AMPHENOL TCS

TB-2091

AMPHENOL TCS VHDM-HSD™CONNECTOR DESIGN FOR MANUFACTURING (DFM)

Revision “G“

Specification Revision Status

Revision	SCR No.	Description	Initial	Date
“-“	37388	Initial Release	M. Pelletier	1-3-02
“A”	38840	Revised Paragraphs 2.1.4, 2.3,7.3, Added Paragraph1.4 and Revised Chart 3.2.1	M. Pelletier	6-5-02
“B”	39892	Renamed and Reformatted	P. Yeh	9-17-02
“C”	45599	Revised Sec. 2.2, added Sec. 4.4, removed Sec. 10	K. Taber	3-25-05
“D”	S0043	Replaced template format	M.Lee	02-07-06
“E”	S0802	Updated Copyright Information	C.Palmer	02-25-08
“F”	S0809	Added eHSD 8 information to sections 1.3, 5.0, 5.2, 5.4, 6.0, 6.1, 6.2,	M. Hanrahan	03-10-08
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1.0 Document Introduction

This document is intended to provide information and design criteria that will promote automation, cost and cycle time reduction, and help produce designs that will yield quality products assembled at Amphenol TCS. **This document is not intended to define the limitations of the manufacturing process at Amphenol TCS, nor is it intended to constrain designs.**

1.1 Scope

This document has been prepared to communicate the product design rules, manufacturing capabilities and design for manufacturability (DFM) guidelines concerning Amphenol TCS. Updates and revisions will be issued on a continuous basis to expand the guidelines, address changes in technology and cover modifications and/or additions to Amphenol TCS Connection System's (TCS) current manufacturing capability.

1.2 Benefits of Design for Manufacturing (DFM)

DFM is the sharing of manufacturing guidelines developed from industry standards and the knowledge gained from design and production. Applying these guidelines concurrently in new product development with the design and application of Amphenol TCS’s custom connectors can positively impact cost, time to market, and quality of the end product.

1.3 Description of Connectors to be included in Design for Manufacturing (DFM) Guide

This document will examine the VHDM, VHDM-HSD, and eHSD 8 series of connectors. This includes the VHDM 6, VHDM 8, VHDM- HSD 5, VHDM-HSD 6, VHDM-HSD 8 and the combinations of those connectors along with brief overviews our new offerings such as VHDM 6 Right Angle Male and the VHDM 6 Stacking Connector. We will also review the guidance options.

1.4 Document Confidentiality

This document is company confidential and may be used only by customers for their internal use. This document contains proprietary information which is not to be used in any way not previously approved be Amphenol TCS Incorporated.

2.0 Guidelines for Design of Daughter Card

Description/Scope of Section: This section will describe the best way of designing daughtercard connectors.

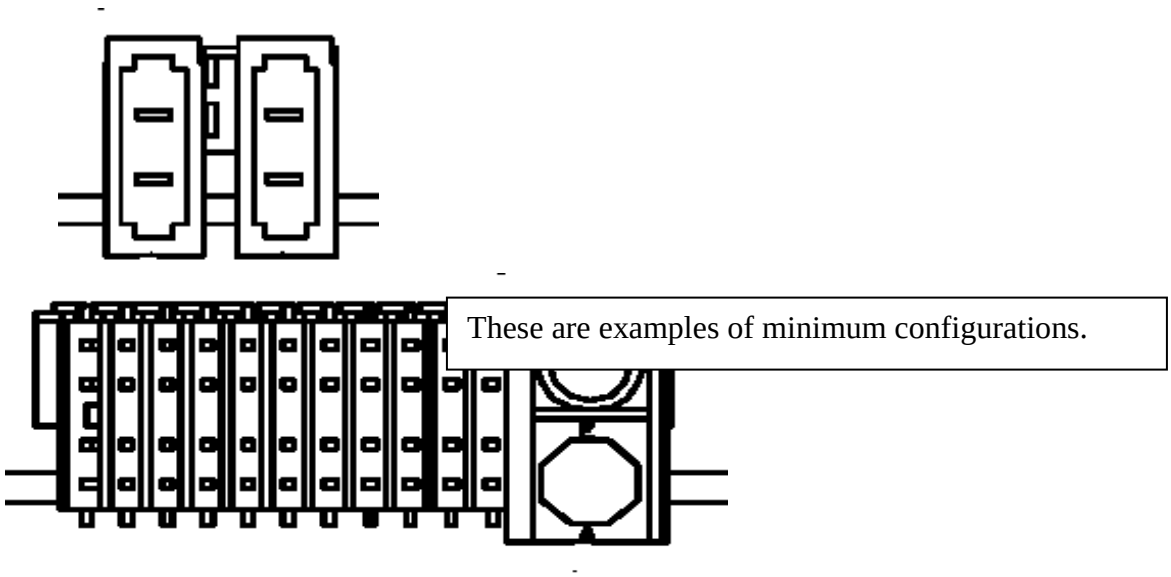
2.1 Daughtercard Connector Organizers (stiffener)

The daughtercard connectors are configured to fit on a mechanical ‘organizer’ or ‘stiffener’. The signal wafers, guide modules, power modules and other components are placed onto the ‘organizers’ in the specific configuration required by the customer. This is usually determined by the design of their backplane slot. This organizer keeps the daughtercard components on the desired 2mm pitch.

