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## AMP Z-PACK 2mm HM Hard Metric Interconnection System

**AMP**

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m = meter  
cm = centimeter  
mm = millimeter  
µm = micrometer  
N = Newton  
kg = kilogram  
g = gram  
C = Celsius

**Technical documents**

**Product Specifications**

108-19082 5 row board-to-board Connections  
108-1622 8 row board-to-board Connections  
108-19107 LF Cable Connectors  
108-19108 HF Cable Connectors  
108-1651 Universal Power Module

**Application Specifications**

114-19029 Standard board-to-board  
114-19036 Ground Return Shields  
114-19039 LF Cable Connector  
114-1103 Universal Power Module

**Electrical Performance Reports**

65721 5 row Connector  
65722 5+2 row Connector  
889065 8 row Connector  
889066 8+2 row Connector

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- Technical Documents
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## Product Outline and Table of Contents

### Product Facts

- High Density System with Small Real Estate on Backplane and Daughtercard
- Extensive Range of Signal, Power, Coaxial, and Fiber Board-to-Board and Cable-to-Board Connections.
- Hard Metric 2mm Pitch in Accordance with IEC 917 and IEC 61076-4-101
- Modular Units give Flexible Configuration
- Special Versions for VME64 Extensions and CompactPCI
- Signal Contact Rating 1.5a Fully Energized
- Universal Power Module rated at 7.8A / line, 23.4A fully energized
- All Lines Impedance Controlled to 50ohm (Single Ended) and 100ohm (Differential) nominal
- Safe Design, complies with IEC950 in Mated Condition; Universal Power Module is Safe in Unmated Condition
- Several Performance Levels for Board and Cable Connectors with Unshielded and Shielded Versions
- Corruption-proof sequencing- Signal Contact Levels exceed Maximum Tolerance of Backplane Distortion and Warpage (ref. Hard Metric Equipment Practice)
- Mismatching Keys Block Mating before any Contact Touch
- Backplane thickness range 1.4 - 5.6 [.055 - .220]
- Daughtercard Thickness Range of 1.4 - 4.3 [.055 - .169] (3.5 [.138] max. with Lower Shields)
- Small Press Fit Board Hole allows Maximum Track Width and Minimum Signal Corruption
- Versions comply with Bellcore Central Office Environment and Uncontrolled Environment
- Single- and Multi-line Models Available or Tyco Electronics Circuits & Design can build a System to your Specification

### Product Outline

The AMP Z-PACK 2mm HM Hard Metric connector system is designed to meet the current and future needs of telecommunication, computer and instrumentation applications giving excellent electrical and mechanical characteristics at an economical price. It is a high performance, high density system with flexible configuration which offers upgradeability. The connector system is fully supported by Tyco Electronics spice models to guarantee choosing the right product to match the application.

Z-PACK 2mm HM connectors comply with the requirements of IEC 917 and IEC 61076-4-101 and valuable product extensions provide great flexibility in the range of applications. The system can provide the following options:

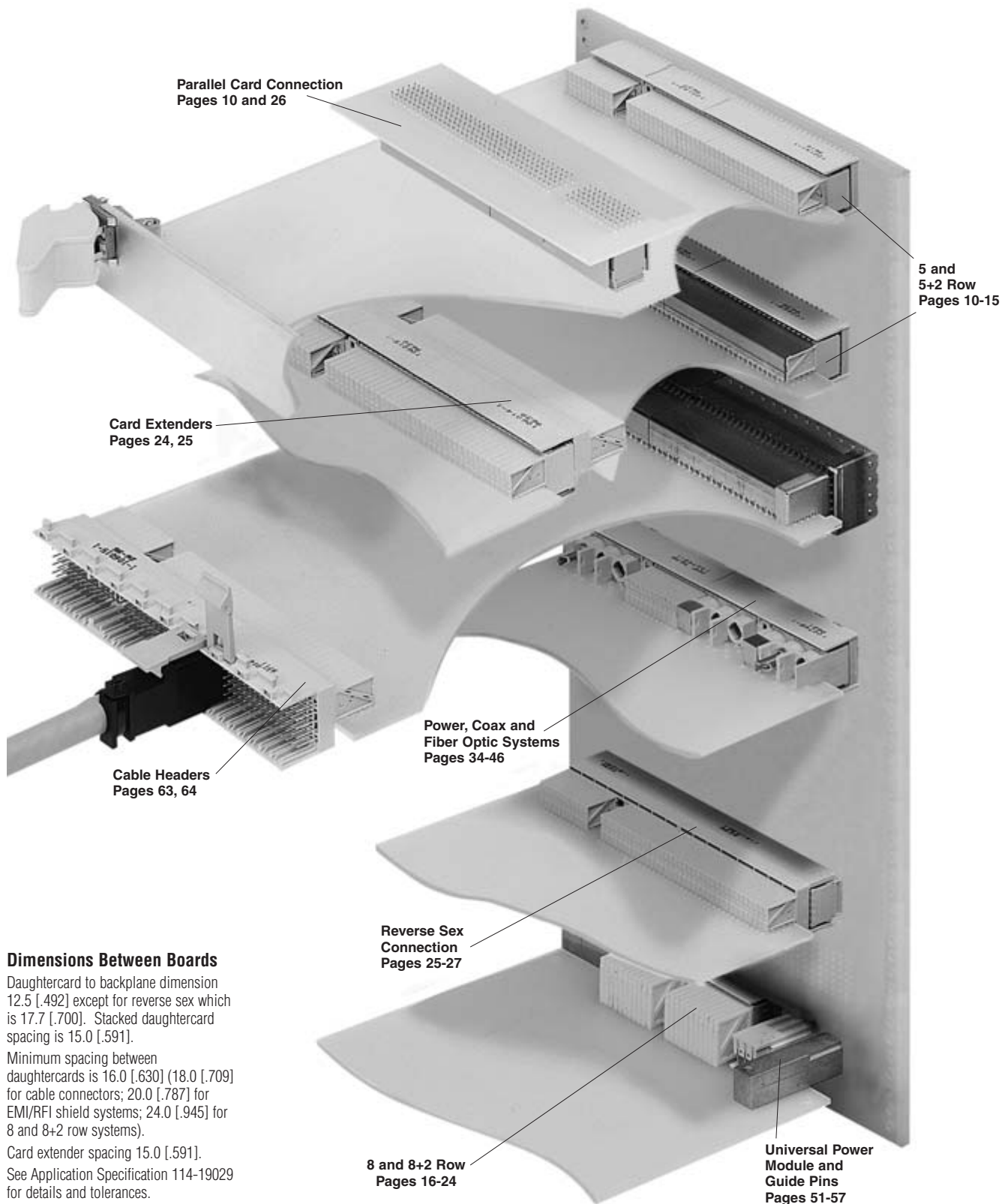
- Backplane and daughtercard connections in standard and reverse sex.
- Parallel daughtercard connection.
- Midplane connections in both planar and cross connect configuration.
- Cable connections for backplane rear and front of daughtercards.
- Extender card connections.

These variations can be arranged for signal contacts, and for backplanes, power, coax and fiber optic cable and board connections.

### Table of Contents

|                                                              |        |
|--------------------------------------------------------------|--------|
| Specifications .....                                         | 2      |
| System Options, Front and Rear .....                         | 4, 5   |
| Product Characteristics and System Features ...              | 6      |
| Electrical Characteristics .....                             | 7      |
| Contact Make and Break Sequence .....                        | 8      |
| Connector Configurations .....                               | 9      |
| Vertical Male Connectors, 5 row .....                        | 10-12  |
| Right Angle Female Connectors, 5 row .....                   | 13-15  |
| Vertical Male Connectors, 8 row .....                        | 16-18  |
| Right Angle Female Connectors, 8 row .....                   | 19-21  |
| 4 & 4+1 Row Slim Connectors .....                            | 22, 23 |
| Vertical Female Connectors, 8 Row .....                      | 24     |
| Right Angle Male Connectors, 5 Row .....                     | 25, 26 |
| Vertical Female Connectors, 5 Row .....                      | 27     |
| Midplane Board-to-Board Arrangements .....                   | 28     |
| Male Shrouds (ZIF Style) .....                               | 29     |
| Spacers .....                                                | 30     |
| Spacer Selection .....                                       | 31     |
| One Piece Shrouds .....                                      | 32     |
| Male Pin Protection Covers .....                             | 33     |
| DIN and Hybrid DIN Systems .....                             | 34-40  |
| AMP Mini-SC (MSC) and Hybrid MSC Systems .....               | 41-46  |
| Coding Keys and Contact Loading Variants .....               | 47     |
| CompactPCI and VME 64 Extensions .....                       | 48     |
| CompactPCI Connectors: At a Glance .....                     | 49, 50 |
| Universal Power Module .....                                 | 51-53  |
| Guiding Hardware .....                                       | 54-57  |
| Cable Connectors and Lead Assemblies .....                   | 58     |
| Cable Connector Mating Arrangements .....                    | 59     |
| 10 and 20 Position Connectors .....                          | 60     |
| Lead Assemblies .....                                        | 61     |
| Male Cable Connector Shrouds .....                           | 62     |
| Male Connectors, Cable-to-Board .....                        | 63, 64 |
| Dimensions and Tolerances .....                              | 65, 66 |
| Customer Specification Chart .....                           | 67     |
| PC Board Layouts .....                                       | 69-72  |
| Connector Insertion Tooling .....                            | 73-77  |
| Non-RoHS to RoHS Compliant Part Number Cross Reference ..... | 78-80  |
| Part Number Index .....                                      | 81, 82 |

**System Options — Front**



**Dimensions Between Boards**

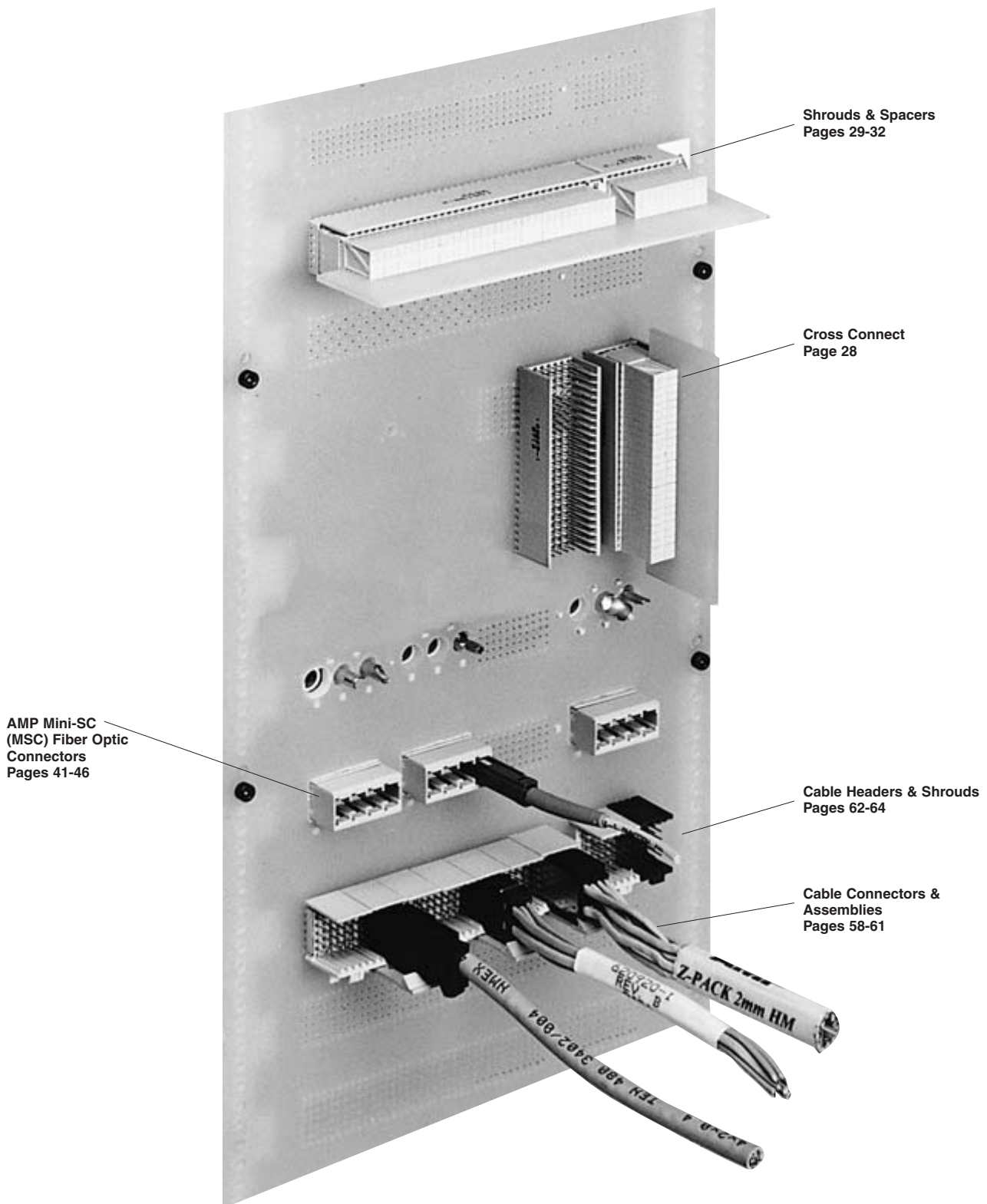
Daughtercard to backplane dimension 12.5 [.492] except for reverse sex which is 17.7 [.700]. Stacked daughtercard spacing is 15.0 [.591].

Minimum spacing between daughtercards is 16.0 [.630] (18.0 [.709] for cable connectors; 20.0 [.787] for EMI/RFI shield systems; 24.0 [.945] for 8 and 8+2 row systems).

Card extender spacing 15.0 [.591].

See Application Specification 114-19029 for details and tolerances.

**System Options — Rear**



## Product Characteristics and System Features

### Product Characteristics

Electronic developments are increasing the demands on system performance, and connectors can no longer be considered as discrete components but as part of a total electrical/electronic design. These aspects can include the following:

#### Higher pin count within tight space constraints.

With 25 and 40 signal pins per cm of 5 row and 8 row connectors respectively, high densities can be achieved, or low signal to ground ratios specified within tight space constraints.

#### Minimum reflections

Matched impedance between cables, connectors and systems give low reflections at interfaces. This is achieved with overmolded receptacle contacts which give impedances close to the values of printed circuit boards, maximizing effective signal strength.

#### Reduced crosstalk

Crosstalk can be minimized by selective use of ground pins between signals, which can be augmented by the use of ground return shields. Reduced cross talk versions of the receptacle connector provide partial shielding between columns.

#### Shielding

Upper and/or lower ground return shields are used with 5+2 and 8+2 row headers to improve signal integrity. EMI / RFI shields are available to totally enclose 5 row connectors to give maximum immunity from, and minimum emission of, radiated noise.

#### Reduced Skew

The design of right angle connectors achieves very low skew between longest and shortest contact and board paths, corrected for board effects. The actual value varies between 5 row and 8 row types.

#### Fiber Optic Connections

As well as the normal power and coaxial DIN contacts, either DIN fiber optic or AMP MSC fiber optic connectors can be included in backplane systems for high speed data transfer without risk of corruption.

#### Upgradeability

The system is upgradeable to give enhanced performance as system demands increase. This allows economical selection of components initially with enhanced version selectable as performance levels increase without a major change in connector design or board layout. Tyco Electronics recommends that board layouts include ground return shield holes for future-proofing.

### System Features

#### Termination

All versions use AMP ACTION PIN press fit contacts, giving high retention force termination conforming to IEC 352-5.

#### Pin Headers

Contact pins are available to give three mating levels on the front face with standard 3.7 [.146] tail, suitable for boards from 1.4 to 4.3 [.055 - .169] thick. Feedthrough vertical headers offer three levels of mating to rear of backplane for midplane and cable connection with special twisted pins used for cross connect applications. A wide variety of standard product exists which offer economy and short lead times, but any variation of selective load can be offered.

#### Receptacle Assemblies

Receptacle assemblies employ a 'chiclet' assembly principle allowing a variety of selective loading and providing the ability to fit reduced cross talk shields. Enhanced versions are pre-fitted with upper shields, with lower shields applied separately as required.

#### Power Connection

Universal Power Module Connectors are press fit three position connectors with the option of three levels of sequencing and 23A rating.

Alternatively, DIN contacts can be used in type L, M and N housings with contact rating up to 40A and first make/last break option. Variations of cable-to-board, board-to-board and cable-to-cable are offered.

#### Coaxial Connection

DIN coax contacts can be fitted to type L, M and N housings in cable and board mount versions.

#### Fiber Optic Connections

DIN style contacts can be fitted to housings as above or higher density AMP MSC contacts to MSC housings.

#### Spice Models

To achieve optimum performance and cost, it is essential to accurately match connector and system parameters. Where customers wish to carry out their own analysis, Tyco Electronics offers single and multi-line models for many connector styles. Please ask for details of the packages available.

#### Modelling Support

Tyco Electronics offers a structured approach to the design and evaluation of packaging and interconnection systems, including a full range of electrical and mechanical support functions.

Using accurate device models, our capabilities include high speed signal propagation analysis using SPICE modelling, and simulation of interconnections and backplane designs. Complete power distribution and thermal analysis can also be included.

#### System Manufacture

Tyco Electronics Circuits and Packaging Division specializes in the design and manufacture of high performance backplanes and subsidiary boards. They will design backplanes and boards to meet your performance criteria, bringing their experience and tools to enhance your design. Ask Tyco Electronics for further details.



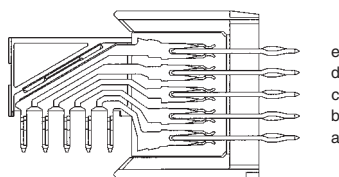
## Electrical Characteristics, Typical

AMP Z-PACK 2mm HM Connector System offers considerable benefits in performance over other 2.00 [.079] systems. Tests have shown values for inductance, capacitive loading and propagation delay to be 18%, 13% and 18% lower respectively than other 5 row systems.

## Shield Types and Selection

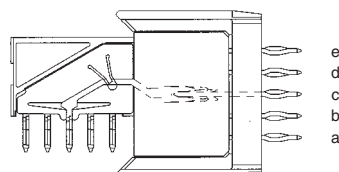
### Standard Version

5 row version gives 250 contacts/100 [3.937], suitable for rise times down to 100ps with cross talk <5% using a 4:1 signal/ground ratio (50 signal/100mm)



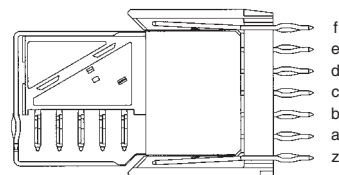
### Reduced Cross Talk Version

Metal shield grounded to row c and to the board (optional) reduces cross talk in the d and e contacts by 25% to the level of a and b. Allows increase in density to 100 signals/100 [3.937].



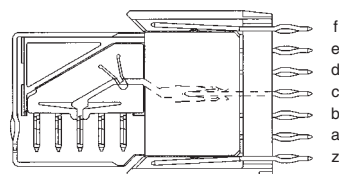
### Ground Return Shields

Performance is enhanced suitable for rise times down to 250ps by using extra pin rows mating to shields on the receptacle. Allows an increase in density to 75 signal/100 [3.937], reduces cross talk by 30% and reduces single ended impedance peaks in rows a and e.



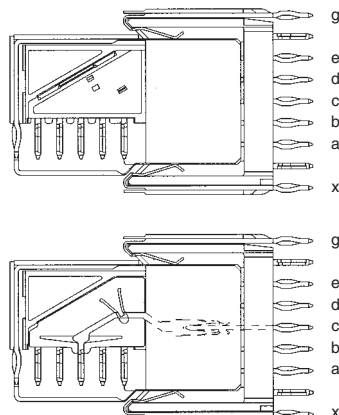
### Ground Return and Reduced X-talk Shields

Increase performance to sub-nanosecond rise times. When used with differential pairs, improves cross talk by 30%, lowers impedance peaks and reduces propagation delay by 10%



### EMI/RFI Shields

These shields, used with end caps, totally enclose the connector and reduce radiation by 20-30dB over the 100MHz-1GHz range. These shields can be used with reduced cross talk shields as shown in the lower view.



## Electrical characteristics, Typical.

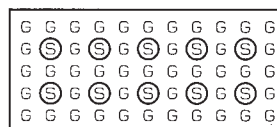
|                                                        |                     |       |                   |
|--------------------------------------------------------|---------------------|-------|-------------------|
| Signal Pin rating, all contacts loaded                 | 1.5a @ 70°C [158°F] |       |                   |
| Nominal resistance                                     | <13.5mOhm           |       |                   |
| Creepage/clearance                                     | <0.8mm              |       |                   |
| Propagation delay, corrected for board effects (5 row) | 104ps               |       |                   |
| Signal/ground ratio                                    | 4:1                 | 1:1   | Differential Pair |
| Impedance                                              | 50-58               | 49-55 | 86-89             |
| Backward x-talk, row to row                            | 4-10                |       |                   |
| " " column to column                                   | <3                  | <1    | <1                |
| " " diagonal                                           | <2                  | <<1   | <<1               |

These values apply at 333ps rise time (10%-90%).

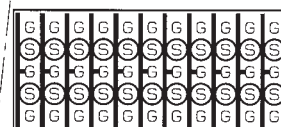
These values have been obtained with 5 row connectors; similar improvements are obtained with 8 row versions.

See page 41 for Z-PACK 2mm HM Connector Optical Performance.

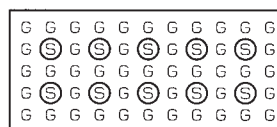
Standard



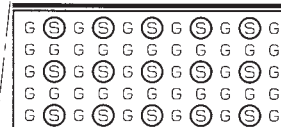
Shielded



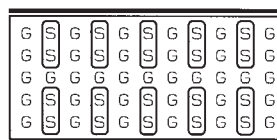
Standard



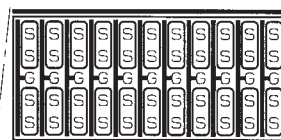
Shielded



Standard



Shielded



## Contact Make and Break Sequence

### Make and Break Sequence

The diagram shows the sequence of make and break for the range of 2mm HM signal contacts, shields, Universal Power Module contacts and DIN 41626 contacts. In relation to the key blocking position, the housings must close by the dimension shown to give first contact point for the respective contact type, with housings fully mated 9.1 [.358] closer than the key blocking point. All dimensions are nominals and assume connectors are assembled flush with the backplane.

#### POWER CONTACT F.M.L.B.

#### UNI.PWR. LEVEL 3

#### UNI.PWR. LEVEL 2

#### SIGNAL CONTACT LEVEL 3

#### UNI.PWR. LEVEL 1

#### POWER CONTACT STD.

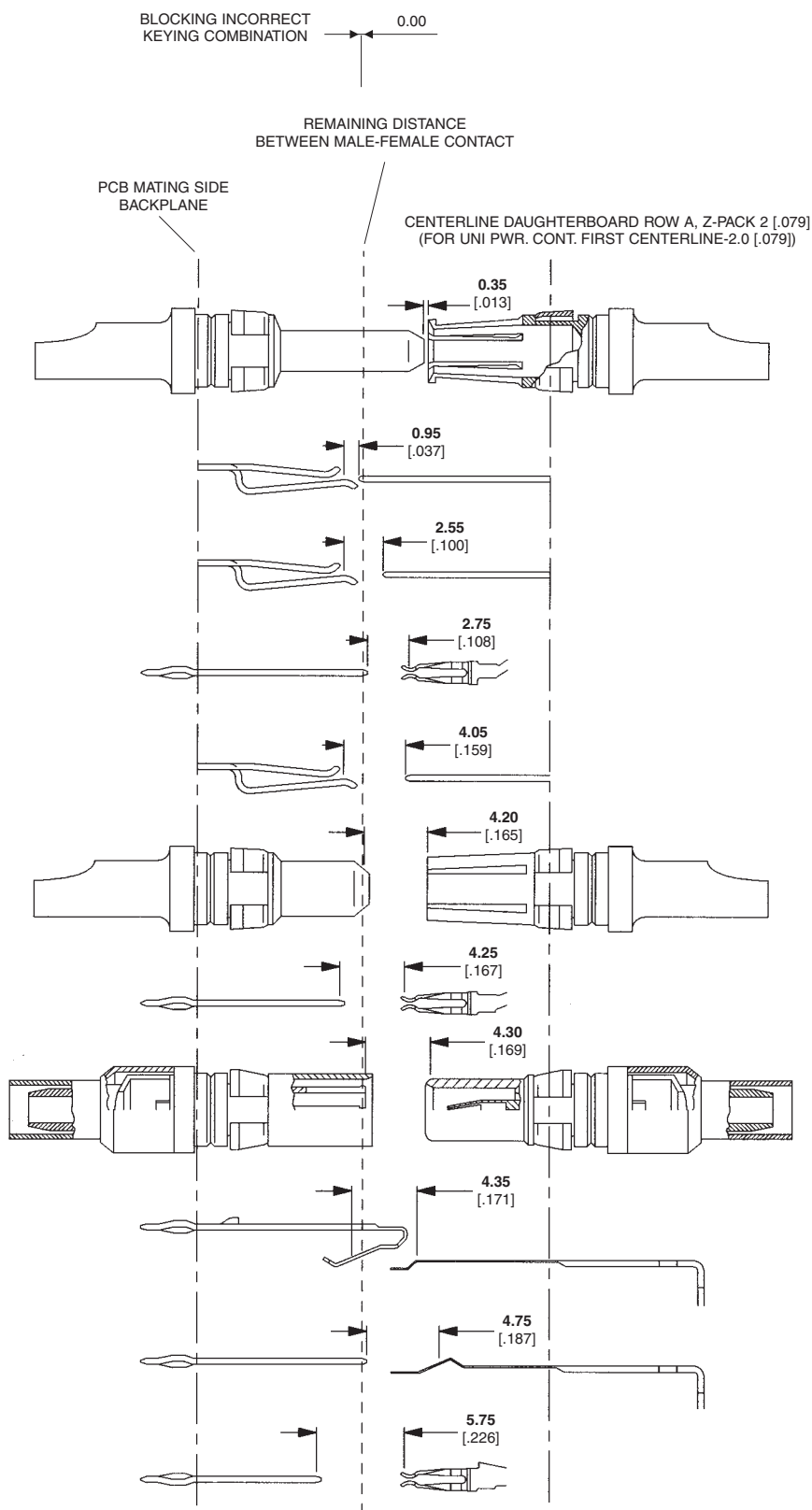
#### SIGNAL CONTACT LEVEL 2

#### COAX CONTACT

#### EMI-RFI SHIELDING

#### ENHANCED SHIELDING

#### SIGNAL CONTACT LEVEL 1





## Connector Configurations

### Connector Stacking

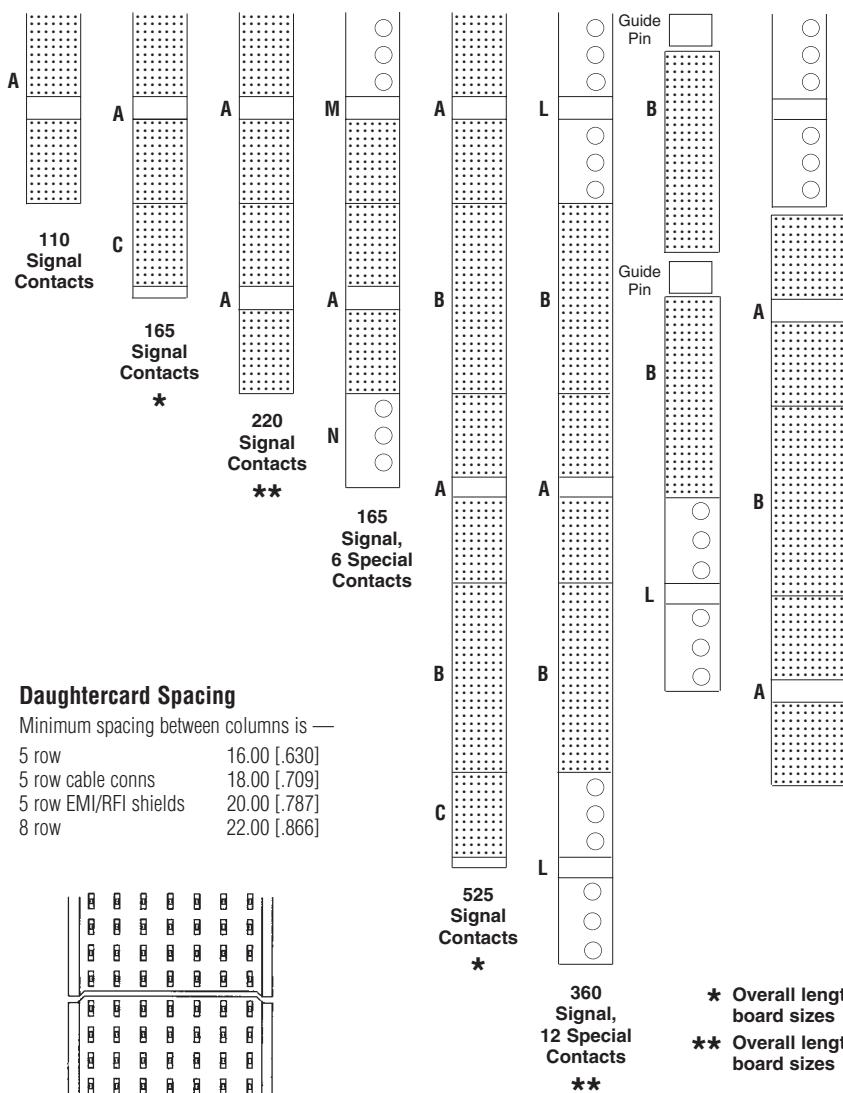
Connectors can be stacked together without change of contact pitch ensuring that the end features shown below nest together.

Guiding features are provided to align connector pairs and avoid contact damage. IEC 61076-4-101 dictates that connectors are end stacked as shown in the adjacent first five columns, with B modules located between modules with location/guiding features. An alternative guiding device can be used instead, such as the guide pin (page 55).

Types C and N are intended for use at a column end.

Universal Power Module connectors can be located at any position. Special arrangements must be made when stacking 8 row to 5 row.

The diagrams show typical arrangements but others are possible.

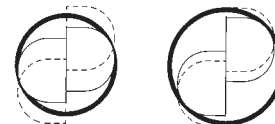
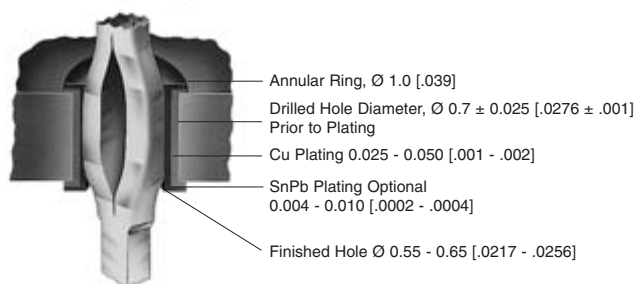


### ACTION PIN Contacts

Details of the pcb hole size and finish apply to all ACTION PIN contacts. IEC 61076-4-101 specifies true position of holes to within 0.1 [.004]. For feedthrough posts, true position within 0.05 [.002] to minimize out-of-position post tips could be used.

A new contact can be inserted into the same hole three times without damage should repair or replacement be necessary.

### AMP ACTION PIN Press-fit Contact Interconnection



Min. Hole  $\varnothing$   
0.55 [.0217]

Max. Hole  $\varnothing$   
0.65 [.0256]

Two spring members compress to different degrees to accommodate hole tolerances max. diagonal 0.84 [.033] dia.

## Vertical Male Connector, 5 Row, Types A, B and C

### Vertical Male Connectors

Types A, B and C male connectors will mate with right angle female and vertical female connectors shown on pages 13 and 27 respectively.

### 5 Row Versions

Type A has 110 signal pins with center guiding and keying facility. Type B has 125 signal pins and Type C has 55 signal pins and guiding features. All are end stackable without change in contact pitch according to the chart on page 9.

### 5+2 Row Versions

For use with females with ground return shields and contacts in rows z and f in addition to those above.

### Short Tail Versions

Standard versions have contact option A in rows a-e with option C in rows z and f on 5+2 row versions.

### Feedthrough Versions

For midplane and rear cable connection. 5 row versions mate with unshielded female connectors and 5 row cable connectors. 5+2 row versions mate with female connectors having ground return shields or 5+2 row shielded cable connectors. Standard versions use contact options K and T instead of A and C.

Mylar tail guides can be fitted to feedthrough posts to aid assembly to the board.

For versions other than those shown, refer to page 47 which gives access to other sizes and loading patterns.

End caps are available for use with special versions of types A and B connectors. Consult Tyco Electronics.

### Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

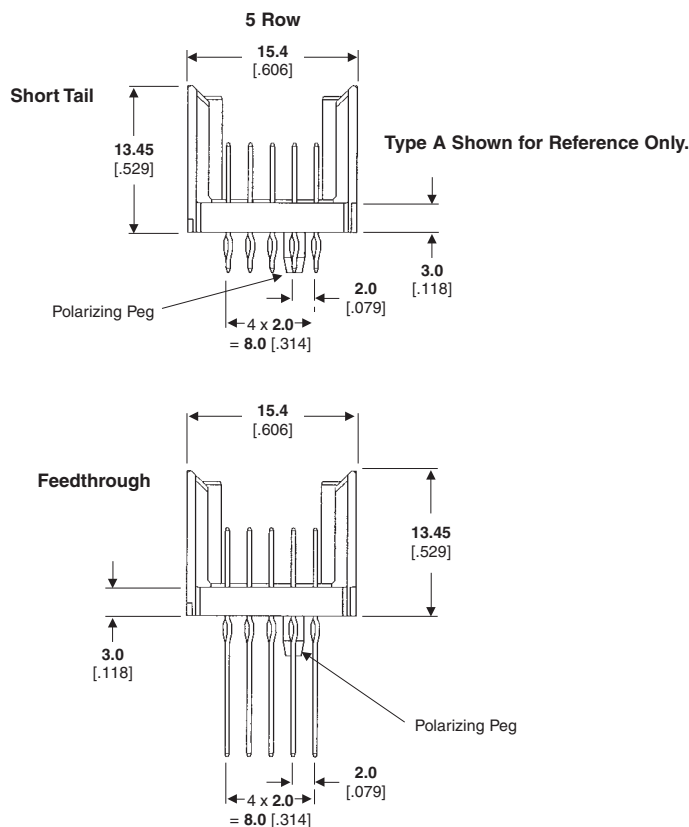
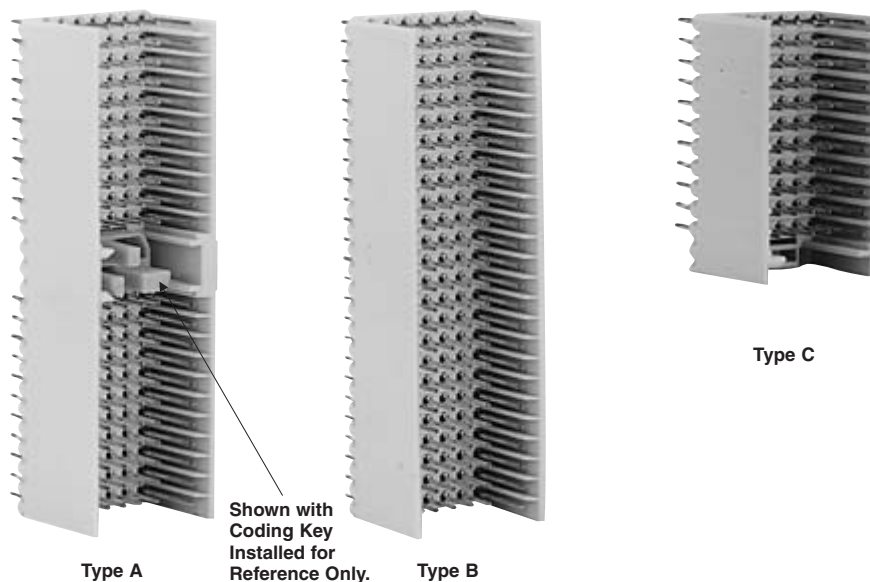
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

### Coding keys for type A page 47.

### Board layout page 69 for guidance only.

### Protection covers available see page 33.



| Description                | Part Numbers |          |             |          |
|----------------------------|--------------|----------|-------------|----------|
|                            | Short Tail   |          | Feedthrough |          |
|                            | 5 Row        | 5+2 Row  | 5 Row       | 5+2 Row  |
| Type A (with locating peg) | 100143-1     | 100668-1 | 106164-1    | 106509-1 |
| Type B (25)                | 100141-1     | 100669-1 | 106165-1    | 106510-1 |
| Type B (19)                | 1392175-1    | 352869-1 | —           | —        |
| Type B (22)                | 352639-1     | 352638-1 | —           | —        |
| Type C                     | 100159-1     | 106081-1 | 106303-1    | 188637-1 |

For VME64 and C-PCI versions, see page 48.

## Vertical Male Connector, 5 Row, Type A/B

### Type A/B Vertical Male Connector

Type A/B male connectors will mate with Type A/B right angle female connectors shown on page 15.

#### 5 Row Version

Type A/B connector offers the guidance ability similar to the Type A connector but also utilizes the center three columns for additional signal pin capability which are not found in the Type A connector.

Available in the Type A/B connector are 95 signal pins, 110 signal pins and 125 signal pins. All are end stackable without change of contact pitch according to the chart on page 9.

#### 5+2 Row Versions

For use with females with ground return shields and contacts in rows z and f in addition to those above.

#### Short Tail Versions

Standard versions have contact option A in rows a-e with option C in rows z and f on 5+2 row versions.

#### Feedthrough Versions

For midplane connection, 5 row versions mate with standard 5 row Type A/B female connectors and 5+2 row versions mate with Type A/B female connectors having ground return shields. Standard versions use contact options K and T instead of A and C.

Mylar tail guides can be fitted to feedthrough posts to aid assembly to the board.

#### Materials and Finish

Glass filled polyester housing, gray  
UL94 V-0 rated

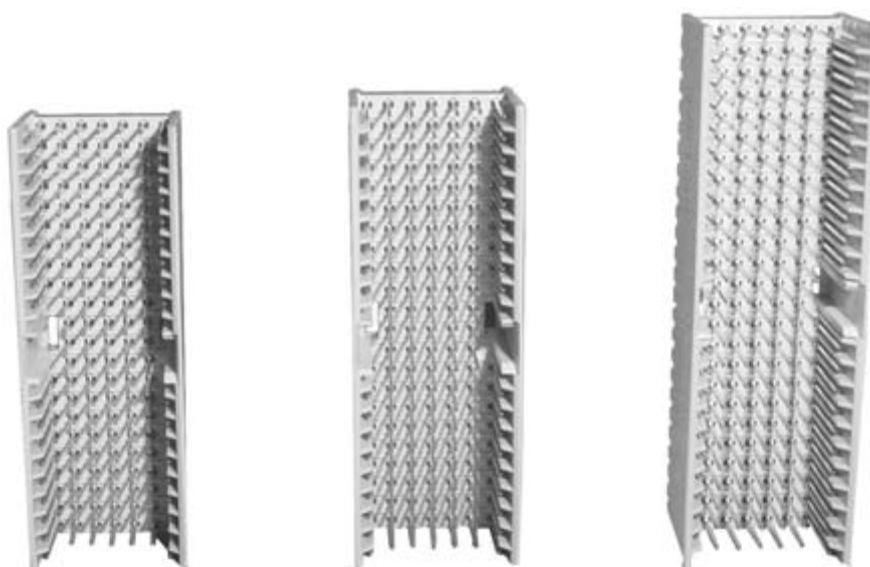
Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over  
1.3µm [.000050] Ni

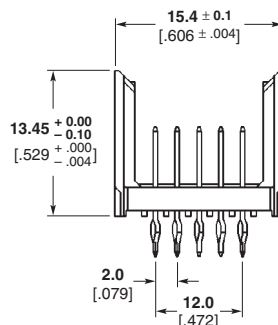
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

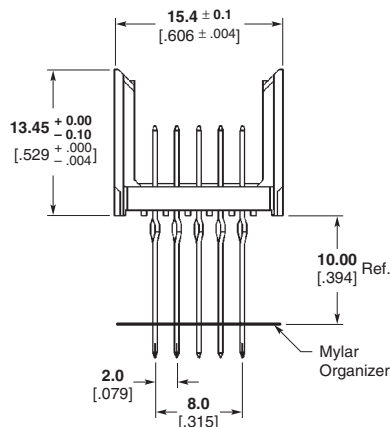
Board layout (see Customer Print).



Type A/B  
Short Tail



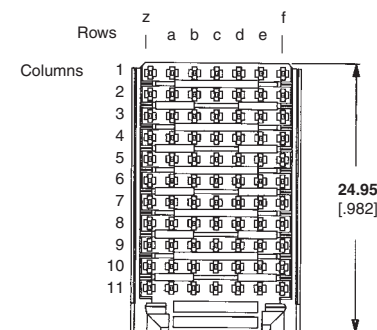
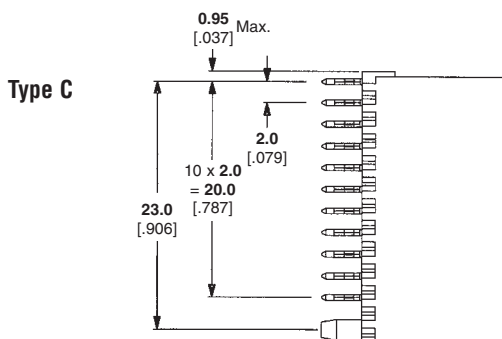
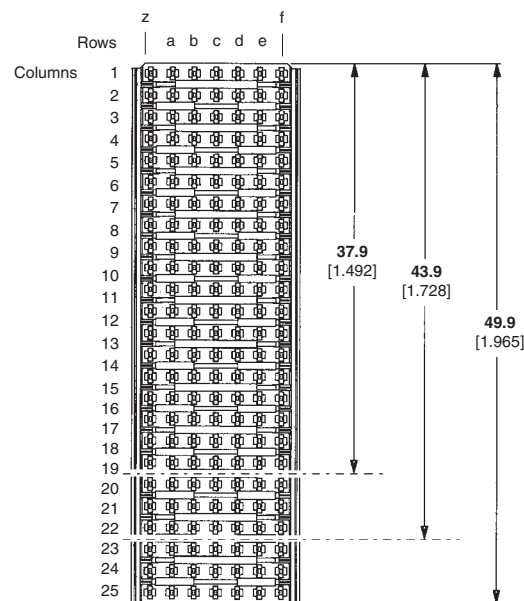
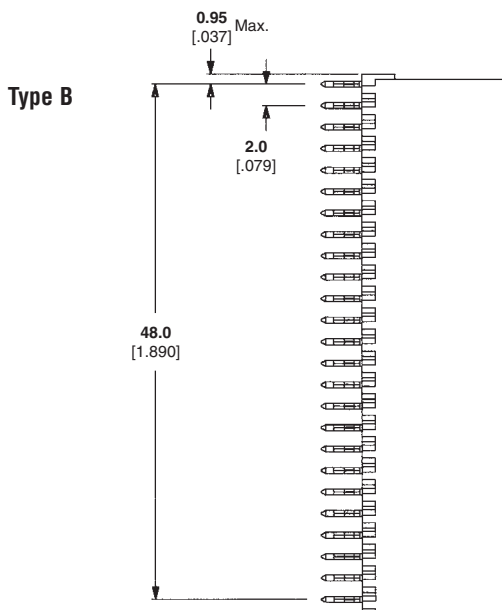
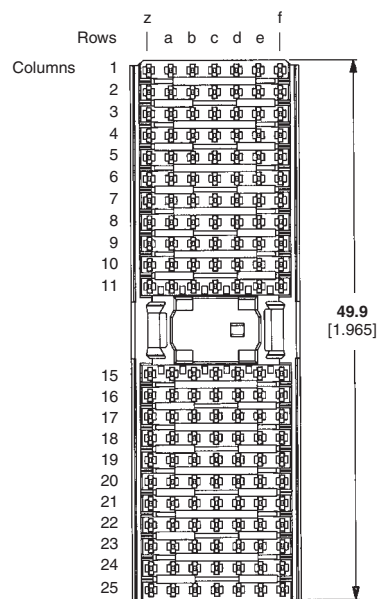
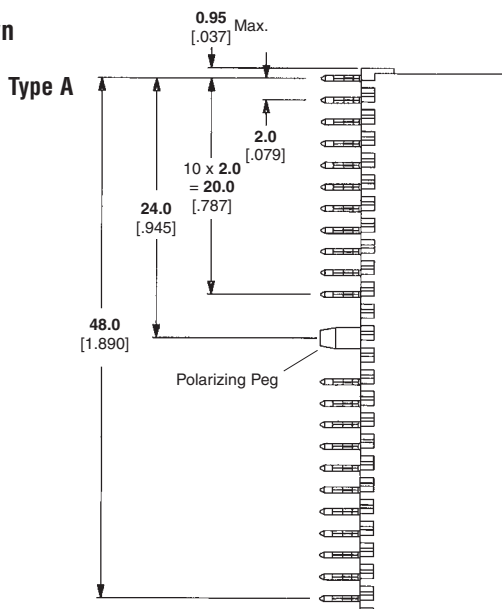
Type A/B  
Feedthrough



| Description   | Part Numbers |          |             |          |
|---------------|--------------|----------|-------------|----------|
|               | Short Tail   |          | Feedthrough |          |
|               | 5 Row        | 5+2 Row  | 5 Row       | 5+2 Row  |
| Type A/B (25) | 646731-1     | 646529-1 | 646938-1    | 646535-1 |
| Type A/B (22) | 646737-1     | 646533-1 | 646949-1    | 646735-1 |
| Type A/B (19) | 646948-1     | 646530-1 | 646950-1    | 646732-1 |

**Vertical Male Connector, 5 Row, Types A, B and C (Continued)**

Short Tail Version Shown





## Right Angle Female Connectors, 5 Row, Types A, B and C

### Right Angle Female Connectors

Types A, B and C female connectors will mate with respective vertical and right angle male connectors and with shrouds shown on pages 10 and 29.

