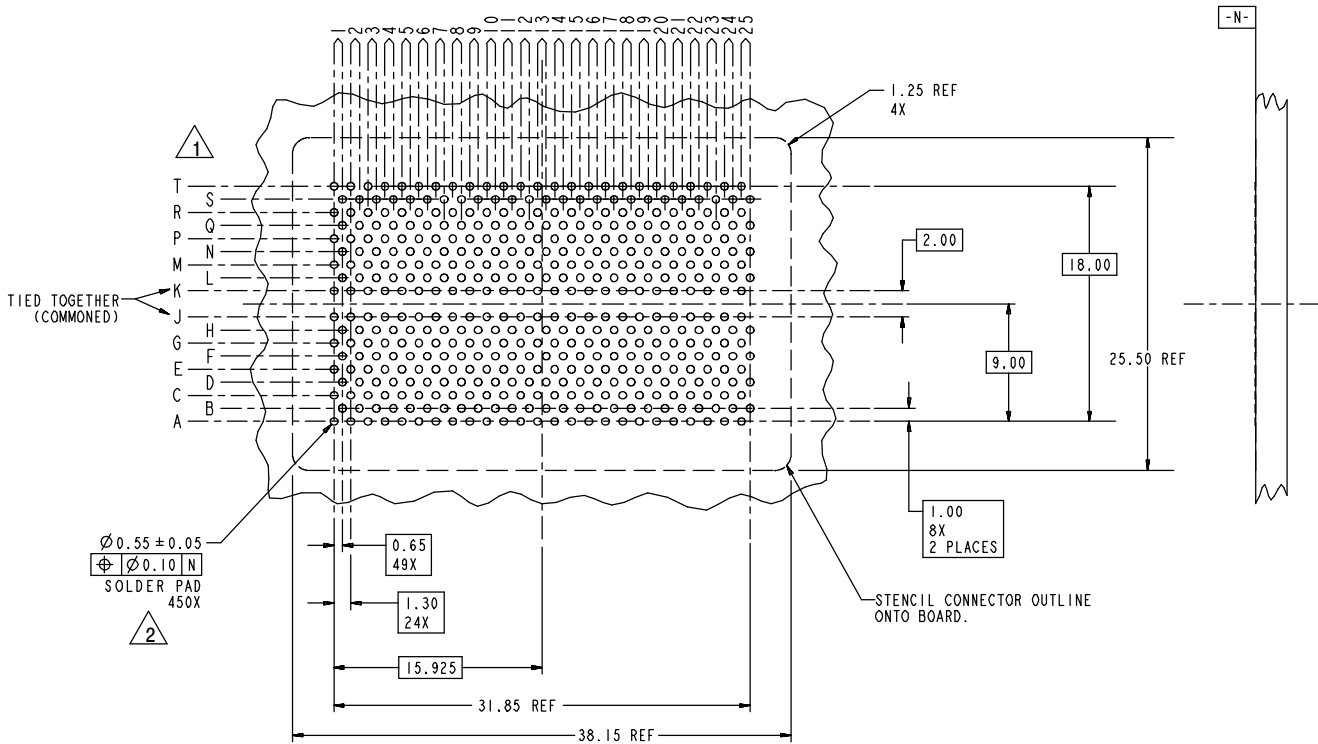
B. Vias

The pc board vias should not be directly under the ball grid array solder pads. The via pad diameter shall be 0.55-0.60 mm.

On the component side, they shall be fully covered with a solder mask. To assist, the mask may be truncated along the interconnect trace.

C. Layout

The pc board layout must be designed using the dimensions provided on the customer drawing for the specific connector. A reference *sample* of the recommended pc board layout is shown in Figure 4.

Sample PC Board Layout


- 1 Rows A, C, E, G, J, K, M, P, R, and T contain single beam contacts. These contacts are typically used as ground pins.
- 2 The specified positional tolerance defines the pad-to-pad location within the land pattern. Positional tolerance of pc board datums (or land pattern-to-fudicial marks) are customer determined.

Figure 4

3.3. Wiring Pattern

An example pattern of both 100-ohm differential and 50-ohm single-ended application and possible associated pad and trace routings required to distribute the signals is shown in Figure 5.

NOTE

Since these examples show only half of the 104 positions, they should be used for reference only.



