

Mark 4 formatter upgrade with a VSI card

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ÍNDICE

1

Índice

1. Introduction	2
2. Hardware upgrade. Removal process	2
3. Hardware upgrade. Installation process	6

1. Introduction

We describe the process we followed at the Observatorio Astronómico Nacional (OAN) to upgrade the Mark4 formatter to a Mark5B sampler module. The process requires removing 4 cards from the old formatter and installing a new VSI card. The VSI card has been designed by D. Smythe (2006) and was purchased to Haystack Observatory. The new card converts the Mark 4 formatter to a Mark 5B sampler module which provides a VSI flux from BBCs.

2. Hardware upgrade. Removal process

The following parts were withdrawn from the Mark4 formatter:

- *Mark 4 Formatter Board.* Before removing this board follow these steps:
 1. Unscrew the right and left covers.
 2. Unscrew the black plastic block on top of the board which prevents the board from bending.
 3. Unscrew the two screws at the bottom which hold two small black plastic blocks attached to the board and to the frame.
 4. Remove flat cables from connectors J9, J3, J2, and J1. Label connector end for cable J9 with a permanent ball pen since it will be reused later.
 5. Remove the rest of flat cables.
 6. Remove power cable from connector 4.

Figure 1 shows the Mark 4 formatter before being dismantled.

- *Mark 4 Interface Board.* To remove this board first take the following steps:
 1. Unscrew both screws at the bottom which hold two small black plastic blocks attached to the board and to the frame.
 2. Remove flat cables coming from the Formatter Board.
 3. Remove flat cables from connectors J4 (from sampler 1), J3 (from sampler 2), J2 (from sampler 3), J1 (from sampler 4), J11 (from front panel) and J14 (from J13 on the rear panel). Label connector ends for J14, J11, J4, J3, J2 and J1 with a permanent ball pen since they will be reused later.
 4. Remove power cable from connector J3.
 5. Unscrew both SMC coax cables labeled 13 (32 MHz from connector 11 at the *Frequency Synthesizer Board*) and 12 (1 pps sync signal from connector 13 at the *Frequency Synthesizer Board*) with a wrench.
- *Single Board Computer and Mark 4 Formatter Utility PC Board.* Before removing these boards follow these instructions:

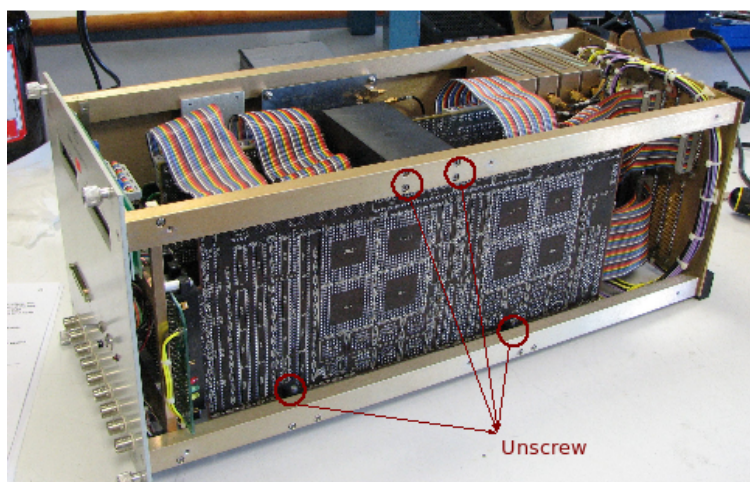


Figure 1: View of the Mark 4 formatter. The card on the front is the Mark 4 Formatter Board. Behind it one can see the Interface Board. To remove this board it is necessary to remove the screws marked in the image.

1. Remove the screws that hold the black plastic block on top of both cards.
2. Remove cables from SBC40A.
3. Remove flat cables from connectors J3 (coming from the *Mark 4 DC Power Panel*) and J2 (coming from the front panel). Label both cables with a permanent ball pen since we will reuse them later.

Figure 2 shows the Mark 4 formatter before dismantling the *Single Board Computer* and the *Mark 4 Formatter Utility PC Board*.