The daughtercard configuration may also be determined by the VHDM RAM Connector (Right Angle Male) to which it will mate.

The organizer (sometimes called a stiffener) can help to straighten the board edge but does not necessarily preclude the need for traditional mechanical stiffening. (for example, ¼”x ¼ “ stiffener bar)

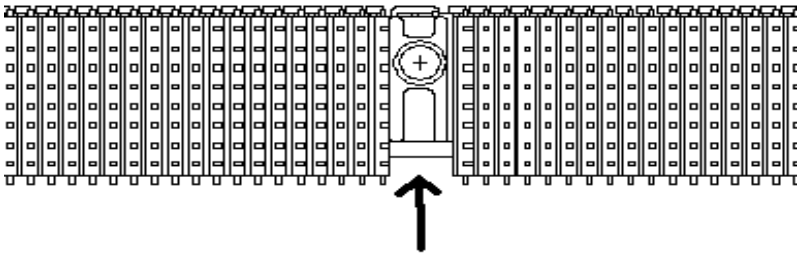
2.1.1 The minimum length of a daughtercard connector is determined by the minimum required number of signal wafers [which is **10**] **and** other components. For smaller increments of wafers, please consult your Amphenol TCS Field Application Engineer. (*see DFM impact box below)
For a daughtercard with only power modules or guide modules, there is a minimum Organizer (stiffener) length of 7.3mm.



2.1.2 If a connector needs to be longer than 12”, then the connector must be divided into segments 12” or less and connected using a Joiner Module. The longest individual stiffener length will be 12” long. The design considerations for connectors over 20” long are insertion force between the daughtercard and backplane, tolerance buildup issues, and bowing of daughtercard board. Please consult your Amphenol TCS Field Application Engineer for connectors over 20” long.

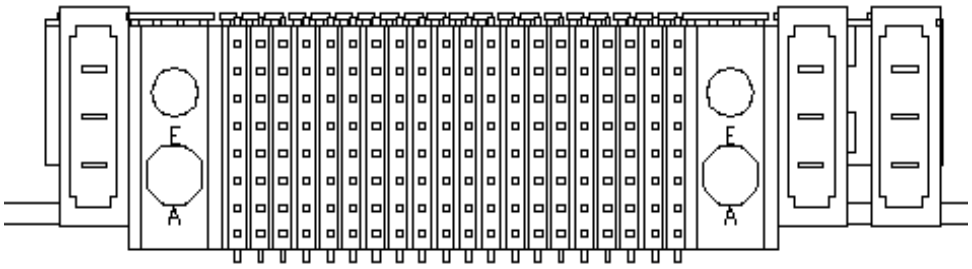
2.1.3 A Joiner Module is a metal piece that links two stiffeners together mechanically. The Joiner Module is pushed onto the daughtercard connectors after they have been applied to the board. It is not recommended to use the plastic guide module as a joiner module. The forces upon the Joiner Module are strong enough to break the plastic of a Guide Module used as a joiner module. There are various widths of Joiner Modules. The torque for the Joiner Module hold down screw (#2-56 machine screw) is 2 ½ to 3 inch pounds.

A Joiner Module cannot be used as a guidance module.



A Joiner Module connecting two halves of a long connector

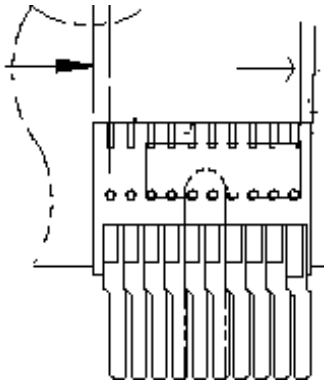
2.1.4 The optimal design of VHDM-HSD daughtercards is incremental groupings of 10 and 25 wafers. This matches 10 and 25 column groupings of the backplane modules. If one chooses to design something other than 10 or 25 wafer increments, wafers must be added in blocks of 5 wafers minimum. Power modules are usually put on the outside area of the daughtercard, outside of the guide modules. This keeps the power module away from the signal traces and holes and reduces signal noise while improving routability. **The minimum number of wafers is 10 for a standard configuration**



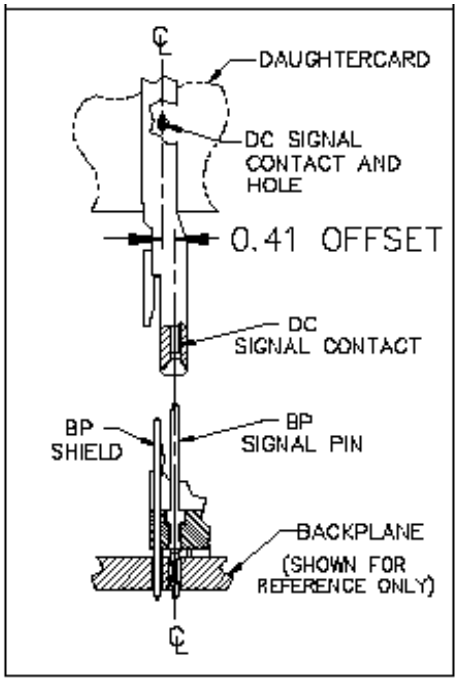
The VHDM-HSD daughtercard stiffener overhangs the left and right end of the connector.

