ANTCON—Phase 2: Pedestal Rack

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Abstract

This document describes the contents and functionality of 12U rack installed in antenna pedestal, later called "pedestal rack" together with the associated equipment in control room.

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1 The Goal

The goal is to replace existing ESSCO analog servo rack with a combination of pedestal rack residing in antenna pedestal and a control room PC, "`antcon`" connected to it via a RS422 serial link.

2 PC ISA Board Settings

The I/O address allocations of all ISA boards in various antenna control PCs should be kept as common as possible, so that boards can be moved between different PCs: from pedestal PC to "`antcon`" to "`daqqer`" to intermediate test PCs like "`kinukki`". Please refer to table 1 on page 7 for common ISA I/O address allocations.

Some notes:

1. ET1728 D/A converter (which is only used together with old ESSCO analog servo) occupies 16 addresses (according to its manual) although it only uses 4 first of them.
2. The range 0x100–0x1FF should in principle be available for use, although many "Taiwanese" ISA board manuals mention this area as "unusable". At least some multiport RS232 boards are known to use this area.

The leading principle regarding IRQ and DMA lines has been to disable them at all boards where this is possible (leave out IRQ jumpers altogether). The following table 2 on page 8 enumerates IRQ lines used.

When replacing boards it is important to check that IK121 and Pine 512K VGA boards have IRQ jumpers removed. This is contrary to what their manuals say about these jumpers, the manuals consider them mandatory. However, in practice neither of those boards actually needs an interrupt.

3 Pedestal Rack

Pedestal rack is the main enclosure of all electronics located in the antenna. A 12U high and 19" wide wall mount "Imrak 400" is manufactured by VERO Electronics. It is available from Farnell Electronics (Order Code 644-705). It has a tinted glass front door which leaves indicator LEDs visible. The general layout of the rack as seen from the front is shown in figure 1. For rear door cabling arrangements please see section 3.8 on page 19.

Table 1: Common ISA I/O address allocation. 1

Board Name	I/O Address
Standard PC I/O Ports	0x000--0x0FF
“Not Usable”???	0x100--0x1FF
Game I/O Port	0x200--0x207
Available	0x208--0x20F
ET2816 16-ch 16-bit A/D	0x210--0x21F
ACL-7122 6*3*8-bit digital I/O	0x220--0x23F
2nd ACL-7122 (or ET1722B)	0x240--0x25F
ACL-8113 32-ch 12-bit A/D	0x260--0x26F
Available	0x270--0x277
LPT2:	0x278--0x27F
PWMISA board	0x280--0x2BF
(NE2000 Ethernet/kinukki)	0x280--0x28F
ET1728 2-ch 12-bit D/A	0x2C0--0x2CF
Available	0x2D0--0x2F7
COM2:	0x2F8--0x2FF
Wire-wrapped PWM	0x300--0x30F
VAXIF VAX parallel interface	0x300--0x307
VAXIF / Probably available	0x308--0x30F
IK121 (Heidenhain)	0x320--0x32F
Available	0x330--0x33F
NE2000 ISA Ethernet board	0x340--0x35F
Available	0x360--0x377
LPT1:	0x378--0x37F
Available	0x380--0x3AF
VGA, monochrome compatibility	0x3B0--0x3BF
VGA	0x3C0--0x3DF
Available	0x3E0--0x3EF
Floppy, IDE0	0x3F0--0x3F7
COM1:	0x3F8--0x3FF

3.1 Pedestal PC

This is the final pedestal rack PC: an industrial enclosure with a set of ISA-based boards. (The “extra” temporary PC used in pedestal in phase 1 will eventually act as a “live” backup spare and it will be equipped with identical boards as the rack PC.) The following equipment will be needed:

1. An EC-1120 enclosure with 10 ISA slots (9 usable, since the slot nearest to power

Table 2: Common IRQ allocations.

IRQ	Board	Description
0	(mb)	Timer
1	(mb)	Keyboard
2	(mb)	Cascade to IRQ9
3	(mb)	COM2:
4	(mb)	COM1:
5		
6	(mb)	Floppy disk
7	(mb)	LPT1:
8	(mb)	Real-time clock
9		
10	NE2000	Ethernet interrupt
11	PWMISA	1pps interrupt
12	(mb)	PS/2 mouse
13	(mb)	Math error
14	(mb)	ide0
15	(mb)	ide1

supply is needed for LPT1: rear plate and CPU heatsink) (FIM 1891); we already have two of these.

2. A CISA-486H CPU board (FIM 1761).

3. An AMD486DX4-100—120 processor (about FIM 500).

4. ◯Buy: A heat sink without fan for the processor. (Must be acquired: currently we still have a fan.)

5. A 16MB SIMM RAM memory module (about FIM 650).

6. A floppy disk drive (about FIM 200).

7. An 3.5" IDE hard disk drive. We will use some extra drive we already have—capacity is not critical. In the final version the hard disk will be replaced by a non-volatile solid-state flash EEPROM disk such as PC-FD-10 10MB flash disk board (FIM 2337; we already have two of these).

8. The remote end unit of PC-Extender (leftover from AMS project). This allows pedestal PC VGA display, keyboard, and mouse to be remotely operated from control room.

9. A temporary VGA board. (Two identical "Pine" 512kB VGA boards have already been bought.) A VGA extension cord is needed to connect to the PC-Extender.

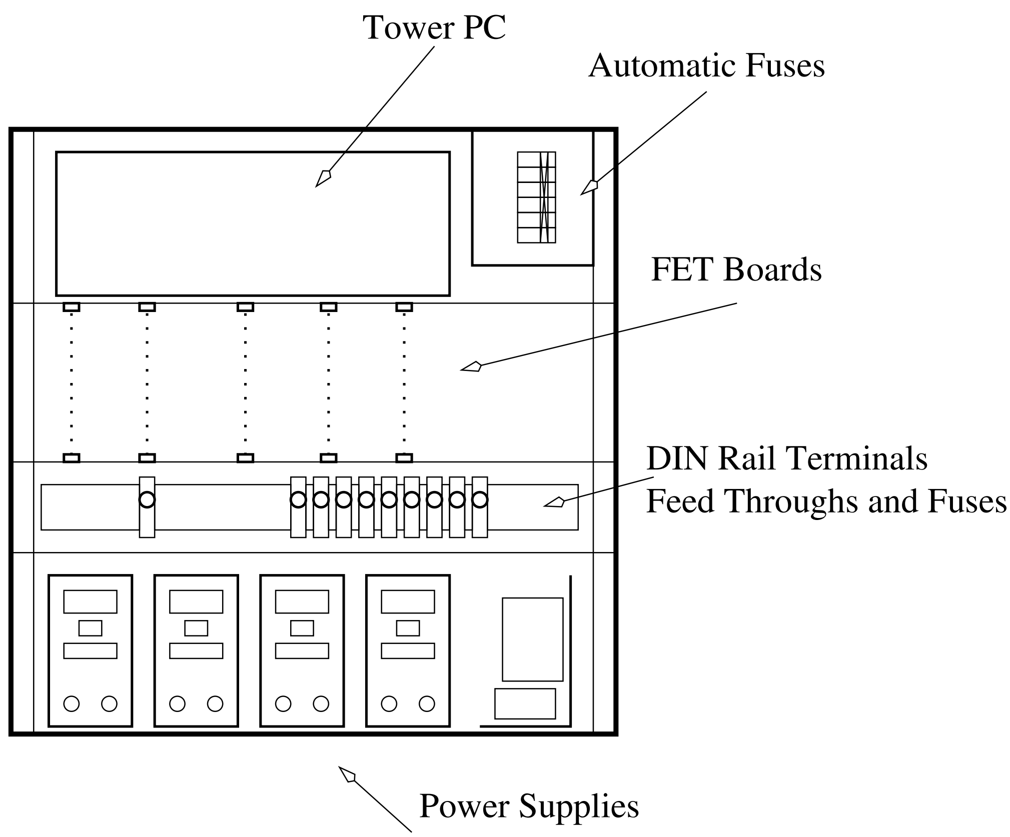

Figure 1: Block diagram of pedestal rack. Front view.

10. A temporary keyboard; we already have it. A DIN5 (or PS/2?) keyboard extension cord is needed to connecto the PC-Extender.

11. An IK121 Heidenhain RON806 interface board; we already have two of them.

12. A generic NE2000-compatible ISA-based Ethernet board with RJ45/BNC auto-selective connectors. The board is set up in permanent address NE2000 mode (not Plug-and-Play) at I/O 0x340, IRQ 10, auto-RJ45/BNC, boot ROM disabled, and half-duplex RJ45 operation. The PnP-based configuration program "EZCFG.EXE" doesn't work with a ACL-712 144-bit digital I/O board installed at 0x220 at the same time, so the boards must be configured in a separate PC before plugging them into pedestal PC(s).

13. A RS232 to RS422 converter to ensure control room—antenna 115kbaud link reliability. (COM-1485 by Capax (FIM 463) seems to work fine and we have four of them, one for FS PC for VLBA rack connection, two for antenna—control room connection, and one spare. These units cannot apparently be purchased from Capax anymore, will four be enough?) This unit needs +9VDC power and in pedestal PC using 220VAC wall-mount power supply is unpractical. Cabling from DB25 connector to

PC D9/D25? connector: ◯. Mounting of converter in rack? ◯

14. A relay connected to the reset switch. This relay can be remotely activated from control room. It can be mounted close to the reset switch or somewhere else in the PC. The relay coil is wired to two pins of the female DB9 connector presented below in table 3. A male DB9 connector in PC is applicable since voltages are present in cable plug connector. The relay will be activated by switching on +5VDC from control room rack box via the JAMAK multipair cable.◯Add DB9 female connector to all (3) PC enclosures.

