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1. **PURPOSE**

This specification covers end product and workmanship requirements for insertion into circuit boards of the following Metral™ headers along with general product information. Additional sizes of selectively loaded headers may exist than those currently listed here. Contact your local FCI representative for additional information

Standard product

55003-type 5-Row Metral™ 4000 Headers
59569-type 5-Row Metral™ 4000 Extended Headers
55004-type 8-Row Metral™ 4000 Headers

Selectively Loaded Product

59566-type 5x6 Metral™ 4000 Headers
59567-type 5x6 Metral™ 4000 Extended Headers
59568-type 8x12 Metral™ 4000 Headers
10055763-type 5x6 Metral™ Headers Select Load of Stripline Shields

2. **SCOPE**

- Product description
- Define possible product variations
- Define header outline for circuit board designs.
- Recommended application equipment
- Recommended requirements and procedure for board insertion
- Recommended repair procedures

3. **GENERAL**

3.1. *Method of Specifying*

The header drawings should reference this specification when applicable. All exceptions to the requirements of this specification should be clearly described in the notes of the board assembly drawing. We do not recommend any exceptions unless approval is obtained in advance from the FCI engineering design group. If there is a conflict between the product drawings and this specification, the product drawings shall take precedence.

3.2. *Workmanship*


Workmanship shall be of a level that indicates controlled conditions of manufacture such that subsequent operations, functionality and performance are not degraded.

3.3. *Usage*

The headers covered by this instruction are intended for use in a wide variety of environments and are designed to meet the conditions specified in Bellcore GR-1217-CORE and IEC-61076-4-104.

3.4. *Visual*

Visual examinations shall be performed with a magnification of up to 10x. (8 to 10x recommended)

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3.5. ***Banned/Restricted Substances***

All product where the part number ends in 'LF' meet the European Union directives and other country regulations as described in GS-22-008. The part numbers that do not end in 'LF' meet all regulations except for Pb in SnPb plating.

3.6. ***Manufacturing Processability***

All products covered by this specification will withstand exposure to 260°C for 60 seconds in a convection, infra-red or vapor phase reflow oven.

4. **Product Descriptions**

4.1. ***General Information on Headers***

This information applies only to product covered by this specification. The following figures only show the smallest module of each product. The 5-row product is designed in increments of 12mm or 6 pin positions up to a maximum of 24 pin positions. The 8-row product design is 24mm or 12 pin positions. Check with your local FCI representative for the availability of each size and the pin variations.

4.2. ***Electrical Performance of Metral™ 4000 Systems***

4.2.1. **Differential Signal Applications**

See FCI publication 'PENDING' for "Electrical Performance Data for Differential Applications".

4.2.2. **Single Ended Signal Applications**

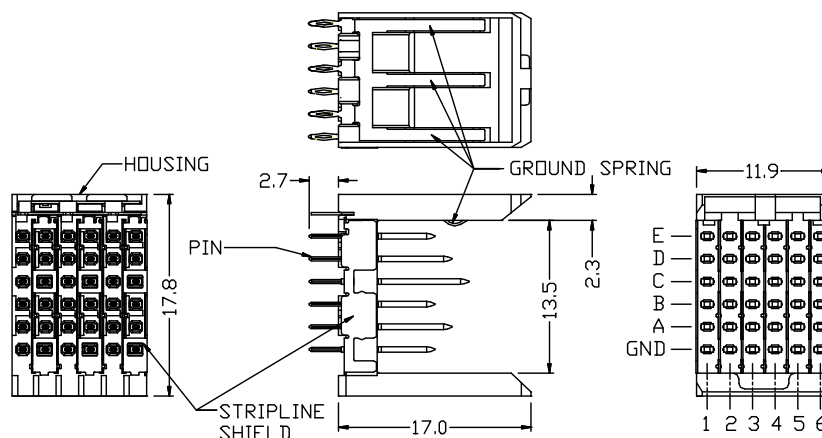
See FCI publication 'PENDING' for "Electrical Performance Data for Single-Ended Applications".

4.3. ***5-row Metral™ 4000 Headers***

The header shown is a 5x6. You can mount the mating receptacle on a 2.5mm maximum thickness board without interference with the header. If thicker boards are used with the receptacle you must machine away the area of the board entering the header to 2.5mm or below. You can use rows A, B, D & E for signal, power or ground pins. These headers have stripline shields between columns. The stripline shields connects the GND and C row pins together in the odd numbered rows and also makes contact to the ground spring. For front plug-up applications, the even numbered pins in row 'C' can be used for power as well as for ground. If the surrounding pins are not used for power, then each pin can carry 3 amps. If the surrounding pins are used for power, then each pin can carry 1 amp. When the surrounding pins are used only for low speed signals, then the even numbered 'C' row pins can also be used for low speed signals.

