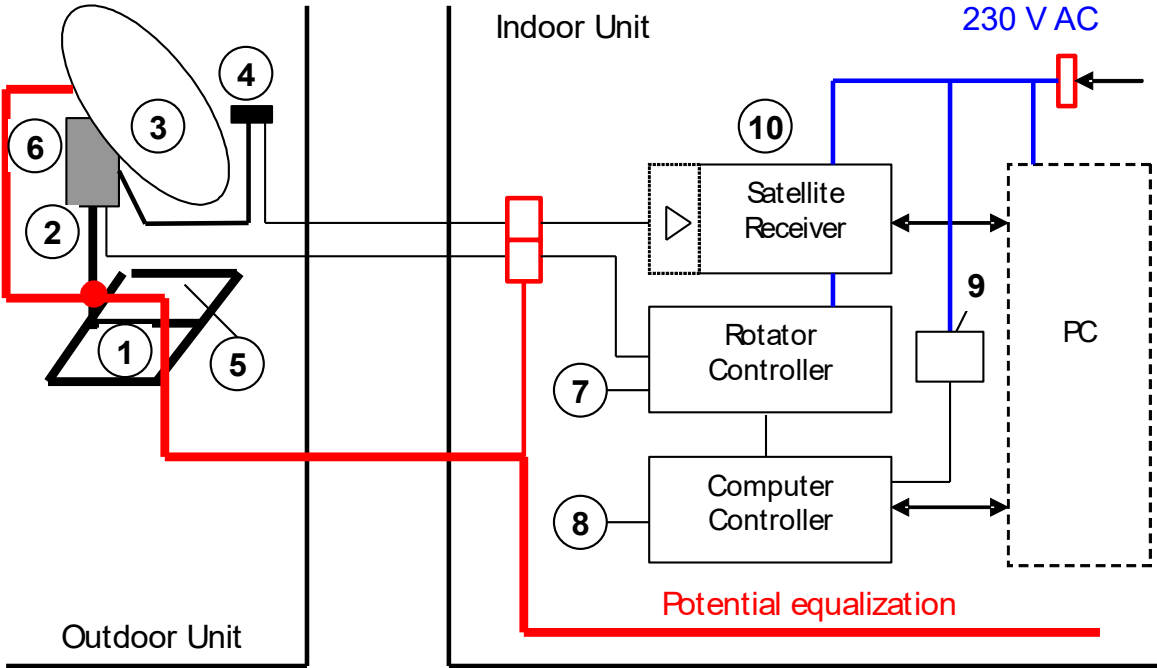
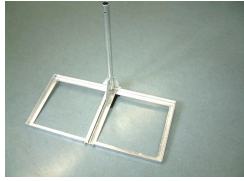



Assembly Manual of the ESA-Dresden Radiotelescope

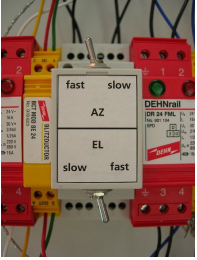

1 Structure of telescope



1. parts list

Package	Description	Weight	Comment	Picture
Balcony Stand # 1	3 main parts	Circa 10 kg	Installation material included	
Rotator Unit # 2	- 2 motors - 1 Controller - Installation material	10 kg	Controller unit is part of indoor unit	

Sat-Dish # 3	Dish, LNB-Arm, Elev. Unit	12 kg	Elevation Mount not used	See chapter 2.5
LNB # 4	2 parts	-	LNB with strain relief	
Concrete Slabs # 5	4 Units	110 kg	Not included, to be bought from a local do-it-yourself store	
Dish Supporting Frame # 6		Circa 10 kg		
Motor Controller # 7	Included in rotator unit	3 kg	- 1 Controller - 3 connectors - 2 water resist caps - Manual	
RS232-Interface # 8	Computer Control Interface for Antenna Rotators GS-232B (YAESU)	0,4 kg		
Power Supply # 9	Power Supply 7 Adapters	Circa 0,1 kg	- yellow adapter will be used	
Measurement Receiver # 10	Receiver Cables, adapter Documents	8 kg	Keep carton and plastic parts!!!	
Cables # 11	Antenna cable Control Cable RS232 cable Cable 16 mm ²	- - - -	Coax SAT AWG 18, 6 x PC accessories Surge protect.	No picture

<p>Speed Control Switch # 12</p>	<p>Self-construction</p>	<p>Circa 0.1 kg</p>	<p>See chapter 10.4</p>	
<p>Overload Protection # 13</p>		<p>1.5 kg</p>	<p>See chapter 4.4</p>	
<p>Documents + CD #14</p>	<p>Operating Manual Assembly Manual RadioAstro CD</p>	<p>0.5 kg</p>		<p>No picture</p>

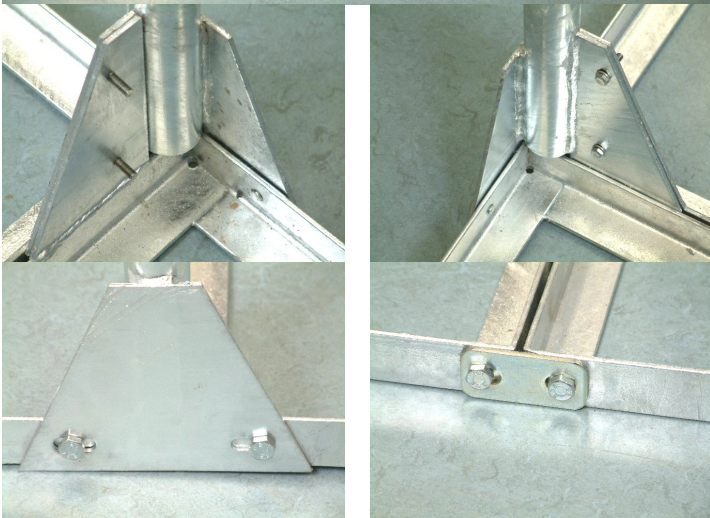
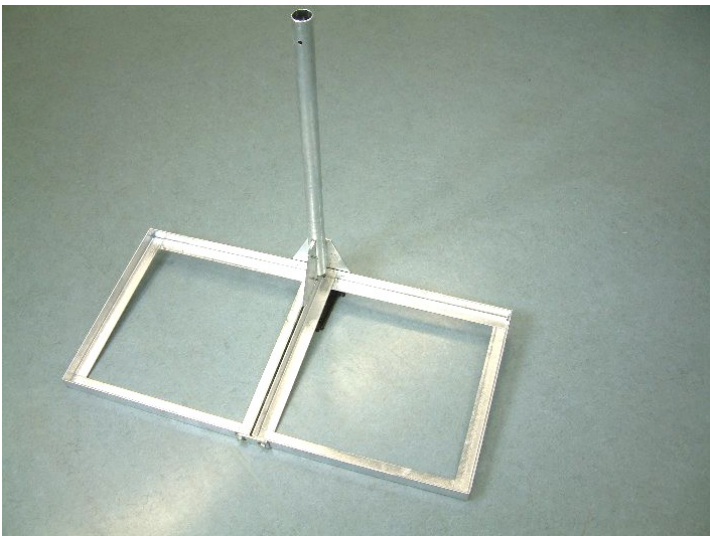
2 Required tools for assembly

Tool	Dimension
Open ended spanner	17 mm
Open ended spanner	13 mm
Open ended spanner	10 mm
Screwdriver for recessed head screws	Ph 3
Allen hex socket wrench	5 mm

3 Dish stand

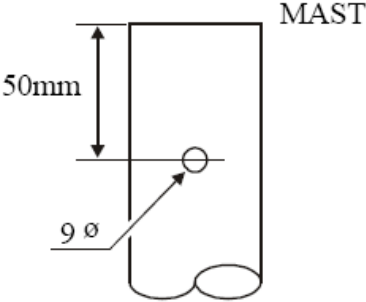
Items	Quantity	Comment	Check
Frame 50 x 50 cm	2	Package Balcony stand	
Tube	1		
Binder	1		
M10 x 10 Hex. Bolt	4		
M6 x 25 Hex. Bolt	2		
6 mm Flat Washer	2		

Tools	Quantity	Comment or notes
Open ended spanner 17 mm	1	
Open ended spanner 10 mm	1	



The parts are connected with screws as described in the stand documentation. Some details are shown on the left side.

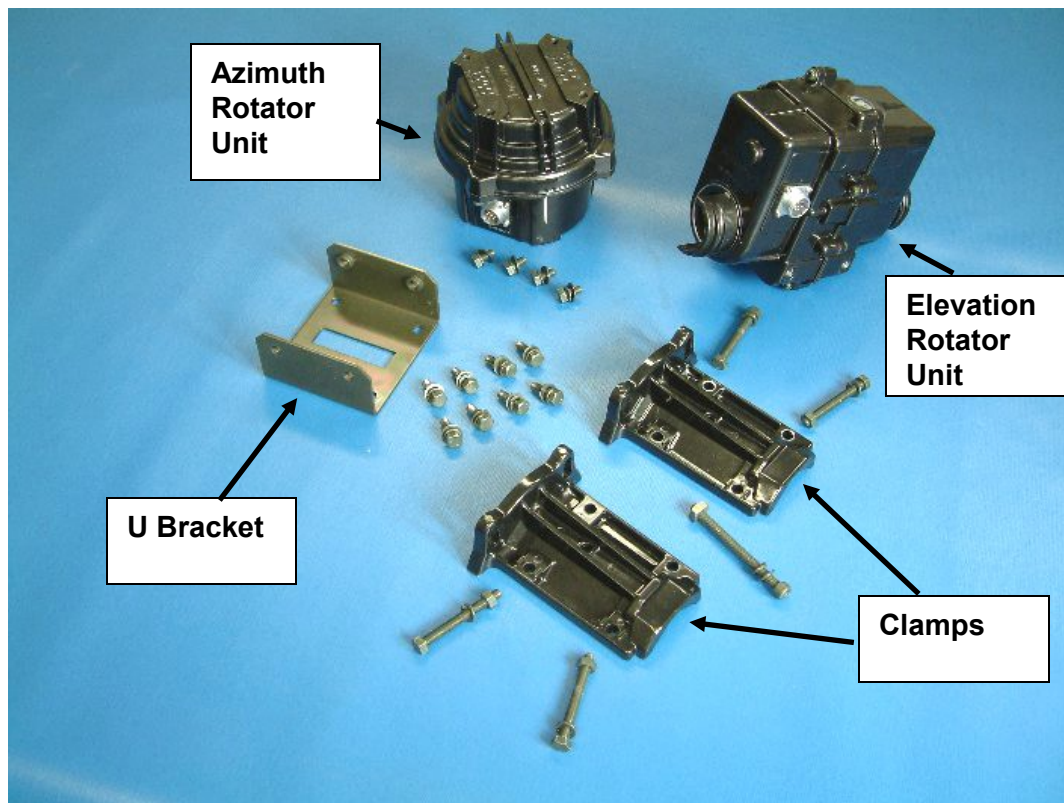
A hole of 9 mm in diameter must be drilled 50 mm below the top of the tube. (Two drill holes through on either side of the tube). It is used to fix the rotator unit.



