

## 1mm Flexible Printed Circuit (FPC) 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  $\pm 0.13$  [ $\pm 0.005$ ] 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 the AMP\* 1mm FPC (flexible printed circuit) horizontal and vertical connectors. These connectors are designed for surface mount technology (SMT) to printed circuit (pc) boards and receive FPCs with zero insertion force (ZIF) action. The connectors have contacts with centerline spacings of 1.00 [.0394] and are available in sizes 4 through 30 contact positions. The horizontal connectors feature solder hold-downs that help to stabilize the connector before and after soldering. The top entry horizontal connector is for FPCs with exposed traces facing upward and the bottom entry is for FPCs with exposed traces facing downward. The connectors may be machine placed on pc boards with robotic equipment.

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.

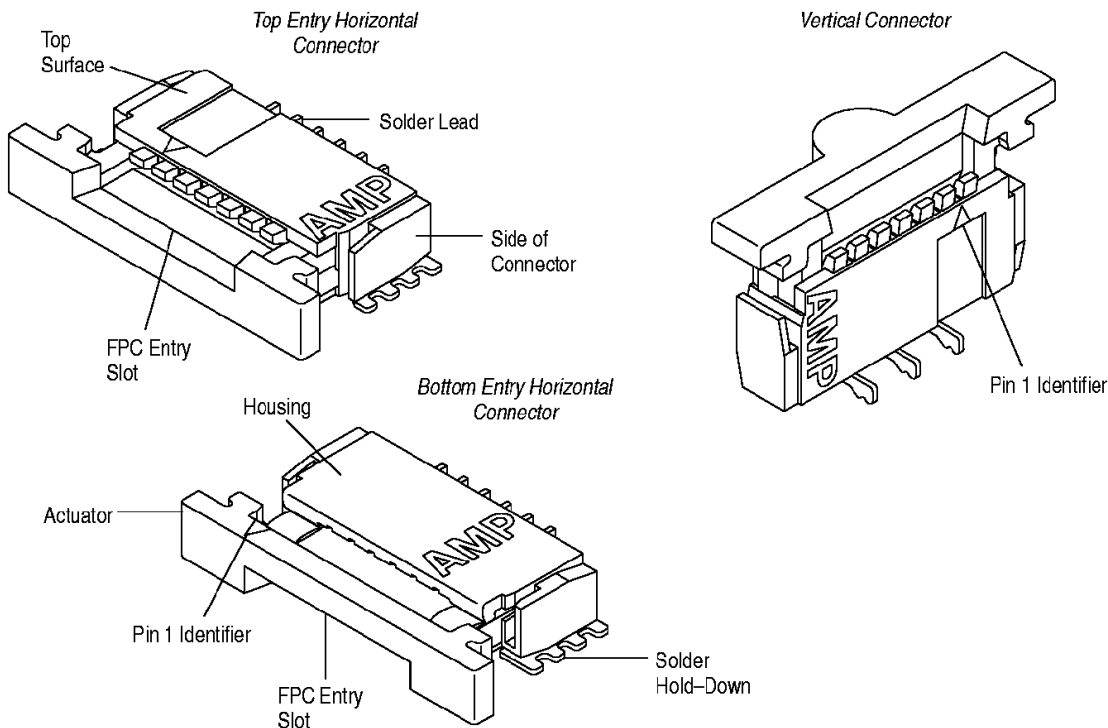


Figure 1

## 2. REFERENCE MATERIAL

### 2.1. Revision Summary

Revisions to this application specification per D20060621024041\_152535 include:

- Added Part Numbers 84953, 1735119 and 1735367 in Paragraph 2.2
- Added Product Specification 108-51074 in Paragraph 2.5
- Added an exception for lead-free process in Paragraph 3.7
- Added Figure 14 and updated subsequent figures.

### 2.2. Customer Assistance

Product Part Numbers 487951, 84953, 1735119 and 1735367 and Product Code 1136 are representative of 1mm FPC 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 the Tooling Assistance Center 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, call product information at the number at the bottom of page 1.

### 2.4. Manuals

Manual 402-40 is available upon request and 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 108-1393, 108-1393-1 and 108-51074 provide product performance requirements and test information. Workmanship Specifications 101-21 and J-STD-001 provide solder joint requirements and Test Specification 109-11 provides requirements and evaluation methods.

### 2.6. Instructional Material

Instruction Sheet 408-6927 provides recommendations for designing a pc board support fixture.

## 3. REQUIREMENTS

### 3.1. Storage

#### A. Ultraviolet Light

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

#### B. 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 them.

#### C. Chemical Exposure

Do not store connectors near any chemicals listed below, as they may cause stress corrosion cracking in the connectors.

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

D. Reeled Connectors

Connectors are packaged and shipped in boxed reels of embossed tape packaging that conforms to Electronic Industries Association (EIA) 481 Packaging Standards. Each reel begins with a leader consisting of an empty strip of carrier which may or may not include cover tape. The trailing end consists of empty carrier strip with cover tape that will unwind freely when the reel empties. There are four tape widths to accommodate the full range of connector positions. See Figure 2.

