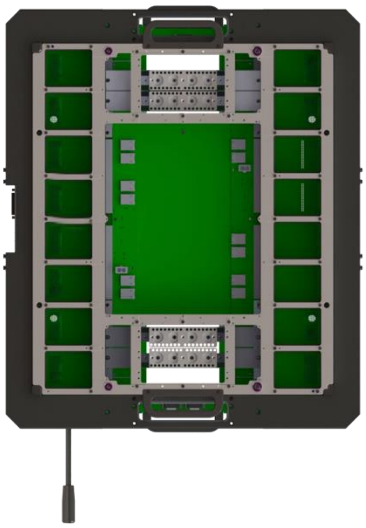
USER MANUAL

AT93000 System User Manual

System Overview

User Manual Revision 0.9.2, March 2021



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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the General Safety Summary in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Only use the power cord specified for this product and certified for the country of use.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal that exceeds the maximum rating of that terminal.

Do Not Operate Without Covers.

Do not operate this product with covers or panels removed.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate with Suspected Failures.

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions. Do Not Operate in an Explosive Atmosphere. Keep Product Surfaces Clean and Dry

⚠ *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Contents

Contents ... 3
Table of Figures ... 4
Overview of the Advantest V93000 High Speed I/O (HSIO) Test System ... 5
Cassette and Backplane Location References ... 8
Master/Slave Clock Sync Configuration on AT93000 backplanes ... 11
Family Board ... 13
Air Intake ... 14
Air Cooling Management ... 14
12V Power Supply ... 16
Docking the AT93000 twinning frame to the V93K testhead ... 17
Docking the DUT loadboard to the AT93000 twinning frame ... 17
Ethernet Connections and IP Addressing ... 19
Software installation when controlling AT93000 via V93K Smartest ... 19
Software installation when controlling AT93000 via PC ... 19
Customer documentation required for proper factory cassette installation ... 20
Appendix 1: Example Customer Documentation ... 21
Appendix 2: Description of Customer Documentation ... 22
Appendix 3: Loadboard reference designators ... 24

Table of Figures

Figure 1: V93k CTH testhead with Multilane AT93000 system attached on top 5
Figure 2: Building blocks of the Multilane AT93000 system 5
Figure 3: ML AT93000 system with red arrows pointing to the 4 Multilane cassettes.............5
Figure 4: Instrument Cassette with protective cover removed...6
Figure 5: AT93000 Cage Area...6
Figure 6: Signal path of the ATE system 8
Figure 7: (Top View) AT93000 Backplane and Cassette numbering...8
Figure 8: Cassette Orientation 1: AT4039D + AT4025 9
Figure 9: Same AT4039D + AT4025 cassette rotated 180 degrees 9
Figure 10: AT4079B 8-channel BERT – 1 per cassette 9
Figure 11: AT4079B 8-channel BERT – rotated...9
Figure 12: Pinouts for different cassette rotations plugged into backplane 1 or 2 10
Figure 13: SMP to K Cable..11
Figure 14: SMP to SMP Cable..11
Figure 15: AT93000 Backplane - Clock routing jumpers..12
Figure 16: AT93000 Backplane - Connectors Numbers 12
Figure 17: AT93000 Backplane - Clock Jumper Configuration...12
Figure 18: Pogo Block, ordered through Advantest. Part number E8028PSD.........................13
Figure 19: (Top View) AT93000 with Pogo Block Reference Designators 13
Figure 20: AT93000 Cooler Tube Input...14
Figure 21: AT93000 Air Cooling Specifications 14
Figure 22: Schematic view of cooling air path...15
Figure 23: Twinning Prototype Air Management 15
Figure 24: Push in connector 16
Figure 25: AT93000 Power Supply..16
Figure 26: AT93000 twinning lift described in the Advantest documentation 17
Figure 27: Manual docking of DUT loadboard to AT93000 twinning frame 18
Figure 28: V93K Remote Control Unit for docking – refer to Advantest documentation........18
Figure 29: Ethernet Connectors Associations with each Backplane.......................................19
Figure 30: AT93000-POGO being installed onto loadboard 24
Figure 31: AT93000-POGO..24
Figure 32: AT93000-POGO with guide pins 25
Figure 33: POGO attached to stiffener 25

Overview of the Advantest V93000 High Speed I/O (HSIO) Test System

Figure 1: V93k CTH testhead with Multilane AT93000 system attached on top

In Figure 1, the AT93000 twinning system is hard docked on top of a V93000 (V93K) test head. The AT93000 is compatible with CTH and STH Advantest V93K testheads. The user's DUT loadboard is hard docketed on top of the AT93000 system and the device handler is hard docked to the DUT loadboard. For wafer probe, the AT93000 system would be upside down from this picture and would be hard docked to the wafer prober. Figure 1 shows the Base twinning frame, one Pogo Segment, and the Family Board. An exploded view of these individual pieces is shown in Figure 2, including four Multilane instrument cassettes.

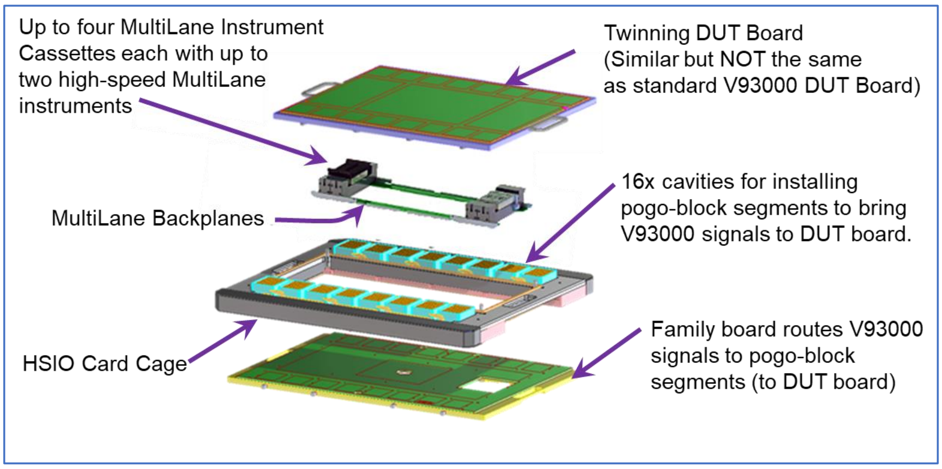


Figure 2: Building blocks of the Multilane AT93000 system

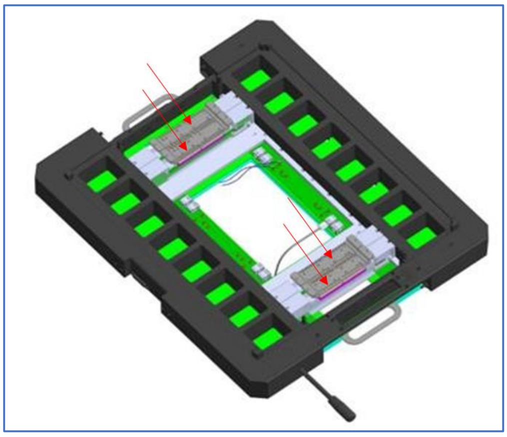


Figure 3: ML AT93000 system with red arrows pointing to the 4 Multilane cassettes

Each Multilane cassette contains either one or two Multilane high-speed instruments. Refer to an instrument's User Manual for the blindmate connector pinout of that instrument in the cassette. Figure 4 shows one side of the cassette with protective cover removed. This exposed PCB is a 4-channel Multilane instrument. The other side of the cassette can have a second 4-channel Multilane instrument for a total of 8 channels per cassette. Figure 4 shows the lower right backplane connector. User Manual pinouts are referenced to the connector. The connector for the instrument on the opposite side of the cassette would be located on the backside, lower left corner. For example, a cassette might contain a 4-channel AT4039D BERT on side 1 of the cassette and a 4-channel AT4025 DSO on side 2 of the cassette. In the case of 8-channel instruments, like the 8-channel AT4079B BERT, there will only be one 8-ch instrument in the cassette with one connector

Figure 4: Instrument Cassette with protective cover removed

Figure 5 shows the AT93000 cage area. When the device loadboard is docked, these components are covered by the loadboard.