4 Motor unit of positioning system

Items	Quantity
Elevation Rotator Unit	1
Azimuth Rotator Unit	1
Mast Clamp	1 Pair
U Bracket	1
M8 x 16 Hex. Bolt	4
M8 x 25 Hex. Bolt	8
M8 x 70 Hex. Bolt	4
M8 x 95 Hex. Socket Bolt	1
8 mm Spring Washer	18
8 mm Flat Washer	12
M8 Square Nut	1
M8 Hex. Nut	4

Tools	Quantity
Open ended spanner 13 mm	2



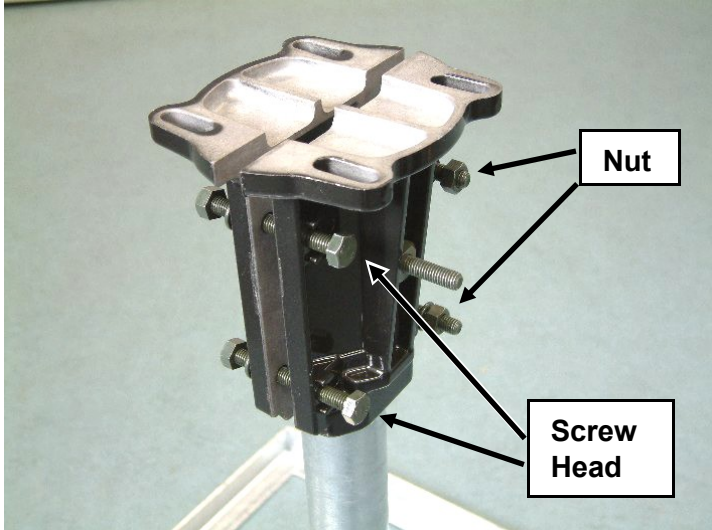
The dish positioning unit consists of an azimuth and an elevation motor. They will be connected by a bracket. A mast clamp and four types of screws are also attached. The installation of this unit is shown in this section. The instructions provided by the device

manufacturer (**where are they?**) must be read prior to assembly. Be careful while tightening the screws: too much pressure may damage the plastic spring washers. See Figure 1.



Set the mast clamp on top of the tube.

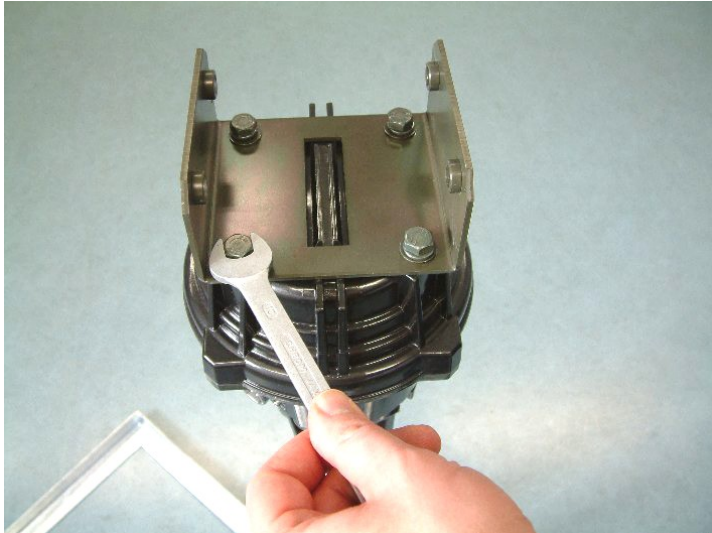
Insert the allen screw (M8x95) into the hole in the middle of the mast clamp. Add the square neck nut. Tighten the screw only loosely at this stage, to allow for further adjustment later.



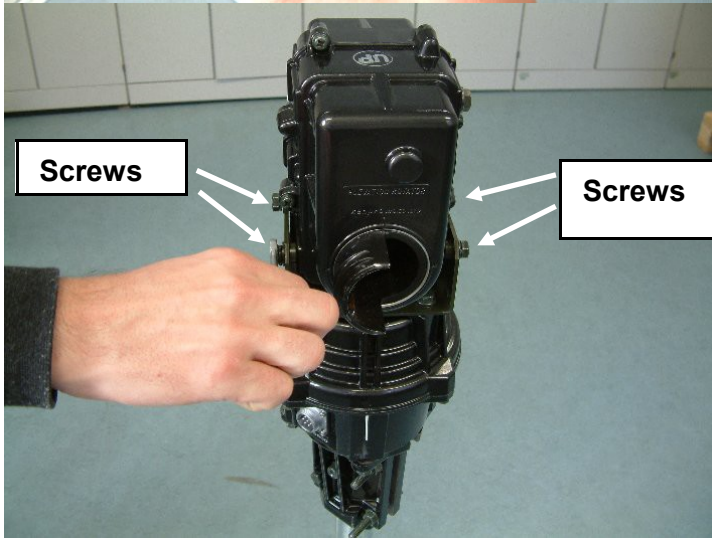
Insert the four long screws (M8x70) and fix each of them with flat and spring washers and a nut. Carefully tighten the nuts in a cross-diagonal sequence, adjusting the clamp to ensure that the top surface is flat and horizontal.



Set the azimuth motor on top of the clamp and fix it with 4 of the 8 medium sized screws (M8x25). Carefully tighten the screws in a cross-diagonal sequence.



Mount the bracket on top of the azimuth motor using the 4 short screws (M8x16).



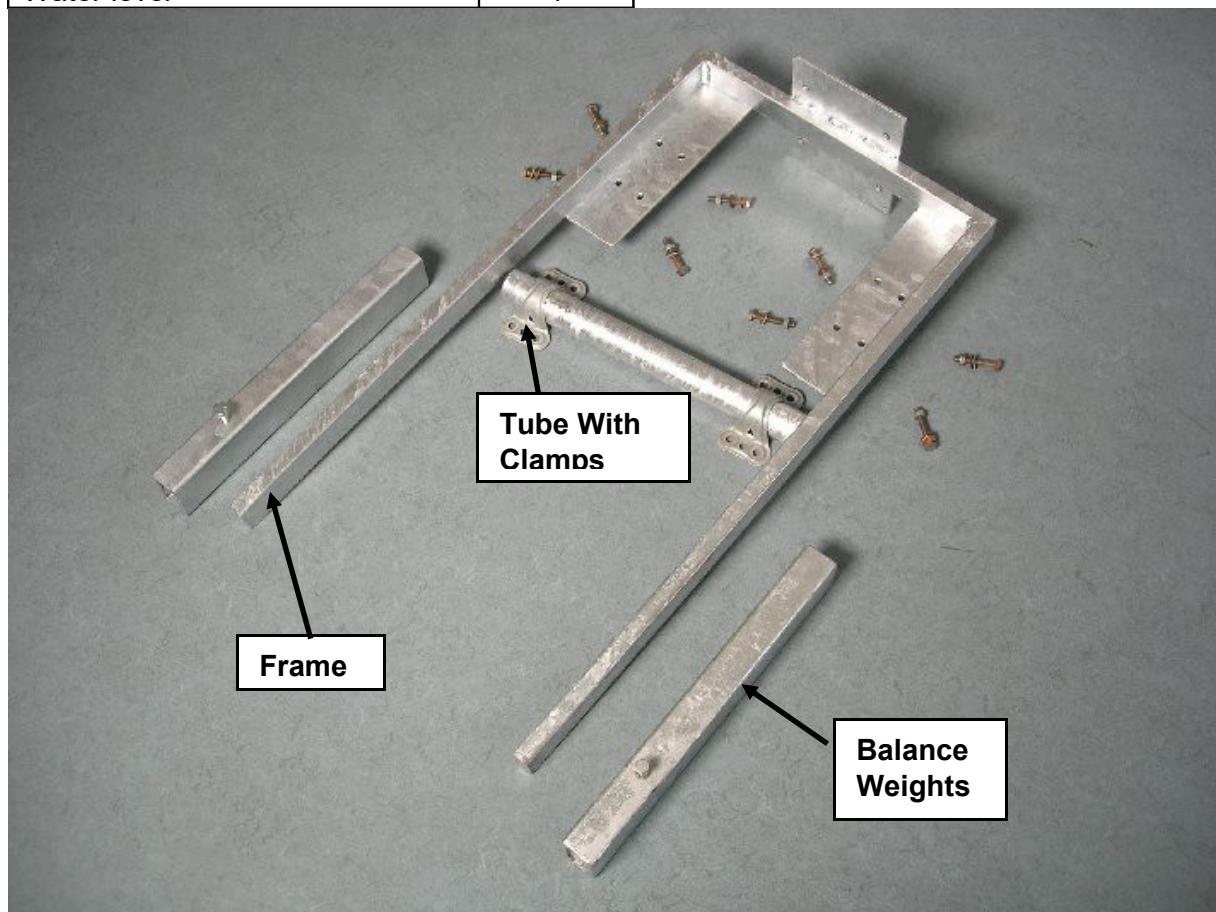
Mount the elevation motor between the blades of the bracket. Use the four remaining medium sized screws (M8x25).