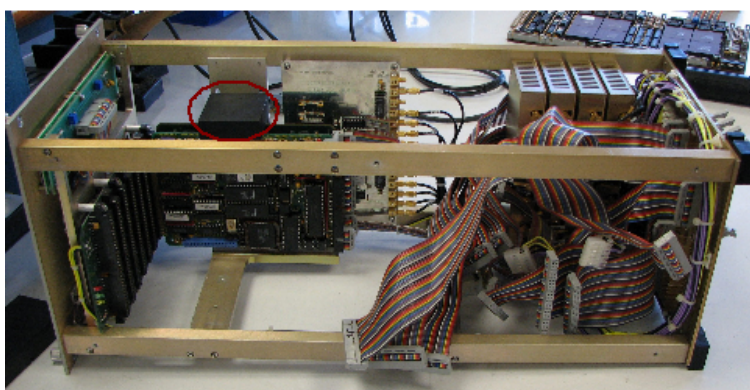


Figure 2: View of the Mark 4 formatter once the Formatter and Interface boards are dismantled. To remove this SBC40A and the Mark 4 Formatter Utility PC Board remove the black plastic block in the image.

Figure 3 shows the Mark 4 formatter after dismantling the 4 main cards.

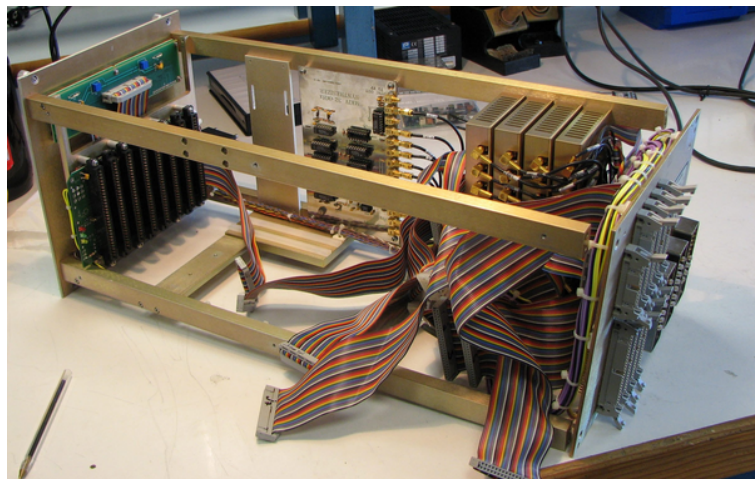


Figura 3: View of the Mark 4 formatter once the Formatter, Interface, SBC40A and Formatter Utility boards are dismantled.

- Rear cover with input/output connectors. It is necessary to remove the AMP connectors and the *Mark 4 DC Power Panel* which will be reused.
 1. Remove the 4 black plastic blocks at the corners. These allow the module to shift through the guides in the VLBI DAR. Some screws are long and some short. Write down the correspondence between the holes and the screws.
 2. Below the black blocks there are screws. Unscrew them. The rectangular rods that go from the front to the rear panel will only be attached to the front panel.
 3. At the rear panel and from the external face unscrew the 4 screws that hold the *Mark 4 DC Power Panel*. Cut the cable ties, so that cables are loose.
 4. Unscrew the AMP connectors. First begin with male screws and then with female ones. Pay attention to the bolts so that they do not fall. It is not necessary to remove individual cables from the AMP connectors since the whole connector with its cables can be taken out if done carefully.
 5. Dismount the AMP connectors on this order: J2, J3 and J4.
 6. Take out the metal cover of the AMP connector by putting it on a perpendicular position relative to the face of the connector. J2 is the most difficult one to loose since there are many cables and there is almost no space for operation.
 7. Take out the blue AMP connector together with the cables from the hole. To do that put it perpendicular to the surface of the rear cover. J2 connector is the most difficult one to since there are many cables and there is almost no space for operation.
 8. Label the AMP connectors since it is necessary to put them in the new rear cover.
 9. Unscrew connector J13 from the cover. It will be used in the new rear cover.

Figure 4 shows the Mark 4 formatter after dismantling the AMP connectors.