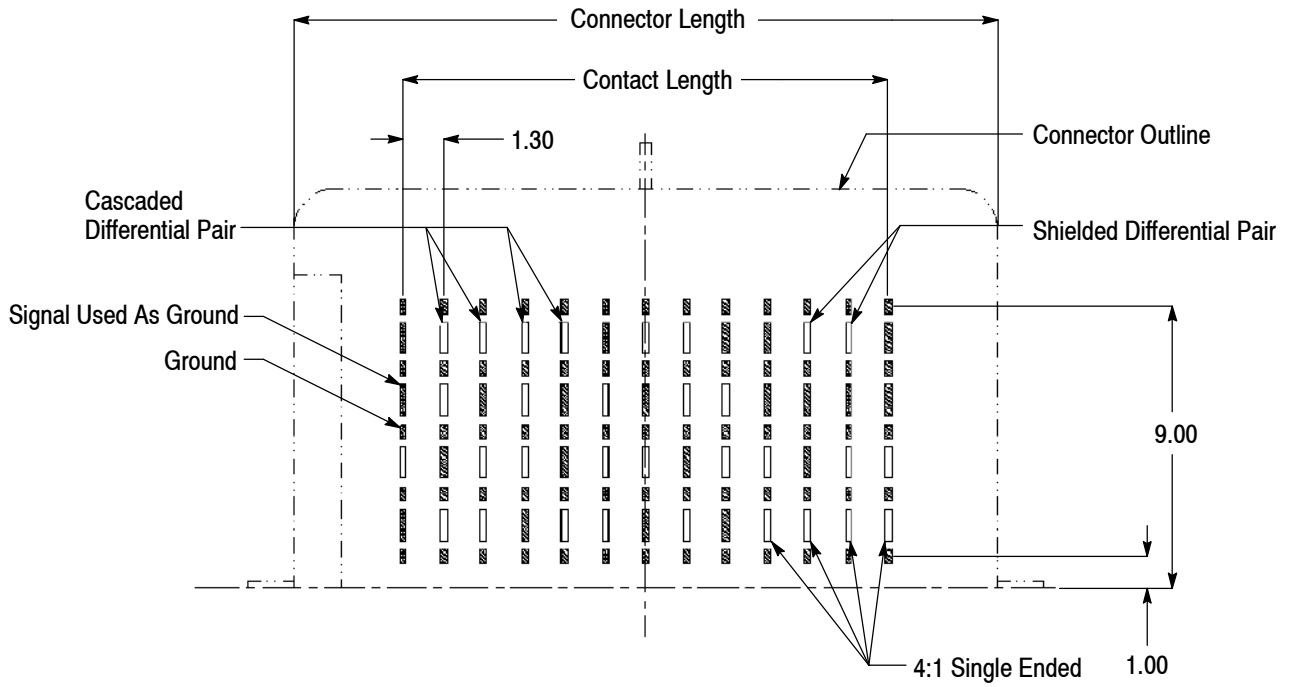
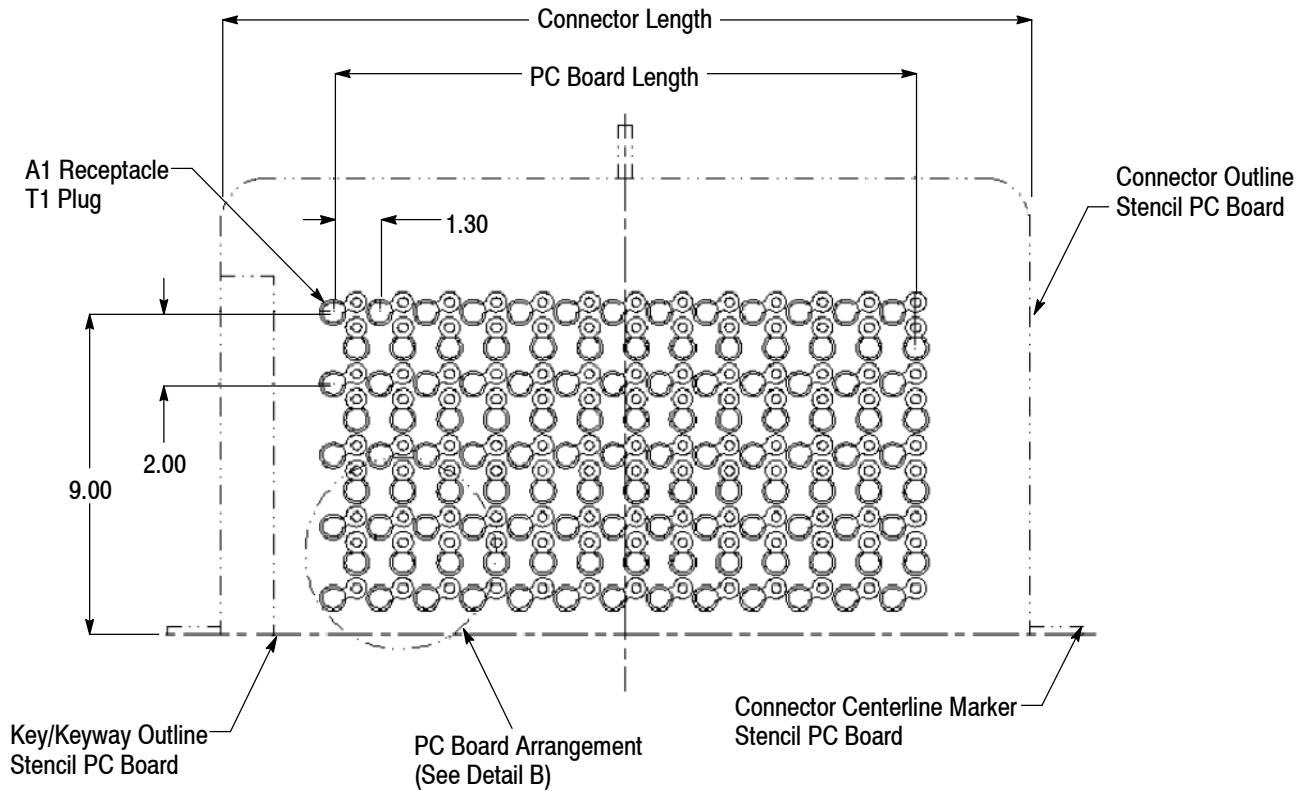
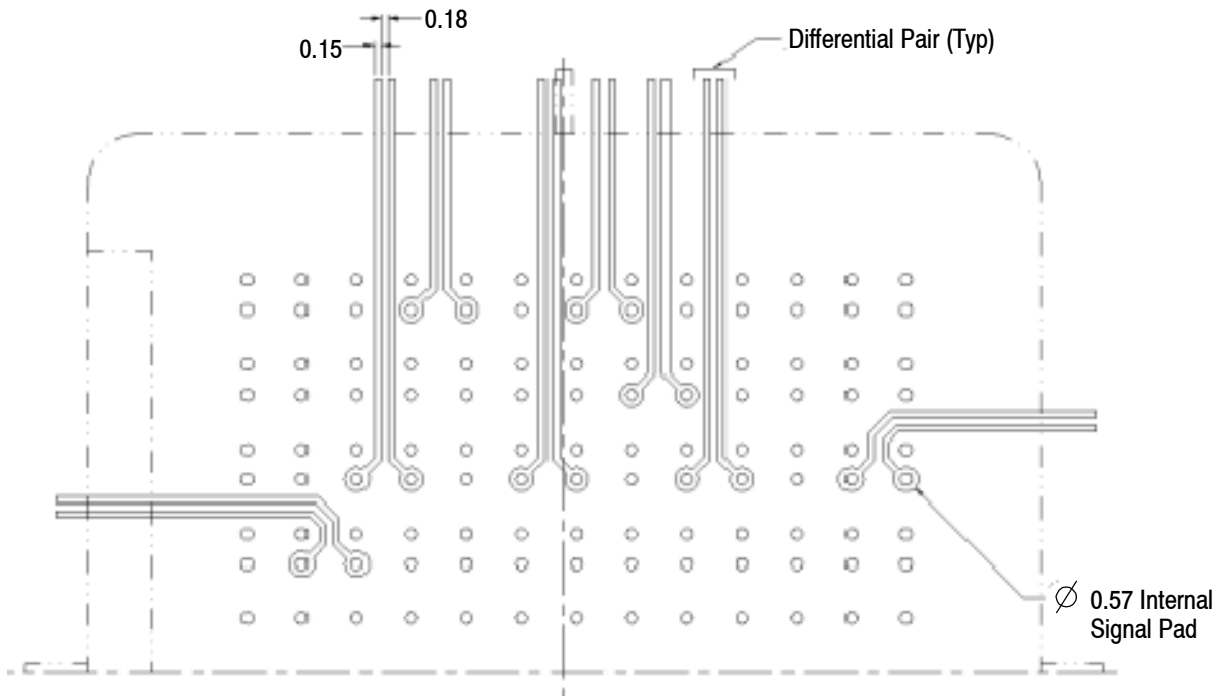
Example of Contact Interface

Example of Pad Layout


Figure 5 (Cont'd)

