NIRSPEC

UCLA Astrophysics Program | U.C. Berkeley | W.M.Keck Observatory

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NIRSPEC Electronics Application Note 18.00
Housekeeping transputer crate

1 Introduction

The majority of the NIRSPEC transputer boards[1] are housed in a card cage, where they plug into a standard VME backplane, but the root transputer (the one that connects directly to the host computer) and two others (providing RS232 support) are housed in a separate enclosure.

The reason for keeping these transputers separate from the rest of the system is so that they can take care of “housekeeping” functions such as monitoring cryogenic and cabinet temperatures, and control power to the rest of the system via a Pulizzi controllable power strip. In the event of a thermal problem all the other units in the cabinet can be turned off, while the housekeeping crate remains on, ready to start everything up again.

The root transputer's main function is to act as a network router between the host and the other transputers. It also reads temperature sensors in the electronics cabinets, and controls and monitors the arc lamps and quartz-halogen bulbs in the calibration unit. Control of the power strip and monitoring of the cryogenic temperatures is performed by the two RS232 transputers.

2 Transputer network description

This section describes where the root and RS232 transputers fit into the layout and operation of the transputer network.

The host computer (a Sparcstation) interfaces to the transputer system using a unit called a MatchBox, made by Transtech. The MatchBox connects to the external SCSI port of the host computer. Coupled with the Transtech driver software, the MatchBox gives the host software access to a single transputer serial link to the transputers running the instrument.

Transputer links are *not* RS232, RS422 or any other standard that can be used over long distances. They are TTL level signals, only reliable over a few feet, such as inside our cabinet, so we have to use some other protocol to bridge the distance between the host computer and the transputer system. The solution we adopted is the same as that used to connect the Photometrics PXL guider cameras; a pair of Black Box SCSI to fiber-optic converters extend the SCSI bus over the long distance, so the MatchBox can be placed in the electronics cabinets near the transputer crates.

[1] DAQ15 and DAQ17, described in NEAN04 and NEAN05 respectively. DAQ15s acquire data from the A/D converters, and DAQ17s are used for clock generation, motor control and housekeeping.

