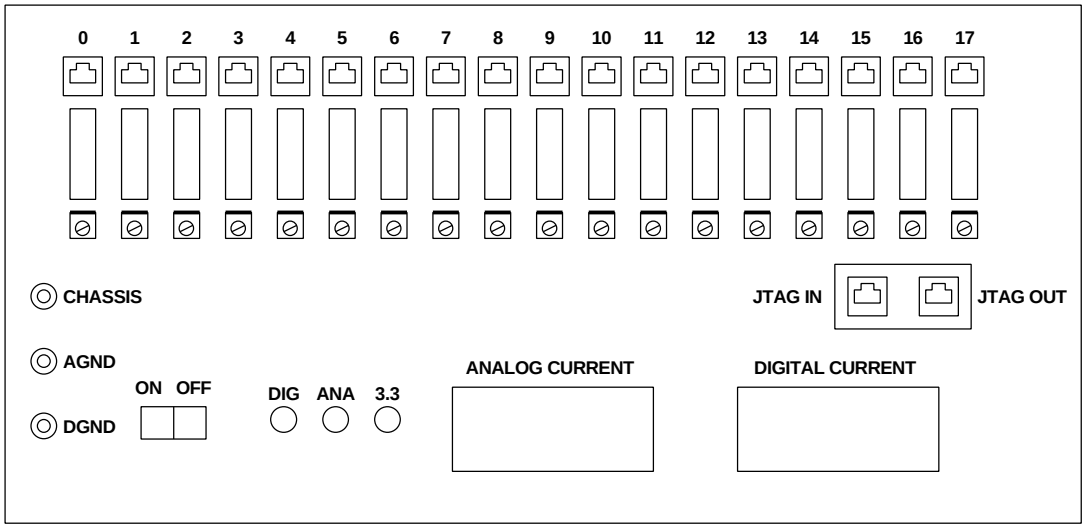
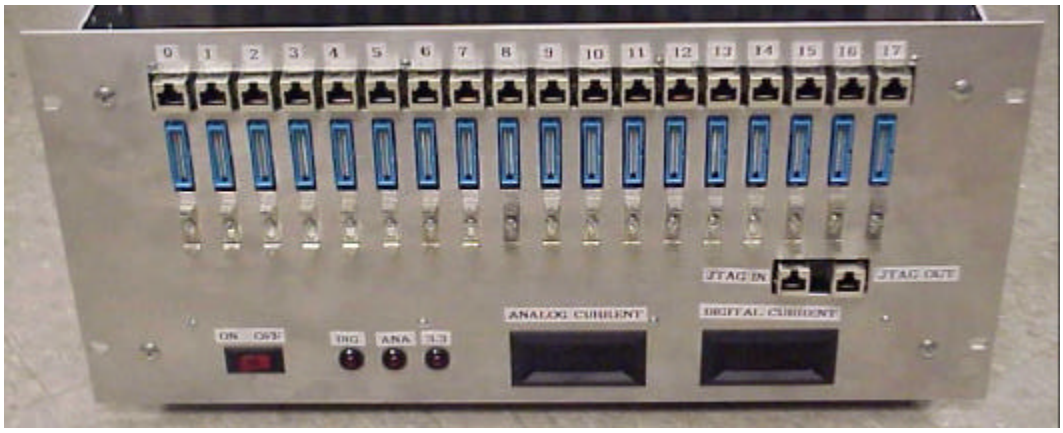
ATLAS CSM Adapter (18 Channel)

E. Hazen – May 7, 2001 ***PRELIMINARY***

The CSM Adapter is designed to connect up to 18 ATLAS MDT mezzanine "lite" cards on an MDT chamber to a CSM-0 VME module. It provides clean DC power for the on-chamber electronics and automatic switching of the JTAG chain.

See the web page http://bmc.bu.edu/bmc/CSM_adapter/ for updates/changes to this document.





Note: Binding posts for ground missing in this photo (see drawing above).

Front-Panel Connections

The front panel is shown above. 18 identical mezzanine card ports are provided for connection of "mezzanine lite" boards. As of this writing, a light blue 40-pin header with 0.05 inch spacing is the standard connector, and is designed to be connected with a one-to-one ribbon cable to a Mezz Lite PC board. An RJ-45 connector should be connected with a shielded twisted pair cable to the corresponding TDC input on the CSM-0.

