TB-2196

Crossbow™ Matrix and Crossbow™ 2mm+ Signal Trace Routing Guidelines For Backplane And Daughtercard Connectors

Revision 03

Specification Revision Status

Revision	Description	Initial	Date
01	Initial Release	C. Heard	01/23/06
02	Added Matrix DC Routing without vias	C. Heard	02/01/06
03	Figure 10 2.667 Was 2.40	C. Heard	04/05/07

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1. Scope

1.1 Intent

The intent of this technical bulletin is to outline the standard signal trace widths, minimum spacing requirements, and finish hole size requirements for the Crossbow™ Matrix and Crossbow™ 2mm+ connector series when used in differential signal applications and low speed applications. This document supercedes all other Crossbow™ Matrix and Crossbow™ 2mm+ documents including customer use drawings when conflicts exist for the stated requirements outlined within this document.

1.2 Efficient routing

Efficient routing of signal traces between connector patterns improves yields and manufacturability. Spacing between trace/pad and trace/trace needs to be considered to allow for proper feature modifications needed for the inner layer fabrication process. Failure to allow for this will result in lower yields and higher PWB costs.

1.3 Finished Hole Sizes

All finish hole size requirements provided within this document are based on testing completed in FR-4 laminate.

2. Definitions

2.1 Fillets

An extension of the pad at the interface of the signal to the pad that will allow more pad area, in the event that the pad to hole relationship compromises the interconnect area. See Figure 1 for details. For further information regarding these routing guidelines, please contact ATCS Applications Engineering.

2.2 Foils/Copper Weights

Copper foil is measured in ounces (or weight). Common copper weights are 0.5 ounces, 1 ounce, 1.5 ounces and 2 ounces (3 ounces up to 10 ounces are available for special order). 1 ounce = 0.0014”, 1.5 ounces = 0.0021”, 2 ounces = 0.0028”.

2.3 Pads/Lands/Annular Ring

A pad is the support around a hole. If you see a specification calling out an annular ring of 0.005”, that will mean the amount of the pad left around the hole after processing.

2.4 Spacing

Spacing is the space between two electrical connections; it can be between two lines, two pads, a line and a pad etc.

2.5 Trace/Circuit/Line Width/Lines/Conductor

These are different terms for a connection. If you see the term 0.008” lines, it means the electrical connection from one point to another will measure 0.008” width.

2.6 Backplane

When used within this document refers to the PCB associated with the male connector half of the connector system mounted to a fixed pcb in a chassis.

2.7 Daughtercard

When used within this document refers to the PCB associated with the female connector half of the connector system mounted to a plug-in card in a chassis.

3. Routing Guidelines

3.1 Minimum Spacing
Minimum spacing, specific pad/trace, and trace/trace between all features should be 0.005" (.127mm) to allow for manufacturing tolerances.

3.2 Impedance
Consider characteristic impedance (if applicable) when designing to ensure line widths will meet requirements. Please contact ATCS Application Engineering for impedance calculations.

3.3 Copper Weights
Consider copper weights when routing. Higher weights will impact minimum trace widths.

3.4 Fillets
Fillets at the interface (egress) of the trace to the pad are required to improve annular ring when the electrical design requires tight hole to pad configurations.

3.5 Trace Centering
Center all traces between holes to optimize spacing.

3.6 Drilled Hole and Copper Thickness
The specified drilled hole size and copper thickness is mandatory, see Table 2 and Figure 2.

3.7 Non Functional Pads
For high speed applications, remove all non-functional pads.

4. Design Rules and Manufacturability Guidelines

4.1 General Design Rules

4.1.1 Drill
Require a 0.0225" (0.57mm) drill, this is a #74 drill.

4.1.2 Footprint
For specific connector footprint see customer use drawings.

4.1.3 Copper Thickness
For copper thickness requirements and finish hole size reference, see Table 2.

4.2 Daughtercard/Backplane Manufacturability Guidelines

4.2.1 Line Widths, Pad Sizes and Spacing
Line widths, pad sizes and spacing applicable for 1/2 ounce and 1 ounce copper weights.

4.2.2 Filleting
Filleting of pads recommended (to be added by fabricator) for 0.000" annular ring, see Figure 1.

4.2.3 Minimum PCB Thickness
Recommended minimum pcb thickness of 0.063" (1.60mm).

4.2.4 Non-functional pads

Non-functional pads on signal can be removed or added at designers option.