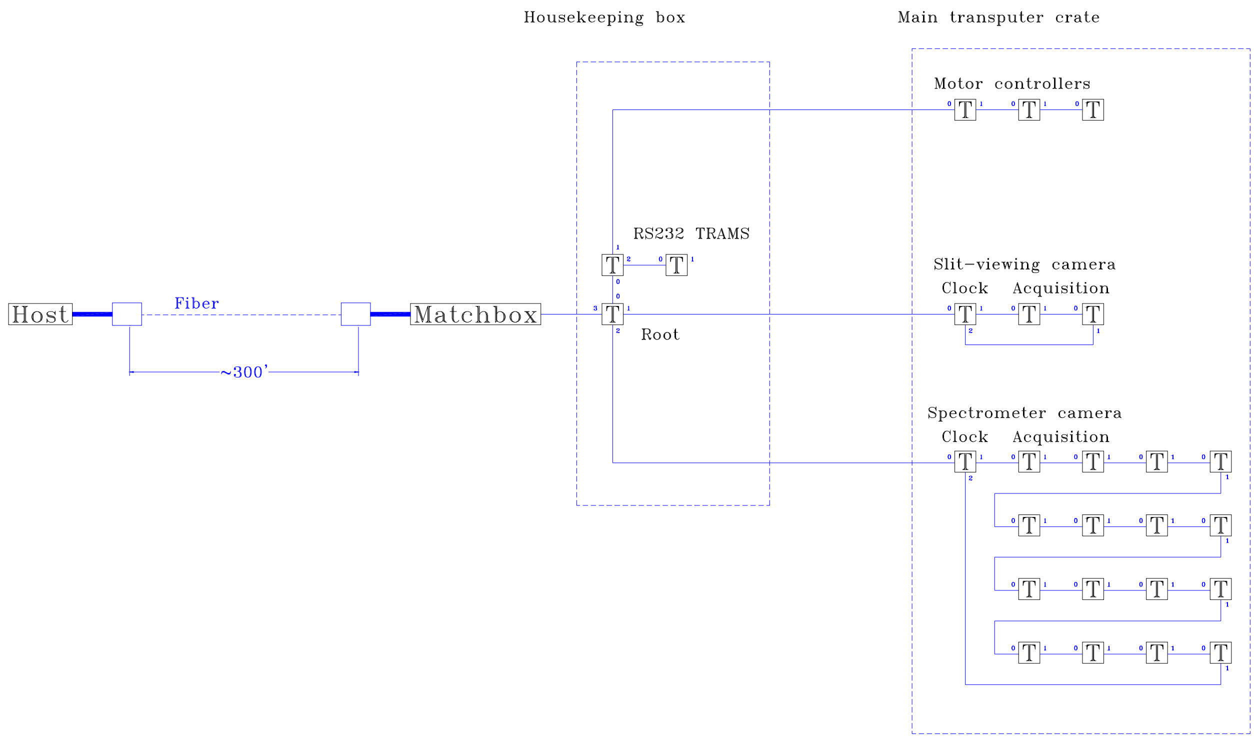

Figure 1: Transputer network layout

The transputer network layout is shown in Figure 1. The link from the host goes to the root transputer, housed in its separate crate, along with two modules which give us RS232 capability. The RS232 transputers interface to the cryogenic temperature controller, an 8-channel cryogenic temperature readout, and the computer-controllable power strip.

From the root transputer box there are three branches of the transputer network. One has the two RS232 transputers and three motor controller transputers, and the other two control the spectrometer and slit-viewing cameras. The spectrometer camera section has one DAQ17 clock generator board and four DAQ15 acquisition boards (with 4 transputers each). The slit-viewing camera (SCAM) uses one DAQ17 and two of the four transputers on a DAQ15.

3 Packaging

3.1 Layout

The housekeeping crate is a 3U size rackmounted box. The internal layout is shown in Figure 2. Everything was custom built in situ so it doesn't look pretty, but we've made sure everything is secure and strain-relieved as much as possible.

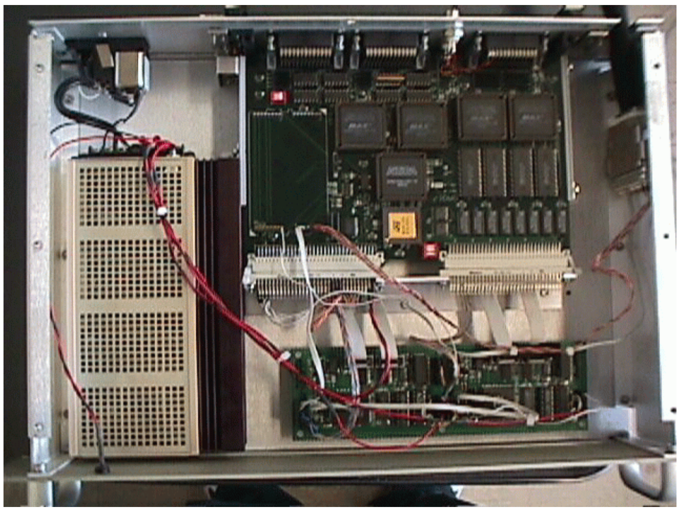

Figure 2: Interior layout

The crate contains is a single 5V power supply, a DAQ17 board and the two RS232 TRAMs. The DAQ17 board was made to be plugged into a VME backplane, but since there's only one in the crate, there is no point having a backplane. Instead it slides into card guides and plugs into a pair of 96-pin DIN connectors mounted on a bracket.

The two RS232 transputers are packaged as TRAM modules. The TRAM (TRansputer Application Module) standard is a daughterboard format commonly used to combine transputers with various kinds of standard interfaces such as SCSI, RS232/442 etc. There is a socket for one TRAM on the DAQ17 (making use of spare real estate on the standard size VME board) but since we needed room for two we mounted a piece of matrix board on standoffs. We created two TRAM sites using socket pins. Alongside and connected to the rows of socket pins are rows of 0.1" header pins, so we can bring power and signal connections to the TRAMs using push-on connectors. This lets us take a TRAM out for replacement with a spare without taking off most connectors. When we refer below to the “J1 header” we mean the header alongside socket J1 of the TRAM, connecting to it pin for pin.

The 5V power supply is mounted to the bottom plate of the crate, and gets its 110V power from an inlet on the rear panel.

Figure 3: Housekeeping crate rear connectors

The front panel of the DAQ17 sits flush in a cutout in the rear panel of the crate. The DB37 connector taking the links and subsystem signals to the main transputer crate is also on the rear, below the DAQ17 front panel. There are also four DB9 connectors for the four RS232 lines from the

RS232 TRAMs. This is shown in Figure 3. The 110V inlet isn't shown but is just out of the picture to the right. Also out of the picture, to the left, is the cable from the MatchBox, which enters the crate through a notch in the rear panel of the crate (at top right in Figure 2).