JTAG IN should be connected to "JTAG Out" on the CSM-0.
JTAG OUT should be connected to "JTAG In" on the CSM-0.

The on-off switch illuminates to indicate that 220V or 117V AC is present when the unit is switched on. The three LEDS indicate that power is present as follows:

DIG – digital 5.0V power to mezzanine PCBs
ANA – analog 5.0V power to mezzanine PCBs
3.3 – digital 3.3V power to internal components of the adapter unit

The two digital panel meters display the current in Amps being drawn from the mezzanine board digital and analog power. These meters are not very well calibrated and may be off by 20% or so. They should however be quite linear and repeatable.

JTAG Chain Operation

The JTAG daisy chain is automatically switched when mezzanine boards are plugged and unplugged. With no mezzanine boards connected, the **JTAG IN** and **JTAG OUT** connectors are connected together. The CSM-0 software provides a JTAG "loopback test" which should pass in this configuration.

The first board in the chain is the board plugged in to the lowest-numbered port. Normally the ports should be used in order starting with "0" so that the TDC numbers correspond to the front panel labels.

The switching is accomplished by means of a "sense" connection on pin 20 of the 40-pin connector. This pin is pulled to ground when a mezzanine board is plugged in. See the section below on circuit details for more information.

Grounding

Correct grounding is crucial to noise-free operation. Production adapter modules have 3 binding posts on the front panel giving access to the various system grounds. Prototype units may be missing these binding posts.

A detailed discussion of how to ground an MDT chamber is beyond the scope of this document; contact the front-end electronics group for more details. Here are some basic suggestions:

- Connect the **AGND** binding post to the MDT chamber ground (faraday cage) with a heavy ground braid.
- Connect the **AGND** and **DGND** binding posts together with a wire jumper.
- Leave the **BOX** binding post floating (it is internally tied to the AC cord ground).
- Tie the MDT chamber ground to earth ground somewhere for safety (preferably not at the CSM adapter but to a water pipe or something similar).
- Feed all cables between the CSM adapter and the CSM-0 through large ferrite cores (take a few turns around the core with each cable)
- Keep the VME crate at least a few m away from the chamber. Ground the VME crate to earth for safety (this may already be done through it's AC cord).

AC Power Input

AC power is input via a standard IEC power cord socket on the rear panel. Voltage switching is provided by way of a small removable panel and a plug which can be inserted in various positions. *IMPORTANT:* Check setting carefully before applying power. An incorrect setting could do serious damage. The AC input module on the rear also contains a fuse (use 4A 250V type only) and a second *power switch* which must be on for the unit to function.

Connector Pinouts

Ribbon Header for Mezzanine Boards

For production boards, this is a blue 40-pin connector. The pin numbers on the schematic unfortunately are not the same as the connector numbering itself, for historical reasons! Pin 1 is in the lower right corner on the 40-pin connector when viewed from the front panel.

Connector Pin No	Schematic Pin No	Function		Connector Pin No	Schematic Pin No	Function
1	35	TDC CLK+		2	36	TDC CLK-
3	33	TDC ENC+		4	34	TDC ENC-
5	31	TDC SDAT+		6	32	TDC SDAT-
7	29	TDC STB+		8	30	TDC STB-
9	27	TDO+		10	28	TDO-
11	25	TDI+		12	26	TDI-
13	23	TCK+		14	24	TCK-
15	21	TMS+		16	22	TMS-
17	19	n.c.		18	20	JTAG Sense
19	17	DVdd		20	18	DGND
21	15	DVdd		22	16	DGND
23	13	n.c.		24	14	n.c.
25	11	n.c.		26	12	n.c.
27	9	n.c.		28	10	n.c.
29	7	n.c.		30	8	n.c.
31	5	n.c.		32	6	n.c.
33	3	AVdd		34	4	AGND
35	1	AVdd		36	2	AGND
37		n.c.		38		n.c.
39		n.c.		40		n.c.

JTAG IN

This connector receives JTAG from the CSM-0. All signals are expected to be LVDS (differential). All pairs are terminated in 100 ohms.

Pin	Name	Notes
1	TDI +	
2	TDI –	
3	TCK +	
4	TMS +	
5	TMS –	
6	TCK –	
7	TRST +	Not used internally – connected only to JTAG OUT
8	TRST –	Not used internally – connected only to JTAG OUT

JTAG OUT

This connector transmits JTAG to the CSM-0. All signals are LVDS (differential). All pairs must be terminated in 100 ohms.