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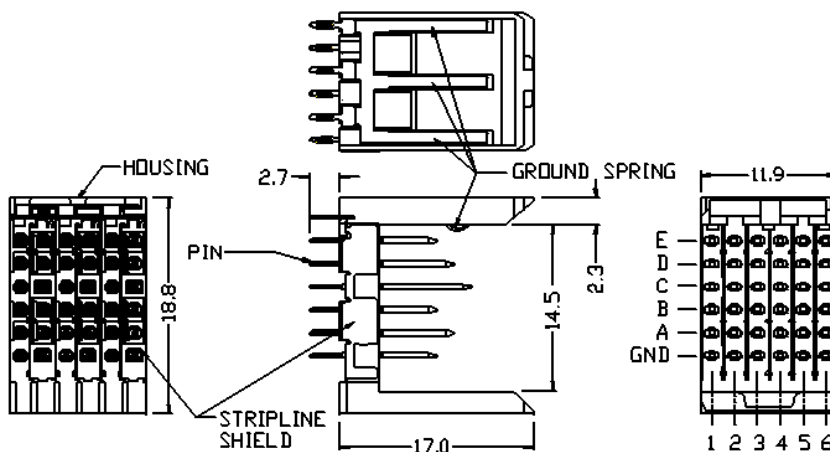
Figure 1 5-row 4000 Headers



4.4. 5-row Metral™ Extended 4000 Headers

The header shown is a 5x6. You can mount the mating receptacle on a 3.5mm maximum thickness board without interference with the header. If thicker boards are used with the receptacle you must machine away the area of the board entering the header to 3.5mm or below. You can use rows A, B, D & E for signal, power or ground pins. These headers have stripline shields between columns. The stripline shields connects the GND and C row pins together in the odd numbered rows and also makes contact to the ground spring. For front plug-up applications, the even numbered pins in row 'C' can be used for power as well as for ground. If the surrounding pins are not used for power, then each pin can carry 3 amps. If the surrounding pins are used for power, then each pin can carry 1 amp. When the surrounding pins are used only for low speed signals, then the even numbered 'C' row pins can also be used for low speed signals.

Figure 2 5-row Extended 4000 Headers

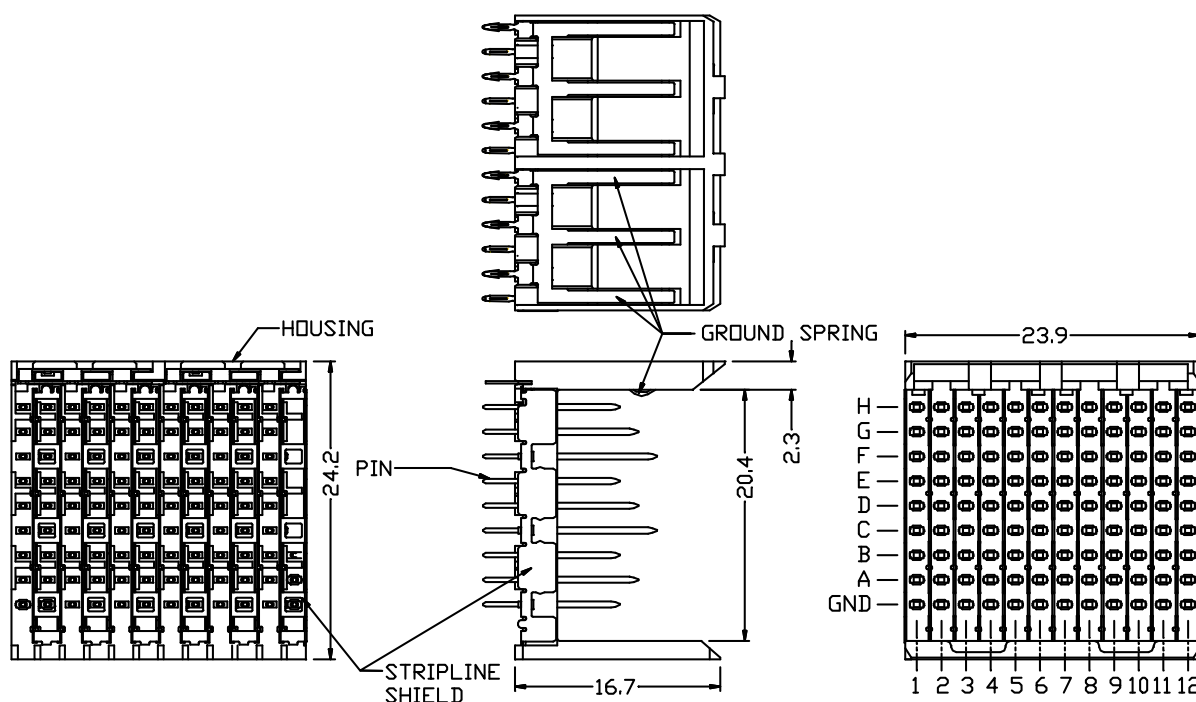



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4.5. 8-row Metra™ 4000 Headers

The header shown is a 8x12. You can mount the mating receptacle on a 3.4mm maximum thickness board without interference with the header. If thicker boards are used with the receptacle you must machine away the area of the board entering the header to 3.4mm or below. You can use rows A, B, D, E, G and H for signal, power or ground pins. These headers have stripline shields between columns. The stripline shields connects the GND, C and F row pins together in the odd numbered rows and also makes contact to the ground spring. For front plug-up applications, the even numbered pins in row 'C' and 'F' can be used for power as well as for ground. If the surrounding pins are not used for power, then each pin can carry 3 amps. If the surrounding pins are used for power, then each pin can carry 1 amp. When the surrounding pins are used only for low speed signals, then the even numbered 'C' and 'F' row pins can also be used for low speed signals.