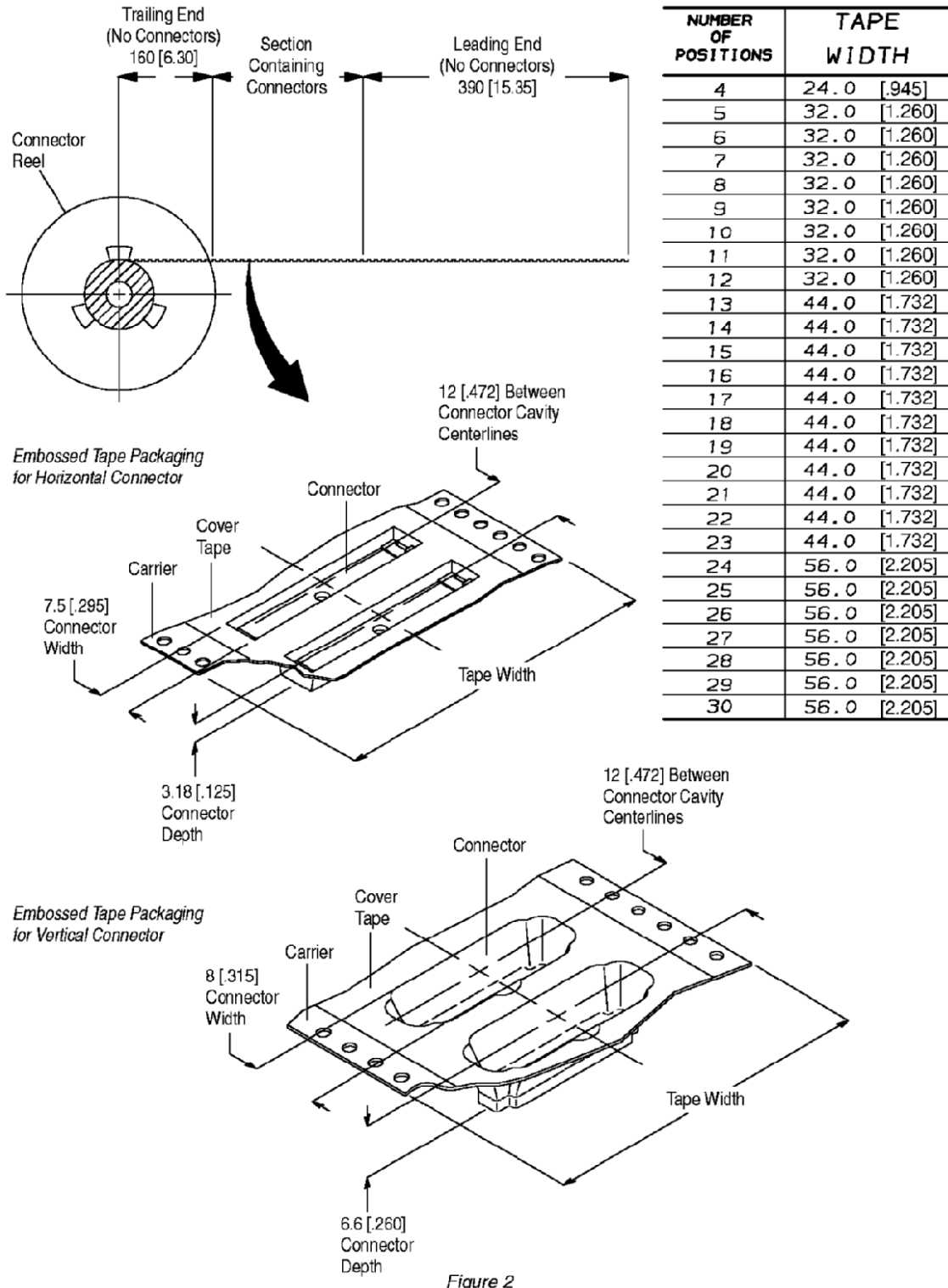


Figure 2

### 3.2. PC Board

#### A. Material

The pc board material shall be glass epoxy (FR-4 or G-10). Call the Product Information at the number at the bottom of page 1 for suitability of other materials.

#### B. Tolerance

Maximum allowable bow of the pc board shall be 0.10 [.004] over the length of the connector.

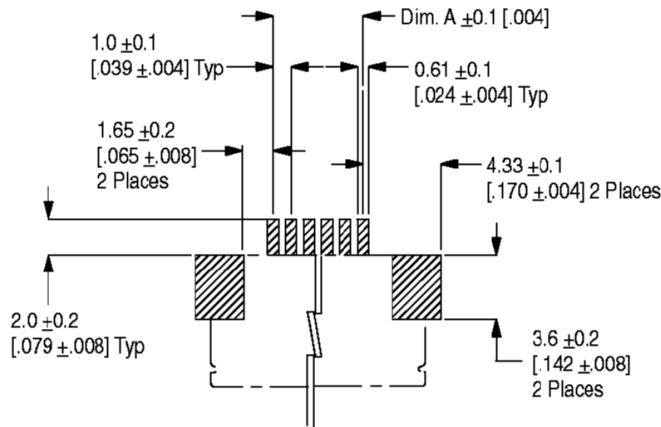
#### C. Pads

At time of connector placement, coplanarity of the pad pattern must be held to 0.05 [.002] maximum.

#### D. Layout

Recommended pc board patterns for these connectors are provided in Figure 3 (the layouts are viewed from the connector side).

