TB-2025

PROCESS FOR INSTALLATION OF RIGHT ANGLE PRESS FIT VHDM® DAUGHTERCARD CONNECTORS

Revision “F“

Specification Revision Status

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“A”	26392	Revised in its Entirety	C. Murphy	12-18-98
“B”	29606	Revised in its Entirety	C. Kowalczyk	12-2-99
“C”	39896	Added Appendix A and Reformatted	A. Solan/ P. Yeh	10-31-02
“D”	S0072	Added “Reference Documents” section, Revised Appendix C, Reformatted Document	K.LeBlanc	1-25-06
“E”	S0802	Updated copyright information	C Palmer	02-25-08
“F”	S1386	Added VHDM eH-series information	J. Lehman	09-28-09

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1.0 SCOPE

1.1 This document describes the method and tools for the seating of the family of VHDM right-angle pressfit daughtercard connectors, including VHDM H-series, eHSD, and VHDM eH-series, into printed circuit boards. See Appendix "A" for seating press recommendations and process recommendations.

2.0 REFERENCE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.1 TB-2026 – Process for Installation of Press Fit VHDM Backplane Connectors

2.1.2 TB-2033 – General Product Specification – VHDM Connectors

2.1.3 TB-2040 - VHDM Signal Trace Routing Guidelines – Backpanel and Daughtercard

2.1.4 TB-2043 – VHDM VHDM 6 Row, 8 Row, VHDM-HSD 5, 6, and Right Angle Male Daughtercard Connector Single Wafer Replacement

2.1.5 TB-2077 – Workmanship Criteria for VHDM Daughtercard Connectors

2.1.6 TB-2078 – Workmanship Criteria for VHDM RAM "Right Angle Male" Connectors

3.0 PROCEDURE

3.1 Locate the correct seating head and pallet.

3.2 Place pallet onto press. Complete the following:

Pallet must squarely and be correctly positioned below seating head.

Pallet must be pinned to press.

Board must be pinned to pallet.

Loading head must be pinned to ram.

3.3 Set the press for optimum seating pressure. See Appendix A for press setting recommendations.

3.4 Place the circuit board onto a pallet and remove the connector from the packaging. If the connector was shipped in a tray just remove the cover and lift the connector from the tray and go to Step 5. If the connector was shipped in a tube, first remove the green shipping tape and hardware. If the tube has a retaining pin, cut the pin with wire cutters (Figure 1) and remove the end connector. Lay the tube flat on a table with the connector pins facing up. To properly remove connectors from the tube packages, use a round or square rod to push the connectors out one at a time (Figure 2).

Figure 1

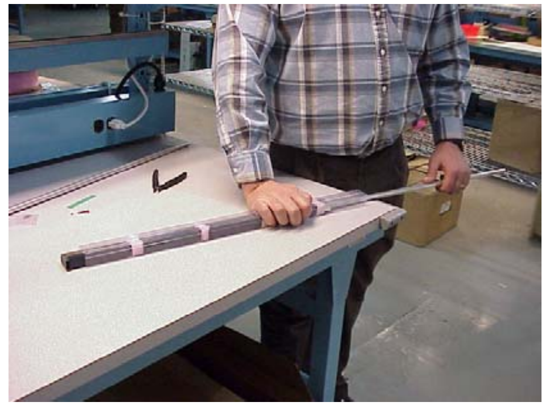


Figure 2

3.5 When placing the connector on the daughtercard, orient the board and pallet so the connector, when placed, will have the window side facing you and the stiffener side facing away from you. Before placing the connector, it must be inspected for any bent pins to insure proper placement. Refer to TB-2077 for general inspection guidelines. Hold the connector with one hand at each end and take one end of the connector and insert the far corner pins into their respective holes (Figure 3). Then while holding the window side of the connector up off of the board roll the back row of pins into their respective holes (Figure 4). After checking that this row of pins was properly placed into the board, the connector can be rolled forward to place the rest of the pins (Figure 6). Another technique which can be used is once the far corner pins are in place, roll the connector forward so the column of pins are in their respective holes and then roll the connector down length wise until all of the pins are placed (Figures 5 and 6).

NOTE: Placing a connector onto a board may not always be easy. This is due to the number of pins, the technique that is used and the amount of practice and time spent placing connectors.