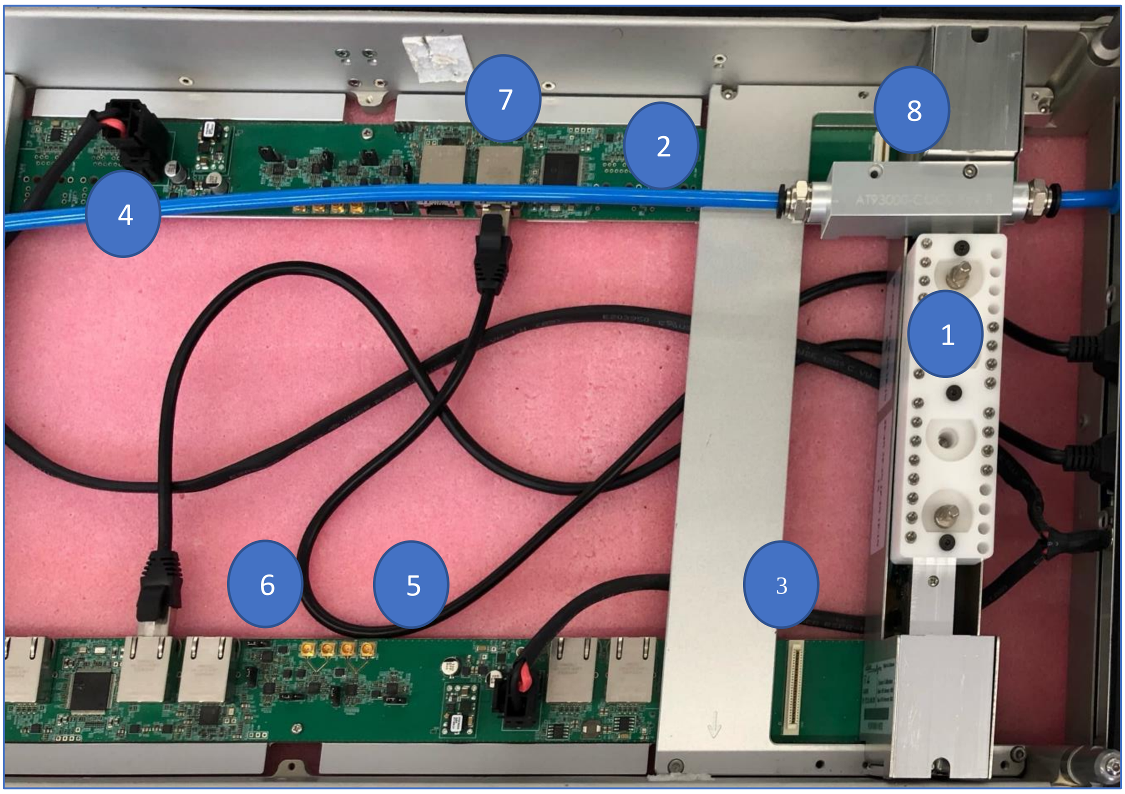


Figure 5: AT93000 Cage Area

	Item	Description of Items in Figure 5
1	Cassette	See "Figure 4: Instrument Cassette with protective cover removed" See "Cassette and Backplane Location References" on page 8
2	Backplane	Two backplanes – one at top and one at bottom of Figure 5. Provides power, communication, and clock sync to the cassettes See "Cassette and Backplane Location References" on page 8
3	Backplane connectors	Instrument PCB's inside cassettes plug into these connectors
4	Power connector	12V, 13A power supply External 12V power supply module is supplied by Multilane. See "12V Power Supply" on page 16
5	Clock out	Clock cabling between backplanes See "Master/Slave Clock Sync Configuration on AT93000 backplanes", page 11
6	Clock In	Clock cabling between backplanes See "Master/Slave Clock Sync Configuration on AT93000 backplanes", page 11
7	Ethernet	See "Ethernet Connections and IP Addressing" on page 19
8	Air Intake	(not shown in picture). Air intake used to cool the cassettes. See "Air Intake" on page 14

Table 1 : AT93000 System Parts

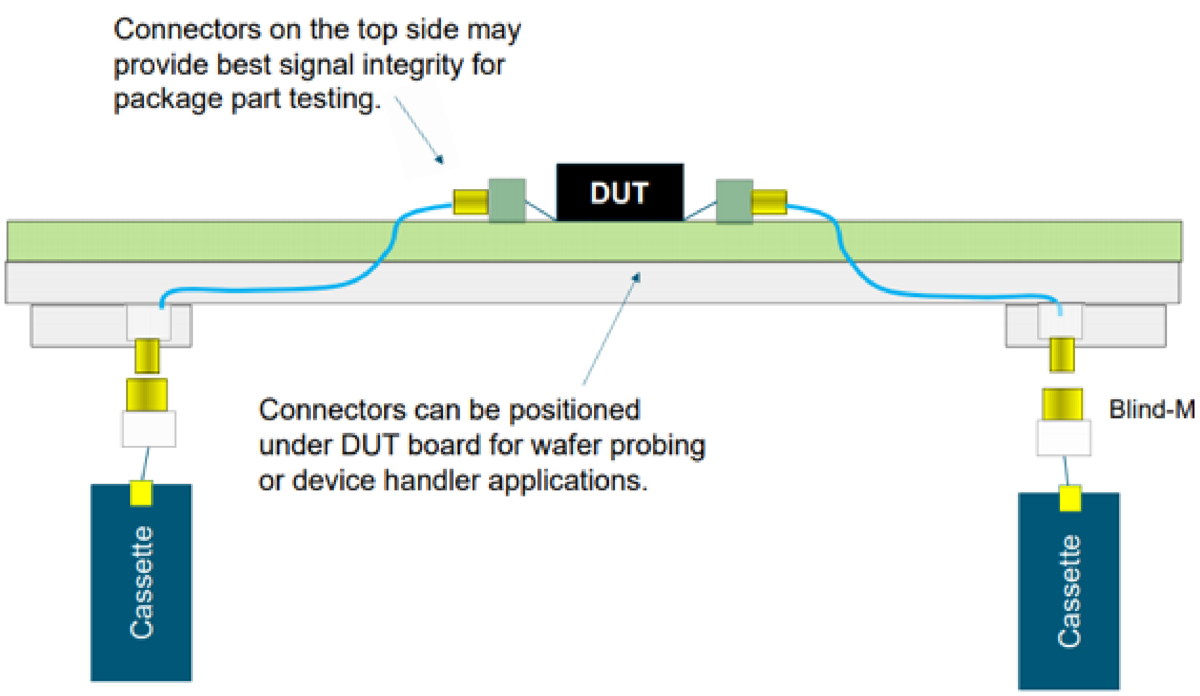


Figure 6: Signal path of the ATE system

The main advantage of the ATE system as compared to using benchtop instruments, is that the signal path between DUT and Cassette instruments is considerably shorter thus reducing insertion and return losses. The AT93000 channel density maximum is up to 32 channels if all 4 cassettes are fully populated. In Figure 6, the blindmate connections (Blind-M) are where the device loadboard will mate to the Multilane instrument cassettes after the loadboard has been docked to the AT93000 twinning frame. See "Docking the DUT loadboard to the AT93000 twinning frame" on page 17 for more about docking.

Cassette and Backplane Location References

For consistency across all AT93000 configurations, the backplane and cassette reference numbers are arbitrarily chosen to be defined as shown in Figure 7. The "arrow up" engravings on the twinning frame are used as the datum points. Note that instrument cassettes can be rotated 180 degrees, so that instruments can be plugged into either backplane 1 or 2. BERTs can generate a sync clock used to synchronize other BERTs and DSO scopes. The backplane that a BERT is plugged into becomes important when determining the Master Clock synchronization scheme. See "Master/Slave Clock Sync Configuration on AT93000 backplanes" on page 11.