15. LM35 temperature sensor wires are routed out of the PC enclosure using one DB25 cut-out at its upper rear panel. A male DB25 connector in PC is applicable since voltages are present in cable plug connector. The connector pinout is presented in table 4. ◯Add DB25 female connector to all (3) PC enclosures.

Table 3: Pedestal PC reset relay DB9 male connector pinouts.

Pin#	Wire Color	Description
6		+5VDC relay coil 1
7		GND relay coil 2

Table 4: Pedestal PC LM35 temperature sensor DB25 male connector pinouts.

Pin#	Wire Color	Description

3.1.1 ISA Board Locations

The following table 5 enumerates the ISA boards in pedestal PC, starting with the board slots closest to the PC enclosure power.

3.1.2 PWMISA–5MHz/1pps/PWM-out/watchdog

This board will be a new ISA board made in-house with MACH211 chips. (Alternatively it could have been one or two small (Euro-1?) boards with a 50-pin “Opto-22”-style ribbon cable connector(s) to parallel digital I/O board.) The alternatives are briefly as follows:

Table 5: Pedestal PC ISA board slot locations.

Slot#	Board
1	LPT port connector
2	CPU board
3	PC-FD-10 10MB flash disk
4	VGA board
5	NE2000 Ethernet board
6	IK121 Heidenhain encoder board
7	ACL-8113 32ch 12-bit A/D board
8	
9	PWMISA
10	ACL-7122 6x3x8-bit digital I/O

1. One ISA board with 5MHz/1pps clock submodule and PWM submodule on it. 5MHz/1pps circuitry is located at rear panel with two BNC card edge connectors. PWM and ANTIPH outputs and other per-FET-board signals are generated in one MACH211 chip (one MACH per one FET board). Three 26-pin ribbon cable connectors (one per two FET boards) are on the board and the cables are routed over the board out in a slot in rear panel.

2. The whole 5MHz/1pps/PWM circuitry can also be put on one PCB, possibly one Euro-1, perhaps a prolonged one. One 50-pin "Opto-22"-style ribbon cable connector will be enough for I/O: one 8-bit output for register selection, one 8-bit input for 5MHz/1pps clock readout, and one 8-bit output for PWM value setting.

3. 5MHz/1pps clock submodule and PWM submodule can also be split into two boards, two Euro-1(?) boards or either one as an ISA board. Please note that the 5MHz/1pps clock submodule is also used in the sampling PC (see section "4.3" on page 17 below) where it must also be able to generate 10kHz sampling clock for the sampling A/D converter board. If two Euro-1 boards are used they both will need one 50-pin port from the digital I/O board (or perhaps the cable split in two approximately 25-pin ribbon cable connectors: 4-bit register selection and one 8-bit data in or out port).

Since it seems that PWMISA requires 64 I/O addresses (0x00–0x3F) there are relatively few ranges in PC-ISA I/O address map into which it can be allocated. We tried to use 0x380–0x3CF only to find out that 0x3C0–0x3CF is being used by DOS (not Linux) as "VGA board in Monochrome adapter compatibility mode". Thus we are planning to use 0x280–0x2CF for this board.

The PWMISA board is further described in a separate CVS/LyX document "`ant/doc/pwmisa.lyx`".

3.1.3 QDR—Quadrature Encoder Input (4 diff.)

The motors will be equipped with digital optical tachometers (Heidenhain ERN420). These can be used to maintain constant slow (tracking) speed in motors. The encoders have quadrature outputs and we can either use HP decoder chips on an in-house PCB (either an ISA board or a small (Euro-1) board with 50-pin "Opto-22"-style ribbon cable connector to parallel digital I/O board) or alternatively buy a "CyberResearch ESH 254" 4-channel quadrature encode 8-bit bus ISA board at $875+S&H+VAT.

A prototype Euro-1 board has been tested with both ERN420 (RS422) and HP panel rotary (TTL) encoders and it has been found to operate correctly.

The QDR Euro-1 board is further described in a separate CVS/LyX document "`ant/doc/qdr.lyx`".

3.1.4 Space for A Future Subreflector Position Sensor Input Board

xxx it is possible that a LVDT, optical, or similar input board must be added later to the pedestal PC.

3.1.5 16-channel 16-bit A/D

This is a 16-channel 16-bit A/D converter board such as ET-2816 (FIM 2863, one has been bought from Capax) or ACL-8316/L (FIM 2250 from Lab Hi-tec) which will read the tiltmeter outputs. Adapter board ETD-8125 (FIM 441) plus a D37 cable (ET-10137-1, 1m, shielded, FIM 113) has screw terminals for tiltmeter open ended cable and this has been used in temporary phase 1 installation. The sensors are:

1. Temperature of tiltmeter
2. x-tilt
3. y-tilt
4. 13 spares (5 if used in 8-channel differential mode)

This board can (and will likely to) be omitted initially. 12-bit A/D board (below) gives LSB resolution of 4.88mV/bit in the default $\pm$10VDC range, and this means that with tiltmeter range of $\pm 400\mu$radians producing $\pm$8VDC we will get about 14μdegrees or 0.014 millidegrees.

It may be worthwhile to add this board to the PC if new subreflector position sensing is voltage-based because this board would have enough accurate channels for a new 4–8-axis subreflector. The existing FET motherboard design allows for this since the tiltmeter signals have been separated so that they can be moved from 32-channel board (presented in section 3.1.6 below).

3.1.6 32-channel 12-bit A/D

AdLink ACL-8113 (FIM 2250+VAT) measures voltages, currents, temperatures. Three of them have already been bought from Lab Hi-tech (one for pedestal PC, one spare, and one for SunAnt).

1. 4×28V power (from motor FET boards via Eurocard FET motherboard)
2. 1×future subreflector motor power (from its FET board via Eurocard FET motherboard)
3. 5×Imotor (from all FET boards via Eurocard FET motherboard)
4. 5×Tfet (from all FET boards via Eurocard FET motherboard)
5. +15V power, -15V power (from Eurocard FET motherboard)
6. 24V power (safety interlock, motor contactor power; from xxx)
7. 5V digital logic power (directly from power?)
8. Temperature of pedestal PC (LM35 sensor arrangement (with +/-15V power) on Eurocard FET motherboard)
9. Temperature of pedestal rack (see above)
10. 110V brake power? (directly from power?)
11. 2×fan voltage? (directly from fans?)
12. Three signals from the tiltmeter if the above 16-bit A/D board is not used
13. 27 (25) signals, 5 (7) spares

3.1.7 6 connectors×3×8-bit Digital I/O

An AdLink ACL-7122 digital I/O board (from Lab Hi-tech for FIM 899+VAT) (an identical board was called ET-1722B from Capax at FIM 919+VAT) provides digital I/O for various purposes. The board is jumpered at I/O address location 0x220 with all interrupt logic disabled with jumpers (IRQ jumper at "X", individual port jumpers at "D").The board is used for:

1. Absolute ROC412 encoders (2conn×3×8 bit).
    - Soldered interface cable for converting ROC412 open cable end to 50-pin ribbon cable connectors.

2. 24-bit opto in (1conn×3×8 bit)

    - Interlock, safety limit switches. Used with AdLink TB-24P optoisolated input board (FIM 680+VAT from Lab Hi-tech, two of them already bought) with a standard 50-pin ribbon cable.

3. 4..8-bit TTL output and 8-bit in (1conn×3×8 bit)

    - Motor tachometer (digital quadrature encoders) readout. Can be omitted, if this encoder is on an ISA board.

4. Approx. 8-bit direct out (may need its own 1conn×3×8 bit)

    - Subreflector motor switcher control output bits.

5. (Approx. 5-bit direct out)

    - FET driver board enable control output bits. These go to via PWM driver/watchdog/interlock circuitry so that computer inactivity/hangup will disable these signals and stop FET boards and thus motors. These enable signals need also go to the motor contactor relay board (see “3.6” on page 17 below).

6. (4..8-bit TTL output and 8-bit in (0.5/1conn×3×8 bit))

    - Readout of accurate 5MHz/1pps clock. Can be combined with PWM output or omitted, if 5MHz/1pps clock is on an ISA board.

7. (4..8-bit TTL output and 8-bit out (0.5/1conn×3×8 bit))

    - Setting FET board PWM output counters. Can be combined with 5MHz/1pps or omitted, if PWM is on an ISA board.

Depending on the amount of in-house custom ISA boards we may need 4–8 50-pin parallel connectors, thus one or two ACL-7122 boards may be needed inside the pedestal PC. At the moment it seems that PWM, FET, and 5MHz/1pps functionality will be on PWMISA board and thus five 50-pin connectors will be enough and the items in parenthesis will be left out.

3.1.8 PC→Rack Cabling

xxx See table 6.

The cables are manufactured according to tables 7to xxx on pages 15 to xxx.

Table 6: Pedestal PC to pedestal rack cabling.