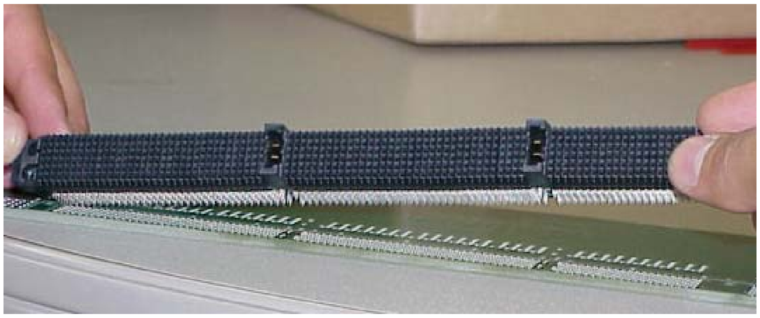


Figure 3

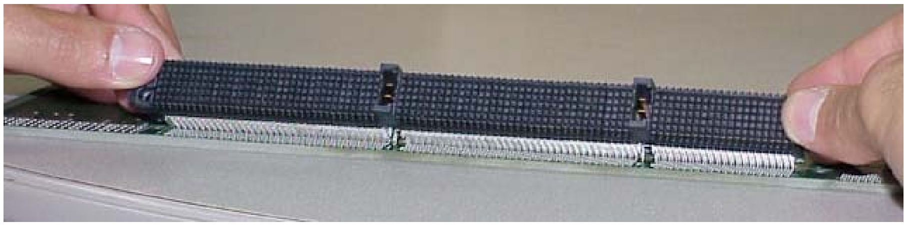


Figure 4

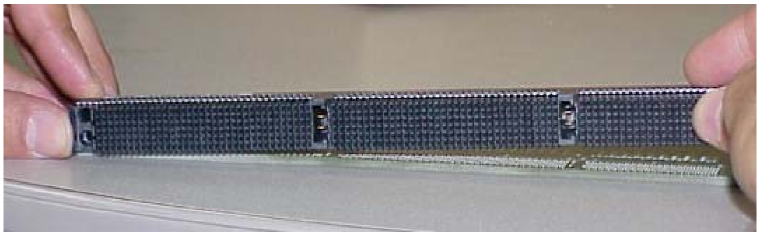


Figure 5

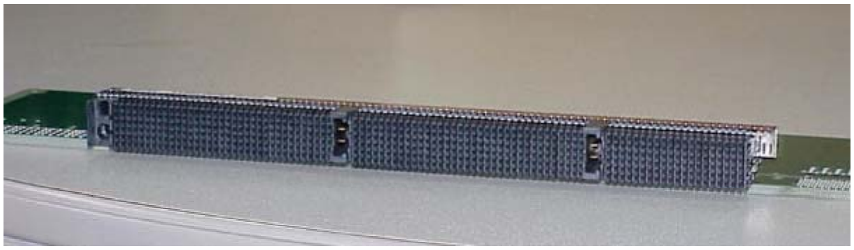


Figure 6

3.6 Check for any bent pins protruding from under the connector assembly.

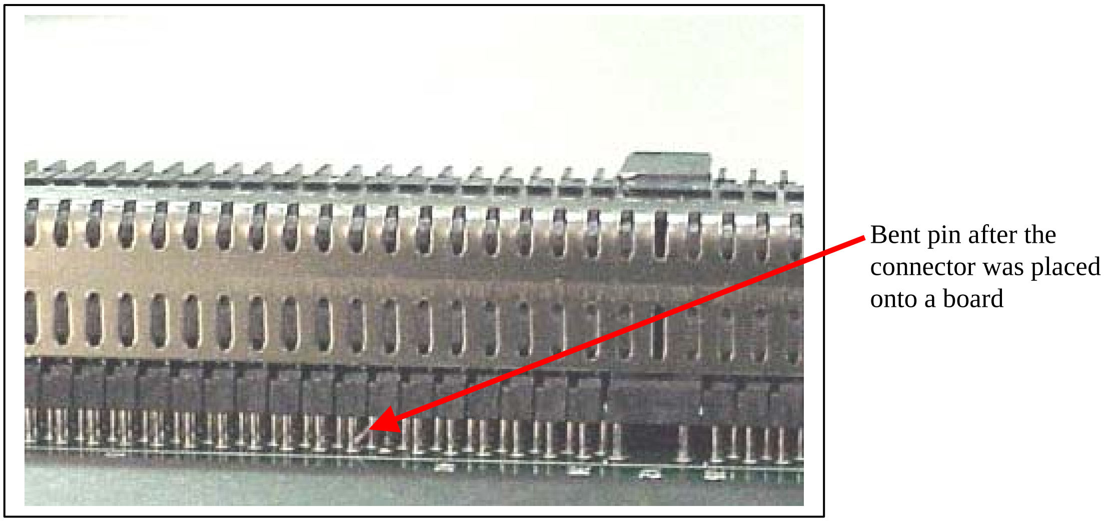


Figure 7

3.7 Bring seating head directly over the VHDM daughtercard connector.

3.8 Center seating head over connector assembly.

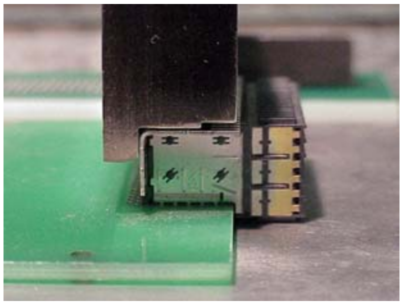


Figure 8

3.9 Position seating head onto connector assembly as shown before final seating.

NOTE: Ensure that seating head will not come into contact with other components directly to either side of connector assembly before engaging the press cycle.

3.10 Engage press cycle and seat connector onto board. See Appendix A for recommended pressing procedures and press process setup.

3.11 Verify connector is properly seated.

3.12 Check for the following: See Appendix "A" for additional inspection information.

Seating depth gap must be less than .25 mm (see Figure 9).

Check to make sure all pins are through board.

Install hardware screws if necessary.

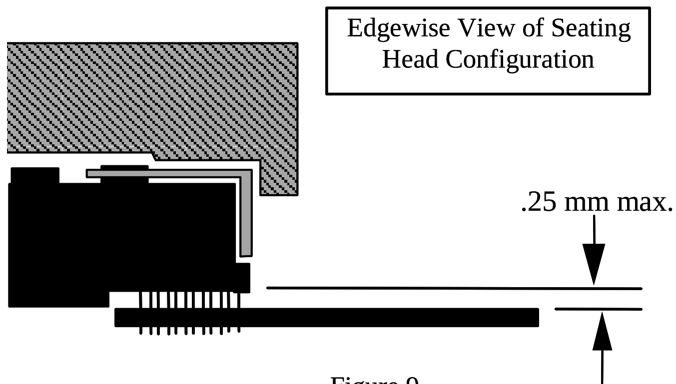
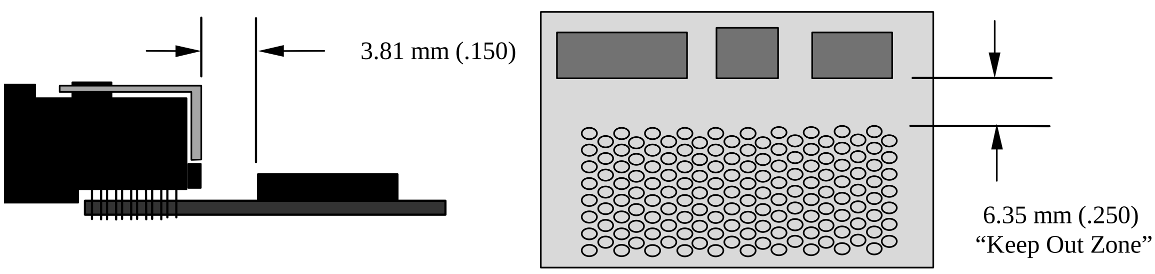


Figure 9

NOTE: The "Keep Out Zone" in between the plated thru press fit holes and the closest component is to allow for the proper clearance of seating heads and to allow for field repair of the VHDM connector. No components should be placed in this "Keep Out Zone" area.