**Recommended PC Board Layout for Horizontal Connectors**



**Recommended PC Board Layout for Vertical Connectors**

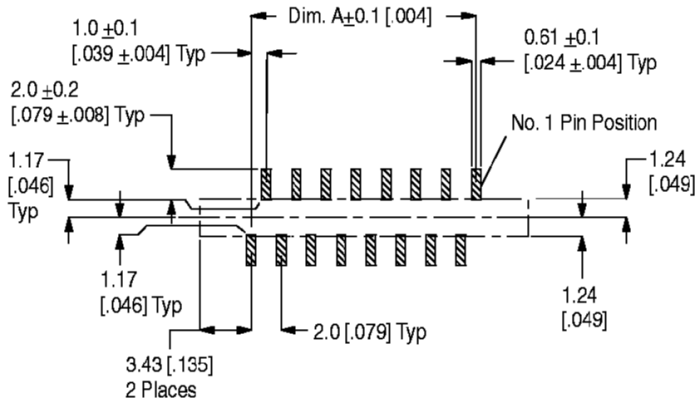
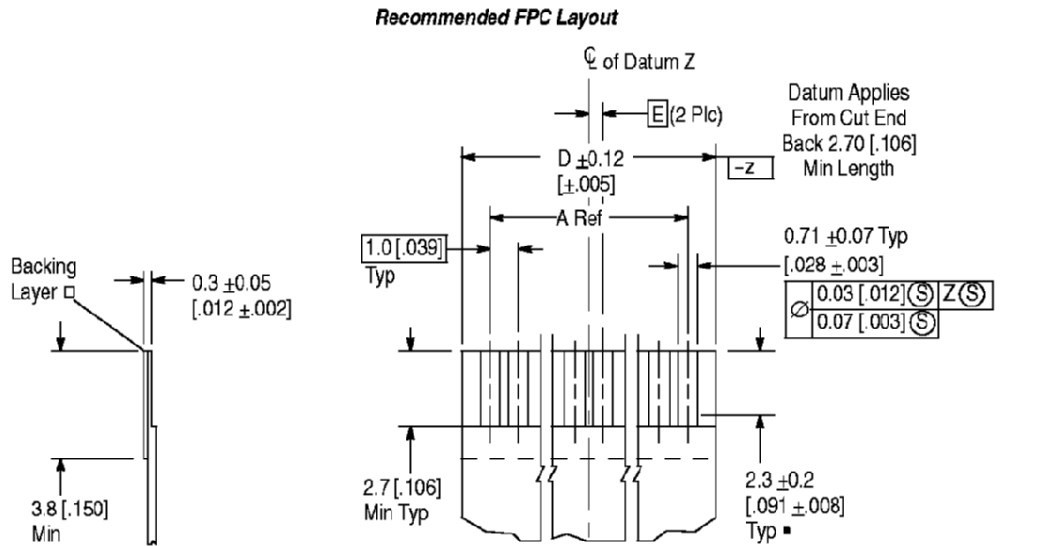


Figure 3

NUMBER OF POSITIONS	DIMENSION A
4	3.0 [.118]
5	4.0 [.157]
6	5.0 [.197]
7	6.0 [.236]
8	7.0 [.276]
9	8.0 [.315]
10	9.0 [.354]
11	10.0 [.394]
12	11.0 [.433]
13	12.0 [.472]
14	13.0 [.512]
15	14.0 [.551]
16	15.0 [.591]
17	16.0 [.630]
18	17.0 [.669]
19	18.0 [.709]
20	19.0 [.748]
21	20.0 [.787]
22	21.0 [.827]
23	22.0 [.866]
24	23.0 [.906]
25	24.0 [.945]
26	25.0 [.984]
27	26.0 [1.024]
28	27.0 [1.063]
29	28.0 [1.102]
30	29.0 [1.142]

E. FPC Layout

Recommended patterns for mating, customer supplied flexible printed circuits are provided in Figure 4.



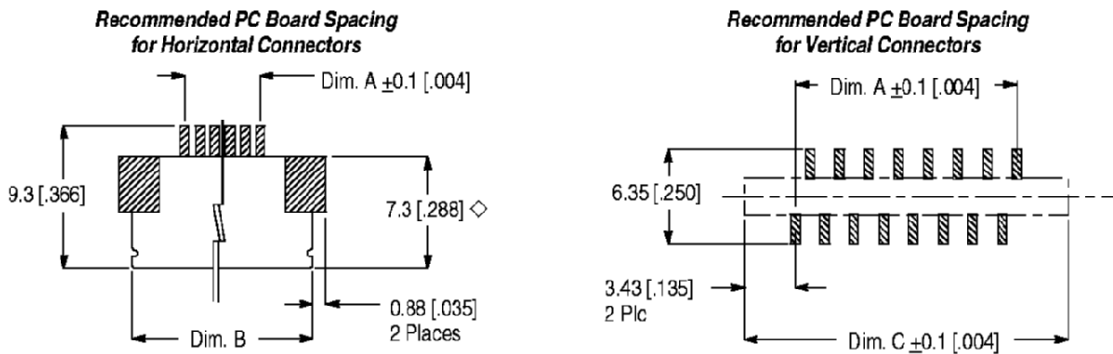
- A backing layer or stiffener is required to bring film thickness in mating area to specified thickness range.
- Maximum engagement length to the contact point on the flex film when inserted fully into connector.