Figure 1: Procedure for Mounting of Motor Units

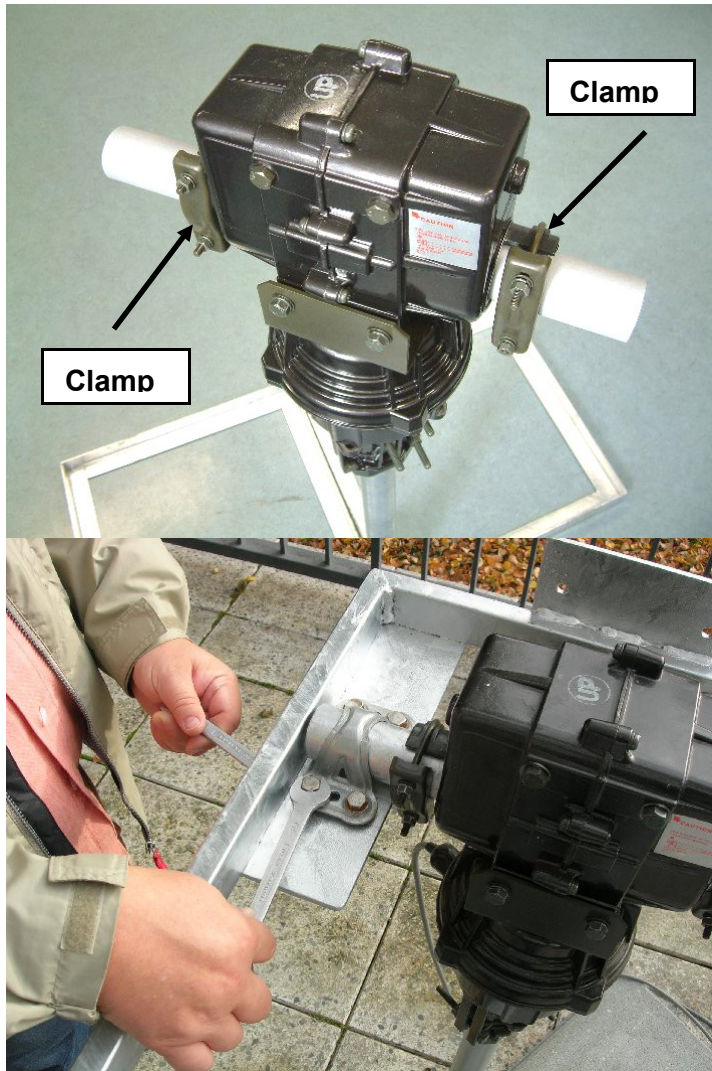
5 Dish supporting frame

Items	Quantity
Dish Supporting Frame	1
Tube 42 x 400 mm	1
Mast Clamps	2
M8 x 20 - 30 Hex. Bolt	8
8 mm Spring Washer	8
8 mm Flat Washer	8
M8 Hex. Nut	8
Pipe clamp	2
U-Bolt	2
6 mm Spring Washer	4
6 mm Flat Washer	4
M6 Hex. Nut	4

Tools	Quantity
Open ended spanner 10 mm	1
Open ended spanner 13 mm	2
Water level	1



The dish supporting unit consists of a steel frame, a tube fixed with mast clamps and two balance weights. **At least two persons are needed to mount this part on the rotator unit.**



First insert and centre the tube into the elevation motor. The tube is fixed with the small dark green clamps. Carefully tighten the clamps to fix the tube.

Connect the frame to the tube with the clamps using 4 screws at each clamp.

Note that the balance weights will be added only after the dish has been mounted.

Figure 2: Assembly Procedure for Dish Supporting Frame

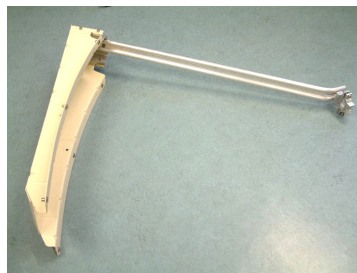
6 Dish and LNB

Items	Quantity
Offset Reflector 120 cm	1
Reflector support with LNB arm	1
LNB with protective cover	1 / 1
Balance Weight	2
M6 x 20 Hex. Bolt	4
Rubber Band	1

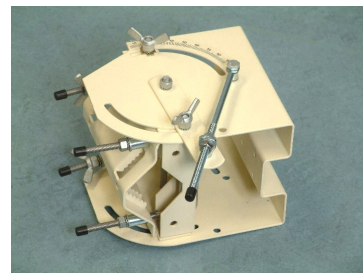
Tools	Quantity
Open ended spanner 10 mm	1
Open ended spanner 13 mm	1
Screwdriver for recessed head screws Ph 3	1
Allen hex socket wrench 5 mm	1



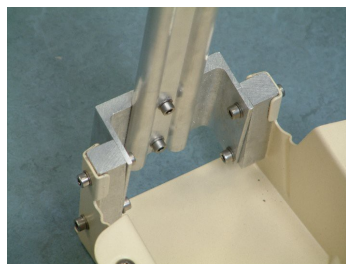
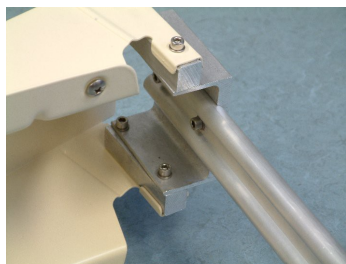
Offset reflector



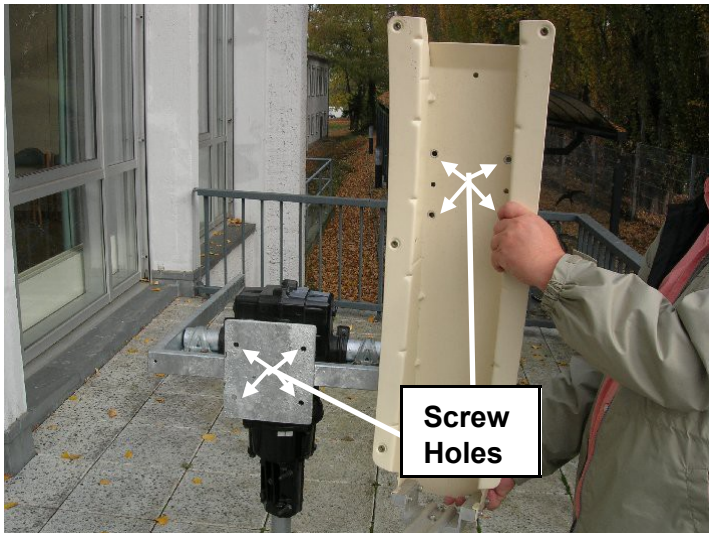
Reflector support with LNB arm



Unused elevation unit.
(not used here. To be discarded)



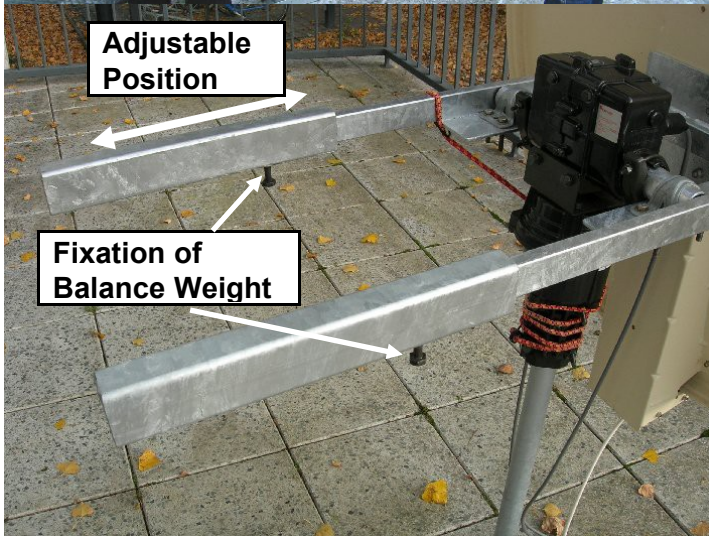
Connect the reflector support to the LNB arm with the attached allen screws.



Mount the reflector support on the square plate of the frame using 4 screws and nuts.



Attach the reflector to the support using 6 lens head screws.



Attach the balance weights to the frame. Each weight is clamped with two screws.