Daughtercard Layout

Figure 10

Appendix A – VHDM Daughtercard Press Recommendations and Pressing Procedures

VHDM Daughtercard Press Recommendations

The press used for insertion of VHDM Daughtercard connectors into PWB should have minimum capabilities defined as follows.

1) The press shall be suitably rigid and stiff to provide a stable platform to support the pressing of any size connectors. High first pass yields on VHDM connectors can be achieved with connectors as long as 20 inches (with the use of joiner modules to combine connector halves). Press forces routinely run as high as 5000 lbs and can be much higher depending on connector design and the variability in plated thru hole size. The press, tooling and fixtures need to be sufficiently rigid to transmit the required pressing forces to the connector while maintaining their integrity. In other words, the press, tooling and fixtures cannot bow or deflect significantly while under force.

2) The press shall be capable of applying a pre-load force of approximately 100lbs and dwelling at that force for approximately 1-2 sec. This allows the entire press setup to stabilize just prior to inserting the connector. This pre-load force eliminates any bow that might exist in the PWB and/or the support fixture and firmly seats the connector in the PWB just prior to beginning the insertion.

3) The press shall be capable of precisely controlling the insertion rate. It is important that the insertion of the connector, and more specifically the compliant pin into the plated thru hole, be controlled and held to 0.05 in/sec. This is to ensure the compliant pin collapses correctly and creates the gas tight fit that yields the highly reliable interconnect. It also ensures that the PTH is not damaged in any way, such as barrel cracking.

4) The press shall be capable of a pressing process per a force gradient curve. To do this, the press must have real time force feedback from the press head and the necessary software. This allows for consistent presses every time, despite PWB thickness and connector height tolerances. It is not recommended to press to a specific height, as the PWB and connector tolerance build up will not result in consistent connector seating. Under pressing and over pressing can occur if seating to a specific height is used, and over pressing may cause connector damage. Therefore, it is not recommended to over press the connector to compensate for the tolerance build up as this may cause damage to the connector, PWB, or both.

Automation Services Group, or ASG, of West Palm Beach Florida, manufactures a press that meets all these requirements. The press is model number MEP-12T. Amphenol-TCS recommends using the ASG MEP-12T for all VHDM connector pressing.

VHDM DC Recommended Press Procedures

The following are recommended process steps to follow when pressing VHDM DC connectors.

Fixtures and tools should be designed to be strong and rigid enough to transmit the required pressing forces without bowing or deflecting. It is recommended that the tools and fixtures be made from steel rather than aluminum. Even a slight bump or scrape mark may alter the flatness on aluminum fixtures or tools, adversely affecting the pressing process. It is important that all tooling and fixtures be flat and parallel to ensure consistent seating of the connector and that these surfaces remain flat and parallel over time. The surface finish of the fixtures and tooling should also be smooth (check 63 finish minimum) so that the tooling appears as one continuous surface to the connector.

1) Each PWB should be inspected for blocked holes. This can be accomplished quickly and easily by simply holding the board up to a light and visually looking at the connector plated thru hole pattern for any holes that are not clear. This ensures that the connector will insert and seat properly in a PWB.

2) Each PWB should be inspected for finished plated thru hole size. Compliance to the finished plated thru hole size is extremely important in maintaining a consistent pressing process. This can be easily accomplished by using two gauge pins. A 0.0198" diameter gauge pin should pass freely in the holes. A 0.0242" gauge pin should not pass though the holes. **Note! The 0.198" and 0.0242" pins are for verifying a 0.020" to 0.024" plated through hole. Consult TB-2033 and TB-2040 for specific hole ranges based on VHDM product and PWB finish type.** Approximately 6-12 holes should be inspected across the connector hole pattern. It is also extremely important that the correct drill hole size be used. In most cases, even if the finished hole size is correct, pressing can be adversely affected by over or under plating to compensate for an incorrectly drilled hole. This can only be determined by cross sectional analysis. When trouble shooting a problem, this analysis can be performed after all other potential pressing errors are eliminated. See TB-2033 and TB-2040 for specific details around plated through hole requirements.

3) After pressing, the completed assembly should be inspected. First, inspect the PWB opposite the connector to verify that every pin made it into every hole. If a pin is missing, you should see it as a break in the geometric pattern of pins in holes. The assembly can be repaired by removing the defective wafer and inserting a new one per TB-2043. The most common cause of a pin not finding a hole is improper loading of the connector, which causes a bent pin prior to pressing. Second, inspect the back of the connector. The plastic standoff at the rear of the connector should be seated evenly against the PWB across the length of the connector. The standoffs can be as much as 0.25 mm (0.010") above the board, but should still be even all the way across. Connectors may be repressed if the seating is not correct. Also, the plastic standoff should not be cracked or deflected, as may result from over pressing.
Amphenol-TCS has already designed generic press tooling for use with the ASG MEP-12T Press and can assist customers with using this tooling and in designing product specific tools and fixtures.

VHDM DC Recommended Press Settings for Tyco (ASG) MEP-12T Presses

The following settings are recommended for applying VHDM connectors using MEP-12T presses. If the press is not an MEP-12T, please contact your Ampehenol-TCS representative for assistance in establishing correct settings for the specific type of press used.

Figure A-1. MEP-12T Manual-Electric Press.

Amphenol-TCS has developed a press profile that can be used on MEP presses to install VHDM connectors onto PWBs. The profile utilizes force feedback features on the MEP-12T press that ensure proper pressing of connectors. The VHDM press profile developed by Amphenol-TCS is named:

- *VHDM_STD_FG_DWELL.prf*

If this profile is not installed on your press, please contact your Amphenol-TCS representative for assistance. Other profiles tailored to specific connector and application needs may also be used. Consult your Amphenol-TCS representative for more information and assistance.