Type A has 110 contacts with center guiding and keying facility, type B has 125 contacts and type C has 55 contacts with end guiding feature. All are end stackable without change of contact pitch according to the chart on page 9.

Four levels of performance are offered; standard, reduced crosstalk, ground return shield and reduced crosstalk + ground return shields. Upper ground return shields are pre-fitted to receptacles; lower shields are supplied and fitted separately as required. 5+2 male connectors are used with ground return shield versions.

For versions other than those shown, refer to page 47 which gives access to other sizes and loading patterns.

Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

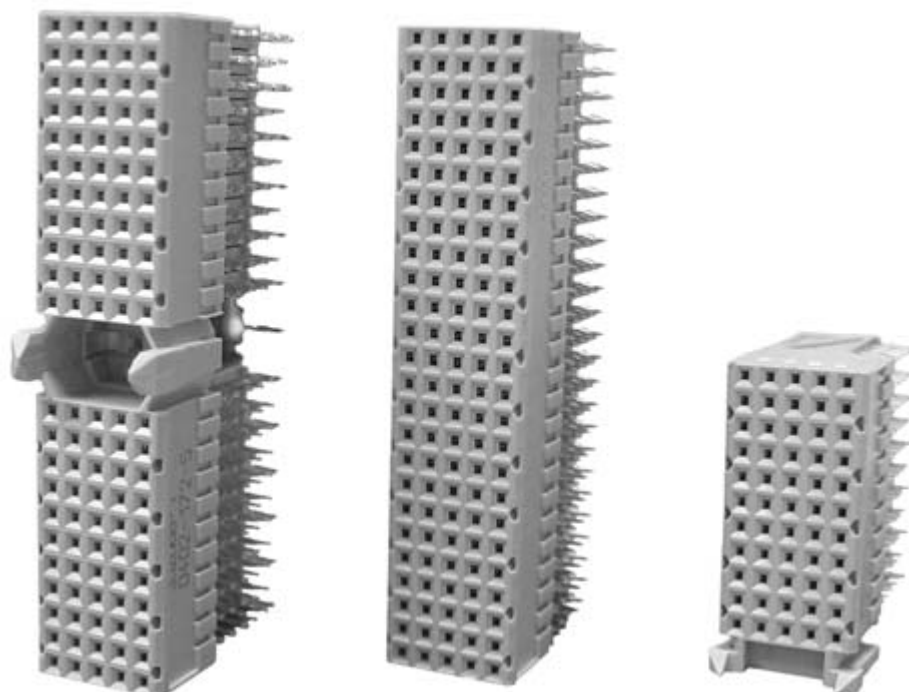
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

Coding keys for type A page 47.

Board layout page 69 for guidance only.

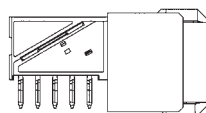
Daughtercard thickness range of 1.4 - 4.3 [.055 - .169] (3.5 [.138] max with lower shield).



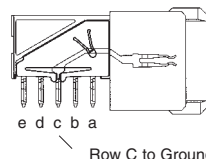
Standard Version

Reduced Crosstalk Version

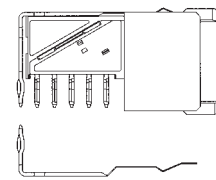
With Upper Shield Attached



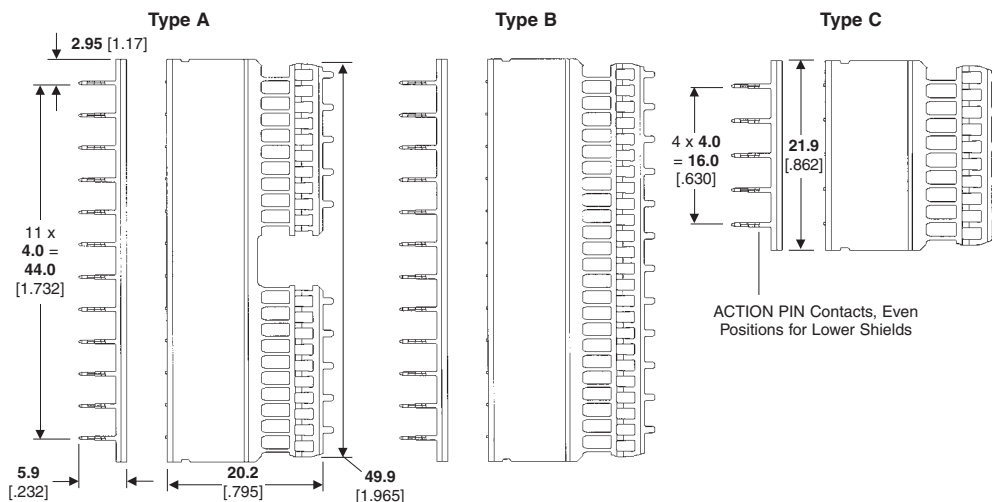
Lower Shields



Row C to Ground



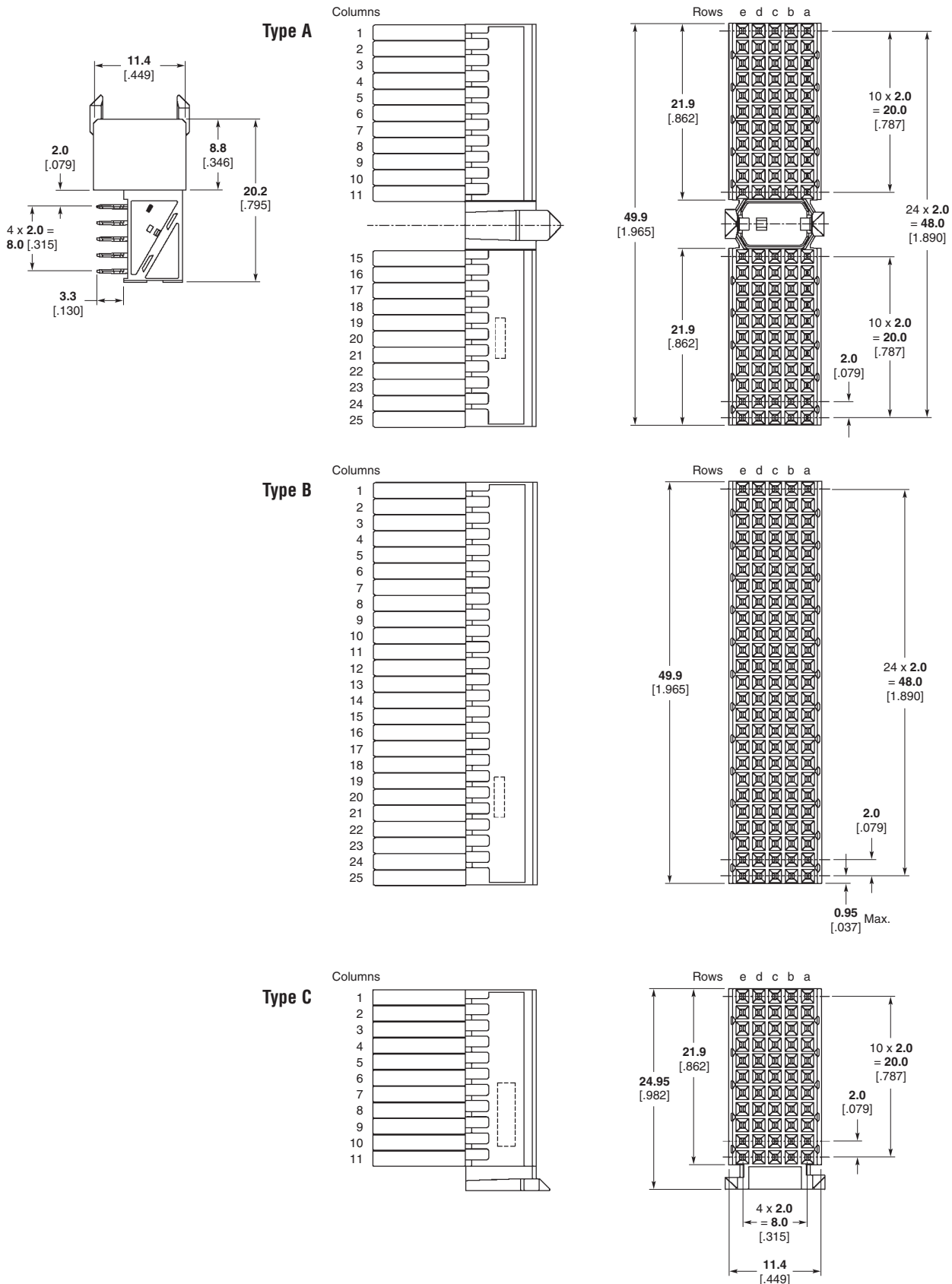
Separate Lower shield



| Description | Part Numbers |                            |                    |                                      |              |
|-------------|--------------|----------------------------|--------------------|--------------------------------------|--------------|
|             | Standard     | Standard with Upper Shield | Reduced Cross Talk | Reduced Cross Talk with Upper Shield | Lower Shield |
| Type A      | 100147-1     | 352068-1                   | 100623-1           | 352344-1                             | 338108-2     |
| Type B      | 100145-1     | 352069-1                   | 100624-1           | 352345-1                             | 338110-2     |
| Type B (22) | 188836-1     | 352152-1                   | —                  | 1345007-1                            | 352468-2     |
| Type B (19) | 352009-1     | 352171-1                   | —                  | 1345008-1                            | 352029-2     |
| Type C      | 100161-1     | 352115-1                   | 188224-1           | 352346-1                             | 352112-2     |

For VME64 and C-PCI versions, see page 48.

**Right Angle Female Connectors, 5 Row, Types A, B and C (Continued)**



## Right Angle Female Connectors, 5 Row, Type A/B

### Type A/B Female Connectors

Type A/B female connector will mate with respective vertical male connector as shown on page 11.

Type A/B connector offers the guidance ability similar to the Type A connector but also utilizes the center three columns for additional signal pin capability which are not found in the Type A connector.

Available in the Type A/B connector are 95 contacts, 110 contacts and 125 contacts. All are end stackable without change of contact pitch according to the chart on page 9.

Two levels of performance are offered; standard and with upper ground return shields. Upper ground shields are pre-fitted to receptacles. 5+2 male connectors are used with ground return shield versions.

### Performance Data pages 6-7.

### Material and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

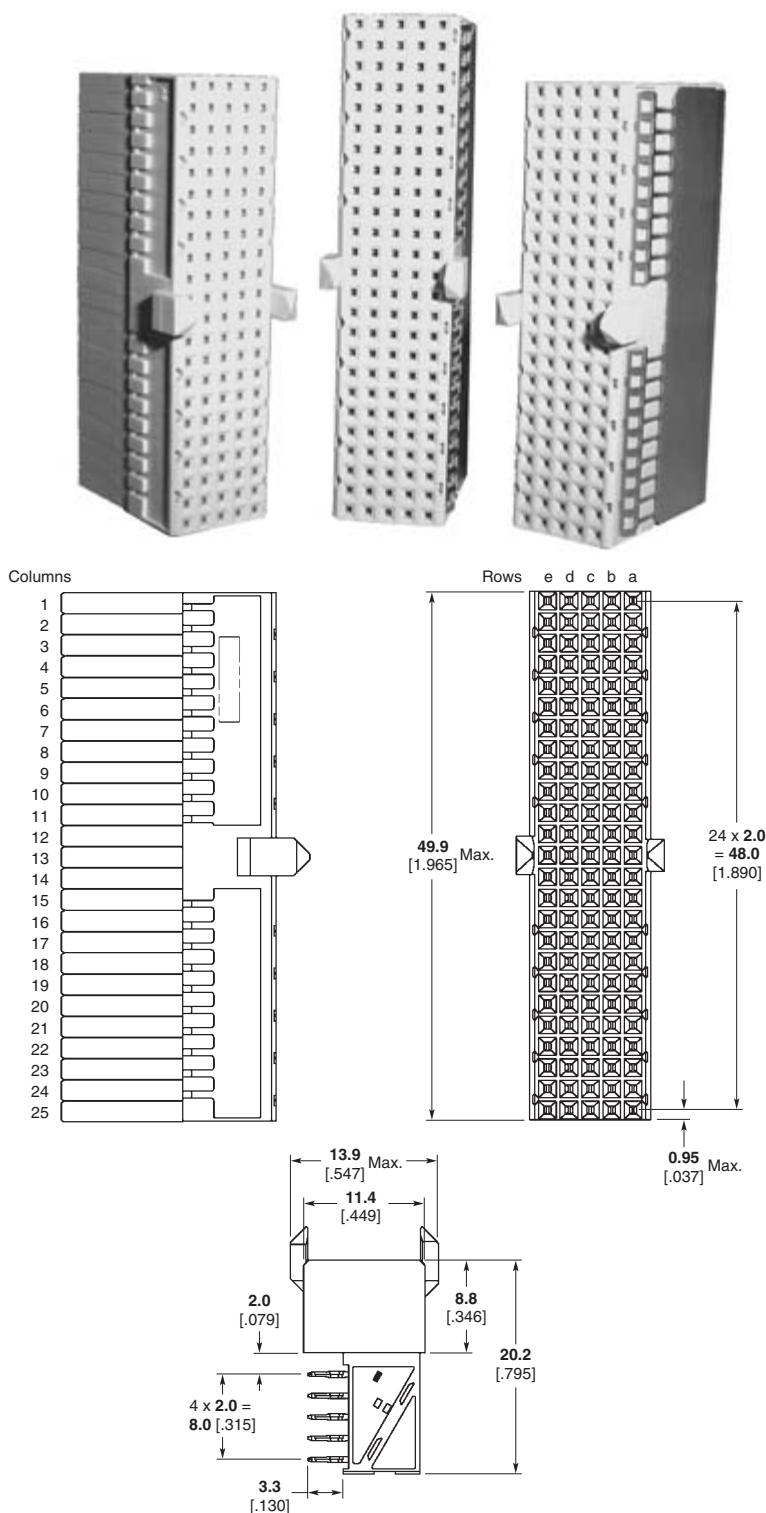
Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020] Sn/Pb over 1.3µm [.000050] Ni

### Board layout (see Customer Print).

### Daughtercard thickness range of 1.4 - 4.3 [.055 - .169].



| Description   | Part Numbers |                            |
|---------------|--------------|----------------------------|
|               | Standard     | Standard with Upper Shield |
| Type A/B (25) | 646574-1     | 646547-1                   |
| Type A/B (22) | 646573-1     | 646489-1                   |
| Type A/B (19) | 646572-1     | 646488-1                   |

## Vertical Male Connectors, 8 Row, Types D, E and F

### Vertical Male Connectors

Types D, E and F mate with respective right angle receptacle connectors shown on page 19.

#### 8 row Versions

For use with unshielded female connectors. Type D has 176 signal pins with center guiding and keying facility, and type E has 200 signal pins and type F has 88 signal pins. They are stackable without change of contact pitch according to the chart on page 71.

#### 8+2 Row Versions

For use with females with ground return shields and have contacts in rows z and i in addition to those above.

#### Short Tail Versions

Standard versions have contact option A in rows a-h with option C in rows z and i on 8+2 row versions.

#### Feedthrough Versions

For midplane connection, 8 row versions mate with standard 8 row female connectors and 8+2 row versions mate with female connectors having ground return shields. Standard versions use contact options K and T instead of A and C.

For versions other than those shown, refer to page 47 which gives access to other sizes and loading patterns.

Guide pin Part No. 532808-1 may be used with type D male connectors to give early alignment.

#### Performance Data pages 6-7.

#### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

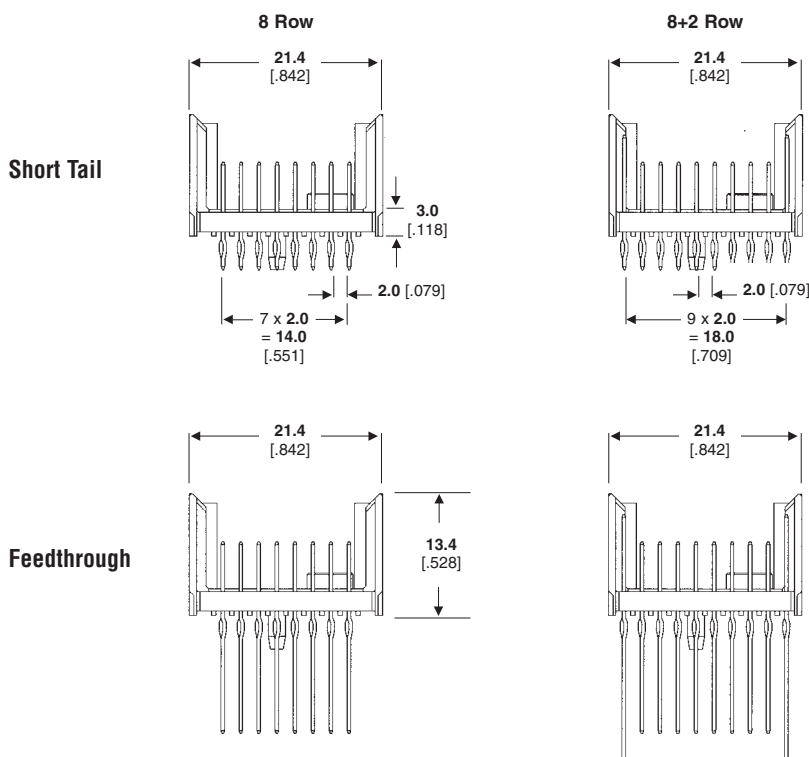
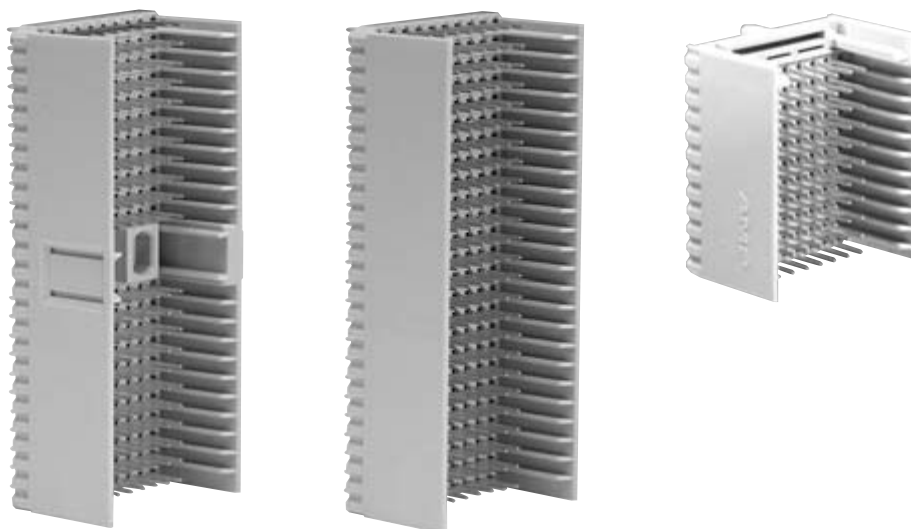
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

#### Coding keys for type D page 47.

#### Board layout page 71 for guidance only.

#### Protection Covers available, see page 33.

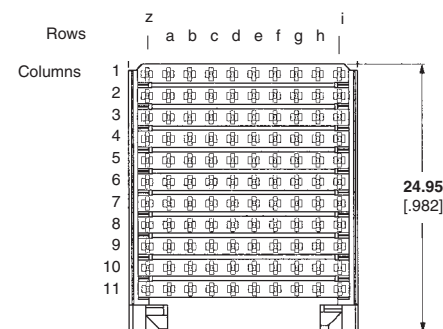
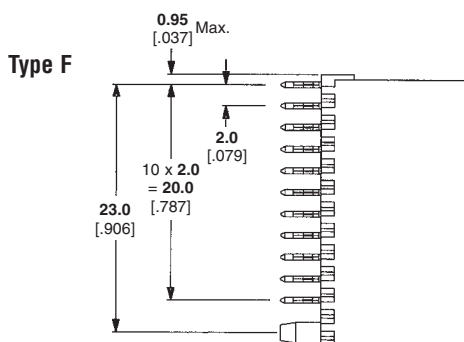
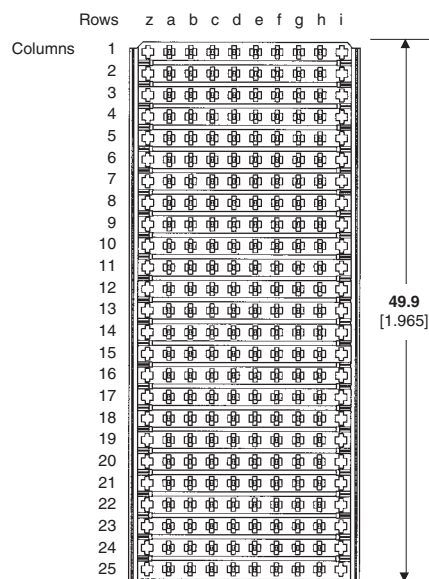
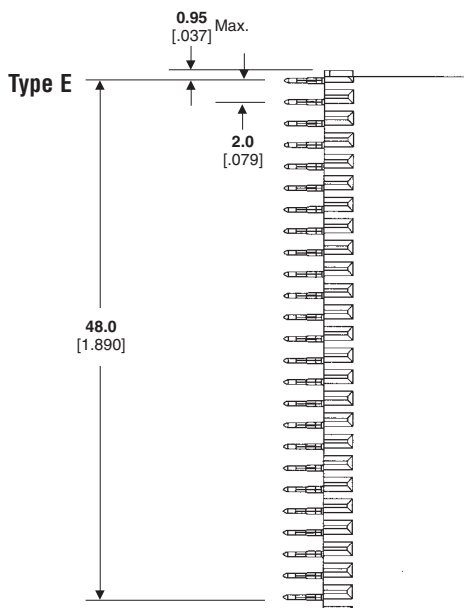
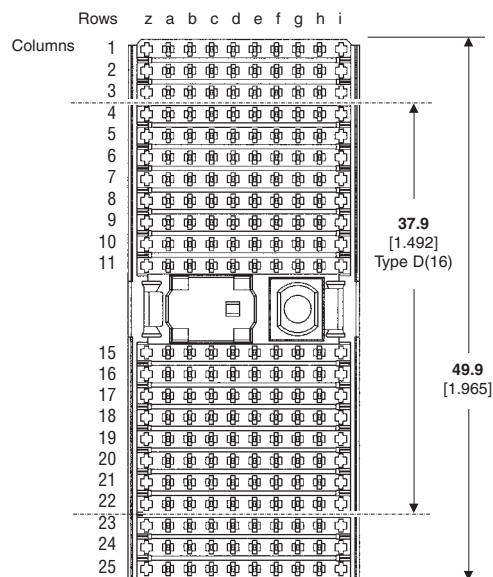
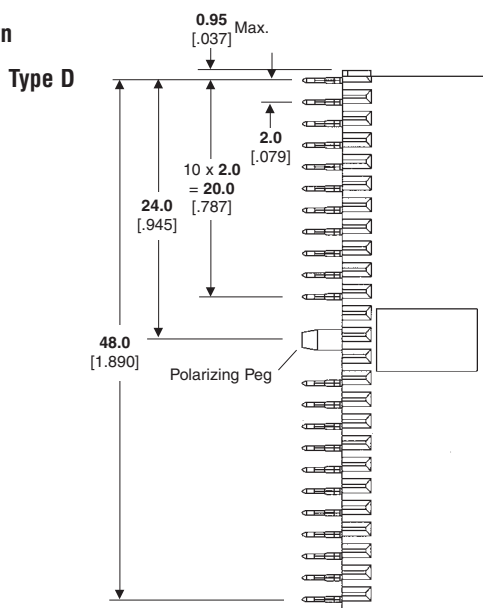


| Description                      | Part Numbers |          |             |          |
|----------------------------------|--------------|----------|-------------|----------|
|                                  | Short Tail   |          | Feedthrough |          |
|                                  | 8 Row        | 8+2 Row  | 8 Row       | 8+2 Row  |
| Type D                           | 646346-1     | 646356-1 | 646372-1    | 646375-1 |
| Type D (16 column, 128 position) | 646362-1     | —        | —           | —        |
| Type E                           | 646347-1     | 646357-1 | 646373-1    | 646376-1 |
| Type F                           | 646457-1     | 646513-1 | 646514-1    | 646515-1 |



# Vertical Male Connectors, 8 Row, Types D, E and F

## Short Tail Versions Shown



## Vertical Male Connectors, 8 Row, Type D/E

### Type D/E Vertical Male Connector

Type D/E male connectors will mate with Type D/E right angle female connectors shown on page 21.

#### 8 row Version

Type D/E connector offers the guidance ability similar to the Type D connector but also utilizes the center three columns for additional signal pin capability which are not found in the Type D connector.

Available in the Type D/E connector are 200 signal pins which are end stackable without change of contact pitch according to the chart on page 9.

#### 8+2 Row Versions

For use with females with ground return shields and contacts in rows z and i in addition to those above.

#### Short Tail Versions

Standard versions have contact option A in rows a-h with option C in rows z and i on 8+2 row versions.

#### Feedthrough Versions

For midplane connection, 8 row versions mate with standard 8 row Type D/E female connectors and 8+2 row versions mate with Type D/E female connectors having ground return shields. Standard versions use contact options K and T instead of A and C.

Mylar tail guides can be fitted to feedthrough posts to aid assembly to the board.

#### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

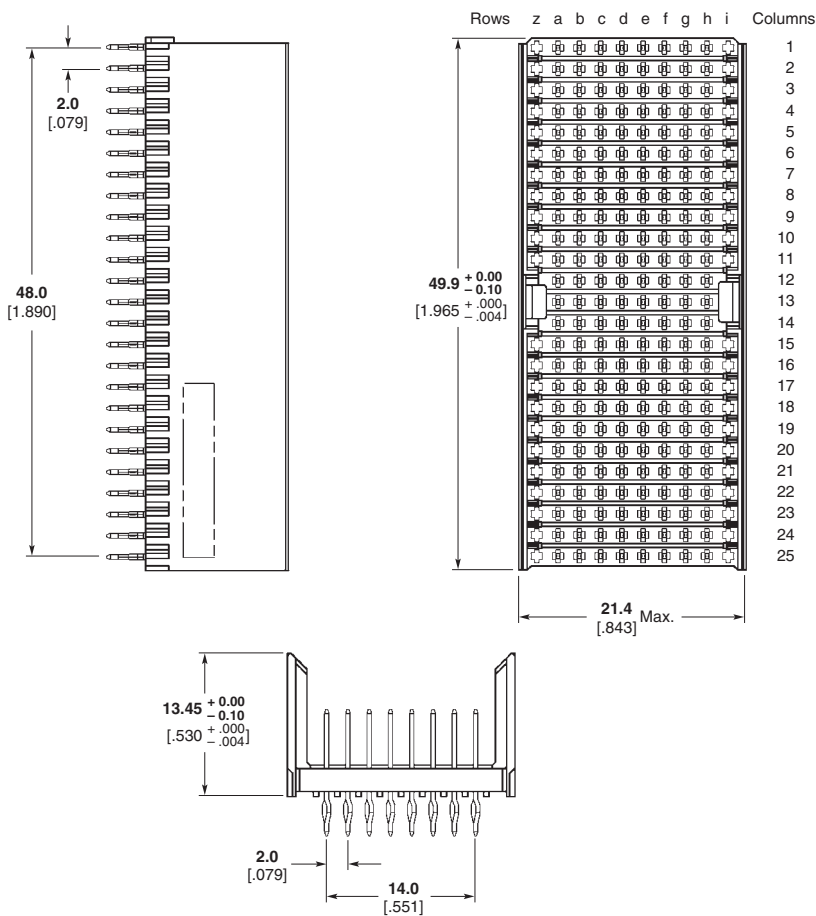
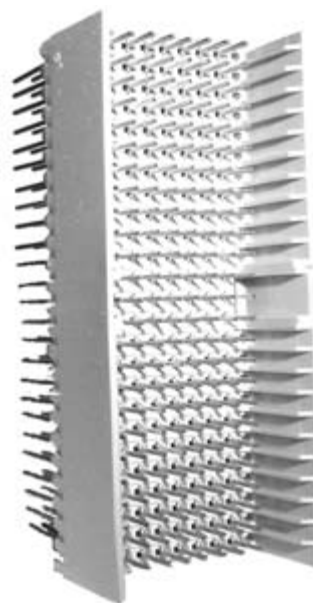
Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

Board layout (see Customer Print).



| Description | Part Numbers |          |             |          |
|-------------|--------------|----------|-------------|----------|
|             | Short Tail   |          | Feedthrough |          |
|             | 8 Row        | 8+2 Row  | 8 Row       | 8+2 Row  |
| Type D/E    | 646729-1     | 646951-1 | 646952-1    | 646953-1 |

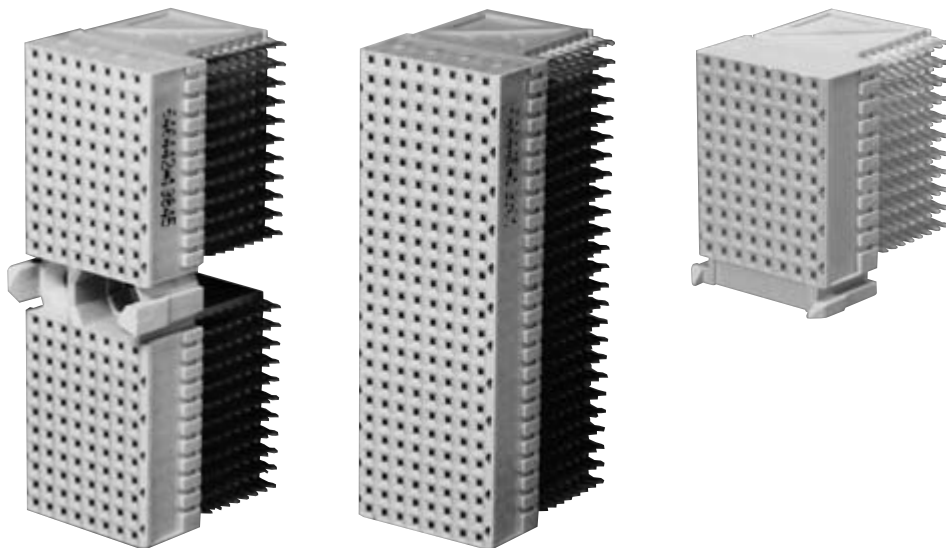
## Right Angle Female Connectors, 8 Row, Types D, E and F

### Right Angle Female Connectors

Types D, E and F female connectors will mate with respective vertical male connectors shown on page 16.

Type D has 176 contacts with center guiding and keying facility and type E has 200 contacts and Type F has 88 contacts. Connectors are end stackable without change of contact pitch according to the chart on page 9. Two levels of performance are offered; standard and ground return shield versions. Upper ground return shields are pre-fitted to receptacles; lower shields are supplied and fitted separately as required. 8+2 male connectors are used with ground return shield versions.

For versions other than those shown, which gives access to other sizes and loading patterns, consult Tyco Electronics.



Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester + LCP housing, gray, UL94 V-0 rated

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

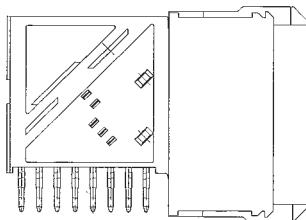
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

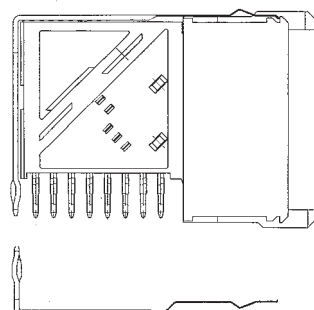
Coding Keys for Type A page 47.

Board layout page 71, for guidance only.

Standard

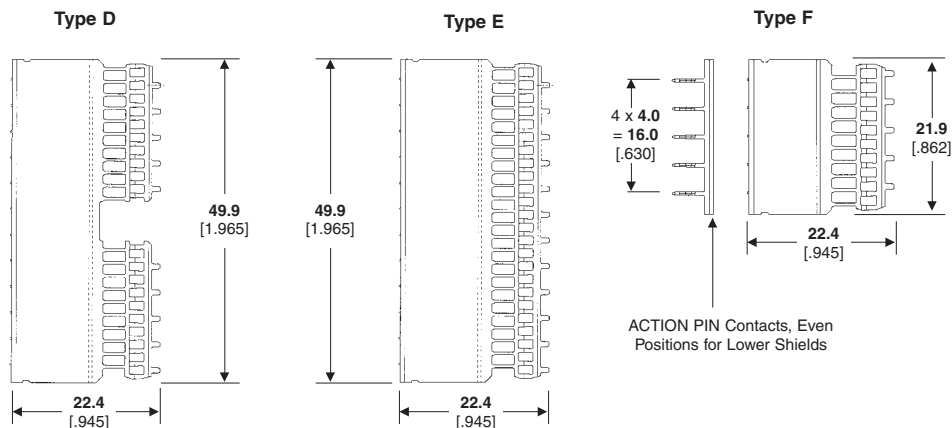


With Shields



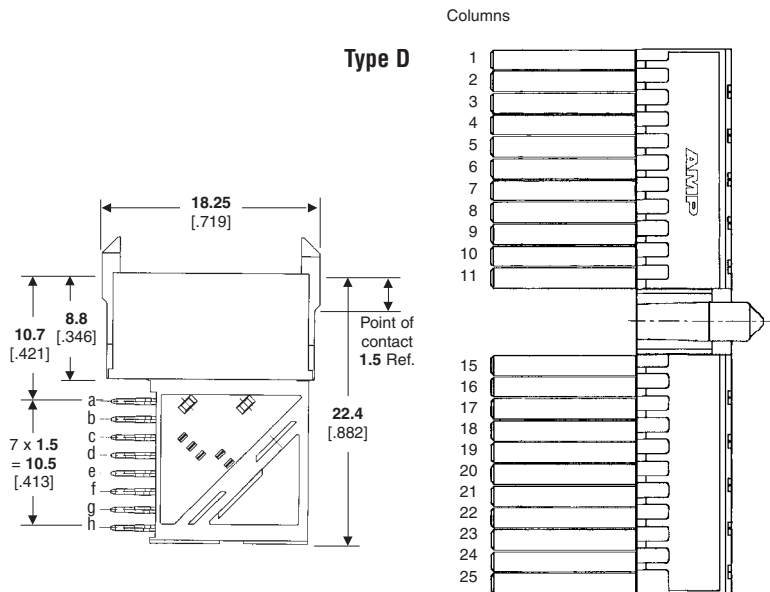
### Shields

Daughtercard thickness range of 1.4 - 4.3 [.055 - .169] (3.5 [.138] max. with lower shield)



| Description | Part Numbers |                            |              |
|-------------|--------------|----------------------------|--------------|
|             | Standard     | Standard with Upper Shield | Lower Shield |
| Type D      | 646442-1     | 646486-1                   | 646428-1     |
| Type D (16) | 646447-1     | —                          | —            |
| Type E      | 646445-1     | 646487-1                   | 646430-1     |
| Type F      | 646446-1     | 646492-1                   | 646493-1     |

**Right Angle Female Connectors, 8 Row, Types D, E and F (Continued)**



**Materials and Finish**

Glass filled polyester housing, gray,  
UL94 V-0 rated

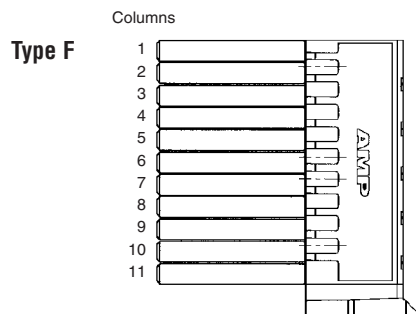
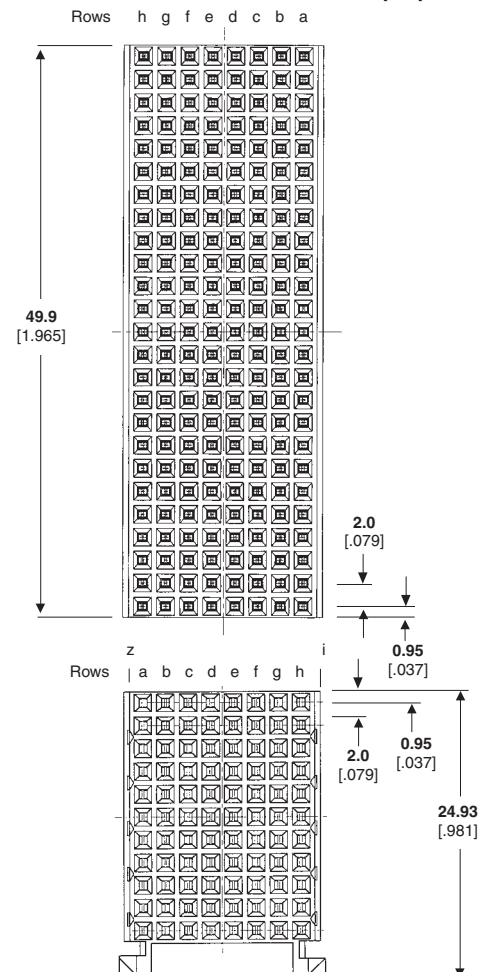
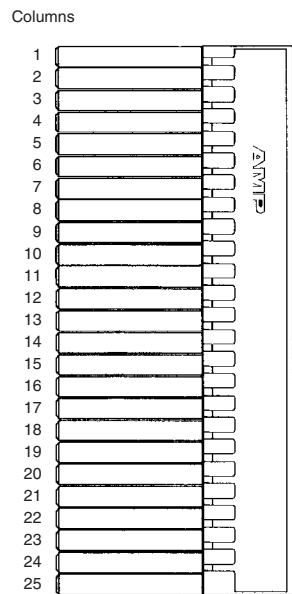
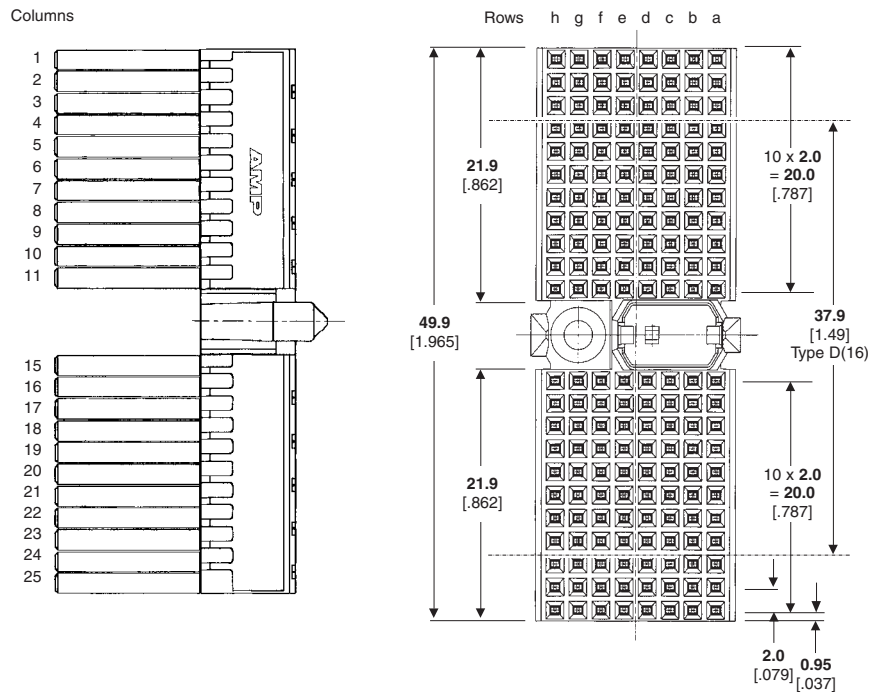
Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over  
1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

**Daughtercard thickness range of  
1.4 - 4.3 [.055 - .169].**





## Right Angle Female Connectors, 8 Row, Type D/E

### Type D/E Female Connectors

Type D/E female connector will mate with respective vertical male connector as shown on page 18.

Type D/E connector offers the guidance ability similar to the Type D connector but also utilizes the center three columns for additional signal pin capability which are not found in the Type D connector.

Available in the Type D/E connector are 200 contacts. All are end stackable without change of contact pitch according to the chart on page 9.

Two levels of performance are offered; standard and with upper ground return shields. Upper ground shields are pre-fitted to receptacles. 8+2 male connectors are used with ground return shield versions.

### Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

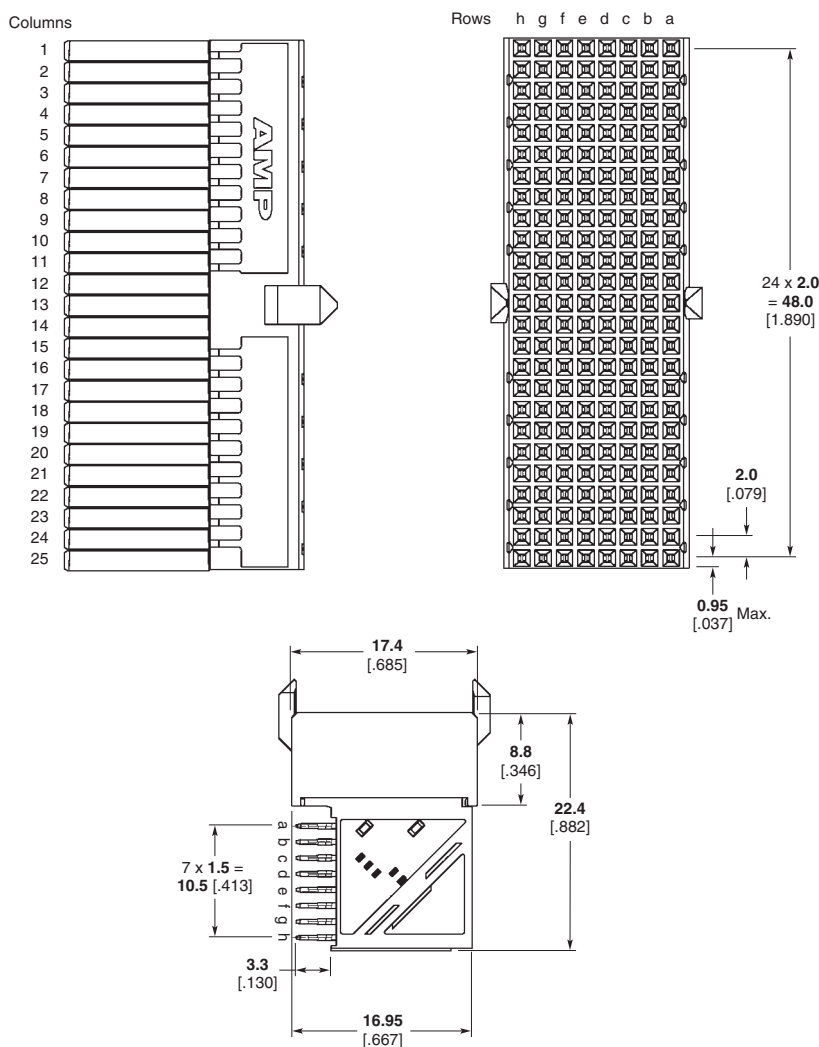
ACTION PIN Contact 0.5µm [.000020]

Sn/Pb

over 1.3µm [.000050] Ni

### Board layout (see Customer Print)

Daughtercard thickness range of  
1.4 - 4.3 [.055 - .169]



| Description | Part Numbers |                            |
|-------------|--------------|----------------------------|
|             | Standard     | Standard with Upper Shield |
| Type D/E    | 646728-1     | 646759-1                   |

## 4 & 4+1 Row Slim Connectors

### 4 & 4+1 Row Slim Connectors

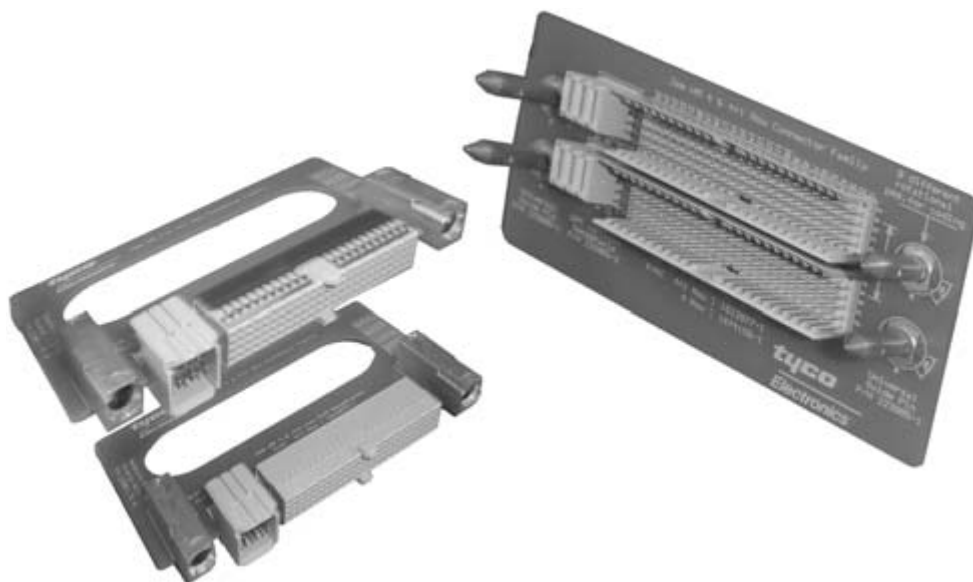
A newly designed Z-PACK 2mm HM 4 row & 4+1 row slim version of the Z-PACK Hard Metric (HM) 5 row standard backplane connector.