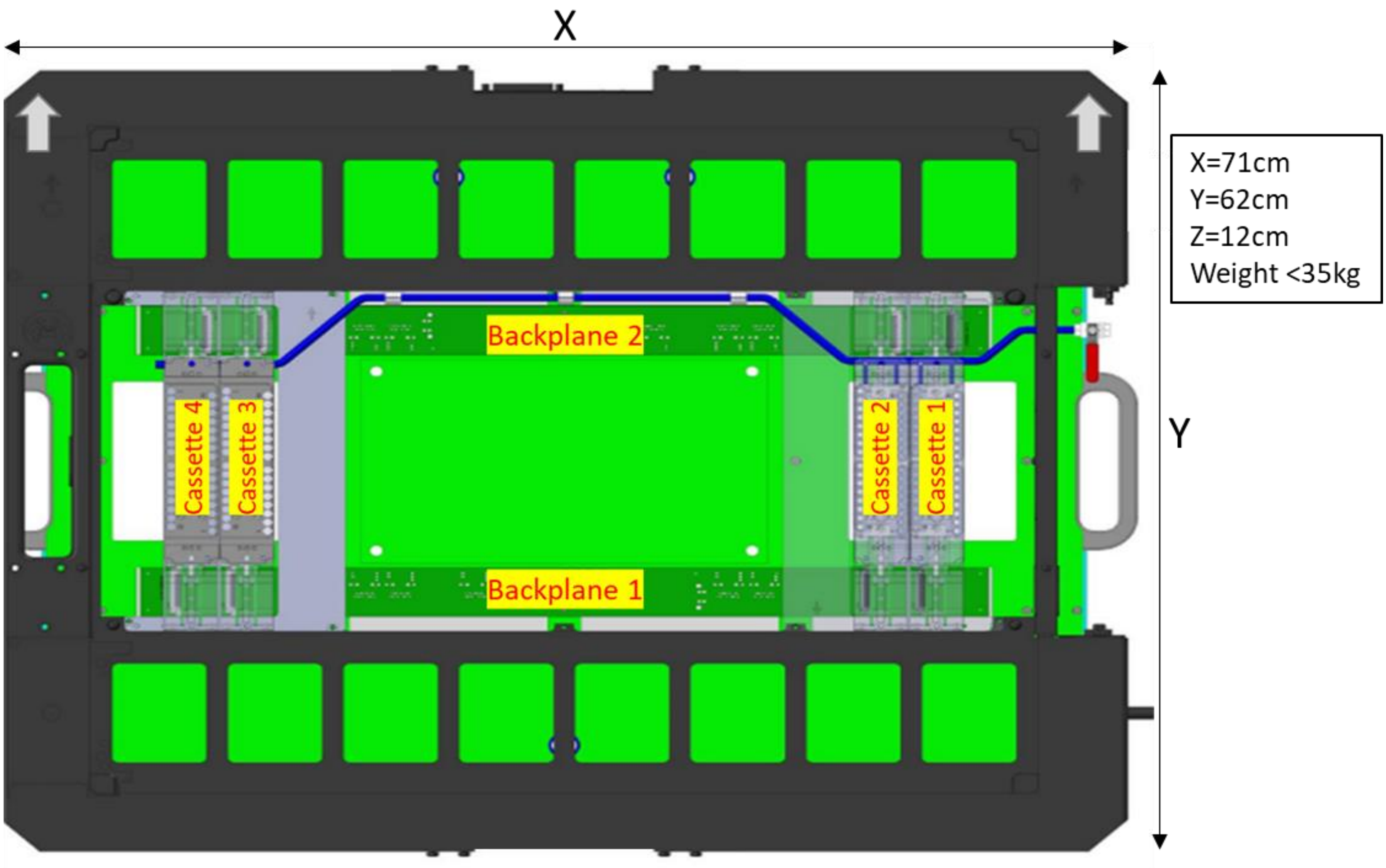


Figure 7: (Top View) AT93000 Backplane and Cassette numbering

Each cassette's blind mate connector contains up to 8 differential pin pairs on each side. (See each instrument's User Manual for official pinouts). Each cassette can plug into the backplanes in one of two different orientations. For example, if Figure 8 represents the AT4039D connector plugged into backplane #2, then the same cassette can be plugged in like Figure 9 where the AT4039D is plugged into backplane #1. User documentation must be provided to explain to the cassette installer which direction to plug in the cassette. In a similar fashion, Figure 10 shows an 8-channel BERT with AT4079B connector plugged into backplane 2. If rotated, it would be plugged into backplane 1 and the Rx signals would be on top and Tx on bottom, as shown in Figure 11.

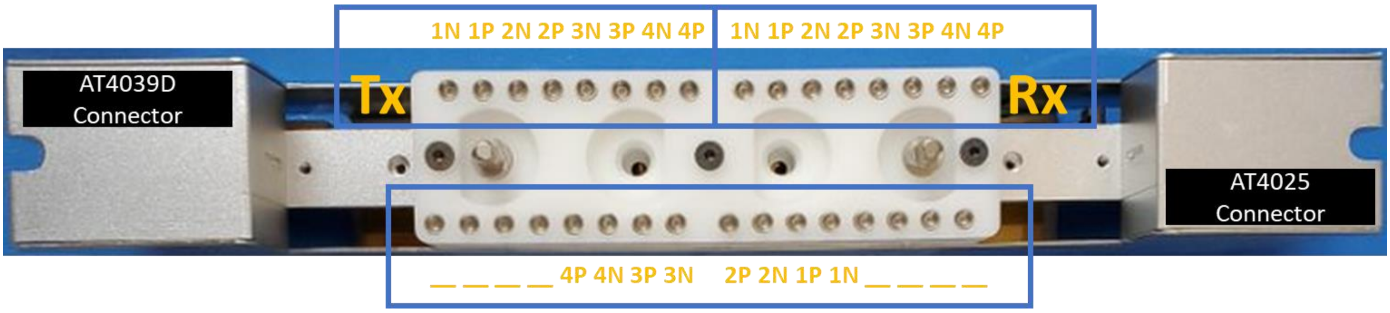


Figure 8: Cassette Orientation 1: AT4039D + AT4025

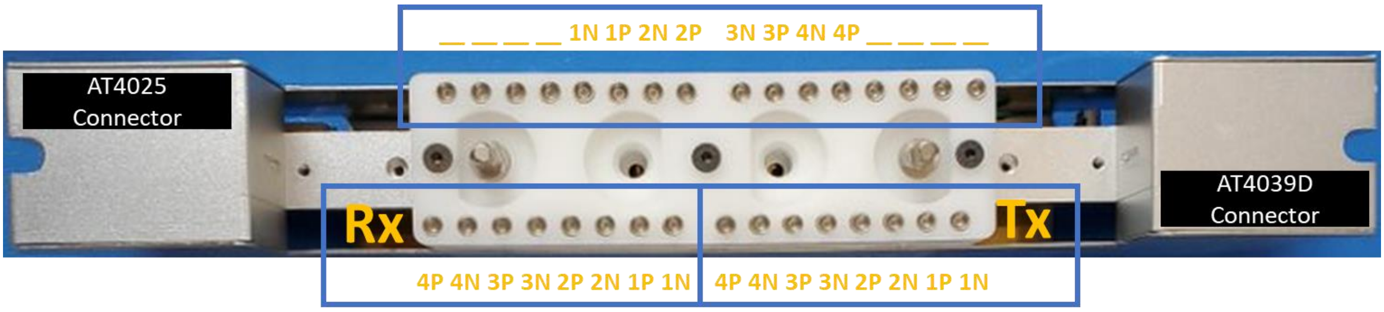


Figure 9: Same AT4039D + AT4025 cassette rotated 180 degrees

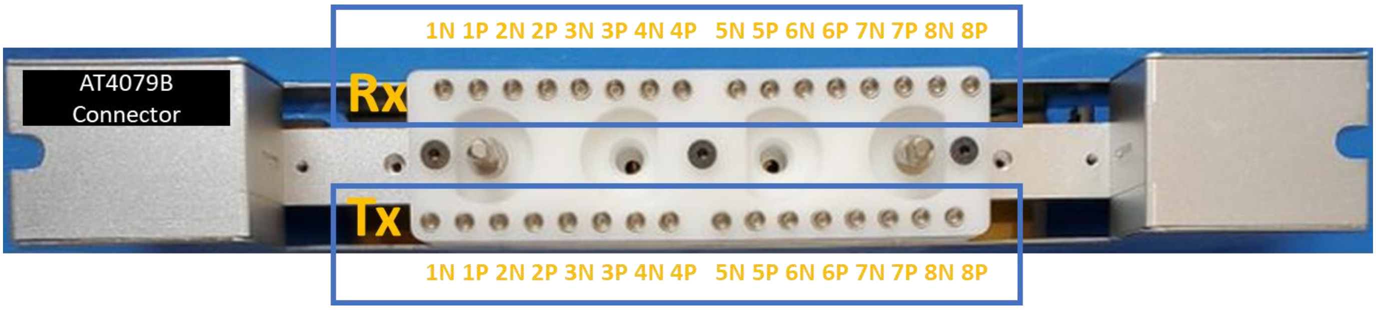


Figure 10: AT4079B 8-channel BERT – 1 per cassette

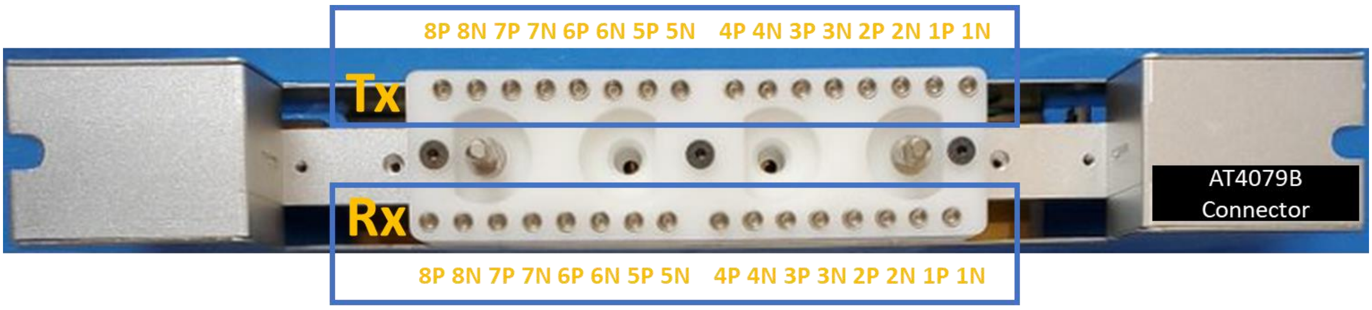


Figure 11: AT4079B 8-channel BERT – rotated

Figure 12 below shows the three cassette examples plugged into backplanes 1 and 2.