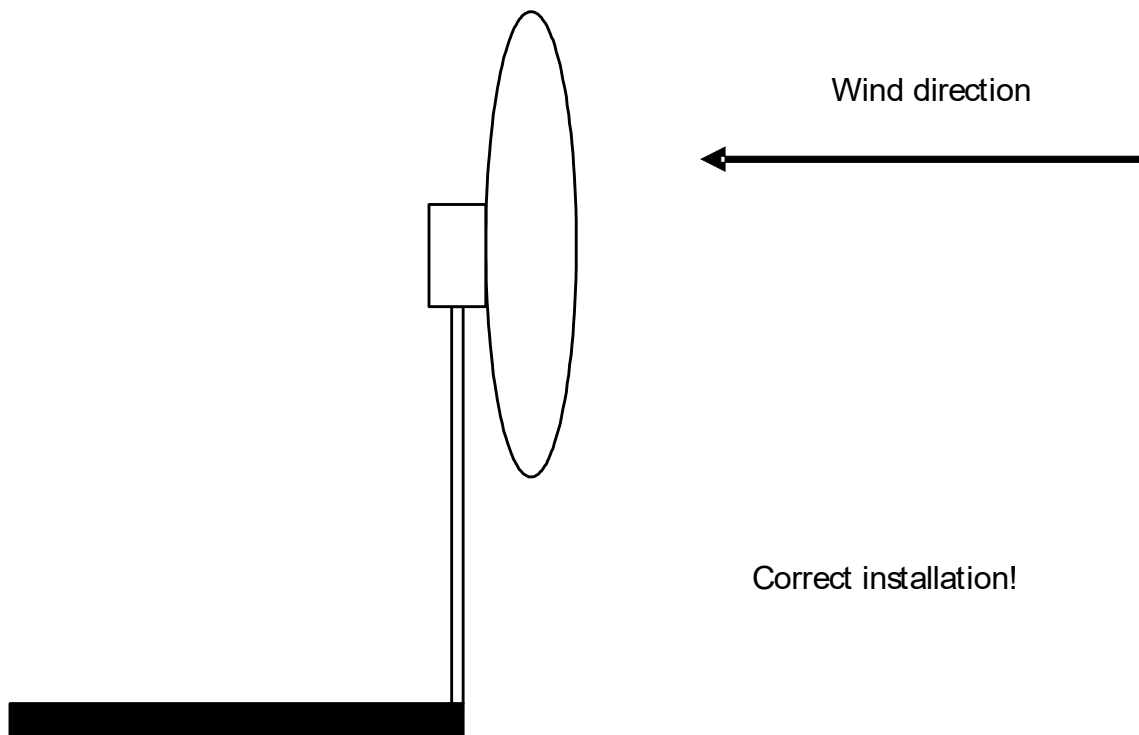
Mount the LNB as depicted.



Finally, mount the rubber band as depicted.

7 Mounting Preferences

- The radio telescope should be mounted weather proofed, if at all possible. For example, a canopy can be used for this.
- The free view to the sky should not be obstructed (observation of Sun, Moon, ..).
- The distance between outdoor and indoor unit should be as short as possible. Cable lengths larger than 50 m should be avoided.
- The indoor unit has to be located in a dry room with temperature above 10°C.
- The antenna and motor cables have to be laid so that there is no risk that a person might trip over the cables.
- Installation of the antenna should be done in a manner that wind from major wind direction cannot cant over the telescope.



8 Cables for motor controller

Items	Quantity
Cable AWG18 (6 x , shielded)	max. 50 m
Heat shrinkable tubing	-
Terminal tag	14 pieces
7-pin metal connector	2
Water resist cap	2

Tools	Quantity
Screwdriver for recessed head screws	1

The YAESU motor controller is connected to the external unit by 2 cables, each with 6 pins. These cables must be cut to the required length. Afterwards the circular plug (supplied in the kit) is soldered at one end of each cable. Pin 7 of the plug remains free.

Wiring details:

Function	Pin Controller	Pin Connector	Color	Interface	Remark
azimuth motor	A1	1	red	Analog signal Position Azimuth	
	A2	2	green		
	A3	3	blue		
	A4	4	white	DC 24 V Motor Azimuth	
	A5	5	yellow		
	A6	6	black		

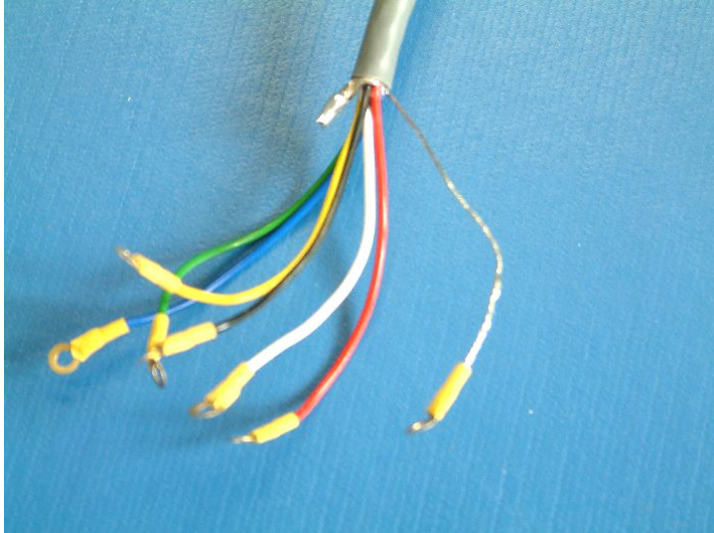
Function	Pin Controller	Pin Connector	Color	Interface	Remark
elevation motor	E1	1	red	Analog signal Position Elevation	
	E2	2	green		
	E3	3	blue		
	E4	4	white	DC 24 V Motor Elevation	
	E5	5	yellow		
	E6	6	black		



Two separate controller cables are used for azimuth and elevation.



The connector for the outdoor units.



At the indoor side, cable lugs are used. They are crimped or soldered. The lugs are isolated with shrinkable tubing (yellow in the figure).

9 Antenna cable

Items	Quantity	Comment
Antenna cable Coax Sat 2150	max. 50 m	Package Cables
F-connectors	4	
Cable support sleeve	1	Package: LNB Attention: Sleeve must be attached to the antenna cable BEFORE mounting the F-connector (LNB side)

9.1 Installation hints

The cables must be laid with attention to the following:

- Avoid mechanical tension in the cable.
- Lay the cables as straight as possible and avoid loops or knots.
- Provide a suitable free length of cable in a loop at the outdoor unit, to allow the movement of the dish in direction of azimuth and elevation direction.
- The cable entry to the telescope control room should be arranged above the splash water zone (at least 30 cm above the ground). Provide adequate sealing at this point.



Cable support sleeves are also provided with the circular plugs of the rotator motors. They should be pushed over the plugs after the plugs are connected to the motors.

Tie the cables together with cable ties at intervals of 50-100 cm. After installation of the cables, move the rotator unit to its final positions (minimum and maximum of azimuth and elevation range). Verify that the cables permit a full range of movement of the dish.

10 Indoor unit



KWS AMA 301 Receiver



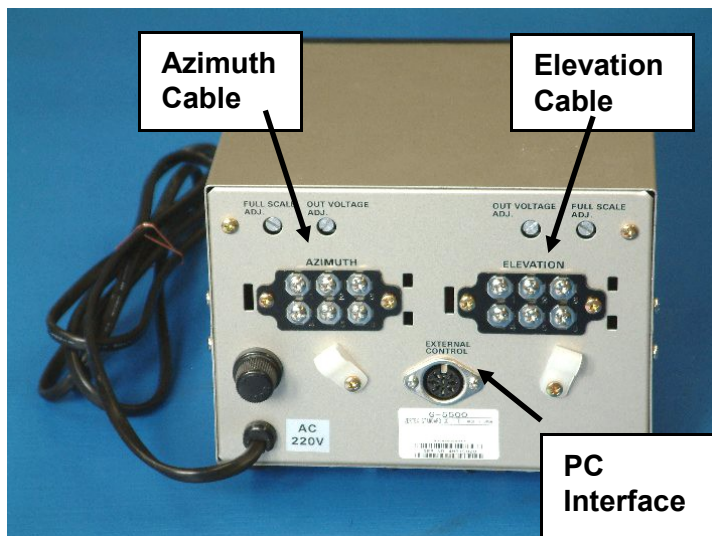
Yaesu Motor controller



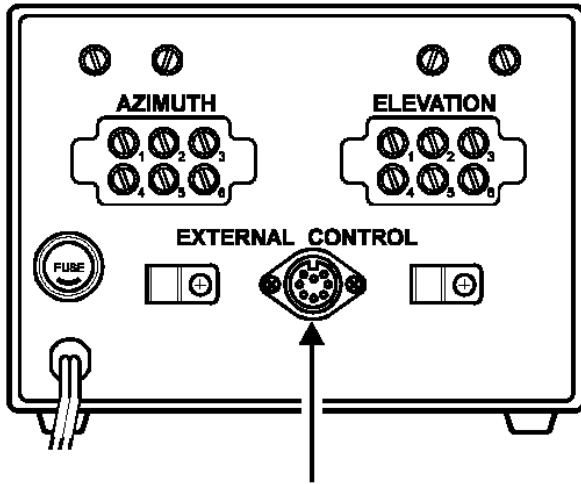
PC interface for motor controller Yaesu GS-232B

10.1 Motor controller

The motor controller unit is connected to the azimuth and elevation motors of the outdoor unit. The position of the dish is displayed on analog instruments in front of the device. The dish can be moved on left/right and up/down by pressing the keys. These keys are not used in regular operation because this device is remote controlled by the PC. Therefore a PC controller device is connected to this unit



The cables are connected on the back side of the motor controller cable. For each direction six wires are clamped with screws. The cable to the PC-Interface has a special plug which is inserted into the circular plug socket.

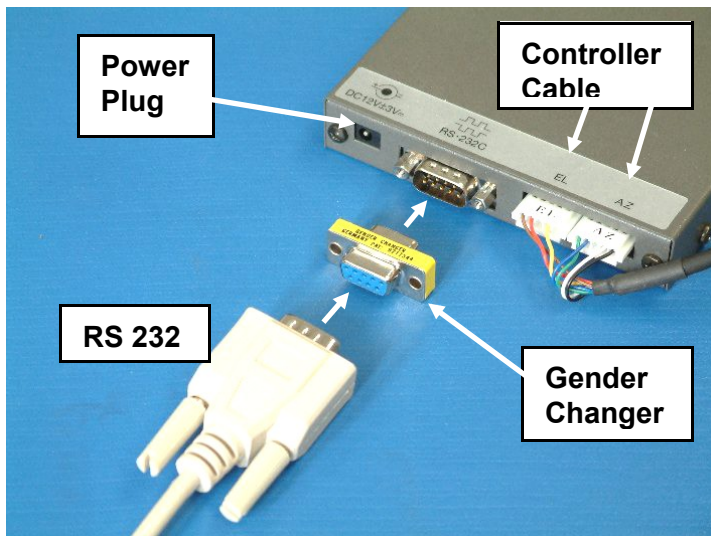


External Control

The contacts of the control cables from the controller to rotators (pin 1... 6) are not marked at the rear wall of the device. The pin assignment is depicted in the technical documentation of the rotator unit.