The following steps describe proper creation, setup, and application of VHDM Daughter Card connectors:
The MEP press main menu has 4 major screens that are required to setup a connector, tool and PWB for pressing (See Figure A-2):

- 1 - Tool Editor
  This screen is where the tool name, ID and dimensions are entered.

- 2 - Connector Editor
  This screen is where connector name, dimensions, pin count, error limits, and termination method are entered.

- 3 - Profile Editor
  This screen is where the list of action steps for the press to execute is entered (the *VHDM_STD_FG_DWELL.prf* profile)

- 4 - Press Data Editor
  This screen is where a PWB is assigned connectors to be pressed, board thickness, and fixture thickness.

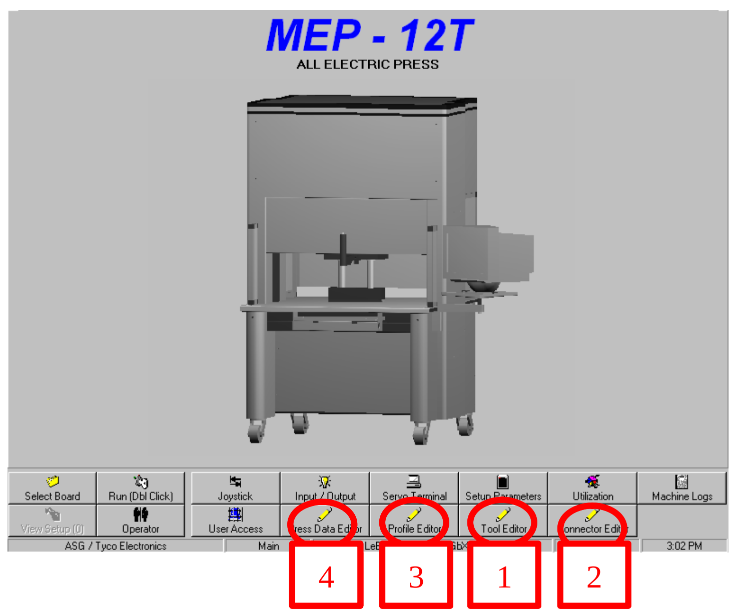


Figure A-2. Main Menu of MEP-12T Press.

1 - Tool Editor:
The Tool Editor screen allows for the creation of a new tool (See Figure A-3). This screen is the setup for top tooling only. Bottom tooling setup is in the press data editor screen and is categorized as "Fixture" (See Press Data Editor Screen).

- Tool Type – Unique identifier (User specified).
- Tool ID – Tool part number (User specified).
- Tool Clearance – Typically 0.100 inches unless additional height is needed for taller components on PWB.
- Tool Height – Overall height of tool from top of tool to tool contact point of connector.
- Tool Width – Width of tool.
- Tool Length – Length of tool.

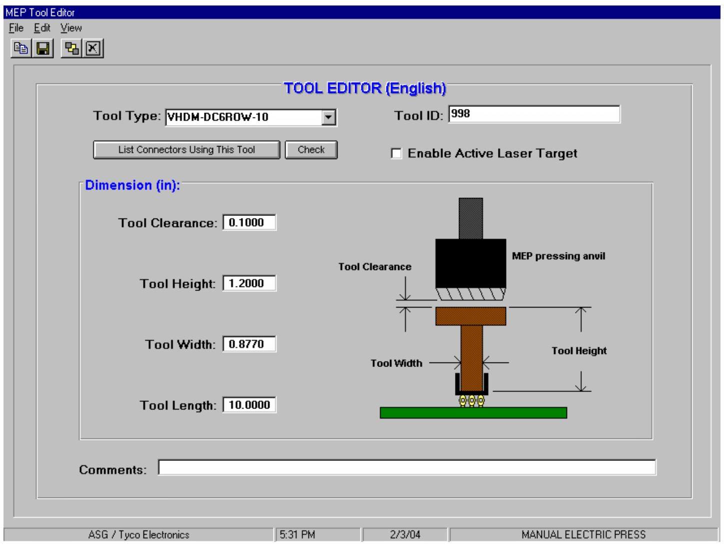


Figure A-3. Tool Editor Screen of MEP-12T Press.

2 – Connector Editor:
The Connector Editor screen allows for the creation of a new connector (See Figure A-4).

- Connector – Part number for connector being created (User specified).
- Tool – "Tool Type" and "Tool ID" from Tool Editor screen.
- Profile – Pressing profile used by the MEP-12T to install the VHDM connector (Amphenol-TCS recommendation is *VHDM_STD_FG_DWELL.prf*)
- Number of Pins – Sum of all pins entering PTHs on the connector (signal, shield, and power).
- Graph Scale – 10.0 for VHDM Daughter Card
- Distance – 0.1500
- Min Force / Pin – 0.5
- Max Force / Pin – 10.0 for VHDM Daughter Card
- User Force / Pin – Not used for *VHDM_STD_FG_DWELL.prf* profile.
- Other Force – Not used for *VHDM_STD_FG_DWELL.prf* profile.
- PARS – Not used for *VHDM_STD_FG_DWELL.prf* profile.
- Force Gradient Degrees – 75.0.
- SPC – Values to be dictated by process owner. Not covered in this document.
- Dimension – Unique to connector being installed. See Figure A-5.

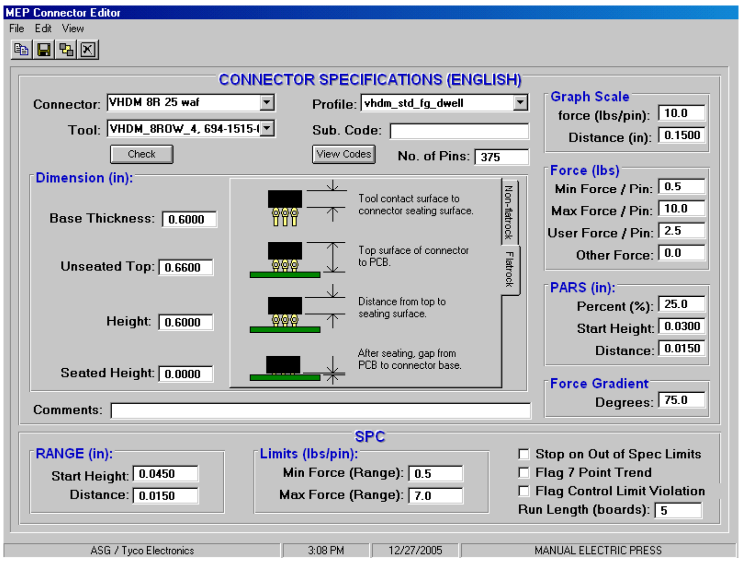


Figure A-4. Connector Editor Screen of MEP-12T press.