Slot#	Board	Connector	Type	To Rack	
10	Dig. I/O	CN0xxx	50-pin ribbon	Az ROC412 Abs encoder (see table 7	
		CN1xxx	50-pin ribbon	El ROC412 Abs encoder	
		CN2xxx	50-pin ribbon	QDR board of motor tachos	
		CN3xxx	50-pin ribbon	Interlock chain opto board	
		CN4xxx	20?-pin ribbon	Subreflector switcher	
		CN5xxx		(spare)	
9	PWMISA	Jxxx	BNC	5MHz	
		Jxxx	BNC	1pps	
		Jxxx	20-pin ribbon	relays/limits (see table 8)	
		Jxxx	26-pin ribbon	Az1/2 FET control (mb)	
		Jxxx	26-pin ribbon	El1/2 FET control (mb)	
		Jxxx	26-pin ribbon	Subreflector FET control	
7	32ch A/D	Jxxx	DB37F cable	to FET motherboard (see xxx)	
6	IK121	Jxxx	DB9F cable	to Az RON806 Incr encoder	
		Jxxx	DB9F cable	to El RON806 Incr encoder	
5	NE2000		RJ45	CAT5 #3 to control room 100Mbit hub	
4	VGA		DB15F cable	to PC-Extender	
2	CPU	Jxxx	DB9F cable	COM1 to DB25F RS422 (see table 9)	
		Jxxx		COM2 (spare)	
		Jxxx	MiniDin8	Keyboard to PC-Extender	
		Jxxx	MiniDin8	PS/2 Mouse to PC-Extender	
1	Conn. plate	Jxxx	DB25F conn	LPT1 (spare)	
Back	DB9 Hole		DB9F cable	Reset relay connector (see table 3)	
	DB25 Hole		DB25F cable	LM35 temperature sensor (see table 4)	
	230VAC		IEC	Power cord from xxx	

Table 7: ACL-712 digital I/O 50-pin ribbon cables.

Copies	Length	Description
3	80cm	Az, El, QDR
1	90cm	Opto board, with middle "tap" connector
1		20-pin subreflector switcher

3.2 Power Supplies

1. 110VDC (brakes),
2. 4×28VDC (motors),
3. 1×24VDC (safety interlock chain, motor contactors, control room rack box LED

Table 8: PWMISA ribbon cables.

Copies	Length	Pins	Description
1	60cm	26	Az
1	70cm	26	El
1	80cm	26	Subreflector
1		20	Relays & limits

Table 9: Pedestal PC COM1: to RS422 converter cable, length xxxcm.

DB9F	DB25F	Color	Description
3	2		to RS422
2	3		to PC
1		20	Relays & limits

indicators),

4. ±15VDC (analog electronics on FET boards),
5. 5VDC (digital logic on FET and other boards), replaced 24.5.2010 (XP POWER ECM60UT31, switching power supply).
6. +12VDC primarily for fans, replaced 24.5.2010 (XP POWER ECM60UT31, switching power supply).

3.3 Fuses

The following power supplies have their 230VAC primaries protected with Klöckner-Moeller FAZN C1 automatic fuses (six (6) fuses altogether):

1. PC, +12VDC power, ±15VDC power
2. Brake power
3. Az1, Az2, El1, El2 powers (4pcs)

Isolated glass-tube fuses mounted in DIN rail (with indicator lamps; all?) have been used for:

1. xxx
2. xxx

There is a 230VAC emergency cutoff switch located in control room rack area. This disconnects all other 230VAC supplies to pedestal rack except pedestal PC power. (It can be switched off using UPS circuit breaker is absolutely required.)

3.4 Fans

On below of PC-rack has four fans (12 Vdc, 200 mA, 2,4 W, ebmpapst), replaced 24.5.2010.

Top part of the rack has two fans (12 Vdc, Farnell order number: 149-428), replaced 24.5.2010.

3.5 Motor Contactors

There are four KLÖCKNER MOELLER DIL-EM-10-GI type contactors (with 24VDC coil voltage) which are used to connect motors to FET board outputs and simultaneously disengage axis brakes. (The future subreflector motors have their own switcher which performs a slightly different function, connecting one FET board to one of many motors at a time, see section 2 on page 8.)

3.6 Motor Contactor Switch-On Relay Board

This board has up to eight (but a minimum of four) small dual-pole dual-position relays which can be controlled with TTL signals in a fashion restricted by a programmable GAL chip. The same board can be equipped with four relays to activate motor contactors or with 4–8 relays to switch the fifth FET board to any of 4–8 subreflector move motors.

1. Interlock GAL. This can combine a watchdog signal and individual enable signals, however, the individual TTL signals from 5M/1pps/PWM/watchdog ISA board will most probably be already "protected" in ISA board. The 24VDC supply voltage for motor contactors being switched on by relays on this board nevertheless comes from interlock chain, thus the motor contactors cannot be activated unless interlock chain is unbroken (or manually overridden with a keylock switch downstairs).

2. ULN-chip based driver for 5VDC coil (24VDC contacts) relays driving motor contactors.

3. Motor contactor relays mounted on a DIN rail behind the Eurocard subrack.

Connects to 5M/1pps/PWM/watchdog ISA board which has a 20-pin ribbon cable connector with TTL "activate relay" signals for four FET boards. (The connector on PWMISA is shared with "slow limit switch" inputs, so the 20-pin ribbon cable is spliced and only 8 wires are routed to this relay board.)

◯Do metal TTL relay pinout in PowerPCB. ◯Complete the design. ◯Build the prototype. ◯Test it.

3.7 Euro-1 Card Cage (Subrack)

xxx

3.7.1 Motherboard

Initially the rear panel area of Euro-1 subrack was decided to split into two parts: FET motherboard and relay motherboard. At the moment it seems likely that "relay motherboard" will be omitted and direct connectors to Euro-1 boards will be used. Also, the vacant "relay motherboard" area will msot probably be used as "subreflector area": new subreflector power(s) and position encoder electronics.

The FET motherboard supports connecting three LM35 temperature sensors, one for PC inside temperature and two for rack inside temperature.

FET motherboard design files (PowerLogic schematics and PowerPCB layouts) can be found in CVS directory "`ant/fetmb`".

3.7.2 5×FET Board

Totally 5 FET boards are mounted in the rack at the same time. Four of them controls the antenna azimuth and elevation motors and the last but not least one will be used as a subreflector motor controller. The design is quite far from cost effective, and one of the design goals was to make FET boards "rock-solid". High current traces are 70μm thick and 100 mils wide so 10 Amps peak currents do not burn traces.

All design files can be found in CVS directory "`ant/fet`". A separate CVS/LyX document describes the board in "`ant/doc/fet.lyx`".

3.7.3 Subreflector Motor Switcher

This is basically the same board as in the above section 3.6. Possibly the relay contact output routing and/or connectors have to be different.

1. Interlock GAL (prevents driving multiple motors at the same time).
2. ULN-chip based driver for 24V DPDT(?) relays selecting one motor at a time to be connected to one FET board.

Connects to digital output ISA board and by using, say, 20-pin ribbon cable connector with pins 1–16 in use, odd pins for TTL signals and even pins for ground, we can make the connection to standard "Opto-22" 50-pin 3x8-bit ports "spliceable", i.e. a splice of 16 wires out of those 50 results in 8 control bits for the switcher. The bits can be further interpreted inside the GAL programmable chip.

3.7.4 Space for Subreflector Position Encoder Signal Processing Circuitry

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◯Quick decision: keep existing unchanged or move current encoder signal processing board plus power supplies to tower.

3.8 Pedestal Rack Rear Door

The figure 2 illustrates the location of pedestal rack cables in rear door lower part.

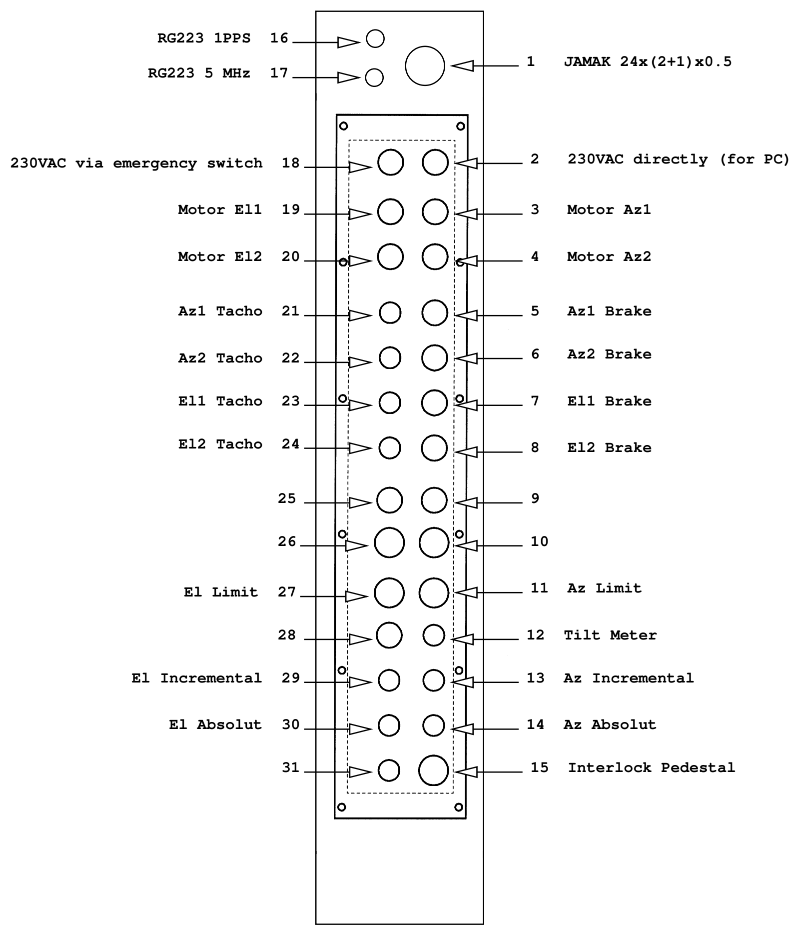

Figure 2: Pedestal rack thru-mounting cable holes.