10.2 PC-Interface

Items	Quantity	Comment
Computer Control Interface GS-232B	1	Package GS-232B
Control cable for azimuth rotator	1	
Control cable for elevation rotator	1	
DC cable with coaxial plug	1	(not used)
Power supply 12 V DC	1	With adapters
RS232 Modem cable	1	female and male connectors (Null-Modem cable not suitable)
Gender changer 9 pin	1	female / female



This small device has four connectors on the back side. The leftmost plug socket is used to connect an AC adaptor plug. The RS232 interface is used for PC connection. A gender adaptor is used to attach a standard RS232 cable.

The attached cable is used for connection to the motor controller. Azimuth and elevation signals are connected by separate plugs as labeled on device and plug.

An external 12V DC power supply must be used to power the GS-232B interface box. The current consumption is about 110 mA.

Cable RS232 Interface Box	Power supply
Red lead	+ 12 V DC
Black lead	- 12 V DC (Ground)

This cable is not needed if an AC adaptor plug is used.



AC-DC adapter by RS Components (part. No. 472-8516) provides a voltage of 12 V DC with maximum 700 mA. Different plugs and sockets are supplied to the power supply. Only one socket fits to the RS232-Interface box GS-232B.

If the AC adaptor plug is used, then the correctt socket (to be checked with GS-232B interface box!) must be attached with the correct polarity:

The arrow at the socket → points to the negative (minus) symbol at the adaptor
Attention

Plug and socket connection is not exchangeable!
Incorrect polarity may cause damage of the GS-232B interface!

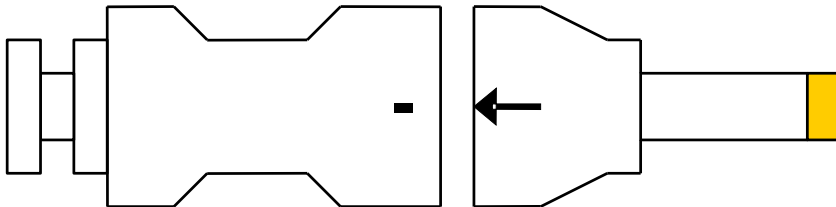
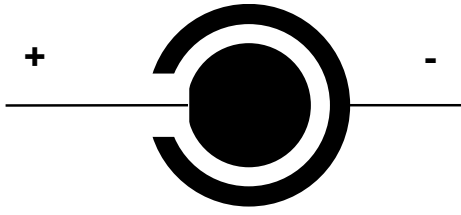


Figure 3: Polarity of GS-232B Interface Connectors

The polarity of the voltage supply is depicted on the GS-232B interface above the plug for the operating voltage. The outer connector of the socket must be wired to negative polarity (Ground). The inner connector must be wired with +12 V DC.

Figure 4: Polarity of GS-232B Interface Plug



10.3 Receiver



Antenna Measurement Automat AMA 301

(Vendor KWS-Electronic
www.kws-electronic.de)

Items	Quantity	Comment
Transport packaging	-	Keep carton and plastic parts!
Receiver AMA 301	1	
Documentation	1	
Program short reference card	1	
Measurement cable with F-adapter	1	
RS232 Nullmodem cable	1	female and female connectors
Gender changer 9 pin	1	male / male

Read and understand the documentation provided with the device before installing it as measurement receiver of the radio telescope.

When the PC is not used, the device is controlled by the built-in keyboard. Important settings of the device are displayed at the LCD display. The small CRT display on the left side of the equipment can be used as spectral analyzer (displays the received signal level versus the frequency) or as monitor for analog television (satellite or terrestrial). An audio signal can be heard also with the integrated amplifier and loudspeaker.

The primary device functionality of the device can be tested very well within VHF broadcast range (87.5 to 108 MHz) or in the TV frequency range. If a sufficient signal level is available from local TV or radio stations a short piece of wire can be used as antenna.

Note: The receiver contains a rechargeable battery, which is usually already charged on delivery. Thus the equipment is immediately ready for use without external power supply voltage 230 V AC. The battery is charged when the receiver is connected to the power supply voltage. The state of charge is shown on the LCD display, indicated in percent.

Ensure that the battery is always sufficiently charged.

Total discharge or overloading is prevented by an internal protective circuit (see the operating instructions of AMA 301). A fully loaded battery (100 %) allows a receiver operation for 0.5 hours without mains connection. The battery is also charged if the device is switched off and connected to the power supply.

Setting the Baudrate for the RS232 interface:

In some cases the initial Baudrate for the RS232 interface of the receiver is not set to the required 9600 baud. Therefore the communication between receiver and RadioAstro software could not be established. The correct baudrate has to be set to 9600 baud on the device as follows:

- Press the MODE button on the AMA301, followed by the numbers 9 and 6
- The page "RS232-interface" is display on LCD
- select "9600 baud" with the Softkeys F1 (decrement) or F2 (increment)
- Confirm your selection with pressing the button EXIT
- The new baud rate will be stored permanently and used from now on

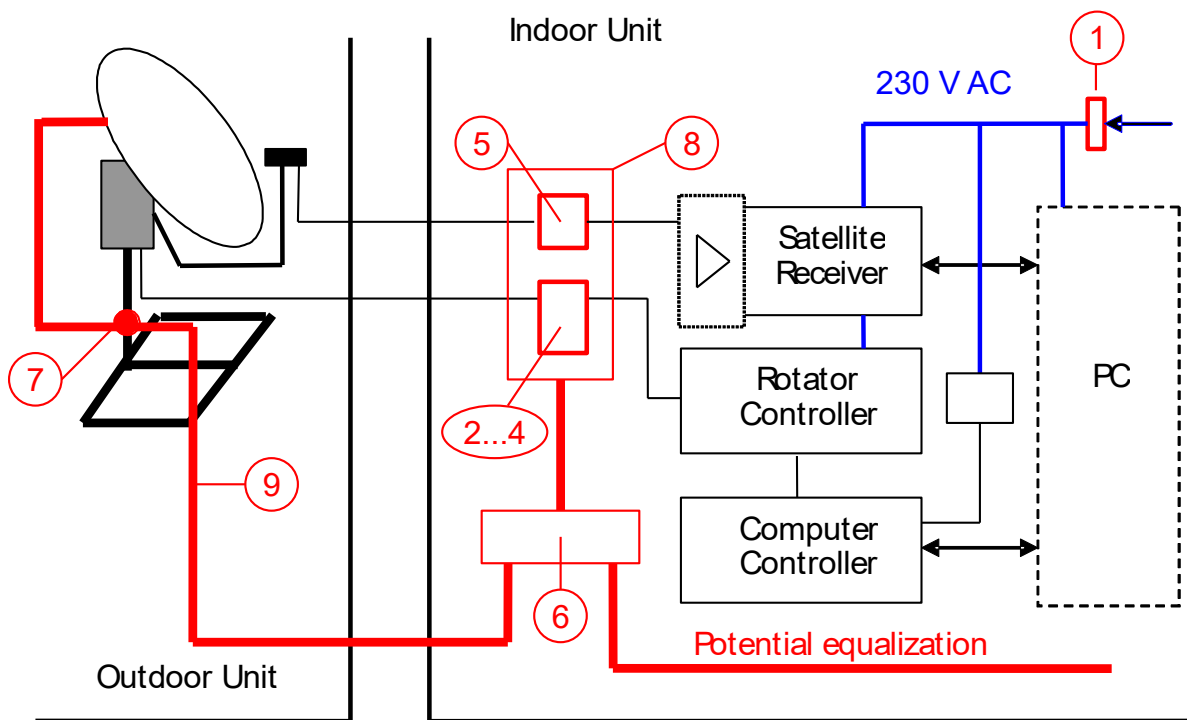
10.4 Overload protection

Lightning strikes which are close to the radio telescope cause danger for humans and devices. The concept, introduced in this section, shall help to arrest disturbing energy as safely as possible. These disturbing energies may be caused by thunderstorms, by switching actions in the energy distribution network, or by switching on/off of high inductive loads such as motors.

The following remarks must be noted:

The installation of surge protection shall be executed by qualified personnel only.

An operative lightning protection of the building is presumed.

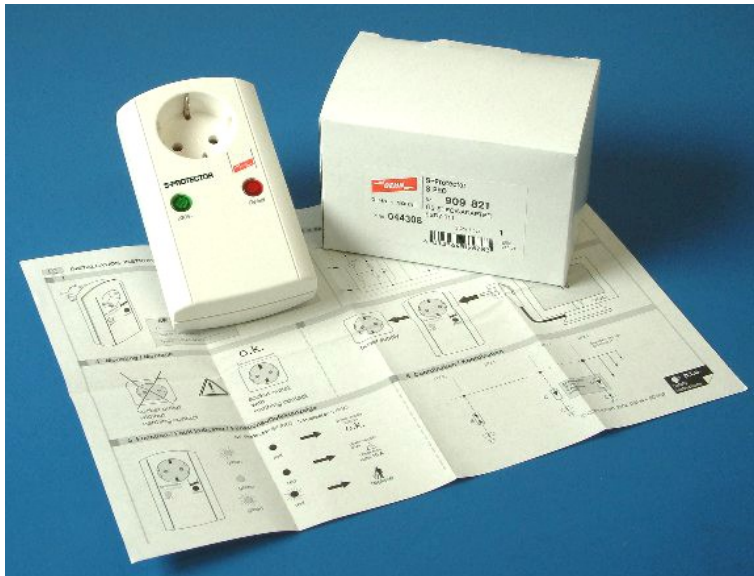


The protection devices are developed and produced by Dehn & Söhne (www.dehn.de). These products are available from specialized electric dealers in Europe. Details about technical parameters and functions are described in the Dehn & Söhne "Surge Protection" catalogue.