Of the connectors on the front panel of the DAQ17 board, the two DB25 “CLOCK OUT” connectors to the left (with dust covers) and the two BNC connectors aren't used in this application, but we use the other four DB25s, labeled Digital I/O 1 through 4, to connect to the cabinet temperature sensors (Dallas Semiconductor DS1820), the halogen lamp relays, the arc lamp relays, and the lamp sensor circuit respectively.

4 Interconnections

The interconnections inside the unit are the power from the power supply to the three boards, serial links and transputer control signals in and out of the crate and between the three transputers, four RS232 connections between the serial TRAMs and the back panel, and a 5 MHz processor clock signal from the DAQ17 board to the two TRAMs.

4.1 Power

The 110V supply from the inlet goes to screw terminals on the power supply, and +5V and ground go from screw terminals to the boards.

DAQ17	+5V	DIN connector J2, pin B1
	Gnd	DIN connector J2, pin B2
Serial 1	+5V	Connector J1, pin 3
	Gnd	Connector J2, pin 6
Serial 2	+5V	Connector J1, pin 3
	Gnd	Connector J2, pin 6

4.2 Clock signal

TRAM modules don’t have their own on-board clock, so this signal is fed from the 5 MHz processor clock to the TRAM socket on the DAQ17. It comes out on pin 8 of J3 on the TRAM socket. We plug an 8-pin header into J3, even though the clock signal is the only connection, since we don't want it to shake loose. This and other connections to the TRAM site are shown in Figure 4. From there the wire goes to pin 8 of the J1 header on serial TRAM 1, and from there it daisychains to pin 8 of the J1 header on serial TRAM 2.

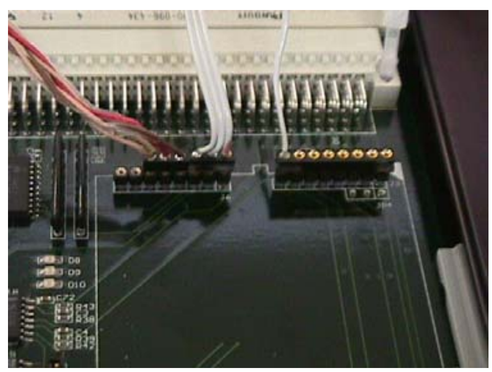

Figure 4: DAQ17 TRAM site connections

4.3 RS232 connections

There are two 10-pin headers on each serial TRAM, with ribbon cables taking the RS232 connection to four DB9 connectors on the back panel. These DB9 connectors have standard pinouts. Looking at Figure 2, the TRAM on the left is Serial 1 and the one on the right is Serial 2. Confusingly, the DB9 connectors on the back panel are labeled Serial 1 through 4. **When making connections, it is these back panel labels which should be matched to those on the cables.** The mapping from the software ports to the ports on the outside is given in the table below.

Software port	Physical port
Serial 1A	3
Serial 1B	4
Serial 2A	1
Serial 2B	2

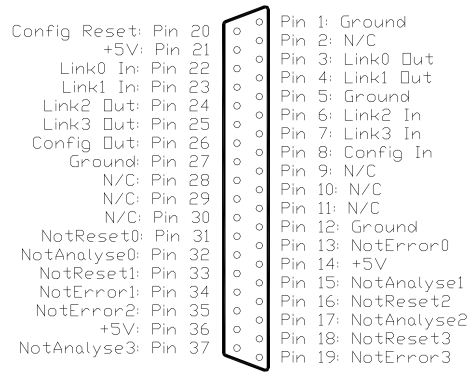

Figure 5: MatchBox links pinout

4.4 Links and subsystem signals

A single transputer serial link consists of two signals, one for each direction. From cabinet to cabinet each is sent over twisted-pair cable (each signal twisted with a ground). Over short distances, such as along a backplane, a single strand of wire wrap is OK (where “not OK” means “picks up noise and doesn't work”). Each transputer has four of these bi-directional links. It also interfaces to the host and all the other transputers in the system via 3 “subsystem” signals, called **error**, **reset** and **analyze**, which daisychain from transputer to transputer. In the cables between the MatchBox and the housekeeping box, and the housekeeping box and the main transputer crate, the links are on twisted pairs, but the subsystem signals run on flat ribbon cable. These wires are sheathed together in a braided plastic sleeve.