Inside the door there is a aluminum plate for making drillings for boards and DIN rails is mounted inside the back door of the rack. Next to DIN rails there is also the +24VDC optoisolated digital input board. The overall layout of inside door is depicted in figure 3.

The interlock chain is formed using it and possibly a DIN rail of screw terminals. Interlock wiring happens in the following order (table 10):

Figure 3: Pedestal Rack Read Door Layout

Table 10: The chain of interlock switches.

Switch #	Name	Cable
SW2	CW Slow Limit	A
SW4	CCW Slow Limit	A
SW6	UP Slow Limit	B
SW8	DOWN Slow Limit	B
SW11	MAIN sw	JAMAK (pair# 8)
SW12	EMERGENCY sw	JAMAK (pair# 13)
SW13	Interlock Tower	JAMAK (pair# 14)
SW14	Bronto OK (down)	JAMAK (pair# 15)
SW15	Hoist sw	C
SW16	Receiver Position OK sw	C
SW17	Interlock Pedestal	C
SW10	Not In Use	
SW3	CW Final Limit	A
SW5	CCW Final Limit	A
SW19	Az Standby	JAMAK (pair# 9)
SW20	Az Override	JAMAK (pair# 11)
SW21	Stow Pin	C
SW7	UP Final Limit	B
SW9	DOWN Final Limit	B
SW23	El Standby	JAMAK (pair# 10)
SW24	El Override	JAMAK (pair# 12)

Please note that the first four "limit" signals are not actually a part of the interlock chain. They are connected to the +24VDC optoisolator board only to get +24VDC→TTL level translation so that PWMISA board can accept these "slow-down" inputs.

A detailed description of rear door cabling can be found in ANTBL block diagrams on pages xxx, "xxx".

4 ANTCON Equipment in Control Room

4.1 Control Room PC, "`antcon.kurp.hut.fi`"

The control room PC is a rack-mounted model similar to the existing VLBI control PC. It will eventually run Linux-based antenna control programs and take care of antenna status monitor display, located in control room rack. Apart from the standard PC equipment the following should be added:

1. A RS232 to RS422 converter to ensure down-up 115kbaud link reliability. (See section "3.1" on page 7 for discussion.)
2. A RS232-mux/switchbox required for testing the controlling system before final installation. Will be connected next to control room RS232 to RS422 converter.
3. An interface to accept coordinates from VAX parallel output. The "VAXIF" ISA board by Jouko (only one copy has been built and exists) will be sufficient.
4. An old VAX-wire-wrap or new PWMISA board is required for FET board testing.
5. A two-channel D/A output board ET-1728 (FIM 1433) plus its adapter board ETD-7285 (FIM 215) to send analog position error signal to old servo electronics; we already have them.
6. Interface cable from the D/A board to ESSCO servo rack. We already have the cable ready with a MIL-type connector at ESSCO end.

4.1.1 5MHz/1pps/Sampling Clock Generator

xxx maybe this will be located in "`daqqer.kurp.hut.fi`" sampling PC, maybe another copy of this board will be added to "`antcon.kurp.hut.fi`" to provide accurate UTC clock. (On the other hand, "`antcon`" does not really require "super-accurate" time since pedestal PC has it.) xxx 50/50 percent "duty cycle" control output signal for controlling receiver (Dicke) switchers?

4.1.2 QDR—Quadrature Encoder Input Board (4 TTL)

This board is like the motor digital tachometer input board, but with 4 TTL inputs (instead of 4 differential RS422 inputs). HP digital panel "knobs" (most probably HEDS-5701-A00, 500 counts per revolution, free-spinning 1/4" round axis, as this is available from Farnell) will be used in control room operations/control panel.

4.1.3 LEDIM—Control Panel Digital In/Out

Using two 50-pin connectors of a standard ACL-7122 6×3×8 bit digital I/O ISA board plus a separate (Euro-1) board with:

1. MACH211 and ULN-based driver for 5V LEDs or 24V LED-lamps (with 2-bit off/dim/bright selection).
2. Debouncing push buttons, maybe a standard opto-in board to accomplish 24V to 5V TTL conversion. (Debouncing is not actually very critical, can be done in software which in any case is polling the interface.)

4.2 ANTBOX—Control Panel Rack Box

A 6U high 19" rack-mountable enclosure with hinged front plate. This box will house:

1. DIN rail screw terminals for terminating the new JAMAK twisted-pair cable (24 pairs).
2. RS422 converter for converting pedestal PC RS422 to RS232 for control room PC plus its power supply (+9VDC). DB25 female connector to "antcon" COM2: port can be connected using a 1:1 "modem"-style (ribbon) cable to a DB25 male connector. The box will be equipped with a DB25 female connector, just like a typical external RS232 modem. Crimped DB25 connectors and flat (non-twisted) ribbon cable can be used for both external and internal box cabling.
3. A standard RS232 LED box. It will be mounted/glued directly to the backside of front panel so that LEDs will show up from drilled holes in front panel.
4. At least a +5VDC power supply, possibly the +24VDC power supply from pedestal rack could be moved to this box since the interlock chain actually originates from the main front panel "OFF" switch. (Don't forget the RS422 converter power!)
5. One quadrature encoder board (described above in section 4.1.2) for front panel rotary encoders ("knobs"). This connects via one 50-pin ribbon cable to control room PC parallel I/O board.
6. Control panel digital I/O (described above in section 4.1.3) for connecting to front panel buttons and LED indicators. This connects via two 50-pin ribbon cables to control room PC parallel I/O board, one cable for lighting up LEDs and another for reading in the state of pushbuttons.
7. Pushbuttons (illuminated with LEDs), LED indicators (max 16), and rotary encoders (probably 3, max 4). All pushbutton switches are terminated to one ribbon cable connector (40–50-pin), and all LEDs to another. Encoders have individual cables with DB9 male connectors.

A suggested front panel layout is shown in figure 4. The ANTBOX construction is further described in a separate CVS/LyX document "ant/doc/antbox.lyx".

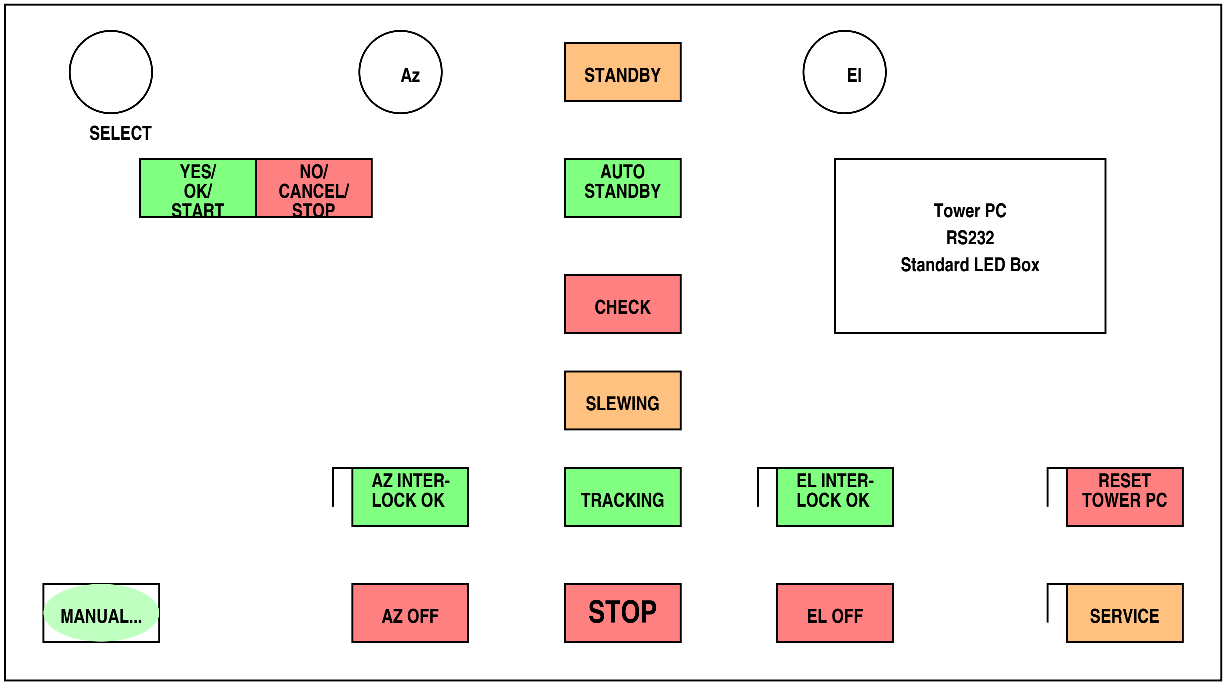

Figure 4: Control Panel Rack Box Front.