Pin	Name	Notes
1	TDO +	
2	TDO –	
3	TCK +	
4	TMS +	
5	TMS –	
6	TCK –	
7	TRST +	Not used internally – connected only to JTAG IN
8	TRST –	Not used internally – connected only to JTAG IN

TDC

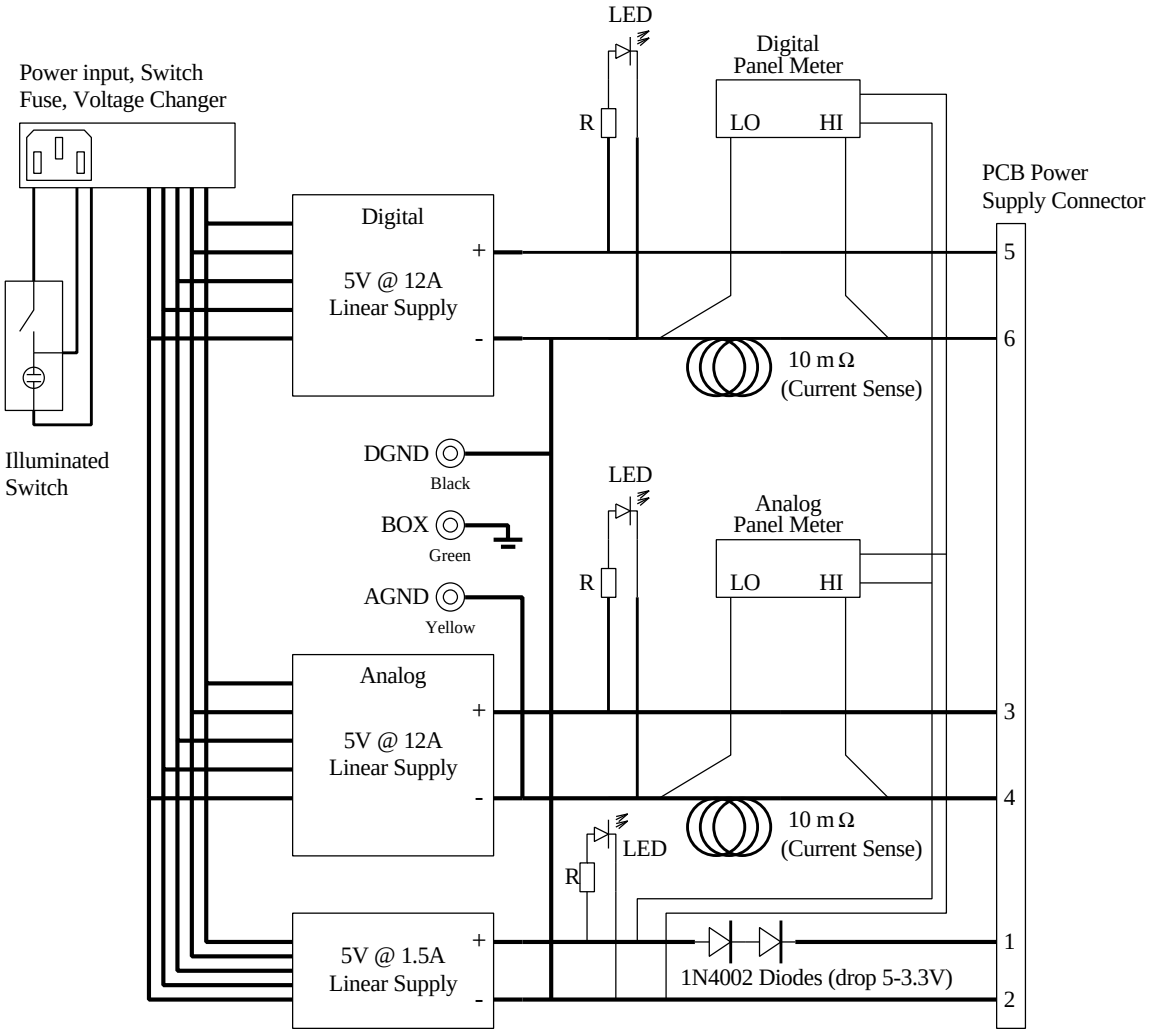
These carry the bi-directional AMT TDC trigger/data link. They are connected one-to-one to the corresponding ribbon header signals, with no internal connections in the adapter module.