The MatchBox pinout is shown in Figure 5. The cable from the MatchBox into the housekeeping box is wired straight through. The cable from the DB37 connector on the back of the housekeeping box to the main transputer crate is also straight through (in fact it’s identical). By wiring the links on the housekeeping box connector to the appropriate pins, the housekeeping box looks to the main crate just like a MatchBox, except there is only one set of subsystem signals. During the early stages of building up the system we were thus able to connect the matchbox directly to the main transputer crate without the housekeeping box in between. We could still do so for purposes of troubleshooting.

The cable from the Matchbox comes in through the slot in the back of the crate, where its connector is attached by a nylon cable tie to the side wall of the crate. As shown in Figure 6, a female DB37 connector with flying leads plugs into it (threaded posts and screws were added since this picture was

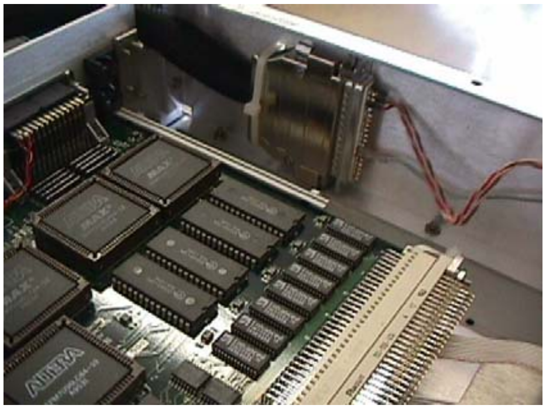

Figure 6: Links connector inside crate.

taken). The twisted pairs carrying the link from the matchbox go to the TRAM site on the DAQ17, for historical reasons. At one time there was a fiber-optic TRAM in the TRAM site bringing in the link from the MatchBox, but we switched to using the Black Box SCSI extenders which were much more reliable.

The subsystem signals (**reset**, **error** and **analyze**) come from the MatchBox connector to pins A30, A32 and A31 on the J2 VME connector.

MatchBox DB37	Connects to	Description
Pin 1	TRAM site J6 pin 6	Gnd
Pin 3	TRAM site J6 pin 4	MatchBox link 0 out
Pin 22	TRAM site J6 pin 5	MatchBox link 0 in
Pin 13	DIN J2 pin A32	MatchBox NotError 0
Pin 31	DIN J2 pin A30	MatchBox NotReset 0
Pin 32	DIN J2 pin A31	MatchBox NotAnalyze 0

The DAQ17 supplies the processor clock, power and ground, and the subsystem signals to the TRAM site, but there is no direct link between a transputer on a TRAM and the DAQ17's own transputer. The links for the TRAM site go to the J2 VME connector, on row C, and the DAQ17 transputer has all its links on row A, so all link connections are made at the backplane connector.

From J2 row C the MatchBox link goes to the DAQ17 transputer's link 3 via pins on row A. The DAQ17 transputer’s links 1 and 2 go to the DB37 connector on the crate’s back panel, while link 0 goes to link 0 on TRAM Serial 1. Serial 1's link 1 goes to the back panel DB37 (and so to the motor controller transputers), and link 2 goes to the other serial TRAM (see Figure 1).

DIN J2 connector	Connects to	Description
C10	A16	Gnd
C11	A14	MatchBox link 0 out to DAQ17 link 3 in
C12	A13	MatchBox link 0 in to DAQ17 link 3 out

DIN J2 connector	Connects to	Description
A10	Serial J2 pin 6	Gnd
A11	Serial 1 J2 pin 5	DAQ17 link 0 out to Serial 1 link 0 in
A12	Serial 1 J2 pin 4	DAQ17 link 0 in to Serial 1 link 0 out
A3	DB37 pin 4	DAQ17 link 1 out (to SCAM clock generator)
A4	DB37 pin 23	DAQ17 link 1 in (from SCAM clock generator)
A8	DB37 pin 24	DAQ17 link 2 out (to spectrometer clock generator)
A9	DB37 pin 6	DAQ17 link 2 in (from spectrometer clock generator)
A5	DB37	Gnd for A3, A4
A6	DB37	Gnd for A8, A9

The two TRAMS are linked, and serial 1 connects to the back panel DB37 connector as follows:

Serial 1 pin	Connects to	Description
J1 pin 4	DB37 pin 3	Link 1 out (to motor transputer 1)
J1 pin 5	DB37 pin	Link 1 in (from motor transputer 1)
J1 pin 1	Serial 2, J2 pin 5	Link 2 out to serial 2 link 0 in
J1 pin 2	Serial 2, J2 pin 4	Link 2 in from serial 2 link 0 out

The subsystem signals are daisy-chained from the DIN connector to the DB37 back panel connector.