◯Select the box type and buy the box. ◯Buy max 16 buttons and LED indicators, power supplies. ◯Design the box. ◯Build the boards. ◯Wire the box. ◯Test it.

4.3 Sampling PC, "daqqer.kurp.hut.fi"

Another rack-mounted PC in the control room is equipped with Datel PCI-416 4-channel 16-bit simultaneous 200kHz sampling PCI A/D converter board. xxx

4.3.1 Differential Receiver Amplifier and Sampling Filters

xxx The existing 5MHz-to-10kHz sampling clock divider MACH211 chip subboard must be redesigned to use "wait for 1pps rising edge". Possibly "daqqer" can be equipped with a copy of the PWMISA ISA board with only 5MHz/1pps clock chips populated—although the software doesn't have much use for the accurate sub-second UTC clock, starting sampling at next 1pps UTC second will be sufficient.

4.4 Measurement Control PC, "meacon.kurp.hut.fi"

xxx a larger 17" monitor

4.5 AutoView Commander—PC Keyboard Switcher

Autoview Commander changes the common keyboard and the mouse between "`meacon`" (the default), "`antcon`", and "`daqqer`". The fourth PC input is connected with PC-Extender to the pedestal PC. "`antcon`", and "`daqqer`" will have their own 15" monitors directly connected., and the 17" main measurement control monitor will be directly connected to "`meacon`". Pedestal PC display is presented in a small 9" monochrome monitor "tucked away" in old VAX rack.

4.6 UPS System Arrangement

◯Allocate UPSes sensibly.

UPS#1 ANTCON:

1. Pedestal rack (without emergency switch), for pedestal PC, TARMO 3 ×1,5S.
2. Rest of pedestal rack (via emergency switch), TARMO 3 × 1,5S.
3. "antcon" control room PCs and its 15" monitor, without emergency switch, third cable (ATON?).
4. Control room antenna control box (with RS422 converter).
5. Control room ANTCON 100Mbit/s 8-port mini-hub.

UPS#2 Receivers:

1. Wall sockets for receivers in pedestal, TARMO 3 × 2,5S.
2. "Back-end" style differential amplifiers and sample clock generators in control room.
3. "daqqer" A/D sampling PC and its 15" monitor.
4. "meacon" (previously "vault") control PC and its 17" monitor.
5. GroWeather weather stations.
6. ADAM/NuDAM network.

UPS#3 Compressor:

1. TARMO 3 × 2,5 to pedestal compressor location.

2. Another ATON to control room cable channel, hidden away

- “pulsar” supervise UPSes 1–3

UPS#4 “New 1000VA” :

1. “pulsar”, its monitor, and modems.
2. 24-port 10/100Mbit network switch.

UPS#5 “Old 1000VA” Measurement data storage:

1. “data” NFS server PC and its rack.

UPS#6 “Old 1600VA” VLBA Rack:

1. Until year 2000, feeds VAX only (instead of VLBA BBC rack).
2. BBC rack.
3. VLBA (or in the future MkIV) formatter.
4. “eclipse” FS PC plus its MCB RS422 converter.

UPS#7 “Old 1200VA” VLBA Recorder

1. Just one cord to the recorder.

UPS#8 “University UPS” AOS equipment:

1. xxx if Univ of Helsinki wants to UPS their equipment.

5 Test Setup: Pedestal Rack in Control Room

Before transferring the pedestal rack into antenna pedestal it was necessary to verify that:

1. FET boards function properly and are virtually non-destructible.
2. The simplest P (“proportional”) control loop can drive the antenna according to VAX instructions in a similar way as the old analog servo did. This was the necessary prerequisite for irreversibly dismantling old ESSCO electronics.

FET board outputs were connected via temporary switch-over relays using old ESSCO motor cabling directly. “`antcon`” control room PC (with VAXIF coordinate input/output board) was connected to pedestal PC COM1: and the temporary pedestal PC (with Heidenhain IK121) was connected to COM2:. In this way the new pedestal PC could access both VAX and Heidenhain coordinates, calculate the difference between them (position error), and apply a proportional drive to motors.

6 Final Setup: Pedestal Rack in Antenna Pedestal

6.1 Dismantling Tasks

6.1.1 Dismantling at Antenna Pedestal

- Parking antenna at Az about 0 degrees, El about 0.22 degrees.
- Finding out a place for items which need to be stored for reinstallation.
- Removing receivers and other items (like the compressor) from pedestal.
- Removing pedestal floor metal plates to expose access to cabling.
- Vacuum cleaning all the exposed cable areas.
- Possibly removing tiltmeter to protect it from damage during re-cabling.
- De-cabling the temporary pedestal PC.

All pedestal cabling was removed. Motor hi-speed gearbox MIL connectors and their mounting plates were removed and swapped into another plate described in drawing xxx. This plate has thru-holes for three cables, motor, tacho, and brake/switch cables.

Both hi-speed and lo-speed gearbox heater cables were permanently removed. (Heaters were left in place.)

Limit switch boxes were dismantled and removed for re-wiring. New wiring is shown in ANTBL schematics on page xxx.

6.1.2 Dismantling at Control Room

- After disconnecting old cable connectors ESSCO rack modules can be removed and shipped to Yebes, if needed. ◯Must check with Yebes.

6.1.3 Cleaning up Cable Channels

- Removing unused cables from radome and control room cable channels. (Also other cable channels in old building, since lots of unused old cable is still there.)
- Removing unused modules and cables from control room racks.
- Labeling every cable which is left. Labels should be placed at both ends plus at places where the cable is exposed (walls and such).

6.1.4 Removing Old Cables

- Disconnecting cable upper ends
- Dropping cables down.
- Reeling cables out from cable channels.
- Disconnecting control room rack (MIL connector) ends.
- Optimal position for changing the cables for the antenna is azimuth -14.1° and elevation 0.22°
- If the cables have been wound abnormal way (3 / 2008), have to be really carefully. The cables might have been rotated several rounds around center axis. To clear this mess, turn on the antenna opposite way slowly and same time try to pull down the cables (do this easily).

Table 11: Removing/reusing old pedestal cables.

Cable Code	Old Usage	Action
W33	Az, El Motor Tachometers	Remove
W34	Az Motor Power Amp	Remove
W35	El Motor Power Amp	Remove
W36	Brake 110VDC Power	Remove
W37	Old Stdby switches/lights	Remove
W38	Final Limit Switches	Remove (reuse upper cables)
W39	El Inductosyn	Remove
W40		
W41	Bronto Interlock/Hoist220VAC	Remove
W42	Az Inductosyn	Remove

Two additional cables (located in hole number 14, see figure 5) from the old subreflector system remain. They can be removed if the current subreflector position encoder electronics (one about Euro-1 board plus its power supplies) are moved closer to the new pedestal rack and motor cables are rerouted to new subreflector switcher relay board.

6.2 Receiver Requirements

Future receiver control system will be quite universal. This means that receivers must look as similar as possible to controlling system front-end. To ensure this, cooled receivers should have similar LakeShore temperature sensors, and similar pressure meters. The big Military/Multipole connectors (i.e. M2, M3, M4) should be replaced with suitable ADAM/NuDAM-control units.

Antenna position for the changing the receiver is azimuth -38,7° and elevation 0,22°.

6.2.1 22 GHz Continuum Receiver

1. IN 230 VAC Mains from UPS #2.
2. IN/OUT Military M2.
   (a) IN Dicke Switch.
   (b) IN Amplitude Calibration Diode – Relay.
   (c) Thermoelectric Coolers (TECs) Controlling and Monitoring.
      i. IN 2-bit Address.
      ii. OUT Selected value, four different.
         A. Temperature Setting.
         B. Temperature Control.
         C. Air Temperature Sensor.
         D. Control Voltage.
   (d) Other Monitoring.
      i. OUT Receiver Voltages.
         A. +28 Volts.
         B. +15 Volts.
         C. -15 Volts.
         D. +5 Volts.
         E. +10 Volts.
      ii. OUT LO Monitoring.
      iii. OUT Ambient Temperature.
      iv. OUT Peltier-element Temperature.
   (e) IN Attenuator (optional).
3. OUT IF 0.2–1.2 GHz Linear Pol.
4. OUT + and − Total Power Signals.

6.2.2 22 GHz VLBI/Spectral Line Receiver

1. IN 230 VAC Mains from UPS #2.
2. IN/OUT Military M2.
   (a) IN Dicke Switch.
   (b) IN Amplitude Calibration Diode.
   (c) OUT Temperature Monitors.
   (d) xxx etc.
3. OUT 2x IF 0.2–1.2 GHz LCP and RCP.
4. OUT + and − Total Power Signals.
5. Coaxial cable from LakeShore temperature meter? Or A/D ADAM module?
6. Coaxial cable from pressure meter? Or A/D ADAM module?
7. ◯For VLBI/FS use requires adding one digital I/O NuDAM module for:
   (a) lock indicator readout
   (b) calibration noise diode control

6.2.3 37 GHz Continuum Receiver

1. IN 230 VAC Mains from UPS #2.
2. IN/OUT Military M3 (26-pole Amphenol).
   (a) IN Dicke Switch A & B.
   (b) IN Amplitude Calibration Diode (+28Volts).
   (c) IN Waveguide Switch QSO⇔SUN.
   (d) IN Power to Waveguide Switch.
   (e) Controlling and Monitoring Voltages and Temperatures.
      i. OUT Temperature Setting Value.
      ii. OUT Temperature Setting Value Sensor.
      iii. OUT Box Temperature.
      iv. OUT +15 Volts from IF Amplifiers.
      v. OUT Thermoelectric Cooler Voltage.
      vi. OUT LO Power.