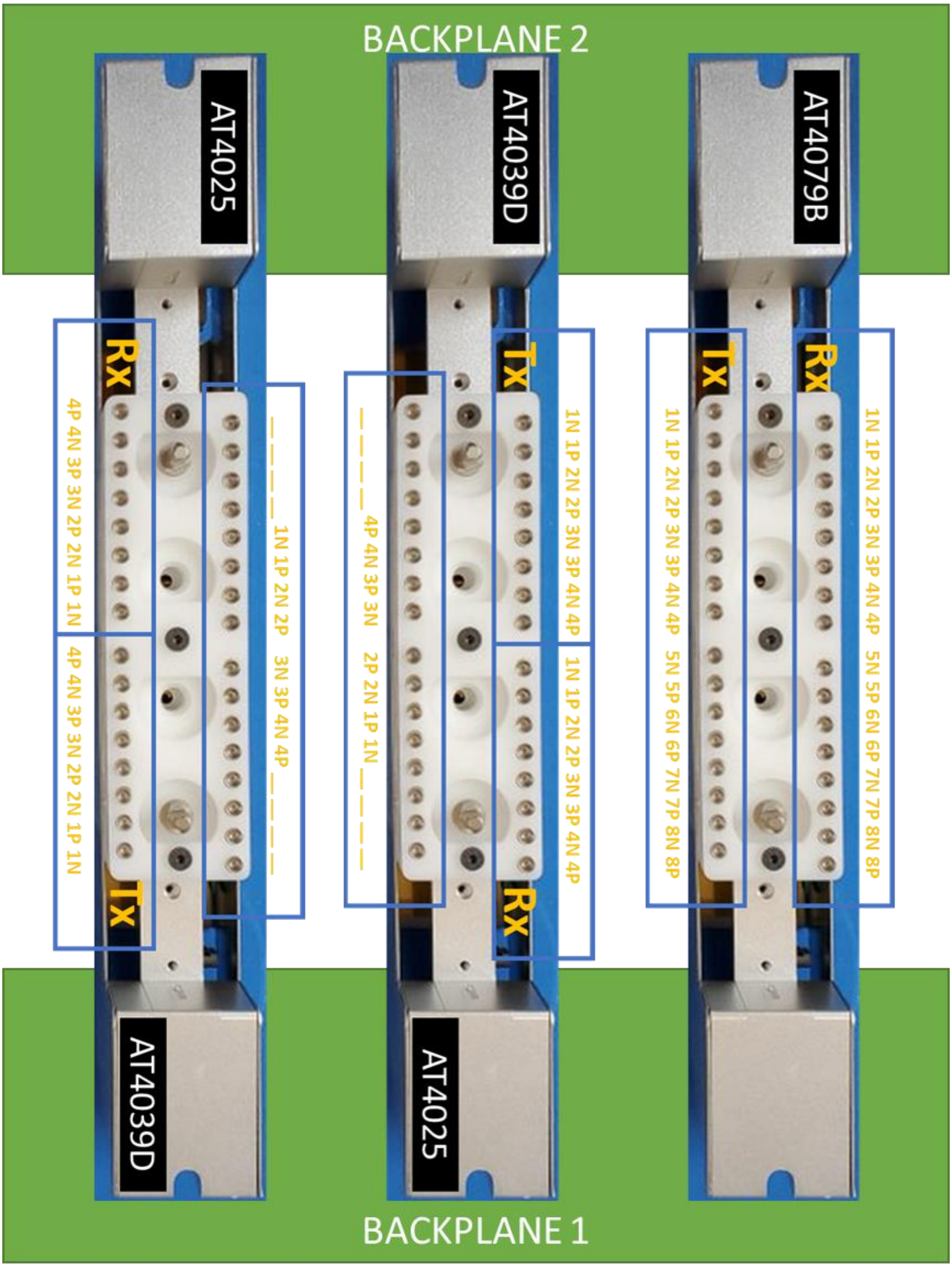


Figure 12: Pinouts for different cassette rotations plugged into backplane 1 or 2

Master/Slave Clock Sync Configuration on AT93000 backplanes

A master clock can either be generated by one of the installed BERT instruments, or by an external clock reference supplied by either the DUT or V93K pin resource. There can only be one clock master for synchronizing all BERTs and DSOs. All other instruments are clock slaves and will synchronize their operation to the master clock. The Master/Slave clock configuration is controlled through jumper settings on backplane 1 and backplane 2 and is explained later in this section.

If the clock is coming from the DUT or V93K, then all cassette instruments will be slaved to the external master clock. In this case, the external differential clock should be cabled to the "clock-in" SMP connectors on the backplane having the slaved instruments, using two high-speed cables. In the case of a single ended clock master clock coming from the DUT or V93K, a 50-ohm termination is needed for the 2nd differential clock input on the backplane clock connector by using an SMP to K cable, as the one shown in Figure 13. (Backplane side is SMP). Check Multilane instrument datasheets for maximum clock sync frequency.

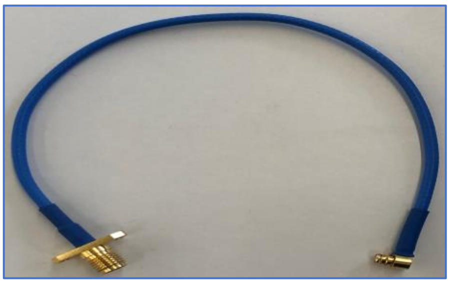


Figure 13: SMP to K Cable

If all Multilane instruments are plugged into the same backplane, then there is no need to connect a sync cable from backplane #1 to backplane #2. If there are Multilane instruments plugged into both backplanes, then one SMP-to-SMP cable is needed to connect the differential clock-out (+) of the master backplane to the clock-in (+) of the slave backplane, as shown in Figure 15 and Figure 16.

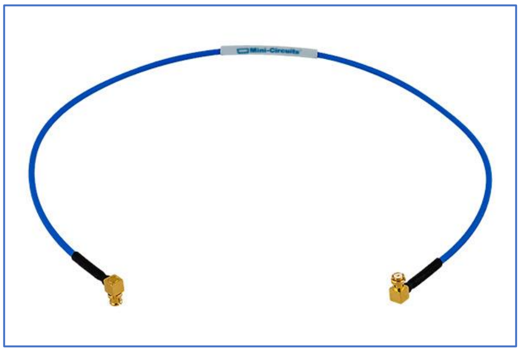


Figure 14: SMP to SMP Cable

There are 5 jumpers on each backplane that control the master/slave modes by setting the jumper headers to either '0' or '1', as shown in Figure 17. In this picture, U7 is set to '0'while U13 is set to '1'. CON1-CON4 are cabled depending on which backplane is driving the Master Clock, as shown in Figure 16. The (-) ports do not have to be connected because the BERT Master Clock is only 156.25MHz.

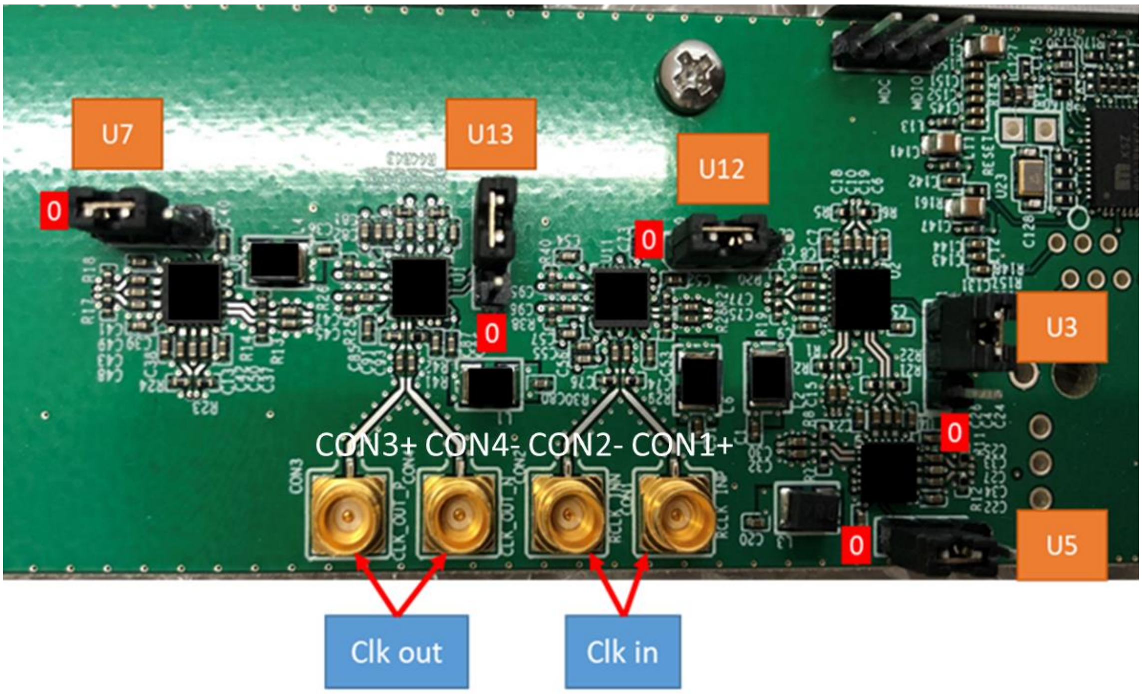


Figure 15: AT93000 Backplane - Clock routing jumpers

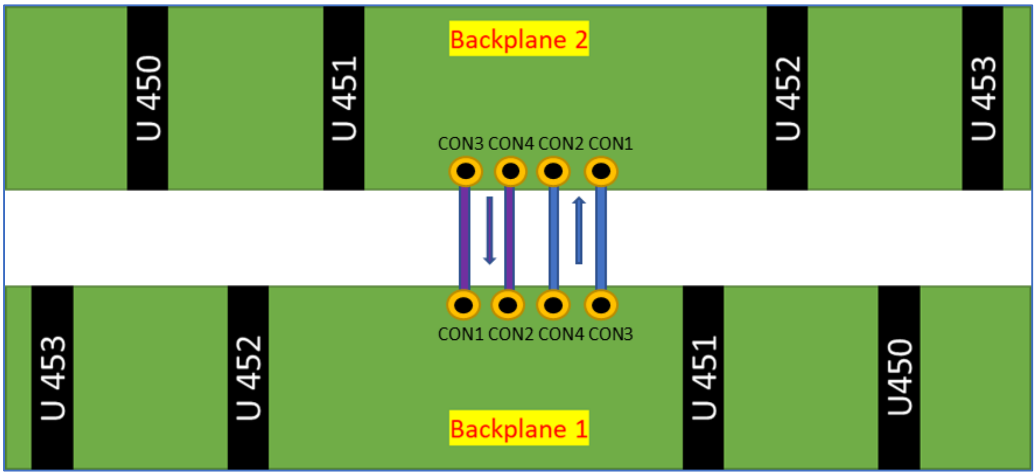


Figure 16: AT93000 Backplane - Connectors Numbers

	U450 is MASTER	U451 is MASTER	U452 is MASTER	U453 is MASTER	All U45x SLAVE
U3	0	0	1	1	0
U5	1	1	0	1	1
U7	1	1	0	0	0
U12	1	1	1	1	0
U13	0	1	0	0	0

Figure 17: AT93000 Backplane - Clock Jumper Configuration

Family Board

The Family board's function is to bring the Advantest V93K testhead resources through the pogo blocks up to the DUT loadboard. Figure 2 on page 5 shows the orientation of the Family Board at the bottom of the twinning frame. The 16 cavities around the perimeter of the AT93000 system are shown in Figure 1 on page 5. In this picture, there is also one pogo block installed in the middle cavity of the top eight cavities. A pogo block is shown below in Figure 18. Advantest documentation refers to the pogo block locations as shown in Figure 19.