#### Application

This Z-PACK 2mm HM 4 row & 4+1 row slim connector is specifically designed to extend the Z-PACK 2mm Hard Metric standard connector product line. The connector enables the usage of Hard Metric practice in Telecommunications and Computer systems, as well as instrumentation applications with slot spacing as narrow as 15mm, giving excellent performance and mechanical characteristics at an economical price.

#### Product Facts

- Z-PACK 2mm HM 4 & 4+1 row slim version of HM 5 row standard connector
- Designed specifically to fit into a 15mm slot spacing and wider
- Designed in accordance with IEC 917-2-2 and IEC 61076-4-101 specifications
- Modular connector with basic module size of 50mm built in 2mm square grid
- Safe Design, complies with IEC950 in mated condition
- 1.4mm (55 mil) minimum backplane thickness
- 1.4 to 2mm (55 – 80 mil) daughtercard thickness range
- Supports applications at data rates up to 2.5 Gb/s (differential signaling) with edge rates of 100 psec., and 1:1 signal to ground ratio (10 pair/20mm), and up to 1.5 Gb/s (differential signaling) under same conditions but with 3:1 signal to ground ratio (15 pair/20mm)



| Description                                             | Part Number |
|---------------------------------------------------------|-------------|
| Right Angle Receptacle 4 row Type A/B with upper shield | 1612872-1   |
| Vertical Header 4+1 row Type A/B (122 pos.)             | 1612877-1   |
| Right Angle Receptacle 4 row Type A/B                   | 1612913-1   |
| Vertical Header 4 row Type A/B (100 pos.)               | 1674156-1   |
| <b>Insertion Tools</b>                                  |             |
| Vertical Header                                         | 1-715836-1  |
| Right Angle Receptacle                                  | 1596463-1   |

## 4 & 4+1 Row Slim Connectors (Continued)

### Product Dimensions

#### Typical Electrical Properties

##### Flexible Pin Assignment for Differential Pair

—Max. Noise at 100ps Edge Rate  
(AA)S — G = 1:1 Across the Column  
Suitable for Data Rate — 2.5 Gb/s and up  
Near End Noise — 3.4%  
Far End Noise — 1.4%  
(BB)S — G = 1:1 in Column  
Suitable for Data Rate — 2.5 Gb/s and up  
Near End Noise — 1.8%  
Far End Noise — < 1%  
(CC)S — G = 3:1  
Suitable for Data Rate — 1.5 Gb/s  
Near End Noise — 6.4%  
Far End Noise — < 1%

##### Flexible Pin Assignment for Single Ended

—Max. Noise at 500ps Edge Rate  
S — G = 1:1  
Frequency — 200MHz (Max 400 Mb/s)  
Near End Noise — 4.0%  
Far End Noise — 1.2%

### Technical Documents

#### Focus on Global Standards Consortium

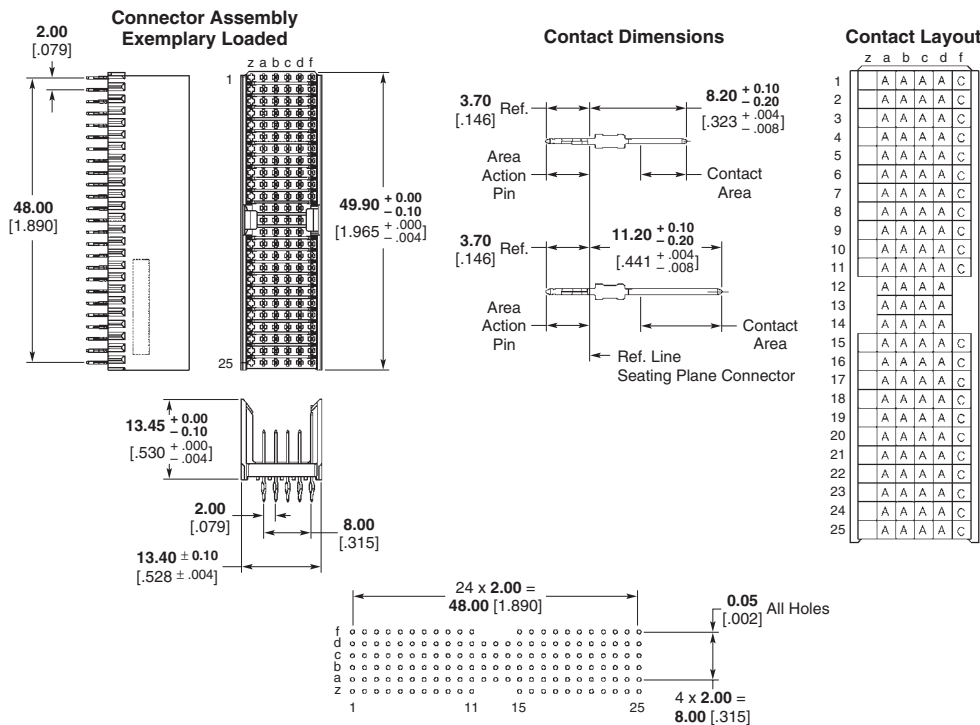
##### Base Station

OBSAI (Open Base Station Architecture Initiative) Established in Oct/02: <http://www.obsai.org/index.asp> Nokia/Samsung/LG/Hyundai/Syscom/ZTE

##### E-PON (Ethernet Passive Optical Network)

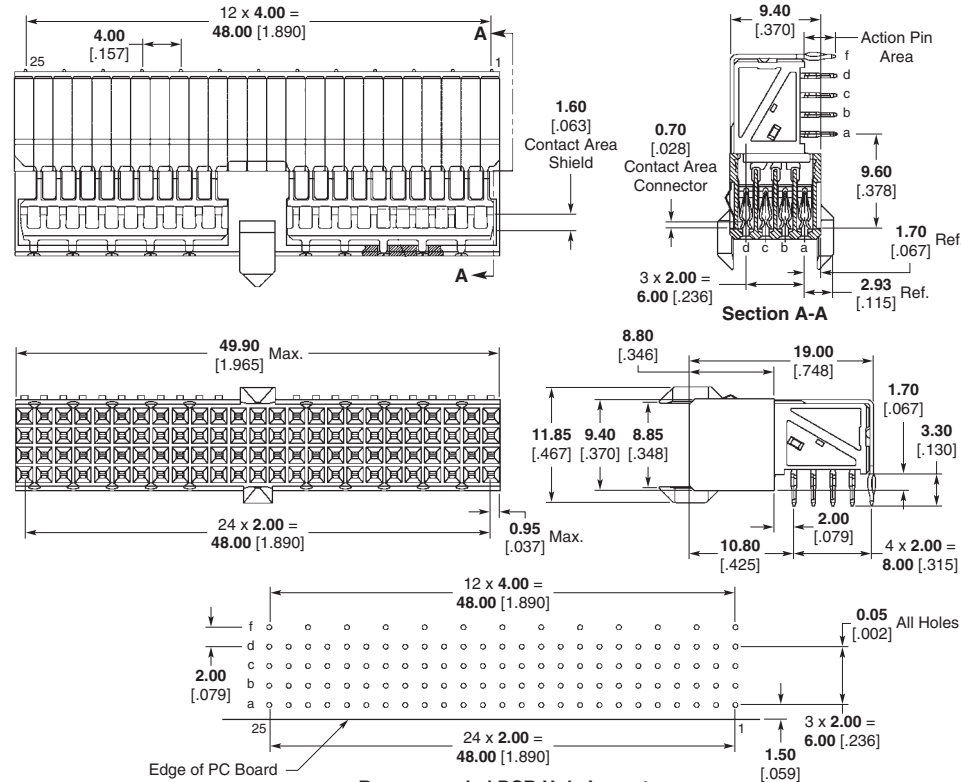
Not Standards yet but some Ad-hoc level working group in IEEE802.3 <http://www.ieee802.org/3/efm/baseline/index.html>

### Vertical Header



Recommended PCB Hole Layout  
Component Side Shown

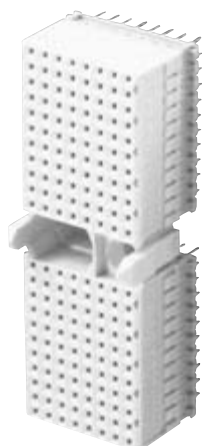
### Right Angle Receptacle



Recommended PCB Hole Layout  
Component Side Shown

Recommended PC Board Thickness 1.60 ± 0.16 [0.063 ± 0.006]

## Vertical Female Connectors, 8 Row, Types D, E, and F



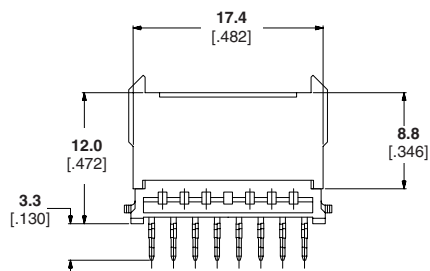
Type D Shown

### Vertical Female Connector

Type D, E, and F mate with respective vertical male connectors shown on page 18. They are used in stacking applications offering high density in a limited space.

### Materials and Finish

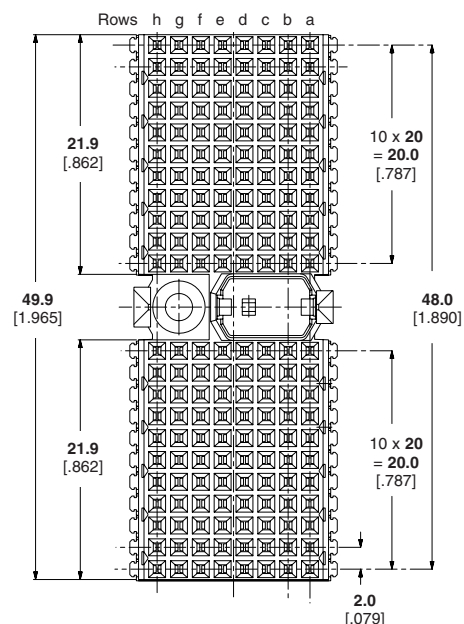
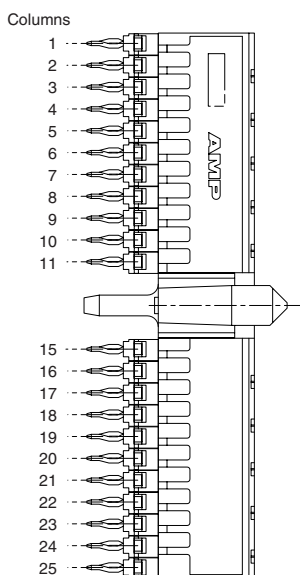
Glass filled polyester housing, gray,  
UL94 V-O rated  
Phosphor-bronze signal contacts  
Contact area 0.8µm [.000030] Au over  
1.3µm [.000050] Ni  
ACTION PIN Contact 0.5µm [.000020]  
Sn/Pb over 1.3µm [.000050] Ni



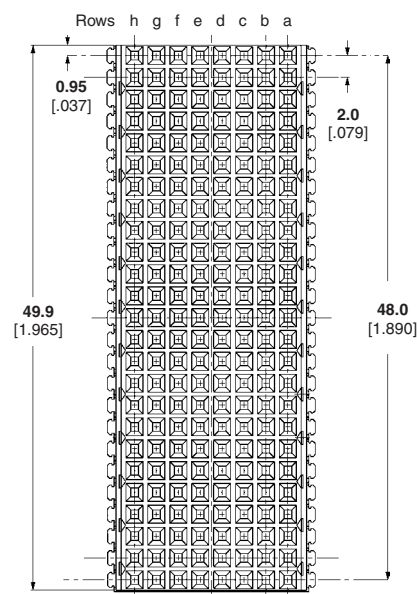
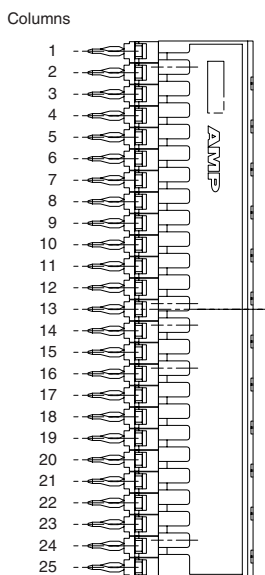
Type F Shown

| Description | Part Numbers |
|-------------|--------------|
| Type D      | 646538-1     |
| Type E      | 646539-1     |
| Type F      | 646540-1     |
| Type D/E    | 646773-1     |

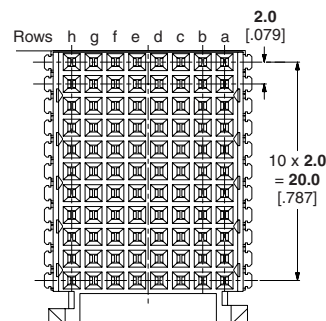
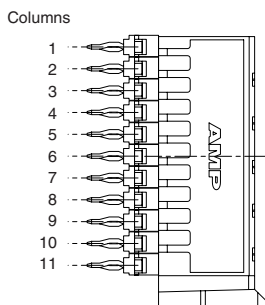
### Type D



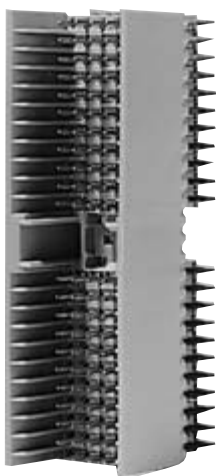
### Type E



### Type F



## Right Angle Male Connectors, Type A, B, C



### Right Angle Male Connector

Used for card extender and reverse sex daughter-to-backplane application

Types A, B and C connectors mate with respective right angle female connectors for card extenders and with vertical female connectors for reverse sex connection. Refer to pages 13 and 27.

Type A has 110 contacts with center guiding and keying facility; Type B has 125 contacts and Type C has 55 contacts with guiding feature. Standard versions have pins with mating level 1; see page 47 for other options.

Two performance levels are available; standard and reduced crosstalk

Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated

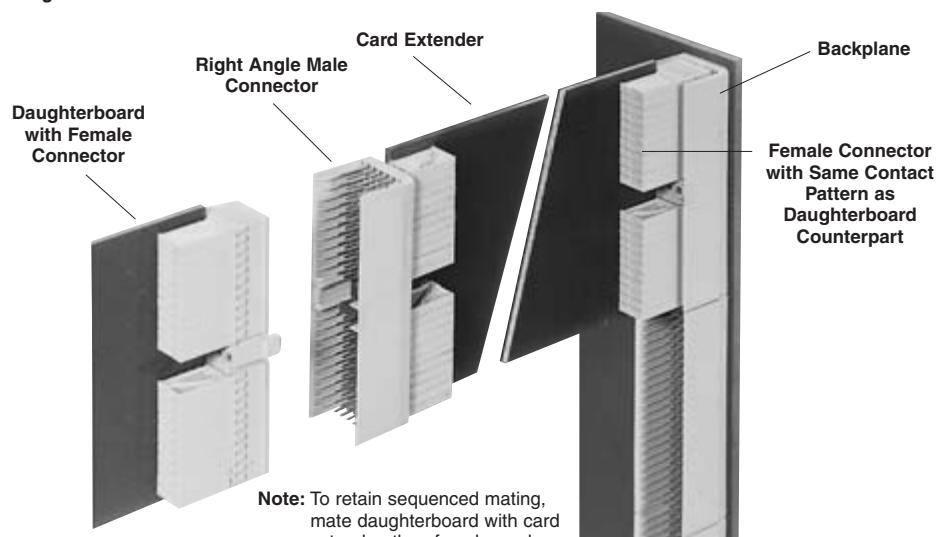
Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020] Sn/Pb over 1.3µm [.000050] Ni

Coding keys for type A page 47.

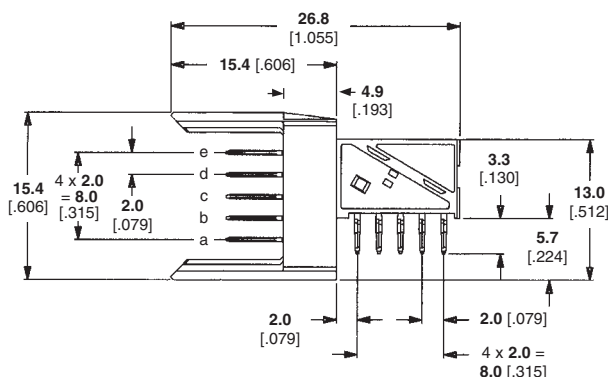
Board layout page 69 for guidance only.

### Arrangement

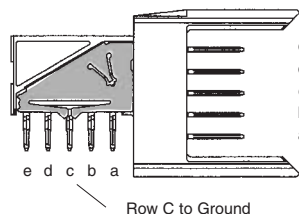


### Side Elevation

#### Standard Version



**Reduced crosstalk version.**  
Same dimensions as standard version. Consult Tyco Electronics.

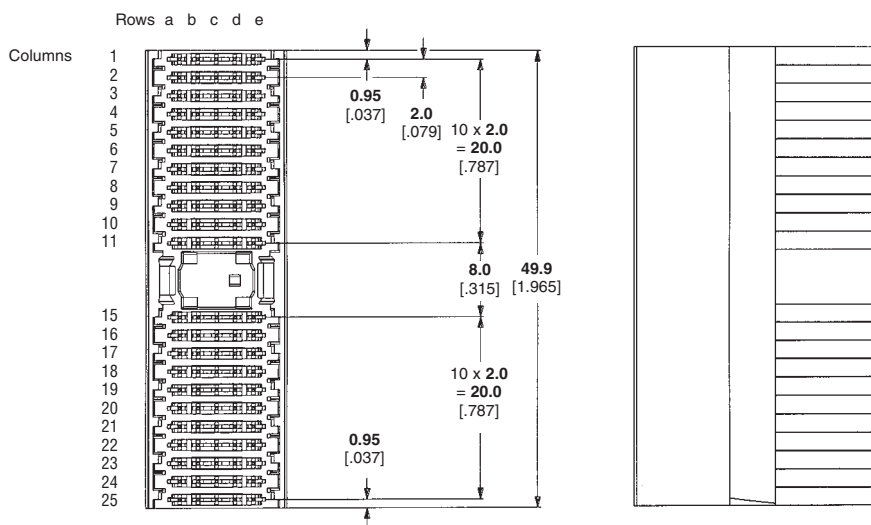


| Description  | Part Numbers |                   |
|--------------|--------------|-------------------|
|              | Standard     | Reduced Crosstalk |
| Type A       | 106015-1     | 352271-1          |
| Type B       | 106014-1     | 352272-1          |
| Type B 22col | 352131-1     | —                 |
| Type B 19col | 352406-1     | —                 |
| Type C       | 106012-1     | 352273-1          |

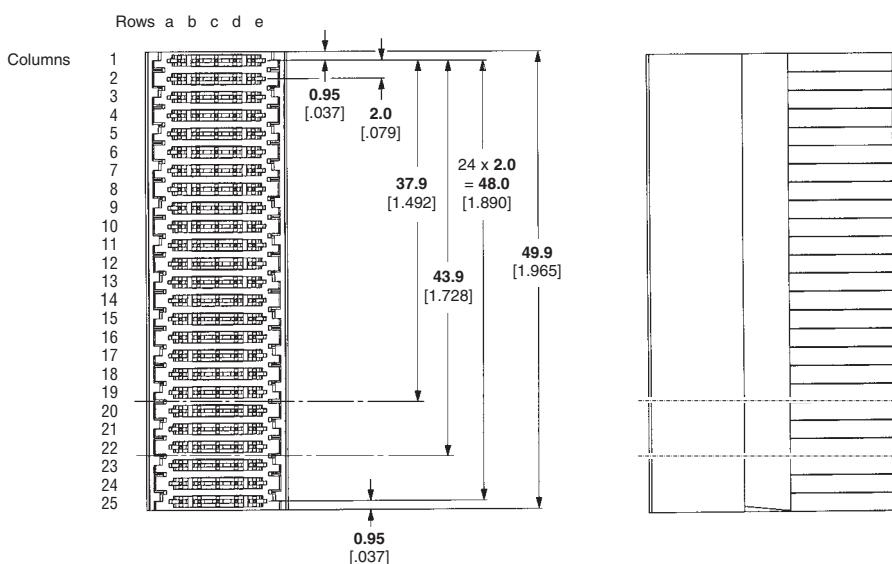


**Right Angle Male Connectors, Type A, B, C (Continued)**

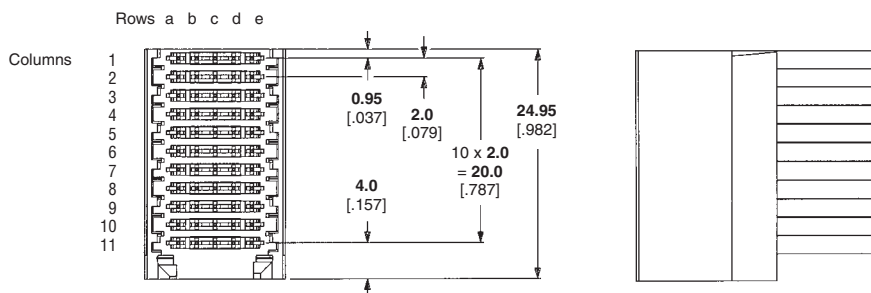
**Type A, 110 Signal Pins,  
50mm Module**



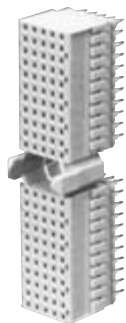
**Type B, 125 Signal Pins,  
50mm Module**



**Type C, 55 Signal Pins,  
25mm Module**



## Vertical Female Connectors, 5 Row, Types A, B, and C



### Vertical Female Connectors

Types A, B and C mate with respective right angle and vertical male connectors shown on pages 10 and 25.

Type A has 110 contacts and center keying and guiding. Type B has 125 contacts and Type C has 55 contacts with guiding feature. All are stackable without change in contact pitch according to the chart on page 9.

Limited other contact patterns are available; see page 47.

Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing.

Phosphor-bronze signal contacts

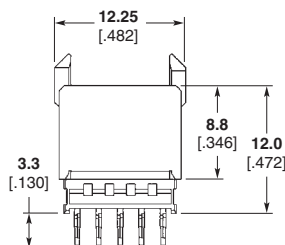
Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

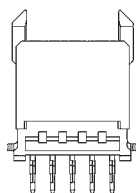
Sn/Pb over 1.3µm [.000050] Ni

Coding keys for type A page 47.

Board layout page 69 for guidance only.

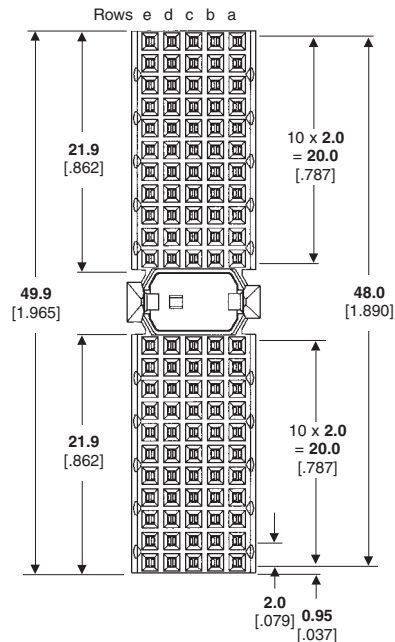
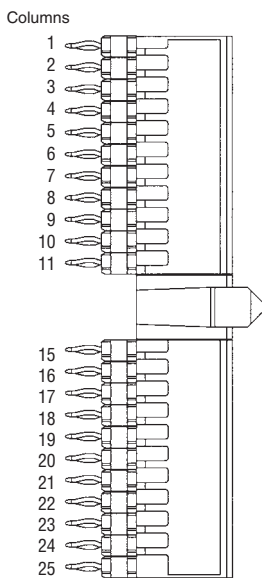


Type A shown

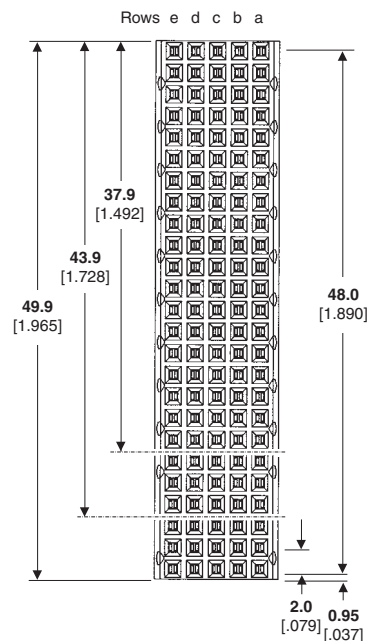
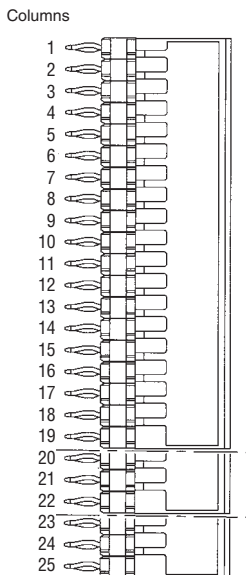


Optional Configuration

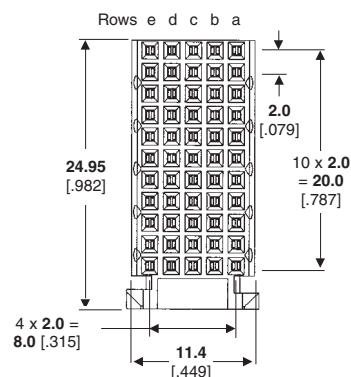
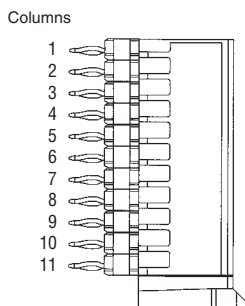
### Type A



### Type B



### Type C



| Description                   | Part Numbers |
|-------------------------------|--------------|
| Type A (without locating peg) | 106773-1     |
| Type A (with locating peg)    | 352457-1     |
| Type B                        | 106774-1     |
| Type B 22 col                 | 352268-1     |
| Type B 19 col                 | 352269-1     |
| Type C                        | 106775-1     |

## Midplane Board-to-Board Arrangements

### Midplane Connection

Daughterboards can be connected to either side of a backplane in parallel, asymmetric parallel and cross connect configuration. Vertical male connectors with feedthrough pins are used with shrouds and spacers.

Feedthrough pins can be in 5, 5+2, 8 or 8+2 row configuration. Spacers are selected according to backplane thickness to give the required resultant post mating level. See page 31.

Optional one piece shrouds available. See page 32.

Daughtercard connectors are the same for front and rear using types A, B, C, D, E and F.

### Parallel Connection

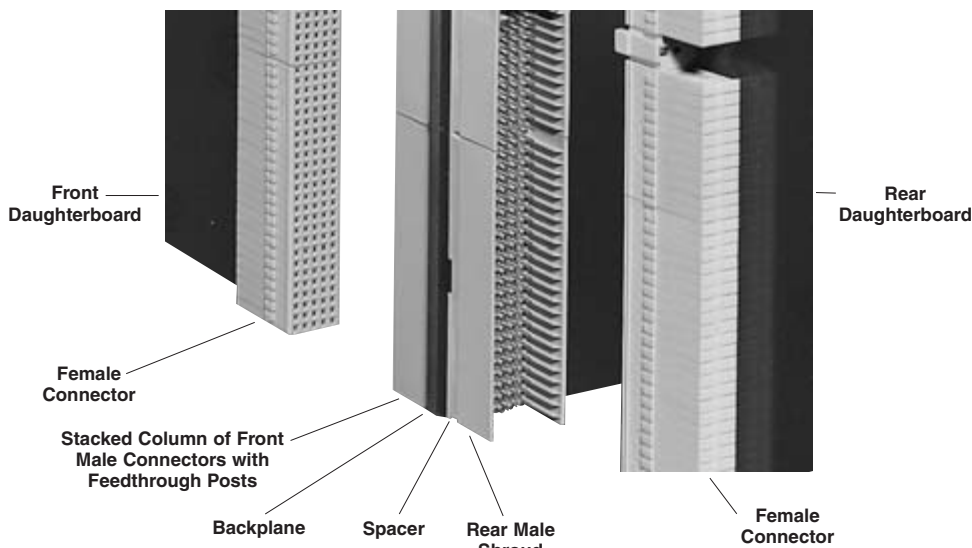
Parallel connection can be symmetric, where the daughtercards are the same way up, or asymmetric, where they are reversed. Column numbers are reversed on the backplane rear with symmetric orientation.

### Cross Connect

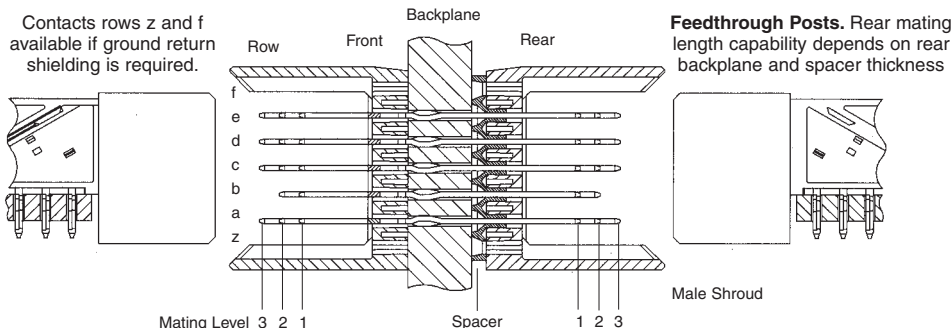
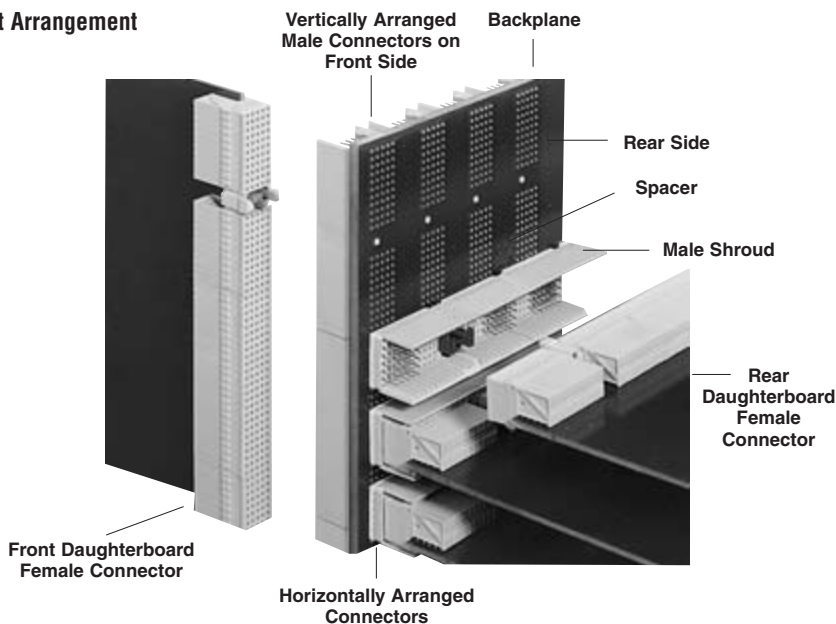
Cross connect can be configured with spacers and shrouds as above giving a matrix of pins where male connectors and shrouds coincide, or selective loaded male connectors can be used at the rear, with empty positions to allow for feedthrough posts from the front. Post options U, V, or X must be used. When male connectors are used front and rear, spacers cannot be used to adjust post lengths.

All arrangements can use receptacles with ground return shields. Consult Tyco Electronics if EMI/RFI shielding is required.

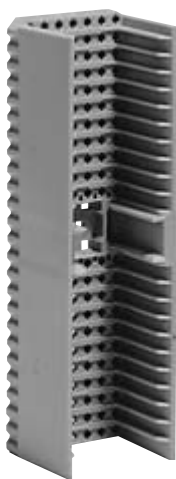
### Vertical Board Arrangement, shown with symmetrical daughterboards



### Cross-connect Arrangement



## Male Shrouds (ZIF Style)



### ZIF Shrouds

Zero insertion force shrouds are used with spacers which have two functions.

- Allows the shroud to fit over the pins without scratching the surface, yet retain the shroud when pressed in position.
- Compensate for differing backplane thicknesses to provide required pin mating levels.

Spacers are fitted to shrouds and then assembled to the pins.

Clamping is effected by pressing the shroud with a male insertion tool.

5 row shrouds are suitable for 5 or 5+2 rows of pins; likewise 8 row shrouds are suitable for 8 or 8+2 rows.

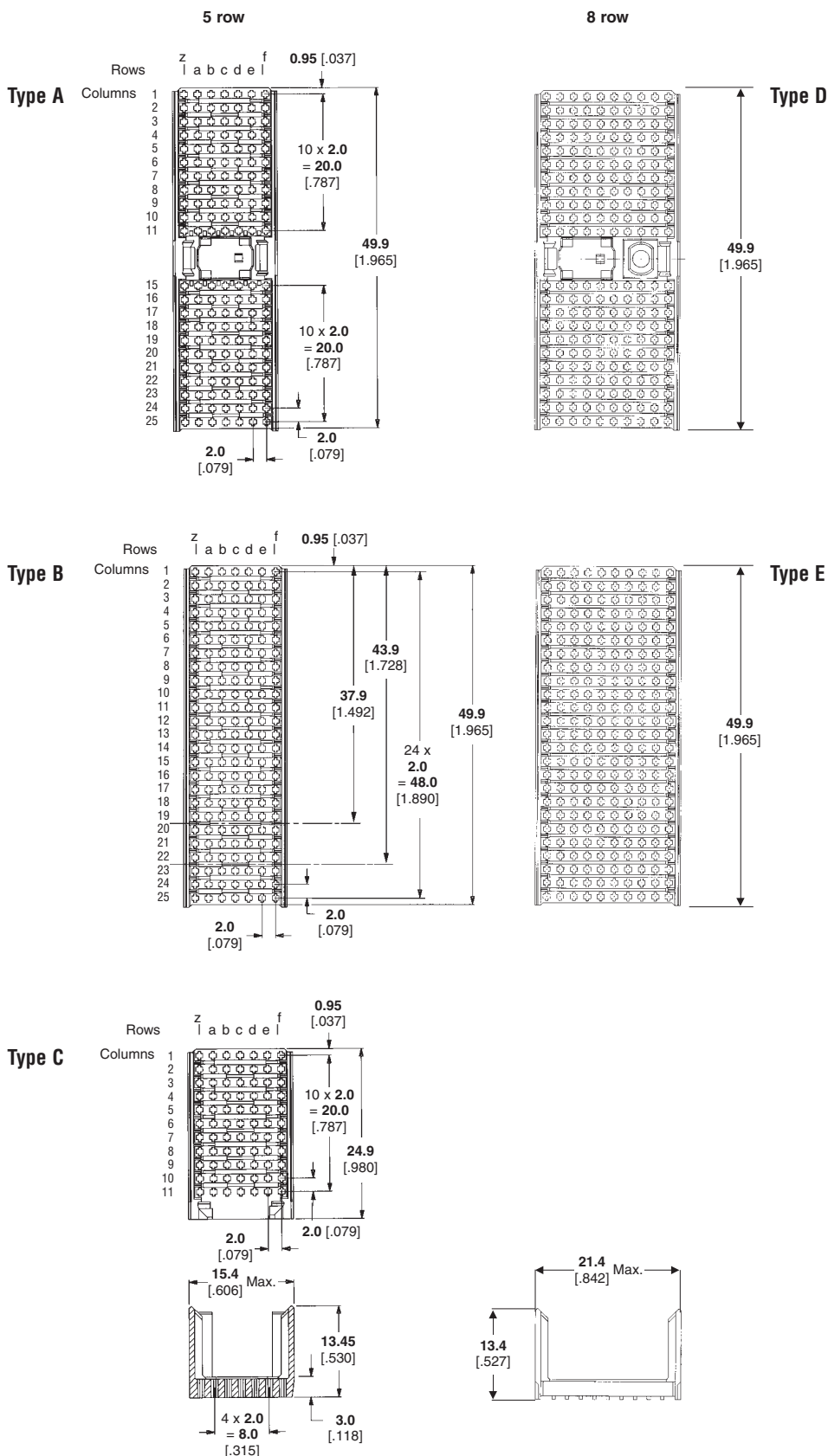
Performance data pages 6-7.

### Materials

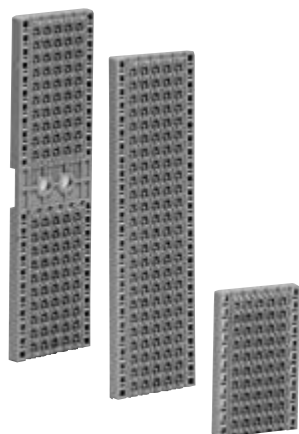
Glass filled polyester housing, gray, UL94 V-0 rated

Coding Keys for type A page 47.

| Shroud Type | Part Numbers |
|-------------|--------------|
| A           | 106137-2     |
| B           | 106138-2     |
| 19 col B    | 352011-2     |
| 22 col B    | 352130-2     |
| C           | 106182-2     |
| D           | 646370-1     |
| E           | 646345-1     |



## Spacers for Type A, B, and C Male ZIF Shrouds



### Spacers

Spacers are available to suit the shrouds on the page opposite in various thicknesses to compensate for a range of backplane thicknesses.

The sum of backplane and spacer thickness could be 4.7 [.185], which would give pin mating levels equivalent to those of a pin header, but users should study the conditions overleaf in view of large backplane thickness tolerances.

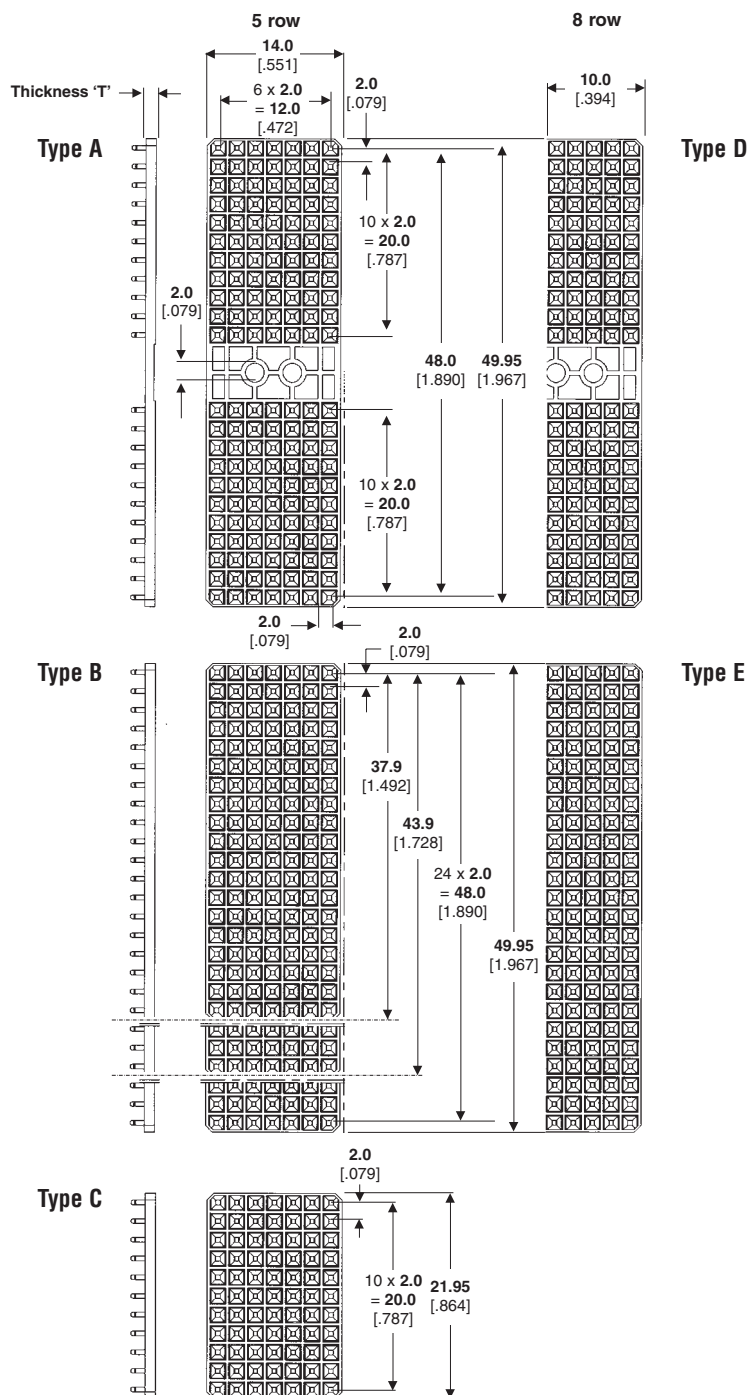
If this dimension cannot be met, use the data overleaf to select pin lengths to compensate for thicker or thinner backplane/spacer combinations.

Spacers are assembled to shrouds before fitting over pins, and then pressed down using a male insertion tool. The tapered projections grip the pins and help to ensure true positioning of the pin tips.

**Note:** Two spacers are used for each 8 row shroud

### Materials

Polyester, gray, UL94 V-0 rated.



| Spacer Type<br>T | 0.9 [.035] | 1.1 [.043] | 1.3 [.051] | 1.5 [.059] | 1.7 [.067] | 1.9 [.075] |
|------------------|------------|------------|------------|------------|------------|------------|
| A                | 106457-2   | 106457-3   | 106457-4   | 106457-5   | 106457-6   | 106457-7   |
| B                | 106458-2   | 106458-3   | 106458-4   | 106458-5   | 106458-6   | 106458-7   |
| 19 col B         | 352012-2   | 352012-3   | 352012-4   | 352012-5   | 352012-6   | 352012-7   |
| 22 col B         | 352129-2   | 352129-3   | 352129-4   | 352129-5   | 352129-6   | 352129-7   |
| C                | 100773-2   | 100773-3   | 100773-4   | 100773-5   | 100773-6   | 100773-7   |
| D*               | 646386-1   | 646386-2   | 646386-3   | 646386-4   | 646386-5   | 646386-6   |
| E*               | 646387-1   | 646387-2   | 646387-3   | 646387-4   | 646387-5   | 646387-6   |

\* Two spacers per shroud



## Spacer Selection

For midplane arrangements, it is generally a requirement to have the same contact sequencing on the front and rear of the backplane.

This can be achieved using the chart below. A simple solution would be to select a spacer such that the combined backplane and spacer thickness have a maximum thickness of 4.7 [.185] using pins having the same mating level front and rear (see page 66).

If this is not possible, then sequenced mating can still be achieved using other pin versions, with either longer or shorter tail lengths according to the backplane thickness, but three mating levels will not be achievable.

The following limits of exposed post length should be adhered to:

- Minimum 5.3 [.209]
- Maximum 8.3 [.327] except post which mates with right angle female connector row b, which must be 6.8 [.268] max.
- These dimensions are different from those given elsewhere in this catalog because they allow for component tolerances in deriving the resultant post length.
- Backplane tolerances are not included.

### Example

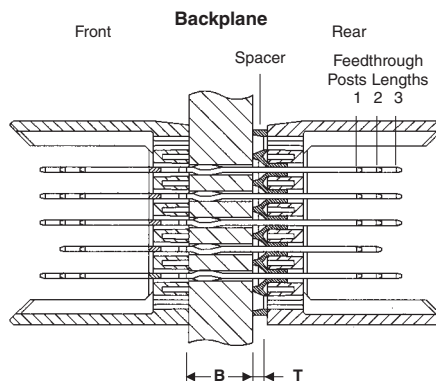
Backplane thickness = 3.0 [.118] and three levels of mating are required. Backplane thickness tolerances are generally +/-10%, giving a maximum value of 3.3 [.130].