4.2.5 Plane Clearances

Plane clearances are applicable for copper weights up to 2 ounces. Please contact ATCS Application Engineering for applications with more than 2 ounce copper.

4.2.6 Surface Traces

Surface traces are not recommended. If surface traces are used refer to the customer drawings for keep-out zones.

5. Routing Guidelines

5.1 Crossbow™ Matrix and Crossbow™ 2mm+ Signal and Shield Pad Sizes

PCB Material Thickness	Copper Weight Ounces	Process	Min. Pad Size 0.000 A/R	Min. Pad Size 0.001 A/R	Min. Pad Size 0.002 A/R
0.062" to 0.350" (1.60 to 8.80)	0.5 (17μm)	Inner Layer	0.035" (0.89)	0.037" (0.94)	0.039" (0.99)
		Outer Layer	0.0375" (0.95)	0.0395" (1.00)	0.0415" (1.05)
0.062" to 0.260" (1.60 to 6.60)	1.0 (35μm)	Inner Layer	0.036" (0.91)	0.038" (0.96)	0.040" (1.02)
		Outer Layer	0.0375" (0.95)	0.0395" (1.00)	0.0415" (1.05)

Table 1: Minimum Pad Size vs. Copper Weight and Annular Ring

Notes for Table 1:

1. Outer layer pad sizes reflect panel plating process.
2. Use inner layer pad sizes for outers when pattern plating.
3. Values in ( ) are metric equivalents. For printed circuit board layout use metric units.
4. For plane clearances see Section 5.5, for all other plane clearances contact ATCS Application Engineering.

5.2 Copper Thickness Requirement and Finished Thickness Reference

Finish Type	Copper thickness, inches (mm) per side	Drill size, in	Typical Finish Thickness (ref only)
Solder Finish (1)	0.0010 (0.0254) min 0.0025 (0.0635) max	0.0225 (0.57)	300 to 500 micro inches
Immersion Sn (Tin)	0.0010 (0.0254) min 0.0025 (0.0635) max	0.0225 (0.57)	35 to 75 micro inches minimum
Immersion Ag (Silver)	0.0010 (0.0254) min 0.0025 (0.0635) max	0.0225 (0.57)	4 micro inches minimum
Copper - OSP	0.0010 (0.0254) min 0.0025 (0.0635) max (DC) 0.0030 (0.0762) max (BP)	0.0225 (0.57)	N/A
Ni Au (Nickel-Gold)	0.0010 (0.0254) min 0.0025 (0.0635) max	0.0225 (0.57)	53 to 210 micro inches Ni-Au compositions combined

Table 2: Copper Thickness Requirement and Finished Thickness Reference

Notes:

1. Solder finish includes: Tin/lead reflowed (plated and reflowed) and HASL

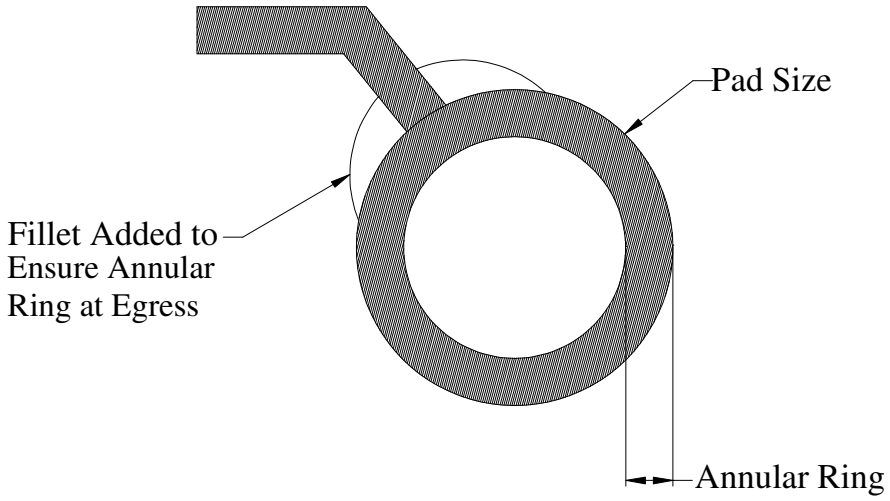

Figure 1: Preferred Fillet

Fillet Diameter equals one half size of plated through hole pad diameter located on a line central to trace so that fillet size equals minimum annular ring plus 0.005" (0.13).