The Organizer (stiffener) has a right and left overhang.

Refer to customer use drawings for actual dimensions



2.1.5 It is important to note that the VHDM-HSD hole patterns of the backplane connector and the daughtercard are offset by 0.41mm



2.2 End Caps

End Caps are plastic non-conductive wafers. End Caps can be used to protect exposed end wafers from debris, handling damage, or shorting. They can also be used between certain power, signal, and ground components as protection from shorting.

Where to use End Caps?

1. When there is a break in the connector pattern
2. Between signal wafers and power modules and/or ESD modules
3. Between power modules and ESD modules

Note: Although an end cap can be mated to a populated backplane slot, it is recommended that this be avoided. End caps are less robust than signal wafers, and have been found to deflect easily and induce damage during mating. The use of end caps should be limited to outside of the working connector configuration (ie, not mating to anything).

End Caps are offered with and without plastic pegs that go into the daughtercard board. There are pros and cons to each style. However, most customers use End Caps without 'pegs'.

With Pegs	Without Pegs
End Cap will be 'pegged' to board	End Cap held in place by only two points in Organizer
Custom gauge required from Amphenol TCS Inc.	End Cap has no vulnerable parts to break off
Pegs can break off during assembly and insertion into the board	No custom gauge required from Amphenol TCS Inc.

2.3 VHDM–HSD 6 End Caps

The VHDM–HSD 6 connector series have a unique requirement with regards to End Caps. When the VHDM is used with the VHDM–HSD 6 signal wafers on the same Organizer (stiffener) , there must be an empty space or and End Cap in-between the different styles of signal wafers. An End Cap is always needed to the left of a VHDM–HSD 6 signal wafer and a Power Module or Guide Module.

Design Rules & Notes:

Recommendations	**DFM Impact/Benefit**
• Minimum length is 10 wafers	• Cost, leadtime and test could be adversely impacted • Electrical test may be impacted
• Use metal Joiner Module	• Keep stability of connector when in two pieces
• Blocks of wafers in increments of 5	• Cost, leadtime and test could be adversely impacted

3.0 Guidance & Keying

3.1 Daughtercard Guidance Recommendations:

There are four main guidance systems when using the VHDM-HSD system for the daughtercard. One of the four following systems is required to ensure proper gathering of the daughtercard to the backplane. (ref. 3.2)

1. The Standard Guide Module Receptacle
2. The Anti-rotational Guide Module Receptacle
3. The Heavy Duty Guide Module Receptacle
4. The ESD Guide Module

3.1.1 Certain applications may require the Anti-rotational (Screwless) Guide Module Receptacle. Unlike the standard Guide Module Receptacle, this one has two extra plastic pegs that locate it into the board. When the daughtercard weight exceeds 30 pounds, the Anti-rotational Guide Module Receptacle is recommended. This component includes additional NRE charges due to a customized process. This part can be keyed.

The torque for the Guide Receptacle hold down screw is 2 ½ to 3 inch pounds.

3.1.2 The ESD (Electric Static Discharge) Guide Module acts as not only a guide module but also as an electrical (ESD only) conductor. The ESD Module is made of metal and has a 'louvertac' band inside the conductor area. The module is screwed down to the daughtercard board with a plated through hole to provide the electrical path. The ESD Module is placed in the Organizer (stiffener) like the other daughtercard components. This part cannot be keyed.

The ESD Guide Module requires End Caps between it and any adjacent wafers/modules to prevent shorting.

3.1.3 The Heavy Duty Guide Receptacle is made of metal with a non-conductive black epoxy coating. It has no provision for keying. This receptacle is recommended when the daughtercard assembly weighs over 20 pounds. Consult your Amphenol TCS Field Applications Engineer for further details.

3.1.4 As mentioned earlier, the Joiner Module is used to join two separate Organizers (stiffeners). It is not to be used as a guide module. This part has no provision for keying.

3.1.5 Every guide receptacle requires a hold down screw. There are various length screws depending on the thickness of the daughtercard board. The standard screw length is a 2-32 x 9.5mm. For boards thicker than 0.125", please consult your Amphenol TCS Field Application Engineer.