From the chart, three mating levels are achieved on the line where  $b + t = 4.7$  [.185], and the pins can be selected from K, L or M for post length 5.3 [.209], N, P, or Q for post length 6.8 [.268] and R, S or T for post length 8.3 [.327], dependent on the front pin length required. Note that posts longer than 6.8 [.268] cannot be mated to row b on right angle receptacles See page 66.

If  $b + t = 4.7$  [.185] and the backplane thickness  $b = 3.3$  [.118], required spacer  $t$  must be 1.4 [.055] thick. Select the spacer which is this thickness or the next thinner one. The next value below this is 1.3 [.051].

With minimum backplane thickness of 2.7 [.106] and spacer of 1.3 [.051],  $b + t$  min. is 4.0 [.157], which satisfies the minimum value conditions.

Referring to page 30, the required spacer for an A type shroud would be part number 106457-4.



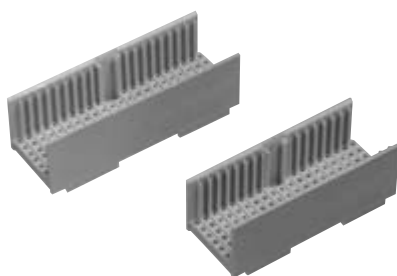
### Ideal Spacer/Board Combinations

| PC Board Thickness (B) | Contact Tail Length | Spacer Thickness (T) | Mating Level | Pin Length  |
|------------------------|---------------------|----------------------|--------------|-------------|
| 1.5 [.059]             | 13.0 [.512]         | 1.7 [.067]           | 2            | 6.85 [.270] |
|                        | 14.5 [.571]         | 1.7 [.067]           | 3            | 8.35 [.329] |
| 1.7 [.067]             | 13.0 [.512]         | 1.5 [.059]           | 3            | 6.85 [.270] |
|                        | 14.5 [.571]         | 1.5 [.059]           | 3            | 8.35 [.329] |
| 1.9 [.075]             | 13.0 [.512]         | 1.3 [.051]           | 2            | 6.85 [.270] |
|                        | 14.5 [.571]         | 1.3 [.051]           | 3            | 8.35 [.329] |
| 2.1 [.083]             | 13.0 [.512]         | 1.1 [.043]           | 2            | 6.85 [.270] |
|                        | 14.5 [.571]         | 1.1 [.043]           | 3            | 8.35 [.329] |
| 2.3 [.091]             | 13.0 [.512]         | 0.9 [.035]           | 2            | 6.85 [.270] |
|                        | 14.5 [.571]         | 0.9 [.035]           | 3            | 8.35 [.329] |
| 2.8 [.110]             | 13.0 [.512]         | 1.9 [.075]           | 1            | 5.35 [.211] |
|                        | 14.5 [.571]         | 1.9 [.075]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 1.9 [.075]           | 3            | 8.35 [.329] |
|                        | 13.0 [.512]         | 1.7 [.067]           | 1            | 5.35 [.211] |
| 3.0 [.118]             | 14.5 [.571]         | 1.7 [.067]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 1.7 [.067]           | 3            | 8.35 [.329] |
| 3.2 [.126]             | 13.0 [.512]         | 1.5 [.059]           | 1            | 5.35 [.211] |
|                        | 14.5 [.571]         | 1.5 [.059]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 1.5 [.059]           | 3            | 8.35 [.329] |
|                        | 13.0 [.512]         | 1.3 [.051]           | 1            | 5.35 [.211] |
| 3.4 [.134]             | 14.5 [.571]         | 1.3 [.051]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 1.3 [.051]           | 3            | 8.35 [.329] |
| 3.6 [.142]             | 13.0 [.512]         | 1.1 [.043]           | 1            | 5.35 [.211] |
|                        | 14.5 [.571]         | 1.1 [.043]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 1.1 [.043]           | 3            | 8.35 [.329] |
|                        | 13.0 [.512]         | 0.9 [.035]           | 1            | 5.35 [.211] |
| 3.8 [.150]             | 14.5 [.571]         | 0.9 [.035]           | 2            | 6.85 [.270] |
|                        | 16.0 [.630]         | 0.9 [.035]           | 3            | 8.35 [.329] |
| 4.3 [.169]             | 14.5 [.571]         | 1.9 [.075]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 1.9 [.075]           | 2            | 6.85 [.270] |
| 4.5 [.177]             | 14.5 [.571]         | 1.7 [.067]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 1.7 [.067]           | 2            | 6.85 [.270] |
| 4.7 [.185]             | 14.5 [.571]         | 1.5 [.059]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 1.5 [.059]           | 2            | 6.85 [.270] |
| 4.9 [.193]             | 14.5 [.571]         | 1.3 [.051]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 1.3 [.051]           | 2            | 6.85 [.270] |
| 5.1 [.201]             | 14.5 [.571]         | 1.1 [.043]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 1.1 [.043]           | 2            | 6.85 [.270] |
| 5.3 [.209]             | 14.5 [.571]         | 0.9 [.035]           | 1            | 5.35 [.211] |
|                        | 16.0 [.630]         | 0.9 [.035]           | 2            | 6.85 [.270] |
| 5.8 [.228]             | 16.0 [.630]         | 1.9 [.075]           | 1            | 5.35 [.211] |
| 6.0 [.236]             | 16.0 [.630]         | 1.7 [.067]           | 1            | 5.35 [.211] |
| 6.2 [.244]             | 16.0 [.630]         | 1.5 [.059]           | 1            | 5.35 [.211] |
| 6.4 [.252]             | 16.0 [.630]         | 1.3 [.051]           | 1            | 5.35 [.211] |
| 6.6 [.260]             | 16.0 [.630]         | 1.1 [.043]           | 1            | 5.35 [.211] |
| 6.8 [.268]             | 16.0 [.630]         | 0.9 [.035]           | 1            | 5.35 [.211] |
| 7.0 [.275]             | 16.0 [.630]         | 0.7 [.027]           | 1            | 5.35 [.211] |

## One Piece Shrouds

### Type A, B, C, D, E or F Shrouds

One piece shrouds can be used with several backplane thicknesses to provide required pin mating levels (see chart for options available). The single piece design also provides a reduced part count, lower applied cost solution.

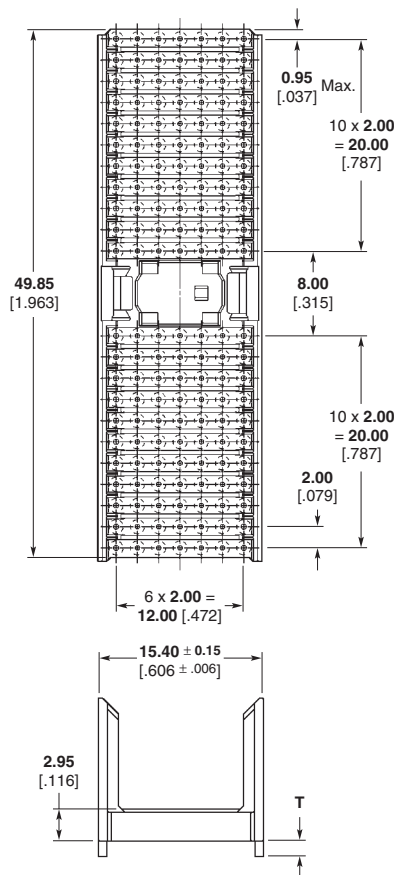


### Type AB Shrouds

Type AB shrouds require male feed thru connectors with short tail or vacant ground pin positions in the guide feature locations.

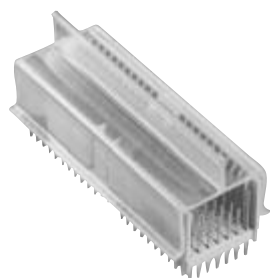
Type B

5 row



| Shroud Type<br>T | 0 [.000] | .9 [.035] | 1.1 [.043] | 1.3 [.051] | 1.5 [.059] | 1.7 [.067] | 1.9 [.075] | 2.1 [.080] |
|------------------|----------|-----------|------------|------------|------------|------------|------------|------------|
| A                | 646478-1 | 646478-2  | 646478-3   | 646478-4   | 646478-5   | 646478-6   | 646478-7   | —          |
| B                | 646479-1 | 646479-2  | 646479-3   | 646479-4   | 646479-5   | 646479-6   | 646479-7   | —          |
| C                | 646480-1 | 646480-2  | 646480-3   | 646480-4   | 646480-5   | 646480-6   | 646480-7   | —          |
| B (19)           | 646481-1 | 646481-2  | 646481-3   | 646481-4   | 646481-5   | 646481-6   | 646481-7   | —          |
| B (22)           | 646482-1 | 646482-2  | 646482-3   | 646482-4   | 646482-5   | 646482-6   | 646482-7   | —          |
| AB (19)          | 646483-1 | 646483-2  | 646483-3   | 646483-4   | 646483-5   | 646483-6   | 646483-7   | —          |
| AB (22)          | 646484-1 | 646484-2  | 646484-3   | 646484-4   | 646484-5   | 646484-6   | 646484-7   | —          |
| AB (25)          | 646576-1 | 646576-2  | 646576-3   | 646576-4   | 646576-5   | 646576-6   | 646576-7   | —          |
| D                | 646476-1 | 646476-2  | 646476-3   | 646476-4   | 646476-5   | 646476-6   | 646476-7   | —          |
| E                | 646477-1 | 646477-2  | 646477-3   | 646477-4   | 646477-5   | 646477-6   | 646477-7   | —          |
| F                | 646525-1 | 646525-2  | 646525-3   | 646525-4   | 646525-5   | 646525-6   | 646525-7   | —          |
| DE               | 646726-1 | 646726-2  | 646726-3   | 646726-4   | 646726-5   | 646726-6   | 646726-7   | 646726-8   |

## Male Pin Protection Covers



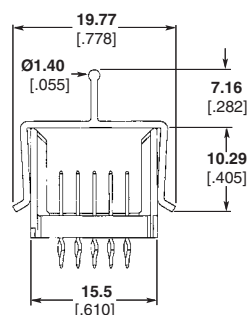
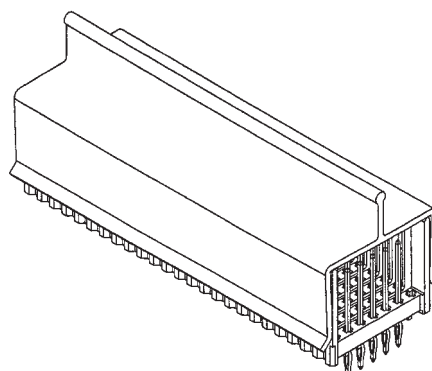
New male pin protection covers are now available for all vertical male and right angle male connectors. These covers prevent the exposed pin fields from being damaged (e.g. bent, broken), until the connector is mated. The covers easily slide over the outside housing of the connector and can easily be removed. No tooling is necessary.

Sizes are available for 5/5+2 and 8/8+2 row male connectors (Types A-F).

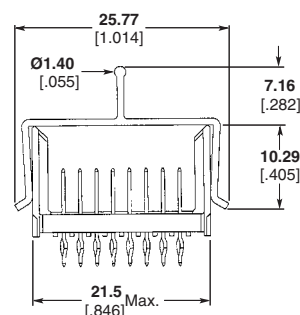
### Material

Polycarbonate, color—clear

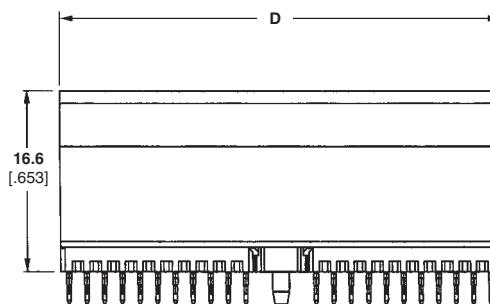
Used with male connectors.



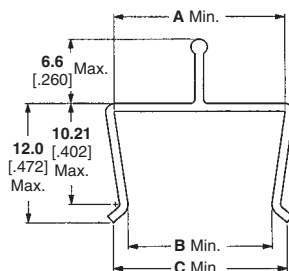
5 Row



8 Row



Cover shown on A & D module for reference only.



| Type | Dimensions    |               |               |                | Part Number |
|------|---------------|---------------|---------------|----------------|-------------|
|      | A             | B             | C             | D              |             |
| A,B  | 15.75<br>.620 | 13.28<br>.523 | 17.27<br>.679 | 49.23<br>1.938 | 646502-1    |
| C    | 15.75<br>.620 | 13.28<br>.523 | 17.27<br>.679 | 23.97<br>.943  | 646502-3    |
| D,E  | 21.74<br>.855 | 19.28<br>.759 | 23.27<br>.916 | 49.23<br>1.938 | 646502-2    |
| F    | 21.74<br>.855 | 19.28<br>.759 | 23.27<br>.916 | 23.97<br>.943  | 646502-4    |

## Types L, M and N Backplane Connectors with DIN Cavities

### DIN Contacts

DIN contacts can be fitted to types L, M and N male and female housings. These housings have 3 or 6 4.8 [.189] diameter cavities for high current, coaxial or fiber optic contacts conforming to DIN 41626.

Male housings are press fit polarized to backplanes.

Contacts for these housings are shown on pages 38 and 39.

Standard Type M housings have option A contacts loaded in columns a to e, with option C used in rows z and f of 5+2 row versions. Feedthrough pins are option K. Other arrangements can be provided; refer to page 47 for other contact patterns. Variations not listed should be specified using the pin specifications on page 66 and chart on page 71.

**Performance Data pages 6-7, also refer to DIN specifications.**

### Materials and Finish

Glass filled polyester housing.

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

**Coding Keys for type L & M, page 47.**

**Board layout page 71 for guidance only.**

Special Version of type L is available for vertical press fit coax contacts



Type L  
6 DIN Cavities



Type M  
55 Signal Contacts and  
3 DIN Cavities



Type N  
3 DIN Cavities



### Type L, M, N connectors with DIN contact cavities for high current, coaxial and fiber optic connections

Plastic modules provide press-fit-polarized assembly on backplanes. Cavities allow connectors to be loaded in any position with high current, coaxial or fiber optic contacts as per DIN 41626.

Illustration shows Type L connector, top to bottom:

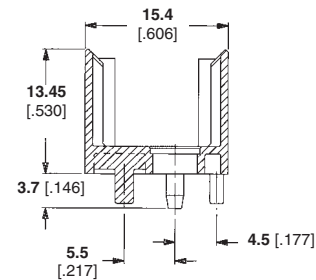
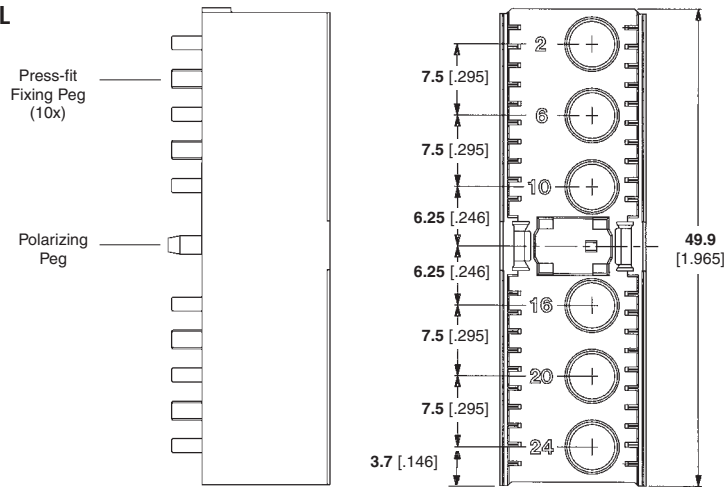
- High current cable contact (2x). Also available for backplane soldered connection. First make-last break versions can be provided for high current contacts.
- Fiber optic plug for cable-to-cable connection (2x).
- Coaxial cable contact (2x).

| Description               | Part Numbers  |              |
|---------------------------|---------------|--------------|
|                           | Cable & Panel | Flush Board* |
| Type L                    | 100745-1      | 646704-1*    |
| Type M 5 row short tail   | 100749-1      | 646709-1*    |
| Type M 5+2 row short tail | 352049-1      | 646730-1*    |
| Type M 5 row feed through | 106326-1      | 646886-1*    |
| Type N                    | 100751-1      | 646703-1*    |
| Type N Right Angle        | —             | 646858-1*    |

\*All connectors accept cable or board mount contacts.

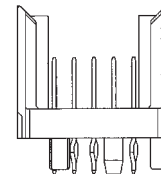
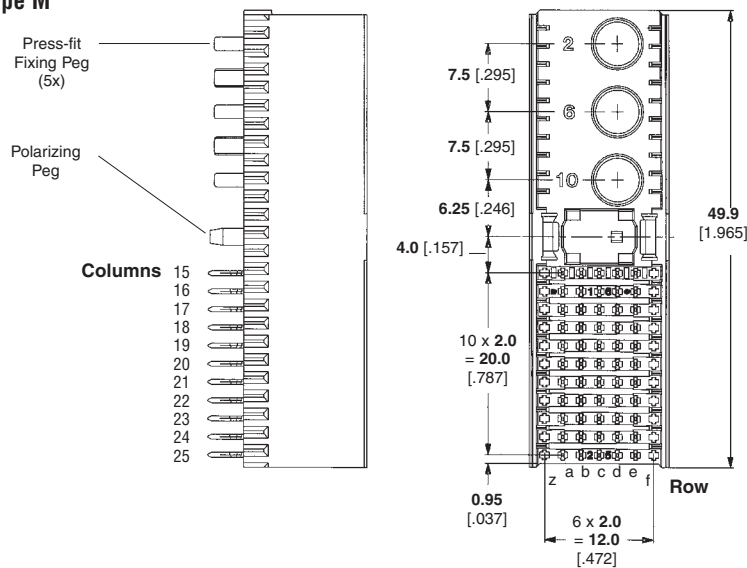
**Types L, M and N Backplane Connectors with DIN Cavities (Continued)**

**Type L**

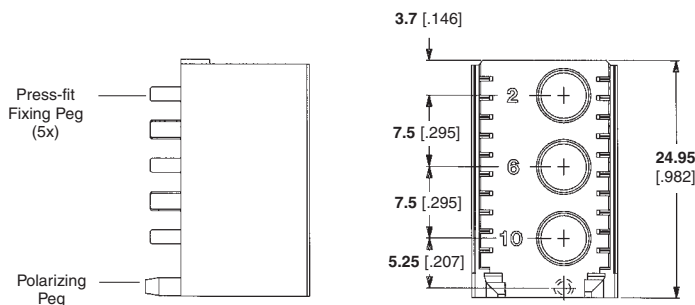


Section of All DIN Cavities

**Type M**



**Type N**





## Types L, M and N Daughterboard Connectors with DIN Cavities

### DIN Contacts

DIN contacts can be fitted to types L, M and N male and female housings. These housings have 3 or 6 4.8 [.189] diameter cavities for high current, coaxial or fiber optic contacts conforming to DIN 41626.

Female housings are press fit to the daughtercards.

Contacts for these housings are shown on pages 38 and 39.

**Performance Data pages 6-7, also refer to DIN specifications.**

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated.

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

Sn/Pb over 1.3µm [.000050] Ni

**Coding Keys for type L & M, page 47.**

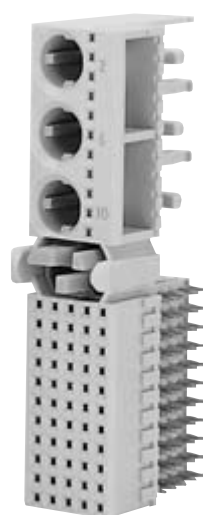
**Board layout page 71 for guidance only.**

### Note:

Housings should be reamed to accept DIN Fiber Optic Contacts. Use Tyco Electronics tool pn 434779-1 to ream the cavities. Fiber Optic Contacts are available from specialist manufacturers.



**Type L**  
6 DIN Cavities



**Type M**  
55 Signal Contacts and  
3 DIN Cavities



**Guiding &  
Polarizing Lugs**

**Type N**  
3 DIN Cavities



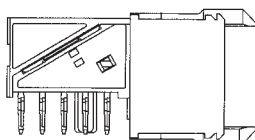
### Type L, M, N Connectors with DIN contact cavities for high current, coaxial and fiber optic connections

Plastic modules provide press-fit, polarized assembly onto free boards. Cavities accept high current, coaxial or fiber optic contacts as per DIN 41626.

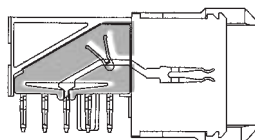
Illustration left, shows Type L connector, top to bottom:

- high current contact, to-board
- high current contact, to-cable
- fiber optic contact
- fiber optic contact
- coaxial contact, to-cable
- coaxial contact, to-board

### Standard Version



### Reduced Crosstalk Version

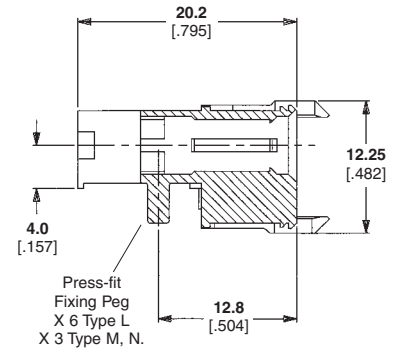
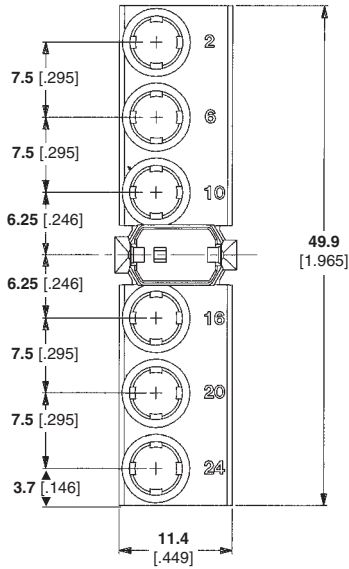
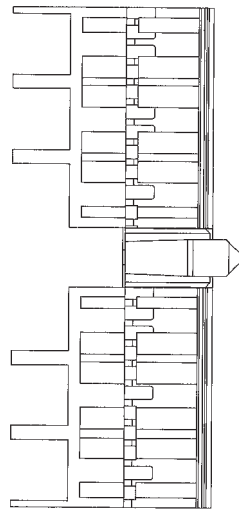


Row C to Ground

| Description                                   | Cable & Panel Part Numbers |
|-----------------------------------------------|----------------------------|
| Type L                                        | 100746-1                   |
| Type M                                        | 100750-1                   |
| Type M Reduced Crosstalk                      | 188215-1                   |
| Type M with upper Ground Return Shield fitted | 352177-1                   |
| Type M Reduced Crosstalk with Upper Shield    | 352380-1                   |
| Type M lower Ground Return Shield             | 352112-2                   |
| Type N                                        | 100752-1                   |

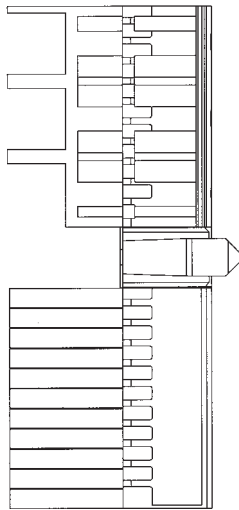
**Types L, M and N Daughterboard Connectors with DIN Cavities (Continued)**

**Type L**



**Section of All DIN Cavities.**

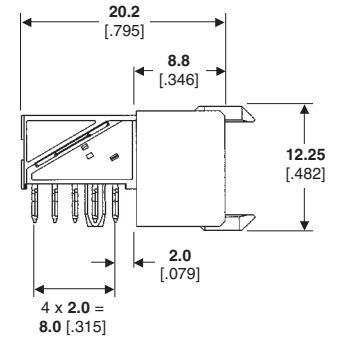
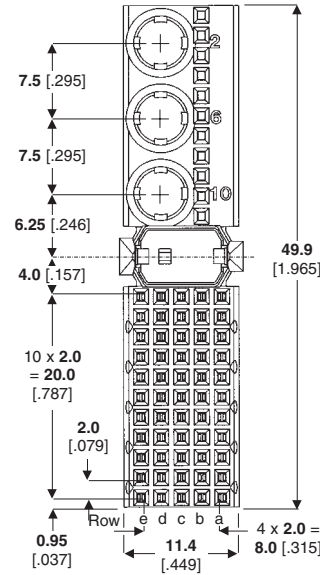
**Type M**



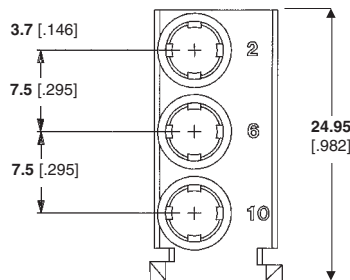
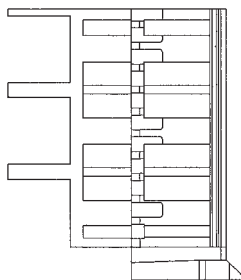
Columns

15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

Signal Contacts



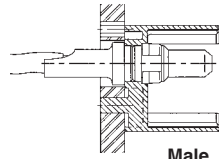
**Type N**



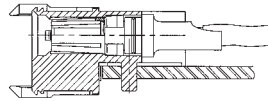
## High Current Contacts for Type L, M and N Connectors

### Contacts in accordance with DIN 41626, for Ø4.8 [.189] Cavities

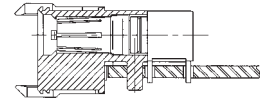
For Type L, M and N modules, available for cable and solder terminations. Contact Tyco Electronics for press fit versions.



Male



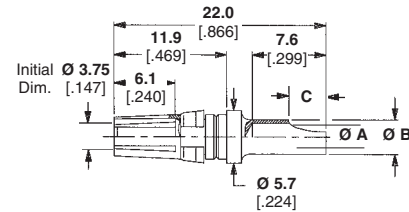
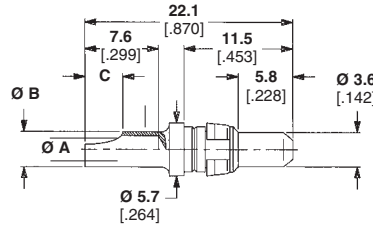
Female, Cable



Female with Solder Pins

### Pin and Socket Contacts for Cable Termination

Solder versions shown.



| Current Rating | Solder Part Numbers |             | Solder Dimensions |            |            | Crimp Part Numbers |          | Crimp Dimensions |             |
|----------------|---------------------|-------------|-------------------|------------|------------|--------------------|----------|------------------|-------------|
|                | Pin                 | Socket      | A                 | B          | C          | Pin                | Socket   | A                | B           |
| 40A            | 1393589-1           | 1393589-7   | 4.7 [.185]        | 5.7 [.224] | 5.0 [.197] | 148430-1           | 148432-1 | .181 [.007]      | .230 [.009] |
| 30A            | —                   | —           | —                 | —          | —          | 148406-1           | 148357-1 | .136 [.005]      | .185 [.007] |
| 20A            | 1393589-3           | 1393589-9   | 2.7 [.106]        | 3.8 [.150] | 4.0 [.157] | 148248-1           | 148221-1 | 2.54 [.100]      | 3.8 [.149]  |
| 10A            | 1393589-5           | 1-1393589-1 | 1.6 [.063]        | 2.7 [.106] | 3.0 [.118] | 148407-1           | 148410-1 | .067 [.003]      | .102 [.004] |

### Board-to-Board Mounting

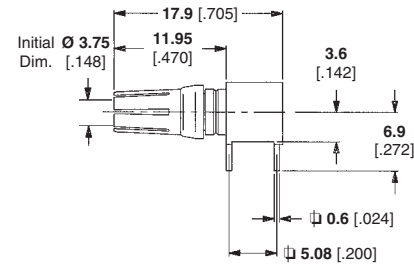
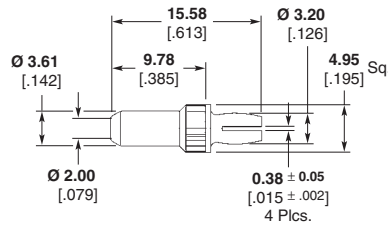
#### Pin Contact

Part Number **148546-1**

#### Socket Contact

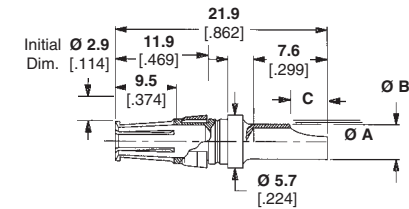
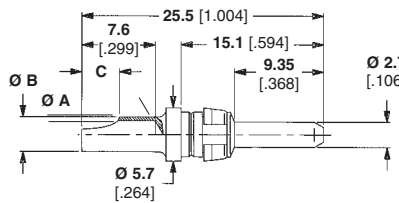
Part Number **148513-2**

**Current Rating** — up to 25A dependent on copper thickness or wire cross section.



### First Make/Last Break Pin and Socket Contacts for Cable Termination

Solder versions shown.



| Current Rating | Solder Part Numbers |             | Solder Dimensions |            |            | Crimp Part Numbers |          | Crimp Dimensions |             |
|----------------|---------------------|-------------|-------------------|------------|------------|--------------------|----------|------------------|-------------|
|                | Pin                 | Socket      | A                 | B          | C          | Pin                | Socket   | A                | B           |
| 40A            | 100072-1            | 100084-1    | 4.7 [.185]        | 5.7 [.224] | 5.0 [.197] | 148431-1           | 148433-1 | .181 [.007]      | .230 [.009] |
| 30A            | —                   | —           | —                 | —          | —          | 148408-1           | 148358-1 | .136 [.005]      | .185 [.007] |
| 20A            | 100073-1            | 100085-1    | 2.7 [.106]        | 3.8 [.150] | 4.0 [.157] | 148249-1           | 148250-1 | 2.54 [.100]      | 3.8 [.149]  |
| 10A            | 3-1393589-5         | 1-1393589-4 | 1.6 [.063]        | 2.7 [.106] | 3.0 [.118] | 148409-1           | 148410-1 | .067 [.002]      | .102 [.004] |

### First Make/Last Break Pin and Socket Contacts for Board-to-Board Mounting

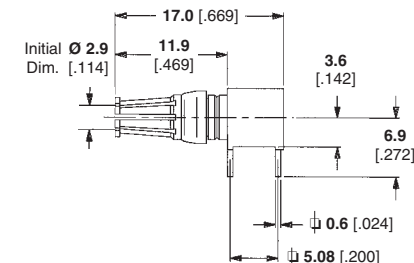
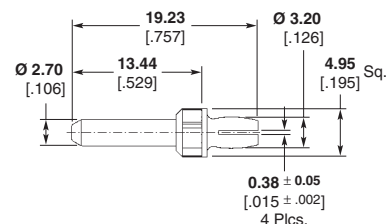
#### Pin Contact

Part Number **148547-1**

#### Socket Contact

Part Number **2-1393589-7**

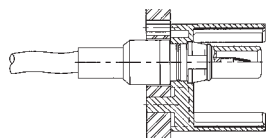
**Current Rating** — up to 25A dependent on copper thickness or wire cross section.



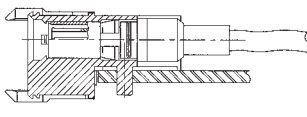
## Coaxial Contacts for Type L, M and N Connectors

### Contacts in accordance with DIN 41626 for Ø4.8 [.189] Cavities

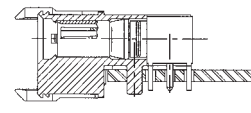
For Type L, M and N modules, available for cable and solder terminations.



Jack Contact



Plug Contact



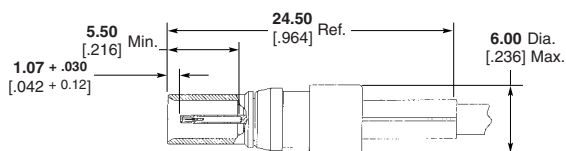
Plug Contact with Solder Pins

## Type C Coax, Standard DIN Contacts

### DIN 41626 Socket Contacts

Crimp, Straight Cable  
Mount, RG179

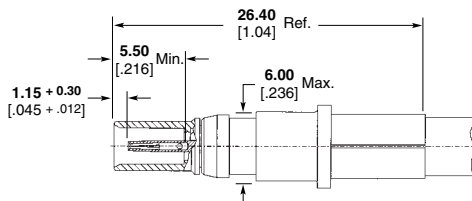
75 Ohm  
Eurocard or 2mm HM



Part Number 148254-1

Crimp, Straight Cable  
Mount, RG142

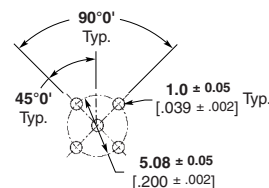
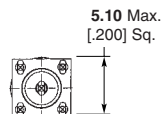
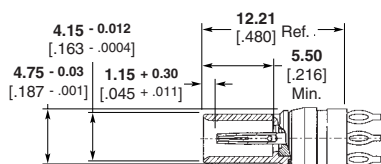
50 Ohm  
Eurocard or 2mm HM



Part Number 148338-4

Vertical PC Board Mount,  
Compliant

50 Ohm  
2mm HM



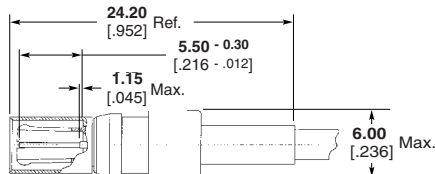
Part Number 148385-1  
Recommended PC Board Layout

**Type C Coax, Standard DIN Contacts** (Continued)

**DIN 41626 Pin Contacts**

**Crimp, Straight Cable  
Mount, RG179**

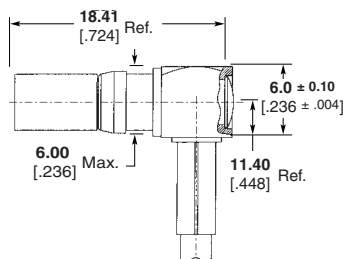
**75 Ohm  
Eurocard or 2mm HM**



**Part Number 148253-1**

**Right Angle Cable Mount,  
RG316**

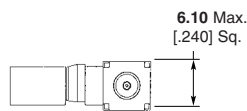
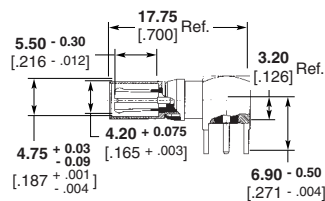
**50 Ohm  
Eurocard or 2mm HM**



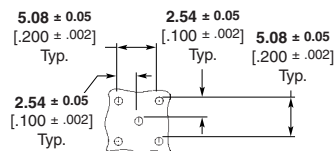
**Part Number 148342-1**

**Right Angle PC Board  
Mount, Solder**

**50 Ohm  
2mm HM**



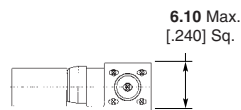
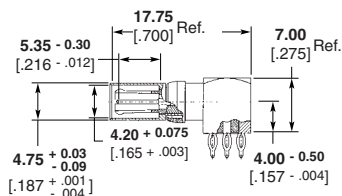
**Part Number 1-1393662-2**



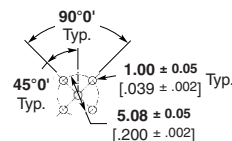
**Recommended  
PC Board Layout**

**Right Angle PC Board Mount,  
Compliant**

**50 Ohm  
2mm HM**



**Part Number 148386-1**



**Recommended  
PC Board Layout**



## Type L-MS-C, M-MS-C & M-MS-C-rev Male Connector, for MS-C Fiber Optic Plugs and Signal Contacts

### AMP Mini-SC (MS-C) Housings

MS-C fiber optic system provides increased density compared with DIN fiber optic contacts. Contacts float within the housing and are self aligning, and apply no force to the backplane. These housings mate with those shown on page 43.

MS-C series housings provide 4 or 8 cavities for these connectors. M-MS-C and M-MS-C reverse have 55 signal contacts and 4 fiber optic cavities; L-MS-C have 8 fiber optic cavities. Housings are press fitted to boards before installing fiber contacts.

Male connectors have sleeves fitted to the cavities which align the contacts, but they can be omitted from any cavity for economy. Retro fitting is possible.

Standard versions have alignment sleeves fitted to all MS-C cavities.

M-MS-C and M-MS-C rev have 55 option A signal contacts.

Other signal contact arrangements are possible, see page 47 for available versions. Use the chart on page 67 if your needs cannot be met from these.

Performance Data pages 6-7.

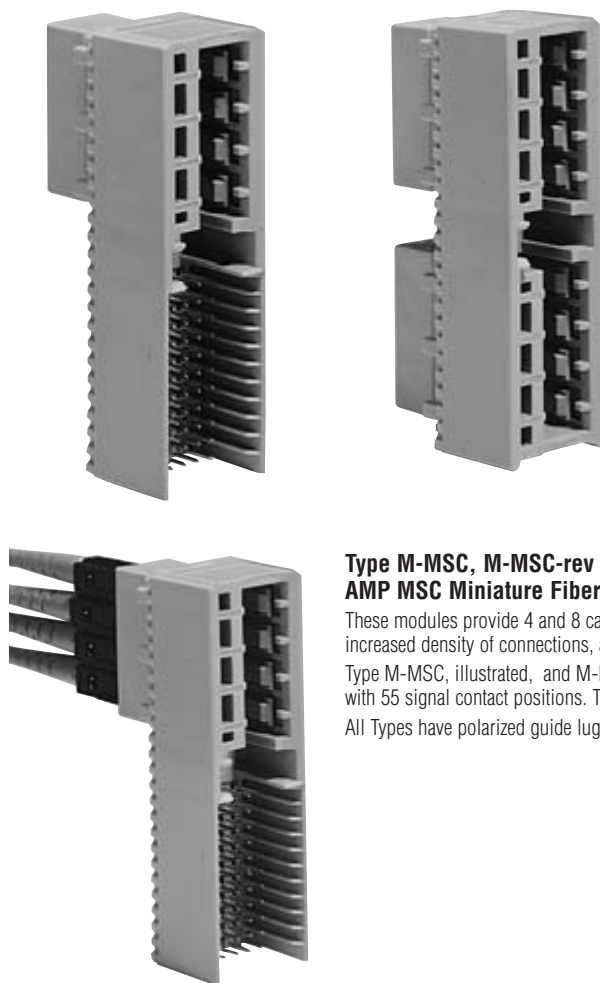
### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated.

Phosphor-bronze signal contacts  
Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni ACTION PIN  
Contact 0.5µm [.000020] Sn/Pb over 1.3µm [.000050] Ni.

MS-C Cable Plug, see page 45.

Board layout page 72 for guidance only.

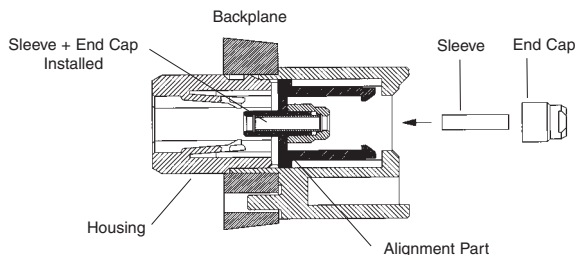


### Type M-MS-C, M-MS-C-rev and L-MS-C, 50mm Modules for AMP MS-C Miniature Fiber Optic Plugs

These modules provide 4 and 8 cavities for AMP MS-C fiber optic plugs, bringing increased density of connections, also zero force on backplane when fully mated.

Type M-MS-C, illustrated, and M-MS-C-rev have 4 cavities for MS-C fiber optic plugs, with 55 signal contact positions. Type L-MS-C, has 8 cavities.

All Types have polarized guide lugs; coding keys cannot be used.



Sleeve Part Number 106854-1  
End Cap Part Number 106855-1

### Z-PACK MS-C Typical Optical Performance

| Parameter              | Singlemode                    | Multimode  |
|------------------------|-------------------------------|------------|
| Insertion Loss         | <0.5 dB                       | <0.3 dB    |
| Random Mated Pair Loss | <1.0 dB                       | <0.7 dB    |
| Tuned Mated Pair Loss  | <0.6 dB                       | <0.7 dB    |
| Mated Return Loss      | >65dB (APC)                   | >35dB (PC) |
| Operating Temp.        | -20/+70° Celsius [-68/+158°F] | Same       |
| Cable Pull Force       | >70N 2.0mm cable              | Same       |
| Mechanical Endurance   | 500 Mating/dematings          | Same       |

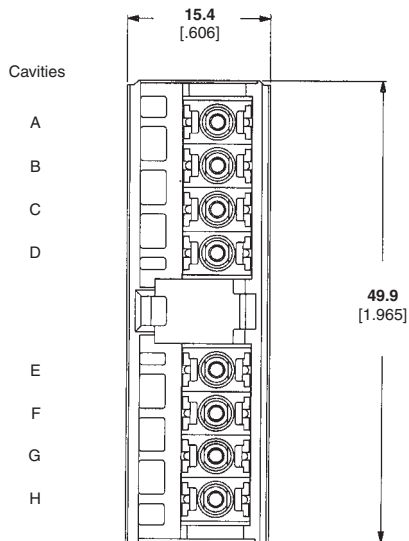
Assembly on backplane showing location of sleeve, for aligning MS-C fiber optic plug ferrules, and end cap.

Sleeves and end caps are available for retrofitting to housing cavities.

| Part Numbers    |          |
|-----------------|----------|
| Standard        |          |
| Type L-MS-C     | 106743-1 |
| Type M-MS-C     | 106745-1 |
| Type M-MS-C rev | 106747-1 |

**Type L-MS-C, M-MS-C & M-MS-C-rev Male Connector,  
for MS-C Fiber Optic Plugs and Signal Contacts (Continued)**

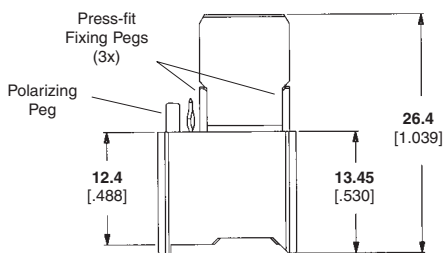
**Type L-MS-C**



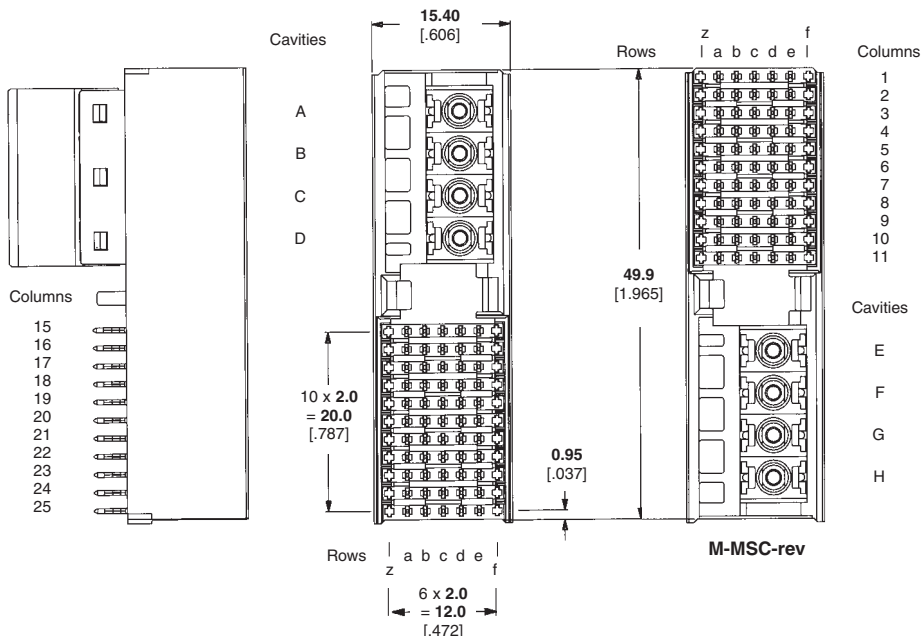
**Type M-MS-C**

**Type M-MS-C-rev**

Same as M-MS-C, with  
signal contacts in columns  
1 ... 11 as shown below.



End View of Type M-MS-C



M-MS-C-rev

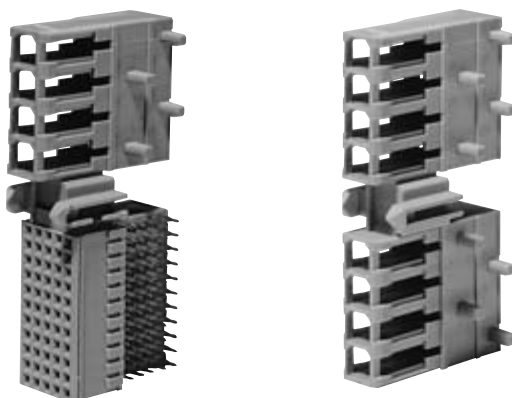
## Type L-MSD, M-MSD & M-MSD-rev Female Connector, for MSD Fiber Optic Plugs and Signal Contacts

### AMP MSD Housings

MSD fiber optic system provides increased density compared with DIN fiber optic contacts. Contacts float within the housing and are self aligning, and apply no force to the backplane. These housings mate with those shown on page 41.