Example of Signal Layer 1



Example of Signal Layer 2

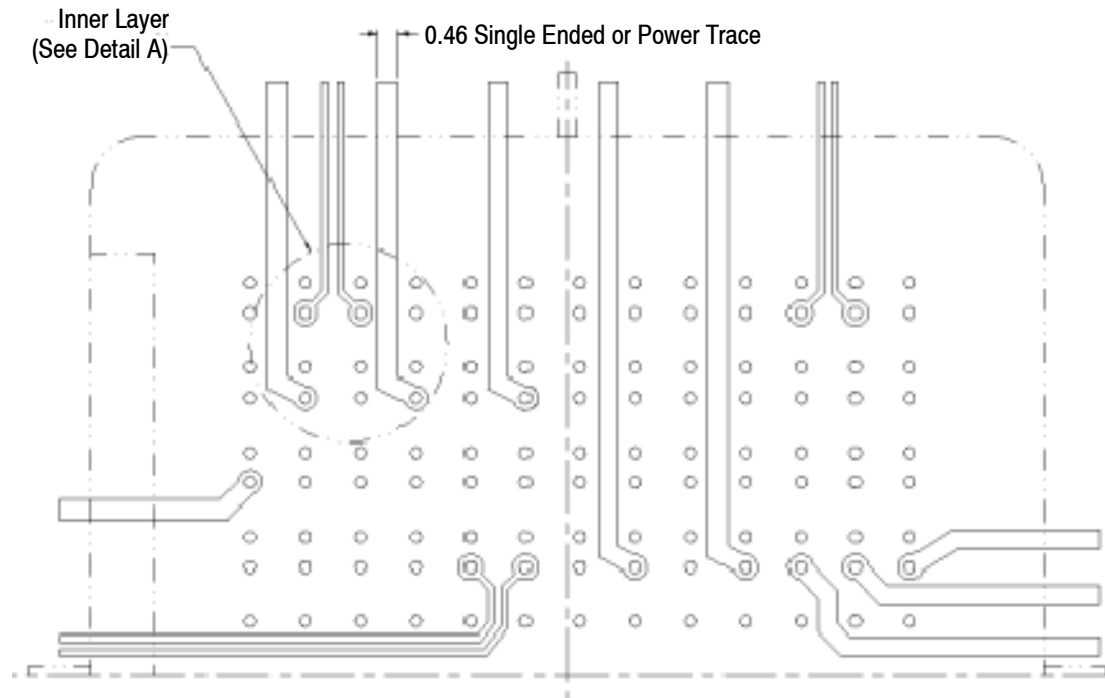


Figure 5 (Cont'd)

Example of Ground Layer

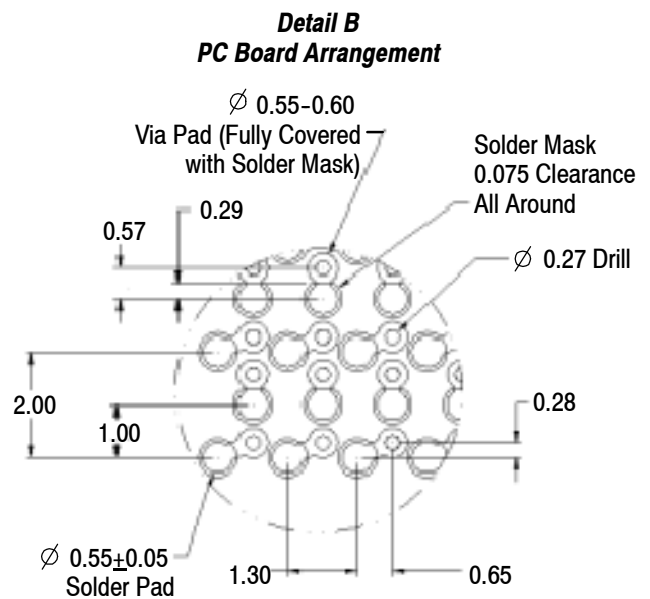
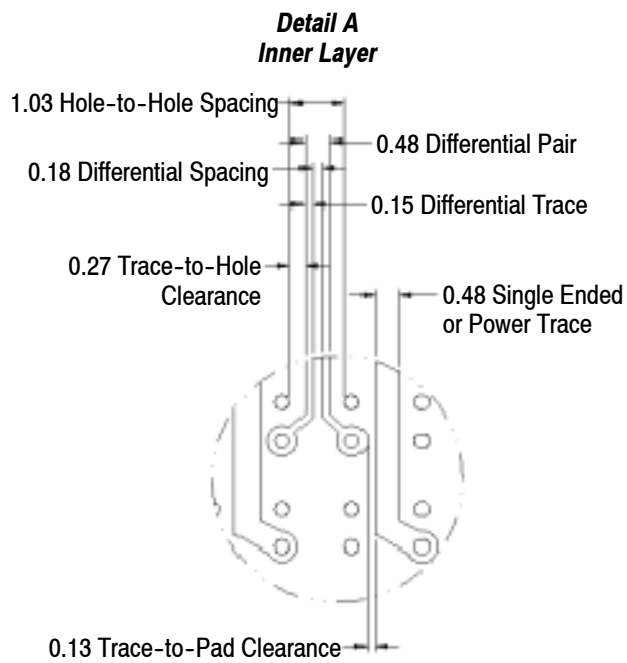
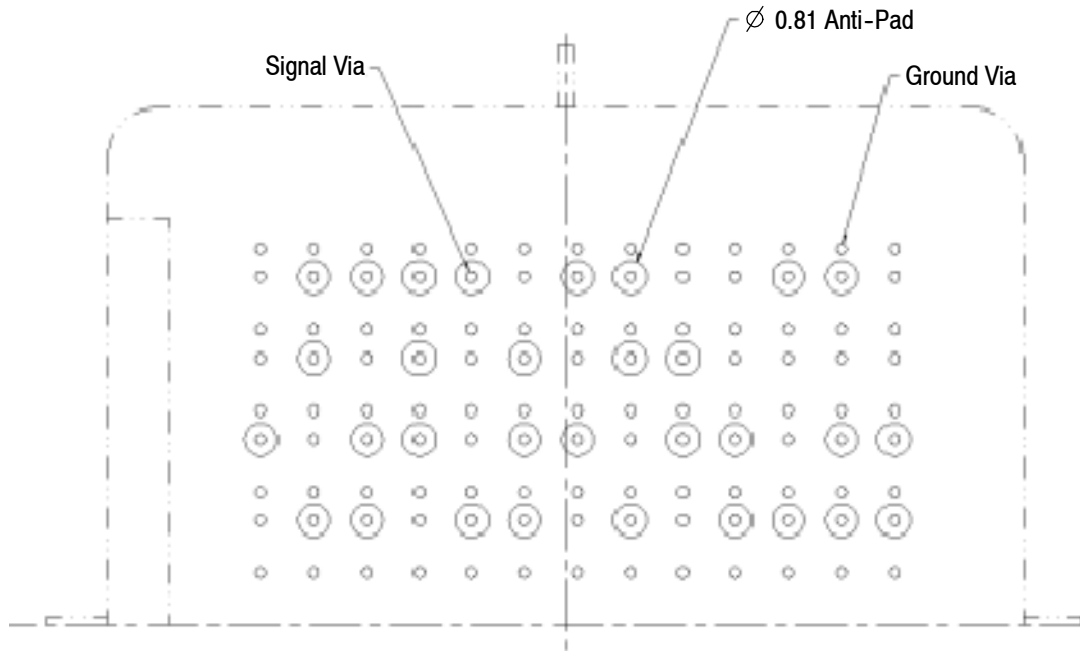