5.3 Drill and Finished Hole Size

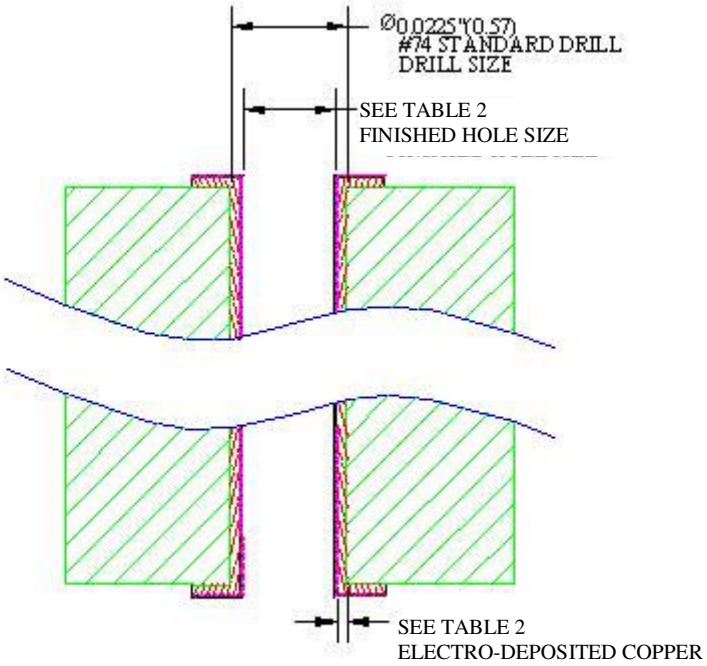

Figure 2: Drill and Finished Hole Size

5.4 Compliant Pin Critical Zone

The "Critical Working Zone" shown in Figure 3 is defined as the compliant working zone where the plated through hole requirements must meet the specifications defined within this document. In the "Non Critical Zone", the plated through hole is allowed to go below the minimum required finish hole size of 0.016" for non midplane applications