3. OUT IF 0.5–1.5 GHz Linear Pol.

4. OUT + and − Total Power Signals.

5. ADAM/NuDAM-Control Network.

   (a) ADAM N:o 15 (0x0F) (ADAM-4017)[1] Temperature Monitoring.

      i. Temperature Setting Value.
      ii. Temperature Setting Value Sensor.
      iii. Air Temperature in IF-box.
      iv. Thermal Plate Temperature.
      v. Noise Diode Temperature.
      vi. Pedestal Level Ambient Temperature.
      vii. Thermoelectric Cooler Amplifier State Temperature.

   (b) ADAM N:o 16 (0x10) (ADAM-4017) Voltage Monitoring.

      i. LO Power.
      ii. IF Amplifier Power +15 Volts.
      iii. LO Voltage.
      iv. Dicke Switch Power +15 Volts.
      v. Logarithmic Amplifier + Balancer Power +12 Volts.
      vi. Logarithmic Amplifier + Balancer Power -12 Volts.
      vii. Thermoelectric Cooler Power + Fan Power +15 Volts.
      viii. Thermoelectric Cooler Power -15 Volts.

6.2.4 37 GHz Solar Receiver

1. IN 230 VAC Mains from UP7S #2.

2. IN TTL-level signal to phase shifter and noise calibrator.

3. OUT IF 0.25–1.0 GHz (does it come out?).

4. OUT 4 Stokes parameters, each differential +and − : total 8 coaxial cables.

5. ADAM-Control Network.

[1] ADAM-4017 is a 8-channel Analog Input Module (mV, mA, High Voltage).

6.2.5 43 GHz VLBI/Spectral Line Receiver

1. IN 230 VAC Mains from UPS #2.
2. IN 100 MHz reference.
3. OUT 2x total power detectors.
4. OUT 2x IF 0.2–1.2 GHz LCP and RCP.
5. OUT + and − Total Power Signals.
6. ADAM-Control Network. (Mainly controls PLL chip).
   (a) ADAM N:o 4 (ADAM-4017PLL Monitoring.
      i. Two separate "in lock" voltages.
      ii. Two separate "PLL monitor" voltages.
      iii. Air Temperature in IF-box.
      iv. Thermal Plate Temperature.
      v. Noise Diode Temperature.
      vi. Pedestal Level Ambient Temperature.
      vii. Thermoelectric Cooler Amplifier State Temperature.
   (b) ADAM N:o 10 (0x0A) (ADAM-4017) Temperature Monitoring.
      i. Four temperatures from RX boxes (not cryogenic temperatures).
   (c) ADAM N:o 5 (ADAM-4xxx) PLL tuning setting.
      i. Control voltage for PLL.
   (d) ADAM N:o 3 (NuDAM-6xxx) Calibration noise diode setting.
      i. On/Off.

6.2.6 80–115 GHz VLBI/Spectral Line Receiver

1. IN 230 VAC Mains from UPS #2. Uses 5 plugs.
2. IN/OUT Military M4.
   (a) mirror control signals. (Possible to control from FS via an ADAM unit in control room rack).
3. IN 2x 100 MHz reference signals. One to the PLL, other to the second LO.
4. IN Synthesizer frequency (e.g. 103.92 MHz).

5. OUT Diode current (typical value is $I_d = 0.905$ V).
6. OUT PLL lock indicator (locked if voltage = 4.7 V)
7. OUT Temperature monitoring from back-end.
8. OUT 2x IF 0.01–0.3 GHz and 0.5–1.5 GHz both Linear ,possible to use LCP with polarizer plate.
9. OUT + and − Total Power Signals.
10. ◯One ADAM/NuDAM module must be added to get “in lock” status to VLBI/FS. This can be either a digital I/O module or an A/D module measuring the lock indicator voltage mentioned above.

6.2.7 2mm SIS VLBI/Spectral Line Receiver

1. IN 230 VAC Mains from UPS #2.
2. IN 5 MHz for phase lock (?)
3. IN 100 MHz for phase lock (?)
4. IN 5 MHz PLL lock for Rohde & Schwarz
5. IN 3-phase 110 VAC for cooler (via tranformer, down in radome floor), not UPSed
6. Nudam/Adam for chopper control
7. Nudam/Adam for mirror control (carousel, hot flap etc.)
8. OUT RCP/LCP IF frequency
9. OUT phase lock indicator

6.2.8 Geo-VLBI (2/8 GHz)-receiver

1. IN 230 VAC Mains from UPS #2.
2. IN 230 VAC Mains from UPS #2 for the comb generator.
3. IN 5 MHZ (-5 dBm) to PLL lock (RG223, BNC)
4. IN 5 MHZ (0 dBm) to comb generator (RG223, BNC)
5. IN 24 VAC to motor of cold head (4-pole connector)
6. IF OUTPUT X-band and S-band (RG214 / N-connector)

7. Adam/Nudam for the monitoring (temperatures etc.)

8. Adam/Nudam for the controlling the calibration noise diode

Cable	22/37 GHz continuum	Geo-VLBI	Astronomical- (22 G
V1+	22 GHz cont. (out)	-	-
V2 -	22 GHz cont. (out)	-	-
V3+	37 GHz cont. (out)	-	-
V4 -	37 GHz cont. (out)	-	-
V5+	Sun (lin.) (out)	-	-
V6 -	Sun (lin.) (out)	-	-
V7+	Sun (log.) (out)	-	-
V8 -	Sun (log.) (out)	-	
V9+	-	5 MHz (in), 10 dBm (1	PLL IF (left) 120 MHz (out),
V10 -	-	5 MHz (-10 dBm atten.) (in), 0 dBm (1	5 MHz (-10 dBm atten.)
V11+	-	cable measurement	-
V12 -	-	cable measurement	-
X1	-	X-band (out)	LCP (out)
X2	-	S-band (out)	RCP (out)
X3	-	-	540 MHz (in), 0 dBm (from
X4	-	-	-

(1 Real output is +11 dBm, 1 dBm will lose in cables.

(2 Real output is +2 dBm, 4,2 dBm will lose in cables.

IF input	Geo-VLBI	Astronomical- (22 GHz) VLBI	86 GHz-HEMT VLBI
A	X-band	LCP	LCP
B	S-band	-	-
C	-	RCP	RCP
D	-	-	-

6.3 Control Room—Pedestal Cabling

6.3.1 New Cables

The cable channels in radome floor and in control room floor will be enhanced with aluminium cable shelves (Nokia XYHA 730 compatible) which keep cables from lying in the channel and makes it possible to clean up the channel. An aluminium xxx×xxx mm cable channel is used in tower leg for a route for all new pedestal cables. In the brackets is renewing (installation) time (after cable type).

Cable Pos	Type	Usage in Antenna
1	Cu-wire	Antenna Grounding Cable
2	7 pcs RG223 Coax (5/2008)	5 pcs to Patch Panel
		2 pcs to Rack
3	JAMAK 24×(2+1)×0,5	Multifunctional Connections to Rack
4	TARMO 5×6S (4/2008)	Compressor (3-phase supply)
5	5 pcs CAT5E Ethernet (4/2008)	4 pcs to PC Extender
		1 pcs to Spare 100Mbit/s Ethernet
	TARMO 3×2,5S (4/2008)	UPS #3 230VAC ⇒ Compressor
	TARMO 5×1,5S (4/2008)	Direct 230VAC Lights and Outlets
6	TARMO 3 × 6S (2/2008)	Receiver crane (230 VAC)
	5 pcs FMMS 2GKT (7/2008)	Fibers
7	TARMO 3×1,5S (4/2008)	UPS #1 230VAC via Emergency Switch ⇒Rack
	TARMO 3×1,5S (4/2008)	UPS #1 230VAC ⇒Pedestal PC
	Heidenhain Multipole (4/2008)	HH Incremental Encoder Azimuth ⇔Pedestal PC
8	7 pcs RG223 Coax (5/2008)	To Patch Panel
		no. 13 –> 1pps, no. 14 –> 5 MHz
9	RG214	To Patch Panel (X1)
10	RG214	To Patch Panel (X2)
11	JAMAK	Receiver Monitoring (M1 etc.)
12	JAMAK	Receiver Monitoring (M2xxx etc.)
13	JAMAK	Instrumentation Cable to Pedestal Level
14	2 Cables (4/2008)	Subreflector Position and Controlling
	TARMO 3× 2,5S (4/2008)	UPS #2 230VAC ⇒Receivers
15	RG214	To Patch Panel (X3)
16	RG214	To Patch Panel (X4)

Table 13: New cable positions, types and usages. See position figure 5.