Figure 5 (End)

3.4. Connector Spacing

As with any application involving the use of multiple connectors to mate two pc boards, considerable thought must be given to maintaining a uniform distance between connectors on each pc board. A true position requirement of 0.20 mm diameter (centered on the connector's nominal position) must be maintained for connector-to-connector spacing on a pc board in order to reduce axial load stresses on the connectors and their solder joints. If more than two pairs of mating connectors are necessary to meet design requirements, consult with TE product engineering by contacting the Product Information number located at the bottom of page 1.

A keep-out area around the connector perimeter of 3.0 mm is generally recommended for clearance of equipment used for possible rework; however, use the equipment manufacturer's recommended clearance specifications.

3.5. Standoffs

The connectors require the use of commercially-available mechanical standoffs (standoffs are not included with the connectors). Standoffs provide load support and intermate retention for the connectors. Requirements for the standoff are provided in Figure 6.

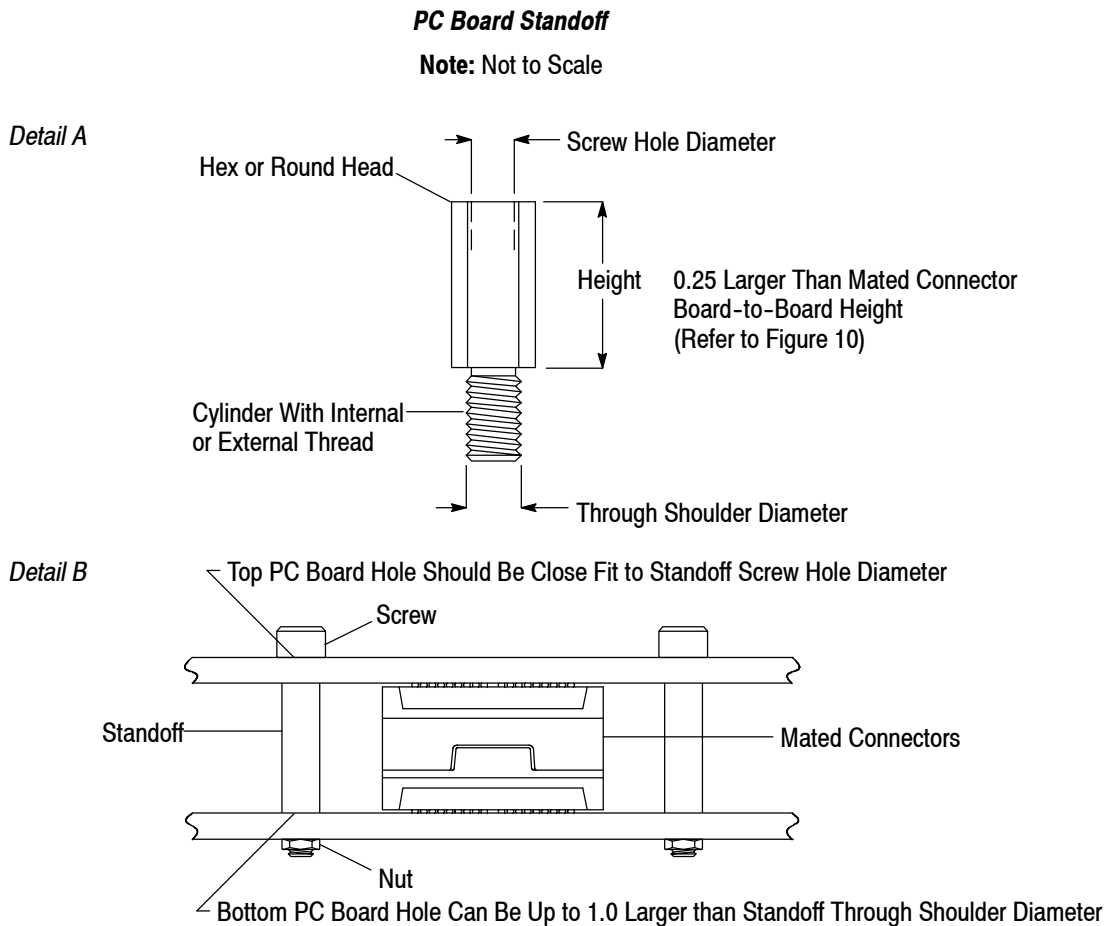


Figure 6

3.6. Connector Placement

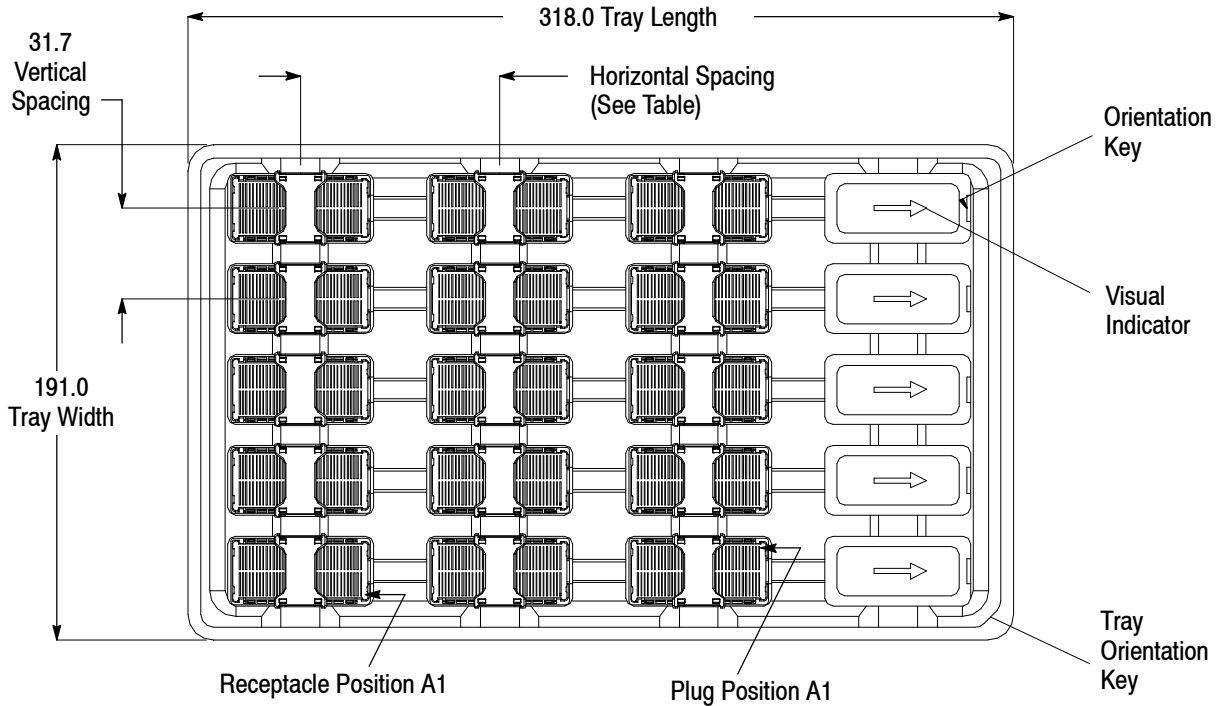
The connector packaging trays can be used individually or stacked. Prior to stacking the trays, shipping covers (not shown) must be removed.