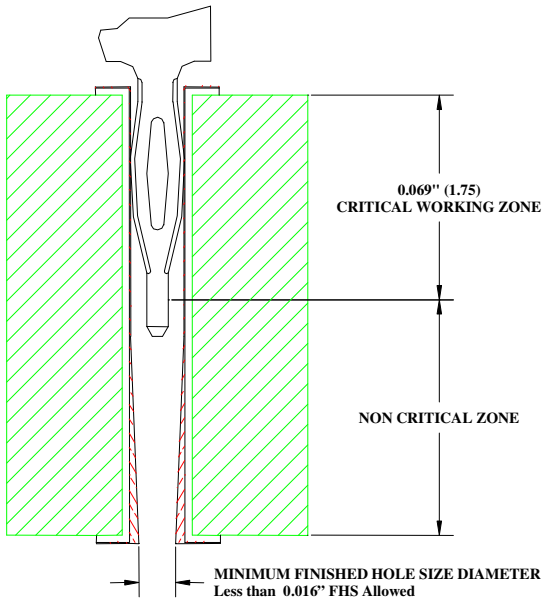

Figure 3: Compliant Pin Critical Zone

5.5 Anti-pad Geometry

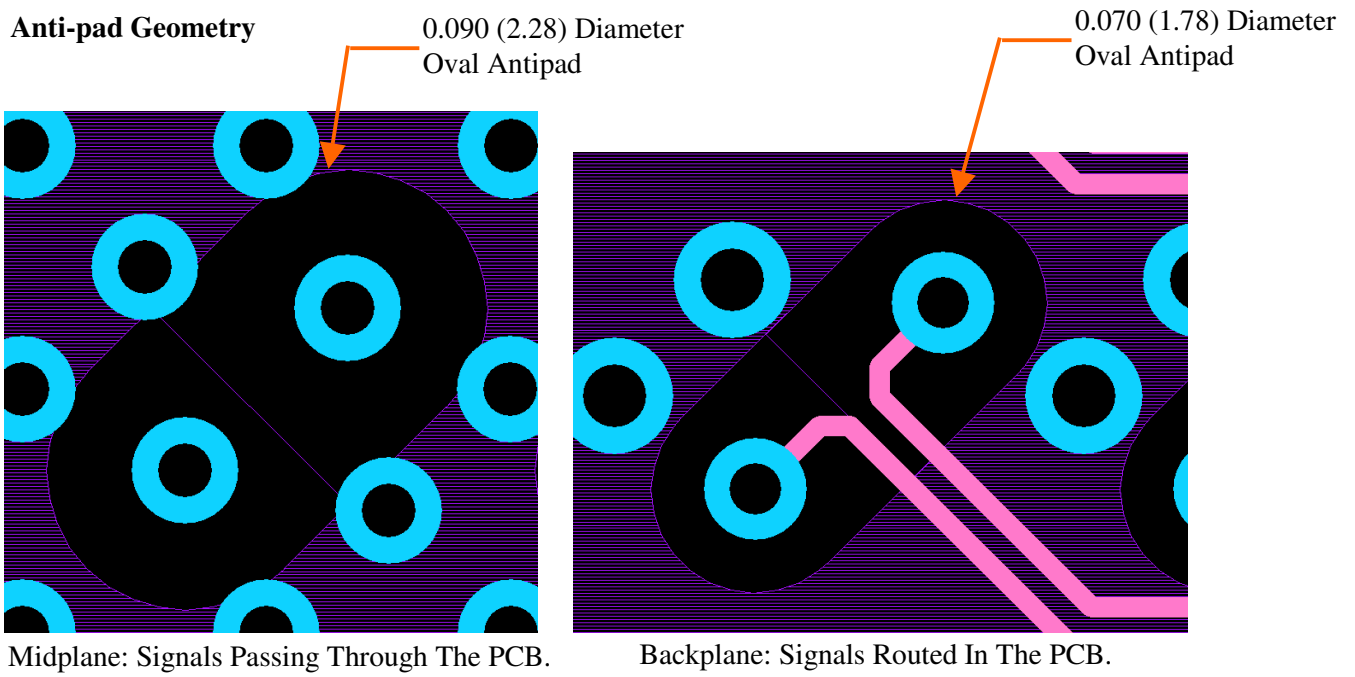

Figure 4: Antipad Clearance – Crossbow™ Matrix Backplane Connector

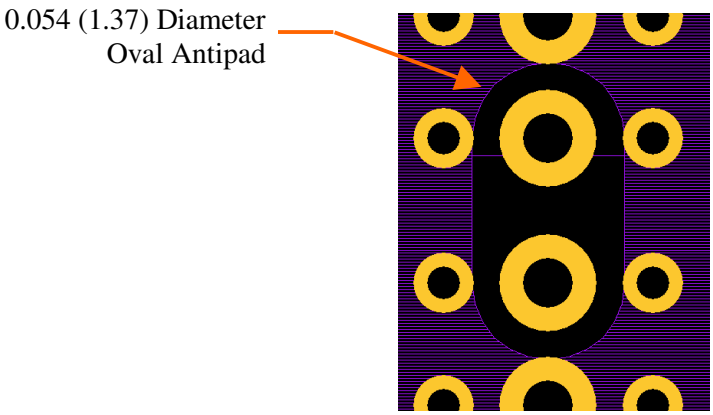

Figure 5: Antipad Clearance – Crossbow™ Matrix Daughtercard Connector

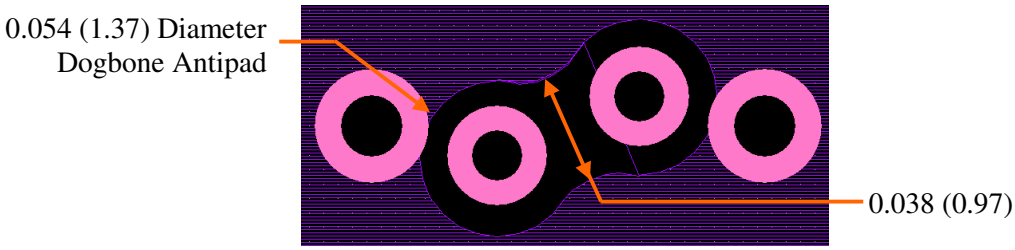

Figure 6: Antipad Clearance – Crossbow™ 2mm+ Backplane Connector

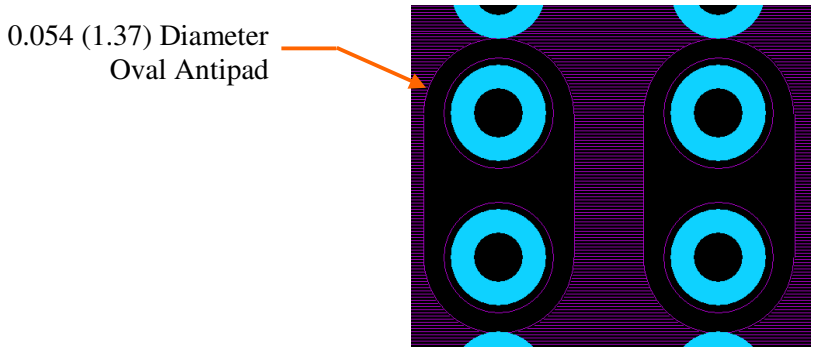

Figure 7: Antipad Clearance – Crossbow™ 2mm+ Daughtercard Connector

5.6 Crossbow™ Matrix Typical High Speed Differential Routing

For complete hole pattern dimensions please refer to the customer use drawings.

5.6.1 Crossbow™ Matrix Daughtercard Routing

5.6.1.1 Crossbow™ Matrix Daughtercard Routing With "Shadow Vias"

There are two dimensions that limit the amount of space available for routing the daughtercard footprint when "shadow vias" are used for additional electrical performance. They are the dimensions between ground vias and are labeled Dim "A" and Dim "B" in Figure 8. Dimension "A" and "B" do not change with differences in annular ring or copper weight. The following table details how to calculate the space available for routing between two ground holes on an inner layer, where there is no pad present.

	Routing Channel A	Routing Channel B
Center to Center	0.051 (1.300)	0.084 (2.120)
- Drill Diameter	0.016 (0.400)	0.016 (0.400)
- 2 * Space needed for drill wander	0.006 (0.152)	0.006 (0.152)
- 2 * Clearance to the trace	0.010 (0.254)	0.010 (0.254)
= Resulting Space for Traces	**0.019 (0.482)**	**0.052 (1.320)**
Recommended Line Width	**0.006 (0.152)**	**Same as Dim "A"**
Recommended Space Between Lines	**0.007 (0.178)**	**Same as Dim "A"**