Pos.	Description	Type	Function	Remark
1	S-Protector	S Pro	Surge Protective Adapter	230 V AC
2	BLITZDUCTOR Base Part	BCT BAS	Protection cable: Rotator Controller to outdoor unit (AZ / EL)	Position part
3	BLITZDUCTOR	BCT MOD BE 24		Motor part
4	DEHNrail	DR 24 FML		
5	DEHNGate FF TV	DGA FF TV	Surge arrester for coaxial connection (TV systems)	5 – 3000 MHz
6	Equipotential	PAS 9AK	connector	

	bonding bar			
7	Pipe clip	-	connector	
8	Top Hat Rail	35 mm	Mounting element	Pos. 2 - 5
9	Cable (green/yellow)	16 mm ²	Potential equalization	

All disturbing energy, which is injected on cables going to system, shall be arrested to ground by the surge protection. That means all cables between indoor unit (control room) and outdoor unit (antenna, positioning system, power supplies) has to be included in the protection concept. The arresting of disturbing energy is provided by a copper cable with a large cross section, which is connected to the circle grounding of the building. The S-Protector (Pos. 1) blocks the disturbing energy, which may be come from the 230 VAC power supply.



S-Protector
with documentation

The PC, the AZ/EL rotator controller, the measurement receiver as well as the power supply for the RS232 Interface must all be connected to the S-Protector. A standard distribution box for 230 V / 16 A with protection contacts may be used for connection to different consumer loads.

The S-Protector provides two operational displays:

- LED green: is lit, if device is fully functional
- LED red: is lit, if device is defective (overload through disturbing energy)

The antenna input of the measurement receiver is at special risk in the presence of thunderstorms. Therefore, insert a surge arrester for coaxial connection (DEHNgate FF TV, Pos. 5). This arrester has been developed especially for the frequency range from 5 to 3000 MHz and has 75 Ohm impedance. The attenuation is 1 – 2 dB. The DC voltages of the LNB supply will not be blocked ($U_{\max} = 24 \text{ V}$, $I_{\max} = 2 \text{ A}$). The additional test output will not be used for the radio telescope.

Mount the surge arrester on the top hat rail :



Left hand components:

BLITZDUCTOR (yellow)
DEHNrail (red)

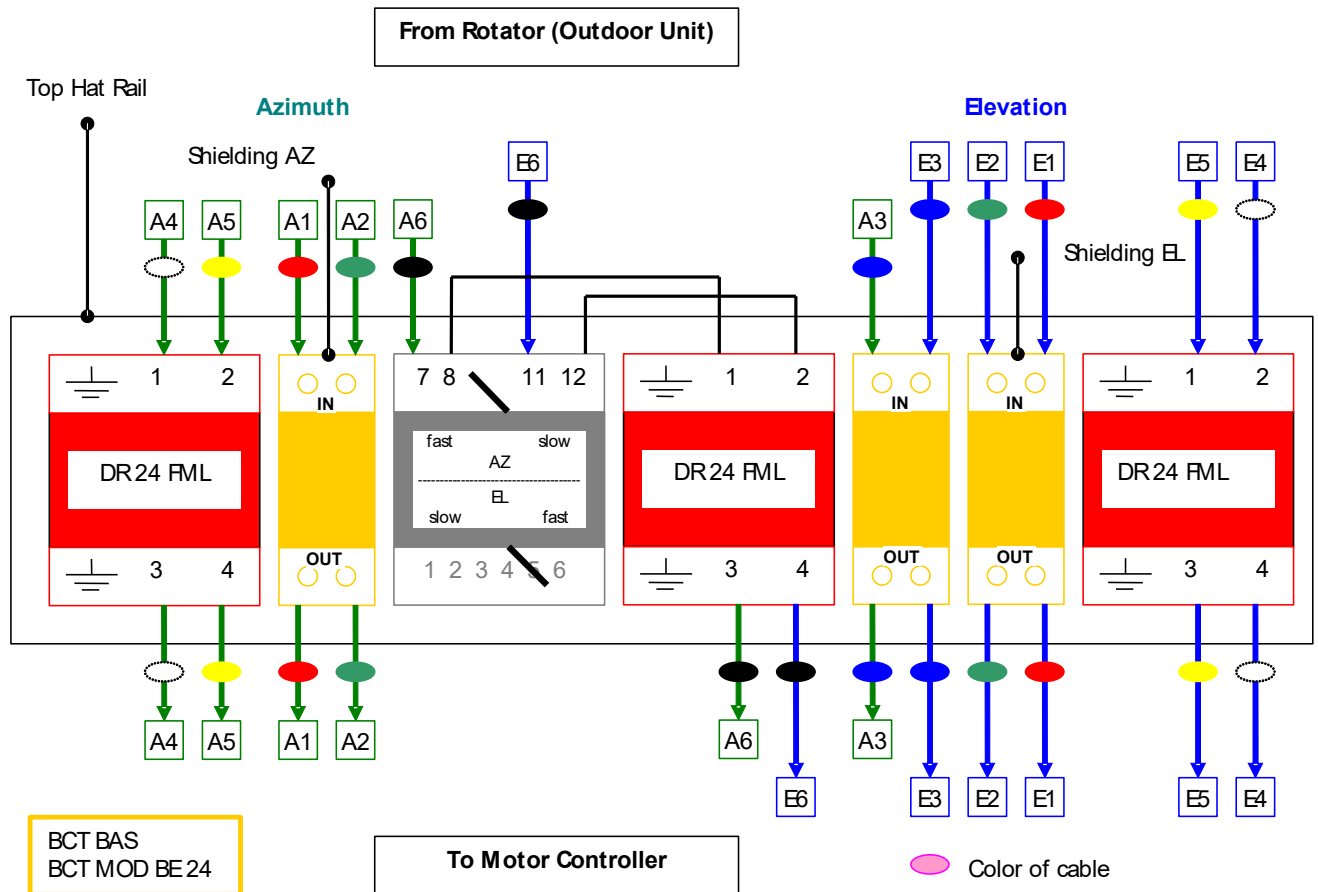
Right hand component:
DEHNgate FF TV
(grey / black)

The controller cables for the positioning system must also be protected. Two different protection devices are used for that purpose.

- BLITZDUCTOR: for the position sensor cables (outdoor → indoor)
- DEHNrail: motor controlling cables (indoor → outdoor)

These protection devices are designed for 2-pole unbalanced loads and are tailored to the power parameters (voltage and current) of the intended electric circuits. The two part BLITZDUCTOR comprises a function module (BCT MOD BE 24), which is plugged into the base element (BCT BAS).

The next figure shows the connection scheme for the protection devices, the motor controller and the outdoor unit. Mount the protection modules on a top hat rail. Mount the top hat rail on the wall of controlling room, near the grommet for the cable entry/exit.



A simple switching of rotation speed (fast or slow) is realised with the Speed Control Switch. It has to be connected as depicted. It may be left out for the first operations, to keep the system as simple as possible.

Cables which lie parallel to each other cause injection of disturbing energy from input to output. Therefore, attention must be paid during installation that all cables coming *from* protection devices are not located parallel to cables going *to* protection devices. See Figure 5 for illustration.

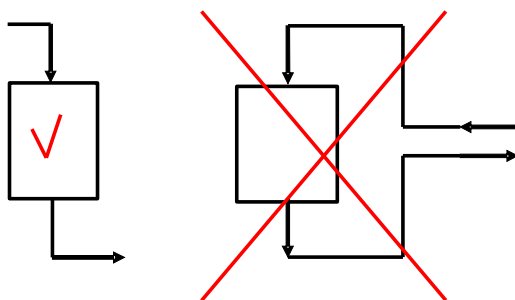


Figure 5: Correct and Incorrect Cable Installation

Disturbing energy injected into steel standing of dish must also be arrested. A cable with large cross section (Pos. 9) has to be connected to vertical mast with a pipe clip (Pos. 7), as well as with the rotating steel frame of the antenna. This cable, together with the other cables (antenna, positioner), has to be laid in direction to control room and has to be

connected to the equipotential bonding bar (Pos. 6). The equipotential bonding bar has to be connected to potential equalisation of the building.



Equipotential bonding bar

10.5 Personal computer

The PC is used for the following tasks:

- Control of dish rotator unit Yaesu G-5500
- Control of measurement receiver AMA 301
- Recording, post-processing and visualization of the results

No special PC or laptop is required for using the **RadioAstro** software. The following equipment is sufficient:

- Operating system: Microsoft Windows 2000 or XP
- Microsoft Excel (or equivalent spreadsheet software) to provide further data processing and visualisation
- Graphics resolution at least 1024 * 768
- Hard disk at least 30 MByte
- Two serial ports (RS232 / COM-Ports)