MSD series housings provide 4 or 8 cavities for these connectors. M-MSD and M-MSD reverse have 55 receptacle contacts and 4 fiber optic cavities; L-MSD have 8 fiber optic cavities. Housings are press fitted to boards before installing fiber contacts.

Limited other receptacle contact arrangements are possible, see page 47 for available versions. Use the chart on page 67 if your needs cannot be met from these.



### Performance Data pages 6-7.

### Materials and Finish

Glass filled polyester housing, gray, UL94 V-0 rated.

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over

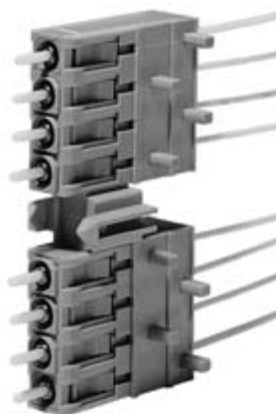
1.3µm [.000050] Ni ACTION PIN

Contact 0.5µm [.000020] Sn/Pb over

1.3µm [.000050] Ni

**MSD Board Plug, see page 46.**

**Board layout page 72 for guidance only.**



### Type M-MSD, M-MSD-rev and L-MSD, 50mm Modules for AMP MSD Miniature Fiber Optic Plugs

These modules provide 4 and 8 cavities for AMP MSD fiber optic plugs, bringing increased density of connections, also zero force on backplane when fully mated.

Type M-MSD and M-MSD-rev have 4 cavities for MSD fiber optic plugs, with 55 signal contact positions. Type L-MSD, illustrated, has 8 cavities.

All Types have polarized guide lugs; coding keys cannot be used.

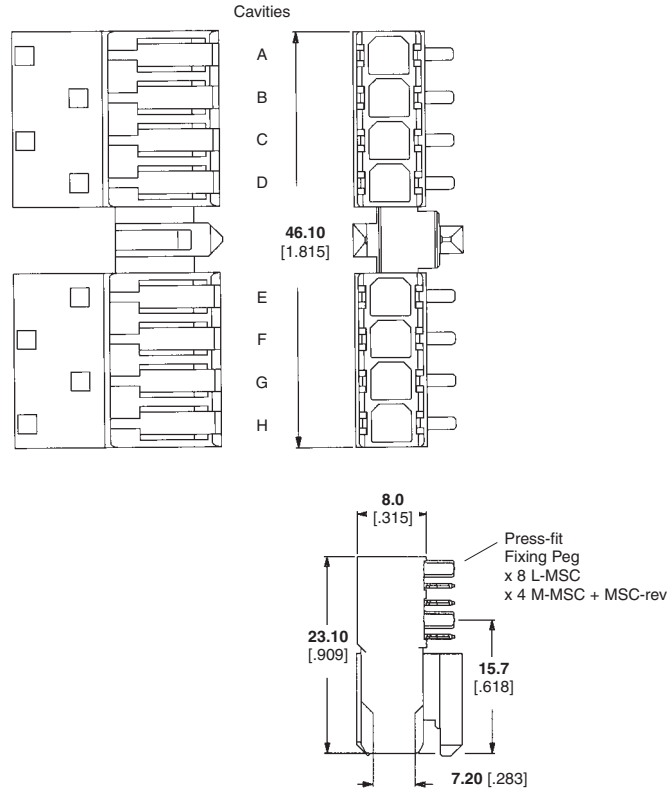
#### Part Numbers

| Part Numbers       |          |
|--------------------|----------|
| Standard           |          |
| Type L-MSD         | 106744-1 |
| Type M-MSD         | 106746-1 |
| Type M-MSD reverse | 106748-1 |

For Reduced Crosstalk, Consult  
Tyco Electronics

**Type L-MS-C, M-MS-C & M-MS-C-rev Female Connector,  
for MS-C Fiber Optic Plugs and Signal Contacts (Continued)**

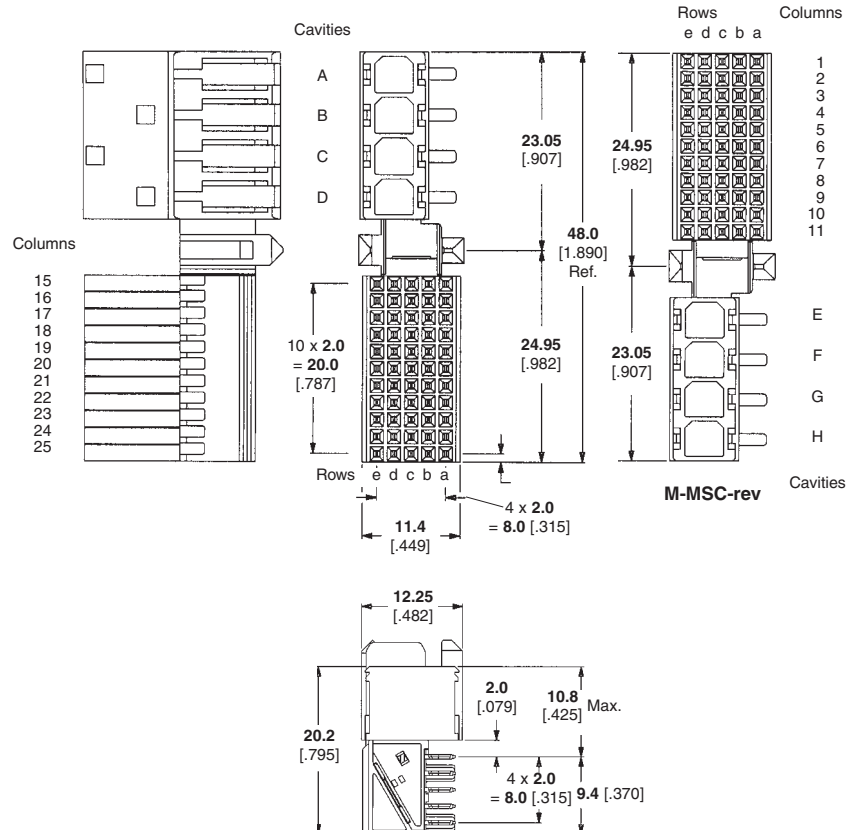
**Type L-MS-C**



**Type M-MS-C**

**Type M-MS-C-rev**

Same as M-MS-C, with  
signal contacts in columns  
1 ... 11 as shown below.



## Miniaturized Plugs for Type M-MSC, M-MSC-rev and L-MSC Connectors

Developed for the Z-PACK 2mm HM System, these fiber optic plugs are now offered as an industry standard.

AMP MSC plugs provide single or multi-mode performance comparable with standard Ø4.8 [.189] contacts.

### System Benefits

AMP MSC fiber optic plugs provide important advantages for systems incorporating opto-electronic circuitry. Principal benefits are:

- Increased fiber optic circuit density; 4.7 [.185] pitch gives 1 extra line per 25 [.984] module length, compared with DIN 41626 contacts.
- Zero force on backplane when connector is fully mated.
- Standard, constant fiber optic plug mating force during full 2.5 [.098] float.
- Full 2 [.079] misalignment capture during mating.
- Full 2.5 [.098] tolerance on insertion depth.
- PC or APC end face finish for single mode.
- Factory prepared plugs with fiber optic cable lengths as required.
- Economy; unused connector cavities can be easily retrofitted with alignment sleeves.
- M-MSC, M-MSC-rev and L-MSC connectors can be stacked in columns with other types.

### Performance Specification

Attenuation, (method 7)

Single mode typ. 0.25db

Multimode typ. 0.3db

Repeatability 0.2db

Return loss, PC ≥40db  
APC mated ≥60db

Operating temperature -20°C  
+70°C

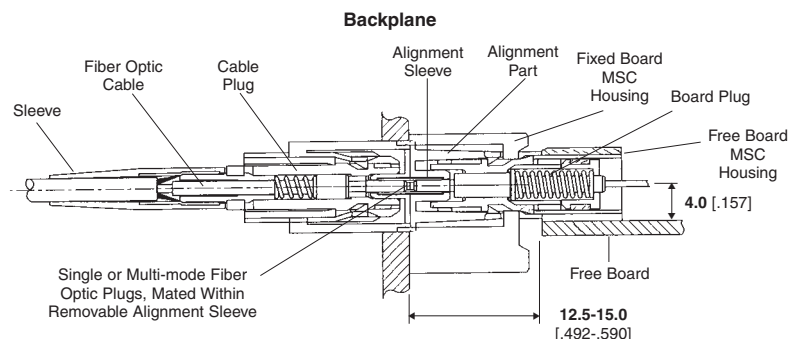
Strain relief, cable 70N

Design according to IEC 874-1 and/or CECC 86000.

Environmental category 20/70/21.

Protective cover for fiber optic contacts  
Part Number 233212-1.

## Fiber Optic Contacts for MSC Cavities



### Fully mated connector

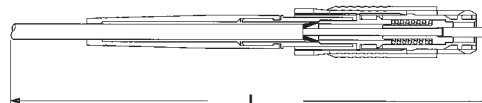
When cable and board plugs are inserted into their respective housings, flexible molded-in latches ensure firm retention. The fiber optic plugs with prepared ferrules are spring loaded.

**Mating.** Engagement of the free board MSC connector with the fixed board MSC connector, opens the alignment part which closes when the fiber optic ferrule is within the alignment sleeve. Further forward movement brings the mated ferrules under constant pressure from their respective springs.

During engagement, a sequence of latches on the fixed board housing and plug allows the board plugs to 'float' within the fully mated connector, so removing the contact force from the backplane.

Withdrawal of individual boards causes the latching sequence to reverse. Plugs can be individually removed from mated housings.

MSC Cable Plug, for backplane housing



### Complete Assembly on SM\* fiber optic LDS (Light Duty Single) cable to length specified by customer

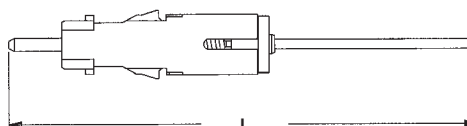
| Mode   | Ferrule Finish | Fiber Size | Cable Type  | Cable Ø    | Part Number | Cable Length L |
|--------|----------------|------------|-------------|------------|-------------|----------------|
| Single | PC             | —          | Single Lead | 2.0 [.079] | 106781-1    | 1.0m [39.37"]  |
| Single | PC             | —          | Pigtail     | 2.0 [.079] | 106749-1    | 1.0m [39.37"]  |
| Single | APC            | —          | Single Lead | 2.0 [.079] | 106888-1    | 1.0m [39.37"]  |
| Single | APC            | —          | Pigtail     | 2.0 [.079] | 106750-1    | 1.0m [39.37"]  |
| Multi  | —              | 50/125     | Single Lead | 2.0 [.079] | 1206073-1   | 1.0m [39.37"]  |
| Multi  | —              | 50/125     | Pigtail     | 2.0 [.079] | 1206074-1   | 1.0m [39.37"]  |
| Multi  | —              | 62.5/125   | Single Lead | 2.0 [.079] | 1206075-1   | 1.0m [39.37"]  |
| Multi  | —              | 62.5/125   | Pigtail     | 2.0 [.079] | 1206076-1   | 1.0m [39.37"]  |

For other lengths, consult Tyco Electronics.

For completion of free cable end with any Tyco Electronics fiber optic contact, consult Tyco Electronics.



**Fiber Optic Contacts for MSC Cavities** (Continued)

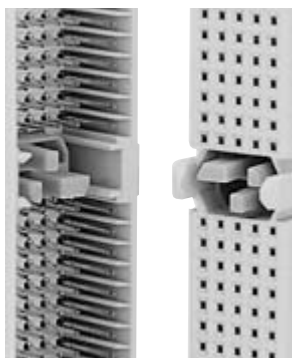


**Complete Assembly, on SM\* buffered fiber optic cable, Standard length 1m [39.37"]**

| Mode   | Ferrule Finish | Fiber Size | Cable Type | Cable Ø    | Part Number | Cable Length L |
|--------|----------------|------------|------------|------------|-------------|----------------|
| Single | PC             | —          | Pigtail    | 0.9 [.035] | 106751-1    | 1.0m [39.37"]  |
| Single | APC            | —          | Pigtail    | 0.9 [.035] | 106752-1    | 1.0m [39.37"]  |
| Multi  | —              | 50/125     | Pigtail    | 0.9 [.035] | 1206077-1   | 1.0m [39.37"]  |
| Multi  | —              | 62.5/125   | Pigtail    | 0.9 [.035] | 1206078-1   | 1.0m [39.37"]  |

For other lengths, consult Tyco Electronics.

For completion of free cable end with any Tyco Electronics fiber optic contact, consult Tyco Electronics.



### Coding key sets with combinations of matching colors and complementary numbering

Used in Type A, D, L and M male and female connectors and shrouds.

Male and female keys are polarized for male and female housing multi-purpose centers; unambiguous keying is by combination of color and code numbered posts.

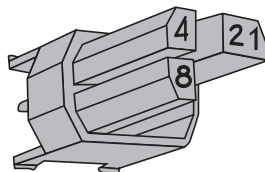
Keys are inserted from the mating faces of male and female housings, retained by foot clips snap-fitting into housing slots. Removal from the front is possible whenever required.

### Material

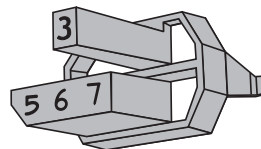
Glassfilled Polyimide 6.6.

### Key Insertion Tool

Part Number **352999-1**



Key for Male Connectors



Key for Female Connectors

| Color            | RAL <sup>1</sup><br>Number | For Male Connector |              | For Female Connector |              |
|------------------|----------------------------|--------------------|--------------|----------------------|--------------|
|                  |                            | Code No.           | Key Part No. | Code No.             | Key Part No. |
| Nut brown        | 8011                       | 1236               | 100525-3     | 4578                 | 100526-3     |
| † Strawberry red | 3018                       | 1248               | 100525-9     | 3567                 | 100526-9     |
| Blue lilac       | 4005                       | 1356               | 2-100525-0   | 2478                 | 2-100526-0   |
| • Brilliant blue | 5007                       | 1567               | 3-100525-2   | 2348                 | 3-100526-2   |
| Reseda green     | 6011                       | 2578               | 5-100525-4   | 1346                 | 5-100526-4   |
| * Cadmium yellow | 1021                       | 3456               | 5-100525-6   | 1278                 | 5-100526-6   |
| Slate gray       | 7015                       | 3467               | 5-100525-9   | 1258                 | 5-100526-9   |
| Steel blue       | 5011                       | 3478               | 6-100525-1   | 1256                 | 6-100526-1   |
| Pastel orange    | 2003                       | 3568               | 6-100525-3   | 1247                 | 6-100526-3   |
| Ochre yellow     | 1024                       | 4678               | 6-100525-9   | 1235                 | 6-100526-9   |

<sup>1</sup> RAL is a Trademark of the Central Organization for product assurance in Germany.

**Note:** The color/code no. combinations, listed above, follow IEC 61076-4-101 recommendations. Other versions are available, see drawings.

• For CompactPC1 5.0V

\* For CompactPC1 3.3V

† For CompactPCI Telephony  
Rating: UL94 HB

### Contact Loading Variants

For contact loading variants of Z-PACK 2mm HM connectors, refer to the appropriate instruction sheet shown here. These sheets can be obtained from Tyco Electronics and allow you to select an existing contact loading to suit your requirements. Should a suitable loading not be available, special loading patterns can be specified using the chart on page 67.

### Instruction Sheet Numbers

| Description                   | 5 Row     | 5+2 Row   | 5 row feedthrough | 5+2 feedthrough | 8 and 8+2 row               |
|-------------------------------|-----------|-----------|-------------------|-----------------|-----------------------------|
| Type A Male                   | 411-19410 | 411-19412 | 411-19411         | 411-19413       | Consult<br>Tyco Electronics |
| Type B Male                   | 411-19414 | 411-19416 | 411-19415         | 411-19417       |                             |
| Type C Male                   | 411-19418 | 411-19420 | 411-19419         | 411-19421       |                             |
| Type B 22 Column Male         |           |           | 411-19425         |                 |                             |
| Type B 19 Column Male         |           |           | 411-19426         |                 |                             |
| Type M Male                   |           |           | 411-19422         |                 |                             |
| Type M-MSD and Rev Male       |           |           | 411-19423         |                 |                             |
| Right Angle Male, all types   |           |           | 411-19428         |                 |                             |
| Right Angle Female, all types |           |           | 411-19429         |                 |                             |

## CompactPCI and VME 64

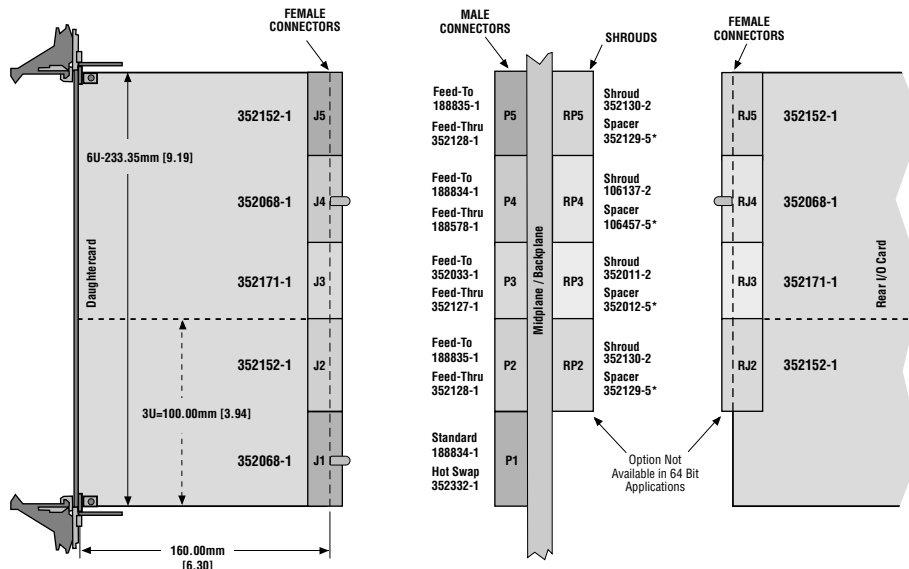
### CompactPCI and VME 64 Extensions

AMP Z-PACK 2mm HM shielded connectors have been chosen for the interconnection of both CompactPCI and VME 64 Extensions because of high density, sequencing levels and profile compatibility with IEC Eurocard connectors. CompactPCI 32 bit and 64 bit on 3U cards (P1-2/J1-2) and on 6U cards (P1-5/J1-5) use standard and special length connectors, with one of these also being used between the two Eurocard connectors J1/P1 and J2/P2 on VME 64 Extensions.

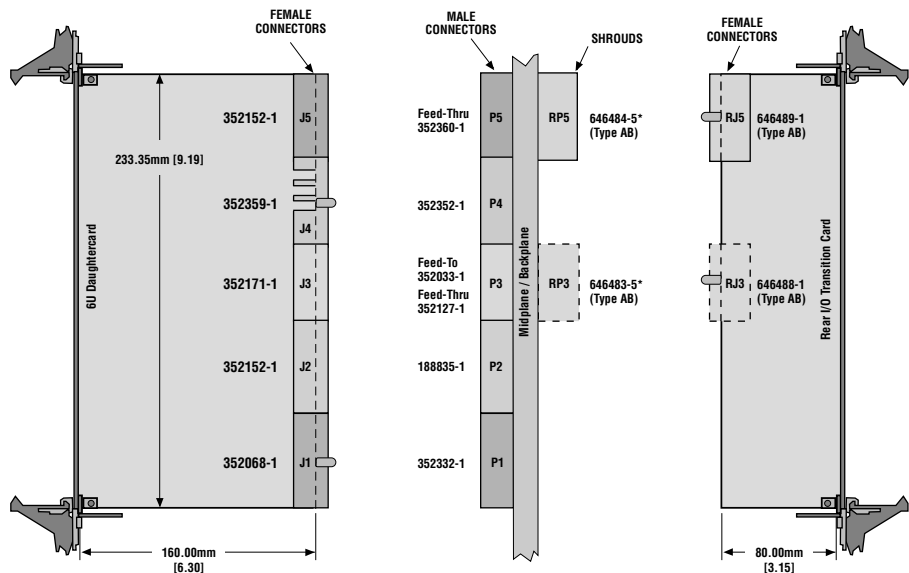
Backplane and daughter-card connectors for single side or midplane applications are listed, the latter using corresponding one piece shrouds or separate spacers and shrouds for the backplane rear.

Standard AMP HM cable connectors can be used with appropriate shrouds. Vertical receptacles allow the use of mezzanine cards to extend or increase card application flexibility.

### Standard and Hot Swap



### Computer Telephony

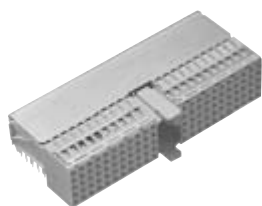


| VME 64 Extension Components                  | Part Numbers |
|----------------------------------------------|--------------|
| <b>Backplane Connectors (P0 &amp; P3)</b>    |              |
| 19 column type B header                      | 352033-1     |
| 19 column type B header, midplane            | 352127-1     |
| ZIF Shroud for above                         | 352011-2     |
| Spacer for ZIF Shroud above                  | 352012-x     |
| One Piece Shroud for above                   | 646481-x     |
| Cable Shroud                                 | 352673-2     |
| Spacer                                       | 352012-x     |
| <b>Daughtercard Connectors (J0 &amp; J3)</b> |              |
| 19 col type B shielded receptacle            | 352171-1     |
| 19 col type B vertical receptacle            | 352269-1     |

Reference CompactPCI Designer's Guide #1307224 for more detail.  
x = Part Number Stand Off Height. See page 31.

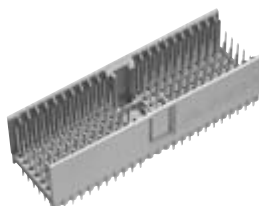
CompactPCI is a trademark of  
PICMG-PCI Industrial Computer  
Manufacturers Group Incorporated.

## CompactPCI Connectors: At a Glance



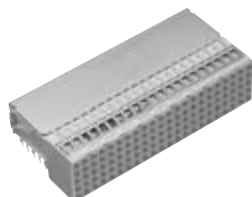
### J1/J4 Type A Right Angle Female with Shield

- 110 signal contacts
- Length 49.9 [1.964]
- Integrated pre-alignment and polarizing guide lug
- Daughtercard applications
- Part Number 352068-1



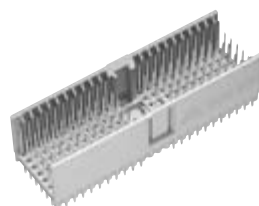
### P1/P4 Type A Vertical Male Feed-To

- 110 signal contacts
- Length 49.9 [1.964]
- Integrated pre-alignment and polarizing guide features
- Backplane applications
- Part Number 188834-1



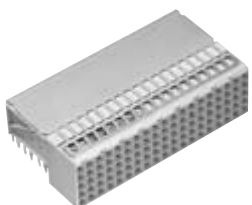
### J2/J5 Type B Right Angle Female with Shield

- 110 signal contacts
- Length 43.9 [1.728]
- Daughtercard applications
- Part Number 352152-1



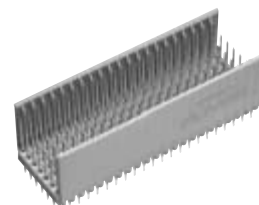
### P1 Type A Vertical Male Feed-To (Hot Swap)

- 110 signal contacts
- Length 49.9 [1.964]
- Integrated pre-alignment and polarizing guide features
- Backplane applications
- Part Number 352332-1



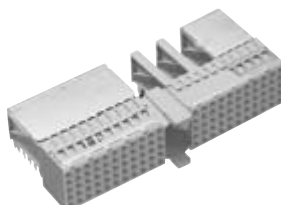
### J3 Type B Right Angle Female with Shield

- 95 signal contacts
- Length 37.9 [1.492]
- Daughtercard applications
- Part Number 352171-1



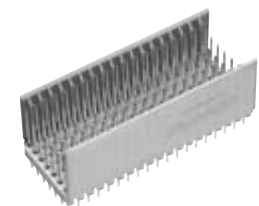
### P2/P5 Type B Vertical Male Feed-To

- 110 signal contacts
- Length 43.9 [1.728]
- Backplane applications
- Part Number 188835-1



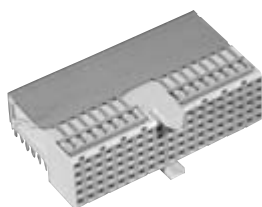
### J4 Type A Right Angle Female (Select Load) with Segmented Shield (Computer Telephony)

- 90 signal contacts
- Length 49.9 [1.964]
- Daughtercard applications
- Part Number 352359-1



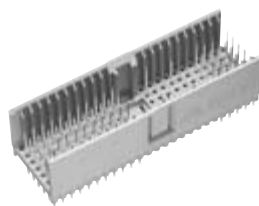
### P3 Type B Vertical Male Feed-To

- 95 signal contacts
- Length 37.9 [1.492]
- Backplane applications
- Part Number 352033-1



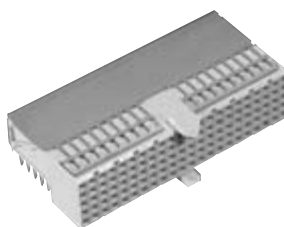
### RJ3 Type AB Right Angle Female with Shield

- 95 signal contacts
- Length 37.9 [1.492]
- Rear Transition Card applications
- Part Number 646488-1



### P4 Type A Vertical Male Header Feed-To (Computer Telephony)

- 84 signal contacts
- Length 49.9 [1.964]
- Integrated pre-alignment and polarizing guide features
- Backplane applications
- Part Number 352352-1



### RJ5 Type AB Right Angle Female with Shield

- 110 signal contacts
- Length 43.9 [1.728]
- Rear Transition Card applications
- Part Number 646489-1

See CompactPCI Designer's Guide #1307224 for additional information.

**CompactPCI Connectors: At a Glance** (Continued)

**P2/P5 Type AB Vertical Male Feed-Thru**

- 110 signal contacts
- Length 43.9 [1.728]
- Mid-plane applications
- Part Number 646735-1, 646736-1  
(use with type AB shroud)


**P3 Type AB Vertical Male Feed-Thru**

- 95 signal contacts
- Length 37.9 [1.492]
- Mid-plane applications
- Part Number 646732-1, 646734-1  
(use with type AB shroud)


**P2/P5 Type AB Vertical Male Feed-To**

- 110 signal contacts
- Length 43.9 [1.728]
- Backplane applications
- Part Number 646533-1, 646534-1


**P3 Type AB Vertical Male Feed-To**

- 95 signal contacts
- Length 37.9 [1.492]
- Backplane applications
- Part Number 646530-1, 646532-1



## Universal Power Module — Vertical Receptacle

The Tyco Electronics Universal Power Module is a three position, modular, Hard Metric board-to-board power connector designed to be compatible with Z-PACK 2mm HM Connectors. The design is in an "inverse-sex" orientation and the vertical receptacle module meets the IEC 950 safety requirements for finger probe protection.

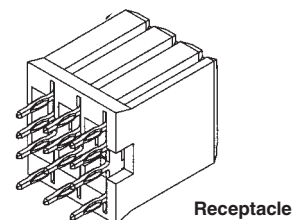
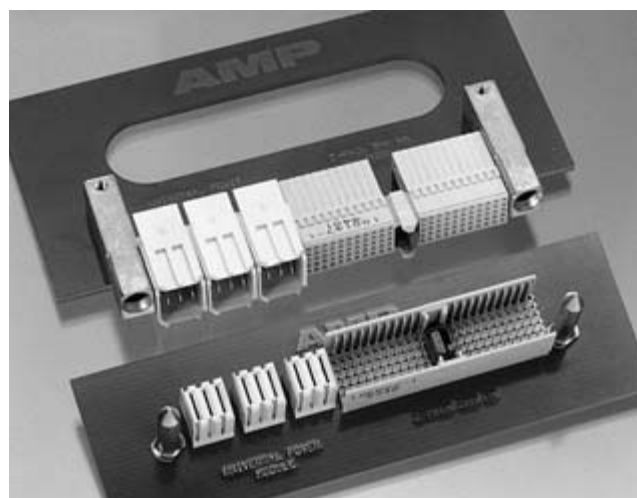
Both the headers and receptacle utilize AMP ACTION PIN press-fit leads for ease of assembly onto printed circuit boards. Additionally, the vertical receptacle leads are polarized to allow only one orientation onto the printed circuit board, eliminating the possibility of reverse placement.

The Universal Power Module is compatible with a wide variety of other Tyco Electronics board-to-board connectors including Z-PACK Stripline 100, AMP-HDI, TBC, TBC Plus and Eurocard connectors.

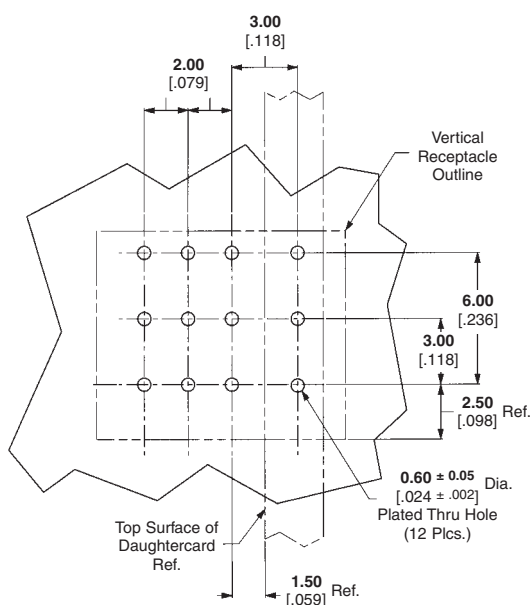
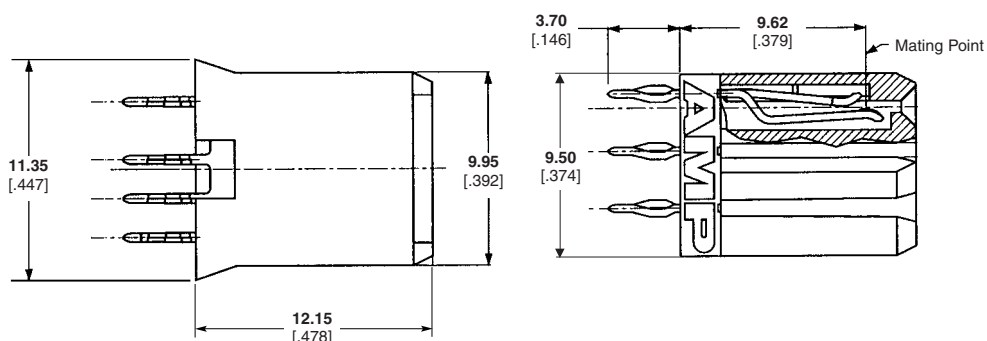
The housing is a high temperature thermoplastic, and the phosphor bronze contacts are gold-over-nickel plated on the mating surfaces. The modules are rated to carry a maximum of 23.5 amperes or 7.8 amperes per contact, fully energized for up to 250 mating cycles.

The right angle header contacts are available with sequenced lengths for "make-first/break-last" applications.

Generous alignment features designed into the housings and optional guide pins and receptacles make the Tyco Electronics Universal Power Module ideal for "blind mating" applications.



Receptacle



Recommended PC Board Hole Layout

| Description         | Position Loaded | Part Numbers |
|---------------------|-----------------|--------------|
| Vertical Receptacle | ABC             | 223955-2     |
|                     | AC              | 223984-1     |

## Universal Power Module — Right Angle Header

### Material and Finish

**Housing** — Valox, natural color,  
UL94 V-0 Rated

**Contacts** — Phosphor bronze,  
plated 0.00127 [.000050] min. gold in  
mating area, 0.00050 [.000020] min.  
tin-lead on ACTION PIN Contact post  
area, with entire contact underplated  
0.00127 [.000050] min. nickel

**Note:** Contact lubrication with  
Bellcore approved lubricant

### Related Product Data

**Guiding Hardware (Optional)** —  
page 54.

### Application Tooling —

#### Header

Seating Tool, 224441-1  
Board Support Fixture, 224442-1.

#### Receptacle

Seating Tool, 224421-1  
Board Support Fixture, 217602-1.

### Technical Documents

#### Product Specification

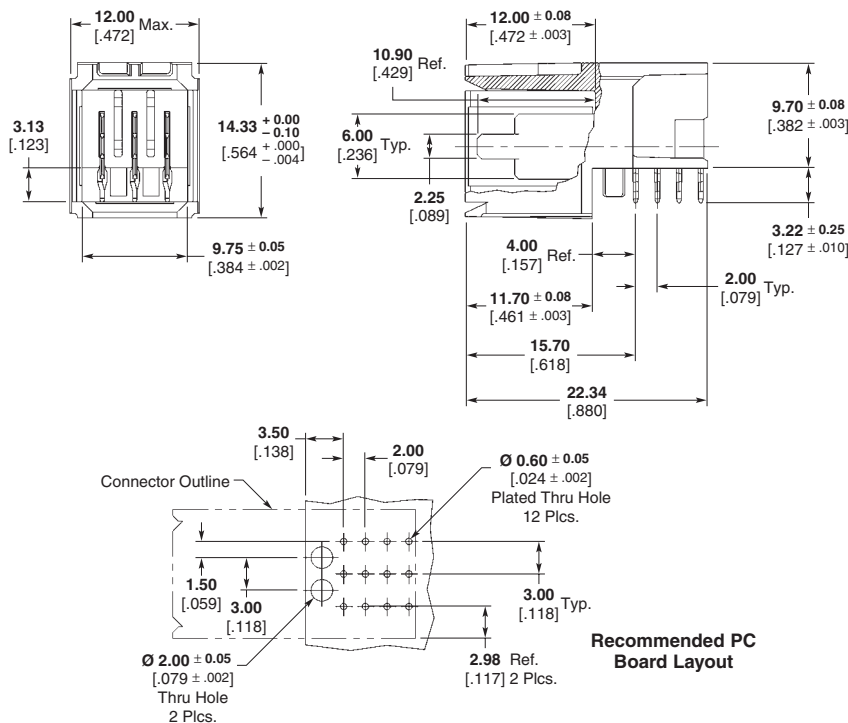
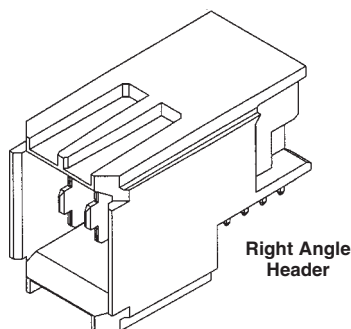
108-1651

#### Application Specification

114-1103

#### Instruction Sheet

408-4169 (Receptacle  
Seating Tool 224421-1)



**Recommended PC  
Board Layout**

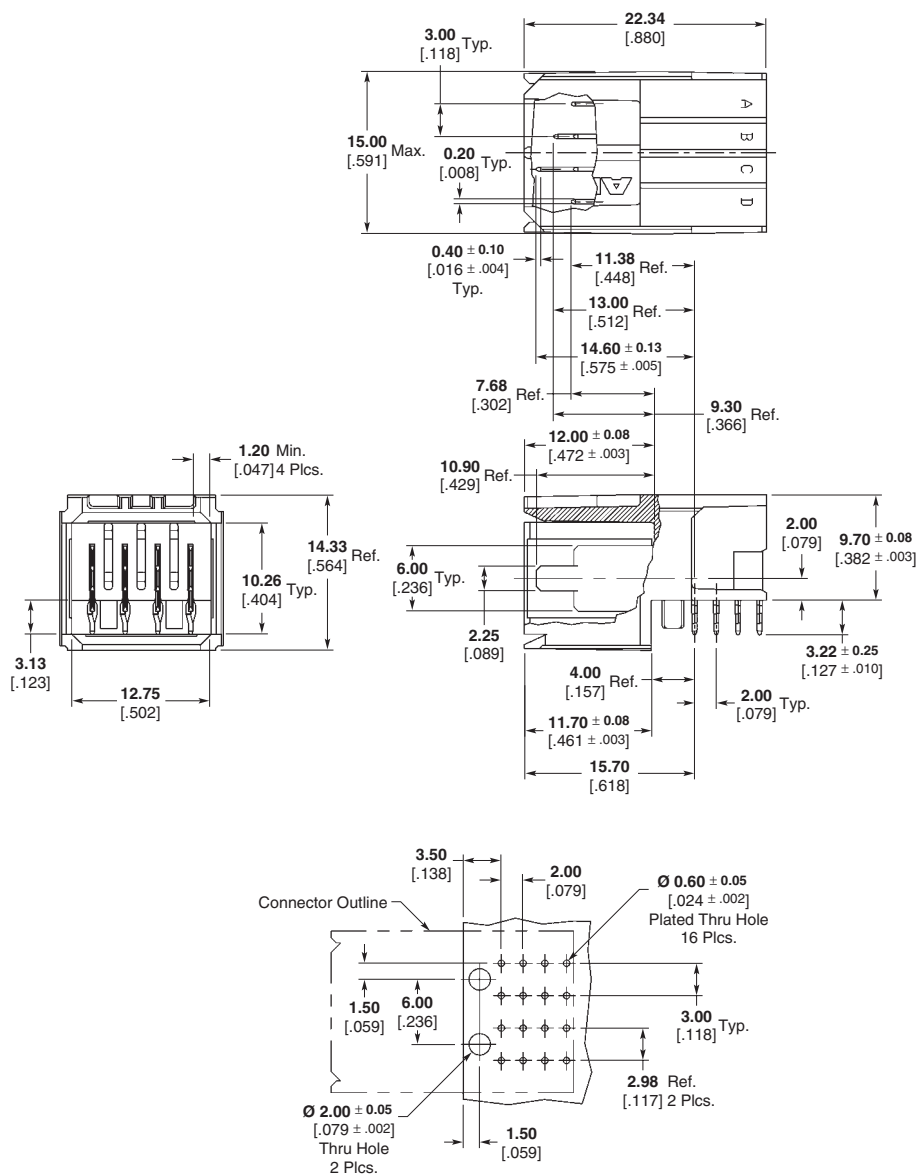
| Part Number | Position A   | Position B   | Position C   |
|-------------|--------------|--------------|--------------|
| 120912-1    | 7.68 [.302]  | 9.30 [.366]  | 10.90 [.429] |
| 120914-1    | 9.30 [.366]  | —            | 7.68 [.302]  |
| 223938-1    | 7.68 [.302]  | 10.90 [.429] | 10.90 [.429] |
| 223961-1    | 10.90 [.429] | 10.90 [.429] | 10.90 [.429] |
| 223962-1    | 10.90 [.429] | 9.30 [.366]  | 10.90 [.429] |
| 223963-1    | 9.30 [.429]  | 10.90 [.429] | 9.30 [.366]  |
| 223964-1    | 9.30 [.366]  | 10.90 [.429] | 7.68 [.302]  |
| 223965-1    | 9.30 [.366]  | 7.68 [.302]  | 9.30 [.366]  |
| 223967-1    | 9.30 [.366]  | 9.30 [.366]  | 9.30 [.366]  |
| 223968-1    | 10.90 [.429] | 9.30 [.366]  | 9.30 [.366]  |
| 223970-1    | 10.90 [.429] | 7.68 [.302]  | 7.68 [.302]  |
| 223971-1    | 10.90 [.429] | 7.68 [.302]  | 9.30 [.366]  |
| 223972-1    | 10.90 [.429] | 7.68 [.302]  | 10.90 [.429] |
| 223974-1    | 7.68 [.302]  | 7.68 [.302]  | 7.68 [.302]  |
| 223975-1    | 9.30 [.366]  | —            | 9.30 [.366]  |
| 223980-1    | 7.68 [.302]  | 7.68 [.302]  | 9.30 [.366]  |
| 223981-1    | 9.30 [.366]  | 9.30 [.366]  | 7.68 [.302]  |
| 223983-1    | 7.68 [.302]  | 9.30 [.366]  | 7.68 [.302]  |
| 223989-1    | 9.30 [.366]  | 9.30 [.366]  | 10.90 [.429] |
| 223990-1    | 9.30 [.366]  | 7.68 [.302]  | 8.28 [.326]  |
| 223991-1    | 7.68 [.302]  | 10.90 [.429] | 7.68 [.302]  |

## Expanded Universal Power Module Headers

### Material and Finish

**Housing** — Polyester, gray

**Contacts** — Phosphor bronze,  
plated 0.00127 [.000050] min. gold in  
mating area, 0.00054 [.000021] min.  
tin-lead on ACTION PIN post area, with  
entire contact underplated 0.00127  
[.000050] min. nickel



Recommended PC Board Layout

| Part Number | Positions | All Contacts |
|-------------|-----------|--------------|
| 646954-1    | 4         | 10.90 [.429] |
| 646955-1    | 5         | 10.90 [.429] |
| 646956-1    | 6         | 10.90 [.429] |
| 646957-1    | 7         | 10.90 [.429] |
| 646958-1    | 8         | 10.90 [.429] |
| 646959-1    | 9         | 10.90 [.429] |
| 646960-1    | 10        | 10.90 [.429] |
| 646961-1    | 11        | 10.90 [.429] |
| 223996-1    | 12        | 10.90 [.429] |

## Power and Guide Hardware

### Expanded Universal Power Module Vertical Receptacles

#### Material and Finish

**Housing** — Polyester, gray

**Contact** — Copper alloy, plated  
0.00127 [0.00050] min. gold in mating  
area, 0.00050 [0.00020] min. tin-lead  
on ACTION PIN Post area, with entire  
contact underplated 0.00127 [0.00050]  
min. nickel

#### Related Product Data

**Guiding Hardware** (Optional) —  
pages 58-60

#### Application Tooling

##### Header

Seating Tool, 224441-1

Board Support Fixture, 224442-1

##### Receptacle

Seating Tool, 224421-1

Board Support Fixture, 217602-1

#### Technical Documents

##### Product Specification

108-1651

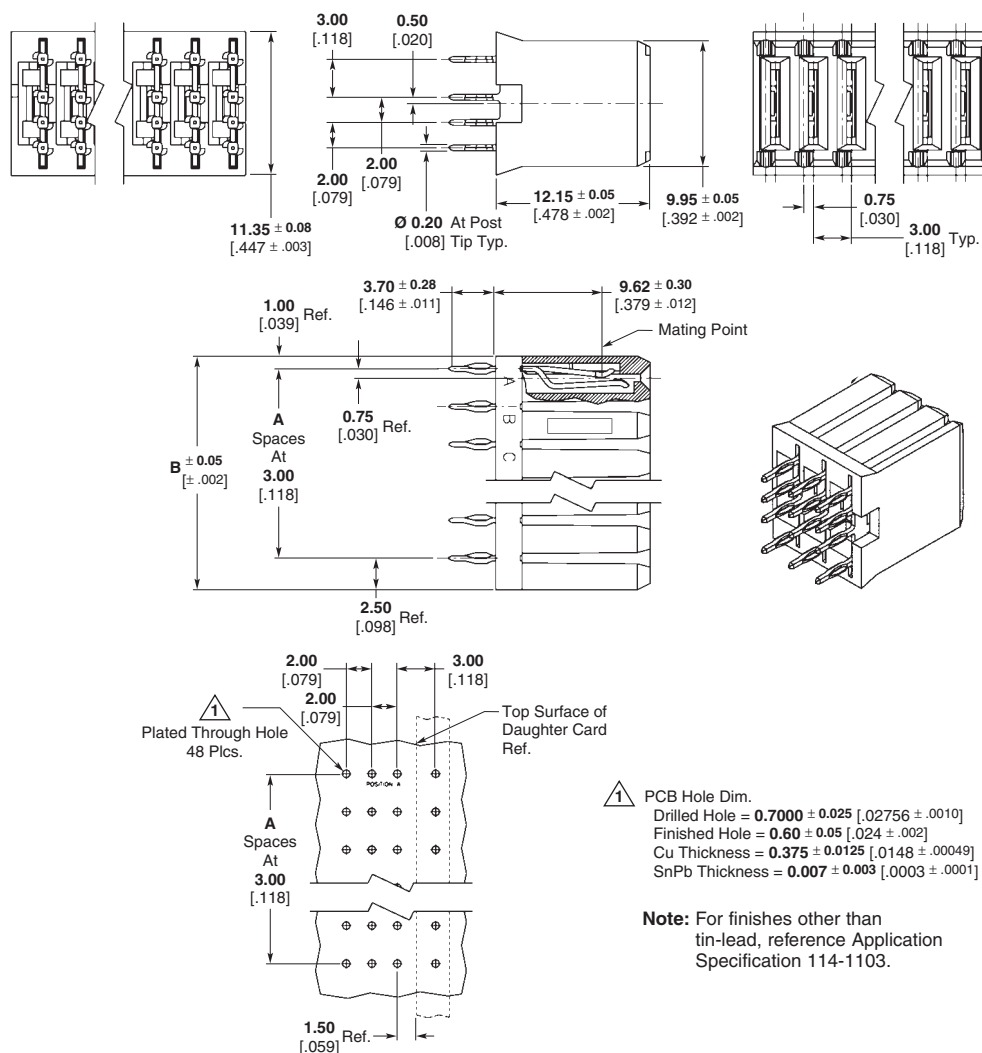
##### Application Specification

114-1103

##### Tyco Electronics Instruction Sheet

408-4169 (Receptacle)

Seating Tool 224421-1)



Recommended PCB Hole Layout

| Position | A | B<br>Ref.     | Standard<br>*10A<br>Part Number | High Current<br>*15A<br>Part Number |
|----------|---|---------------|---------------------------------|-------------------------------------|
| 4        | 3 | 12.50<br>.492 | 223995-1                        | 120953-1                            |
| 5        | 4 | 15.50<br>.610 | 223995-2                        | 120953-2                            |
| 6        | 5 | 18.50<br>.728 | 223995-3                        | 120953-3                            |
| 7        | 6 | 21.50<br>.846 | 223995-4                        | 120953-4                            |
| 8        | 7 | 24.50<br>.965 | 223995-5                        | 120953-5                            |

\*Reference Product Specification 108-1651.