The trays have visual indicators and orientation keys to assure tray and connector orientation. Orientation, dimensions, connector spacing in the tray, and connector weight are shown in Figure 7.

The connector must be placed so that the solder balls are on top of or slightly pushed into the solder paste. The connector shall not be dragged into place since this will track solder paste that may cause bridging and result in an electrical short.

Packaging (Soft) Tray

Note: Plugs and receptacles are not packaged in the same tray—this is a composite illustration.



Packaging (Hard) Tray

Note: Plugs and receptacles are not packaged in the same tray—this is a composite illustration.

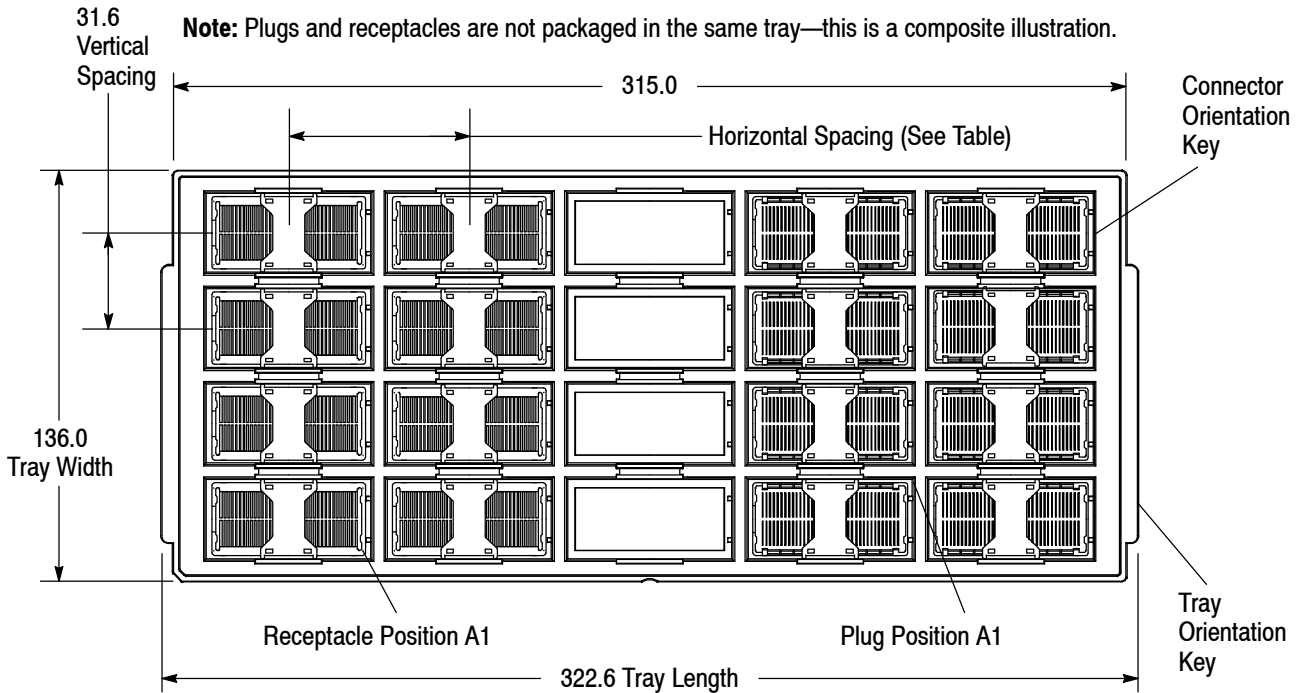


Figure 7 (cont'd)

CONNECTOR					HORIZONTAL SPACING IN TRAY					
TYPE	HEIGHT	WEIGHT (Grams)▪			SOFT CLEAR TRY CONNECTOR SIZE			HARD JEDEC STYLE TRAY● CONNECTOR SIZE		
		CONNECTOR SIZE			104	200	296	104	200	296
		104	200	296						
Plug	10	6.7	11.3	15.6	44.35 (30 Parts Per Tray)	59.84 (25 Parts Per Tray)	74.93 (20 Parts Per Tray)	28.40 (40 Parts Per Tray)	43.40 (28 Parts Per Tray)	59.60 (20 Parts Per Tray)
	12	8.6	14.6	20.3						
	13	9.5	16.2	22.8						
	15	10.0	17.1	24.0						
	20	12.3	21.4	29.8						
	25	14.2	24.7	34.5						
Recpt	5	6.4	10.7	15.0	44.35 (30 Parts Per Tray)	59.84 (25 Parts Per Tray)	74.93 (20 Parts Per Tray)	28.40 (40 Parts Per Tray)	43.40 (28 Parts Per Tray)	59.60 (20 Parts Per Tray)
	11	9.6	16.6	23.1						
	15	11.8	20.5	28.8						

▪Weight estimated Based on CAD Models.

●Hard Tray Color: Black (Tin/Lead Parts), Blue (Lead Free Parts)

Figure 7 (end)

3.7. Solder Process

A. Solder Paste

A no-clean solder paste is recommended.

B. Solder Volume

Solder volume must be approximately 0.044 mm³ per pad.

C. Solder Mask

The solder mask opening diameter must be greater than the pc board pad diameter and be registered properly so that a minimum clearance of 0.075 mm is around the pad. The pc board vias should not be directly under the solder pads of the ball grid array. The component side of the pc board shall be fully covered with solder mask. The mask may be truncated along the interconnect trace.

D. Stencil

A stencil thickness range of 0.152 mm through 0.178 mm is recommended. A round aperture diameter of 0.56 mm for 0.178 mm thick stencils and round aperture diameter of 0.61 mm for 0.152 mm thick stencils is recommended.