The dimensions of connectors that are critical to proper installation onto a PWB are:

- Base Thickness – The connector thickness between the contact point of the installation tool and the seating surface of the connector.
- Unseated Top – The unseated connector height from the contact point of the installation tool to the PWB surface.
- Height – Same as Base Thickness for VHDM Connectors.
- Seated Height – Gap between PWB and connector seating surface, ideally 0.00.

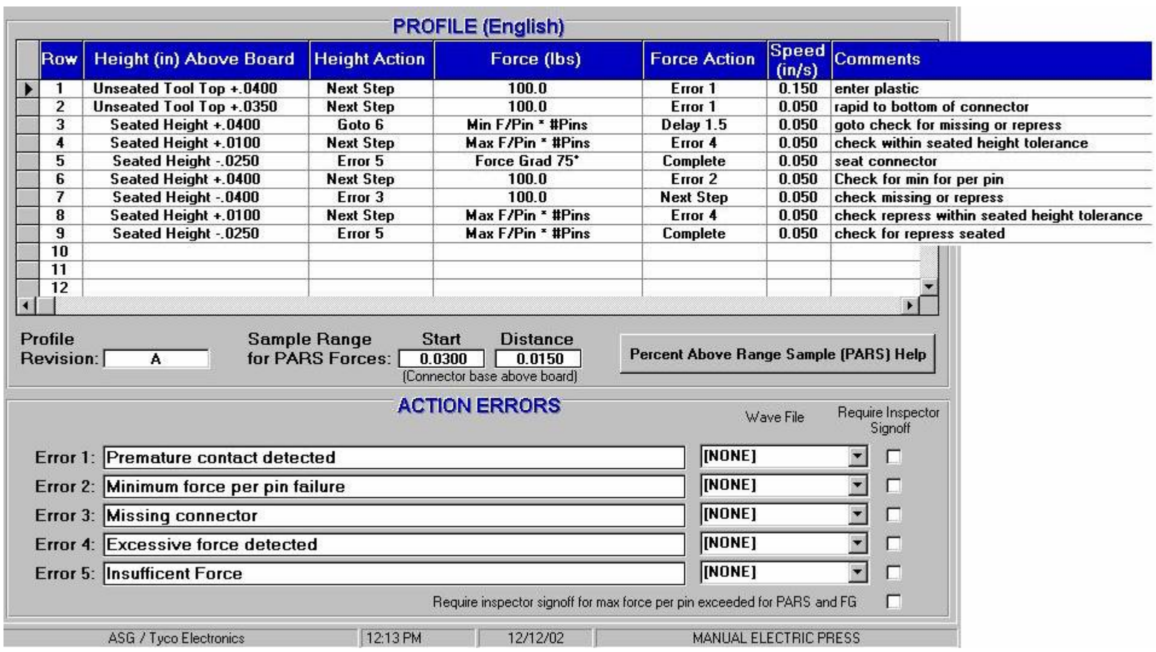
Figure A-5 below describes the dimension values for the Connector Setup screen of the MEP-12T press for the various VHDM Daughter Card connector sizes. If a particular VHDM connector is not listed, please consult your Amphenol-TCS representative for assistance.

VHDM Daughter Card Dimensional Values				
	Base Thickness (inches)	Unseated Top (Inches)	Height (inches)	Seated Height (inches)
5-Row HSD	0.360	0.420	0.360	0.000
6-Row VHDM, HSD, L-Series	0.500	0.560	0.500	0.000
6-Row H-Series	0.500	0.555	0.500	0.000
8-Row VHDM, HSD, L-Series	0.600	0.660	0.600	0.000
8-Row H-Series	0.600	0.655	0.600	0.000
6-Row RAM	0.550	0.610	0.550	0.000
8-Row RAM	0.695	0.755	0.695	0.000
Stacker 18 mm	0.215	0.275	0.215	0.000
Stacker 22 mm	0.375	0.435	0.375	0.000
Stacker 28 mm	0.610	0.670	0.610	0.000
5-Row eHSD	0.360	0.420	0.360	0.000
8-Row eHSD	0.600	0.660	0.600	0.000
6-Row VHDM eH-series	0.500	0.555	0.500	0.000
8-Row VHDM eH-series	0.600	0.655	0.600	0.000

Figure A-5. Connector Setup dimensions for VHDM connectors for MEP-12T press.

3 – Profile Editor:
The Profile Editor screen provides the detail of the Amphenol-TCS *VHDM_STD_FG_DWELL.prf* profile created for installing VHDM connectors onto PWBs (See Figure A-6). Rows 1 through 5 are the commands for a normal press sequence. Rows 6 through 9 are the commands for a “Re-Press” sequence. At each step in the profile sequence, the press executes on the event that occurs first. If the “Height Above Board” occurs first, then the press executes the “Height Action”. If the “Force” occurs first, the press executes “Force Action”.
The press speed during the press sequence is set to 0.050 inches / second. This speed is intended to ensure that the VHDM compliant pins remain stable during the pressing process. Speeds exceeding this are not recommended, and may result in connector pressing failures. Row 3 has a 1.5 second delay built into the press profile as a settling time for connectors to minimize the potential for pressing failures.

- Profile – Set of steps found in *VHDM_STD_FG_DWELL.prf* profile to perform normal press and re-press operations for VHDM connectors
- Sample Range for PARS Forces – Not used in *VHDM_STD_FG_DWELL.prf* profile.
- Action Errors – Messages that appear on MEP-12T monitor if error occurs.