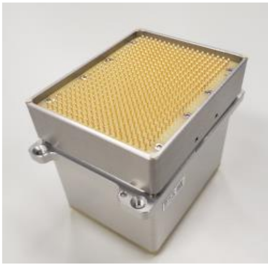


Figure 18: Pogo Block, ordered through Advantest. Part number E8028PSD

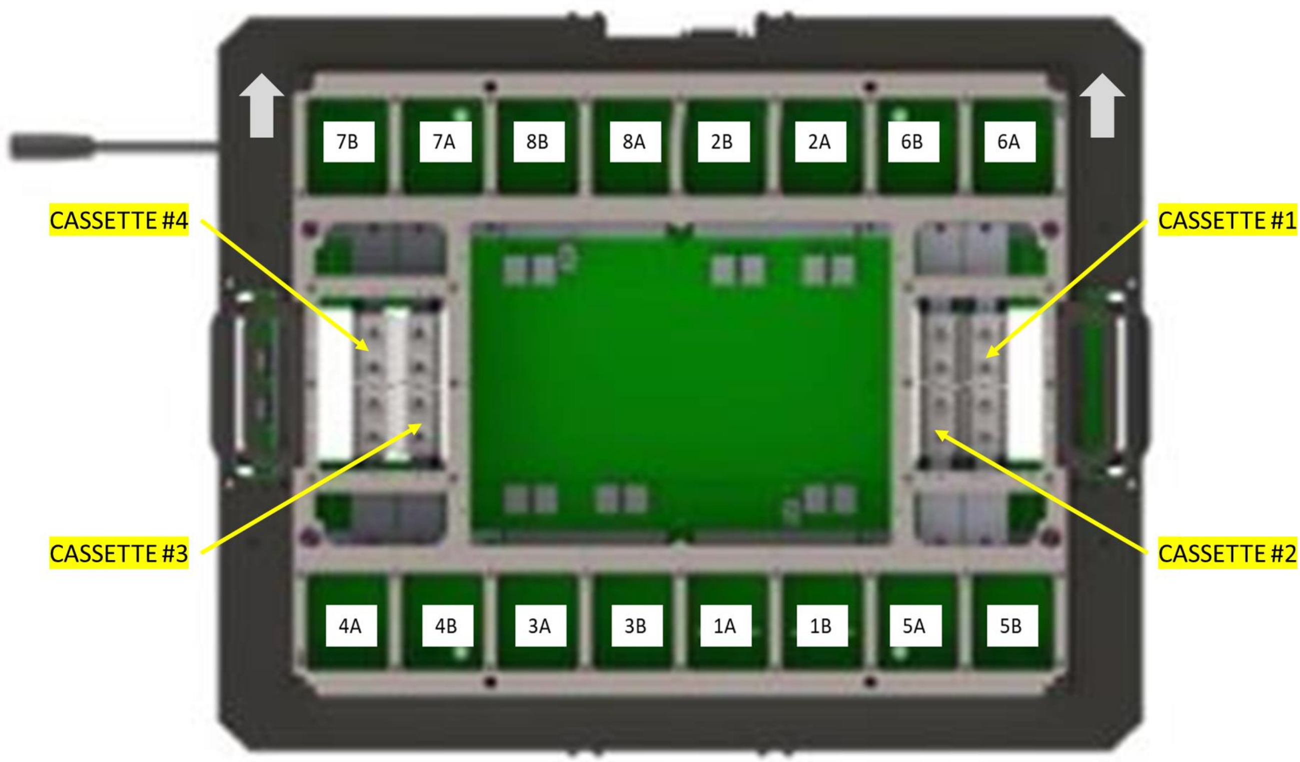


Figure 19: (Top View) AT93000 with Pogo Block Reference Designators

The Multilane family board, AT93000-1900002, is a general-purpose solution and is optimized for high-speed devices with relatively low digital pin counts. If this Family board does not suit your application and you require a different selection of V93K tester resources, you can design your own custom family board.

V93K mapped resources through the AT93000-1900002 are as follows:

- 11x PS1600 (1408 pins)
- 3x PS9G (192 pins)
- 4x DPS64 (256 supplies)
- 2x DPS128 (256 supplies)
- 2x UHC4 (8 supplies @ 40A)
- 1x MBAV8

Further details can be found in the Advantest HSIO Cookbook, available from Multilane or Advantest.

Air Intake

The AT93000 cassette instruments are cooled using compressed air. Each system's faceplate includes a "through wall push to connect" connector, while each 2 cassettes are accompanied with a cooling manifold.

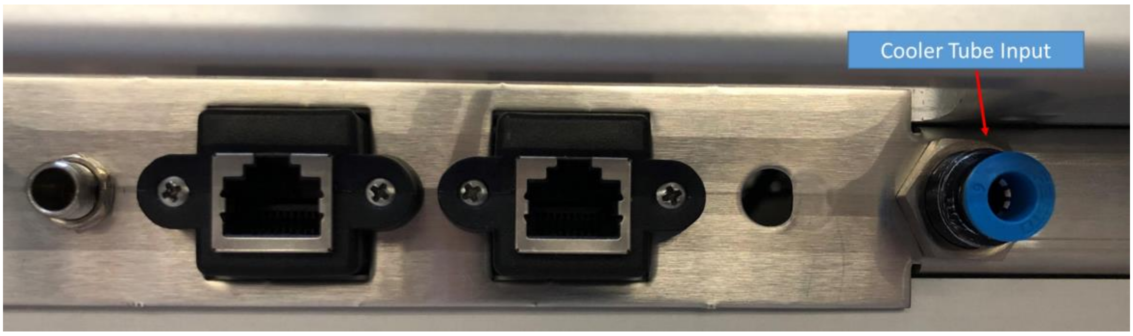


Figure 20: AT93000 Cooler Tube Input

The air input connection is a ¼"/6mm OD for push in connectors.

Parameter	Min Spec	Max Spec
Air flow (through 1/4"/6mm OD nylon tubing)	1 CFM	20 CFM
Air Temperature	+10° C	+30° C

Figure 21: AT93000 Air Cooling Specifications

Air Cooling Management

The 93K/Multilane HSIO option requires compressed air cooling for the Multilane twinning instruments. To minimize compressed air CFM requirements and ambient sound levels near the test system we have developed an optional prototype air management setup.

This air-cooling management setup example can control power, air on/off using an IP Power device. This allows power outlet control over TCP/IP for remote power and air control. Other air connection schemes can be utilized depending on requirements and the users own environment.

The Dwyer airflow control allows CFM user adjustment for cooling based on the instruments measured temperature and ambient noise.