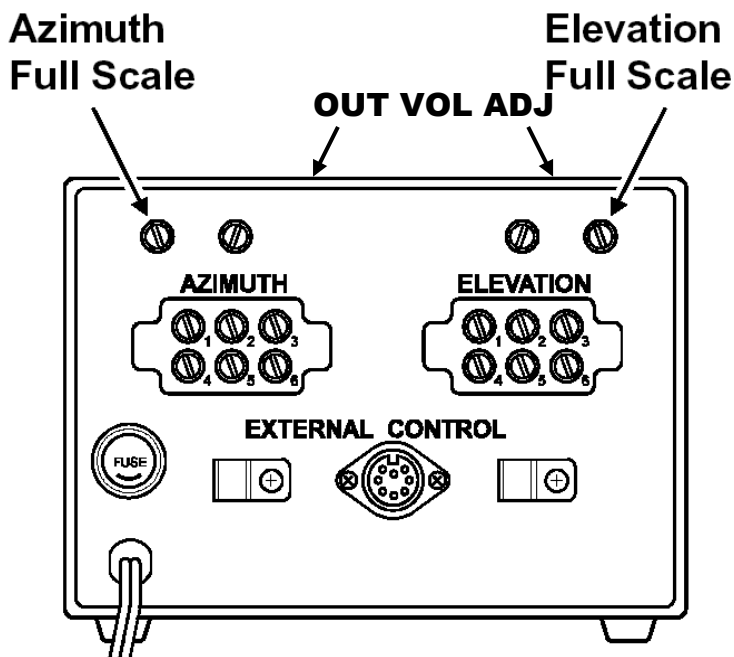
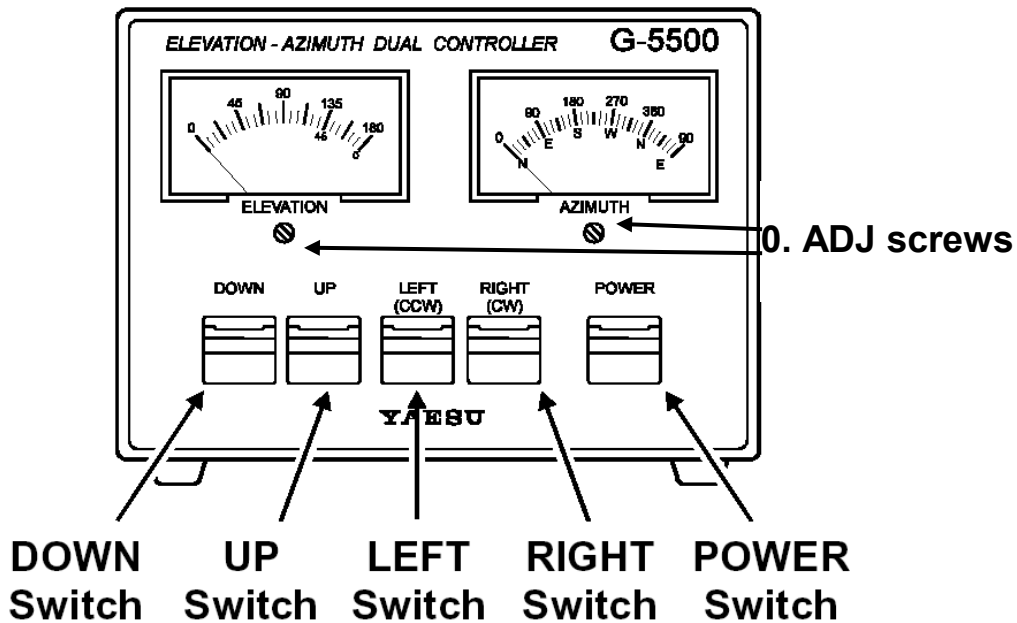
If the PC is not equipped with two serial ports, one or two USB-to-RS232-converters may be used instead. These converters are commonly available at hardware stores.

Additional software must be installed as listed below::

- Visual C++ application
- Visual Basic application (optional)
- Public domain software "Le Cartes du Ciel"

The software installation is not further described here. See the Operating Manual for a detailed description of software installation.

10.6 Calibrate the Motor Controller



Preparation:

Connect the Motor Controller with the **unmounted** AZ and EL rotators. Use the two 6-wired cables (see 3.1 and 4.1) for that purpose.

Connect the the Motor Controller to the power supply.

Zero adjustment of meters:

Switch off the Motor Controller.

Adjust the **0. ADJ screws** beneath each meter face, as necessary, so that each meter points to the left edge of the scale.

Then turn the controller back on for the following steps.

Azimuth Indicator:

Press and hold the **LEFT switch** and allow the azimuth rotator to turn until it reaches its end stop.

Note the precise position of the rotator (mark the housing, if necessary), and then press and hold the **RIGHT switch** to bring the rotator around one full turn to exactly the same position. The meter should now point precisely to 360° of the scale.

If not, adjust the **FULL SCALE ADJ potentiometer** at the upper corner of the rear panel above the AZIMUTH terminals.

Press the **RIGHT switch** again to continue clockwise rotation until the rotator reaches its end-stop.

The indicator should now point to right edge (90°) of the scale.

Elevation Indicator:

Press the **UP switch** to align the 180° markers on the rotator.

The meter should now point precisely to 180° at the right end of the scale.

If not, adjust the **FULL SCALE ADJ potentiometer** at the upper corner of the rear panel above the ELEVATION terminals.

Notes on Controller Operation:

If the rotator motors are used for their maximum of five minutes intermittent duty they must be brought to rest for at least 15 minutes afterwards.

If both UP and DOWN switches or RIGHT and LEFT switches are pressed at the same time, the corresponding rotator turns up or right (clockwise).

Release the switch when the meter indicates that the motors are in the end zones (the rotator stops).

Remember to turn the controller off when the rotators are not in use.

10.7 Calibrate Computer Controller

Preparation:

Switch on the Computer Controller (GS-232B). Start the RadioAstro software and configure it as described in Operating manual.

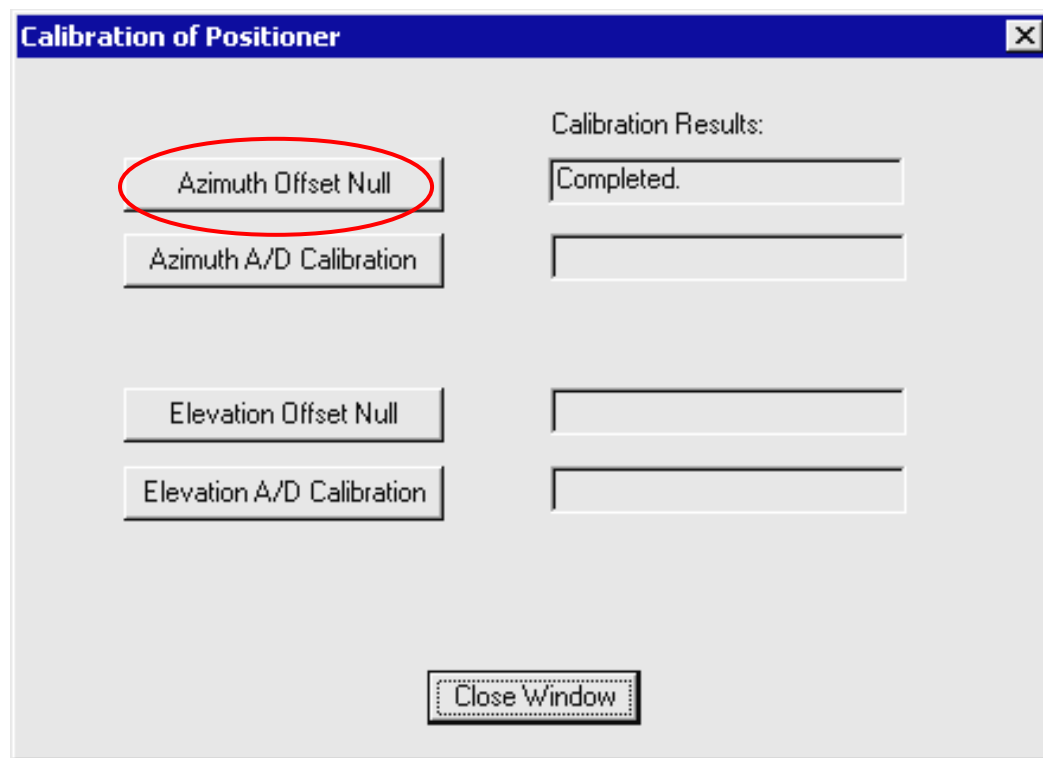
Establish the connection to the positioner by pressing the "Open" button in the Positioner subwindow.

Check if the values for AZ and EL displayed in the "Status" subwindow are displayed (proper connection is established).

Press the "Calibration" button and execute the following instructions:

Azimuth Offset Null:

From the Motor Controller panel, set the Rotator fully counterclockwise (LEFT switch, set to 0°).



Press the "Azimuth Offset Null" button in calibration subwindow.

After some seconds the calibration result "Completed." is displayed on the right side.

Azimuth A/D Calibration:

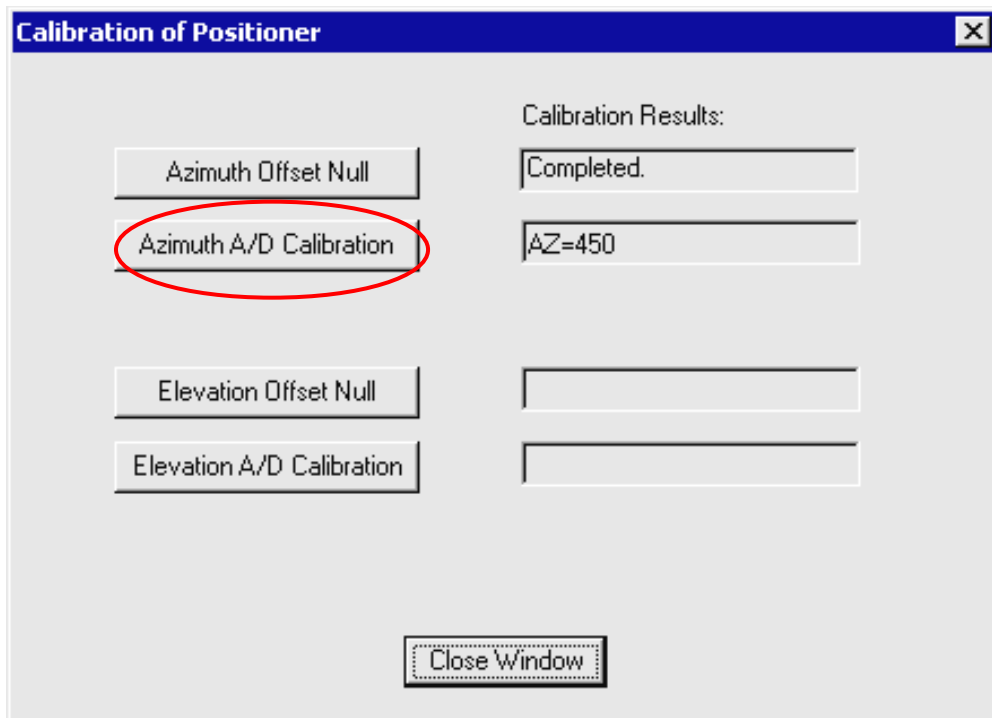


Figure 6: Azimuth A/D Calibration for Computer Controller

From the Motor Controller panel, set the Azimuth Rotator fully clockwise (RIGHT switch, 450°).