PROFILE (English)

Row	Height (in) Above Board	Height Action	Force (lbs)	Force Action	Speed (in/s)	Comments
1	Unseated Tool Top +.0400	Next Step	100.0	Error 1	0.150	enter plastic
2	Unseated Tool Top +.0350	Next Step	100.0	Error 1	0.050	rapid to bottom of connector
3	Seated Height +.0400	Goto 6	Min F/Pin * #Pins	Delay 1.5	0.050	goto check for missing or repress
4	Seated Height +.0100	Next Step	Max F/Pin * #Pins	Error 4	0.050	check within seated height tolerance
5	Seated Height -.0250	Error 5	Force Grad 75°	Complete	0.050	seat connector
6	Seated Height +.0400	Next Step	100.0	Error 2	0.050	Check for min for per pin
7	Seated Height -.0400	Error 3	100.0	Next Step	0.050	check missing or repress
8	Seated Height +.0100	Next Step	Max F/Pin * #Pins	Error 4	0.050	check repress within seated height tolerance
9	Seated Height -.0250	Error 5	Max F/Pin * #Pins	Complete	0.050	check for repress seated
10						
11						
12						

Profile Revision: A
Sample Range for PARS Forces: Start 0.0300 Distance 0.0150 (Connector base above board)
Percent Above Range Sample (PARS) Help

ACTION ERRORS

	Message	Wave File	Require Inspector Signoff
Error 1:	Premature contact detected	[NONE]	
Error 2:	Minimum force per pin failure	[NONE]	
Error 3:	Missing connector	[NONE]	
Error 4:	Excessive force detected	[NONE]	
Error 5:	Insufficent Force	[NONE]	

Require inspector signoff for max force per pin exceeded for PARS and FG

ASG / Tyco Electronics | 12:13 PM | 12/12/02 | MANUAL ELECTRIC PRESS

Figure A-6. Profile Editor of MEP-12T press displaying the Amphenol TCS *VHDM_STD_FG_DWELL.prf* profile, Revision A.

4 – Press Data Editor:
The Press Data Editor screen allows for the creation of a unique PWB assembly (See Figure A_7).

- Description – Unique identifier of assembly (User specified).
- Revision – To be determined by process owner (User specified).
- Board Thickness – Thickness of raw PWB in inches in the location of the VHDM connector. This value may be determined by a board thickness measurement taken automatically prior to press cycle (not covered in this document).
- Fixture Thickness – Thickness of bottom fixture or pallet to ensure that any VHDM connector over hang will not interfere with the MEP-12T press surface (See Figures A-8 and A-9). This thickness includes any tooling between "machine zero" and the bottom surface of the PWB. "Machine zero" is the original press table top, or may be reassigned as the top of a permanent bottom fixture or rolling table.
- Fixture ID – To be determined by the process owner (User specified).
- Press Sequence – Connector pressing order to be determined by process owner.
    - X, Y, and Angle – Locations of the connector being placed on PWB. To be determined by process owner.
    - Connector – Select VHDM connector from pull down menu in "Connector" cell.

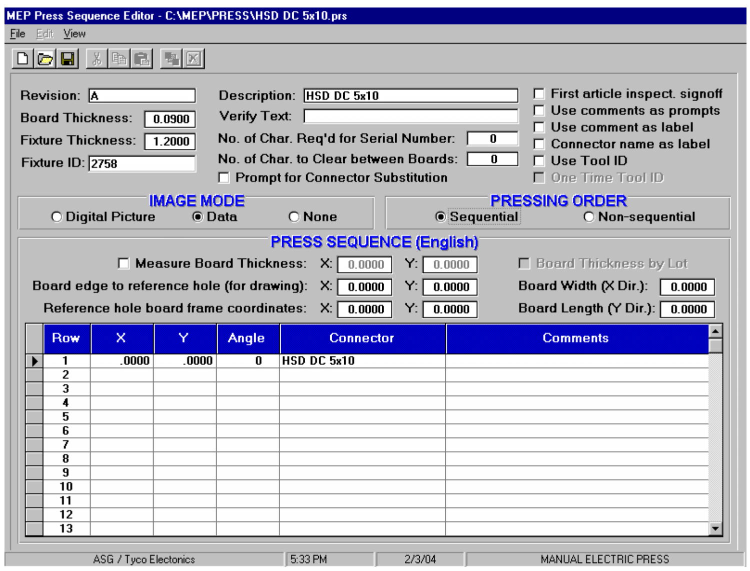


Figure A-7. Press Data Editor of MEP-12T press.

Depending on the PWB thickness and VHDM connector being installed, there is compliant pin tail protrusion and / or a connector overhang that must be accounted for using a fixture or pressing pallet. If there is pin protrusion through the under side of the PWB, then the fixture or assembly pallet will require clearance holes consistent with the VHDM pin pattern. If the PWB is thicker than the complaint pin protrusion of the VHDM connector, then the only requirement is to account for the overhang of the mating face of the VHDM connector being installed. Figure A-8 describes how to design a bottom fixture based on pin protrusion and connector overhang by providing these dimensions for each VHDM connector type. Figure A-9 shows this requirement pictorially.

VHDM Daughter Card PWB + Fixture Thickness Requirements and Compliant Pin Protrusion Lengths		
	PWB + Fixture Thickness Minimum (inches)	Compliant Pin Protrusion (inches)
5-Row HSD, 5-Row eHSD	0.130	0.110
6-Row VHDM, HSD, L-Series	0.125	0.110
6-Row H-Series, 6-Row VHDM eH-series	0.125	0.075
8-Row VHDM, HSD, L-Series, 8-Row eHSD	0.195	0.110
8-Row H-Series, 8-Row VHDM eH-series	0.195	0.075
6-Row RAM	0.180	0.110
8-Row RAM	0.310	0.110
Stacker 18-28 mm	0.125	0.110

Figure A-8. PWB + Fixture dimensions for Press Data Editor setup for MEP-12T press.

