Academia Sinica, Institute of Astronomy & Astrophysics
SMA Project

Subject:	**Date:**	**From:**
Fiber Switch for e-SMA Operations	14 September 2006 ASIAA-HI-002	Derek Kubo
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Introduction: The SMA telescope normally operates with eight antennas, however, in e-SMA (extended SMA) mode the array can be configured to include the CSO and the JCMT telescopes. e-SMA operation provides the following increases: number of baselines from 28 to 45; maximum baseline distance from 509 meters to roughly 800 meters; and collecting area from 226 to 488 square meters.

The SMA IF/LO system utilizes three broadband single-mode fibers to each antenna. Under normal operation fibers A and B carry signals for the low (200, 300 GHz) and high (400, 600 GHz) frequency receivers, respectively[1]. For e-SMA mode the B-fibers for antennas 5 and 6 are redefined to the CSO and JCMT. Thus in order to switch between modes it is necessary to physically reroute these optical signals in the vault of the SMA control building. To facilitate this mode change we have recently installed an electrically controlled optical switch. This memo describes the design and usage for this switch and its associated controller.

Description: The optical switch is shown in Figure 1. It is an SPDT (single pole double throw) unit manufactured by Newport, model number SP-12-9-N-13/15-N-N-9-1-Z. The actual switch mechanism utilizes a moving prism between fixed collimators. Optical loss has been measured to be < 0.7 dB at 1310 nm. The three fibers are terminated with FC/APC connectors. The switch is controlled by TTL logic (2 pins) and has a position sensor (2 pins, open/closed). Size is 67.0 x 23.0 x 16 mm, excluding connector pins and fibers.

Figure 1 Newport 1x2 Prism Switch

The two switches are controlled by a controller panel shown in Figure 2. The panel itself is 5.25 inches in height (3U) and is mounted in the rear of the center rack just below the “Receiver B Splice Cabinet”. Referring to the upper photo in Figure 2, the panel has two green DC power status LEDs on the upper left (+12, +5 VDC), four switch position status LEDs near the center (A5 or CSO, A6 or JCMT), Ethernet connection on the lower left, auxiliary input (15 socket Cannon D) next to it, and an AC power input connector on the lower right.

The rear panel view shows the DC power supply (Sola SKS-12-017T) and the blue controller module (Advantech ADAM-6050). The logic board (see Figure 4) is located beneath the ADAM module. Note that the short Ethernet jumper from the panel connector to the ADAM module is missing in the photo.

[1] The A and B fibers carry signals which are unique to each antenna. Fiber C is optically power divided and sent to each of the 10 antennas.

The schematic for the overall panel is shown in Figure 3. Note that the six LEDs shown on the LOGIC BOARD are actually mounted on the panel. The DC power and A5 (antenna 5) and A6 (antenna 6) LEDs are green to indicate "good", while the CSO and JCMT are amber to indicate "caution"[2]. The +5 VDC logic supply is regulated from +12 VDC using a 7805 regulator. The CSO and JCMT switches located in the upper right of the schematic represent the electrical equivalent of the Newport devices (optical interfaces for these switches are not shown). These switches are physically located within the Century Fiber Optics splice cabinet (Figure 5) just above the controller panel. Interconnection between the panel and the two switches is via a 2 meter length of 8 conductor ribbon cable.