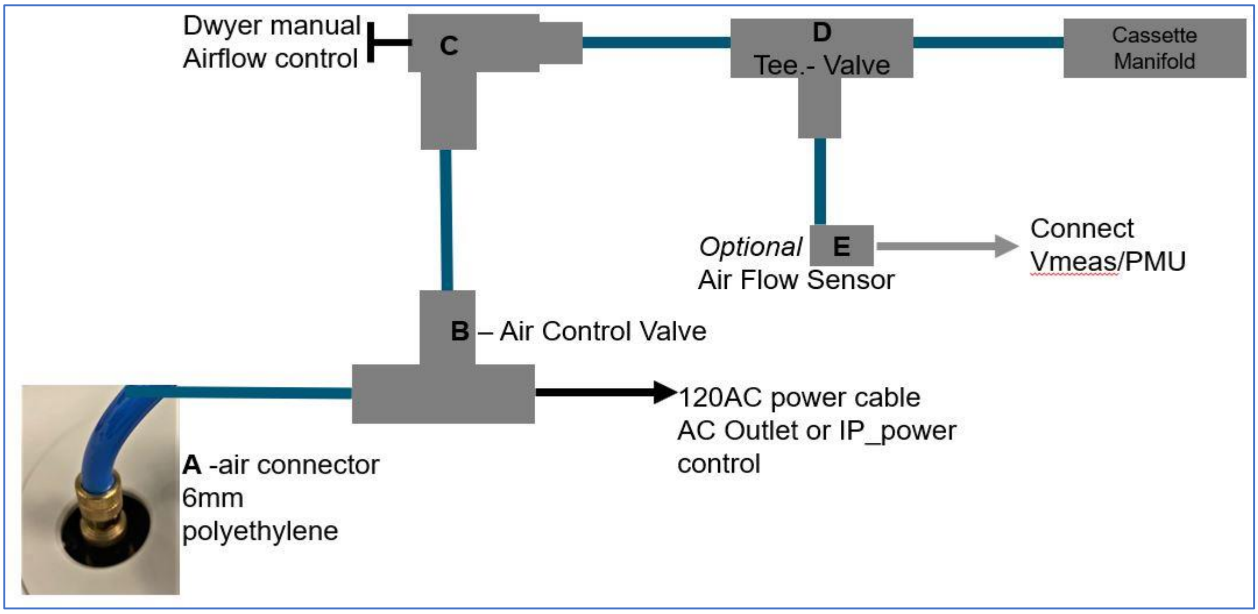


Figure 22: Schematic view of cooling air path

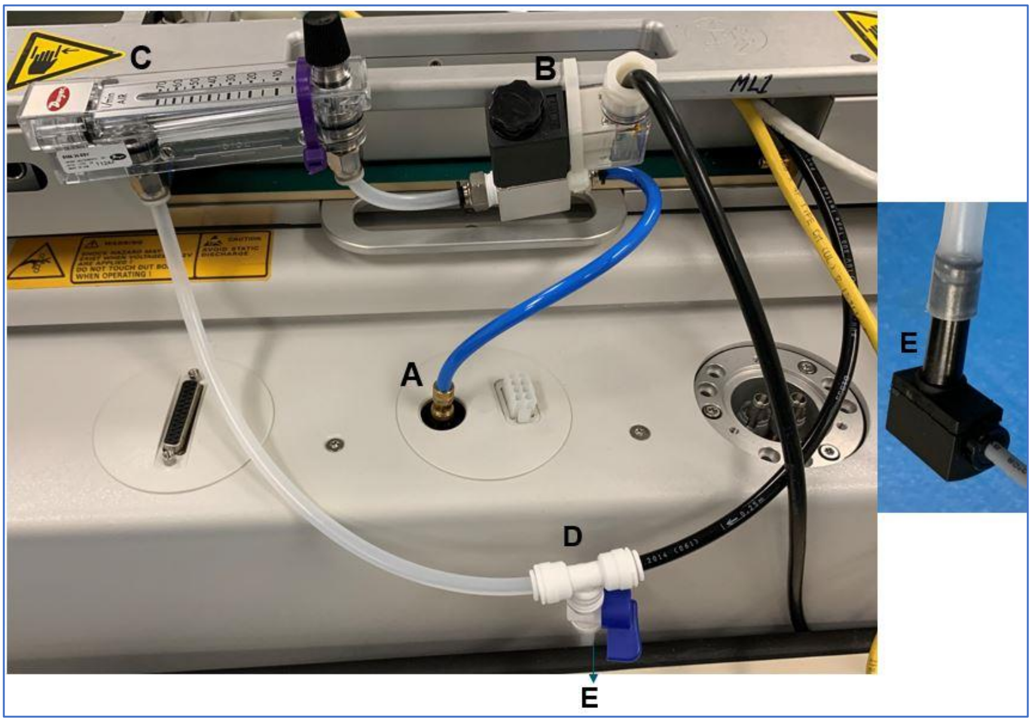


Figure 23: Twinning Prototype Air Management

Bill of Materials (BOM) (refer to Figure 23)

1) A – **QTY1**, twinning quick disconnect to 6mm blue polyethylene airline (included)
2) **QTY 5-10ft**, Polyethylene tubing .170” ID - 1/4” or 6mm OD – 140psi max working pressure ((Available at hardware stores).
3) B – **QTY1**, Tailonz Pneumatic 1/4 Inch NPT 12V/24V/110V/220V 2 Way Normally Closed Electric Solenoid Air Valve (**We used 110V version**)
4) C – **QTY1**, **Dwyer Instruments** Flowmeter / **RMA-24-BV** , 5-70 LPM air, 2in scale, 4% Acc, brass valve, 1/8in NPTF
    a. **ADD – QTY-4,** Festo Push-in Connector, 1 Port NPT 1/8-27 Thread & 1 Port 1/4" OD tube - **QB-1/8-1/4-U-M**
5) D – **QTY1**, ¼” OD Poly Tee Valve (Optional: If using air pressure sensor)
6) E – **QTY1**, Festo **SPTE-P10R-S6-B-2.5K** Pressure Sensor
    a. Requires 12V DC power supply (wall model); See Advantest Festo app note

All air connections are ¼”/6mm OD for push in connectors. Referring to Figure 24, remove an airline by pushing in on the outside ring (black) while pulling tube out of connector

Figure 24: Push in connector

12V Power Supply

Figure 25 shows the AT93000 12V, 13A external power supply. The power supply module is supplied by Multilane along with the AT93000 system and supports 110/220V and 50/60 Hz. It plugs into the AT93000 faceplate and supplies power to the Multilane instruments.

Figure 25: AT93000 Power Supply

Docking the AT93000 twinning frame to the V93K testhead

The AT93000 docks to the CTH/STH testhead using the same method as docking a device loadboard to the testhead. Follow the Advantest documentation for docking a DUT loadboard. The AT93000 weighs approximately 35Kg, so some type of mechanical lift assist may be required. Advantest has documentation showing a mechanical lifting method that they have implemented.

For additional information on using a mechanical lift to assist with docking the AT93000 twinning frame, refer to Advantest Service Documentation, Topic 342435, “Lifting the Twinning equipment”.

Figure 26: AT93000 twinning lift described in the Advantest documentation

Docking the DUT loadboard to the AT93000 twinning frame

After the AT93000 twinning frame is docked to the testhead, position the DUT loadboard over the blindmate connectors. Then either use the Advantest remote control docking mechanism to dock the loadboard or the handle located on the side of the twinning frame to manually dock the DUT loadboard, as shown in Figure 27.

Figure 27: Manual docking of DUT loadboard to AT93000 twinning frame

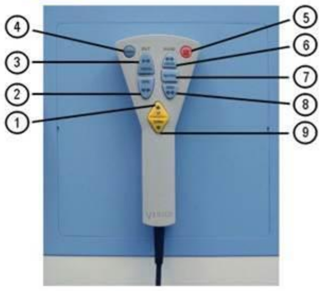
The remote control unit

Subtopics
Docking the test head
Un-docking the test head
Moving the test head (STH and LTH only)

The remote control unit has the following functions:

- It controls the up/down movement of the test head (Large and Small Test Head systems only)
- It operates the hard-docking and DUT-docking mechanisms.

The remote control unit is held by a magnet to the side of the test head, as shown in the figure below.



Legend

1	UP	5	OVERRIDE
2	DUT DOCK	6	HARD UNDOCK
3	DUT UNDOCK	7	HARD NEUTRAL
4	ENABLE	8	HARD DOCK
		9	DOWN

Figure 28: V93K Remote Control Unit for docking – refer to Advantest documentation

Ethernet Connections and IP Addressing

Figure 29 shows two ethernet connection ports located on the faceplate of the AT93000 twinning frame; one for backplane #1 and one for #2. There are only 2 physical RJ45/LAN connections from the AT93000 to the Test Station. If users only have one NICS card or 1 RJ45 port on the Test station, then these 2x RH45 shown here on the faceplate can be connected to the same Ethernet Switch that the Test Station LAN cable is connected too.

Each Multilane instrument comes preloaded with a unique IP address assigned to it. DHCP addressing is not used but, if necessary, each instrument's IP address can be manually changed by consulting the instrument's User Manual on how to input the Ethernet IP address via the instrument's GUI configuration panel.

Figure 29: Ethernet Connectors Associations with each Backplane

Software installation when controlling AT93000 via V93K Smartest

V93K software requirements are as follows:

- Smartest 7.2 and up
- RHEL5U11, RHEL7U4
- 1 Ethernet card to establish connection with the device (2 Multilane ethernet ports)
    - Multilane instruments have IP addresses that have to be manually changed
    - DHCP not supported

Consult the API installation documentation for each Multilane ATE instrument in its respective User Manual.

Software installation when controlling AT93000 via PC

PC minimum hardware requirements are as follows:

- Windows XP SP3 or greater
- Minimum 2 GB RAM
- 1 Ethernet card to establish connection with the device (2 Multilane ethernet ports)
- Pentium 4 processor 2.0 GHz or greater
- .NET Framework 4.0

PC software installation follows. To use an ML instrument under Windows XP, Windows 7 and Vista, it is important that the correct start-up sequence is followed:

- Ensure Microsoft .NET Framework 4.0 is installed
- Install the instrument GUI software from MultiLane's Website
- Connect the power cable to the faceplate
- Change the IP of the instrument to fit in the network range
    - Multilane instruments come with preassigned IP addresses
    - The IP address can be manually changed via their GUI
    - DHCP is not supported
- Communication through Ethernet port is required for data acquisition
- Connect the ethernet cable to the faceplate. Depending on instrument installation, 2 ethernet connections may be required
- Now the instrument is powered up, having the right IP, the Ethernet cable links the instrument to the PC with the GUI correctly installed
- To open the GUI, double click on the software icon located in the Desktop directory

Customer documentation required for proper factory cassette installation

There is a lot of flexibility in how Multilane instrument cassettes can plug into the AT93000 backplanes. Therefore, Multilane requires the following customer documentation to properly configure future copies of the same AT93000 system. We suggest that this documentation be part of the DUT loadboard assembly documentation, since the DUT loadboard assumes a certain Multilane instrument configuration and cassette orientation and pinouts at the blindmate connectors.