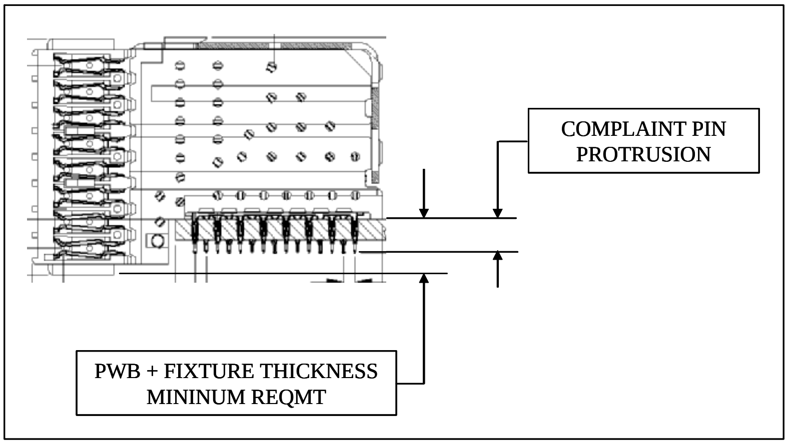


Figure A-9. Detail of PWB + Fixture thickness requirements and compliant pin protrusion of VHDM Daughter Card connectors.

The MEP-12T press produces a Force vs. Distance curve during a pressing sequence similar to the one shown in Figure A-10. The main areas of the curve are: the initial compression of the VHDM compliant pin and compliance of the PWB hole (1), the full collapse of the VHDM compliant pin (2), the sliding of the compliant pin in the PWB hole (3), and the termination force of the pressing sequence at the 75 Degree Force Gradient line (4). The following descriptions of these areas as for reference and are intended as an aid in understanding the pressing characteristics of the VHDM connector utilizing the *VHDM_STD_FG_DWELL.prf* profile.

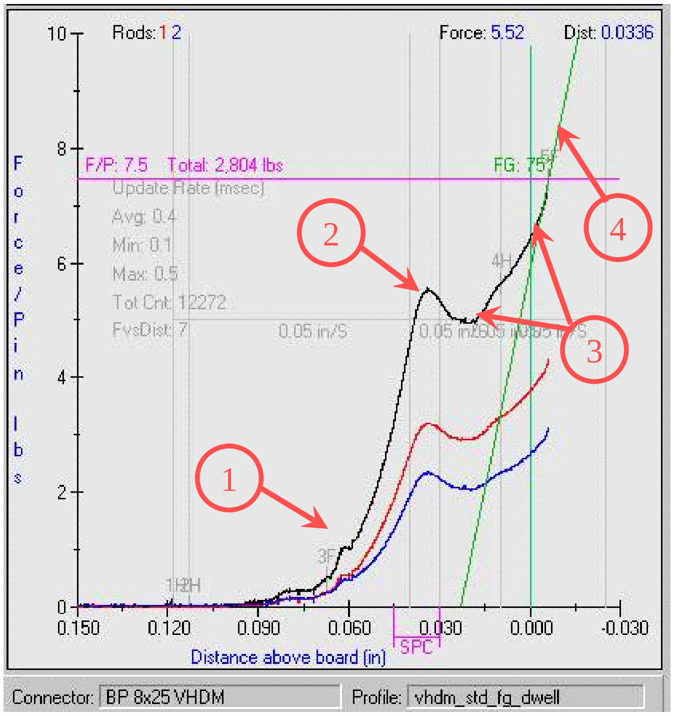


Figure A-10. Typical Force vs. Distance Curve of MEP-12T press for VHDM connectors.

1 – Initial Compression of VHDM compliant Pins:
Part of the initial pressing sequence with the *VHDM_STD_FG_DWELL.prf* profile (Refer to Figure A-6) is to permit settling and alignment of all the compliant pins of the connector prior to a full pressing sequence. In this zone, the VHDM compliant pins and the PWB plated through holes begin to conform to each other and the VHDM complaint pins begin to compress. At this zone the slope of the force gradient line begins to increase as the VHDM compliant pins continue to compress.

2 – Full collapse of the VHDM compliant pin:
At approximately 0.050 to 0.070 inches of insertion into the PWB plated through hole (approximately at the 0.035 inches mark on X axis of the Force Gradient Curve), the VHDM compliant pin is fully collapsed in the PWB plated through hole. This is represented by the peak in the force gradient curve, referred to the knee of the curve. Depending on multiple variables including PWB surface finish, PWB hole diameter, compliant pin feature size, number of power pins vs. signal pins, etc., the knee will be more or less pronounced, but is typically highlighted by an inflection point in the curve as Figure A-11 shows.

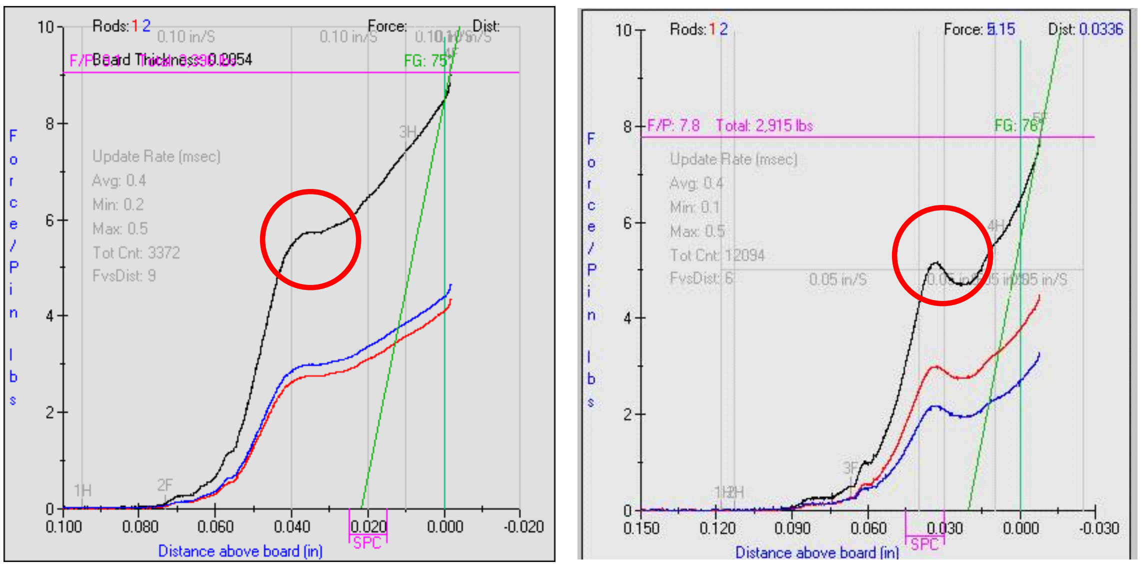


Figure A-11. VHDM pressing Force vs. Distance Graph showing two shapes of the knee area utilizing an MEP-12T press.