NUMBER OF POSITIONS	DIMENSION		DIMENSION E
	A	D	
4	3.0 [0.118]	5.0 [0.197]	0.50 [0.020]
5	4.0 [0.157]	6.0 [0.236]	-
6	5.0 [0.197]	7.0 [0.276]	0.50 [0.020]
7	6.0 [0.236]	8.0 [0.315]	-
8	7.0 [0.276]	9.0 [0.354]	0.50 [0.020]
9	8.0 [0.315]	10.0 [0.394]	-
10	9.0 [0.354]	11.0 [0.433]	0.50 [0.020]
11	10.0 [0.394]	12.0 [0.472]	-
12	11.0 [0.433]	13.0 [0.512]	0.50 [0.020]
13	12.0 [0.472]	14.0 [0.551]	-
14	13.0 [0.512]	15.0 [0.591]	0.50 [0.020]
15	14.0 [0.551]	16.0 [0.630]	-
16	15.0 [0.591]	17.0 [0.669]	0.50 [0.020]
17	16.0 [0.630]	18.0 [0.709]	-
18	17.0 [0.669]	19.0 [0.748]	0.50 [0.020]
19	18.0 [0.709]	20.0 [0.787]	-
20	19.0 [0.748]	21.0 [0.827]	0.50 [0.020]
21	20.0 [0.787]	22.0 [0.866]	-
22	21.0 [0.827]	23.0 [0.906]	0.50 [0.020]
23	22.0 [0.866]	24.0 [0.945]	-
24	23.0 [0.906]	25.0 [0.984]	0.50 [0.020]
25	24.0 [0.945]	26.0 [1.024]	-
26	25.0 [0.984]	27.0 [1.063]	0.50 [0.020]
27	26.0 [1.024]	28.0 [1.102]	-
28	27.0 [1.063]	29.0 [1.142]	0.50 [0.020]
29	28.0 [1.102]	30.0 [1.181]	-
30	29.0 [1.142]	31.0 [1.221]	0.50 [0.020]

Figure 4

### 3.3. Spacing

Sufficient space must be allowed for the connectors, FPC, and other components. Check the component manufacturer's dimensional requirements before laying out on the pc board. The dimensional requirement for these connectors is provided in Figure 5.



◇ Dimension applies to connector with actuator in fully opened position.

NUMBER OF POSITIONS	DIMENSION A	DIMENSION B	DIMENSION C
4	3.0 [.118]	11.66 [.459]	11.91 [.469]
5	4.0 [.157]	12.66 [.498]	12.93 [.509]
6	5.0 [.197]	13.66 [.538]	13.92 [.548]
7	6.0 [.236]	14.66 [.577]	14.91 [.587]
8	7.0 [.276]	15.66 [.617]	15.93 [.627]
9	8.0 [.315]	16.66 [.656]	16.92 [.666]
10	9.0 [.354]	17.66 [.695]	17.91 [.705]
11	10.0 [.394]	18.66 [.735]	18.92 [.745]
12	11.0 [.433]	19.66 [.774]	19.91 [.784]
13	12.0 [.472]	20.66 [.813]	20.93 [.824]
14	13.0 [.512]	21.66 [.853]	21.92 [.863]
15	14.0 [.551]	22.66 [.892]	22.91 [.902]
16	15.0 [.591]	23.66 [.931]	23.93 [.942]
17	16.0 [.630]	24.66 [.971]	24.92 [.981]
18	17.0 [.669]	25.66 [1.010]	25.91 [1.020]
19	18.0 [.709]	26.66 [1.050]	26.92 [1.060]
20	19.0 [.748]	27.66 [1.089]	27.91 [1.099]
21	20.0 [.787]	28.66 [1.128]	28.93 [1.139]
22	21.0 [.827]	29.66 [1.168]	29.92 [1.179]
23	22.0 [.866]	30.66 [1.207]	30.91 [1.217]
24	23.0 [.906]	31.66 [1.246]	31.93 [1.257]
25	24.0 [.945]	32.66 [1.286]	32.92 [1.296]
26	25.0 [.984]	33.66 [1.325]	33.91 [1.335]
27	26.0 [1.024]	34.66 [1.365]	34.92 [1.375]
28	27.0 [1.063]	35.66 [1.404]	35.92 [1.414]
29	28.0 [1.102]	36.66 [1.443]	36.93 [1.454]
30	29.0 [1.142]	37.66 [1.483]	37.92 [1.493]

Figure 5

### 3.4. Position Identifier

The number one pin position is identified by a triangular symbol. The symbol is on the top of the housing of top entry horizontal connectors and on the actuator of bottom entry horizontal connectors. Either Pin 1 identifier can be used for vertical connectors. See Figure 6.