Table 3: Crossbow™ Matrix Daughtercard Routing Channels With Shadow Vias

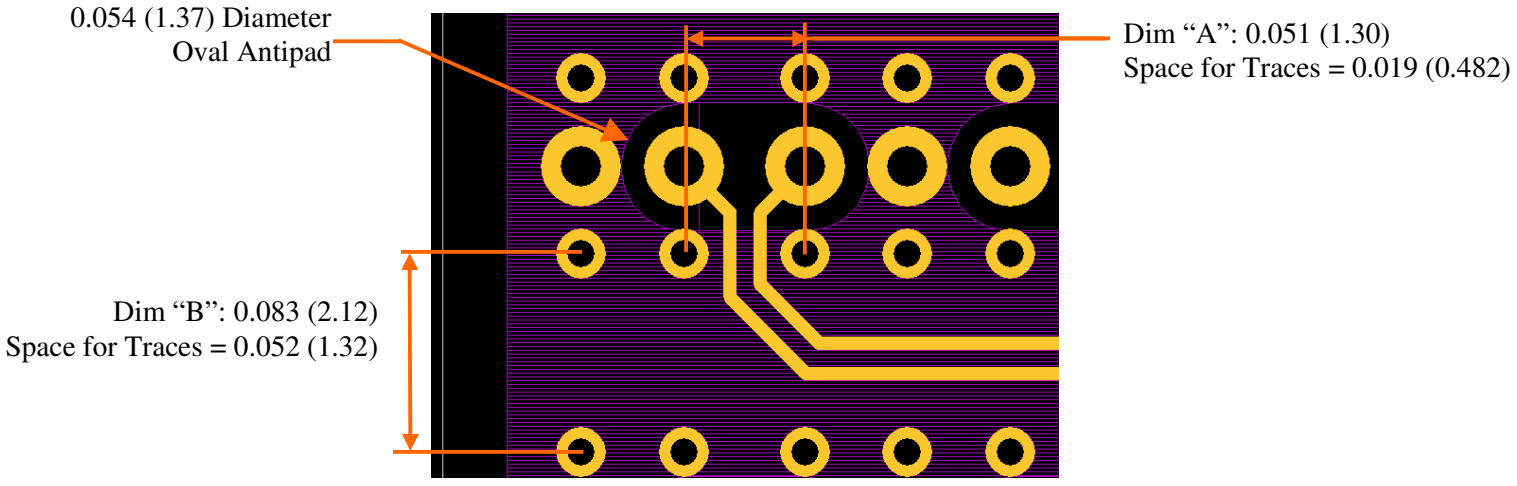

Figure 8: Crossbow™ Matrix Daughtercard High Speed Differential Routing With Shadow Vias

5.6.1.2 Crossbow™ Matrix Daughtercard Routing Without "Shadow Vias"

In this version of the footprint, the additional vias are removed to allow for more traces to be routed in the channel. The 6x6 Matrix connector can be routed in 2 routing layers using this method. The available space for routing is determined by the distance between antipads, not annular ring or copper weight.

	Routing Channel A
Center to Center	0.157 (4.000)
- AntiPad Diameter	0.054 (1.372
= Resulting Space for Traces	**0.103 (2.616)**
Recommended Line Width	**0.006 (0.152)**
Recommended Space Between Lines	**0.007 (0.178)**
Recommended Space Between Diff Pairs	**0.020 (0.508)**
Resulting Ground Plane Web Overhang on Each Side	**0.003 (0.076)**

Table 4: Crossbow™ Matrix Daughtercard Routing Channel Without Shadow Vias

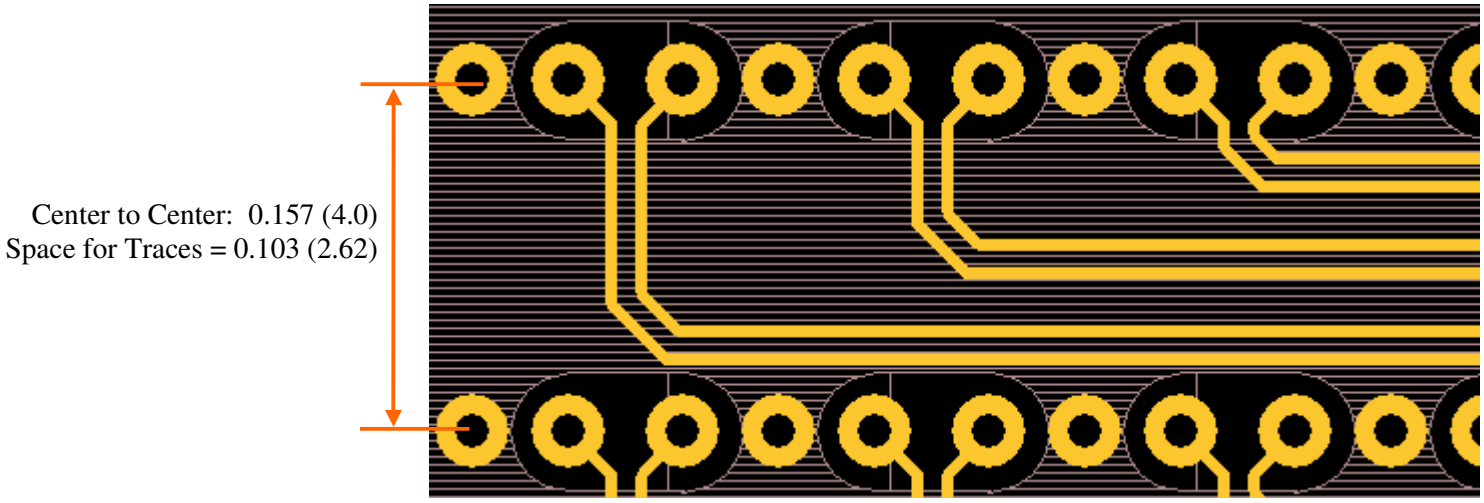

Figure 9: Crossbow™ Matrix Daughtercard High Speed Differential Routing Without Shadow Vias

5.6.2 Crossbow™ Matrix Backplane Routing

There are two backplane footprints for the Crossbow™ Matrix Backplane, one for midplane applications where signals are passing through the pcb and one for applications where traces are routed to the Crossbow™ 2mm+ connector. This section will address the latter case.