3 – Sliding Force of the VHDM compliant pin in the PWB hole:
After the compliant pin of the VHDM connector is fully compressed, the pin travels further into the PWB plated through hole. As this sliding occurs, the force required to continue the installation process of the VHDM connector past this point may decrease between 1 and 10 percent for a short distance before beginning to increase again as the compliant pin travels further into the PWB plated through hole. The specific amount of decrease depends on multiple variables including PWB surface finish, PWB hole diameter, compliant pin feature size, number of power pins vs. signal pins, etc. Figure A-11 shows a typical Force vs. Distance curve where the graph on the left does not show a decrease in force during the pressing process, where the graph on the right shows a slight decrease in the force. Both conditions produce a properly installed VHDM connector.

Figure A-12 shows that between 0.040 inches and 0.010 inches above the PWB surface (spanning zones 2 and 3, refer to Figure 20), the *VHDM_STD_FG_DWELL.prf* profile searches for the "Max Force Per Pin" value entered in the Connector Editor Tool (Refer to Figure 14). If this force is seen by the MEP-12T press in this region, the press will stop and display an error that the Max Force Per Pin has been reached. If the MEP-12T press does not see the "Max Force Per Pin", the *VHDM_STD_FG_DWELL.prf* profile will move to the next phase of the pressing process; the "75 Degree Force Gradient Line".

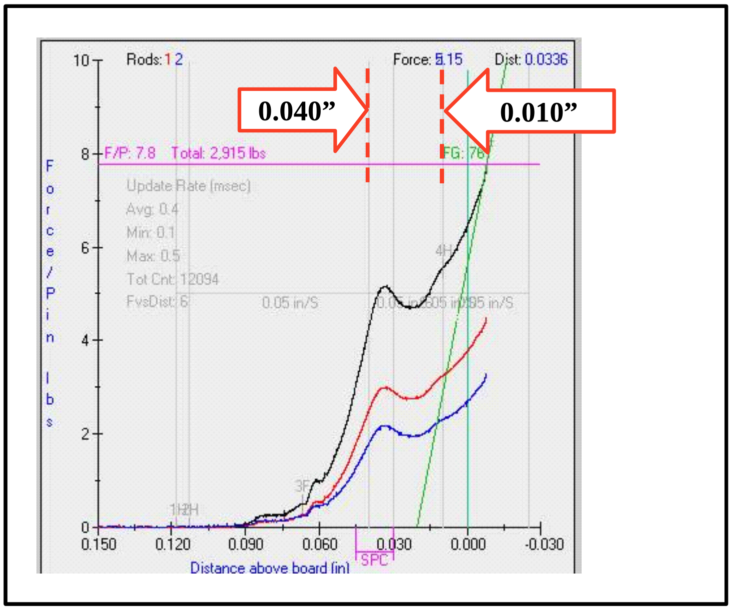


Figure A-12. Force vs. Distance Graph showing the "Max Force Per Pin" zone.

4 – Termination Force at the 75 Degree Force Gradient Line:
Once the VHDM connector standoff features begin to come in contact with the PWB surface, the force vs. distance curve will begin to further increase in slope. During this stage of the pressing sequence, the *VHDM_STD_FG_DWELL.prf* profile is designed to begin to search for the force vs. gradient curve to reach a 75 degree angle at a distance from 0.010 inches above to 0.025 inches below the PWB surface (See Profile Editor and Press Data Editor Sections). Once the connector standoff features come in contact with the PWB surface, the connector is fully seated (flush to 0.25 mm above PWB surface, refer to Figure A-9). Figure A-13 shows the termination phase of the pressing process area on the Force Gradient curve.

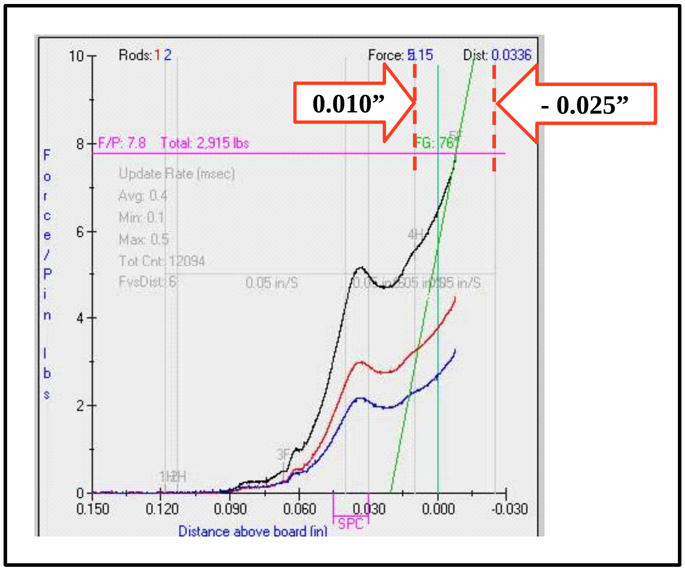


Figure A-13. Force vs. Distance Graph showing the 75 Degree Force Gradient Zone.

The termination force generated by the pressing sequence is a combination of the frictional sliding forces created by the VHDM complaint pins and the PWB plated through hole along with other reactionary forces such as complaint pin alignment during the pressing process, connector standoff interference with the PWB surface, PWB and fixture warping, etc. It is important to understand that the termination force of a connector is not equivalent to the force experienced strictly by the connector complaint pin or PWB plated through holes. As a result of the components and process variables associated with the installation of VHDM onto PWBs, termination forces of VHDM connectors can be expected to be as high or higher than the knee of the curve described within zone 2 (Refer to Figure A-11).