E. Reflow

1. Reflow soldering process profiles should follow the recommendations of the solder paste supplier, with maximum temperatures for the connectors as stated below.
2. To obtain temperature equalization at all ball grid array locations, the assembly should be soaked at a temperature above 145°C [293°F] between 105 and 125 seconds prior to reflow.
3. The reflow time at temperatures above 183°C [361°F] for *tin-lead* solder application and above 218°C [424°F] for *lead-free* solder application should be from 60 to 90 seconds for the perimeter of the solder ball grid array and at least 30 seconds for the center of the solder ball grid array.
4. Recommended peak reflow temperature should be between 210°C and 220°C [410°F and 428°F] for *tin-lead* solder application and between 230°C and 240°C [446°F and 464°F] for *lead-free* solder application for no more than 10 seconds.
5. The maximum temperature on the connector should not exceed 245°C for *tin-lead* solder application, and 260°C for *lead-free* application, and it should be for a duration of not more than 10 seconds.
6. The total cumulative time to ramp up, soak, and reflow shall be limited to 330 seconds.
7. A nitrogen environment of 4,000 ppm O₂ or lower can improve solderability; however, is not required.

8. The ramp rate should be less than 2.5°C [36.5°F] per second.

NOTE

Recommended temperatures are for the top surface of the pc board within or near the connector solder ball grid array.



9. For two-pass reflow, the connector weight, top reflow temperature, pc board thickness and size, and the amount of layers will affect connector retention to the pc board during inverted reflow. If possible, the lighter mating connector (refer to Figure 7) on the inverted reflow side should be used. In any case, the connector applicability for inverted reflow must be verified through process verification testing.

F. Solder Profile

A sample solder profile is shown in Figure 8.

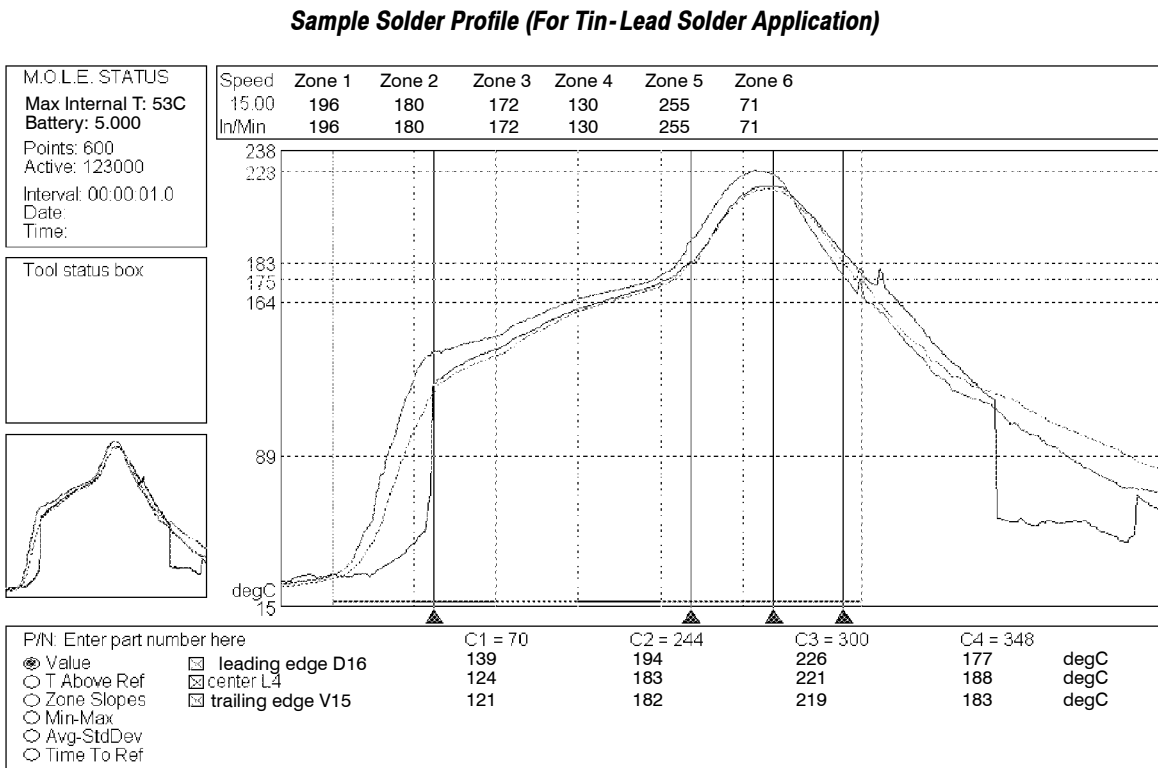


Figure 8

G. Cleaning

After reflow, the assembly can be washed with an appropriate cleaner to remove any residue or contaminants.

3.8. Assembly Inspection

The connectors must be inspected visually for damage and cleanliness. Visual inspection of the solder joint of the ball grid array is not feasible. Solder joints can be inspected using X-ray techniques. A solder pad that is shaped different than the solder ball might assist in viewing the solder plane. Electrical testing may be performed; however, caution must be taken to avoid damage to the connector contacts during the electrical testing.

3.9. Mating and Unmating

A. Mating

The pick-up cap must be removed from both connectors before mating.

These connectors can be mated straight; however, large connectors (for example with 296 positions) should be mated by rolling the connectors together as shown in Figure 9.

A connector can start mating from either end. Align the connectors and when the keys start to enter the keyways, push one end of the connector into the mating connector. Push the other end of the connector until the flange of the receptacle cover bottoms on the face of the plug.

Because of the asymmetric keying, reverse mating is impossible (the key end of the receptacle cannot be inserted into the non-keyway end of the plug). Both connectors have a lead-in around the perimeter that will allow blind mating.

It is NOT permissible to mate connectors by rolling them from the sides. See Figure 9.

B. Unmating

These connectors can be unmated by pulling them straight apart or by “rocking” the connectors from side-to-side while pulling them apart. Refer to Figure 9.