The thickness of the backplane board and length of screw required for holding down all VHDM-HSD guidance modules are detailed in this chart:

Board Thickness		
Minimum	Maximum	Screw Length
0.090"	0.210"	0.250"
0.160"	0.280"	0.312"
0.225"	0.345"	0.375"
0.285"	0.405"	0.437"
0.345"	0.465"	0.500"

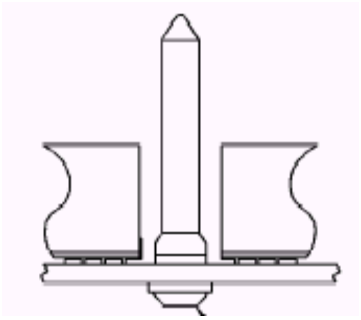
3.2 **Backplane Guidance Recommendations:** Use of the VHDM-HSD Guide Pin is requirement to ensure proper gathering of the daughtercard to the backplane. For daughtercards that weigh over 8 pounds, please consult your Amphenol TCS Field Applications Engineer.

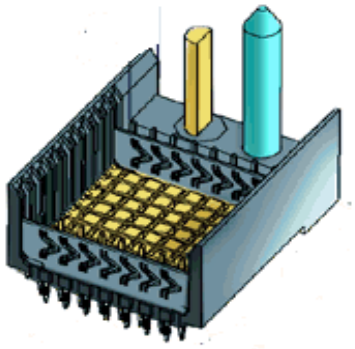
3.2.1 Use of the VHDM and VHDM-HSD guidance to be considered: the guide located in the insulator body or the Free Standing Guide Pin.

Design Considerations:

Free Standing Guide Pin	**Guide Pin in the Insulator**
Separate part number for Guide Pin and accessories	Part included in guided module
Drilled hole needed in backplane	No hole needed in board
ESD capable with daughtercard ESD Guide*	Not ESD capable
Assembly needed into backplane (screw/washer)	Applied to board same time as signal module
Can accept daughtercard of 20 pounds (max.)	Can accept daughtercard of 15 pounds (max.)
Heavy Duty Guide Pin can accept 30 pounds (max.)	

*For ESD Guide, hole must be plated





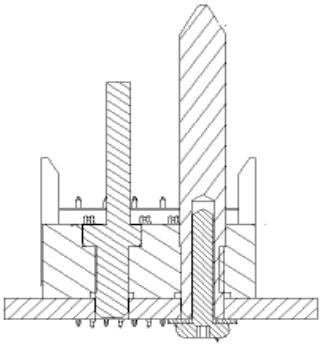
For Free Standing Guide Pin, reference drawing for hole location

3.2.2 For backplane slots (daughtercard connector lengths) under 6" in length, one guide pin is required but two can be used. For slots (daughtercard connector lengths) over 6" in length, two guide pins are required.
It is not recommended to use over 2 guide pins due to probability of 'binding'. In this scenario, the guide pins could work against each other if they are not in a straight line. However, there have been rare applications where a very heavy daughtercard (over 25 pounds) has had three guide pins used. Please consult your Amphenol TCS Field Application Engineer if your application has unique requirements using over 2 guide pins.

3.2.3 The hole pattern required for the Free Standing Guide Pin can be found in the drawing for the Free Standing Guide Pin. Please make careful note that the location of the hole depends on if the pin is to be used for ESD or just for guidance. See drawing 564-0383-553.

3.2.4 The Heavy Duty Free Standing Guide pin can accept 30 pounds of daughtercard weight. There is also a feed-through midplane pin. The Heavy Duty Guide Pin Receptacle is made of metal with a non-conductive coating.

3.2.5 The Free Standing Guide & Keying Module can be used for open-ended signal modules that need guidance and keying. This option allows for more customization to the slot such as spacing between signals and the guide/key pin. For example, used with a wide bus bar.



Free Standing
Guide and Key

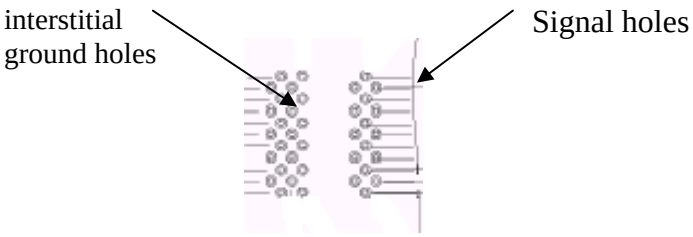
4.0 Power Considerations with VHDM-HSD

4.1 48 Volt issues

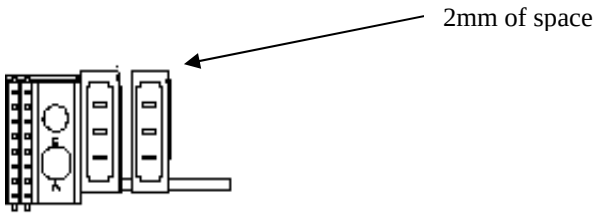
When designs require higher voltages than logic levels (ie:24v, 48v…) special consideration must be made in order to meet applicable UL and other industry requirements. In most cases, industry specs require a 2mm clearance between hi voltage primary and secondary circuits. For these cases power modules should be separated by 2mm (end cap may be used) and all blades of a power module should be of the same voltage. Please consult your Amphenol TCS Field Applications Engineer for more alternatives.