- Four (4) M17/75-RG214 coaxial cables for IF signals (Manufactured by NOKIA KABEL). New terminating panels for these and twelve RG223/U cables. New BNC-connectors (Suhner 25BNC 50-3-17c/133) and N-connectors (Suhner 25N-50-7-14c/133) have already been bought.
- Twelve (12) RG223/U coaxial cables by Huber&Suhner for possible signals that are not measured/monitored with ADAM/NuDAM modules.
- Condition of the all sixteen (16) coaxial cables has been measured, the results can be found from separate document (Koaksikaapelien kuntotarkastus 1.4.2008, kaapelimittaus.pdf, by Petri Kirves)

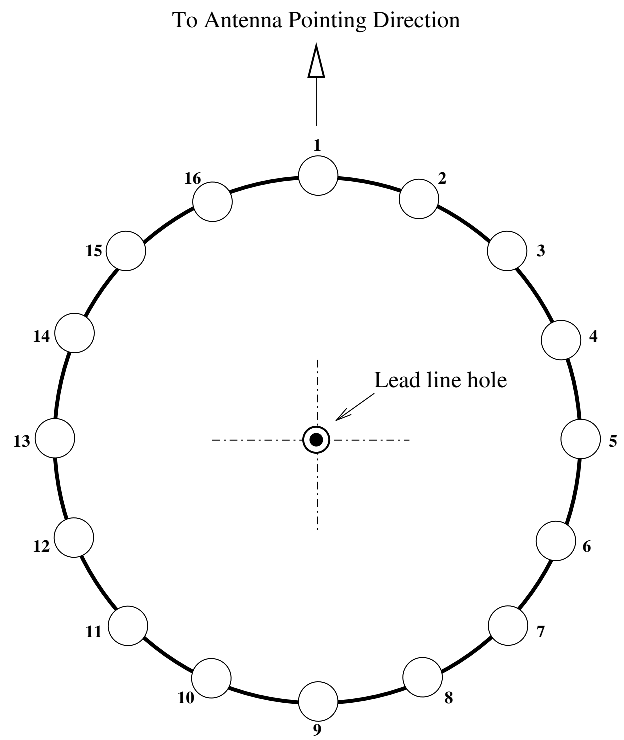

Figure 5: Plan view of cable loop arrangement.

- Five (5) CAT5E RJ45-terminated twisted-pair cables suitable for 10/100M Ethernet and VGA/keyboard remote extender. Four of them are terminated close to pedestal rack and one extends to elevation platform for easy access from receivers.
- Two (2) new 24 pair JAMAK twisted-pair cables.
- Four (4) FMMS-multimode fibers (SC/SC-connectors) to the elevation platform (easy access to receivers) from control room rack (cables 1-4). One (1) FMMS-multimode fiber (SC/SC-connectors) to antenna landing. (Length of the fibers from follow-through hole to fiber panel is 8 meters.), (cable 5). (Fiber type: 2GKT, FMMS, SC/SC, tuotenumero: 1128033)
- Subreflector position and controlling cables are extended with new cables after antenna crash (3 / 2008). Old cables are Belden 8774 (Jamak, twisted-pair, 9 pair) extended with (Elfa 55-751-21) and Belden 8621 (7 single wire) extended with (Elfa 55-743-71).

Belden 8621 (old cable)		Elfa 55-743-71
Color of Belben cable	Letter of Belden cable	Color of Elfa cable
blue	F	blue
red	L	red
green	C	brown
white	B	white
orange	D	yellow / green
black	M	black
white / black	G	gray

Belden 8774	Elfa 55-751-21
Color of Belden cable	Color of Elfa cable
film pair + protective conductor	film pair + protective conductor
yellow / black	yellow / black
blue / black	blue / black
green / black	green / black
red / black	red / black
white / black	white / black
orange / black	orange / black
brown / black	brown / black
white / red	white / red
green / red	green / red

- 230VAC mains
  - UPSed
    * rack (motors, pedestal PC ...)
    * receiver
    * cooling compressor (Cryogenic compressor)
  - not UPSed
    * general lights
    * general wall sockets
    * receiver crane (via emergency switch)
    * bigger (3-phase) (110 VAC) cooling compressor (can be UPSed with the bigger diesel generator)

Length of the cables are approximately followed:

- 35 m: 3×1,5S TARMO
- 33 m: CAT5E, FMMS and coaxial cable RG223

- 30 m: 3×1,5S TARMO, 3×2,5S TARMO
- 25 m: 3×2,5S TARMO
- 20 m: 5×6S TARMO
- 15 m: 5×1,5S TARMO

Length of the Heidenhain incremental sensor extended cable is 15 m.

6.4 Full-Duplex Intercom

Somewhere in the rack or near it there will be a wide-range microphone connected to a small audio amplifier. The speaker output is routed via a JAMAK twisted pair to control room and further extended in parallel from control room to kitchen. The amplifier will have standard volume control but at pedestal level it will be typically left on at high volume. Control room and kitchen speakers can be attenuated or switched off with potentiometers/switches.

A corresponding "mirror" setup brings control room audio to pedestal level.

6.5 Connections between Control Room Panel and the New Pedestal Rack

There are the following main connection categories:

1. 230VAC. The rack power comes from UPS #1 via an emergency switch and to rack 230VAC input using cable TARMO 3×1,5S.
2. During testing 2×CAT5 (4-pair RJ45) cables make VGA and keyboard of the pedestal PC remotely available at control room. The VGA/keyboard extender used in AMS project is reused for this purpose.
3. 1×CAT5 (4-pair RJ45) cable makes 10/100Mbit/s Ethernet available to pedestal PC.
4. The 24-pair JAMAK cable from control room new box to pedestal rack is allocated as follows:

JAMAK Pair#	Usage
1	Az1 motor current
2	Az2 motor current
3	El1 motor current
4	El2 motor current
5	Pedestal PC reset relay
6	RS422 down → up
7	RS422 up → down
8	Main SW ”STOP”
9	Az STOP SW
10	El STOP SW
11	Az Manual Override / OK led
12	El Manual Override / OK led
13	Emergency STOP
14	Interlock SW (tower down)
15	Bronto OK (down)
16	GND of interlock / pedestial rack 24 Vdc
17	
18	
19	
20	
21	
22	
23	
24	

6.6 Control Room Cabling

6.6.1 Equipment Not Yet Placed in a Rack Location

1. Vaisala Weather station isolator boxes.
2. The +12VDC power supply for both Vaisala Weather stations, from UPS#2.
3. ADAM/NuDAM RS232/RS485 converters/repeaters (“start of ADAM/NuDAM network).
4. The +24VDC power supply for ADAM/NuDAM, from UPS#2.
5. The differential amplifier / A/D sampling clock generator. (Its power from UPS#2).
6. 1pps buffer.

7. The monitor, keyboard, and mouse of VLBA FS PC.

6.6.2 UPS Area

1. UPS#3 Compressor
2. UPS#2 Receivers
3. UPS#1 ANTCON
4. UPS#4 “New 1000VA” for Network Rack (“pulsar”).

6.6.3 Network Rack

1. 24-port Patch Panel
   - cleaning up data (CAT5) cabling
2. 24-port 10/100Mbit Network Switch
   (a) 230VAC to UPS#4 “New 1000VA”.
   (b) Gigabit fibers with SC/ST adapter cables to new building.
   (c) One 100Mbit port to 8-port 100Mbit switch in 6.6.8 via 24-port patch panel (which has two CAT5 RJ45 connectors to MEACON Rack area).
   (d) Two 10Mbit ports to two 8-port 10Mbit network hubs (same rack).
   (e) One 100Mbit port to “pulsar.kurp.hut.fi” (same rack).
3. Two 8-port 10Mbit Network Hubs on a shelf
   (a) Two 230VAC→12VDC wall-mount power supplies, from UPS#4 “New 1000VA”.
   (b) Two 10Mbit 10BaseT CAT5 patch cables to 10/100Mbit network switch.
   (c) Two BNC 10Base2 cables to 1) old building 10Base2 network and 2) to geodetic institute. ◯Label the “Geodetic” hub.
4. CAT5 Tester
   (a) 230VAC non-UPSed.
   (b) ◯Add enclosure to the tester.
5. 14" “pulsar.kurp.hut.fi” Monitor
   (a) 230VAC non-UPSed or from UPS#4 “New 1000VA”.

6. “pulsar.kurp.hut.fi”

   (a) 230VAC from UPS#4 “New 1000VA”.
   (b) DIN5 Keyboard from xxx.
   (c) No mouse, ◯eliminate “gpm” configuration.
   (d) VGA directly to 14" “pulsar.kurp.hut.fi” monitor (same rack).
   (e) 100Mbit network from 24-port network switch (same rack).
   (f) Two Boca serial ports to modems (four vacant ports).

7. Two Modems

   (a) Two 230VAC→xxxVDC wall-mount power supplies, from UPS#4 “New 1000VA”.
   (b) Two DCE Boca RJ45/DB25 (male) cables to “pulsar”.

8. Keyboard for “pulsar.kurp.hut.fi”

6.6.4 Back-end Rack

6.6.5 Cable Panel Rack

- from H-maser room?

6.6.6 “Old” Rack

6.6.7 ANTCON Rack (ESSCO#1)

1. Emergency switch

   (a) 230VAC input, from UPS#1.
   (b) 230VAC uninterrupted output, to:
      i. Pedestal PC directly.
      ii. All the connections in control room which refer to “UPS#1”.
   (c) 230VAC emergency-switched output, to:
      i. Rest of pedestal rack.
      ii. Any emergency-switched connections in control room, no?
   (d) Low-voltage switch connections via one twisted pair to antenna control box, same rack.