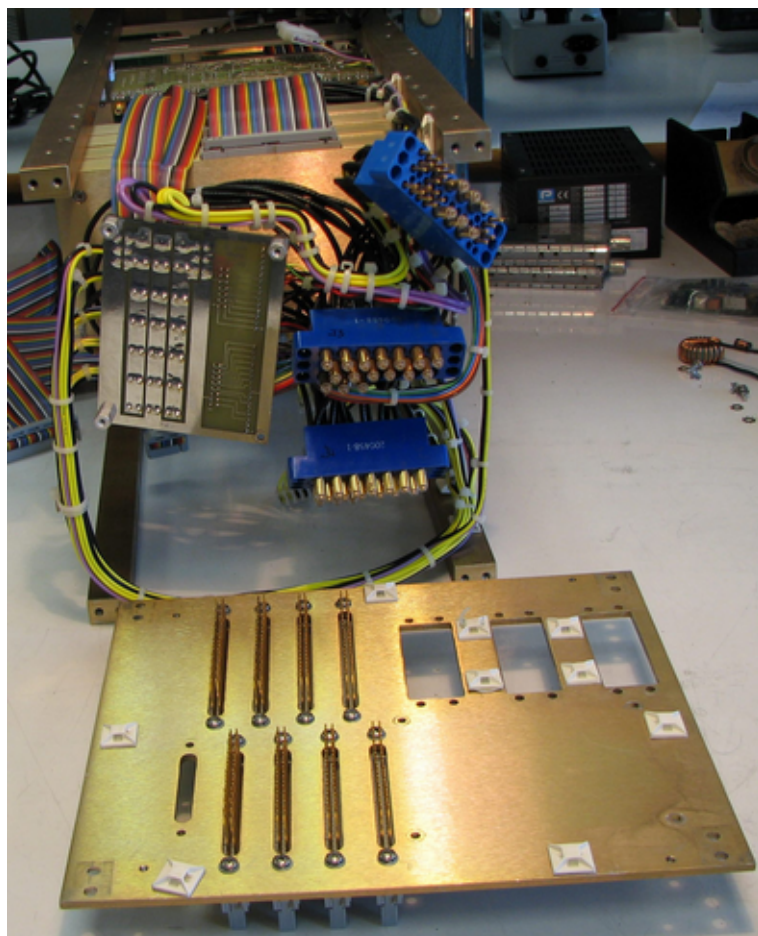


Figura 4: View of the mark4 formatter after dismantling the AMP connectors. The board on the left is the Mark 4 DC Power Panel. Below the old rear cover with the plastic bases for the cable ties.

3. Hardware upgrade. Installation process

We installed the following parts:

- New rear cover.
 1. Mount connector J13 from the old rear cover on position J13 on the new rear cover.
 2. Stick the plastic bases for the cable ties in exactly the same position and orientation than in the old cover and pass the cable ties through the holes leaving them open. Later this will ease tying the cables. Figure 5 shows the inner face of the new rear cover before mounting it.

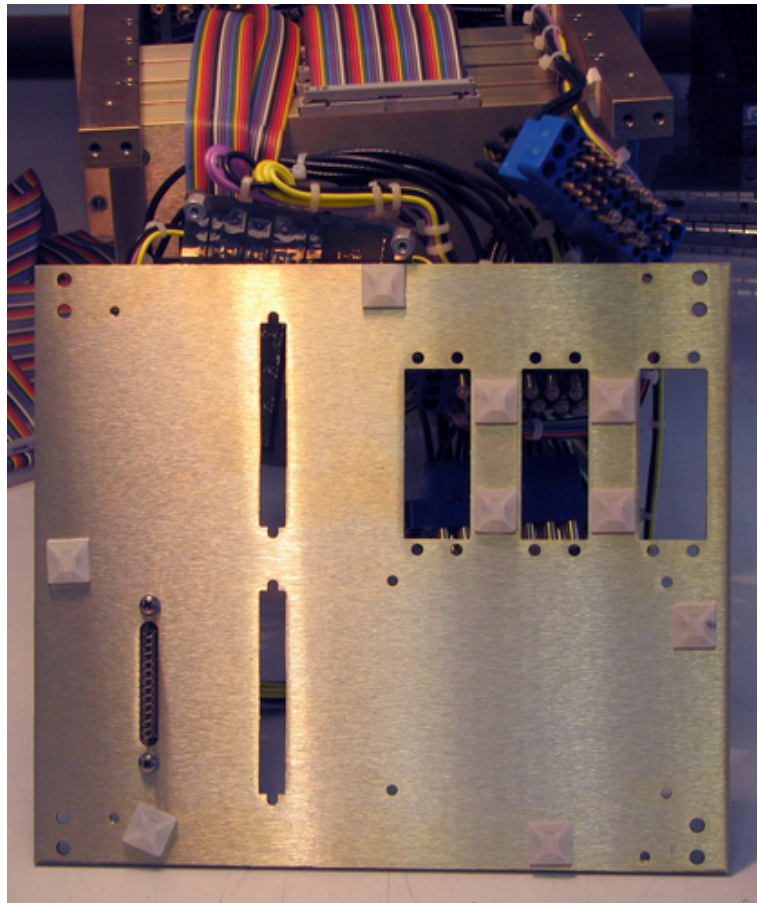


Figura 5: View of the inner face of the new rear cover before mounting it. Cable ties should already be in their plastic bases.