4.1.1 The issue of using 48 volts and higher with regards to various safety agency requirements and specifications are complex. Amphenol TCS can offer suggestions based on experience with several customers and applications to help meet those standards.

For voltage considerations, it is important to use the closest metal to metal dimensions and not just the centerline dimension. For example, a VHDM-HSD Backplane Power Module, 2mm centerline hole to hole dimension actually has just over 1mm of space between the metal annular ring of the plated though hole to the other plated through hole. With the daughtercard VHDM Signals, the interstitial ground tails of the shield leave only half a millimeter of space between the metal plated through holes.



For high voltages (greater than 48 v), the VHDM-HSD Power Modules should be spaced by at least a 2mm space. This will help isolate one Power Module from another. If a larger ‘gap’ is needed, the space has to be in increments of 2mm.



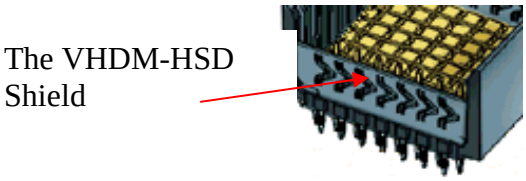
Note: End Cap is optional in-between power modules

For safety reasons in higher voltage applications, it is preferred, but not required, to put power and ground in separate Power Modules.

If real estate of design constraints makes it impossible to meet the above, then consult the Amphenol TCS Field Applications Engineer for alternative options such as depopulation of modules or using non-plated through holes.

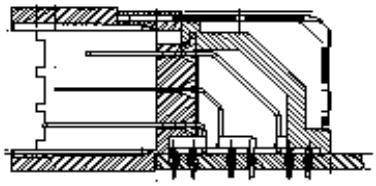
4.1.2 Signal pins are rated for 1 amp maximum. However, they should not be used in high voltage applications. We recommend using Power Modules for power.

4.1.3 All the VHDM-HSD Shields are rated at 3 amps.



4.2 Power Sequencing

4.2.1 The VHDM-HSD Daughtercard Power Module offers four blade lengths except the VHDM-HSD 5 that has only three lengths. These lengths are detailed in the Connector Mating Sequence Chart which can be obtained from your Amphenol TCS Sales Engineer or Field Applications Engineer .
The longest blade length is listed at 12.0 mm long. Since the 12.0mm long blade extends beyond the plastic insulator, it is advised to use shorter lengths if possible.



The VHDM-HSD Daughtercard Power Module with the 10.5, 9 and 7.5mm long Power Blades

4.3 VHDM-HSD 6 Power Bus Bar

4.3.1 The six row version of the VHDM and VHDM-HSD offers an external power busing system ideal for high-power backplane applications. Typically comprising aluminum, copper or brass bars mounted to the top or bottom surfaces of the

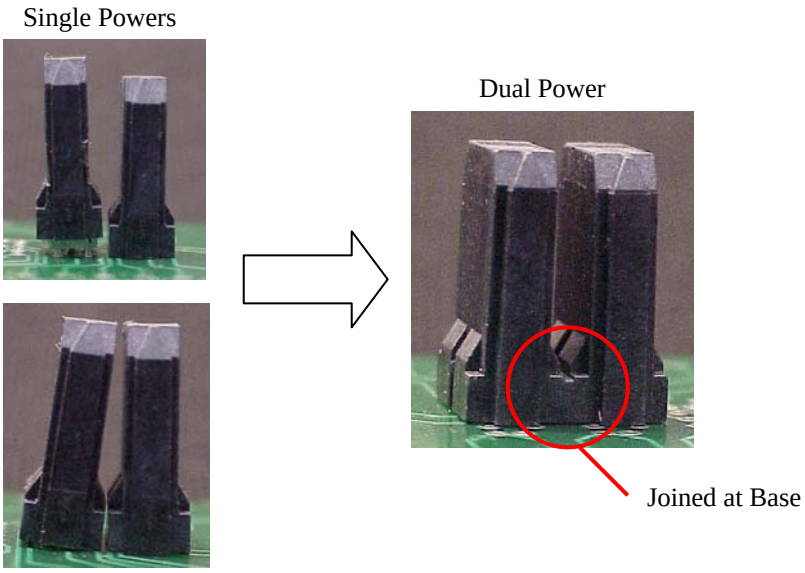
backplane, the bus bar system enables power to be brought directly to the daughtercard without the need for heavy copper planes internally located in the backplane. There are two blades per module rated at 20 amps per blade.

4.4 Dual Backplane Power Modules

VHDM and VHDM-HSD backplane power modules are available in dual-molded configurations. Dual power modules should be used whenever the connector design incorporates consecutive power modules, at 6mm or 8mm pitch.

Dual power modules are easier to install to the board. Their wider base increases stability during installation, and allows for less complex tooling.

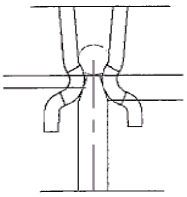
Dual power modules provide added strength in terms of retention to the board and deflection of the housings.