DIN J2 connector	DB37	Signal description
A30	31	nReset
A31	32	nAnalyze
A32	13	nError

The RS232 TRAMs get their subsystem signals from the DAQ17 through the TRAM site connector. A ribbon cable goes from TRAM site connector J6, pins 1, 2, 3 to pins 1, 2, 3 on J2 of Serial 1. The machined pins used to plug the TRAMs into the socket pins on the matrix board have sockets in the top, so that TRAMS can be stacked when other connectors like the RS232 headers don't get in the way. This is used to take the subsystem signals from pins 1, 2, and 3 of J1 on Serial 1 to the same pins on J1 of Serial 2.

Also plugged into the top of each TRAM are short cables connecting pin 3 to pins 6 and 7 on J1. This selects the link speed to be 20 Mbit/s for all the transputer links on each TRAM.

5 Maintenance

Maintenance of this subsystem consists of replacing modules if one of them fails.

5.1 DAQ17 board

If it is ever necessary to replace the DAQ17 board, there are a couple of pitfalls to avoid.

First of all, since there are cables plugged into the TRAM socket, you MUST take out the crate, open it up, and take off the connectors before trying to take out the board. Make a note of where they go before you do: they are shown in Figure 4. There is a warning label on the back of the crate, but in case someone doesn't read warning labels, the board is attached to the DIN connector bracket with cable ties. Clip these off, undo the four screws holding the DAQ17 front panel in place (just like in a regular card cage) and gently slide out the board. When you replace the board you should replace the cable ties in case the next person to do this operation isn't as smart or attentive as you.

Secondly, before putting in a replacement board, you have to make sure of two things. First, there is a 3-pole DIP switch on the DAQ17 which sets the transputer link speeds. It's shown in Figure 2, at the rear edge of the board between the two DIN connectors. The DIP switches must be set the same as on the board you are removing, or the transputer won't be able to communicate with the rest of the system. (There's also a two-position DIP switch but you can ignore that one). Secondly, the DAQ17 in the housekeeping enclosure has been modified from the standard configuration. It's the only DAQ17 board in the whole system that is different.

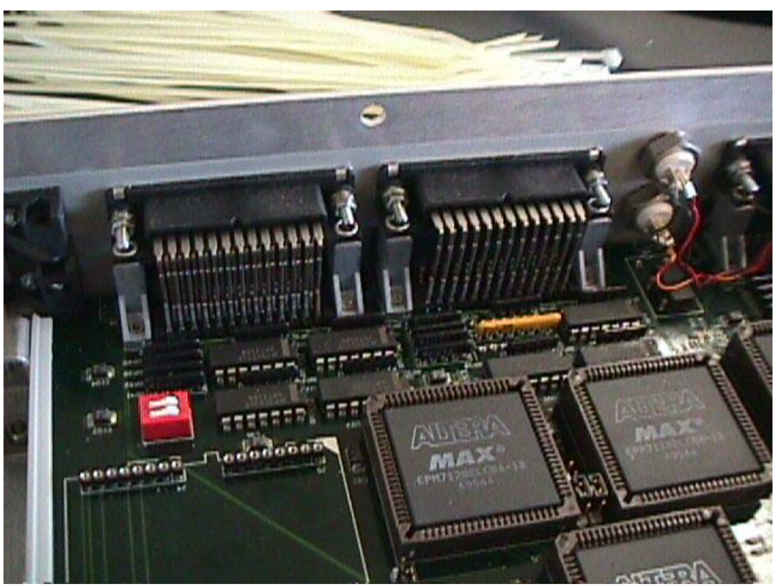

Figure 7: SIP resistor placement

The four digital I/O ports normally have eight output bits and eight input bits, on separate pins. To drive the Dallas Semiconductor DS1820 temperature sensor chips, we need to make four of the output lines on one of the ports bidirectional. This is achieved by taking out driver chip U24 (SN7438N) and plugging in a SIP resistor (SIP4ISO-33) in socket RP10. If you don't do this the cabinet temperature sensing won't work. You can re-use the SIP resistor, and put the 7438 in the board you pull out.