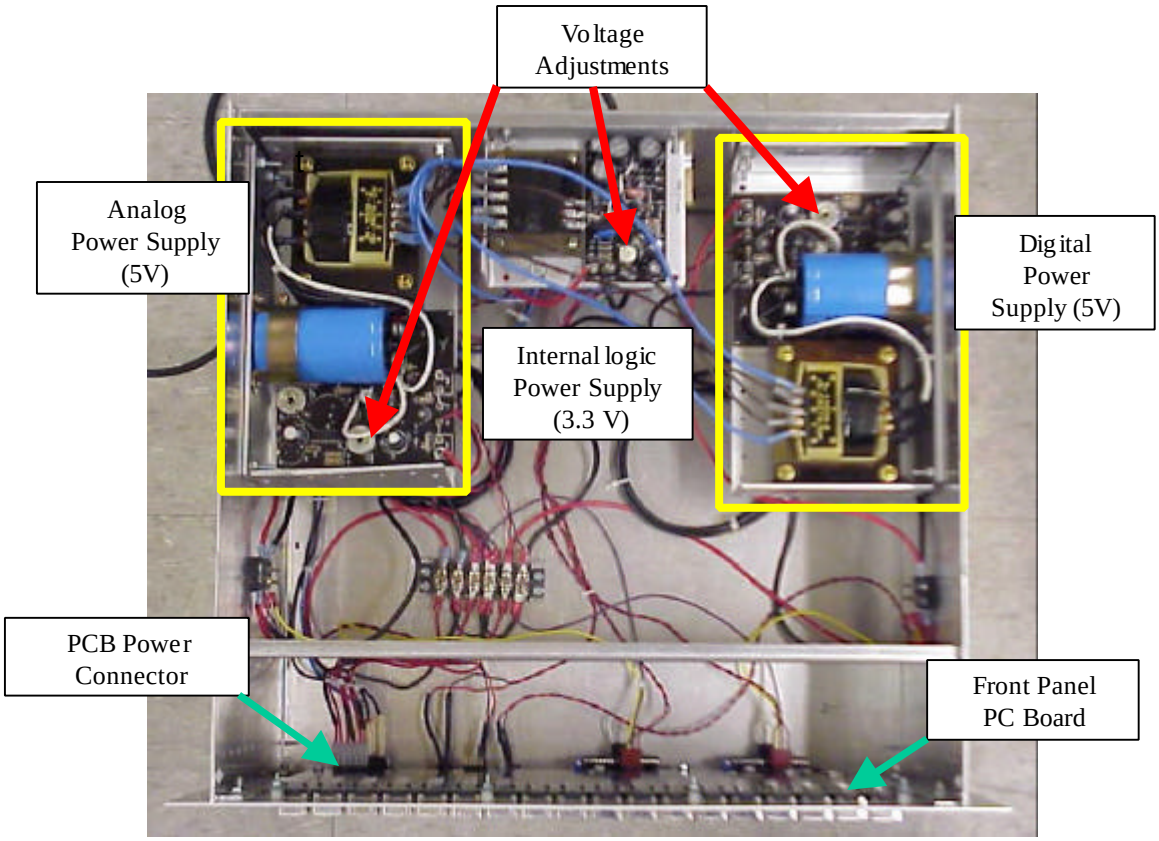
Pin	Name	Notes
1	TDC CLK+	Clock from CSM → AMT
2	TDC CLK–	
3	TDC ENC +	Encoded control from CSM → AMT
4	TDC SDAT+	Serial data from AMT → CSM
5	TDC SDAT–	
6	TDC ENC–	
7	TDC STB+	Data strobe from ATM → CSM
8	TDC STB–	

Schematics and Circuit Operation

A schematic for the wiring of the box is shown below, along with a photograph of the interior identifying the main components. The wiring is quite straightforward, but there are a few points worth mentioning:

- The logic on the internal PC board is supplied with 3.3V by a 5V power supply. Two rectifier diodes provide a voltage drop of about 1.5V, and the output of the small 5V supply is set a little low to provide 3.3V at the board.
- The current meters measure voltage drop in a 10mΩ resistor, formed of about 2m of 12AWG (2mm) stranded wire.