Figure 3 8-row 4000 Headers



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5. **Product Variations**

The following two table lists the various pin sizes that can be used in the headers covered by this application specification. Please check with your local FCI representative on pin availability. Dimensions are in millimeters.

5.1. **Pin Variations Available for Metral 4000 Headers**

This table lists the various pin sizes that can be used in the headers covered by this application specification. Please check with your local FCI representative on pin availability. Dimensions are in millimeters.

DIMENSION "A"	PIN CODES
5.00	01
5.75	02
6.50	03
7.25	04
8.00	19

5.2. **General Information on Headers**

Pins in the 'GND' row when present make contact with the bottom shield of the mating receptacle. Due to possible interference with the receptacle circuit board you can only use the dim "A" 5.0mm and 5.75mm internal pin lengths in the 'GND' row of the headers. If you use a pin with dim "A" of 5.00mm or 5.75mm length in the 'E' position of the 5-row header or the 'H' position of the 8-row header, the pin tip will be below the protruding section of the ground spring. Thus if the pin is accidentally bent toward the ground spring, it should not make contact and short. The ground spring, when present, makes contact to the top shield of the mating receptacle. See the product customer drawings for more detailed dimensional information and the size and layout of circuit board holes. All product described specification are on a 2mm pitch.

5.2.1. **Restrictions for use with Metral™ 4000 8-row Receptacles**

Dim "A" of pins must be 5.00mm minimum, 6.50mm maximum in rows A, B, D, E, G and H.
Dim "A" of pins must be 5.00mm minimum, 8.00mm maximum in rows C and F.

5.2.2. **Restrictions for use with Metral™ 4000 5-row Receptacles**


Dim "A" of pins must be 5.00mm minimum, 6.50mm maximum in rows A, B, D and E.
Dim "A" of pins must be 5.00mm minimum, 8.00mm maximum in row C.

5.2.3. **Restrictions for use with Metral™ 1000 8-row Receptacles**

Dim "A" of pins must be 5.00mm minimum, 8.00mm maximum in rows A, B, C, D, E, F, G and H.

5.2.4. **Restrictions for use with Metral™ 1000 5-row Receptacles**

Dim "A" of pins must be 5.00mm minimum, 8.00mm maximum in rows A, B, C, D and E.

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5.3. **Restrictions on Circuit Board Thickness**

The thinnest circuit board thickness in which you can insert a header is 1.6mm. However for maximum performance of the header, the tail of the press-fit section should not stick out the bottom of the mother board. The tail extends 2.7mm below the top of the mother board.

5.4. **Plating Options**

See the product customer drawings for contact area plating options.

5.5. **Circuit Board Via Hole Requirements.**

See the product customer drawings for requirements on generating circuit board via holes for mounting the header and shrouds covered by this application spec.

6. **Other Design Considerations on Header Circuit Boards**

6.1. **Multiple size Headers on same Circuit Board**

When using multiple size receptacles on the same circuit board side-by-side, mating thus to multiple size headers on the header board, use a guide pin to locate the two boards to each other before the receptacles enter the headers. If the receptacles are not located to the headers the larger receptacle may hit the top of the smaller header next to the larger header intended for mating. The receptacle will hit the top of the smaller header before the lead-in features of the larger header are engaged. The use of the guide pin should bring the various size components in close enough alignment for mating. This is not a problem if the various size headers are not side-by-side. So another way to prevent this problem is to space different size headers 2mm apart.

When using multiple size and product variation of standard Metral, Metral 1000, Metral 2000, Metral 3000 and/or Metral 4000 headers on the same daughter board be sure the associated headers on the mother board are lined up on the "A" row of pins. This will ensure that all parts are in the right alignment for plug-up of the daughter board to the mother board.

6.2. **Guide Pin Modules**

The modules are the same size as the 5-row product except the header housing has no side walls. They can be used in line with any size headers. See the following customer drawings for information

- 63735 for header housing
- 70295 for header guide pins
- 73474 for receptacle

6.3. **Keying Modules**

The modules are the same size as the 5-row product except the header housing has no side walls. They can be used in line with any size headers. See the following customer drawings for information

- 98099 for header housing
- 88914 for header keying pins
- 63730 for receptacle

6.4. **Header End Wall**

Header end walls are available for the 5-row headers.