For each Cassette from 1 to 4:

- **List cassette instrument type(s). Up to 2 instruments per cassette**
- **List which instrument plugs into backplane 1 and which plugs into backplane 2**
- **Refer to "Cassette and Backplane Location References" on page 8**

For each Backplane from 1 to 2:

- **List jumper configuration (0 or 1) for U3, U5, U7, U12, U13**
- **List cabling instructions for CON1, CON2, CON3, CON4**
- **Refer to "Master/Slave Clock Sync Configuration on AT93000 backplanes" on page 11**

Appendix 1: Example Customer Documentation

In this example, one AT4079B BERT and two AT4025's are used. An AT4079B takes up an entire cassette. Each AT4025 uses ½ of a cassette; however, in this example, we will assume that each AT4025 is in its own cassette. An AT4039E pair resides in Cassette #2; however, it is not used in this application. Further description of "Cassettes" "Cables" and "Jumpers" can be found in "Appendix 2: Description of Customer Documentation" on page 22.

Notes:

- B1 = Backplane #1 | B2 = Backplane #2
- "Not installed" means cassette exists, but no connector on this side of the cassette
- "Not used" means there might be a cassette here, but this DUT loadboard does not use it

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Cassettes

Cassette #	B1	B2
1	Not installed	AT4079B
2	Not used	Not used
3	Not installed	AT4025
4	AT4025	Not installed

Cables

Cable #	From	To
1	B1-CON1	B2-CON3
2	--	--
3	--	--
4	--	--

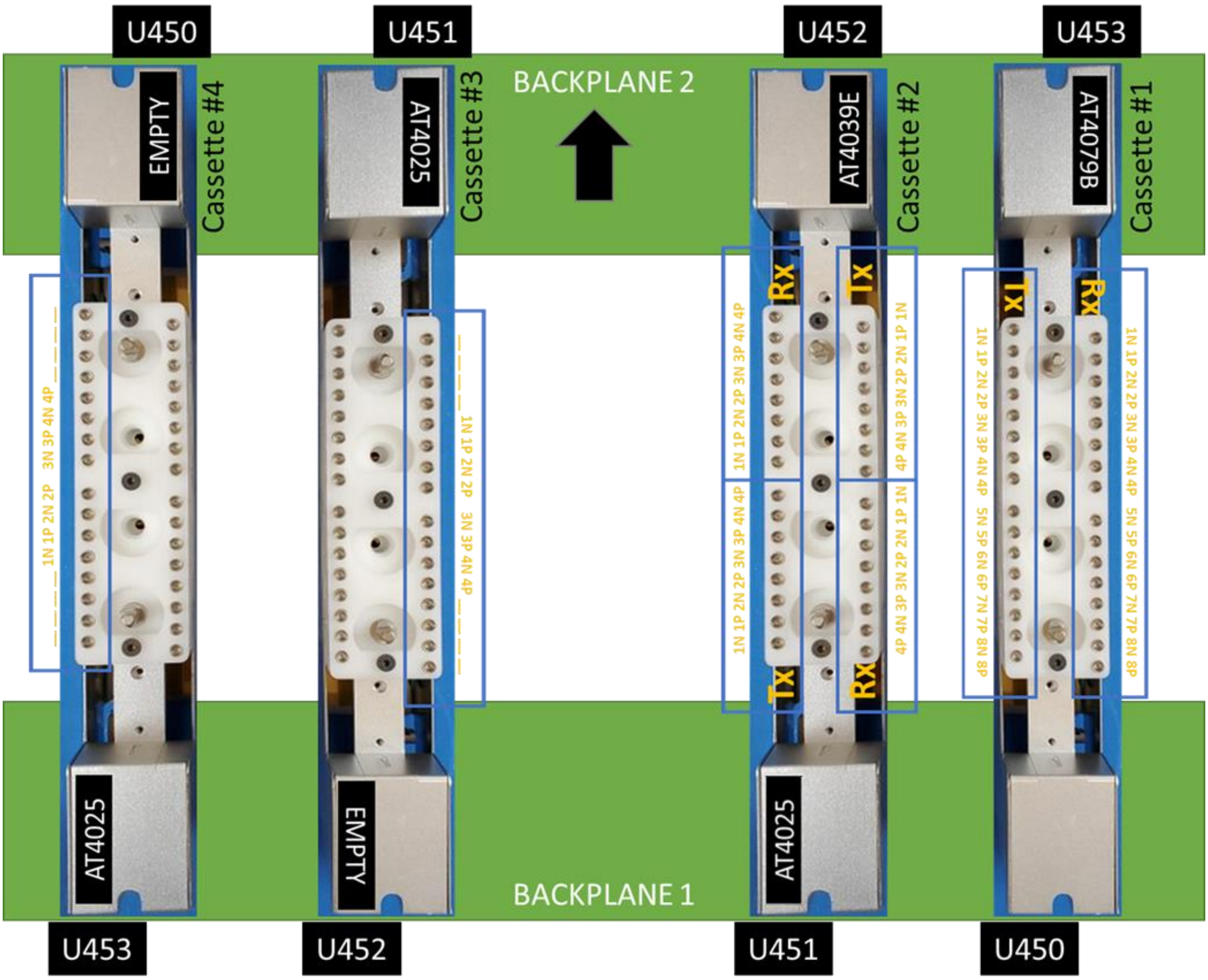
Jumpers

Jumper #	B1	B2
U3	0	1
U5	1	1
U7	0	0
U12	0	1
U13	1	0

Appendix 2: Description of Customer Documentation

Cassettes

Cassette #	B1	B2
1	Not installed	AT4079B
2	AT4025	AT4039E
3	Not installed	AT4025
4	AT4025	Not installed

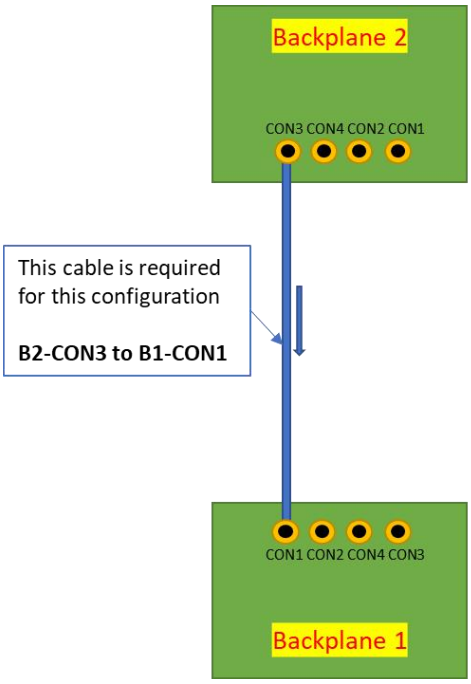


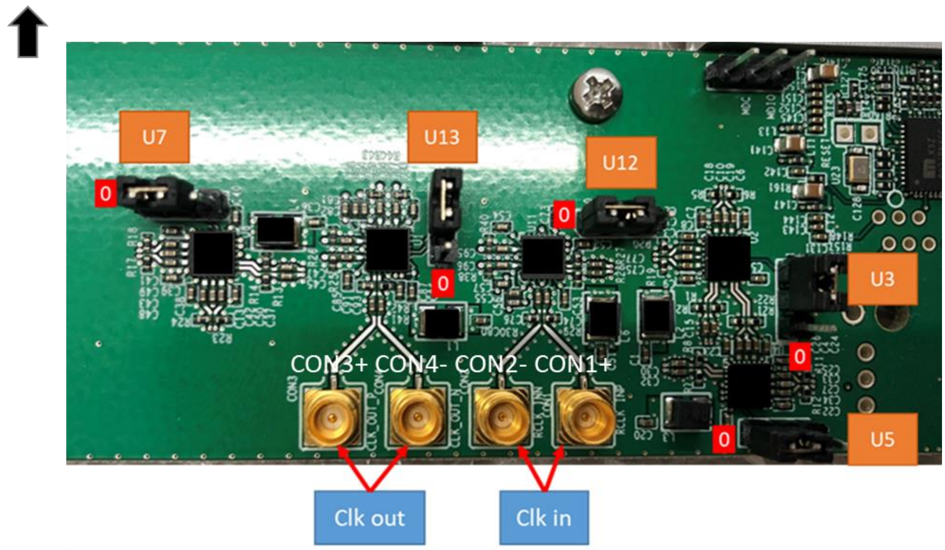
Cables

Cable #	From	To
1	B1-CON1	B2-CON3
2	--	--
3	--	--
4	--	--

Jumpers

Jumper #	B1	B2
U3	0	1
U5	1	1
U7	0	0
U12	0	1
U13	1	0





Appendix 3: Loadboard reference designators

The loadboard can have up to 4 AT93000-POGO brackets installed onto it; two on each side. When the loadboard is docked to the AT93000 twinning frame assembly, each bracket mates with one of the cassette's blindmate connectors, thus making a connection from the high-speed cables shown in Figure 30 to the instruments inside the cassettes.