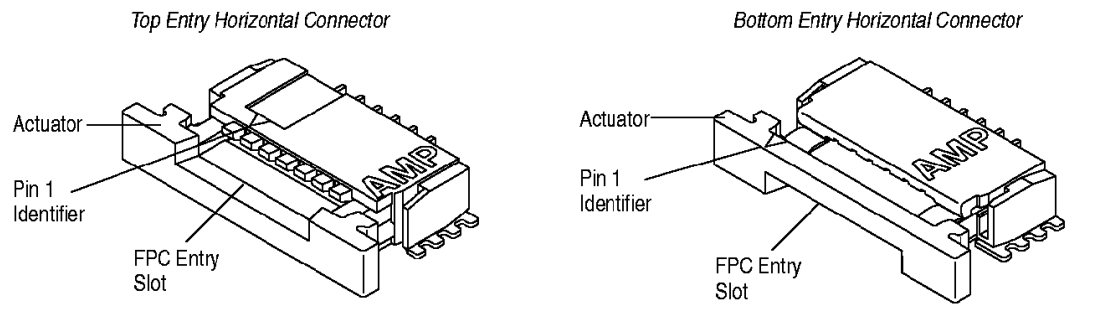


Figure 6

### 3.5. Mechanical Supports

Hold-downs are an integral part of the horizontal connectors. The hold-downs go onto pads on the pc board to help stabilize the connector and provide some strain relief after soldering. They are soldered to the pads during the soldering of the contact leads.

### 3.6. Stencil

Stencil aperture will be determined by the thickness of the stencil being used. Generally, the thinner stencils will have a larger aperture to maintain a given volume of solder paste. Solder deposition should be within the pad area of the contact leads and hold-downs. Typical horizontal and vertical aperture openings are shown in Figure 7.

#### CAUTION

*If a hold-down aperture is required other than that specified, the design must ensure that the connector housing will not sit on the solder deposit.*

#### CAUTION

*All traces must be covered by solder mask in the solder deposit area. Exposed traces could cause bridging and create a short, or wick solder away from the solder leads, producing a weak solder joint.*

#### NOTE

*The recommended aperture width is 0.41 [016] for the contact leads. It may be wider; however, care must be given to insure against solder bridging during processing.*

### 3.7. Recommended Solder Paste Characteristics

1. Alloy type shall be either 63Sn/37Pb, 60Sn/40Pb or its lead-free equivalent.
2. Flux shall be RMA type.
3. Solids by weight shall be 85% minimum.
4. Mesh designation -200 to +325 (74 to 44 square micron openings, respectively).
5. Minimum viscosity of solder paste for screen print shall be  $5 \times 10^5$  cp (centipoise).
6. Minimum viscosity of solder paste for stencil print shall be  $7.5 \times 10^5$  cp (centipoise).

### 3.8. Solder Volume

Solder volume for each component shall be:

1. Contact lead shall be  $0.0708\text{mm}^3$  [ $4.32 \times 10^{-6}$  in.<sup>3</sup>] per contact.
2. Hold-down shall be  $0.7032\text{mm}^3$  [ $4.29 \times 10^{-5}$  in.<sup>3</sup>] per hold-down (applies to horizontal connectors only).