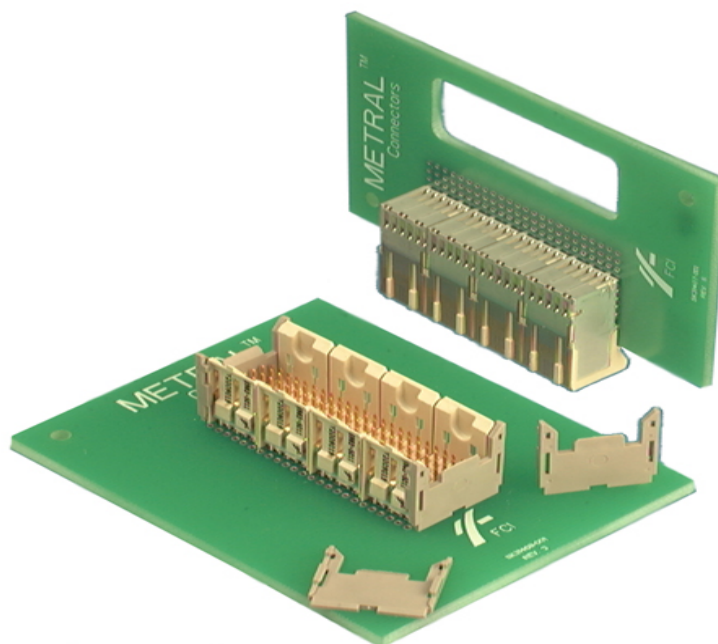
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- 73996-011 for 5-row headers
- 73996-012 for 5-row extended headers

The end wall easily slips and locks in place after the header is inserted into the board. They can be removed just as easily. The end walls are symmetric and fit on either end of the header. The end walls offer the following advantages.

- They protect the pins at the ends of a row of headers from handling damage
- They help align a daughter card into a card slot
- They prevent air flow from building up dust on the exposed end pins.
- They strengthen the header side walls by tying them together.
- They greatly increase the resistance to daughter card being insert off position.

Figure 4 Header End Walls



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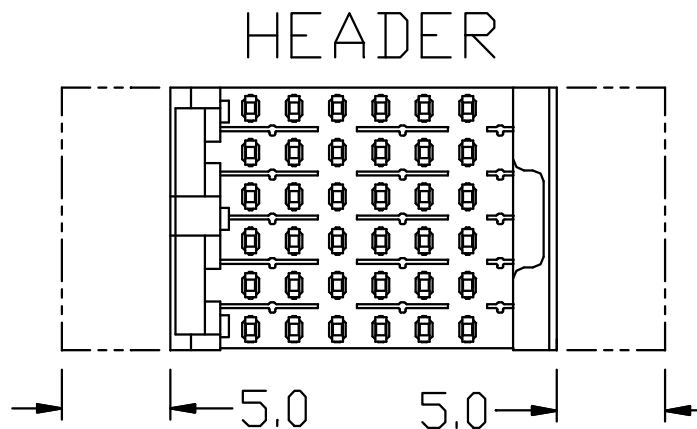
6.5. *Circuit Path Routing on Circuit Boards*

On Metral 4000 headers the stripline ground shields are very close to the surface of the circuit board. We do not recommend routing any signal or power paths on the top surface because of the potential of shorts. Only the power and signal via holes should be on the top surface. There are several potential problems. If the header is over inserted resulting in the partial crushing of the plastic standoffs, the stripline shields may touch the surface. While the header may still be functional, a short will occur if a signal or power path has been routed through that area. Another problem may be that the routing of the path may create a locally high feature reducing the actual clearance between the stripline shields and that area of the board.

6.6. *Defining the Header Outline on the Circuit Board*

The minimum space or outline that is required for headers covered by this application spec. is shown on the individual customer drawings. Additional space is required to allow for various repair operations. Generally no additional space is required for individual pin replacement but to allow support tooling for replacement of the whole header we recommend as shown on the following figure.

Figure 5 Header Repair Outline



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7. Installation Tooling

Installation tooling needed for 5 & 8-row 4000 headers consist of the following.

7.1. **Brief Summary**

In order to properly insert press fit headers onto a circuit board you need two items:

- A press
- Insertion tooling

7.2. **Insertion Press**

The tooling can work in a variety of presses. Each header needs 60 Newtons or 13.5 pounds of force per pin for insertion. The press ram should be long enough to cover the tooling to prevent any flexing in the tool. The important thing to remember is that you need to have a press with enough force to insert the specific configuration you are working with and that the press table can properly hold the your circuit board size.