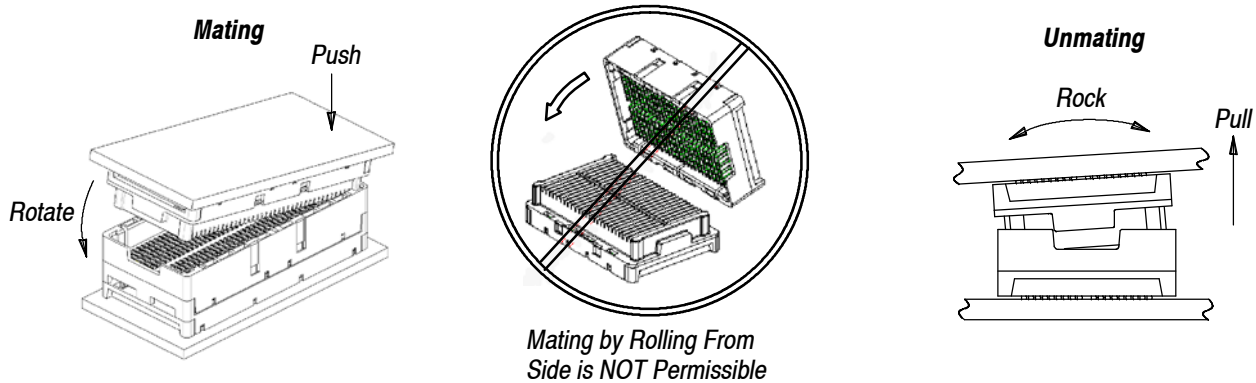
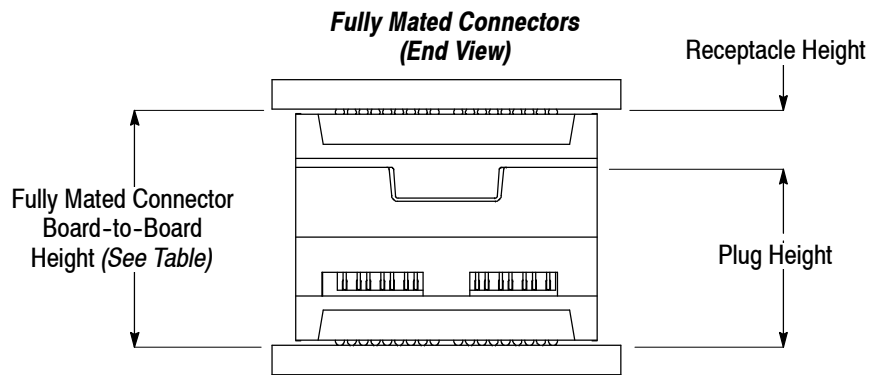


Figure 9

3.10. Fully Mated Connector Board-to-Board Height

The mated connector board-to-board height is affected by the pc board pad size, pad plating, solder paste, and solder profile. The fully mated connector board-to-board height is given in Figure 10.



FULLY MATED CONNECTOR BOARD-TO-BOARD HEIGHT						
PLUG NOMINAL HEIGHT						RECEPTACLE NOMINAL HEIGHT
10	12	13	15	20	25	
14.95	16.95	17.95	19.95	24.95	29.95	5
20.95	22.95	23.95	25.95	30.95	35.95	11
24.95	26.95	27.95	29.95	34.95	39.95	15

Figure 10

3.11. Mating Sequence

The mating sequence as related to the distance between the surfaces of pc boards for connectors having a mated connector board-to-board nominal height of 20 mm (plug nominal height of 15 mm mated with a receptacle nominal height of 5 mm) is shown in Figure 11.

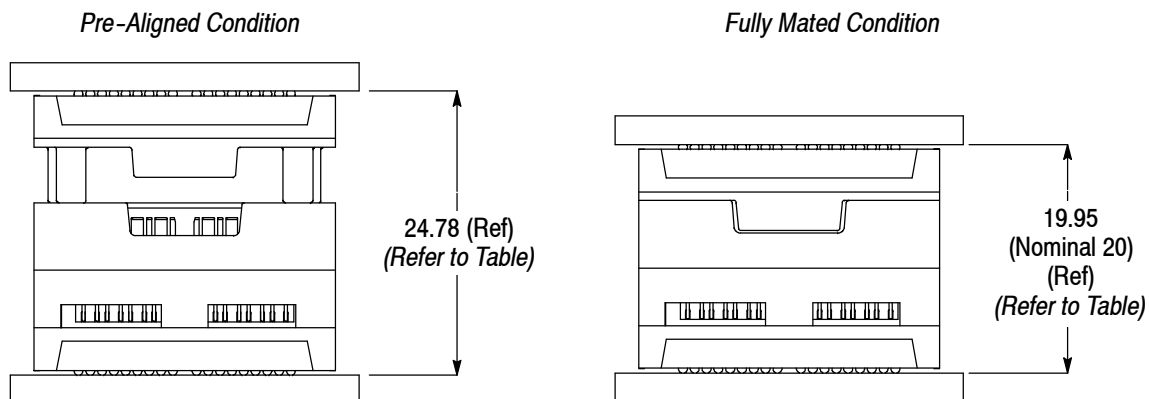
The mating sequence board-to-board heights of the other mated connectors is determined as follows (example is given in parenthesis):

plug nominal height + receptacle nominal height = the mated connector board-to-board nominal height
(example: 20 mm + 15 mm = 35 mm)

the mated connector board-to-board nominal height - 20 mm (this value would be used as a constant; it is the mated connector board-to-board nominal height used in Figure 11) = the difference
(example: 35 mm - 20 mm = 15 mm)

the difference + one of the mating sequence condition values given in Figure 11 = the mating sequence board-to-board height for that mating sequence condition
(example: 15 mm + 24.78 mm is pre-aligned = 39.78 mm)
(example: 15 mm + 19.95 mm is fully mated = 34.95 mm — this is the same value as given in Figure 10)

Mating Sequence Board-to-Board Height



MATING SEQUENCE			WIPE LENGTH
CONDITION	DESCRIPTION	BOARD-TO-BOARD HEIGHT FOR 20 ■	
Pre-Aligned	Connectors Start to Mate	24.78	—
Key and Keyway Aligned	Key and Keyway Start to Engage	24.33	—
Fully Aligned	Plug Contacts Start Into Receptacle Cavities	23.45	—
Contacts Pre-Aligned	Front of Plug Contacts Past Cover Slot	22.75	—
Contacts Aligned	Plug Contacts Starts Into Receptacle Cover Lead-Ins	22.46	—
Contacts Engaged	Plug and Receptacle Contacts Make Contact	21.51	0.0
Fully Mated	Plug Cover Bottoms on Receptacle	19.95	1.56

■ Mated connector board-to-board nominal height. Refer to Paragraph 3.11 for heights of other mated connectors.

Figure 11

3.12. Rework

Prevention of defects is preferred to rework. Rework can be avoided through good process control such as proper equipment setup and maintenance, in-process inspection, SPC use, and adequate operator training. The following rework procedure was developed using an SRT Summit 1100 rework station. A similar procedure should be followed if using other rework equipment and should only need to be modified according to the equipment manufacturer's recommendations.

A. Development of Thermal Process

1. A thermocouple should be attached to the underside of the connector or next to the outer row of solder balls. The underside of the connector is preferred.
2. The connector should be heated using the reflow nozzle by ramping the temperature from 25°C to 150°C [77°F to 302°F] with a maximum slope of 3° per second.
3. The connector should be soaked at a temperature from 130°C to 160°C [266°F to 320°F] for a maximum of two minutes.
4. Depending upon thermocouple placement, reflow for one to two minutes with a peak temperature of 210°C to 225°C [410°F to 437°F] for *tin-lead* solder application and 230°C to 240°C [446°F to 464°F] for *lead-free* solder application should be used, ensuring that the center of the solder ball grid array reflows.
5. The connector should be cooled to 50°C [122°F] with a maximum ramp of 3° per second.