5.0 Backplane Module

Signal Pin Lengths

There are four signal pin lengths for the VHDM-HSD and eHSD 8. Each length has different characteristics that need to be examined for the benefit of the customer’s application. Please consult your Amphenol TCS Sales Engineer or Field Application Engineer for the Connector Mating Sequence Chart.



4.25mm signal pin: Provides only 1mm (minimum) wipe. This mates after the Standard, Advanced Mate, and eHSD 8 Shield. Some customers require more than a 1mm wipe and use the other signal pins. Please consult your Amphenol TCS Field Applications Engineer for further details when using this pin.

4.75mm signal pin: Mates simultaneously with the Standard Shield but after the Advanced Mate and eHSD 8 Shield. Provides a minimum of 1.5mm of wipe. This pin is the most commonly used signal pin.

5.15mm signal pin: Mates before the Standard Shield, simultaneously with the eHSD 8 Shield, and after the Advanced Mate Shield. Provides a minimum of 2mm of wipe.

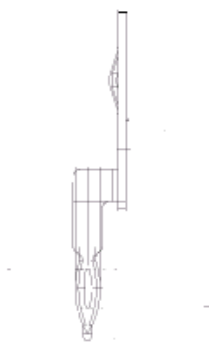
6.25mm signal pin: Longest signal pin offered with a minimum of 3mm of wipe. Mates before the Standard, Advanced Mate, and eHSD 8 Shield. Note that the pin tip extends above the Standard Shield. Consult your Amphenol TCS Field Applications Engineer if using this length pin on a mid-plane shared hole application.

5.2 Shielding (Standard and Advanced Mate)

There are two types of Backplane Module Shields for the VHDM-HSD; the Standard and Advanced Mate and one for the eHSD 8. The Standard Shield gives 1.5mm minimum wipe (like the 4.75mm signal pin). The Advanced Mate Shield is taller than the Standard Shield and gives 2.5mm minimum wipe, the eHSD 8 shield provides 2.0mm wipe.

Each Shield has compliant tails that go into the board. The VHDM Shield has straight complaint tails that go directly down into the board. There are either 5 (for VHDM 6) or 7 (for VHDM 8) complaint tails. See the customer use drawings on our web site for further details.

The VHDM-HSD Shield has fewer compliant tails, VHDM-HSD 6 & 8 have two tails and VHDM-HSD 5 has one tail. However, these shield tails go into the pin field before going down into the board. This 90 degree turn of the tail allows it to come in line with the signal pin field for better routing in the board.



Side View of HSD Shield

Side View of VHDM Shield

Side View eHSD 8 Shield

5.3 Customization

5.3.1 Signal Pins

The VHDM-HSD Backplane Signal Modules can be configured with different length signal pins. The customer needs to inform Amphenol TCS of which locations have which signal pin lengths.
The module can also have signal pins depopulated from the pin field. There is a cost associated with this option, so be sure to consider other methods of sequencing first. Consult your Amphenol TCS Sales Engineer or Field Applications Engineer for more details.

5.3.2 Shield Options

The Standard Shield cannot be used in the same module as the Advanced Mate Shield.

It is not recommended to depopulate shields. This is due to the fact that our automatic machinery is set up to only fully populate shields. To depopulate a shield, a special 'hand operation' or expensive machine configuration would have to be created.

5.3.3 Plating of Signals and Shields

There are several gold plating thicknesses available for the VHDM-HSD signals and shields; 10 and 20 micro inches of gold over 20-40 micro inches of NiW alloy or 30 and 50 micro inches of gold over 50-150 micro inches of Ni. You cannot mix the different platings within the same backplane module/daughtercard connector.

The low gold plating (10 micro inches of gold over 20-40 micro inches of NiW alloy or 30 micro inches of gold over 50-150 micro inches of Ni) costs less than the high gold plating (20 micro inches of gold over 20-40 micro inches of NiW alloy or 50 micro inches of gold over 50-150 micro inches of Ni) and is usually more available. Most standard/indoor applications only require low gold plating.

For Telcordia Uncontrolled Environmental specification GR-1217-CORE (Outdoor Specification), most customers are required to use high gold plating. However, for other applications, such as Central Office Environment (Indoor), only low gold plating maybe required. Consult your Amphenol TCS Field Application Engineer for further details.

5.4 Backplane Modular Design

The VHDM-HSD Backplane connector series are available in 10 and 25 column connectors. These are either open ended, left or right guided. The eHSD 8 Backplane connector series are available in 10 and 25column open connectors and 10 column left and right guided. There are some special modules in odd number configurations for the VHDM-HSD 6. See your Amphenol TCS Field Application Engineer for more details.

5.4.1 On applications where one end of the connector does not have a guide module or Backplane guide pin, that portion of the connector should end with a shield. A shield will offer mechanical protection to the inner signal column. The shield can be protected by an end cap.

5.4.2 Spaces can be put in-between Backplane Modules to accommodate routing. The daughtercard connector must have similar spaces.