Typical types of presses are:

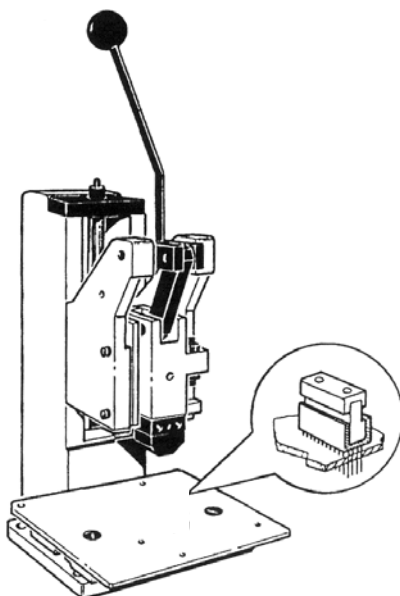
- * Manual arbor press
- * Pneumatic press
- * Hydraulic press
- * Servo driven electronic press


You also need to decide the type of frame you want

- * "C" frame
- * "H" frame

The preferred type of press to insert the headers is the servo driven electronic press. This press gives you the best control during the insertion process and offers the most flexibility. FCI offers arbor, pneumatic and electronic presses. For more information contact your local Customer Service Representative. The hand press is shown below.

Figure 6 MT-301 Hand Press P/N 194205-002



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By means of the IMPRESS family, FCI provides a range of state-of-the-art press-fit insertion machines. The IMPRESS family covers:

IMPRESS 2000 : is a modular based fully automated pick-and-place insertion machine.

IMPRESS 1000 : is a semi-automatic step-and-repeat press with motor driven xy-table.

IMPRESS 500E : is a hand-operated servo driven C-frame press.

Baby IMPRESS : is a flat-bed servo motor driven bench-press.

IMPRESS 500M+ : is a hand-operated C-frame bench-press.

Please refer to the following table for the relevant key specifications:

Type	2000 XL	1000 XXL	500E	Baby IMPRESS	500M+
Cat. No.	PAH13302	PAH156	PAY284A2	PAY326	PAY479
Press force	40 kN	80 kN	80 kN	20 ... 50 kN	15 kN
Board size (1)	950 x 635 mm	1200 x 625 mm	720 x 580 mm	600 mm between posts of the H-bridge	270 mm throat depth
Max. tool size	160 mm	255 mm	255 mm	255 mm	150 mm
Press cycle per hour (2)	900	700 ... 900	600	500	300
Tool exchange	automatically	manually or automatically (option)	manually	manually	manually
Board stuffing	Automatic pick-and-place	manually	manually	manually	manually
Board positioning	automatically	automatically	manually (LMT-system optionally)	manually	manually
Board support	rising post	rising post	rising post	Flat bed	Fixed anvil or flat bed
Force controlled press stroke	provided	provided	provided	provided	not provided

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7.3. **Press Blocks and Press Block Holders**

The press blocks fit inside the headers. In the headers the press block presses on both the pin shoulders and the inside bottom of the header housing. The press block holder allows multiple blocks to be held at one time.

EX: Perhaps you need to have a tool that is 12 modules in length. You can use two 6 module tools and the holder will keep the tooling in one piece.

For IMPRESS related insertion tooling, please contact your local Customer Service Representative'.

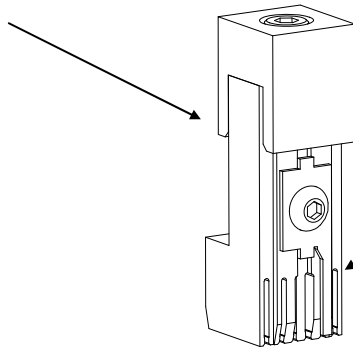
7.3.1. **5-row 4000 Headers**

FEATURES


- Inserts Metral 5 Row 4000 Series headers onto PCB.
- End-to-End stackable.
- Use manually or in an automatic insertion machine.
- Polarization keys insure proper tooling-to-connector alignment.
- End web design allows tooling to fit within length of connector & prevents end wall damage.
- Press block can be used as bottom PCB support.

Figure 7 5-row Press Block and Press Block Holder

Press Block Holder
P/N 415446-XXX



Press Block Assembly
with keys installed
P/N 430072-XXX
shown

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PRESS BLOCK HOLDER SIZE	PRESS BLOCK HOLDER ORDERING INFORMATION	
	5-ROW	5-ROW EXTENDED
1 – 12mm modules	415446-001	415446-001
2 – 12mm modules	415446-002	415446-002
3 – 12mm modules	415446-006	415446-006
4 – 12mm modules	415446-003	415446-003
5 – 12mm modules	415446-007	415446-007
6 – 12mm modules	415446-008	415446-008
7 – 12mm modules	415446-009	415446-009
8 – 12mm modules	415446-004	415446-004
9 – 12mm modules	415446-010	415446-010
10 – 12mm modules	415446-011	415446-011
11 – 12mm modules	415446-012	415446-012
12 – 12mm modules	415446-013	415446-013
13 – 12mm modules	415446-014	415446-014
14 – 12mm modules	415446-015	415446-015
15 – 12mm modules	415446-016	415446-016
16 – 12mm modules	415446-017	415446-017
17 – 12mm modules	415446-018	415446-018
18 – 12mm modules	415446-019	415446-019
19 – 12mm modules	415446-020	415446-020
20 – 12mm modules	415446-021	415446-021
21 – 12mm modules	415446-101	415446-101