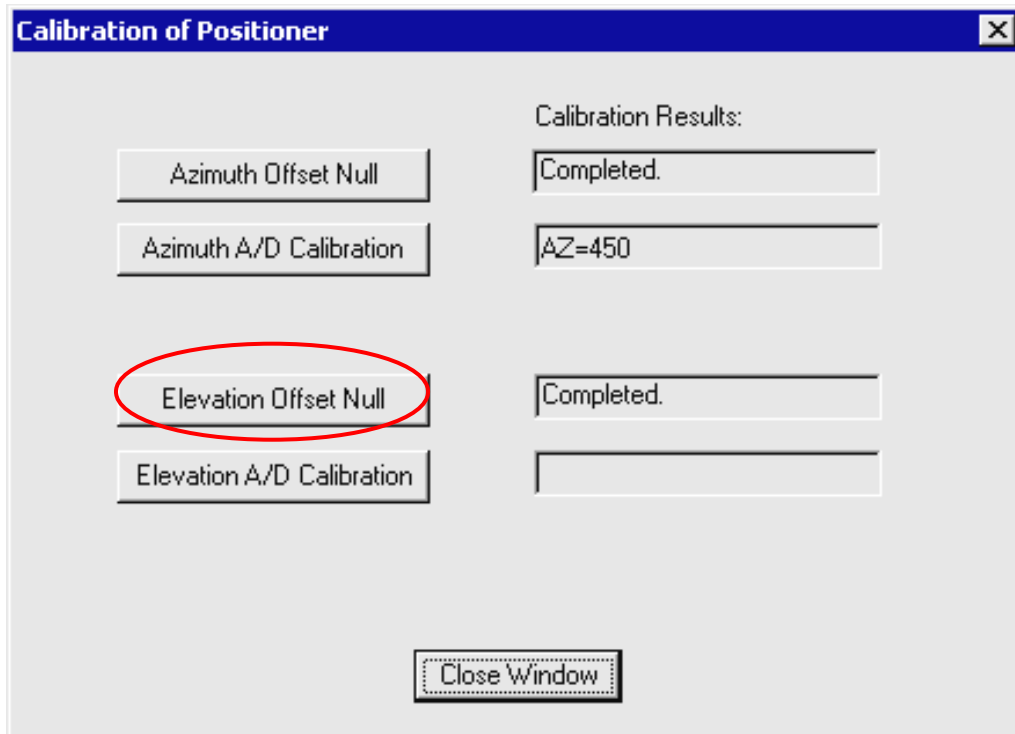
Press the "Azimuth A/D Calibration" button in the calibration subwindow (Figure 6).

The textfield on the right side should show "AZ=aaa", where "aaa" is a three-digit number indicating the azimuth heading in degrees.

Adjust the **OUT VOL ADJ potentiometer** on the left side of the rear panel of the Motor Controller so as to get a reading of "AZ=450" on the textfield.

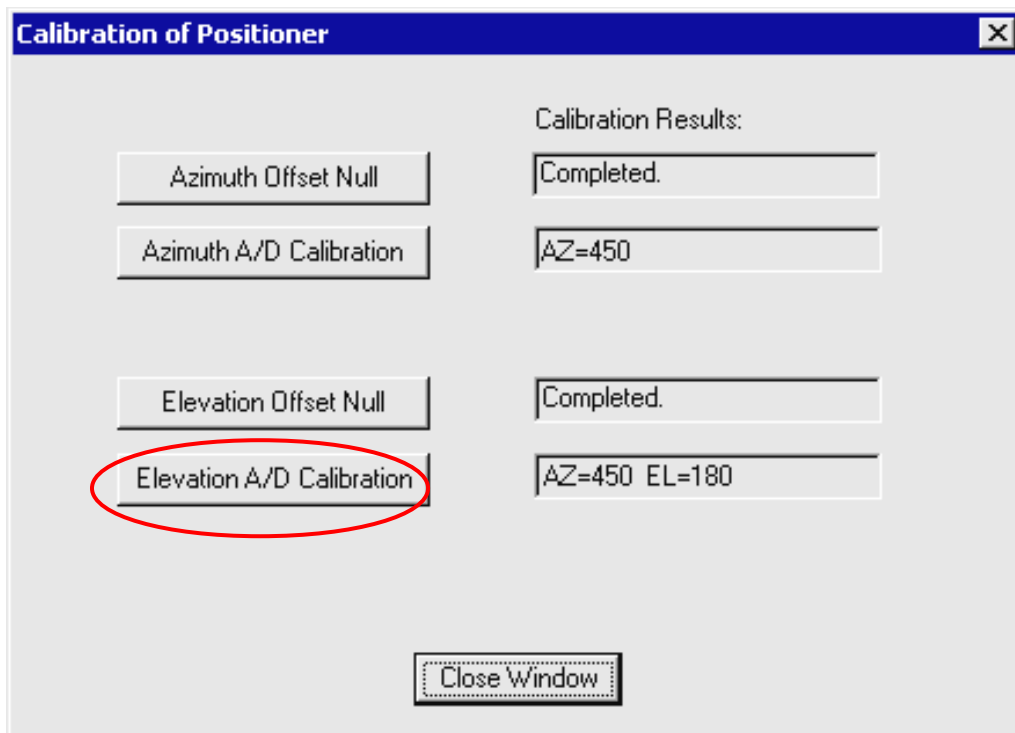
Elevation Offset Null:

From the Motor Controller panel, set the Rotator fully down (DOWN switch, set to 0°).



Press the "Elevation Offset Null" button in calibration subwindow.
 After some seconds the calibration result "Completed." is displayed on the right side.

Elevation A/D Calibration:



From the Motor Controller panel, set the Elevation Rotator to full scale (UP Switch, 180°).
 Press the "Elevation A/D Calibration" button in calibration subwindow.

The textfield on the right side should show "AZ=aaa EL=eee", where "eee" is a three-digit number which indicates the elevation heading in degrees.
For the purpose of this alignment, you may ignore the AZ value.
Adjust the **OUT VOL ADJ** potentiometer on the right side of the rear panel of the Motor Controller so as to get a reading of "EL=180" on the textfield.
Press the "Close Window" button.

Finish:

Fill in the values "**180**" for Azimuth and "**5**" for Elevation in the Positioner subwindow for preparation of the following assembling.
Press the "Goto Position" button.
Wait until both rotators have reached this position.
Switch off the Motor Controller and the Computer Controller.

11 Start-up a first operation

After the wiring of all devices, perform a first functional test. Ensure that the PC is ready for use and that all devices are switched on.

The position of the dish positioners can be seen on the analogue instruments of the motor controller device (in degrees). The following relationship applies between the position of the dish and the instruments:

Azimuth

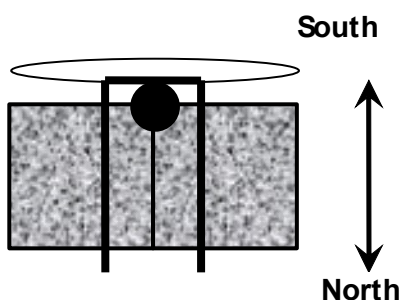
90°	180°	270°	360° / 0°

Elevation

0°	90°

First verify the functioning of the rotator unit. It must be possible to move the dish to the appropriate positions for azimuth and elevation as described in the tables above. If this fails (rotator in end position or dish supporting frame blocks with the vertical mast), the appropriate screws must be released and the dish must be mounted again in the correct position.

Next, roughly position the dish stand:



Top view of the outdoor unit:

Align the dish stand in the north south direction with the help of a compass.

11.1 Absolute Position Calibration

This first adjustment is not accurate enough for scientific measurements. A geostationary broadcast and television satellite can be used for the accurate mechanical calibration of the radio telescope. The high performance ASTRA TV broadcast satellites are located at the orbital position $19,2^\circ$ east. The exact values for azimuth and elevation of ASTRA depend on the location of the antenna. These values are listed in tables available at local Sat-TV dealers. On the Internet, see:

www.ses-astra.com

Media Room / Publications / Azimuth & Elevation
Seite Deutschland : Broschüren / Antenneninstallation
Sat-Infos / AZ/EL-Werte for Germany and Europe

www.technisat.de

The dish is then aligned to the satellite with the help of software and the positioning unit (AZ and EL). The measurement receiver must be adjusted to a transponder of this satellite.

→ Setting of transponder frequency, polarisation and mode

Example 1:

Astra 1G	Digital
Transponder	#116
Frequency	12,6695 GHz
Symbolrate	22,000 MS/s
Code-rate	5/6
Polarisation	V
Program:	VIVA

Example 2:

Astra 2C	Analog (television picture visible)
Transponder	#55
Frequency	10,8027 GHz
Polarisation	H
Program:	N24

Adjust the satellite dish position for azimuth and elevation in such a way that a maximum signal level is reached. The signal level is displayed on the measurement receiver; additionally a control tone can be activated to indicate the maximum signal strength. In order to reach the maximum signal for the elevation, the screws M8 (wrench width 13) at the pipe clamps of the upper positioning motor must be released slightly and tightened again.

Optionally, this procedure can be repeated for a satellite on another orbital position to check the accuracy of the adjustment.