3. Pass the AMP connectors through the holes of the new panel. Insert them through the hole using a perpendicular orientation relative to the plate.
4. Place the metal covers for the AMP connectors. Insert them using a perpendicular orientation relative to the plate. Letters on the cover should be in the same place as when dismantled from the old rear cover. Letters are close to the male screws.

5. Mount the AMP connectors on this order: J4, J3, J2.
6. Place a male AMP connector to fit the metal cover in its proper position.
7. Tie the cables using the cable ties already in the holes of the plastics bases.
8. Screw the rear cover to the rectangular rods and screw the black blocks that allow the module to shift on the rails in the rack. Figure 6 shows rear cover already mounted and with the black plastic blocks on the corners. This operation **may be performed after** installing the VSI card at the end of the process described on this report since plugging the VSI card on its place may be easier if the rear cover is still loose.

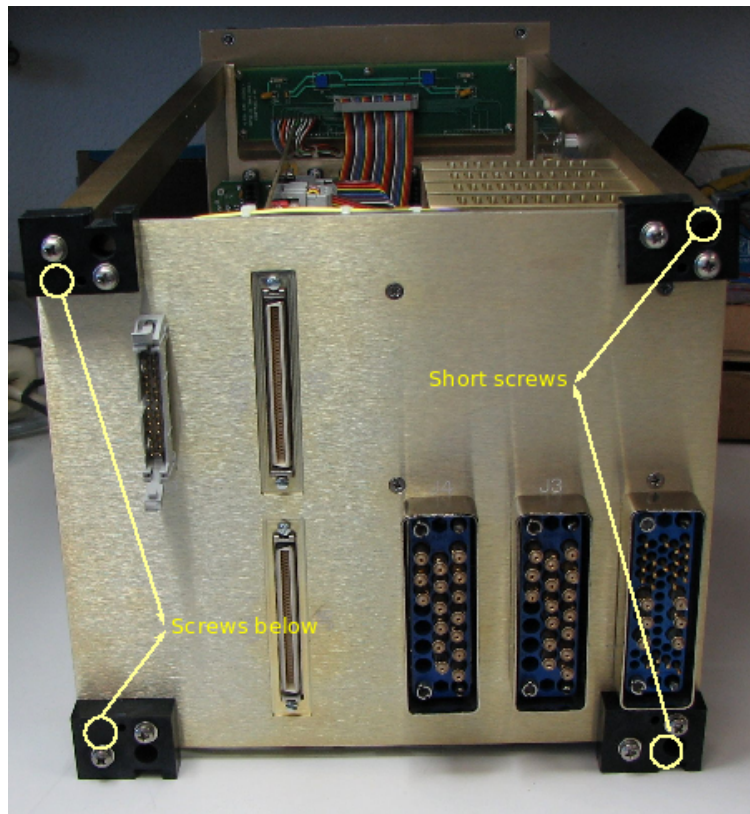


Figura 6: Rear cover already mounted. Black plastic blocks use two kind of screws: the 8 screws that can be seen on this image are long. The ones through the plastic holes on the right corners are short. These have been marked on yellow. There are also two screws below the blocks on the left corners. Two marks on the image identify their location.

■ VSI Card.

1. Populate U29 with chip 100325PC from the *Mark4 Interface Board*
2. Unscrew the screws from VSI connectors J5 and J6.
3. Attach the card to the holes of the rear cover and screw the screws to connectors J5 (VSI 2) and J6 (VSI 1) from the outer face of the rear panel. The card will now be fixed to the frame.

4. Screw one of the small black blocks from the *Mark 4 Formatter Board* to the VSI card and to the frame of the module, so that the card does not bend when plugging the flat cables.

Figure 7 shows the VSI card already mounted and with the black plastic block which attaches it to the frame.