PRESS BLOCK SIZE	PRESS BLOCK ORDERING INFORMATION	
	5-ROW	5-ROW EXTENDED
12mm modules	430072-001	430075-001
24mm modules	430072-002	430075-002
48mm modules	430072-003	430075-003
96mm modules	430072-004	430075-004

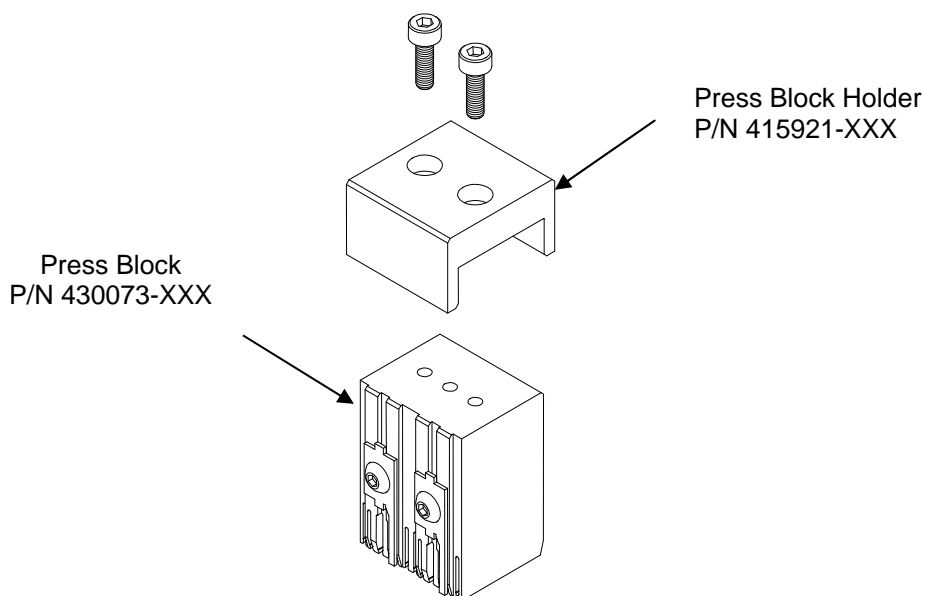
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7.3.2. 8-row 4000 Headers


FEATURES

- Inserts Metral 8 Row 4000 Series headers onto PCB.
- End-to-End stackable.
- Use manually or in an automatic insertion machine.
- Polarization keys insure proper tooling-to-connector alignment.
- End web design allows tooling to fit within length of connector & prevents end wall damage.
- Press block can be used as bottom PCB support.

Figure 8 8-row Press Block and Press Block Holder



PRESS BLOCK HOLDER SIZE	PRESS BLOCK HOLDER ORDERING INFORMATION 8-ROW
2 – 12mm modules	415921-002
4 – 12mm modules	415921-004
6 – 12mm modules	415921-006
8 – 12mm modules	415921-008
10 – 12mm modules	415921-010
21 – 12mm modules	415921-101

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PRESS BLOCK SIZE	PRESS BLOCK ORDERING INFORMATION 8-ROW
24mm modules	430073-002
48mm modules	430073-004
72mm modules	430073-006
96mm modules	430073-008
120mm modules	430073-010

7.3.3. Bottom Tooling - Headers

Bottom tooling can be a board with oversize holes or tooling supplied by the user. A press block will also work for bottom support. For all the 8-row headers, board support P/N 416070-001 is available.

For IMPRESS related bottom tooling, please contact your local Customer Service Representative'.

8. Installation Procedure

The installation procedure for the headers and cover by this application specification can be summarized as follows:

- Properly place header in desired location on PC board. Check to see compliant sections line up with holes in board.
- Place appropriate top and bottom tooling in their correct locations. See manual on insertion tooling for correct locations of top and bottom tooling for press being used.
- To insure proper insertion into the board, **HEADERS MUST BE CENTERED BENEATH RAM OF PRESS**. Offset loading may result in improper seating of headers and lead to bending of pins.
- Actuate insertion press and then remove assembly from press after press returns.
- On Metral 4000 headers we recommend that headers that are side-by-side be assembled so that the exposed stripline shield of the next header to be inserted faces the side of the last inserted header. If the headers are assembled in the opposite order, there is a chance of catching the top of the shield in the assembled header, and bending that portion of the shield under the header being inserted.


FCI recommends that the insertion force for headers to be between 100 to 120 Newtons (22.5 to 27 pounds) per pin.

EXAMPLE: For each 5-row 4000 straight press fit headers there are 36 straight pins and 3 Eye-of Needle pins on the ground spring for a total of 39 pins. The insertion force is an average force that has been determined to yield the best results for insertion.