#### NOTE

*Solder volume may vary depending on solder paste composition.*



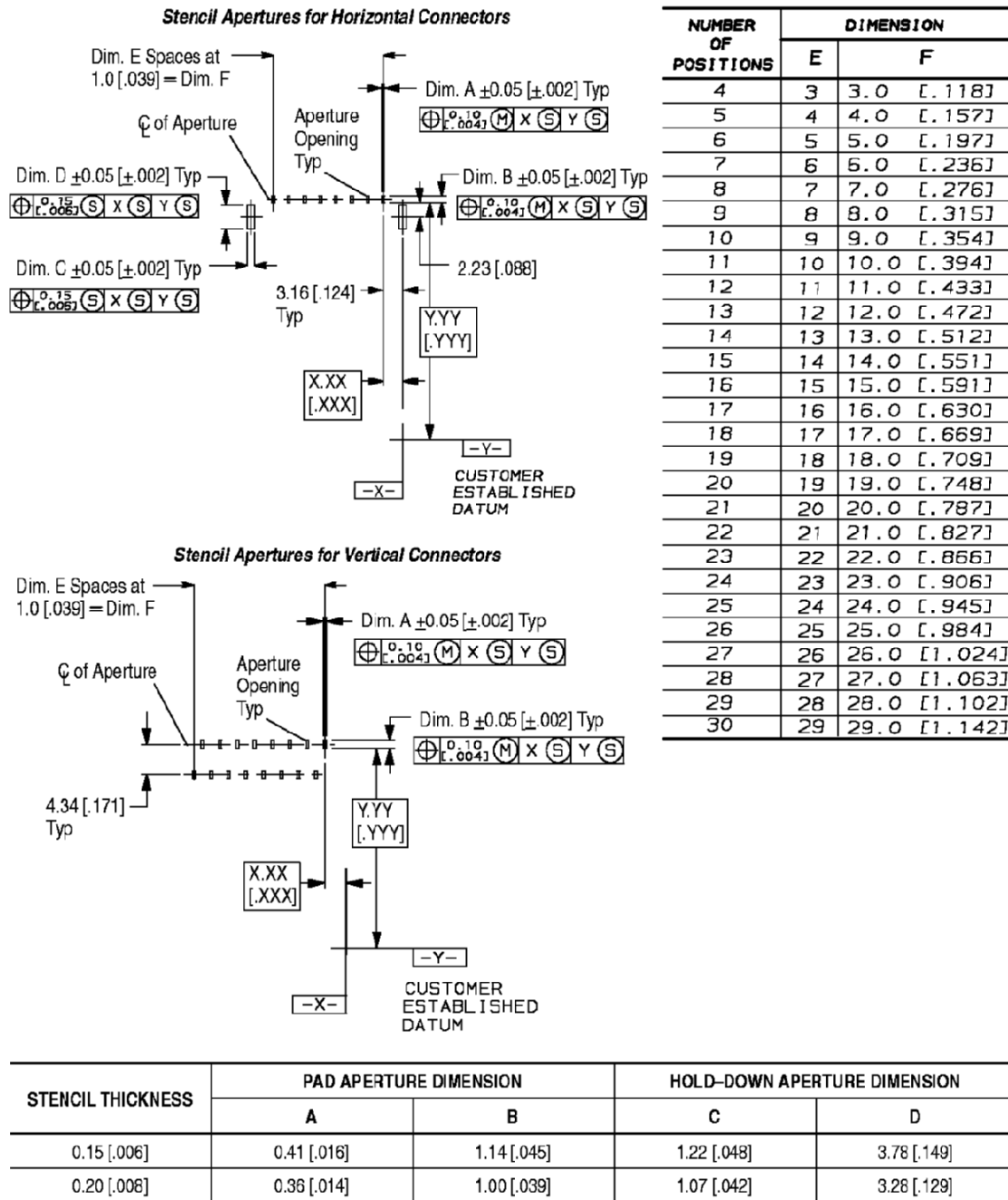


Figure 7

3.9. Solder Screen

Generally, we do not recommend screen application of solder paste because of the limited volume of paste that can be deposited. If a screen application is required, it is recommended to remove all screen from the solder tine and hold-down pad areas. Consult your supplier for compatibility of screen and paste, and for application techniques.

3.10. Solder Mask

Solder mask is recommended between all pads when soldering connectors to minimize solder bridging between pads. The mask must not exceed the height of the pad by more than 0.05 [.002]. If a trace is run between adjacent pads on the solder side of the PC board, a solder mask must be applied over the trace to prevent bridging and wicking of solder away from the contact solder tines. Additionally, there should be solder mask covering any traces in the area of the hold-down solder deposit. Those most suitable are Liquid Photo Imageable and Dry Film.

**CAUTION** *Since the connector housings may rest on top of the solder mask, an excessively high mask will allow too much space between the lead and pad for a good solder joint. A solder joint under these conditions would be weak, and would not provide long term performance for the connector.*

3.11. Connector Placement

Machine placement of the connector is recommended due to the inherent difficulty of manually placing fine-pitch connectors. The top surface of the connector housing has a flat area in the center to facilitate vacuum pick-up and handling. To avoid damage, the connectors should be picked up directly out of the embossed-tape packaging by the pick-up device. The placement machine is used to position the connectors to minimize the possibilities of damage that could result from improper handling.

**CAUTION** *Placement of the connectors may be done by hand; however, extreme caution must be used when handling connectors to prevent deformation and contamination of the solder tines and hold-downs.*

3.12. Coplanarity

Optimally, the connector contact solder tines should be centered on the pc board pads. However, misregistration is permissible for some performance classifications. See Figure 8.

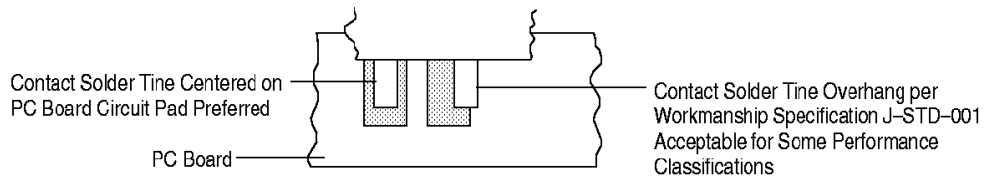


Figure 8

3.13. Soldering

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

A. 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. Call Product Information at the number at the bottom of page 1 for consideration of other types of flux. Flux that is compatible with these connectors are provided in Figure 9.

FLUX TYPE	ACTIVITY	RESIDUE	COMMERCIAL DESIGNATION	
			KESTER <sup>88</sup>	ALPHA <sup>□</sup>
RMA	Mild	Noncorrosive	185/197	611

<sup>88</sup> Product of Kester Solder Co.    <sup>□</sup> Product of Alphametals Inc.

Figure 9

## B. Process

The connectors should be soldered using vapor phase (VPR), non-focused infrared (IR), or equivalent convection soldering technique provided the temperatures and exposure time are within the ranges specified in Figure 10.

### NOTE

*It is recommended using Corpane Batch Vapor Phase † (Model VVP 10 BU) and Vitronics IR ‡ (Model SMD 718) equipment.*

SOLDERING PROCESS	TEMPERATURE (Max)	TIME (At Max Temp)
Vapor Phase	215°C [419°F]	3 Minutes
Infrared Reflow (IR)	230°C [446°F]	3 Minutes

† Manufactured by Corpane Industries Incorporated, Louisville, KY

‡ Manufactured by Vitronics Corporation, Newburyport, MA

Figure 10

Due to the many variables involved with the reflow process (i.e., component density, orientation, etc.), it is recommended that the user conduct trial runs under actual manufacturing conditions to ensure product and process compatibility. Process temperatures and times are listed in Figure 11.