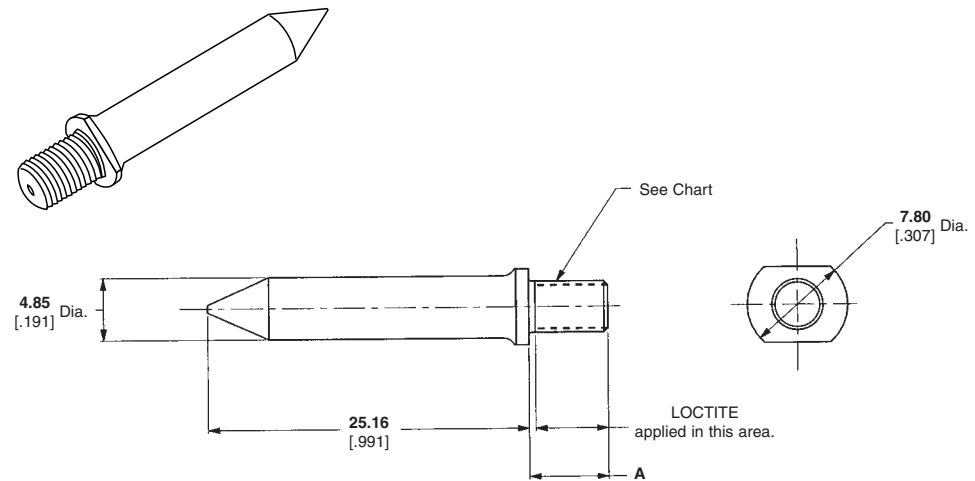
**Note:** For additional Power Module  
options reference Catalog  
1773096, "Power Connectors  
and Interconnection  
Systems," or contact your  
Tyco Electronics Sales  
Representative.

## Guiding Hardware – Unkeyed

### Guide Pin

#### Material and Finish

Passivated stainless steel  
Part Number **223956-1**



| A           | Thread      | Part Numbers |
|-------------|-------------|--------------|
| 7.5 [.295]  | M4 X .7-6g  | 223982-1*    |
| 9.2 [.362]  | M4 X .7-6g  | 223969-7     |
| 12.7 [.500] | 8-32 UNC-2A | 223969-4     |
| 12.7 [.500] | M4 X .7-6g  | 223969-1     |
| 6.2 [.244]  | M4 X .7-6g  | 223956-1     |

\*6.35 Hex Base

### Female Guide Module

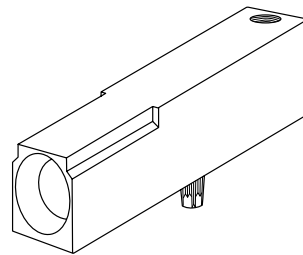
#### Material and Finish

Zinc alloy, chromate conversion coated

#### Related Product Data

##### Application Tooling

Seating Tool, 224440-1  
Board Support Fixture, 217603-1



### Technical Documents

#### Product Specification

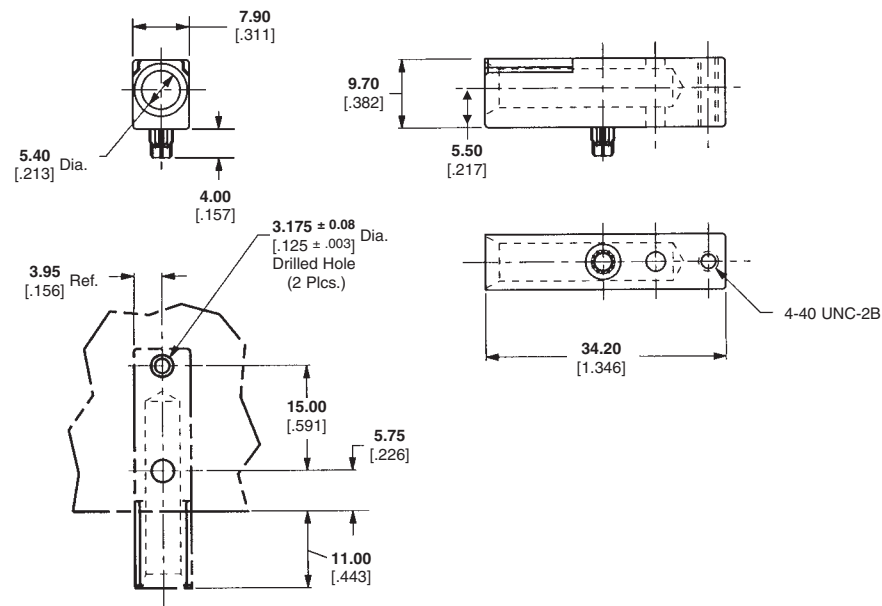
108-1651

#### Application Specification

114-1103

Part Number **223957-1**  
(as shown)

Part Number **223979-1**  
(dual alignment posts)



Recommended PC Board Hole Layout

LOCTITE is a trademark of Henkel Corp.

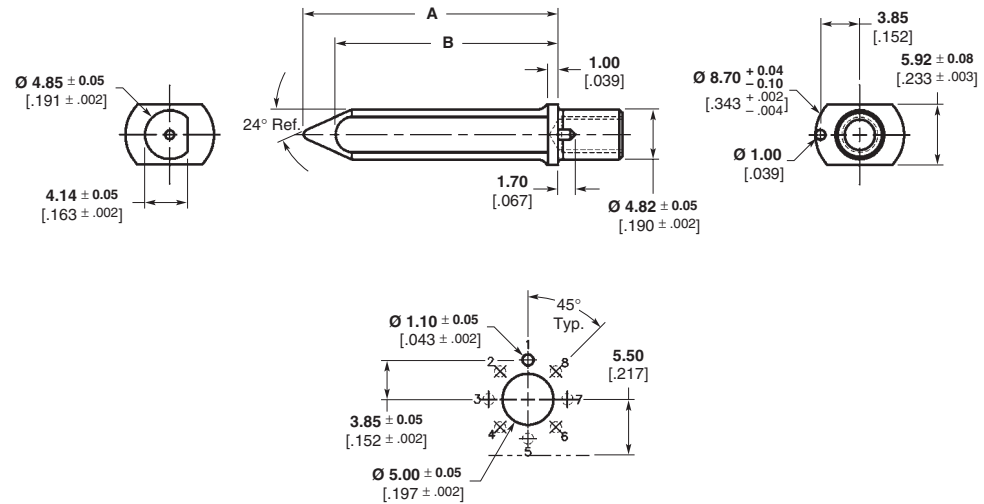
## Guiding Hardware – Keyed

### Guide Pin, Universal Power Module

#### Material and Finish

Zinc Alloy Die Casting,  
Chromate Conversion Coating Finish

| Part Number | Dim. A         | Dim. B        |
|-------------|----------------|---------------|
| 223985-1    | 25.16<br>.990  | 20.39<br>.802 |
| 223985-3    | 29.00<br>1.141 | 24.23<br>.953 |



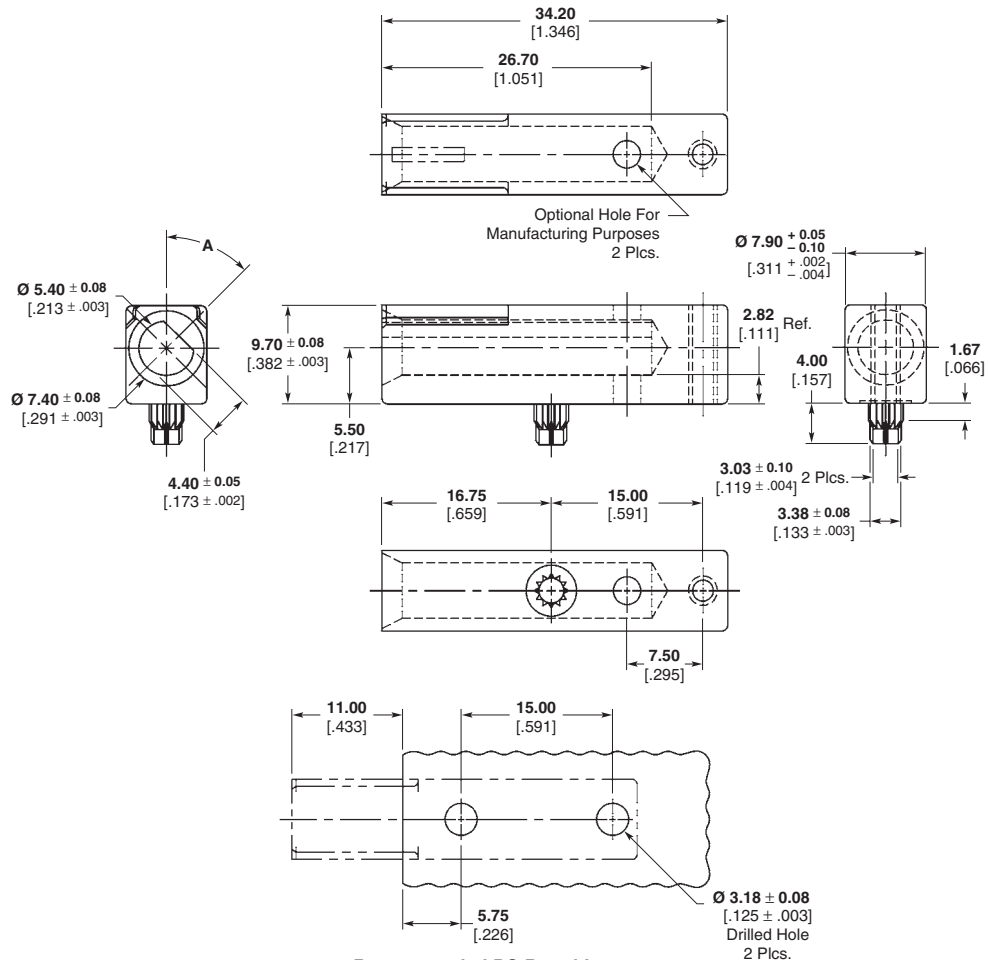
Recommended PC Board Layout  
(Position Shown Used With  
Part Number 223986-1)

### Module, Female, Universal Power Module

#### Material and Finish

Zinc Alloy Die Casting,  
Chromate Conversion Coating Surface  
Finish

| Part Number | Dim. A |
|-------------|--------|
| 223986-1    | 0°     |
| 223986-2    | 45°    |
| 223986-3    | 90°    |
| 223986-4    | 135°   |
| 223986-5    | 180°   |
| 223986-6    | 225°   |
| 223986-7    | 270°   |
| 223986-8    | 315°   |



Recommended PC Board Layout



## Guiding Hardware

### Static Discharge Guide Pins

Ground connection and guidance can be combined using this system which can be used instead of the guide pins shown on page 54. The contacts have a rating of 10A and give a make/break position 12 [.472] in advance of level 3 signal contacts.

Alternative pin lengths are possible and the pin contact housing can be omitted if desired.

### Materials and Finish

**Housings** — Glass filled polyester gray, UL94 V-0 rating

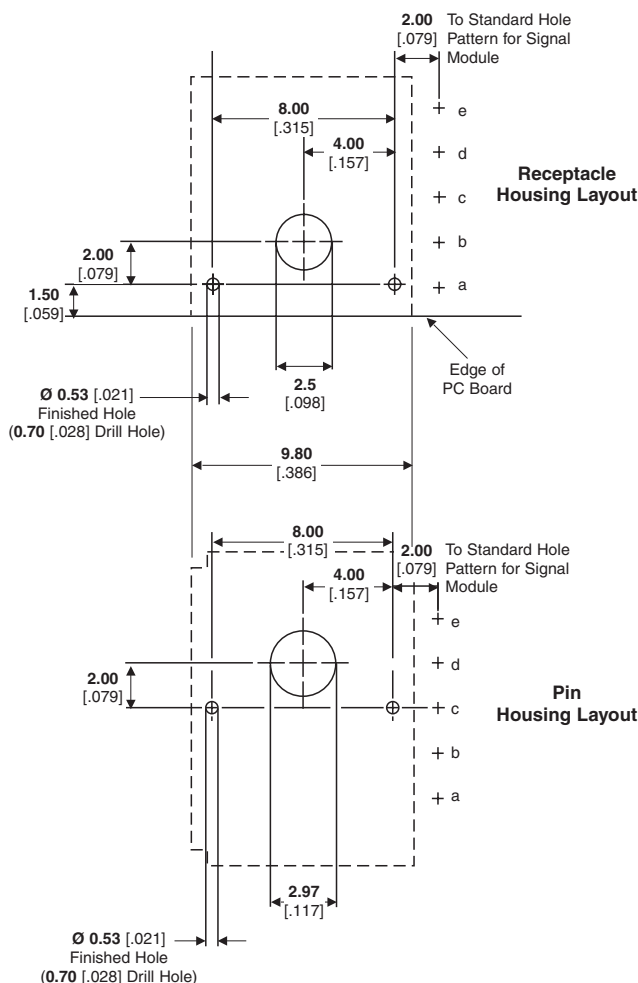
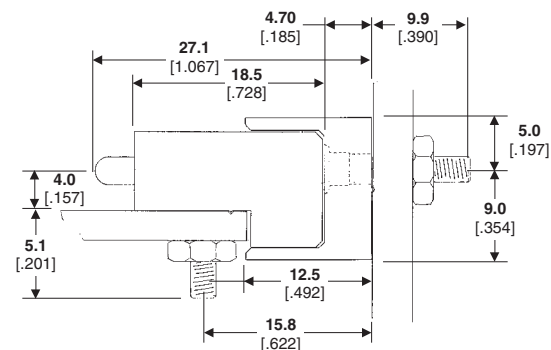
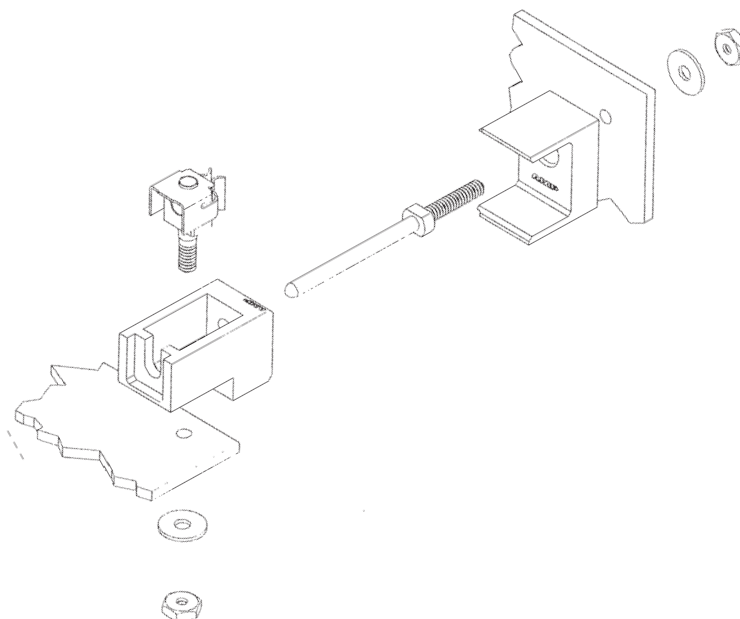
**Contacts** —

Pin — Brass

Receptacle — Copper alloy

Plating — 0.8µm [.000030] Au over

1.3µm [.000050] Ni



| Description         | Part Numbers |
|---------------------|--------------|
| Pin Contact         | 532828-5     |
| Pin Contact Housing | 646274-1     |
| Receptacle Contact  | 533065-6     |
| Rec Contact Housing | 646273-1     |
| Nut                 | 21124-4      |
| Washer              | 986794-1     |

### Tyco Electronics Cable Connectors

The Tyco Electronics range of Hard Metric 2mm [.079] cable connectors and cable assemblies provides circuit designers with a great flexibility in choice of cable types and termination styles.

All types of connectors are end stackable although one pin column is missed with field installable types. This enables high densities of connections using cables from unshielded single wires through to miniature coaxial cable.

### Pin Headers

Cables can be connected to boards both perpendicular and parallel using feedthrough pin headers and cable shrouds for rear of backplanes, or using stand-alone Right Angle or vertical headers.

Sequenced mating can be arranged with all of these options, see detail on page 66.

All cables are retained by using snap latches on the male part, these being ordered separately and fitted where required.

## Cable Connectors and Lead Assemblies

### Specification

| Connector type          | Field Installable                       | Unshielded                                                                                           | Shielded |
|-------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------|----------|
| Sizes                   | 5x2 and 5x4                             | 5x1                                                                                                  | 5+2 x 1  |
| End Stackable           | n                                       | y                                                                                                    | y        |
| Field Terminable        | y                                       | n                                                                                                    | n        |
| Polarized               | y                                       | y                                                                                                    | y        |
| <b>Contact</b>          |                                         |                                                                                                      |          |
| Centers                 | 2mm Matrix                              |                                                                                                      |          |
| Style                   | Twin Beam                               |                                                                                                      |          |
| Contact Rows            | 5                                       | 5                                                                                                    | 5+2      |
| Termination             | IDC                                     | Tyco Electronics Terminated                                                                          |          |
| Material                | Phosphor Bronze                         |                                                                                                      |          |
| Plating                 | 0.8µm Au over 1.3µm Ni                  |                                                                                                      |          |
| Mating Pin Lengths      | 5.3 - 8.3 mm                            |                                                                                                      |          |
| Current Rating          | Dependent on Wire Section, 1.5a max     |                                                                                                      |          |
| <b>Housing</b>          |                                         |                                                                                                      |          |
| Housing Material        | LCP, Black                              | Thermoplastic, Black                                                                                 |          |
| Cover Material          | PBT, Black                              | UL 94 V-0                                                                                            |          |
| UL 94 Rating            | Cable Tie                               |                                                                                                      |          |
| Strain Relief           |                                         |                                                                                                      |          |
| <b>Cable Assemblies</b> |                                         |                                                                                                      |          |
| Cable Types             | Discrete                                | Shielded or Unshielded Twisted Pair;<br>Shielded or Unshielded Flat Pair<br>50Ω or 75Ω Twin Coax etc |          |
| Wire Sizes              | 0.25-0.4/0.4-0.5mm<br>30-26AWG/26-24AWG |                                                                                                      |          |
| Insulation Dia.         | 1.0mm Max.                              |                                                                                                      |          |

Tyco Electronics provides a full range of components for the backplane and daughterboard mating arrangements shown here.

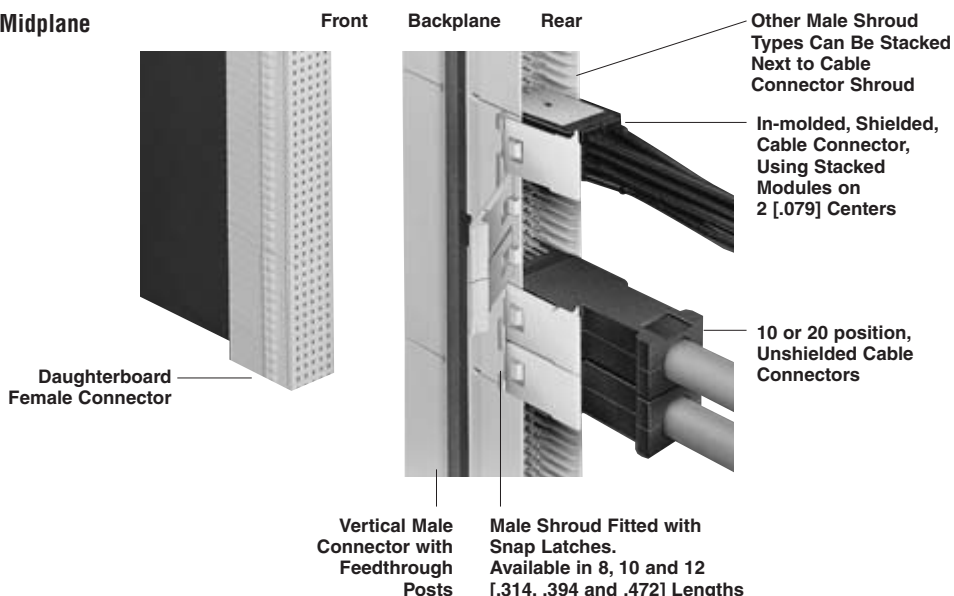
### Midplane

Feedthrough posts from the front male connector, in conjunction with male shrouds, create the male counterpart for polarized mating with cable connectors.

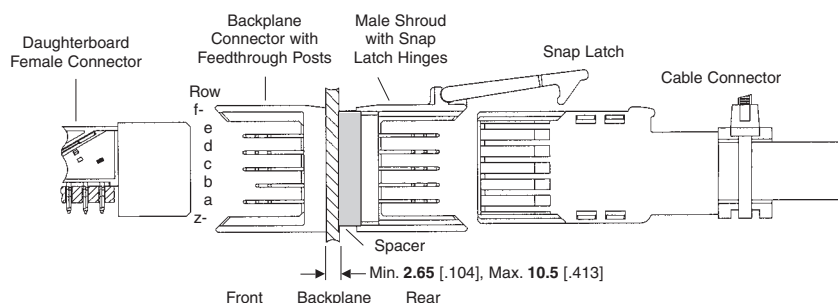
Male Shrouds come in three lengths for end-to-end stacking and use snap latches for firm retention of cable connector housings.

Shrouds are assembled over the feedthrough posts, gripping their sides to ensure rigid location during normal mating/withdrawal of cable connectors.

### Midplane



### Midplane Male Shrouds, without stand-off for PC Board Thickness, min. 2.6 [.104]



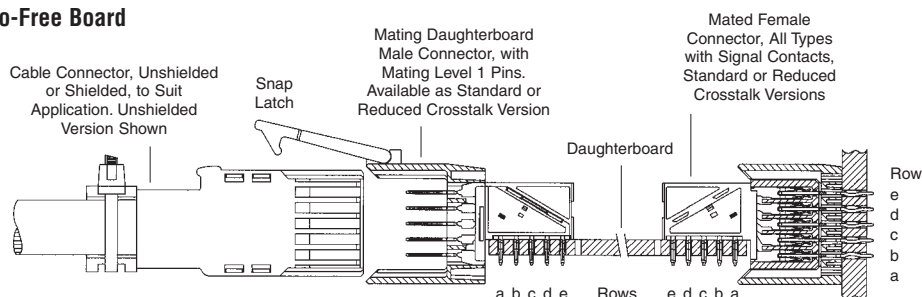
### Spacers

Spacers are available to increase the range of backplane thicknesses possible with sequenced make first and break last. The combined thickness range is 1.65 [.065] to 7.7 [.303], although thicker combinations are possible with reduced function. Consult Tyco Electronics.

### Cable Headers

Vertical and Right Angle cable headers are available with polarizing features. Vertical headers can be fitted with 5 or 5+2 rows of pins for use with shielded connectors. Right Angle versions can be specified with reduced cross talk shields.

### Cable-to-Free Board



## 10 and 20 Position Connectors, with IDC Terminations



### Cable Connector Kits

Unshielded cable connector kits are available in 10 and 20 position sizes. They are suitable for field installation using hand tools and for in-plant assembly using either hand or semi-automatic tooling.

Both methods allow for un-terminated contacts in random positions.

The contact design features double IDC slots with crimp insulation support. Additional outer jacket support is provided by a cable clamp applied round the rear of the cover.

Two versions are available to suit wire ranges from AWG 30-26 and AWG 26-24.

### Tooling

Hand Tool Part Number 734690-1

MT-Matic Bench Terminator

Part Number 1-876095-8

### Cable Connector Mating

Covers are polarized to prevent inversed mating. Keying is not provided to allow flexibility of position in mating to headers. These connectors will not stack end-to-end without loss of one contact column.

### Lead Assemblies

Tyco Electronics can provide lead assemblies to your specification, fully tested and ready for use. A variety of cables can be used.

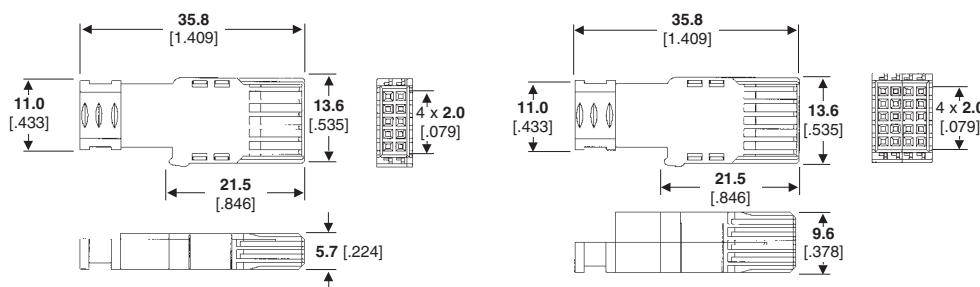
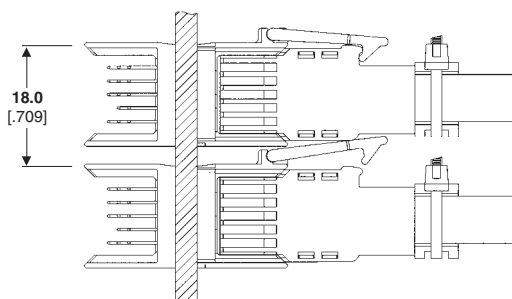
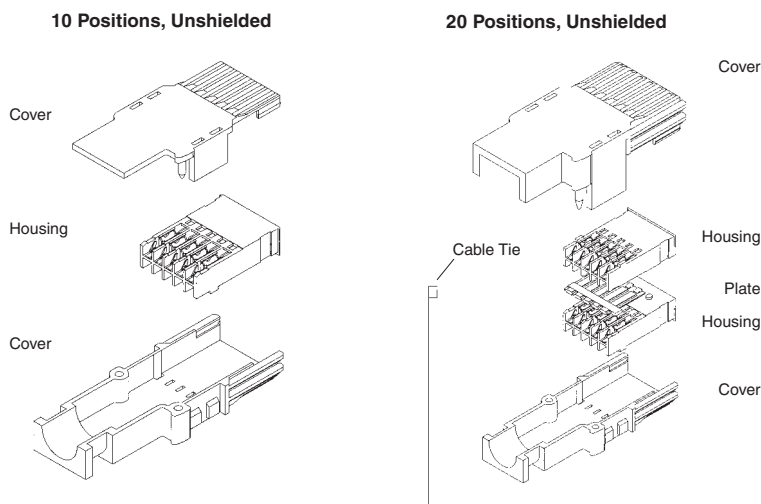
### Row Spacing

Minimum pitch of connector columns is 18mm to allow for operation of the latch.

### Materials

**Housing** — Liquid Crystalline Polymer, Black

**Cover** — Polybutylene Terephthalate, Black



| Wire Size                                      |           | Insulation<br>Max.Ø | Part Numbers |             |
|------------------------------------------------|-----------|---------------------|--------------|-------------|
| AWG                                            | mm²       |                     | 10 Position  | 20 Position |
| Field Installable Kits, Single Item            |           |                     |              |             |
| 30-26                                          | 0.25-0.40 | 1.0 [.039]          | 352167-1     | 352168-1    |
| 26-24                                          | 0.40-0.50 | 1.0 [.039]          | 352167-2     | 352168-2    |
| Field Installable Kits, 50 Items, Bulk Package |           |                     |              |             |
| 30-26                                          | 0.25-0.40 | 1.0 [.039]          | 1-352167-1   | 1-352168-1  |
| 26-24                                          | 0.40-0.50 | 1.0 [.039]          | 1-352167-2   | 1-352168-2  |

**Cable Connector Lead Assembly** Produced to customer requirements, consult Tyco Electronics

## Lead Assemblies, with 5 Position Shielded and Unshielded Cable Connector Modules

### Cable Assemblies Produced by Tyco Electronics to Customer Specifications

- Standard cable offering for unshielded (see below)
- Custom cable offering for unshielded (see your Local Representative)
- Custom cable offering for shielded (see your Local Representative)

### Connector Style

Cable assemblies can be produced with connectors having two different performance levels, 5 row unshielded and 5+2 shielded. Shielded versions have shields between each column connected to row c and to z and f. Although these can be used with 5 row male connectors, better performance is obtained with 5+2 row.

### Cable Assembly Types

Standard assemblies are listed below having flat twin cables with common grounds to row c.

Other configurations can be made to your specification; contact Tyco Electronics.

### Polarization

All cable connectors are polarized at every position. All male connectors, except Right Angle, are also polarized every position. Right Angle male connectors are polarized every other position.

### Basic Module



Figure 1

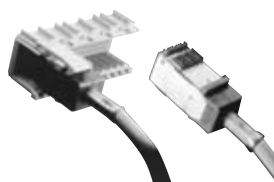
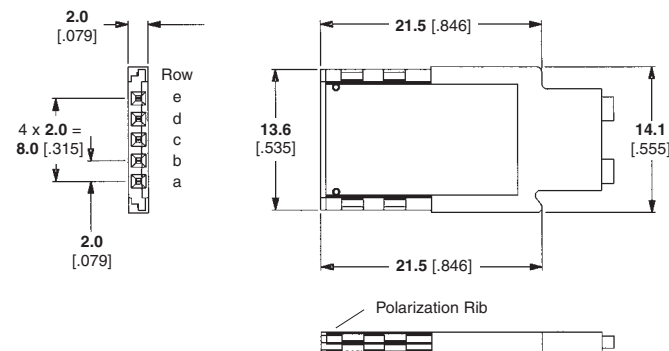


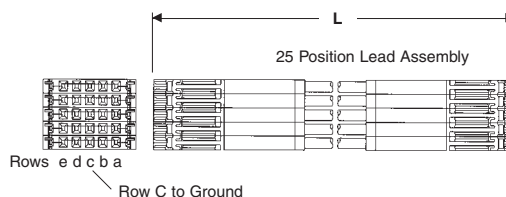
Figure 2



### EMI Shielded Cable Connectors

| Position | Part Numbers |
|----------|--------------|
| 10       | 953383-1     |
| 20       | 953384-1     |
| 30       | 953385-1     |
| 40       | 953386-1     |

### Example of Lead Assembly Stacking



### Part Numbers (Figure 1)

| Modules Length<br>L<br>(Meters) | 1 x (5 + 2) |            | 2 x (5 + 2) |            | 3 x (5 + 2) |            | 4 x (5 + 2) |            | 5 x (5 + 2) |            | 6 x (5 + 2) |            |
|---------------------------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
|                                 | Straight    | Cross Over | Straight    | Cross Over | Straight    | Cross Over | Straight    | Cross Over | Straight    | Cross Over | Straight    | Cross Over |
| 0.5                             | 188956-8    | 352041-8   | 188680-8    | 352199-8   | 188681-8    | 352200-8   | 188682-8    | 352096-8   | 188683-8    | 352196-8   | 188684-8    | 352121-8   |
| 1.0                             | 188956-7    | 352041-7   | 188680-7    | 352199-7   | 188681-7    | 352200-7   | 188682-7    | 352096-7   | 188683-7    | 352196-7   | 188684-7    | 352121-7   |
| 1.5                             | 188956-5    | 352041-5   | 188680-5    | 352199-5   | 188681-5    | 352200-5   | 188682-5    | 352096-5   | 188683-5    | 352196-5   | 188684-5    | 352121-5   |
| 2.0                             | 188956-6    | 352041-6   | 188680-6    | 352199-6   | 188681-6    | 352200-6   | 188682-6    | 352096-6   | 188683-6    | 352196-6   | 188684-6    | 352121-6   |
| 3.0                             | 188956-1    | 352041-1   | 188680-1    | 352199-1   | 188681-1    | 352200-1   | 188682-1    | 352096-1   | 188683-1    | 352196-1   | 188684-1    | 352121-1   |
| 5.0                             | 188956-3    | 352041-3   | 188680-3    | 352199-3   | 188681-3    | 352200-3   | 188682-3    | 352096-3   | 188683-3    | 352196-3   | 188684-3    | 352121-3   |
| 10.0                            | 188956-4    | 352041-4   | 188680-4    | 352199-4   | 188681-4    | 352200-4   | 188682-4    | 352096-4   | 188683-4    | 352196-4   | 188684-4    | 352121-4   |

**Notes:** Mentioned Part Numbers have cable 100 Ohm differential pair. Other lengths on request. Also available with 50 Ohm coax cable, 1 up to 5 loaded signal contacts. See figure 1.

### Part Numbers (Figure 2)

2mm [.079] HM Cable Assemblies, Unshielded Connectors, Shielded Flat Twin Cable, Row c to Ground

| Modules Length<br>(Meters) | 1 x 5    | 2 x 5    | 3 x 5    | 4 x 5    | 5 x 5    | 6 x 5    | 7 x 5    | 8 x 5    | 9 x 5    | 10 x 5   | 11 x 5   | 22 x 5   |
|----------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1.0                        | 621275-1 | 621408-1 | 621409-3 | 621410-4 | 621411-3 | 621720-2 | 636207-1 | 621412-4 | 636171-1 | 636208-1 | 636209-1 | 636210-1 |
| 1.5                        | 621275-6 | 621408-2 | 621409-2 | 621410-1 | 621411-1 | 621720-3 | 636207-2 | 621412-2 | 636171-2 | 636208-2 | 636209-2 | 636210-2 |
| 2.0                        | 621275-2 | 621408-3 | 621409-4 | 621410-5 | 621411-4 | 621720-4 | 636207-3 | 621412-5 | 636171-3 | 636208-3 | 636209-3 | 636210-3 |
| 3.0                        | 621275-3 | 621408-4 | 621409-1 | 621410-3 | 621411-2 | 621720-5 | 636207-4 | 621412-6 | 636171-4 | 636208-4 | 636209-4 | 636210-4 |
| 5.0                        | 621275-5 | 620889-1 | 620888-1 | 621891-1 | 621411-5 | 621720-6 | 636207-5 | 621412-7 | 636171-5 | 636208-5 | 636209-5 | 636210-5 |
| 10.0                       | 621275-7 | 620889-2 | 620888-2 | 621891-2 | 620892-1 | 621720-7 | 636207-6 | 621412-8 | 636171-6 | 636208-6 | 636209-6 | 636210-6 |

See figure 2.

## Male Cable Connector Shrouds

### Zero Insertion Force (ZIF) Cable Shrouds

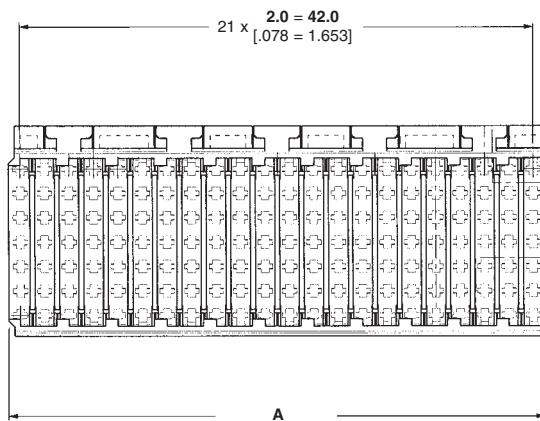
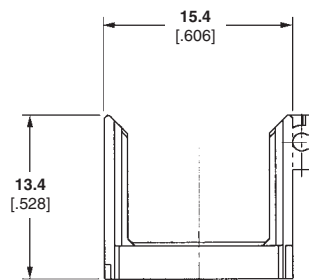
ZIF shrouds are used with 5 row and 5+2 row feed-through male connectors to allow cables to be connected to the rear of the backplane.

Separate variable thickness spacers are available (see page 30) to compensate for a range of backplane thicknesses. Spacers are assembled to shrouds before fitting over pins, and then pressed down using a male insertion tool.

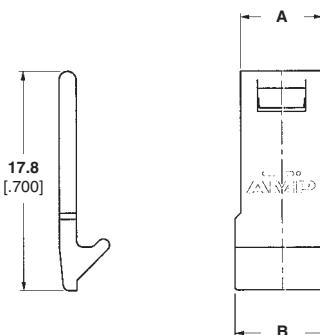
### Material

**Shroud and Snap Latch** — Glass filled polyester, gray; rating, UL94 V-0

| Type   | Part Number | Dim. Length   |
|--------|-------------|---------------|
| A or B | 352601-2    | 49.90<br>1.96 |
| B (22) | 352672-2    | 43.90<br>1.73 |
| B (19) | 352673-2    | 37.90<br>1.49 |
| B (11) | 352674-2    | 21.90<br>0.86 |



### Latches



| Positions | Part Number | Dim. A Length | Dim. B Length |
|-----------|-------------|---------------|---------------|
| 4         | 352706-2    | 7.8<br>0.29   | 6.8<br>0.26   |
| 5         | 352706-1    | 9.8<br>0.38   | 8.8<br>0.34   |



## Male Connectors, Cable-to-Board



### Vertical and Right Angle Cable Headers

Cable connectors can be supplied to give perpendicular or in-line connection to the printed circuit board. Typical applications for vertical headers are for the rear of backplanes and for Right Angle connectors, the outer edge of daughtercards.

Vertical headers can be loaded with 5 rows of contacts for connection to unshielded cable assemblies, or with 7 rows for connection to shielded assemblies.

Right Angle headers can be supplied with optional reduced cross talk shields.

All have polarizing ribs to ensure correct connector position.

Contact Tyco Electronics for ground return shields for Right Angle connectors.

### Performance Data pages 6-7.

### Materials and Finish:

Glass filled polyester housing, gray, UL94 V-O rated.

Phosphor-bronze signal contacts

Contact area 0.8µm [.000030] Au over 1.3µm [.000050] Ni

ACTION PIN Contact 0.5µm [.000020]

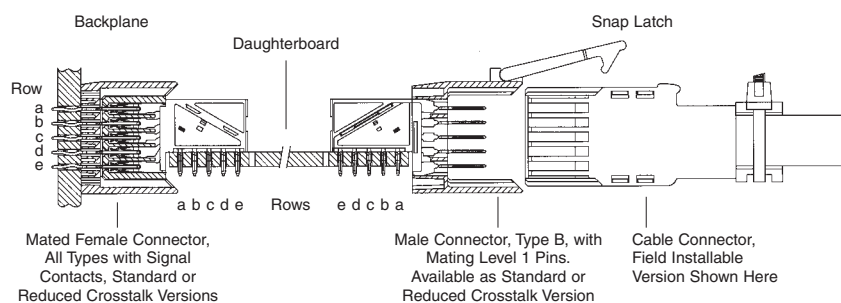
Sn/Pb over 1.3µm [.000050] Ni

### Snap Latches

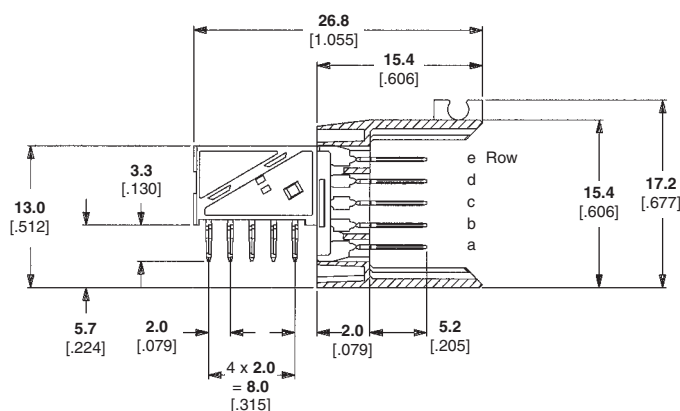
Part Number **620729-1**, 5 Column

Part Number **620729-2**, 4 Column

4 or 5 pos latches should be specified according to cable connector location and size.

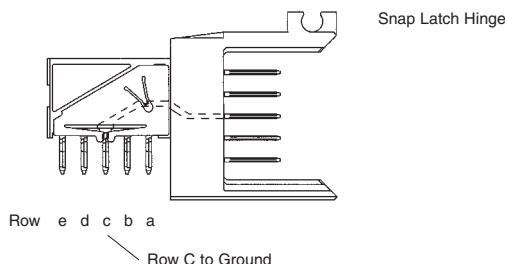


### Standard Version



### Reduced Crosstalk Version

Same dimensions as standard version



## Male Connectors, Cable-to-Board (Continued)

### Assembly on Free Board

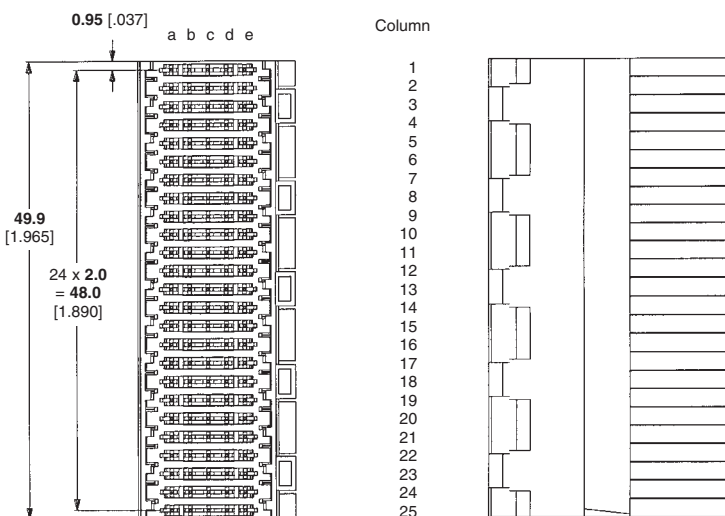
Contacts have ACTION PIN posts for firm retention, same as free board female connectors.

### Type B, Right Angle Male Connector

| Version           | Part Number |
|-------------------|-------------|
| Standard          | 1-106014-1  |
| Reduced Crosstalk | 1-352272-1  |

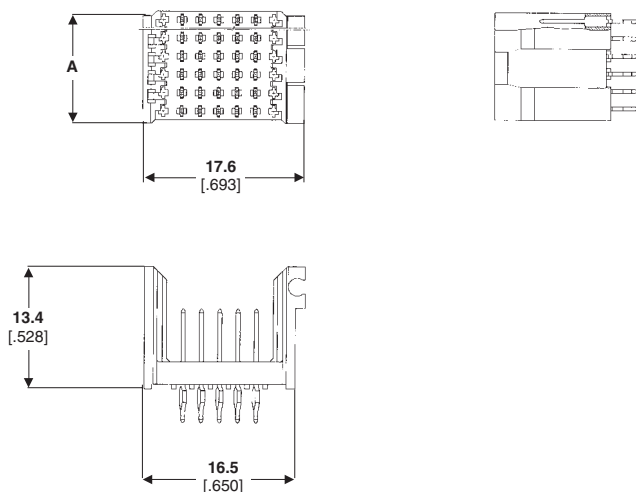
Type A and C versions also available, contact Tyco Electronics.

### Type B, 125 Signal Pins, 50 [1.968] Module



### Vertical Male Connector

**Note:** Housing is black



| No. of Columns | Part Numbers | Dim. A        |
|----------------|--------------|---------------|
| 4              | 636120-1     | 7.88<br>.310  |
| 5              | 636120-2     | 9.88<br>.388  |
| 6              | 636120-3     | 11.88<br>.468 |

Other sizes in planning

## Coordination dimensions and tolerances

The accompanying diagrams show the depth dimensions used in the equipment practice, used for both 2 and 2.5 [.079 and .098] systems, and allowable tolerances for subrack and backplane bending.

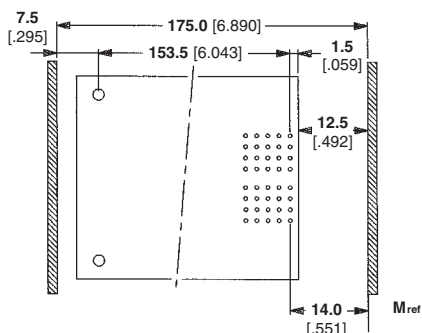
### Coordination Dimension $M_{ref}$

As defined in the DIN 43356 and IEEE 1301 Hard Metric equipment practices for the 2.5mm system, and used in IEC 61076-4-101, the dimension  $M_{ref}$  is the range for free board engagement with the backplane.

The specified contact mating must be maintained on a mated pair of connectors, within the range of  $M = 14$  to  $16.5$  [.551 to .650] for the shortest mating level 1.

For mating levels 2 and 3 the contact ranges are  $14$  to  $18$  [.551 to .709] and  $14$  to  $19.5$  [.551 to .768].

See page 67 for further details on AMP Z-PACK 2mm HM contact mating levels.