Minimum Press Requirements
(39 pins)x(100 Newtons/pin)=3900N (876lb)

Maximum Press Requirements
(39 pins)x(120 Newtons/pin)=4680N (1052lb)

Actuation of Insertion Press should be slow and controlled at a speed of 1.27mm/sec. (.05inch/sec.). Pressing to a certain pressure or to a change in slope will yield more consistent results than pressing to a set distance due to variances in board thickness.

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9. Post-Installation Inspection Procedures

9.1. **Header to Board Clearance**

The headers should be seated flush to the board but in no instance be more than .1mm (.004 inch) off the board

9.2. **Visual**

All pins inserted into via holes. Pins and plastic not damaged.

9.3. **Pin Tip Variations**

The pin tips shall be within .50mm true position ($\pm .25$ mm) of location after insertion.

10. Removal Tooling and Repair Procedures

The removal procedures vary depending on your board layout, the pin length and the board thickness. There are also cases in which a single pin repair is the best action to take. There are manuals supplied with the tooling that is shown below to help you through the pin removal process. If you are not sure what type of repair process is best for your application, please contact your local Customer Service Representative.

10.1. **Replacement Pins**

When removing and replacing individual pins use pins from another equivalent header assembly. Pins may be replaced twice.

Note:

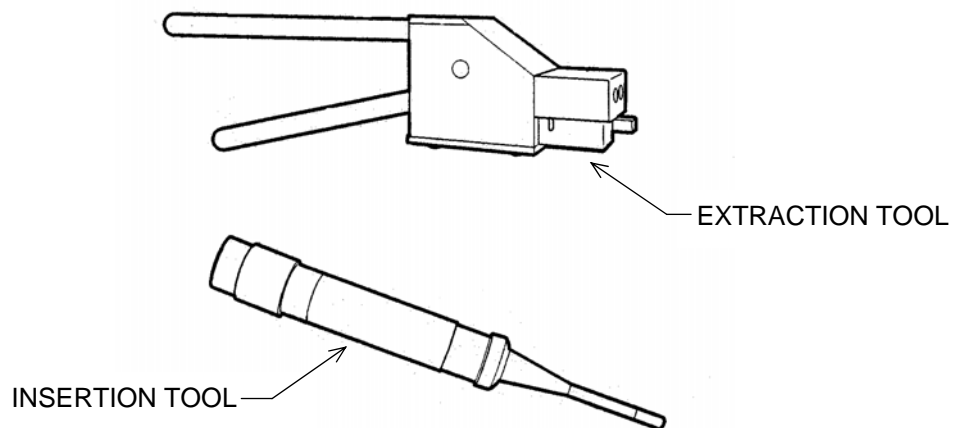
On Metral 4000 headers there are ground connections between the stripline shields and the even number ground pin positions. On all 5-row product the even pin positions in are the 'C' and 'GND' rows. On the 8-row product the even pin positions are the 'C', 'F' and 'GND' rows. We have not run qualification testing on the connections of repaired pin to stripline shield. However each stripline shield has multiple connections to ground pins and an additional connection to the ground spring so there is no chance of electrically isolating the stripline shield.

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10.2. Individual Pin Pullout Tool – MT340

The MT-340 , P/N 194204-001, pulls the pins out of the circuit board from the same side as the header one at a time. After all the pins have been removed you can then pull the header off the board with a pair of pliers. The tool kit comes with the two tools shown. Individual pin repair can be accomplished by removing the defective pin and inserting a replacement pin.

Figure 9 MT-340 Pullout Tool



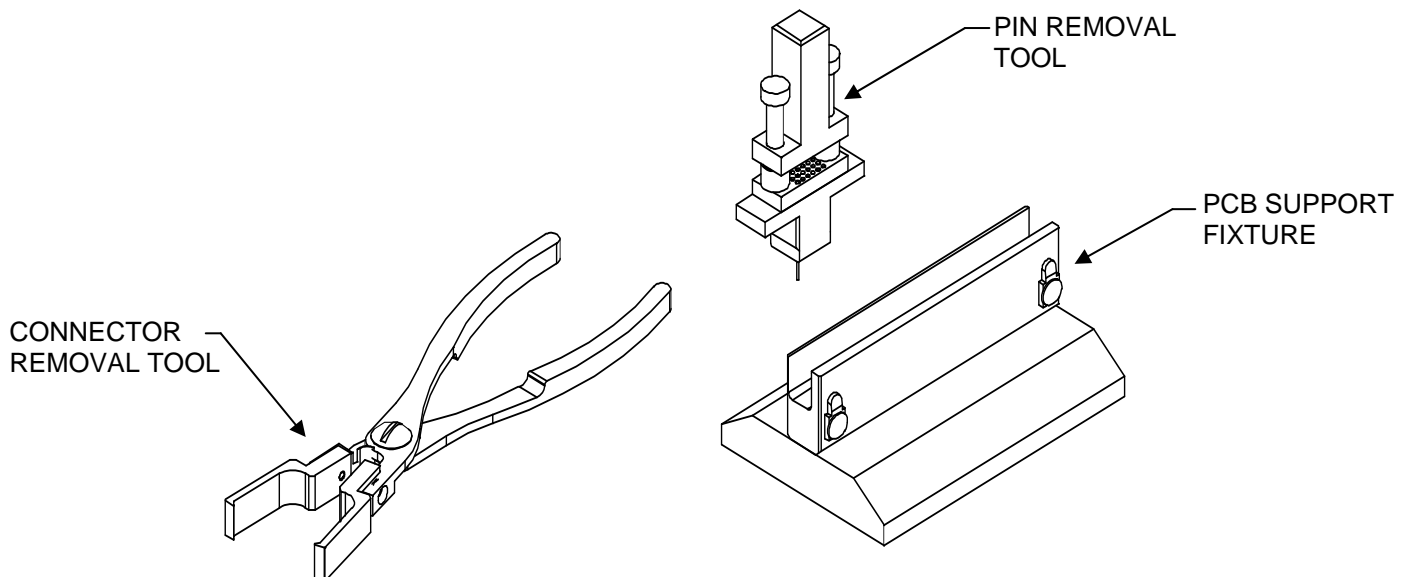
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10.3. 6x6 Pin Pushout Tool