### NOTE

*Connectors will withstand the maximum temperature time limits specified in Figure 10. Higher temperatures can be withstood for short periods of time for IR as indicated in Figure 11.*

VPR				IR
PRIMARY VAPOR TEMPERATURE	PREHEAT TIME	DWELL TIME	COOL DOWN TIME	CONVEYOR SPEED
215°C [419°F]	30 Seconds (In Secondary Vapor)	60 Seconds (In Primary Vapor)	30 Seconds (In Secondary Vapor)	635 [25] or 381 [15] per Minute
REFLOW TEMPERATURE (Preheat 350°C [662°F])				
ZONE 1	ZONE 2		ZONE 3	
260°C [500°F]	240°C [464°F]		320°C [608°F]	

Figure 11

## 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. It is recommended cleaning with the pc board on its edge. If using an aqueous cleaner, standard equipment such as a soak-tank or an automatic in-line machine should be used. The following is a list of common cleaning solvents that will not affect the connectors for the time and temperature specified. See Figure 12.

### CAUTION

*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)	TEMPERATURES(Maximum)	
NAME	TYPE		CELSIUS	FAHRENHEIT
Alpha 2110■	Aqueous	1	132	270
Isopropyl Alcohol	Solvent	5	100	212
Kester 5778■	Aqueous	5	100	212
Kester 5779■	Aqueous	5	100	212
Loncoterge 520●	Aqueous	5	100	212
Loncoterge 530●	Aqueous	5	100	212

■ Product of Fry's Metals, Inc. ● Product of Union Carbide Corp. ■ Product of Litton Systems, Inc.

Figure 12

**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. It is recommended to not use Trichloroethylene and Methylene Chloride because of harmful occupational and environmental effects. Both are carcinogenic (cancer-causing).

**NOTE**

If you have a particular solvent that is not listed, contact Product Information at the number at the bottom of page 1.

D. Drying

Air drying of cleaned connectors is recommended. Temperature for the connectors should not exceed -55 to 105°C [-67 to 221°F]. Degradation of the housings could result from extreme temperatures.

3.14. Mating and Unmating

The FPC can be inserted incorrectly into a connector. Always check whether the connector has a top entry or bottom entry and orient the FPC accordingly. The exposed leads must face upward in top entry connectors and downward in bottom entry connectors, and with vertical connectors, toward the visible contacts.

3.15. Installing and Removing FPC

The connector housing has two detent latches and the actuator has four detent embossments (two engage the latches in the open position and two engage the latches in the closed position). Slight resistance will be apparent as the detents disengage. It is recommended to manually open and close the actuator.

To install or remove the FPC, the actuator must be opened by pulling it straight away from the housing until the second pair of detents engages the detent latches. This will open the entry slot and allow the FPC to be installed or removed with zero force on the circuit leads. When installing the FPC, make sure that the exposed leads are oriented to engage the contacts (e.g., upward for top entry connectors and downward for bottom entry connectors). Insert the FPC until bottomed, then push the actuator in until it bottoms on the housing. See Figure 13.

**NOTE**

With larger size connectors, it may be necessary to push toward the center of the actuator to ensure that the actuator is bottomed over the entire length of the housing. Refer to Figure 13.

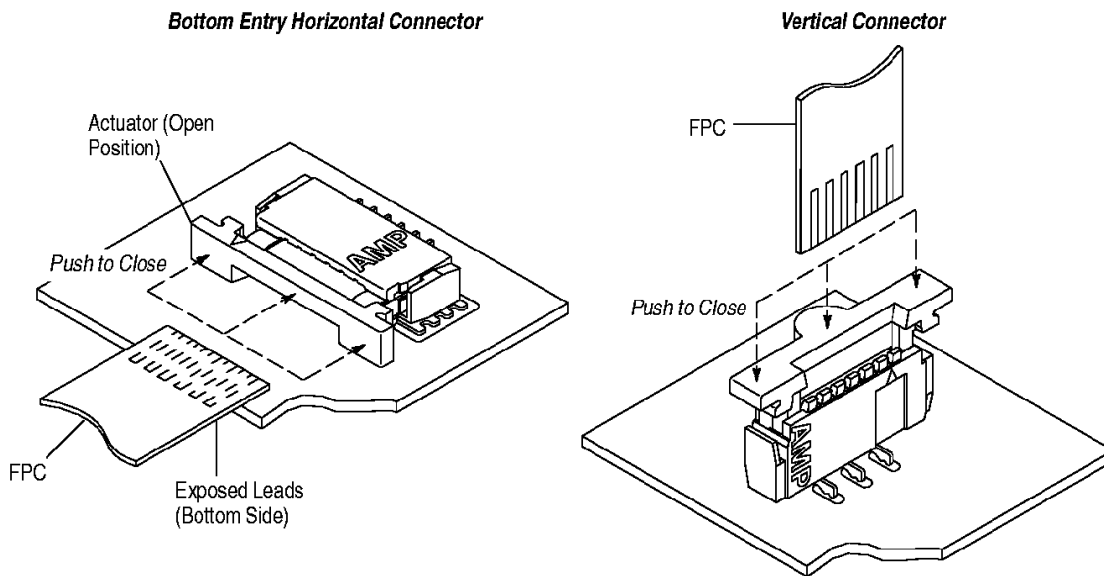


Figure 13

It is recommended inserting the FPC at an angle between 16° and 22° above the horizontal plane for top contact connectors as shown in Figure 14. For bottom contact connectors, the insertion angle of the FPC should be between 16° and 22° below the horizontal plane.