6.0 PWB Considerations

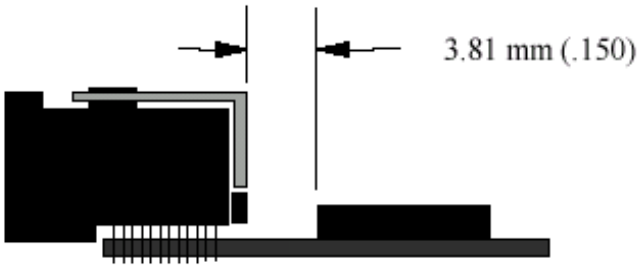
The minimum thickness of a daughtercard or backplane board when using VHDM-HSD and eHSD 8 is 0.070" (1.78mm). The maximum thickness is determined by the printed circuit board manufacturer's capability. Amphenol TCS's **Printed Circuit Backplane Fabrication plant** leads the industry with the highest *aspect ratio* board capability when using connectors like the VHDM-HSD.

There are various board materials that the VHDM-HSD and eHSD 8 can be used on. Please consult your Amphenol TCS Field Applications Engineer for an analysis of the best board material for your specific application.

The surface finish of a board has an affect upon the application insertion force of the compliant tails to the board. Reference Amphenol TCS Technical Bulletin TB-2033 or TB-2040 for these force numbers. These can be found on the Amphenol TCS web site.

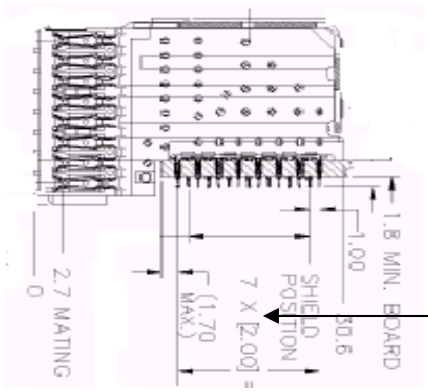
6.1 Keep out area

The VHDM-HSD and eHSD 8 keep out area applies to only the daughtercard. For reparability purposes, place no components 0.150" behind the daughtercard.



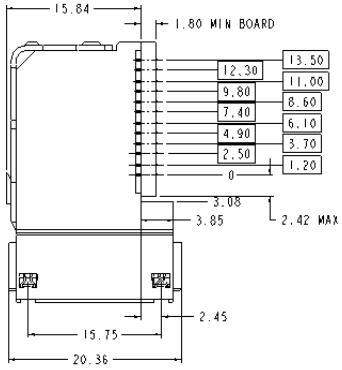
6.2 Edge of daughtercard board to Row A

Row A of the VHDM-HSD signal row of the daughtercard to the edge of the board shall be no more than 1.70mm maximum



The 1.7mm max. figure

Row A of the eHSD 8 signal row to the daughtercard to the edge of the board shall be no more than 5.62mm maximum. The first row of pins on eHSD 8 daughtercard is ground.

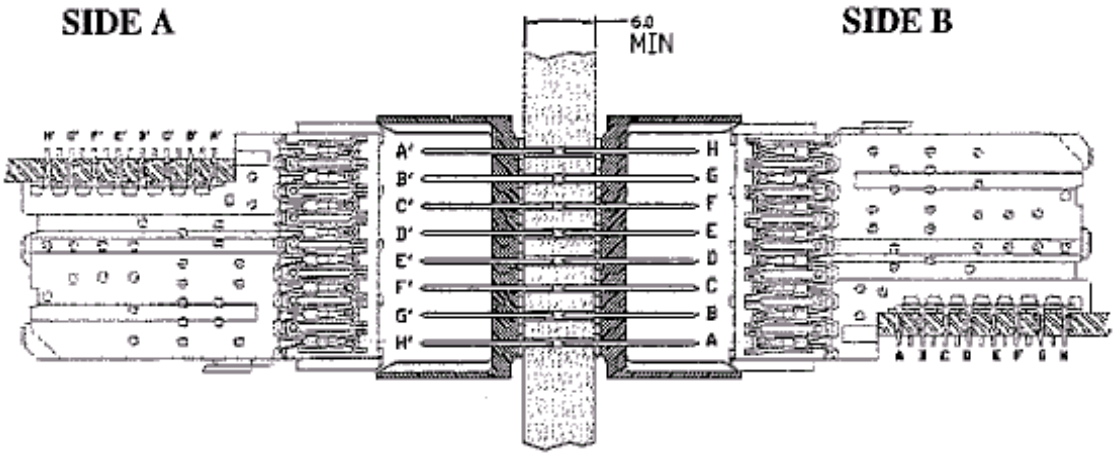


7.0 Application Specific Information

7.1 Mid-Plane

The VHDM-HSD connector series is used in many ‘shared hole’ midplane applications. The tail of the contact is only 0.110” long. Therefore, the plated through hole can be ‘shared’ by two tails on opposite sides of the board if the board has a minimum thickness of 0.230 (given tolerances). In this application, it is best to request a backplane that is 0.250” thick since the backplane thickness can vary due to tolerance.