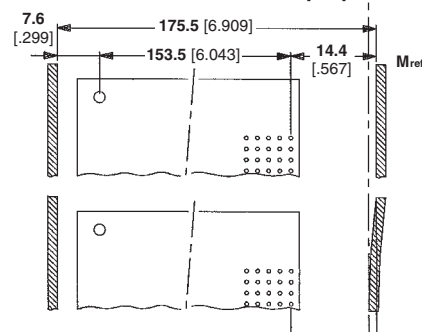
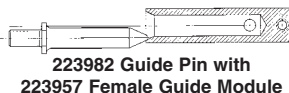


Coordination Dimensions

3.15  
[.124] Max.  
Mismatch



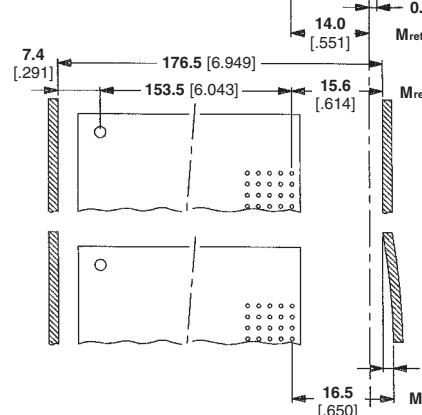
2.75  
[.108] Max.  
Mismatch



Subrack tolerances

Worst case condition 1  
without back panel bending

Worst case condition 1  
with back panel bending



Subrack tolerances

Worst case condition 2  
without back panel bending

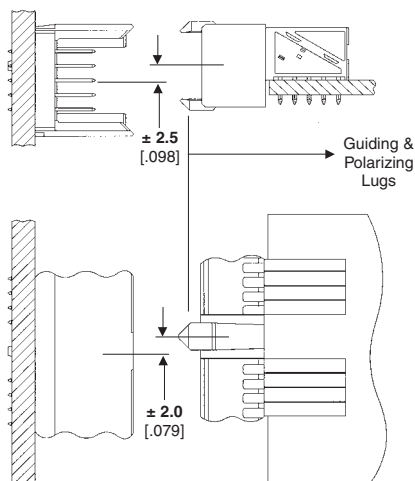
Worst case condition 2  
with back panel bending

## Misalignment and inclination tolerances

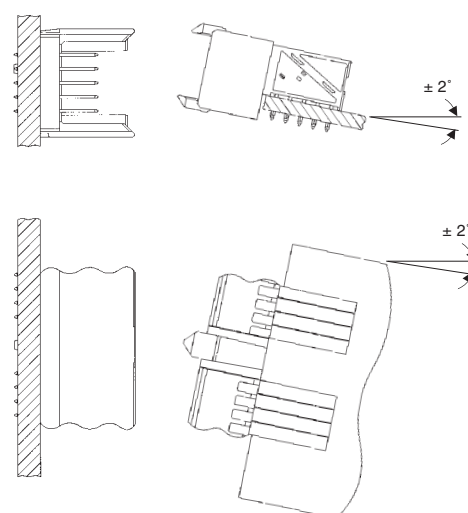
Guiding and polarizing lugs of Type A, M and L connectors, also at ends of Type C and N, allow the mating tolerances shown here.

Tolerances apply only when guide lugs are separated by only one Type B module without lugs.

Allowed Misalignment,  
Transverse & Longitudinal Axes



Allowed Inclination,  
Transverse & Longitudinal Axes



## Fixed Board Male Connectors

Type A, B, C, M, M-MS-C and M-MS-C-rev. fixed board male connectors have signal contact positions identified by row letters and column numbers, shown right, viewed toward the frontside of the backplane.

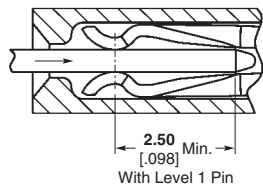
Contact positions can be filled or left unfilled, as required, for a customer's circuit arrangement. Contact pins for each position can be specified from any of the options shown below, excepting:

- Rows **z** and **f**, for ground return shield contacts only, must always be level 3.
- Row **b** is not available for level 3 (length 11.2 [.441]) contacts when mating with a right angle female connector.
- For rear board cable connectors, use posts providing rear mating length 1 after allowing for board thickness, unless sequenced mating is required. Consult the chart page 66.

Use the codes A-V to specify front/rear contact for each position on the special option chart, page 67.

## Midplane Cross-connect Applications

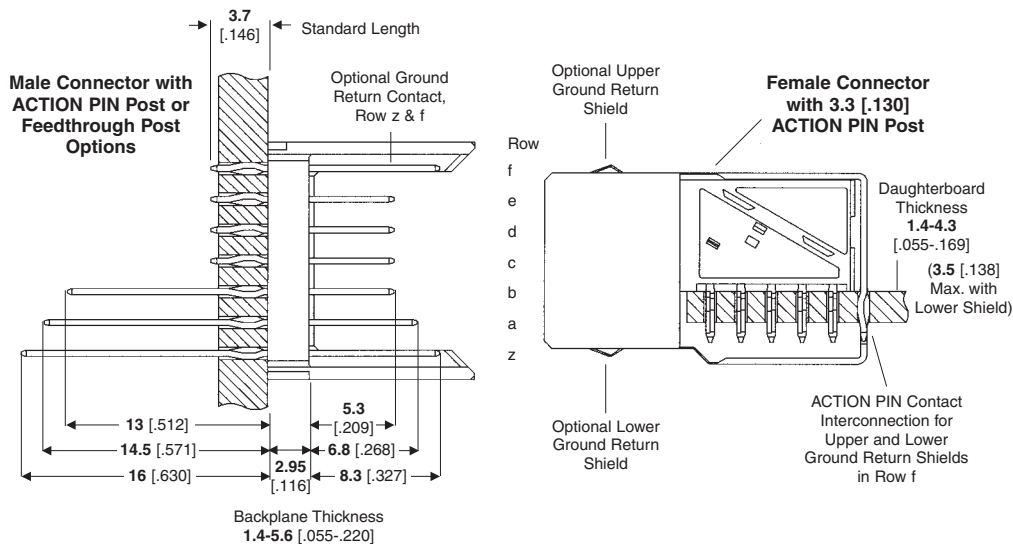
Cross-connections, require the feedthrough posts to be rotated 90°, so that the mating surface aligns with the female receptacle spring beams.



Contact Range

## Dimensions

### Connector Types



### Male Pin Options

| Rear Style                                     | REAR                | Contact Dimensions | FRONT               | Specify by Code |
|------------------------------------------------|---------------------|--------------------|---------------------|-----------------|
| <b>ACTION PIN Posts Only</b>                   |                     |                    |                     |                 |
|                                                |                     | 3.7 [.146]         | 8.2 [.323] Level 1  | A               |
|                                                |                     |                    | 9.7 [.382] Level 2  | B               |
|                                                |                     |                    | 11.2 [.441] Level 3 | C               |
|                                                |                     | 5.2 [.205]         |                     | G               |
|                                                |                     |                    |                     | H               |
|                                                |                     |                    |                     | J               |
|                                                |                     |                    |                     | K               |
|                                                |                     |                    |                     | L               |
|                                                |                     |                    |                     | M               |
|                                                |                     |                    |                     | N               |
|                                                |                     |                    |                     | P               |
|                                                |                     |                    |                     | Q               |
|                                                |                     |                    |                     | R               |
|                                                |                     |                    |                     | S               |
|                                                |                     |                    |                     | T               |
|                                                |                     |                    |                     | X*              |
|                                                |                     |                    |                     | U*              |
|                                                |                     |                    |                     | V*              |
| <b>Feedthrough Posts with ACTION PIN Posts</b> |                     |                    |                     |                 |
|                                                | Level 1 13.0 [.512] |                    |                     |                 |
|                                                | Level 2 14.5 [.571] |                    |                     |                 |
|                                                | Level 3 16.0 [.630] |                    |                     |                 |

\* X, U, V are only used for cross connect applications. Not all versions are tooled.

*Please make a photocopy  
of this page for marking up  
the specification.*

*Fill in chart below with  
contact type designation  
(see guide) required in each  
position. Unfilled positions  
to be left blank.*

## Customer Specification for Signal Pin Arrangement and MSC Plug Cavities

Customer: .....

Prepared by: ..... Dept: .....

Date: ..... Order no. reference, if available: .....

Select Male Conn. Type: A B C D E F M-MSC M-MSC-rev, Vertical/Right Angle

MSC Male Connector Fiber Optic Cavities Type (circle letter): M-MSC M-MSC-rev L-MSC

### Notes

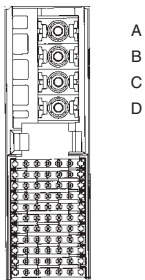
(1) Ground return shield contacts only,  
level 3 (length 11.2 [.441]) required. z+f  
for 5+2 row, z+i for 8+2 row

(2) Not available for level 3 contacts  
when mating with 5 row or 8 row right  
angle female connector.

### MSC Connectors, see below

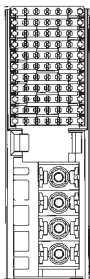
Circle cavity positions to be filled with  
sleeve and end cap.

#### M-MSC



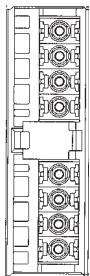
A  
B  
C  
D

#### M-MSC-rev



E  
F  
G  
H

#### L-MSC



A  
B  
C  
D  
  
E  
F  
G  
H

| Row    | z<br>(1) | a | b<br>(2) | c | d | e | f<br>(1) | g | h | i<br>(1) |
|--------|----------|---|----------|---|---|---|----------|---|---|----------|
| Column | 1        |   |          |   |   |   |          |   |   |          |
| 1      |          |   |          |   |   |   |          |   |   |          |
| 2      |          |   |          |   |   |   |          |   |   |          |
| 3      |          |   |          |   |   |   |          |   |   |          |
| 4      |          |   |          |   |   |   |          |   |   |          |
| 5      |          |   |          |   |   |   |          |   |   |          |
| 6      |          |   |          |   |   |   |          |   |   |          |
| 7      |          |   |          |   |   |   |          |   |   |          |
| 8      |          |   |          |   |   |   |          |   |   |          |
| 9      |          |   |          |   |   |   |          |   |   |          |
| 10     |          |   |          |   |   |   |          |   |   |          |
| 11     |          |   |          |   |   |   |          |   |   |          |
| 12     |          |   |          |   |   |   |          |   |   |          |
| 13     |          |   |          |   |   |   |          |   |   |          |
| 14     |          |   |          |   |   |   |          |   |   |          |
| 15     |          |   |          |   |   |   |          |   |   |          |
| 16     |          |   |          |   |   |   |          |   |   |          |
| 17     |          |   |          |   |   |   |          |   |   |          |
| 18     |          |   |          |   |   |   |          |   |   |          |
| 19     |          |   |          |   |   |   |          |   |   |          |
| 20     |          |   |          |   |   |   |          |   |   |          |
| 21     |          |   |          |   |   |   |          |   |   |          |
| 22     |          |   |          |   |   |   |          |   |   |          |
| 23     |          |   |          |   |   |   |          |   |   |          |
| 24     |          |   |          |   |   |   |          |   |   |          |
| 25     |          |   |          |   |   |   |          |   |   |          |

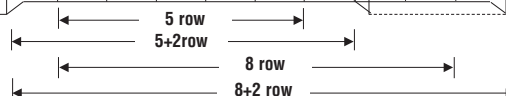
Use for Type C, Type F or  
Type M-MSC-rev.  
Connectors with 55 and  
88 signal Contact  
Positions Respectively

Omit for Type A and  
Type D Connector

Start Here for Type M  
and Type M-MSC  
Connectors with 55  
Signal Contact Positions

Continue for Type A, B,  
D and E Connectors

19 and 22 Column are  
for VME 64 and  
CompactPCI (5 Row only)



**Engineering Notes**

A large grid of graph paper for engineering notes, consisting of 30 columns and 40 rows of small squares.



# PC Board Layout for 5/5+2 row Type A, B, C, Connectors and Ground Return Shields

## General Information

Layouts show connectors in a typical stacking arrangement on a 2 x 2 [.079 x .079] grid, with optional holes for ground return shields.

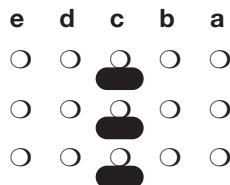
Card extender or cable connector and vertical female connectors use the same 5 row (a to e) layouts; ground return shields are not used with these types.

## Right Angle Connectors

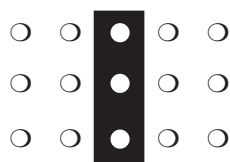
**Standard Version** uses the board layout as illustrated, right.

**Reduced Crosstalk Version**, with metal plates between columns of contacts, requires an additional pad (2.0 x 1.0 [.079 x .039]), or continuous path, connected via row **c**, to the system ground. Examples are shown below:

Pad



Continuous path



## Symbols

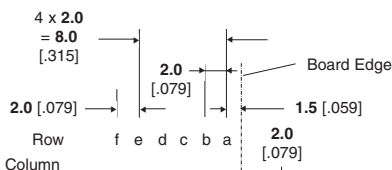
### Plated Through Holes:

- + Signal Contacts.
- Row **f** odd numbers for upper ground return shield.
- Row **f** even numbers for lower ground return shield.
- ✖ Backplane rows **z** and **f**.

### Non-plated Through Holes:

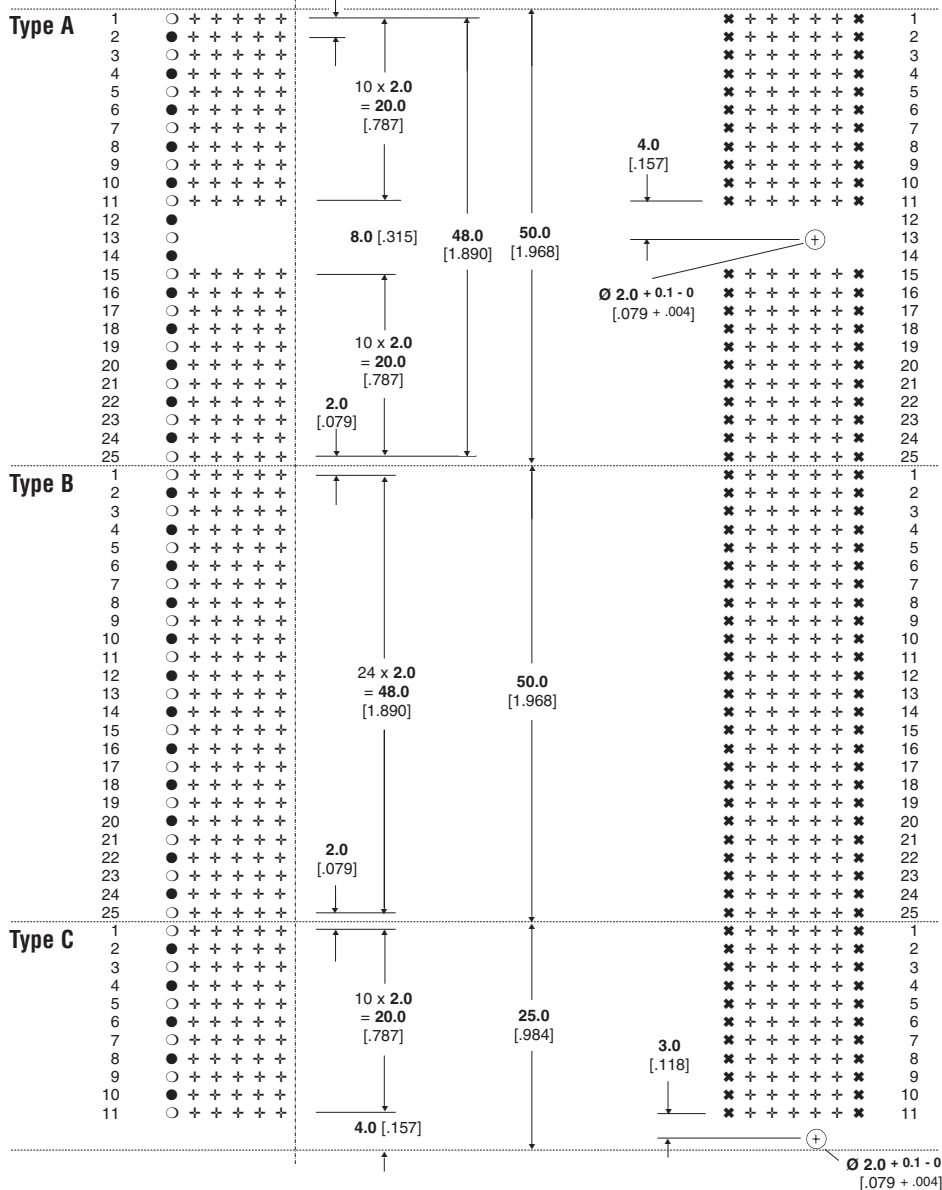
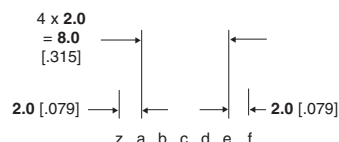
- ⊕  $\varnothing 2.0 + 0.1 - 0$  [.079 + .004] polarizing, location peg hole for press fit.

## Right Angle Male and Female Connector Component Side



*Note: For guidance only. Consult customer drawings for production layouts*

## Vertical Male and Female Connector Front Side



See page 9 for details of plated through holes.

## PC Board Layout for Type L, M, N Connectors

### General Information

Layouts show Type M, L, N connectors, for DIN contacts, in a typical stacking arrangement, including signal contacts on a 2 x 2 [.079 x .079] grid, with optional ground return shielding.

### Female Connector

Standard and Reduced Crosstalk versions, see examples on page 63.

### Symbols

#### Plated Through Holes:

- ⊕ Signal Contacts.
- Row f odd numbers for upper ground return shield.
- Row f even numbers for lower ground return shield.
- ✱ Backplane rows z and f for ground return shield contacts.
- ⊕  $1.3 + 0.1 - 0$  [.051 + .004] plated through holes for board mount DIN high current or coaxial contacts. To be omitted for cable contacts.

#### Non-plated Through Holes:

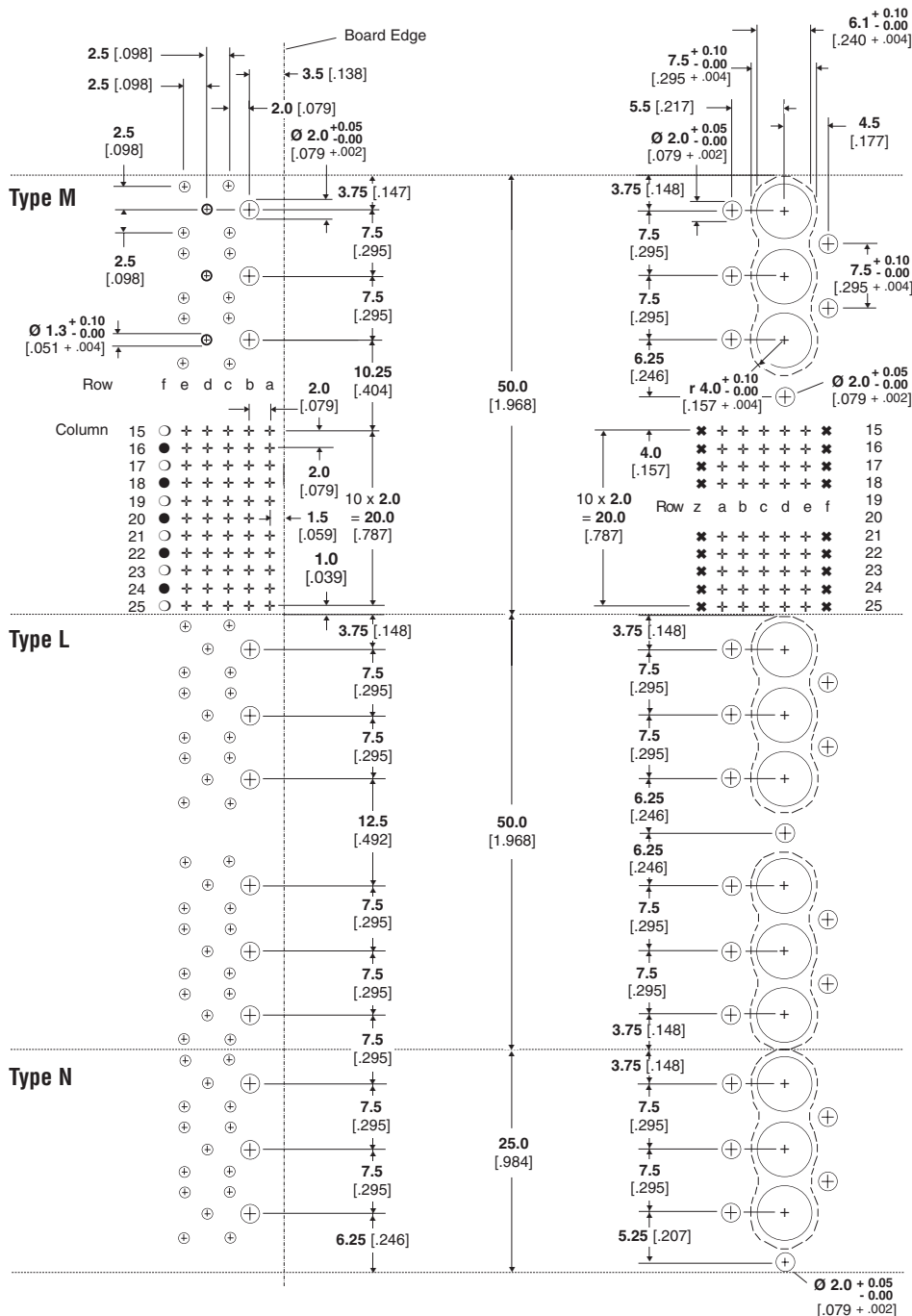
- ⊕  $2.0 + 0.05 - 0$  [.079 + .002] polarizing, location peg hole for press fit.
- $6.1 + 0.1 - 0$  [.240 + .004] hole in fixed board, for DIN high current and coaxial contacts.\*
- Optional cutout, used for DIN fiber optic contacts.\*

\* For reference only, please refer to Power or Coax Contact customer drawing for correct hole pattern.

### Right Angle Female Connectors Component Side

*Note: For guidance only.  
Consult customer  
drawings for production  
layouts*

### Vertical Male Connector Front Side



**Note:** ⊕ Only required for coaxial/omitted for power.

See page 9 for details of plated through holes.

## PC Board Layout for Type D, E, F Connectors & Ground Return Shields

## General Information

Layouts show connectors in a typical stacking arrangement with optional holes for ground return shields.

Pin headers have a 2.0 x 2.0 [.079 x .079] grid. Receptacles have a 2.0 x 1.5 [.079 x .059] grid for signal contacts with ground return shields spaced 1.75 [.069] from row **h**.

## Symbols

### Plated Through Holes:

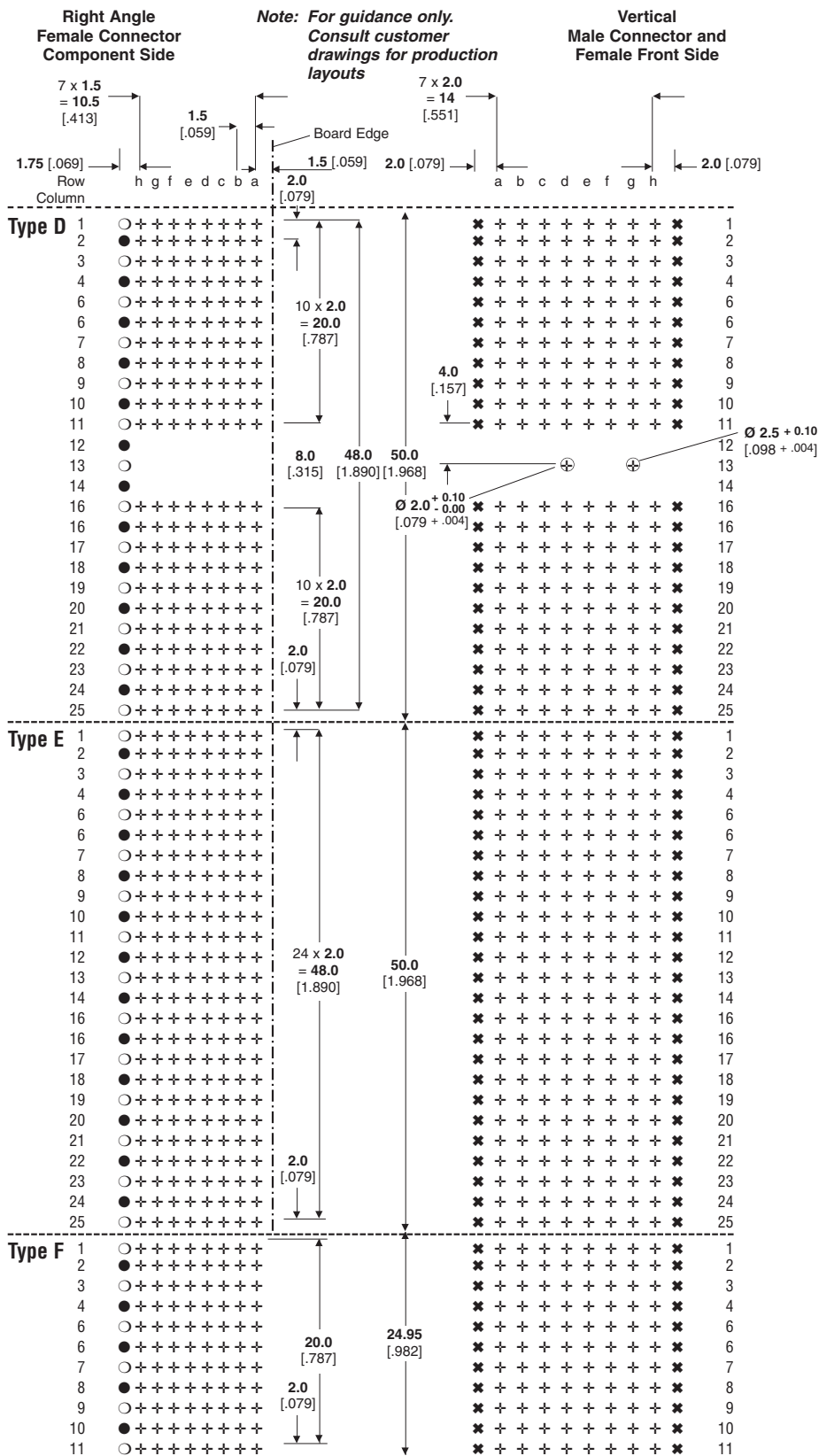
+ Signal Contacts.

### Non-plated Through Holes:

⊕ **Ø 2.0 + 0.1 - 0** [.079 + .004]  
polarizing, location peg hole  
for press fit.

**Note: For guidance only.  
Consult customer  
drawings for production  
layouts**

### Vertical Male Connector and Female Front Side



See page 9 for details of plated through holes.

## PC Board Layout for Type M-MS-C-rev, L-MS-C Connectors

### General Information

Layouts show MSC fiber optic connectors in a typical stacking arrangement, including signal contacts on a 2 x 2 [.079 x .079] grid, with optional ground return shielding.

### Female Connector

**Standard and Reduced Crosstalk versions**, see examples on page 66.

### Symbols

#### Plated Through Holes:

- ⊕ Signal Contacts.
- Row **f** odd numbers for upper ground return shield.
- Row **f** even numbers for lower ground return shield.
- \* Backplane rows **z** and **f** for ground return shield contacts.

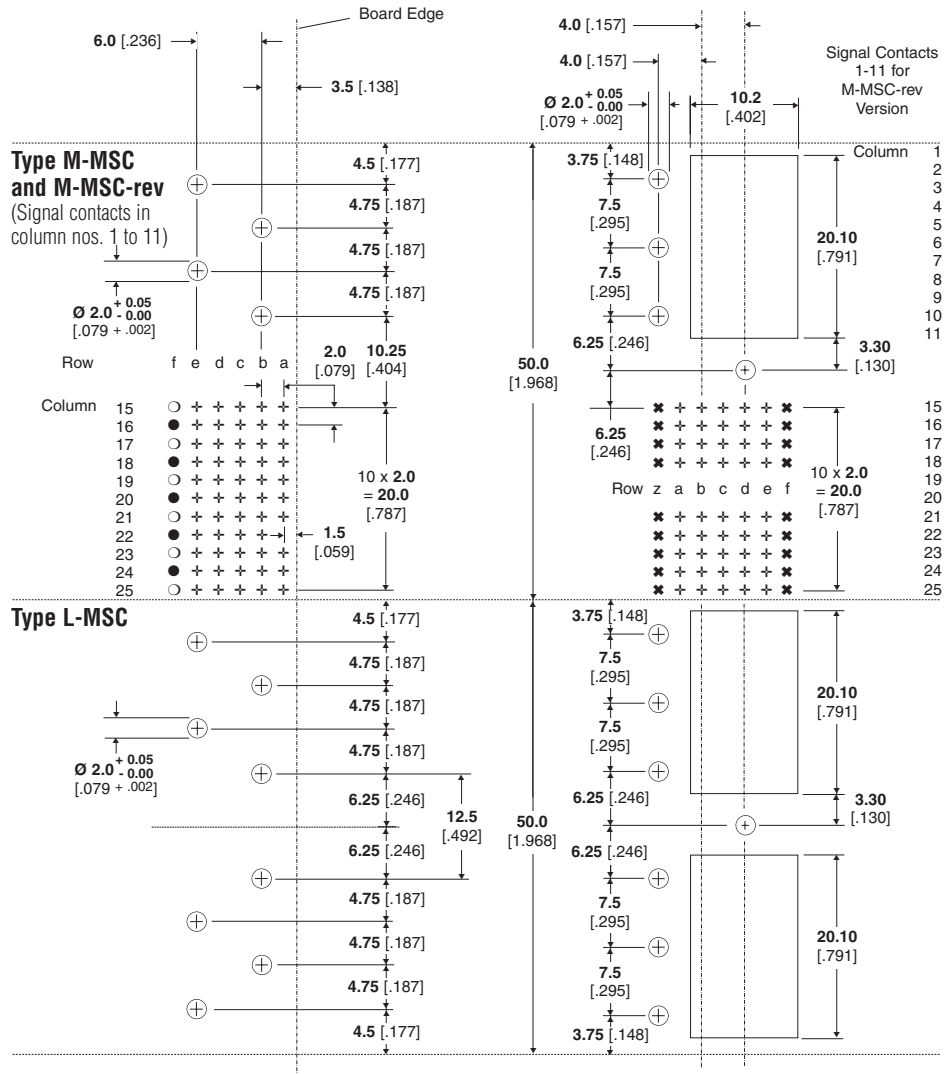
#### Non-plated Through Holes:

- ⊕  $\varnothing 2.0 + 0.05 - 0$  [.079 + .002] polarizing, location peg hole for press fit.
- Cutout.

Right Angle  
Female Connector  
Component Side

*Note: For guidance only.  
Consult customer  
drawings for production  
layouts*

Vertical  
Male  
Connector



See page 9 for details of plated through holes.

There are two styles of connector insertion tooling available to suit different production needs.

- “Flat Rock” — tools are fitted to the connector and as such they are independent of insertion machine type or manufacturer. They are suitable for multiple connector insertion when used with a high force insertion machine.
- Quick Change — inserts are attached to the Tyco Electronics insertion machine. Adapters for other insertion machine manufacturers are possible.

All insertion machines can be supplied to suit local power supply conditions. The manual arbor frame is recommended for repair tasks.

### Pneumatic and Hydraulic “Flat Rock” Seating Machines

These machines are used with the tooling on page 75. They allow the fitting of multiple connectors per cycle, up to the limit of the machine capacity, and can be used with a variety of Tyco Electronics connectors.

#### SM-3 Machine

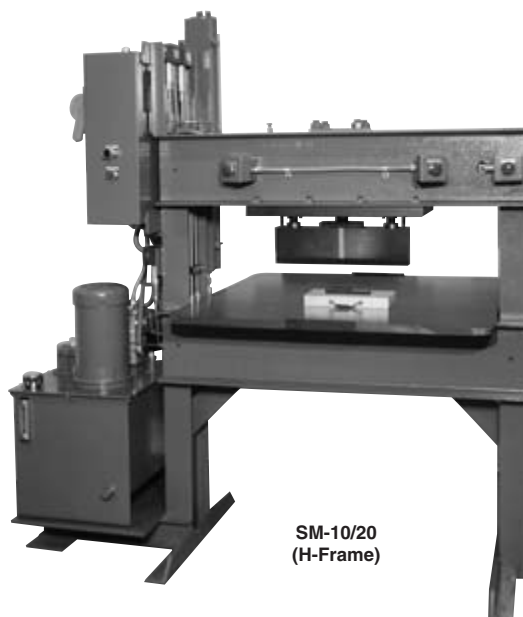
**Part Number 814700-2**  
**(European CE Approved)**  
**814700-5**

- Air powered bench machine
- Capacity of 26 700 N [6000 lb] (adequate for individual Z-PACK 2mm HM modules)
- Pressure response mode
- Cycle time is approximately 4 seconds
- Accommodates printed circuit boards up to 508 [20"] wide.
- Customer Manual 409-5626

#### SM-10/20 Machine

**Part Number 803880-6**

- Electric hydraulically-powered
- Capacity (selectable): 178 000 N [40 000 lb] or 89 000 N [20 000 lb]
- Accommodates printed circuit boards up to 711 [28"] wide



SM-10/20  
(H-Frame)



SM-3

## Connector Insertion Tooling — “Flat Rock Style” (Continued)

### Female Connector Insertion

Same tooling used for unshielded right angle female and unshielded right angle male connectors.

### Male Connector Insertion

Tooling is used for both male connectors and male shrouds in midplane arrangements.

### Upper Insertion Tool

Exchangeable inserts to suit connector types; many inserts can be used for several applications.

Bar stock with a flat surface large enough to cover the top surface of right angle connectors and capable of exerting 67 N per pin.

Tooling for 5+2 row pin headers will also assemble 5 row headers, similarly tooling for 8+2 row pin headers will also assemble 8 row headers.

### PC Board Support Anvils

For all connectors, board supports will be needed to allow the contact tails to pass freely into and through the board. Instruction sheets detail those supports.

### Rear Shrouds

Shrouds used for mid-plane or cable connection to backplane rear are fitted to the feedthrough posts and pressed into position using the same tooling as for male connectors.

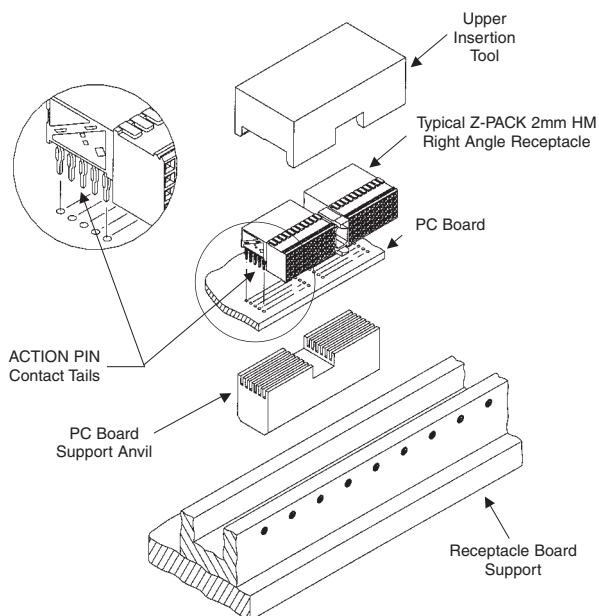
### Shields

EMI/RFI shields and lower ground return shields are fitted over the connector after it is fitted to the board.

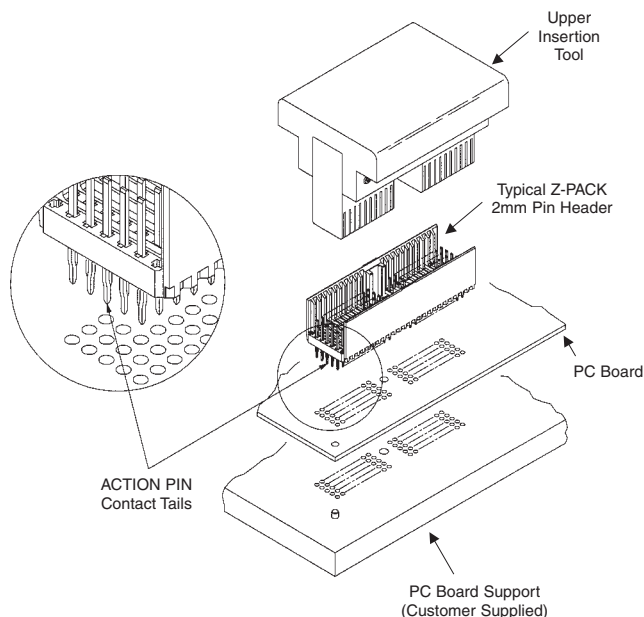
### Instruction Sheets

For details of all the above, refer to the appropriate instruction sheet listed on page 75.

### Female Connector Insertion



### Male Connector Insertion





## Connector Insertion Tooling — “Flat Rock Style” (Continued)

| Description                                                                       | Part Number             |                 | Instruction Sheet Number |
|-----------------------------------------------------------------------------------|-------------------------|-----------------|--------------------------|
|                                                                                   | Upper Insertion Tooling | Support Tooling |                          |
| Instruction sheet summary (with insertion information for most 2mm HM components) | —                       | —               | 411-19305                |
| Upper and Lower Adapters for Tyco Electronics insertion machines. For all types   | —                       | 679980-1/2/3    | 408-4038                 |
| <b>Vertical Males</b>                                                             |                         |                 |                          |
| 5/5+2 row, Type A                                                                 | 90753-1                 | †               | 408-9912                 |
| 5/5+2 row, Type B                                                                 | 90755-1                 | †               | 408-9914                 |
| 5/5+2 row, Type B (19 columns)                                                    | 90755-3                 | †               | —                        |
| 5/5+2 row, Type B (22 columns)                                                    | 90755-2                 | †               | —                        |
| 5/5+2 row, Type C                                                                 | 90757-1                 | †               | 408-9916                 |
| 5/5+2 row, Type A/B                                                               | 91346-1                 | †               | 408-9912                 |
| 5/5+2 row, Type A/B (19 columns)                                                  | 91346-3                 | †               | 408-9912                 |
| 5/5+2 row, Type A/B (22 columns)                                                  | 91346-2                 | †               | 408-9912                 |
| 8/8+2 row, Type D                                                                 | 224671-2                | †               | 408-4281                 |
| 8/8+2 row, Type E                                                                 | 224668-2                | †               | 408-4282                 |
| 8/8+2 row, Type F                                                                 | 224668-3                | †               | 408-4282                 |
| 8/8+2 row, Type D/E                                                               | 91345-1                 | †               | 408-4281                 |
| <b>Right Angle Females - Unshielded</b>                                           |                         |                 |                          |
| Type A                                                                            | 122559-1                | 122561-1        | 408-4216                 |
| Type B                                                                            | 122559-1                | 122561-1        | 408-4216                 |
| Type C                                                                            | 122559-1                | 122561-1*       | 408-4216                 |
| Type A/B                                                                          | 122559-1                | 122561-1        | 408-4216                 |
| Type D                                                                            | 318866-1                | 318867-1        | 408-4304                 |
| Type E                                                                            | 318866-1                | 318867-1        | 408-4304                 |
| Type F                                                                            | 91326-1                 | 318867-1*       | 408-4304                 |
| Type D/E                                                                          | 318866-1                | 318867-1        | 408-4304                 |
| <b>Right Angle Females - Shielded</b>                                             |                         |                 |                          |
| Type A (except TDM J4)                                                            | 122562-1                | 122561-1        | 408-4382                 |
| Type A for TDM J4                                                                 | 91316-1                 | —               | —                        |
| Type B                                                                            | 122562-1                | 122561-1        | 408-4382                 |
| Type B (19 columns)                                                               | 122562-1                | 122561-1*       | 408-4382                 |
| Type B (22 columns)                                                               | 122562-1                | 122561-1*       | 408-4382                 |
| Type C                                                                            | 122562-1                | 122561-1*       | 408-4382                 |
| Type A/B                                                                          | 122562-1                | 122561-1        | 408-4382                 |
| Type A/B (19 columns)                                                             | 122562-1*               | 122561-1*       | 408-4382                 |
| Type A/B (22 columns)                                                             | 122562-1*               | 122561-1*       | 408-4382                 |
| Type D                                                                            | 318868-1                | 318867-1        | 408-4430                 |
| Type E                                                                            | 318868-1                | 318867-1        | 408-4430                 |
| Type F                                                                            | 91327-1                 | 318867-1        | 408-4430                 |
| Type D/E                                                                          | 318868-1                | 318867-1        | 408-4430                 |
| <b>Lower Shields</b>                                                              |                         |                 |                          |
| Type A and B, Right Angle Female                                                  | 122563-1                | 122562-1        | 408-4383                 |
| Type C and M, Right Angle Female                                                  | 122563-1                | 122562-1        | 408-4383                 |
| Type A/B, Right Angle Female                                                      | 122563-1                | 122562-1        | 408-4383                 |
| Type D and E, Right Angle Female                                                  | 318869-1                | 318868-1        | 408-4429                 |
| Type F, Right Angle Female                                                        | 318869-1                | 318868-1        | 408-4429                 |
| Type D/E, Right Angle Female                                                      | 318869-1                | 318868-1        | 408-4429                 |

| Description                            | Part Number             |                 | Instruction Sheet Number |
|----------------------------------------|-------------------------|-----------------|--------------------------|
|                                        | Upper Insertion Tooling | Support Tooling |                          |
| Right Angle Males                      |                         |                 |                          |
| Type A                                 | —                       | 122561-1        | 408-4216                 |
| Type B                                 | —                       | 122561-1        | 408-4216                 |
| Type B (22 columns)                    | —                       | 122561-1*       | 408-4216                 |
| Type B (19 columns)                    | —                       | 122561-1*       | 408-4216                 |
| Type C                                 | —                       | 122561-1*       | 408-4216                 |
| Type D                                 | —                       | —               | —                        |
| Type E                                 | —                       | —               | —                        |
| <b>Vertical Females</b>                |                         |                 |                          |
| Type A                                 | —                       | 122561-1        | —                        |
| Type B                                 | —                       | 122561-1        | —                        |
| Type B (22 columns)                    | —                       | 122561-1*       | —                        |
| Type B (19 columns)                    | —                       | 122561-1*       | —                        |
| Type C                                 | —                       | 122561-1*       | —                        |
| Type D                                 | —                       | —               | —                        |
| Type E                                 | —                       | —               | —                        |
| <b>Shrouds &amp; Spacers</b>           |                         |                 |                          |
| Type A Shroud and Spacer               | 90753-1                 | 90753-1         | 408-9912                 |
| Type A, One Piece Shroud               | 90753-1                 | 90753-1         | 408-9912                 |
| Type B Shroud and Spacer               | 90755-1                 | 90755-1         | 408-9914                 |
| Type B (19 columns)                    | 90755-3                 | 90755-3         | 408-9914                 |
| Type B (22 columns)                    | 90755-2                 | 90755-3         | 408-9914                 |
| Type B, One Piece Shroud               | 90755-1                 | 90755-1         | 408-9914                 |
| Type AB, One Piece Shroud (19 columns) | —                       | 90753-1         | 408-9912                 |
| Type AB, One Piece shroud (22 columns) | —                       | 90753-1         | 408-991                  |
| Type C Shroud and Spacer               | 90757-1                 | 90757-1         | 408-9916                 |
| Type C, One Piece Shroud               | 90757-1                 | 90757-1         | 408-9916                 |
| Type D Shroud and Spacer               | 224671-2                | —               | 408-4281                 |
| Type D/E, One Piece Shroud             | 224671-2                | —               | 408-4281                 |
| Type E Shroud and Spacer               | 224668-2                | —               | 408-4282                 |
| Type E, One Piece Shroud               | 224668-2                | —               | 408-4282                 |
| Type F, One Piece Shroud               | 224668-3                | —               | 408-4282                 |
| <b>Universal Power Module</b>          |                         |                 |                          |
| Right Angle Male                       | 224441-1                | 224442-1        | 408-4280                 |
| Vertical Female                        | 224421-1                | 217602-1        | 408-4169                 |

\* Tool length exceeds connector length; check that tool does not interfere with other components

† Customer Supplied

Contact Tyco Electronics Tooling Assistance Center at 1-800-722-1111 if tooling is not indicated.

### Instruction Sheet

Repair Tool Part Number 354687-1

IS 408-9979

Type D, E One Piece Shroud Tool Part Number 224671-2

IS 408-4281

## Connector Insertion Tooling — Quick Change

There are two styles of connector insertion tooling available to suit different production needs.

- **Quick Change** — inserts are attached to the insertion machine
- **"Flat Rock"** — tools are fitted to the connector and are suitable for multiple connector insertion when used with a high force insertion machine

All insertion machines can be supplied to suit local power supply conditions. The manual hand tool is recommended for repair tasks.