The amount of space available for routing is determined by the ground plane web in between the antipad clearances. This routing space does not change with differences in annular ring or copper weight because the antipad size is independent of annular ring and copper weight.

Center to Center	0.105 (2.667)
- Antipad Diameter	0.070 (1.778)
= Resulting Space for Traces	**0.035 (0.889)**
Recommended Line Width	**0.007 (0.178)**
Recommended Space Between Lines	**0.008 (0.203)**
Resulting Ground Plane Web Overhang	**0.006 (0.165)**

Table 5: Crossbow™ Matrix Backplane Routing Channel

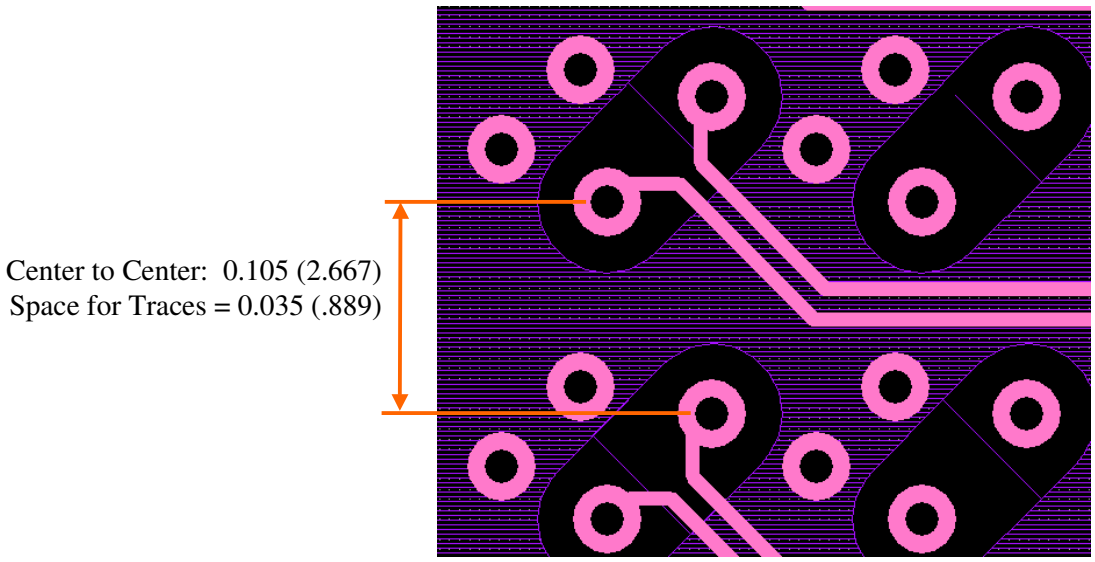

Figure 10: Crossbow™ Matrix Backplane Typical High Speed Differential Routing

5.7 Crossbow™ 2mm+ Typical High Speed Differential Routing

For complete hole pattern dimensions please refer to the customer use drawings.

5.7.1 Crossbow™ 2mm+ Daughtercard Routing

The amount of space available for routing is determined by the ground plane web in between the antipad clearances as shown in the following figure. This routing space does not change with differences in annular ring or copper weight because the antipad size is independent of annular ring and copper weight.

Center to Center	0.0787 (2.00)
- Antipad Diameter	0.054 (1.372)
= Resulting Space for Traces	**0.025 (0.635)**
Recommended Line Width	**0.007 (0.178)**
Recommended Space Between Lines	**0.007 (0.178)**
Resulting Ground Plane Web Overhang	**0.002 (0.051)**