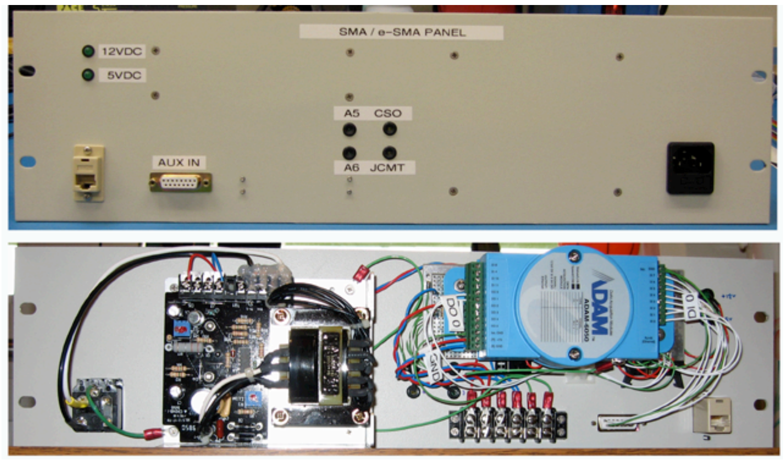

Figure 2 Control Panel, Top – Front View, Bottom – Rear View

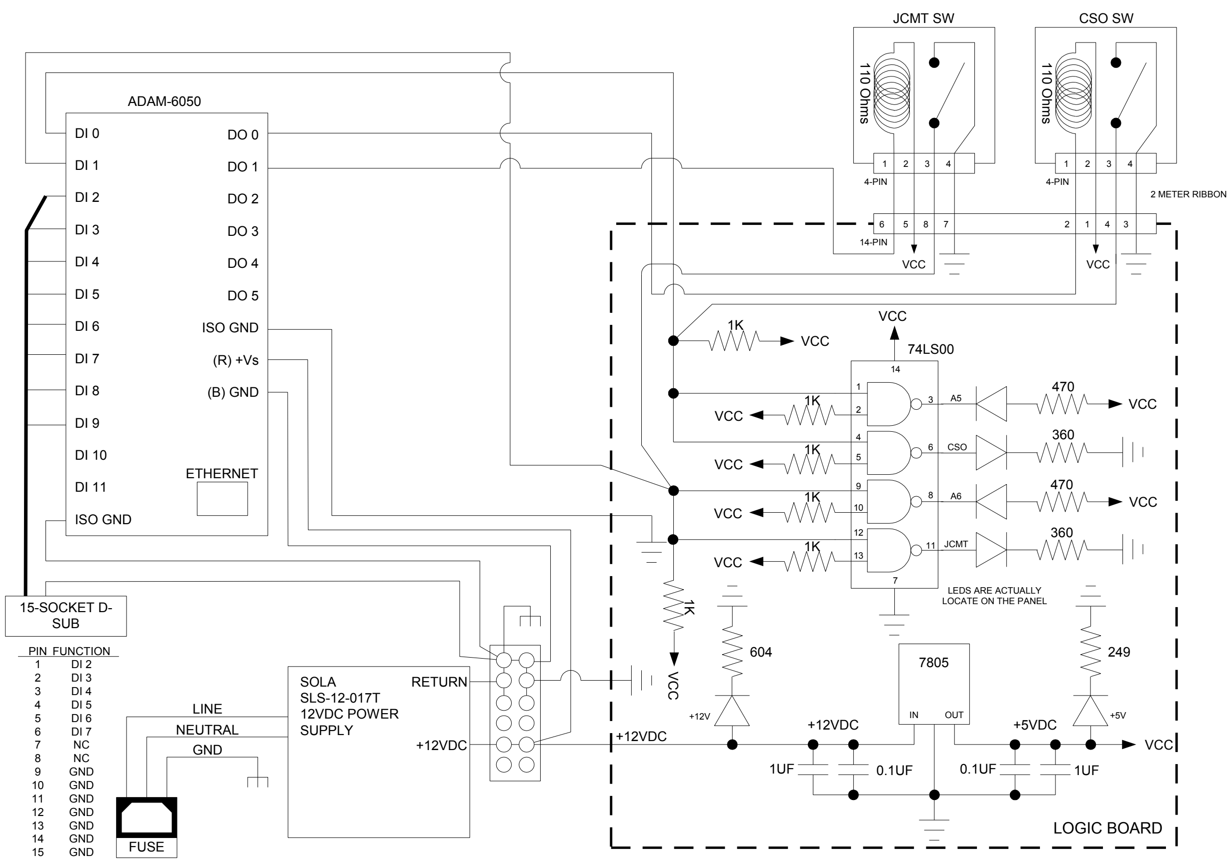

Figure 3 Logic Board Schematic

[2] As in "caution" - do not leave it in this mode for normal SMA operations.

The 15-socket D connector labeled "AUX IN" in the Figure 2 photo provides six additional status inputs. Pins 1, 2, and 3 of the 15-socket D are reserved for the inner vault door, outer vault door, and maser AC power status, respectively. The circuit is asserted by closing the contact to ground. I.e., to assert that the inner vault door is closed pin 1 must be shorted to pin 9.

The Newport switches have been configured such that its power off mode corresponds to normal SMA operation. I.e., if you unplug the AC power to the panel the switches will default to antennas 5 and 6.