### Quick Change

This tooling is designed so that it can be fitted to the machines. These tools allow the sequential fitting of connectors to the board by selection of the appropriate inserts. Fitting to other types of machines is possible by selecting adapters without the upper and lower adapter bars.

### ICIM (Intelligent Connector Insertion Machine)

#### Part Number 67941-□

- Capacity of 27 500 N [6180 lb] with 5 bar air supply
- Force and stroke control (compensates for printed circuit board thickness)
- Fitted with an inhibitor (detects if the X-Y table is not aligned correctly)
- Detects faulty connector insertion
- X-Y tables optional
- Actual dash (-) number depends on voltage needed
- See catalog 889943 for more details

### Pneumatic Insertion Machine

#### Part Number 677420-1

- Controllable insertion force from 0.5-25 000 N [.1-5620 lb]
- 250 [9.843] throat depth
- Moveable lower tool holder
- Manual X-Y table with adjustable stops
- Recommended for high volume production of backplanes and daughter-cards
- See catalog 889943 for more details

### Pneumatic Insertion Machine (with circuit board support platform)

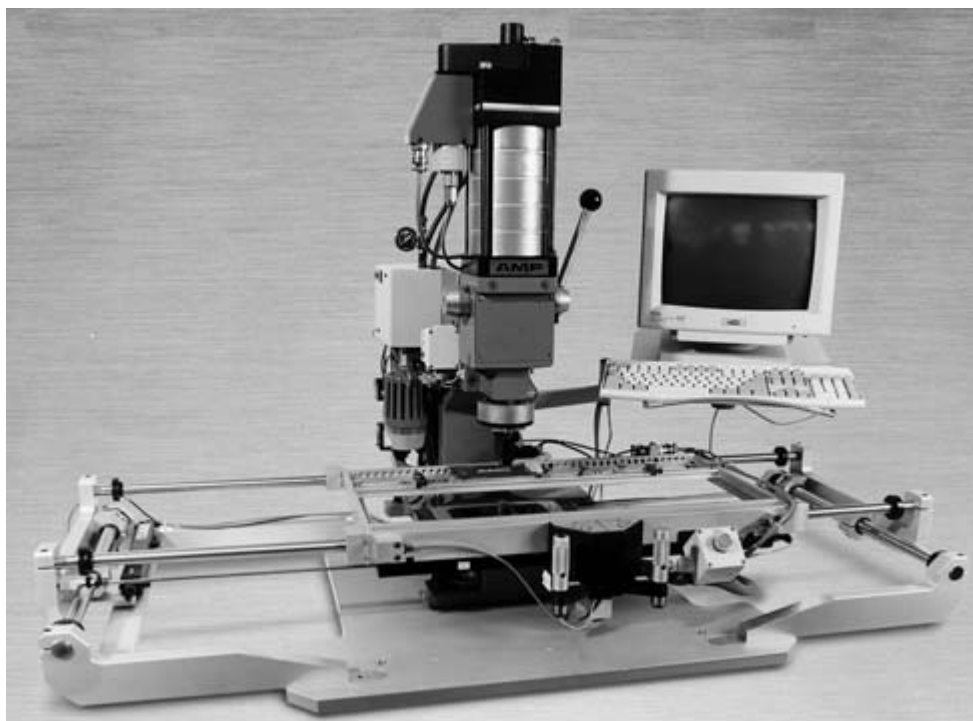
#### Part Number 677427-2

- Similar to Pneumatic Insertion Machine Part Number 677420-1 (above)
- X-Y table replaced with a circuit board support platform
- See catalog 889943 for more details

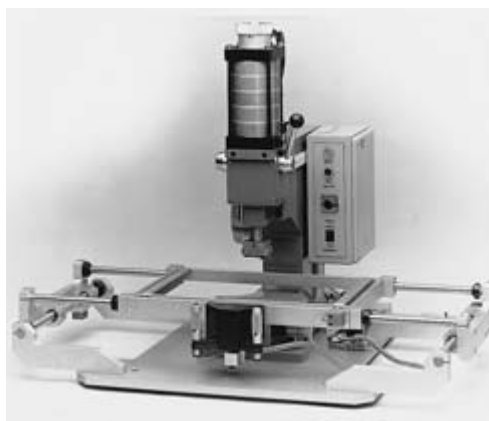
### Manual Hand Tool

#### Part Number — 677430-2

- Insertion force 15 000 N [3370 lb]
- 125 [4.921] throat depth
- Fixed lower tooling and board support
- Low volume production
- Prototyping
- Use with repair tools



ICIM (Intelligent Connector Insertion Machine)



Pneumatic Insertion Machine



Pneumatic Insertion Machine  
(with Circuit Board Support Platform)



Hand Tool

## Connector Insertion Tooling – Quick Change (Continued)

| Description                                                                                             | Part Number       |                 | Instruction Sheet     |
|---------------------------------------------------------------------------------------------------------|-------------------|-----------------|-----------------------|
|                                                                                                         | Insertion Tooling | Support Tooling |                       |
| Instruction sheet summary (with insertion information for most 2mm HM components)                       |                   |                 | 411-19305             |
| Upper and lower adapters for AMP insertion machines.<br>For all types except L, M, N, L-MS C and M-MS C |                   | 679980-1/2/3    | 411-19306<br>408-4038 |
| <b>Vertical Males</b>                                                                                   |                   |                 |                       |
| 5/5+2 row, Type A                                                                                       | 438001-1          | 438051-1        | 411-19312             |
| 5/5+2 row, Type B                                                                                       | 438002-1          | 438051-1        | 411-19313             |
| 5/5+2 row, Type B (19 columns)                                                                          | 438002-2          | 438051-4        | 411-19313             |
| 5/5+2 row, Type B (22 columns)                                                                          | 438002-3          | 438051-6        | 411-19313             |
| 5/5+2 row, Type C                                                                                       | 438003-1          | 438051-2        | 411-19314             |
| 8/8+2 row, Type D                                                                                       | 438051-2          | 438051-3        | 411-19432             |
| 8/8+2 row, Type E                                                                                       | 439491-1          | 438051-3        | 411-19432             |
| 8/8+2 row, Type F                                                                                       |                   |                 |                       |
| Type L                                                                                                  | 438001-1          | 438056-1        | 411-19315             |
| L-MS C                                                                                                  | 438014-1          | 438056-1        | 411-19318             |
| Type M                                                                                                  | 438001-1          | 438057-1        | 411-19316             |
| M-MS C                                                                                                  | 438015-1          | 438057-1        | 411-19319             |
| M-MS C reverse                                                                                          | 438015-1          | 438057-1        | 411-19320             |
| Type N                                                                                                  | 438003-1          | 438056-2        | 411-19317             |
| <b>Right Angle Females - Unshielded</b>                                                                 |                   |                 |                       |
| Type A                                                                                                  | 438031-1          | 438051-1        | 411-19324             |
| Type B                                                                                                  | 438031-1          | 438051-1        | 411-19325             |
| Type C                                                                                                  | 438032-1          | 438051-2        | 411-19326             |
| Type L                                                                                                  | 438031-1          | 438052-1        | 411-19327             |
| L-MS C                                                                                                  | 438070-1          | 438056-1        | 411-19330             |
| Type M                                                                                                  | 438031-1          | 438054-1        | 411-19328             |
| M-MS C                                                                                                  | 438072-1          | 438057-1        | 411-19331             |
| M-MS C reverse                                                                                          | 438071-1          | 438057-1        | 411-19332             |
| Type N                                                                                                  | 438032-1          | 438052-2        | 411-19329             |
| <b>Right Angle Females - Shielded</b>                                                                   |                   |                 |                       |
| Type A (except TDM J4)                                                                                  | 438036-1          | 438051-1        | 411-19334             |
| Type A for TDM J4                                                                                       | 1115335-1         | 438051-1        | 411-19334             |
| Type B                                                                                                  | 436036-1          | 438051-1        | 411-19334             |
| Type B (19 columns)                                                                                     | 438036-2          | 438051-4        | 411-19437             |
| Type B (22 columns)                                                                                     | 438036-3          | 438051-6        | 411-19437             |
| Type AB (19 columns)                                                                                    | 438036-2          | 438051-4        | 411-19437             |
| Type AB (22 columns)                                                                                    | 438036-3          | 438051-6        | 411-19437             |
| Type C                                                                                                  | 438037-1          | 438051-2        | 411-19437             |
| Type D                                                                                                  | 439491-1          | 438051-7        | 411-19351             |
| Type E                                                                                                  | 439491-1          | 438051-7        | 411-19434             |
| <b>Lower Shields</b>                                                                                    |                   |                 |                       |
| Type A and B, Right Angle Female                                                                        | 438041-†          | 438053-1        | 411-19335             |
| Type C and M, Right Angle Female                                                                        | 438042-†          | 438053-2        | 411-19352             |

| Description                         | Part Number       |                 | Instruction Sheet |
|-------------------------------------|-------------------|-----------------|-------------------|
|                                     | Insertion Tooling | Support Tooling |                   |
| Right Angle Males                   |                   |                 |                   |
| Type A                              | 438031-1          | 438051-1        | 411-19344         |
| Type B                              | 438031-1          | 438051-1        | 411-19345         |
| Type B (22 columns)                 | 438036-2          | 438051-4        | 411-19345         |
| Type B (19 columns)                 | 438036-3          | 438051-6        | 411-19345         |
| Type C                              | 438032-1          | 438051-2        | 411-19346         |
| Vertical Females                    |                   |                 |                   |
| Type A                              | 438076-1          | 438051-1        | 411-19377         |
| Type B                              | 438076-1          | 438051-1        | 411-19377         |
| Type B (22 columns)                 | 438076-1*         | 438051-4        | 411-19377         |
| Type B (19 columns)                 | 438076-1*         | 438051-6        | 411-19377         |
| Type C                              | 438077-1          | 438051-2        | 411-19377         |
| Shrouds & Spacers                   |                   |                 |                   |
| Type A Shroud and Spacer            | 438001-1          | 438058-1        | 411*19337         |
| Type B Shroud and Spacer            | 438002-1          | 438058-1        | 411-19338         |
| Type B (19 column)                  | 438002-3          | 438058-1*       | 411-19338         |
| Type B (22 column)                  | 438002-2          | 438058-1*       | 411-19338         |
| Type B, One Piece Shroud            | 438002-1          | 438058-1        | —                 |
| Type C Shroud and Spacer            | 438003-1          | 438058-1        | 411-19339         |
| Type C, One Piece Shroud            | 438003-1          | 438058-1        | —                 |
| EMI/RFI Shields                     |                   |                 |                   |
| EMI/RFI Right Angle Female, Upper   | 438036-1          | 438051-1        | 411-19334         |
| EMI/RFI Right Angle Female , Lower  | 438041-†          | 438053-1        | 411-19335         |
| EMI/RFI Right Angle Female, Closing | 438023-1          | 438051-2        | 411-19336         |
| EMI/RFI Vertical Male, Sides        | 438020-1          | 438051-1        | 411-19322         |
| EMI/RFI Vertical Male, Closing      | 438021-1          | 438051-2        | 411-19323         |

† Part number suffix depends on application. See instruction sheet for details

\*Tool length exceeds connector length; check that tool does not interfere with other components

Contact Tyco Electronics Tooling Assistance Center at 1-800-722-1111 if tooling is not indicated.

## Non-RoHS to RoHS Compliant Part Number Cross Reference

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 21124-4           | 521124-4                |
| 100072-1          | 5100072-1               |
| 100073-1          | 5100073-1               |
| 100084-1          | 5100084-1               |
| 100085-1          | 5100085-1               |
| 100141-1          | 5100141-1               |
| 100143-1          | 5100143-1               |
| 100145-1          | 5100145-1               |
| 100147-1          | 5100147-1               |
| 100159-1          | 5100159-1               |
| 100161-1          | 5100161-1               |
| 100525-3          | 5100525-3               |
| 100525-9          | 5100525-9               |
| 2-100525-0        | 2-5100525-0             |
| 3-100525-2        | 3-5100525-2             |
| 5-100525-4        | 5-5100525-4             |
| 5-100525-6        | 5-5100525-6             |
| 5-100525-9        | 5-5100525-9             |
| 6-100525-1        | 6-5100525-1             |
| 6-100525-3        | 6-5100525-3             |
| 6-100525-9        | 6-5100525-9             |
| 100526-3          | 5100526-3               |
| 100526-9          | 5100526-9               |
| 2-100526-0        | 2-5100526-0             |
| 3-100526-2        | 3-5100526-2             |
| 5-100526-4        | 5-5100526-4             |
| 5-100526-6        | 5-5100526-6             |
| 5-100526-9        | 5-5100526-9             |
| 6-100526-1        | 6-5100526-1             |
| 6-100526-3        | 6-5100526-3             |
| 6-100526-9        | 6-5100526-9             |
| 100623-1          | 5100623-1               |
| 100624-1          | 5100624-1               |
| 100668-1          | 5100668-1               |
| 100669-1          | 5100669-1               |
| 100745-1          | 5100745-1               |
| 100746-1          | 5100746-1               |
| 100749-1          | 5100749-1               |
| 100750-1          | 5100750-1               |
| 100751-1          | 5100751-1               |
| 100752-1          | 5100752-1               |
| 100773-2          | 5100773-2               |
| 100773-3          | 5100773-3               |
| 100773-4          | 5100773-4               |
| 100773-5          | 5100773-5               |
| 100773-6          | 5100773-6               |
| 100773-7          | 5100773-7               |
| 106012-1          | 5106012-1               |
| 106014-1          | 5106014-1               |
| 1-106014-1        | 1-5106014-1             |
| 106015-1          | 5106015-1               |
| 106081-1          | 5106081-1               |
| 106137-2          | 5106137-2               |
| 106138-2          | 5106138-2               |
| 106164-1          | 5106164-1               |
| 106165-1          | 5106165-1               |
| 106182-2          | 5106182-2               |
| 106303-1          | 5106303-1               |
| 106326-1          | 5106326-1               |
| 106457-2          | 5106457-2               |
| 106457-3          | 5106457-3               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 106457-4          | 5106457-4               |
| 106457-5          | 5106457-5               |
| 106457-6          | 5106457-6               |
| 106457-7          | 5106457-7               |
| 106458-2          | 5106458-2               |
| 106458-3          | 5106458-3               |
| 106458-4          | 5106458-4               |
| 106458-5          | 5106458-5               |
| 106458-6          | 5106458-6               |
| 106458-7          | 5106458-7               |
| 106509-1          | 5106509-1               |
| 106510-1          | 5106510-1               |
| 106743-1          | 5106743-1               |
| 106744-1          | 5106744-1               |
| 106745-1          | 5106745-1               |
| 106746-1          | 5106746-1               |
| 106747-1          | 5106747-1               |
| 106748-1          | 5106748-1               |
| 106749-1          | 5106749-1               |
| 106750-1          | 5106750-1               |
| 106751-1          | 5106751-1               |
| 106752-1          | 5106752-1               |
| 106773-1          | 5106773-1               |
| 106774-1          | 5106774-1               |
| 106775-1          | 5106775-1               |
| 106781-1          | 5106781-1               |
| 106854-1          | 5106854-1               |
| 106855-1          | 5106855-1               |
| 106888-1          | 5106888-1               |
| 120912-1          | 5120912-1               |
| 120914-1          | 5120914-1               |
| 120953-1          | 5120953-1               |
| 120953-2          | 5120953-2               |
| 120953-3          | 5120953-3               |
| 120953-4          | 5120953-4               |
| 120953-5          | 5120953-5               |
| 148221-1          | 5148221-1               |
| 148248-1          | 5148248-1               |
| 148249-1          | 5148249-1               |
| 148250-1          | 5148250-1               |
| 148253-1          | 5148253-1               |
| 148254-1          | 5148254-1               |
| 148338-4          | 5148338-4               |
| 148342-1          | 5148342-1               |
| 148357-1          | 5148357-1               |
| 148358-1          | 5148358-1               |
| 148385-1          | 5148385-1               |
| 148386-1          | 5148386-1               |
| 148406-1          | 5148406-1               |
| 148407-1          | 5148407-1               |
| 148408-1          | 5148408-1               |
| 148409-1          | 5148409-1               |
| 148410-1          | 5148410-1               |
| 148410-1          | 5148410-1               |
| 148430-1          | 5148430-1               |
| 148431-1          | 5148431-1               |
| 148432-1          | 5148432-1               |
| 148433-1          | 5148433-1               |
| 148513-2          | 5148513-2               |
| 148546-1          | 5148546-1               |
| 148547-1          | 5148547-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 188215-1          | 5188215-1               |
| 188224-1          | 5188224-1               |
| 188637-1          | 5188637-1               |
| 188680-1          | 5188680-1               |
| 188680-3          | 5188680-3               |
| 188680-4          | 5188680-4               |
| 188680-5          | 5188680-5               |
| 188680-6          | 5188680-6               |
| 188680-7          | 5188680-7               |
| 188680-8          | 5188680-8               |
| 188681-1          | 5188681-1               |
| 188681-3          | 5188681-3               |
| 188681-4          | 5188681-4               |
| 188681-5          | 5188681-5               |
| 188681-6          | 5188681-6               |
| 188681-7          | 5188681-7               |
| 188681-8          | 5188681-8               |
| 188682-1          | 5188682-1               |
| 188682-3          | 5188682-3               |
| 188682-4          | 5188682-4               |
| 188682-5          | 5188682-5               |
| 188682-6          | 5188682-6               |
| 188682-7          | 5188682-7               |
| 188682-8          | 5188682-8               |
| 188683-1          | 5188683-1               |
| 188683-3          | 5188683-3               |
| 188683-4          | 5188683-4               |
| 188683-5          | 5188683-5               |
| 188683-6          | 5188683-6               |
| 188683-7          | 5188683-7               |
| 188683-8          | 5188683-8               |
| 188684-1          | 5188684-1               |
| 188684-3          | 5188684-3               |
| 188684-4          | 5188684-4               |
| 188684-5          | 5188684-5               |
| 188684-6          | 5188684-6               |
| 188684-7          | 5188684-7               |
| 188684-8          | 5188684-8               |
| 188834-1          | 5188834-1               |
| 188835-1          | 5188835-1               |
| 188836-1          | 5188836-1               |
| 188956-1          | 5188956-1               |
| 188956-3          | 5188956-3               |
| 188956-4          | 5188956-4               |
| 188956-5          | 5188956-5               |
| 188956-6          | 5188956-6               |
| 188956-7          | 5188956-7               |
| 188956-8          | 5188956-8               |
| 223938-1          | 5223938-1               |
| 223952-2          | 5223952-2               |
| 223956-1          | 5223956-1               |
| 223956-1          | 5223956-1               |
| 223957-1          | 5223957-1               |
| 223961-1          | 5223961-1               |
| 223962-1          | 5223962-1               |
| 223963-1          | 5223963-1               |
| 223964-1          | 5223964-1               |
| 223965-1          | 5223965-1               |
| 223967-1          | 5223967-1               |
| 223968-1          | 5223968-1               |
| 223969-1          | 5223969-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 223969-4          | 5223969-4               |
| 223969-7          | 5223969-7               |
| 223970-1          | 5223970-1               |
| 223971-1          | 5223971-1               |
| 223972-1          | 5223972-1               |
| 223974-1          | 5223974-1               |
| 223975-1          | 5223975-1               |
| 223979-1          | 5223979-1               |
| 223980-1          | 5223980-1               |
| 223981-1          | 5223981-1               |
| 223982-1          | 5223982-1               |
| 223983-1          | 5223983-1               |
| 223984-1          | 5223984-1               |
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| 223986-4          | 5223986-4               |
| 223986-5          | 5223986-5               |
| 223986-6          | 5223986-6               |
| 223986-7          | 5223986-7               |
| 223986-8          | 5223986-8               |
| 223989-1          | 5223989-1               |
| 223990-1          | 5223990-1               |
| 223991-1          | 5223991-1               |
| 223995-1          | 5223995-1               |
| 223995-2          | 5223995-2               |
| 223995-3          | 5223995-3               |
| 223995-4          | 5223995-4               |
| 223995-5          | 5223995-5               |
| 223996-1          | 5223996-1               |
| 233212-1          | 5233212-1               |
| 338108-2          | 5338108-2               |
| 338110-2          | 5338110-2               |
| 352009-1          | 5352009-1               |
| 352011-2          | 5352011-2               |
| 352011-2          | 5352011-2               |
| 352012-2          | 5352012-2               |
| 352012-3          | 5352012-3               |
| 352012-4          | 5352012-4               |
| 352012-5          | 5352012-5               |
| 352012-6          | 5352012-6               |
| 352012-7          | 5352012-7               |
| 352012-x          | 5352012-x               |
| 352029-2          | 5352029-2               |
| 352033-1          | 5352033-1               |
| 352033-1          | 5352033-1               |
| 352041-1          | 5352041-1               |
| 352041-3          | 5352041-3               |
| 352041-4          | 5352041-4               |
| 352041-5          | 5352041-5               |
| 352041-6          | 5352041-6               |
| 352041-7          | 5352041-7               |
| 352041-8          | 5352041-8               |
| 352049-1          | 5352049-1               |
| 352068-1          | 5352068-1               |
| 352068-1          | 5352068-1               |
| 352069-1          | 5352069-1               |
| 352096-1          | 5352096-1               |
| 352096-3          | 5352096-3               |

## Non-RoHS to RoHS Compliant Part Number Cross Reference (Continued)

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 352096-4          | 5352096-4               |
| 352096-5          | 5352096-5               |
| 352096-6          | 5352096-6               |
| 352096-7          | 5352096-7               |
| 352096-8          | 5352096-8               |
| 352112-2          | 5352112-2               |
| 352112-2          | 5352112-2               |
| 352115-1          | 5352115-1               |
| 352121-1          | 5352121-1               |
| 352121-3          | 5352121-3               |
| 352121-4          | 5352121-4               |
| 352121-5          | 5352121-5               |
| 352121-6          | 5352121-6               |
| 352121-7          | 5352121-7               |
| 352121-8          | 5352121-8               |
| 352127-1          | 5352127-1               |
| 352129-2          | 5352129-2               |
| 352129-3          | 5352129-3               |
| 352129-4          | 5352129-4               |
| 352129-5          | 5352129-5               |
| 352129-6          | 5352129-6               |
| 352129-7          | 5352129-7               |
| 352130-2          | 5352130-2               |
| 352131-1          | 5352131-1               |
| 352152-1          | 5352152-1               |
| 352152-1          | 5352152-1               |
| 352167-1          | 5352167-1               |
| 352167-2          | 5352167-2               |
| 1-352167-1        | 1-5352167-1             |
| 1-352167-2        | 1-5352167-2             |
| 352168-1          | 5352168-1               |
| 352168-2          | 5352168-2               |
| 1-352168-1        | 1-5352168-1             |
| 1-352168-2        | 1-5352168-2             |
| 352171-1          | 5352171-1               |
| 352171-1          | 5352171-1               |
| 352171-1          | 5352171-1               |
| 352177-1          | 5352177-1               |
| 352196-1          | 5352196-1               |
| 352196-3          | 5352196-3               |
| 352196-4          | 5352196-4               |
| 352196-5          | 5352196-5               |
| 352196-6          | 5352196-6               |
| 352196-7          | 5352196-7               |
| 352196-8          | 5352196-8               |
| 352199-1          | 5352199-1               |
| 352199-3          | 5352199-3               |
| 352199-4          | 5352199-4               |
| 352199-5          | 5352199-5               |
| 352199-6          | 5352199-6               |
| 352199-7          | 5352199-7               |
| 352199-8          | 5352199-8               |
| 352200-1          | 5352200-1               |
| 352200-3          | 5352200-3               |
| 352200-4          | 5352200-4               |
| 352200-5          | 5352200-5               |
| 352200-6          | 5352200-6               |
| 352200-7          | 5352200-7               |
| 352200-8          | 5352200-8               |
| 352268-1          | 5352268-1               |
| 352269-1          | 5352269-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 352269-1          | 5352269-1               |
| 352271-1          | 5352271-1               |
| 352272-1          | 5352272-1               |
| 1-352272-1        | 1-5352272-1             |
| 352273-1          | 5352273-1               |
| 352332-1          | 5352332-1               |
| 352344-1          | 5352344-1               |
| 352345-1          | 5352345-1               |
| 352346-1          | 5352346-1               |
| 352352-1          | 5352352-1               |
| 352359-1          | 5352359-1               |
| 352380-1          | 5352380-1               |
| 352406-1          | 5352406-1               |
| 352457-1          | 5352457-1               |
| 352468-2          | 5352468-2               |
| 352601-2          | 5352601-2               |
| 352638-1          | 5352638-1               |
| 352639-1          | 5352639-1               |
| 352672-2          | 5352672-2               |
| 352673-2          | 5352673-2               |
| 352673-2          | 5352673-2               |
| 352674-2          | 5352674-2               |
| 352706-1          | 5352706-1               |
| 352706-2          | 5352706-2               |
| 352869-1          | 5352869-1               |
| 532808-1          | 5532808-1               |
| 532828-5          | 5532828-5               |
| 533065-6          | 5533065-6               |
| 620729-1          | 5620729-1               |
| 620729-2          | 5620729-2               |
| 620888-1          | 5620888-1               |
| 620888-2          | 5620888-2               |
| 620889-1          | 5620889-1               |
| 620889-2          | 5620889-2               |
| 620892-1          | 5620892-1               |
| 621275-1          | 5621275-1               |
| 621275-2          | 5621275-2               |
| 621275-3          | 5621275-3               |
| 621275-5          | 5621275-5               |
| 621275-6          | 5621275-6               |
| 621275-7          | 5621275-7               |
| 621408-1          | 5621408-1               |
| 621408-2          | 5621408-2               |
| 621408-3          | 5621408-3               |
| 621408-4          | 5621408-4               |
| 621409-1          | 5621409-1               |
| 621409-2          | 5621409-2               |
| 621409-3          | 5621409-3               |
| 621409-4          | 5621409-4               |
| 621410-1          | 5621410-1               |
| 621410-3          | 5621410-3               |
| 621410-4          | 5621410-4               |
| 621410-5          | 5621410-5               |
| 621411-1          | 5621411-1               |
| 621411-2          | 5621411-2               |
| 621411-3          | 5621411-3               |
| 621411-4          | 5621411-4               |
| 621411-5          | 5621411-5               |
| 621412-2          | 5621412-2               |
| 621412-4          | 5621412-4               |
| 621412-5          | 5621412-5               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 621412-6          | 5621412-6               |
| 621412-7          | 5621412-7               |
| 621412-8          | 5621412-8               |
| 621720-2          | 5621720-2               |
| 621720-3          | 5621720-3               |
| 621720-4          | 5621720-4               |
| 621720-5          | 5621720-5               |
| 621720-6          | 5621720-6               |
| 621720-7          | 5621720-7               |
| 621891-1          | 5621891-1               |
| 621891-2          | 5621891-2               |
| 636120-1          | 5636120-1               |
| 636120-2          | 5636120-2               |
| 636120-3          | 5636120-3               |
| 636171-1          | 5636171-1               |
| 636171-2          | 5636171-2               |
| 636171-3          | 5636171-3               |
| 636171-4          | 5636171-4               |
| 636171-5          | 5636171-5               |
| 636171-6          | 5636171-6               |
| 636207-1          | 5636207-1               |
| 636207-2          | 5636207-2               |
| 636207-3          | 5636207-3               |
| 636207-4          | 5636207-4               |
| 636207-5          | 5636207-5               |
| 636207-6          | 5636207-6               |
| 636208-1          | 5636208-1               |
| 636208-2          | 5636208-2               |
| 636208-3          | 5636208-3               |
| 636208-4          | 5636208-4               |
| 636208-5          | 5636208-5               |
| 636208-6          | 5636208-6               |
| 636209-1          | 5636209-1               |
| 636209-2          | 5636209-2               |
| 636209-3          | 5636209-3               |
| 636209-4          | 5636209-4               |
| 636209-5          | 5636209-5               |
| 636209-6          | 5636209-6               |
| 636210-1          | 5636210-1               |
| 636210-2          | 5636210-2               |
| 636210-3          | 5636210-3               |
| 636210-4          | 5636210-4               |
| 636210-5          | 5636210-5               |
| 636210-6          | 5636210-6               |
| 646273-1          | 5646273-1               |
| 646274-1          | 5646274-1               |
| 646345-1          | 5646345-1               |
| 646346-1          | 5646346-1               |
| 646347-1          | 5646347-1               |
| 646356-1          | 5646356-1               |
| 646357-1          | 5646357-1               |
| 646362-1          | 5646362-1               |
| 646370-1          | 5646370-1               |
| 646372-1          | 5646372-1               |
| 646373-1          | 5646373-1               |
| 646375-1          | 5646375-1               |
| 646376-1          | 5646376-1               |
| 646386-1          | 5646386-1               |
| 646386-2          | 5646386-2               |
| 646386-3          | 5646386-3               |
| 646386-4          | 5646386-4               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 646386-5          | 5646386-5               |
| 646386-6          | 5646386-6               |
| 646387-1          | 5646387-1               |
| 646387-2          | 5646387-2               |
| 646387-3          | 5646387-3               |
| 646387-4          | 5646387-4               |
| 646387-5          | 5646387-5               |
| 646387-6          | 5646387-6               |
| 646428-1          | 5646428-1               |
| 646430-1          | 5646430-1               |
| 646442-1          | 5646442-1               |
| 646445-1          | 5646445-1               |
| 646446-1          | 5646446-1               |
| 646447-1          | 5646447-1               |
| 646457-1          | 5646457-1               |
| 646476-1          | 5646476-1               |
| 646476-2          | 5646476-2               |
| 646476-3          | 5646476-3               |
| 646476-4          | 5646476-4               |
| 646476-5          | 5646476-5               |
| 646476-6          | 5646476-6               |
| 646476-7          | 5646476-7               |
| 646477-1          | 5646477-1               |
| 646477-2          | 5646477-2               |
| 646477-3          | 5646477-3               |
| 646477-4          | 5646477-4               |
| 646477-5          | 5646477-5               |
| 646477-6          | 5646477-6               |
| 646477-7          | 5646477-7               |
| 646478-1          | 5646478-1               |
| 646478-2          | 5646478-2               |
| 646478-3          | 5646478-3               |
| 646478-4          | 5646478-4               |
| 646478-5          | 5646478-5               |
| 646478-6          | 5646478-6               |
| 646478-7          | 5646478-7               |
| 646479-1          | 5646479-1               |
| 646479-2          | 5646479-2               |
| 646479-3          | 5646479-3               |
| 646479-4          | 5646479-4               |
| 646479-5          | 5646479-5               |
| 646479-6          | 5646479-6               |
| 646479-7          | 5646479-7               |
| 646480-1          | 5646480-1               |
| 646480-2          | 5646480-2               |
| 646480-3          | 5646480-3               |
| 646480-4          | 5646480-4               |
| 646480-5          | 5646480-5               |
| 646480-6          | 5646480-6               |
| 646480-7          | 5646480-7               |
| 646481-1          | 5646481-1               |
| 646481-2          | 5646481-2               |
| 646481-3          | 5646481-3               |
| 646481-4          | 5646481-4               |
| 646481-5          | 5646481-5               |
| 646481-6          | 5646481-6               |
| 646481-7          | 5646481-7               |
| 646481-x          | 5646481-x               |
| 646482-1          | 5646482-1               |
| 646482-2          | 5646482-2               |
| 646482-3          | 5646482-3               |



## Non-RoHS to RoHS Compliant Part Number Cross Reference (Continued)

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 646482-4          | 5646482-4               |
| 646482-5          | 5646482-5               |
| 646482-6          | 5646482-6               |
| 646482-7          | 5646482-7               |
| 646483-1          | 5646483-1               |
| 646483-2          | 5646483-2               |
| 646483-3          | 5646483-3               |
| 646483-4          | 5646483-4               |
| 646483-5          | 5646483-5               |
| 646483-6          | 5646483-6               |
| 646483-7          | 5646483-7               |
| 646484-1          | 5646484-1               |
| 646484-2          | 5646484-2               |
| 646484-3          | 5646484-3               |
| 646484-4          | 5646484-4               |
| 646484-5          | 5646484-5               |
| 646484-6          | 5646484-6               |
| 646484-7          | 5646484-7               |
| 646486-1          | 5646486-1               |
| 646487-1          | 5646487-1               |
| 646488-1          | 5646488-1               |
| 646488-1          | 5646488-1               |
| 646489-1          | 5646489-1               |
| 646489-1          | 5646489-1               |
| 646492-1          | 5646492-1               |
| 646493-1          | 5646493-1               |
| 646502-1          | 5646502-1               |
| 646502-2          | 5646502-2               |
| 646502-3          | 5646502-3               |
| 646502-4          | 5646502-4               |
| 646513-1          | 5646513-1               |
| 646514-1          | 5646514-1               |
| 646515-1          | 5646515-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 646525-1          | 5646525-1               |
| 646525-2          | 5646525-2               |
| 646525-3          | 5646525-3               |
| 646525-4          | 5646525-4               |
| 646525-5          | 5646525-5               |
| 646525-6          | 5646525-6               |
| 646525-7          | 5646525-7               |
| 646529-1          | 5646529-1               |
| 646530-1          | 5646530-1               |
| 646530-1          | 5646530-1               |
| 646532-1          | 5646532-1               |
| 646533-1          | 5646533-1               |
| 646533-1          | 5646533-1               |
| 646534-1          | 5646534-1               |
| 646535-1          | 5646535-1               |
| 646538-1          | 5646538-1               |
| 646539-1          | 5646539-1               |
| 646540-1          | 5646540-1               |
| 646547-1          | 5646547-1               |
| 646572-1          | 5646572-1               |
| 646573-1          | 5646573-1               |
| 646574-1          | 5646574-1               |
| 646576-1          | 5646576-1               |
| 646576-2          | 5646576-2               |
| 646576-3          | 5646576-3               |
| 646576-4          | 5646576-4               |
| 646576-5          | 5646576-5               |
| 646576-6          | 5646576-6               |
| 646576-7          | 5646576-7               |
| 646703-1          | 5646703-1               |
| 646704-1          | 5646704-1               |
| 646709-1          | 5646709-1               |
| 646726-1          | 5646726-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 646726-2          | 5646726-2               |
| 646726-3          | 5646726-3               |
| 646726-4          | 5646726-4               |
| 646726-5          | 5646726-5               |
| 646726-6          | 5646726-6               |
| 646726-7          | 5646726-7               |
| 646726-8          | 5646726-8               |
| 646728-1          | 5646728-1               |
| 646729-1          | 5646729-1               |
| 646730-1          | 5646730-1               |
| 646731-1          | 5646731-1               |
| 646732-1          | 5646732-1               |
| 646732-1          | 5646732-1               |
| 646734-1          | 5646734-1               |
| 646735-1          | 5646735-1               |
| 646735-1          | 5646735-1               |
| 646736-1          | 5646736-1               |
| 646737-1          | 5646737-1               |
| 646759-1          | 5646759-1               |
| 646773-1          | 5646773-1               |
| 646858-1          | 5646858-1               |
| 646886-1          | 5646886-1               |
| 646938-1          | 5646938-1               |
| 646948-1          | 5646948-1               |
| 646949-1          | 5646949-1               |
| 646950-1          | 5646950-1               |
| 646951-1          | 5646951-1               |
| 646952-1          | 5646952-1               |
| 646953-1          | 5646953-1               |
| 646954-1          | 5646954-1               |
| 646955-1          | 5646955-1               |
| 646956-1          | 5646956-1               |
| 646957-1          | 5646957-1               |

| Non-RoHS Part No. | RoHS Compliant Part No. |
|-------------------|-------------------------|
| 646958-1          | 5646958-1               |
| 646959-1          | 5646959-1               |
| 646960-1          | 5646960-1               |
| 646961-1          | 5646961-1               |
| 953383-1          | 5953383-1               |
| 953384-1          | 5953384-1               |
| 953385-1          | 5953385-1               |
| 953386-1          | 5953386-1               |
| 986794-1          | 5986794-1               |
| 1206073-1         | 6206073-1               |
| 1206074-1         | 6206074-1               |
| 1206075-1         | 6206075-1               |
| 1206076-1         | 6206076-1               |
| 1206077-1         | 6206077-1               |
| 1206078-1         | 6206078-1               |
| 1345007-1         | 6345007-1               |
| 1345008-1         | 6345008-1               |
| 1392175-1         | 6392175-1               |
| 1393589-1         | 6393589-1               |
| 1393589-3         | 6393589-3               |
| 1393589-5         | 6393589-5               |
| 1393589-7         | 6393589-7               |
| 1393589-9         | 6393589-9               |
| 1-1393589-1       | 1-6393589-1             |
| 1-1393589-4       | 1-6393589-4             |
| 2-1393589-7       | 2-6393589-7             |
| 3-1393589-5       | 3-6393589-5             |
| 1-1393662-2       | 1-6393662-2             |
| 1612872-1         | 6612872-1               |
| 1612877-1         | 6612877-1               |
| 1612913-1         | 6612913-1               |
| 1674156-1         | 6674156-1               |



**Note:** This index lists all cataloged parts by base no. only. Complete part nos. (with prefixes and/or suffixes) are shown on the page(s) indicated.

## Part Number Index

| Part No. | Page   | Part No. | Page | Part No. | Page       |
|----------|--------|----------|------|----------|------------|
| 21124    | 57     | 148250   | 38   | 223996   | 53         |
| 100072   | 38     | 148253   | 40   | 233212   | 45         |
| 100073   | 38     | 148254   | 39   | 338108   | 15         |
| 100084   | 38     | 148338   | 39   | 338110   | 15         |
| 100085   | 38     | 148342   | 40   | 352009   | 15         |
| 100141   | 10     | 148357   | 38   | 352011   | 29, 48     |
| 100143   | 10     | 148358   | 38   | 352012   | 30, 48     |
| 100145   | 15     | 148385   | 39   | 352029   | 15         |
| 100147   | 15     | 148386   | 40   | 352033   | 48, 49     |
| 100159   | 10     | 148406   | 38   | 352041   | 61         |
| 100161   | 15     | 148407   | 38   | 352049   | 34         |
| 100525   | 47     | 148408   | 38   | 352068   | 15, 49     |
| 100526   | 47     | 148409   | 38   | 352069   | 15         |
| 100623   | 15     | 148410   | 38   | 352096   | 61         |
| 100624   | 15     | 148430   | 38   | 352112   | 15, 36     |
| 100668   | 10     | 148431   | 38   | 352115   | 15         |
| 100669   | 10     | 148432   | 38   | 352121   | 61         |
| 100745   | 34     | 148433   | 38   | 352127   | 48         |
| 100746   | 36     | 148513   | 38   | 352129   | 30         |
| 100749   | 34     | 148546   | 38   | 352130   | 29         |
| 100750   | 36     | 148547   | 38   | 352131   | 25         |
| 100751   | 34     | 188215   | 36   | 352152   | 15, 49     |
| 100752   | 36     | 188224   | 15   | 352167   | 60         |
| 100773   | 30     | 188637   | 10   | 352168   | 60         |
| 106012   | 25     | 188680   | 61   | 352171   | 15, 48, 49 |
| 106014   | 25, 64 | 188681   | 61   | 352177   | 36         |
| 106015   | 25     | 188682   | 61   | 352196   | 61         |
| 106081   | 10     | 188683   | 61   | 352199   | 61         |
| 106137   | 29     | 188684   | 61   | 352200   | 61         |
| 106138   | 29     | 188834   | 49   | 352268   | 27         |
| 106164   | 10     | 188835   | 49   | 352269   | 27, 48     |
| 106165   | 10     | 188836   | 15   | 352271   | 25         |
| 106182   | 29     | 188956   | 61   | 352272   | 25, 64     |
| 106303   | 10     | 223938   | 52   | 352273   | 25         |
| 106326   | 34     | 223955   | 51   | 352332   | 49         |
| 106457   | 30     | 223956   | 55   | 352344   | 15         |
| 106458   | 30     | 223957   | 55   | 352345   | 15         |
| 106509   | 10     | 223961   | 52   | 352346   | 15         |
| 106510   | 10     | 223962   | 52   | 352352   | 49         |
| 106743   | 41     | 223963   | 52   | 352359   | 49         |
| 106744   | 43     | 223964   | 52   | 352380   | 36         |
| 106745   | 41     | 223965   | 52   | 352406   | 25         |
| 106746   | 43     | 223967   | 52   | 352457   | 27         |
| 106747   | 41     | 223968   | 52   | 352468   | 15         |
| 106748   | 43     | 223969   | 55   | 352601   | 62         |
| 106749   | 45     | 223970   | 52   | 352638   | 10         |
| 106750   | 45     | 223971   | 52   | 352639   | 10         |
| 106751   | 46     | 223972   | 52   | 352672   | 62         |
| 106752   | 46     | 223974   | 52   | 352673   | 48, 62     |
| 106773   | 27     | 223975   | 52   | 352674   | 62         |
| 106774   | 27     | 223979   | 55   | 352706   | 62         |
| 106775   | 27     | 223980   | 52   | 352869   | 10         |
| 106781   | 45     | 223981   | 52   | 532808   | 16         |
| 106854   | 41     | 223982   | 55   | 532828   | 57         |
| 106855   | 41     | 223983   | 52   | 533065   | 57         |
| 106888   | 45     | 223984   | 51   | 620729   | 63         |
| 120912   | 52     | 223985   | 56   | 620888   | 61         |
| 120914   | 52     | 223986   | 56   | 620889   | 61         |
| 120953   | 54     | 223989   | 52   | 620892   | 61         |
| 148221   | 38     | 223990   | 52   | 621275   | 61         |
| 148248   | 38     | 223991   | 52   | 621408   | 61         |
| 148249   | 38     | 223995   | 54   | 621409   | 61         |

Part Number Index (Continued)

| Part No. | Page |
|----------|------|
| 621410   | 61   |
| 621411   | 61   |
| 621412   | 61   |
| 621720   | 61   |
| 621891   | 61   |
| 636120   | 64   |
| 636171   | 61   |
| 636207   | 61   |
| 636208   | 61   |
| 636209   | 61   |
| 636210   | 61   |
| 646273   | 57   |
| 646274   | 57   |
| 646345   | 29   |
| 646346   | 16   |
| 646347   | 16   |
| 646356   | 16   |
| 646357   | 16   |
| 646362   | 16   |
| 646370   | 29   |
| 646372   | 16   |
| 646373   | 16   |
| 646375   | 16   |
| 646376   | 16   |
| 646386   | 30   |
| 646387   | 30   |
| 646428   | 19   |
| 646430   | 19   |
| 646442   | 19   |
| 646445   | 19   |

| Part No. | Page   |
|----------|--------|
| 646446   | 19     |
| 646447   | 19     |
| 646457   | 16     |
| 646476   | 32     |
| 646477   | 32     |
| 646478   | 32     |
| 646479   | 32     |
| 646480   | 32     |
| 646481   | 32, 48 |
| 646482   | 32     |
| 646483   | 32     |
| 646484   | 32     |
| 646486   | 19     |
| 646487   | 19     |
| 646488   | 13, 49 |
| 646489   | 13, 49 |
| 646492   | 19     |
| 646493   | 19     |
| 646502   | 33     |
| 646513   | 16     |
| 646514   | 16     |
| 646515   | 16     |
| 646525   | 32     |
| 646529   | 11     |
| 646530   | 11, 50 |
| 646532   | 50     |
| 646533   | 11, 50 |
| 646534   | 50     |
| 646535   | 11     |
| 646538   | 24     |

| Part No. | Page   |
|----------|--------|
| 646539   | 24     |
| 646540   | 24     |
| 646547   | 13     |
| 646572   | 13     |
| 646573   | 13     |
| 646574   | 13     |
| 646576   | 32     |
| 646703   | 34     |
| 646704   | 34     |
| 646709   | 34     |
| 646726   | 32     |
| 646726   | 32     |
| 646728   | 21     |
| 646729   | 18     |
| 646730   | 34     |
| 646731   | 11     |
| 646732   | 11, 50 |
| 646734   | 50     |
| 646735   | 11, 50 |
| 646736   | 50     |
| 646737   | 11     |
| 646759   | 21     |
| 646773   | 24     |
| 646858   | 34     |
| 646886   | 34     |
| 646938   | 11     |
| 646948   | 11     |
| 646949   | 11     |
| 646950   | 11     |
| 646951   | 18     |

| Part No. | Page |
|----------|------|
| 646952   | 18   |
| 646953   | 18   |
| 646954   | 53   |
| 646955   | 53   |
| 646956   | 53   |
| 646957   | 53   |
| 646958   | 53   |
| 646959   | 53   |
| 646960   | 53   |
| 646961   | 53   |
| 953383   | 61   |
| 953384   | 61   |
| 953385   | 61   |
| 953386   | 61   |
| 986794   | 57   |
| 1206073  | 45   |
| 1206074  | 45   |
| 1206075  | 45   |
| 1206076  | 45   |
| 1206077  | 46   |
| 1206078  | 46   |
| 1345007  | 15   |
| 1345008  | 15   |
| 1392175  | 10   |
| 1393589  | 38   |
| 1393662  | 40   |
| 1612872  | 22   |
| 1612877  | 22   |
| 1612913  | 22   |
| 1674156  | 22   |

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