The removal tooling will remove Metral 5-row and 5-row extended 4000 Series Headers. The 6 x 6-grid pin removal tool kits are hand tools used to remove Metral signal pins from the tail side of the circuit board. A hand operated arbor press, not included, is required to actuate the hand tool. The 6 x 6-grid tool kit removes 6 columns by 6 rows of pins at one time. The kit includes top tooling, bottom support tooling, and pliers for plastic & ground spring removal.

Product Style	Hole Pattern	Tool Part Number
4000	6 x 6 Grid	430143-001

Figure 10 5-Row Pushout Tool



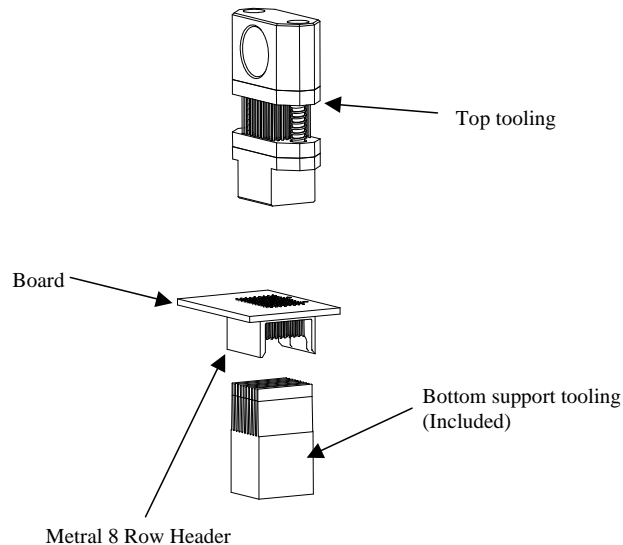
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10.4. 9x12 Pin Pushout Tool

The removal tooling will remove Metral 8-row 4000 Series Headers. The 9 x 12-grid pin removal tool kits are hand tools used to remove Metral signal pins from the tail side of the circuit board. A hand operated arbor press, not included, is required to actuate the hand tool. The 9 x 12-grid tool kit removes 9 columns by 12 rows of pins at one time. The kit includes top tooling, bottom support tooling, and pliers for plastic & ground spring removal.


Product Style 4000	Hole Pattern 9 x 12 Grid	Tool Part Number 430150-001
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Figure 11 8-Row Pushout Tool



10.5. Repairing Bent Pins

Bent pins must either be straightened or replaced. We recommend that if the pin is bent more than 45° it be replaced. If the pin is bent equal to or less than 45°, it can be straightened with a pliers or equivalent tool that has a smooth surface on the inside jaws. The repair shall be considered a success if the repaired pin is not 'kinked' nor the contact surface scraped. Burnish marks on the contact surface of the pins are acceptable. Do not use any pliers or tools made of aluminum as they could contaminate the contact surface.

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11. **NOTES**

The following table lists the cad files imported into this document.

Figure	Autocad File
1	G20014_A
2	G20014_B
3	G20014_C
5	G20014_D

12. **REFERENCE DOCUMENTS**

Bellcore GR-1217-CORE
IEC-61076-4-104

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REVISION RECORD

REV	PAGE	DESCRIPTION	EC #	DATE
A	ALL	NEW DOCUMENT	V21163	07/10/02
B	ALL	Change wording in sections 4.3, 4.4 and 4.5	V03-0451	04/21/03
C	ALL	ADD LEAD FREE INFORMATION	V05-0928	9/30/05
D	ALL	CHANGE LOGO	V06-0405	4/26/06
E	17	REMOVED REFERENCE TO 55001 REPLACEMENT PIN	V07-0704	12/4/07
F	5	CHANGED THE DIMENSION 13.5 TO 14.5 ON PAGE 5 FOR EXTENDED HEADERS	ELX-I-17038	25/02/14

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