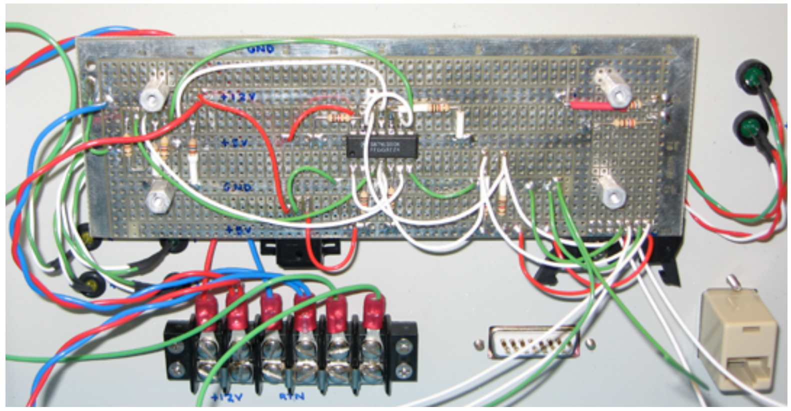

Figure 4 Photo of Logic Board

Figure 5 shows a photo of the splice cabinet where the two optical switches are located at the bottom (black devices). Note the ten fiber-B splice trays for the ten antennas. The white colored fibers are part of the Newport switches (3 fibers per switch), the blue fibers are from the antennas, and the yellow fibers are routed up to the analog room.

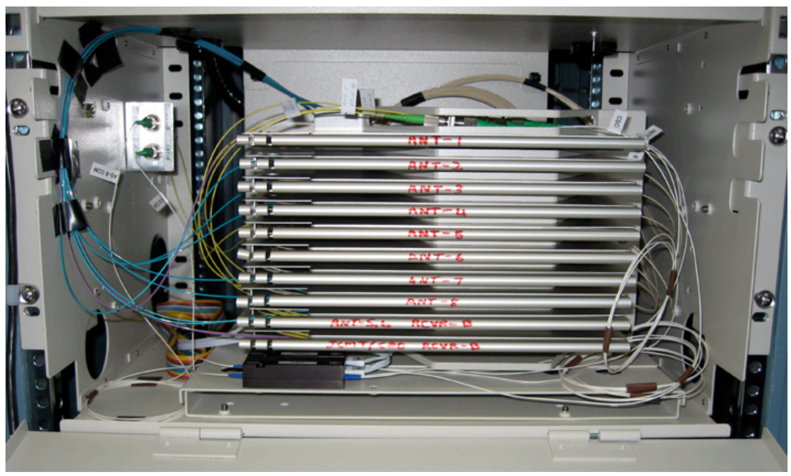

Figure 5 Photo of the Century Fiber Optic Splice Cabinet

Software Control & Status: Control of the two optical switches is via software only, there is no local control. Command and read back[3] of the switches is via hal9000 as follows:

```
hal9000> fiberswitch -h
Usage: fiberswitch -c [command] -s [serverName: default=128.171.116.182]
  some usual commands:
    fiberswitch -c esma both on     (goes to full eSMA mode)
    fiberswitch -c esma both off    (goes to normal SMA mode)
    fiberswitch -c esma cso on      (enables the CSO link, does not touch JCMT)
    fiberswitch -c esma cso off     (disables the CSO link, does not touch JCMT)
    fiberswitch -c esma jcmt on     (enables the JCMT link, does not touch CSO)
    fiberswitch -c esma jcmt off    (disables the JCMT link, does not touch CSO)
  to query the current setting:
     -c esma    (lists only the two fiber-related digital inputs)
     -c di      (lists all digital inputs)
```

[3] Software to control and read back of the ADAM module was written and tested by Todd Hunter.

```
This command can be issued on any of the following computers: hal9000, colossus,
and the acc's. The present status is shown on the mostly-blank line on the 'I' page
under the columns for antennas 5 and 6 at the top of the IF2 section.
```

Example monitor pages are shown in Figure 6.

For diagnostic purposes, Advantech provides a Windows based software utility which is available for download at www.advantech.com. This software automatically checks the local network for ADAM modules (must be performed from the summit network). The IP address for this ADAM-6050 module is 128.171.116.129.