B. Connector Removal

1. A rework clip must be assembled to the connector. A recommended rework clip is shown in Figure 12.

Note: Not to Scale

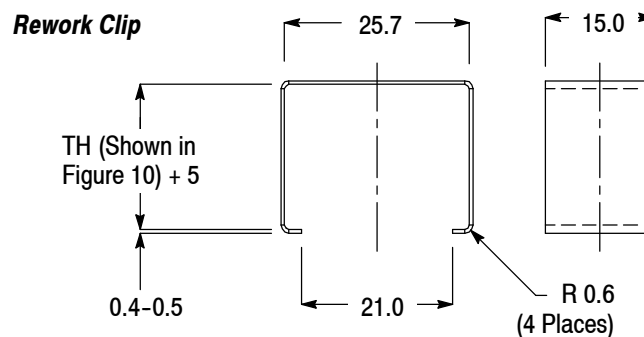


Figure 12

2. Reflow the solder using the thermal process described. A few seconds after the solder has reflowed, the vacuum pick-up will automatically move the connector to the proper location for removal. The removed connector must not be re-used and should be discarded after the solder has solidified. Since the majority of the solder remains on the pc board, the residual solder must be cleaned prior to installation of new connector.

C. Cleaning and Preparing the PC Board

Flux should be applied over the pc board pads and residual solder. This helps to reactivate the solder and clean the pads. A solder scavenging system that uses a hot gas non-contact nozzle to remove the solder is recommended. The nozzle should be programmed to a scavenging height of approximately 0.2 mm with a pre-programmed path that follows the pc board pad layout and limits excess heating to other areas of the pc board. Other hand de-soldering methods can be used; however, extra care must be taken to limit localized heating which could damage the pc board. After removal of the residual solder, isopropyl alcohol can be used to clean any excess flux or debris.

D. Connector Replacement

1. After cleaning, it is recommended to re-paste the pads using the solder paste, volume, mask and stencil defined in Paragraph 3.7.
2. To assist in aligning the connector to the pads, a mark should be placed at the center of the long side of the connector. Mark the pc board at the center of the pad location. These marks should assist in aligning the center of the connector with the center of the pad layout.
3. Assemble the rework clip (used in Paragraph 3.6.B) to the replacement connector.
4. Load and secure the connector to the vacuum pick-up system.
5. Align the mark on the connector with the mark on the pc board. Place the connector onto the pc board.

NOTE

The SRT Summit 110 rework station uses a split prism vision system to allow for simultaneous viewing of the bottom of the connector and top of the pc board.

6. Reflow the solder using the established auto-profile parameters. Remove the rework clip.
7. Re-inspect and re-test the connector.

4. QUALIFICATION

No qualifying support for STEP-Z PC Board Connectors was defined at the time of publication of this document.

5. TOOLING

The connectors can be placed on the pc board manually; however, it is recommended that the connectors be placed on the pc board using automated equipment. Fixturing may be used to assure true position accuracy to properly locate the connectors—the fixturing must reference the datum surfaces detailed on the customer drawing to ensure reliable placement.

6. VISUAL AID

Figure 13 shows a typical application of STEP-Z PC Board 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.

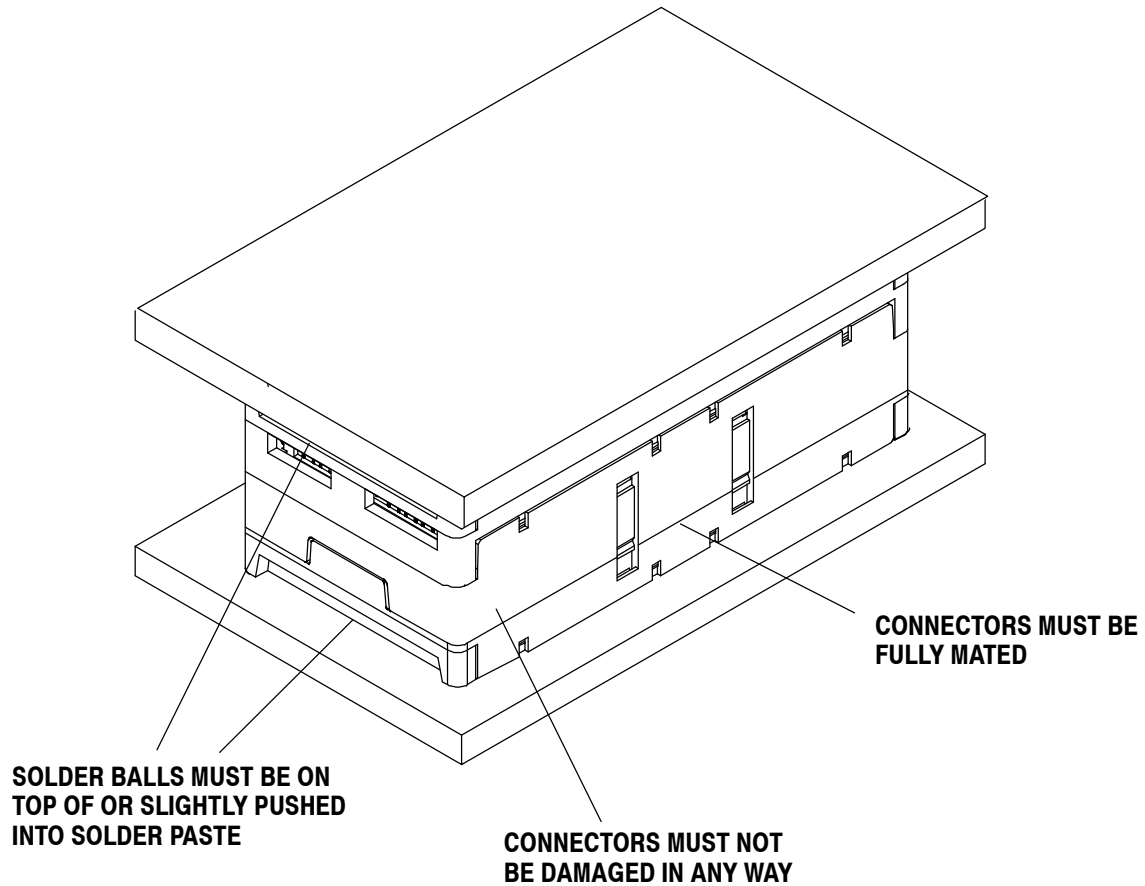


FIGURE 13. VISUAL AID