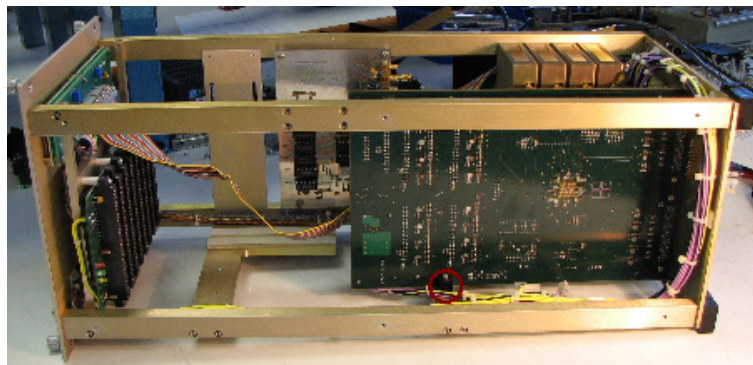


Figura 7: VSI card already mounted. Black plastic block which attaches it to the frame has been marked.

5. Insert flat cables on their connectors according to table 1. The VSI board has printed labels for each connector which allow to easily locate and place the correct cables. The small triangle on each connector marks pin 1.

VSI Connector	Old connection	Target
J2	J4 (Mk4 Interface Board)	clipper/sampler 1
J3	J3 (Mk4 Interface Board)	clipper/sampler 2
J1	J2 (Mk4 Interface Board)	clipper/sampler 3
J4	J1 (Mk4 Interface Board)	clipper/sampler 4
J6		Rear Panel VS1 1
J5		Rear Panel VSI 2
J16	J2 (Mk4 Formatter Utility PC Board)	To/From Front Panel
J8	J3 (Mk4 Formatter Utility PC Board)	To/From Rear Panel DC PWR BRD (J8)
J10	J14 (Mk4 Interface Board)	Rear Panel (J13)
J11	J9 (Mk4 Formatter Board)	1 PPS To Video Converters DC PWR BRD
J13	J11 (Mk4 Interface Board)	Front Panel BNC's
J14	Cable 13 (Mk4 Interface Board)	Mk4 32-MHz Synthesizer Board (11) 32 MHz
J15	Cable 12 (Mk4 Interface Board)	Mk4 32-MHz Synthesizer Board (13) 1 PPS

Cuadro 1: Cabling on the VSI card. All cables are reused from the previous boards. Old denomination is specified in the table.

Figure 8 shows the VSI card already mounted with all cables on its place.

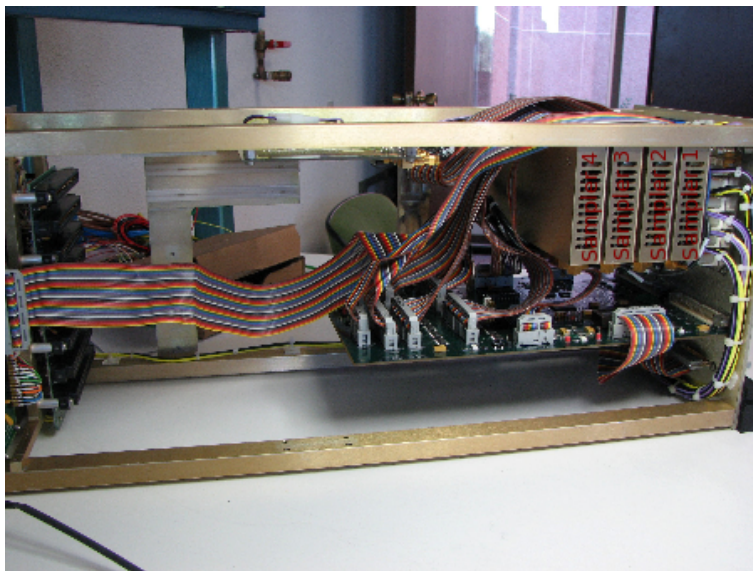


Figura 8: VSI card already mounted. Samplers' numbers are marked.

Cable *To/From Front Panel* may need to be disentangled from below the card with 8 ISA like inputs so that it reaches the VSI board. Sampler's numbers increase from back to front. Sampler 1 is closer to the rear cover. Cable from sampler 4 may be too short to reach the VSI board. Another cable with the same number of pins could be recycled and shortened if necessary. Connector J13 on the rear panel swaps the odd and even pins. Therefore the cable from VSI J10 connector to connector J13 in the rear panel is correctly connected when pin 1 goes to pin 2 (the opposite face of the one where the triangle is).

6. Use any of the old power cables for the VSI board. These cables only fits in one position of the board connector and therefore there is no possibility to mistake +5 V with -5 V.

Referencias

- [1] Smythe D., VSI Interfaces for Legacy Systems. IVS 2006 General Meeting Proceedings, 2006.