* VHDM-HSD Backplane Power Modules **cannot** be used in ‘same hole’ mid-plane applications. Due to their asymmetrical hole pattern, you have to offset them in there own ‘non-shared’ holes. See Section 4.1.2 for a drawing of the unique hole pattern for Backplane Power Modules.



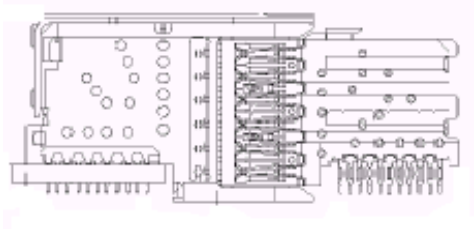
Note that on this picture, the daughtercard orientation is reversed/staggered when using VHDM 8. This also applies to the VHDM 6 connector. There are methods of obtaining an application where the daughtercards are orientated in the same direction, co-linearly. Contact your Amphenol TCS Field Application Engineer for further details.

7.2 Grounding – ESD & EMI

The VHDM-HSD series has an advanced mating Free Standing Guide Pin that can mate to an ESD daughtercard receptacle. There are also four levels of power module blades that allow for advanced mating for ESD purposes.

7.3 Co-planar Applications

By using the Right Angle Male (RAM) VHDM 6 connector, a co-planar application can be created when used with a standard right angle female VHDM 6 receptacle. This application allows the two daughtercard boards to be on the same plane. This is only offered in VHDM 6.

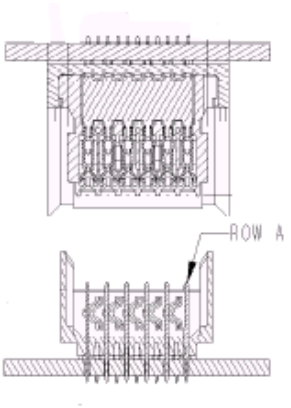


VHDM 6 RAM VHDM 6 Daughtercard

Consult your Amphenol TCS Field Applications Engineer for further details on this VHDM derivative. If you use the ESD Guide Module, you will need to move it 2 mm to the left since it is only 6mm wide, not 8mm like the standard Guide Module.

7.4 Stacking Connector

The VHDM 6 has a ‘Stacking’ or ‘Mezzanine’ connector. The VHDM 6 Vertical Female Connector comes in 60 and 150 signal modules with robust end walls. This is only offered in VHDM 6.



VHDM 6 Vertical Stacking Connector

VHDM 6 Standard Backplane Connector

Consult your Amphenol TCS Field Application Engineer for further details on this VHDM derivative.

8.0 Tolerances

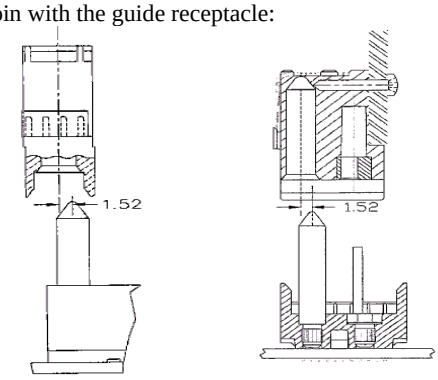
Amphenol TCS offers an in-depth tolerance analysis for the VHDM-HSD series. For the complete tolerance package and further details, please contact your Amphenol TCS Sales Engineer or Field Application Engineer.

9.0 Mating Information

9.1 Mating Sequence Charts: These charts show when the insulators, guide and ESD pins, signal pins and power blades mate together. There are separate charts for the VHDM-HSD 8, VHDM-HSD 6 and the VHDM-HSD 5. To obtain a copy of the latest Mating Sequence Chart, please contact your Amphenol TCS Sales Engineer or Field Application Engineer.

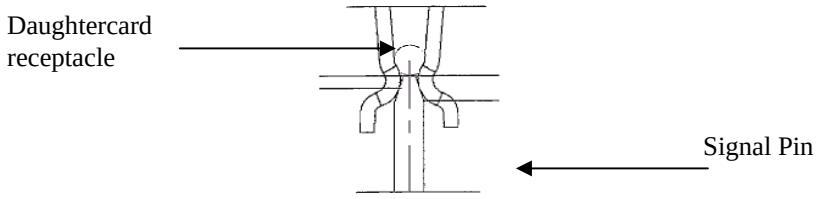
9.2 Connector gathering: As seen in Section 3, the most important item to insure good mating of the VHDM-HSD system is the successful mating of the guide pin with the guide receptacle:

1.52mm of gathering



Make sure that your card guide system can funnel the card within the 1.52mm capability of the connector.

9.3 The amount of signal wipe is an important factor in your design. The ‘wipe’ is defined as the distance of travel the signal pin goes past the mating point on the receptacle as seen below.



Section 5 goes into detail of the amount of wipe for each signal pin length.
Consideration should be given to the remaining minimum wipe after all tolerances have been taken into account (i.e.: tolerance analysis of sheet metal, d/c’s, injectors/ejectors, backplane deflection.