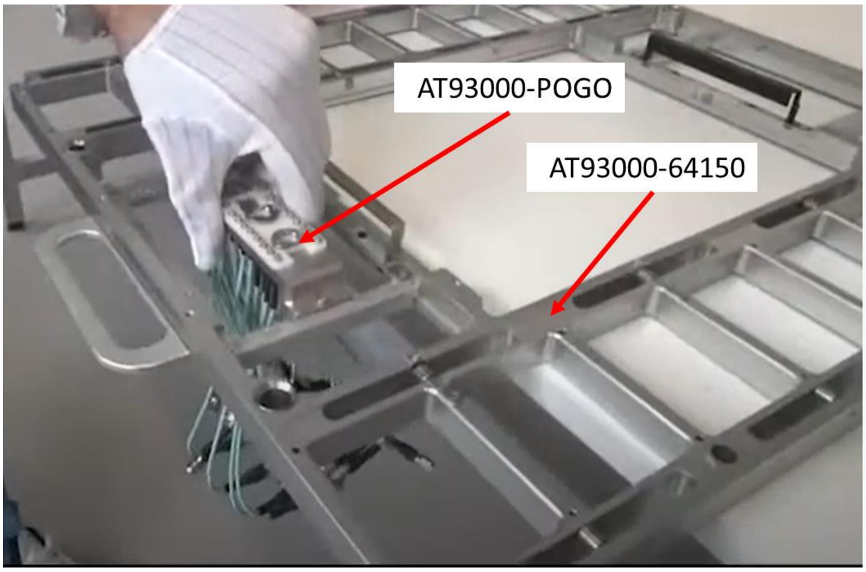


Figure 30: AT93000-POGO being installed onto loadboard

Note the orientation of the AT93000-POGO bracket in Figure 31

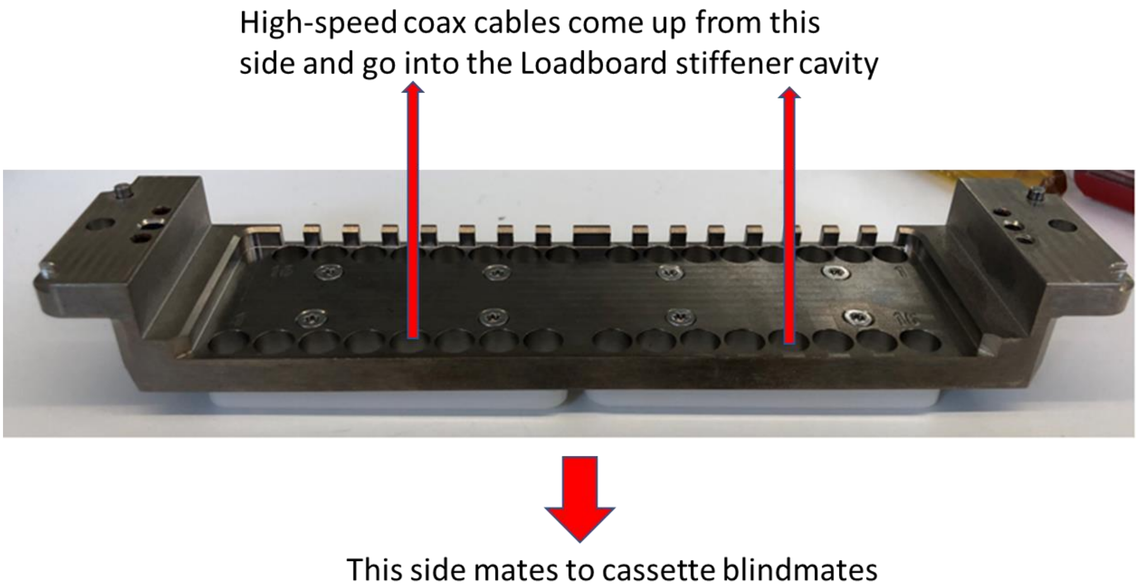


Figure 31: AT93000-POGO

The guide pins on the AT93000-POGO shown in Figure 32 align the orientation of the brackets and the loadboard. See installation manual for a detailed picture set showing how the stiffener and pogo brackets align.

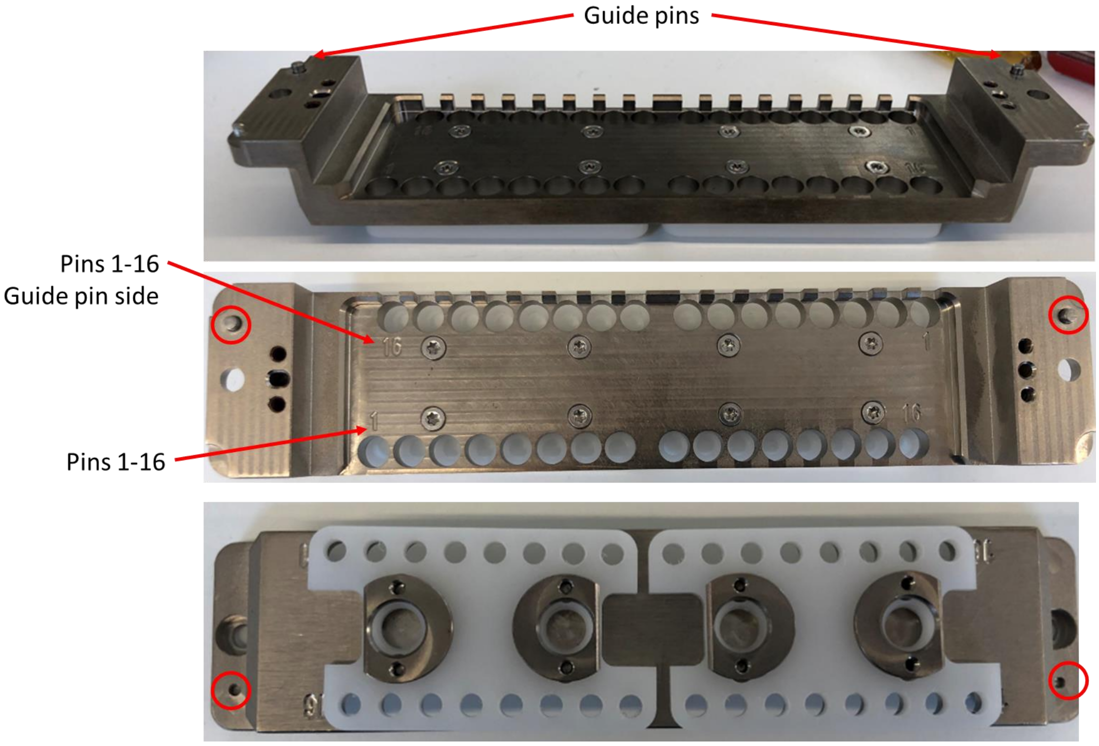
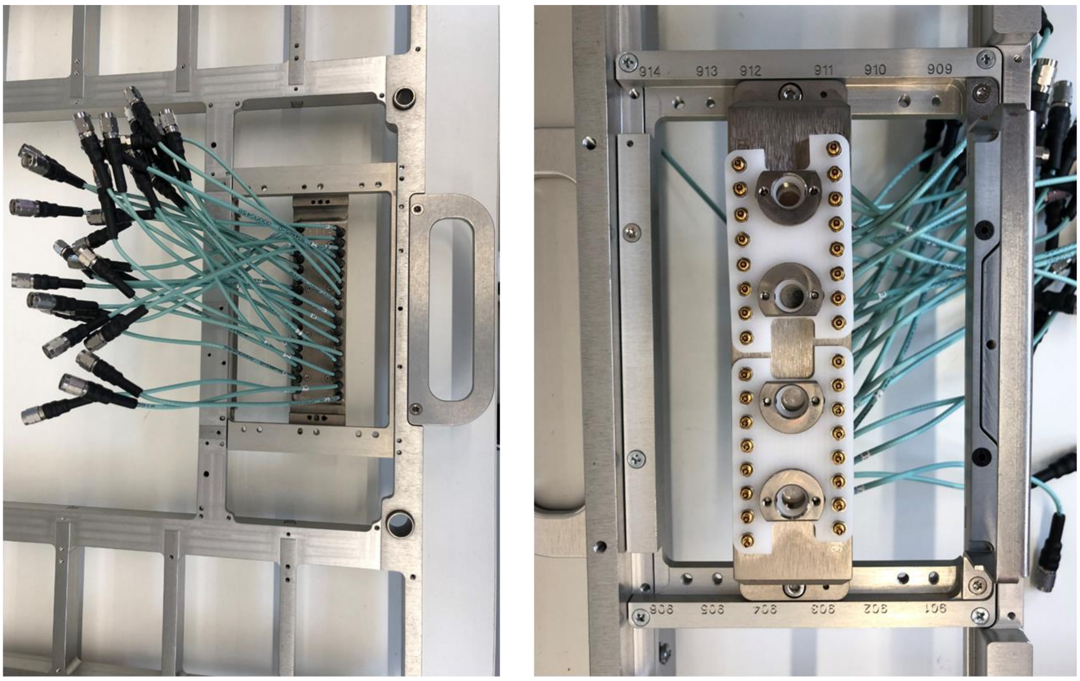


Figure 32: AT93000-POGO with guide pins



Stiffener – Top Side View
Loadboard PCB attaches to Top Side

Stiffener – Bottom Side View
This side blind mates to the Multilane Instruments

Figure 33: POGO attached to stiffener

Rev. No.	Amendments		Revision date
	Section	Description	
0.9		Initial revision uploaded to Multilane website	
0.9.1		Added appendix “Loadboard reference designators” Added cassette #’s to Figure 19	Jan 14 2021
0.9.2		Changed U13 to “0” for “ALL SLAVE” configuration	March 2, 2021

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