Table 6: Crossbow™ 2mm+ Daughtercard Routing Channels

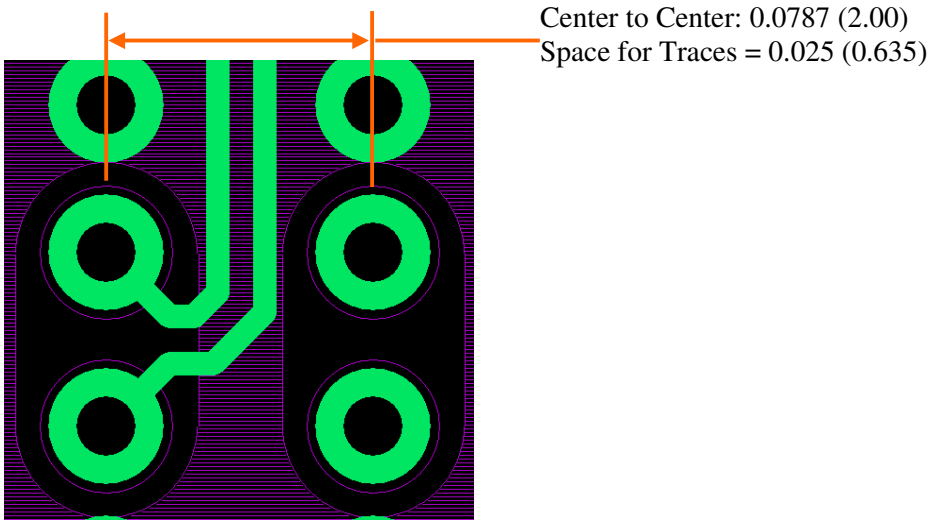

Figure 11: Crossbow™ 2mm+ Daughtercard High Speed Differential Routing

5.7.2 Crossbow™ 2mm+ Backplane Routing

The amount of space available for routing is determined by the ground plane web in between the antipad clearances as shown in the following figure. This routing space does not change with differences in annular ring or copper weight because the antipad size is independent of annular ring and copper weight.

Center to Center	0.076 (1.937)
- Antipad Diameter	0.054 (1.372)
= Resulting Space for Traces	**0.022 (0.558)**
Recommended Line Width	**0.007 (0.178)**
Recommended Space Between Lines	**0.007 (0.178)**
Resulting Ground Plane Web Overhang	**0.0005 (0.013)**

Table 7: Crossbow™ 2mm+ Backplane Routing Channel

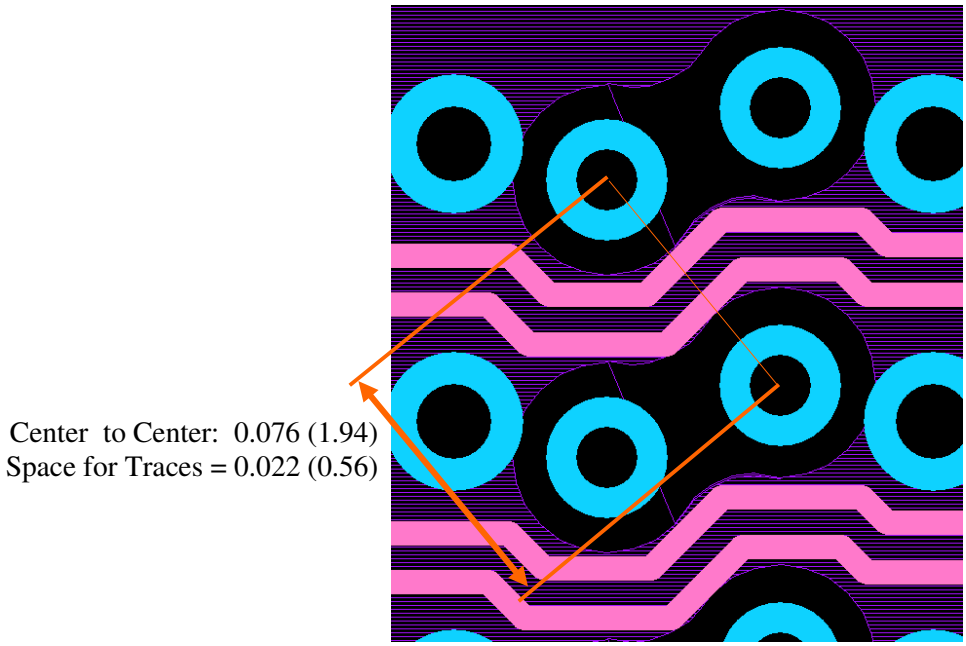

Figure 12: Crossbow™ 2mm+ Backplane High Speed Differential Routing