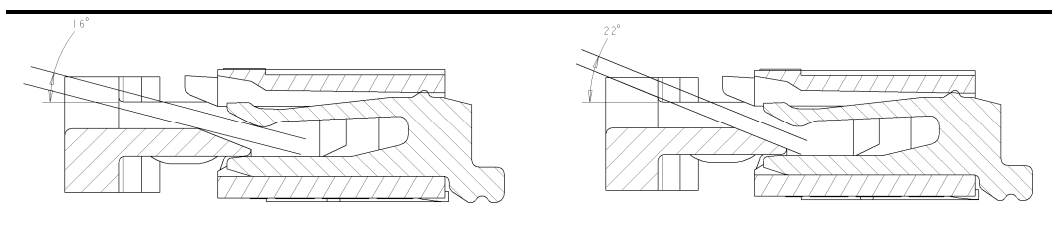


Figure 14

**4. QUALIFICATION**

1mm FPC connectors are recognized by Underwriters Laboratories Inc. (UL) under File E28476 and certified by Canadian Standards Association (CSA) under File LR7189-140.

**5. TOOLING**

The standard packaging used for 1mm FPC connectors is embossed tape packaging supplied on reels and conforming to EIA 481 Packaging Specification. It is recommended using commercially-available machine dereeling, component removal, and placement equipment for these tape packing-supplied connectors.

**6. VISUAL AID**

Figure 15 shows a typical application of 1mm FPC 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.

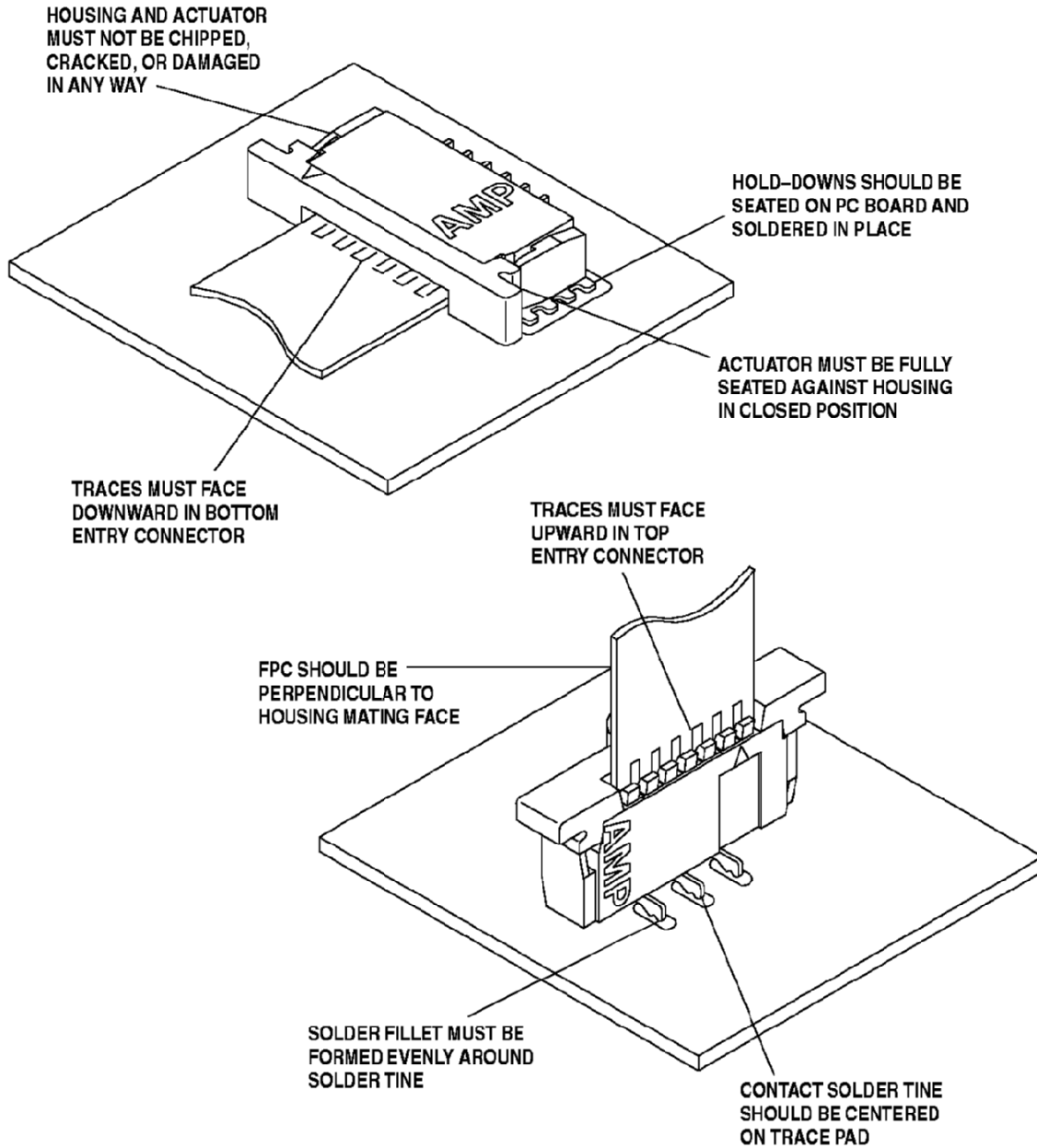


Figure 15. VISUAL AID