LED
Digital
Panel Meter
Power input, Switch
Fuse, Voltage Changer
R
LO
HI
PCB Power
Supply Connector
Digital
+
5V @ 12A
Linear Supply
-
5
6
10 m Ω
(Current Sense)
DGND
Black
Illuminated
Switch
LED
Analog
Panel Meter
BOX
Green
R
LO
HI
AGND
Yellow
Analog
+
5V @ 12A
Linear Supply
-
3
4
10 m Ω
(Current Sense)
LED
R
+
5V @ 1.5A
Linear Supply
-
1
1N4002 Diodes (drop 5-3.3V)
2



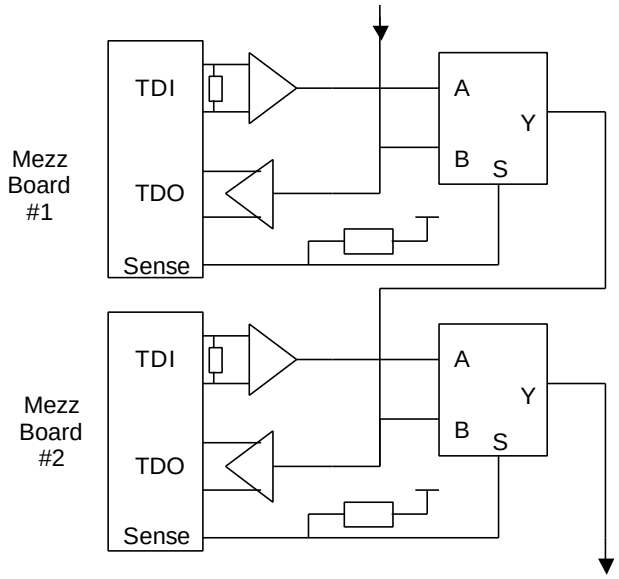
A detailed schematic for the PCB is available on the web at http://bmc.bu.edu/bmc/CSM_adapter/ . Page 1 is the top-level sheet, which shows the overall circuit. It contains 9 identical sub-blocks (green on the top sheet) each of which contains the unique circuitry for two mezzanine board connections.

As mentioned previously, the TDC connections are simply one-to-one from the corresponding header connector pins to the RJ-45 connector.

The JTAG circuitry is somewhat more complex. The TMS and TCK signals are fanned out by SN65LVDS116 Texas Instruments 1:16 LVDS fanout chips. Each input drives two chips; 18 outputs are used to drive the mezzanine card outputs, plus an additional one for the JTAG OUT connector.

The daisy chain switching logic is handled by an Altera EPM3128 FPGA. A simplified diagram is shown below. Each TDC channel has a two-input multiplexor which selects the source of the TDO (data out) signal for the next channel. In the case where the channel has a mezzanine card installed, the **Sense** signal is shorted to ground, selecting

input **A**, which connects the TDI (data in) signal to the TDO for the next channel. In the case where there is no mezzanine card installed the **Sense** signal is pulled to a logic '1' by the resistor, which bypasses the channel and sends the data from the previous channel to the TDO for the next channel. In the extreme case where no mezzanine cards are installed, the data passes through all 18 multiplexors from the JTAG IN to JTAG OUT connectors directly, bypassing all channels.



Troubleshooting and Adjustments

Power Supplies

The output voltage of the three power supplies is adjustable over a limited range (see photo for location of adjustments). If you are having problems with strange behavior of the mezzanine cards, check the voltage at the regulator input on the mezzanine card. If it is less then about 4.5V then you will have problems. You can adjust the voltage of the large analog and digital supplies to compensate for the voltage drop in long cables to the mezzanine boards.

The small supply should not generally require adjustment, but it is set to deliver 3.3V to the PC board. This voltage is not very critical.

PC Board

Not much should go wrong with the PC board. If things aren't working, make sure the power supply connector is firmly seated on the back of the board.

The JTAG chain and FPGA logic can be tested easily by first removing all ribbon cable connectors and then doing a "JTAG loopback" test in the CSM software. This test should pass. If it fails, then either the JTAG IN or JTAG OUT cable is likely bad or mis-plugged, or possibly there is a problem with the adapter PC board.

In the (hopefully very unlikely) event that the FPGA must be reprogrammed, there is a 10-pin header on the rear of the PC board for this purpose. It is intended to be connected to an Altera Byte Blaster MV programming cable, but the *pinout is reversed*. An adapter which swaps all even and odd pairs of pins is needed. Best to contact the designers if this is ever needed.