2. Antenna Motor Current Meters

   (a) Connection cable(s) to antenna control box (same rack).

3. 15" "antcon.kurp.hut.fi" Monitor

   (a) 230VAC from UPS#1.
   (b) VGA directly to "antcon.kurp.hut.fi" (same rack).

4. Antenna Control Box

   (a) 230VAC from UPS#1.
   (b) Permanent connection of 24-pair JAMAK coming from pedestal, with strain relief loop that allows the box to be drawn out of rack on slide rails.
   (c) 3×50-pin parallel interface ribbon cables to "antcon.kurp.hut.fi" (same rack).
   (d) Four twisted pairs of motor current meter signals to antenna motor current meters (same rack).
   (e) Two twisted pairs to Bronto/pedestal interlock switch cables.
   (f) One twisted pair to rack area emergency switch low-voltage contacts.
   (g) One DB25 RS232 connector (female in box) to "antcon.kurp.hut.fi".

5. "antcon.kurp.hut.fi"

   (a) 230VAC from UPS#1.
   (b) Keyboard from Autoview Commander.
   (c) PS/2 mouse from Autoview Commander.
   (d) VGA directly to 15" "antcon.kurp.hut.fi" monitor (same rack).
   (e) 100Mbit network from 8-port network switch ("meacon" rack 6.6.8), directly with CAT5 patch cable.
   (f) 3×50-pin parallel interface ribbon cables to antenna control box (same rack).
   (g) "/dev/ttyS0" DB9 converted to DB25 and connected to antenna control box (same rack).
   (h) 5MHz and 1pps signals connected to "UTC5M-populated" PWMISA board, these come from patch panels in rack xxx.

6. Old Subreflector Box #1

   (a) Cables???

6.6.8 MEACON Rack (ESSCO#2)

1. "meacon.kurp.hut.fi" (ex-"vault")

   (a) 230VAC from UPS#2.

   (b) PS/2 keyboard from Autoview Commander, same rack.

   (c) PS/2 mouse from Autoview Commander, same rack.

   (d) VGA directly to 17" "meacon.kurp.hut.fi" Monitor (same rack).

   (e) 100Mbit network from 8-port network switch ("meacon" rack 6.6.8), directly with CAT5 patch cable.

   (f) DB9(?) COM2(?) to ADAM/NuDAM network RS232→RS485 converter, located in rack xxx.

   (g) Two Boca RJ45 ports with specially-made RJ45(10-pin) cables to Vaisala Weather station isolation boxes, located in rack xxx.

2. Autoview Commander

   (a) 230VAC from UPS#2.

   (b) PS/2 keyboard and mouse cables to: (VGA left unconnected)

      i. "antcon"

      ii. "meacon" (the default everyday setting for Autoview Commander)

      iii. "daqqer"

      iv. Pedestal PC via PC-Extender (same rack).

3. CAT5 Cables in Wall/Rack-mounted RJ45 Connectors

   (a) Two from 24-port patch panel (network rack) and two from 2-port wall/rack mounted box (VLBA FS & BBC rack) into one 4-port box, the "rack CAT5 box".

   (b) Two from "data.kurp.hut.fi" rack area and two from AOS area into one 4-port box., the "room CAT5 box".

   (c) Five from pedestal into one 2-port (only one used, the line from receiver platform) and one 4-port box (four lines from the vicinity of pedestal rack), the "pedestal CAT5 boxes".

   - All of these can be replaced with a 16–24-port CAT5 patch panel. Three 4-port and one 2-port wall-mounted RJ45 boxes can be mounted on an aluminium plate which is then mounted to the rack sides.

- The shield of all CAT5 cables must be grounded in control room rack. The only exception are the cables going to 24-port patch panel since it has internal grounding.

4. PC-Extender
   (a) 230VAC →12VDC power supply unit, from UPS#2.
   (b) Two CAT5 cables , via wall-mounted 2-port "pedestal CAT5 box" to pedestal cables.
   (c) PS/2 keyboard and mouse to Autoview Commander (same rack).
   (d) VGA to a 9" monitor in "old VAX" rack 6.6.10.
5. 8-port 100Mbit Switch
   (a) 230VAC →19VDC power supply unit, from UPS#1.
   (b) 100Mbit connections to:
      i. 24-port network switch via wall-mounted 4-port "rack CAT5 box".
      ii. "antcon", directly with CAT5 patch cable.
      iii. "meacon", directly with CAT5 patch cable.
      iv. "daqqer", directly with CAT5 patch cable.
      v. "eclipse", FS PC, via wall-mounted 4-port "rack CAT5 box".
      vi. "data", via wall-mounted 4-port "room CAT5 box".
      vii. "aos", via wall-mounted 4-port "room CAT5 box".
      viii. (spare)
6. 17" "meacon.kurp.hut.fi" Monitor
   (a) 230VAC from UPS#2.
   (b) VGA directly to "meacon.kurp.hut.fi" (same rack).
7. PS/2 Keyboard
   (a) To Autoview Commander common connectors, same rack.
8. PS/2 Mouse
   (a) To Autoview Commander common connectors, same rack.
9. Old Subreflector Box #2
   (a) Cables???

6.6.9 DAQQER Rack (ESSCO#3)

1. "daqqer.kurp.hut.fi"

   (a) 230VAC from UPS#2.

   (b) Keyboard from Autoview Commander.

   (c) PS/2 mouse from Autoview Commander.

   (d) VGA directly to 15" "daqqer.kurp.hut.fi" monitor (same rack).

   (e) 100Mbit network from 8-port network switch ("meacon" rack 6.6.8), directly with CAT5 patch cable.

   (f) 4×BNC A/D channel cables plus 1×BNC A/D sampling clock cable, to differential back-end/sampling clock generator, in rack xxx.

   (g) 1×50-pin parallel interface ribbon cable to differential back-end/sampling clock generator, in rack xxx.

   (h) 5MHz and 1pps signals connected to "UTC5M-populated" PWMISA board, these come from patch panels in rack xxx.

2. 15" "daqqer.kurp.hut.fi" Monitor

   (a) 230VAC from UPS#2.

   (b) VGA directly to "daqqer.kurp.hut.fi" (same rack).

3. xxxU Space

6.6.10 "Old VAX" Rack

1. 9" pedestal PC monitor, power from UPS#1.

2. "Old Rubik" A/D Converter (will be removed year 2000), power from UPS#6 "Old 1600VA".

3. MicroVAX (will be removed year 2000), power from UPS#6 "Old 1600VA".

6.6.11 VLBA BBC Rack

1. 230VAC from UPS#6 "Old 1600VA" after year 2000 when VAX has been eliminated.

2. 5MHz and 1pps signals from rack xxx.

6.6.12 VLBA FS & Formatter Rack

1. "eclipse.kurp.hut.fi", FS PC
   (a) 230VAC from UPS#6 "Old 1600VA".
   (b) Keyboard from xxx.
   (c) Bar code reader with keyboard DIN5 tap cable.
   (d) 230VAC for bar code reader power supply from UPS#6 "Old 1600VA".
   (e) Serial COM1/DB9 mouse from xxx.
   (f) Serial RJ45/DB25 cable to RS232→RS422 converter (mounted where?)
   (g) Serial cable RJ45/DB25 for MicroVAX connection (will be removed year 2000).
   (h) VGA to 15" "eclipse .kurp.hut.fi" monitor (where?).
   (i) 100Mbit network from 8-port network switch ("meacon" rack 6.6.8), via a 2-port wall-mounted RJ45 box.
2. 2-port wall-mounted RJ45 box
   (a) Two CAT5 cables to MEACON rack area.
3. RS232→RS422 converter (where?)
   (a) 230VAC from UPS#6 "Old 1600VA".
   (b) RS232 DB25 from FS PC.
   (c) RS422 DB9 to VLBA BBC rack 6.6.11.

6.6.13 VLBA Recorder

1. 230VAC from UPS#7 "Old 1200VA".

6.6.14 "data.kurp.hut.fi" Rack

1. 230VAC from UPS#5 "Old 1000VA".
2. 100Mbit network from 8-port network switch ("meacon" rack 6.6.8) via a wall-mounted 2-port RJ45 box, routed to MEACON rack.

6.6.15 AOS Rack

1. 230VAC from UPS#8 “University UPS” or if not required, directly from xxx
2. 100Mbit network from 8-port network switch (“meacon” rack 6.6.8) via a wall-mounted 2-port RJ45 box, routed to MEACON rack.

◯Design control room cabling.

◯Design, build and test 1pps buffer.

7 Limit switches

Both azimuth and elevation limit switches were tested succesfully and serviced after antenna crash (3/2008). Limits for the slow speed and final stop are following (incremental sensors):

- azimuth_{slow} =-354°/ -352°
- azimuth_{final} =-356,69°/ -355,5°/ -356,6°(absolute sensor -365,5°)
- azimuth_{slow} =355,8°/ 365,1°
- azimuth_{final} =359,2°/ 359,19°/ 359,26°(absolute sensor 359,3°)
- elevation_{slow} =1,14°/ 1,5°
- elevation_{final} =0,229°/ 0,22°(absolute sensor -0,47°)
- elevation_{slow} =107,1°/ 106,8°
- elevation_{final} =110,169°/ 110,146°/ 110,159°(absolute sensor 109,67°)

Limit switched were tested 11.4.2008 and 14.4.2008.

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