

PRO. SIS. TEL.

Produzione sistemi telecomunicazioni

Antenna Rotator

**Azimuth "D" DC version
User's manual
Rev.1.7**



FCC

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Warning

This manual must be read carefully before proceeding to assembly.

Warranty

1) The rotator with the control box, hereinafter called “product”, or “rotator”, is warranted for 2 years from date of purchase, provided that it is supported by the document of sale issued by the manufacturer or authorized distributor.

2) The warranty covers replacement or repair of any defective component.

3) This warranty does not apply to product which have been subjected to misuse, negligence, accident, incorrect wiring performed by the user, improper installation or non-compliance to instructions furnished by us, damage to product which has been repaired or altered without authorization or to injury or loss resulting from careless maintenance. The warranty does not cover damage due to transportation and all causes not arising from defects in workmanship, and faults caused by adjustment of internal trimpots.

4) The warranty does not cover costs of transport or insurance for material returned to our workshops.

5) The manufacturer is not responsible for personal injury or property damage resulting from improper or careless use of the product.

6) All product is tested after assembly and is supplied without defect. We exclude the substitution or the prolongation of warranty for a possible damage.

7) After the 2 years warranty period, maintenance or repair will be subject to parts and labor charges.

8) No person is authorized to assume for us any liability in connection with the sale of our products.

9) This warranty does not cover damage to people or things due to misuse, improper or careless installation, or misunderstanding of instructions furnished by us.

10) The right of recession must be exercised in according to the law.

11) Our products are subject to continuous improvement. We reserve the right to implement improvements and changes without prior notification.

12) The legal code applying in MONOPOLI, Italy, will apply, in cases of dispute.

13) Purchasers of product are deemed to accept paragraphs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13 as above.

Model: PST

S/N:

Date of purchase:

Important

Read this instruction manual carefully before attempting to operate with the antenna rotator.

Save this instruction manual.

This instruction manual contains important safety and operating instruction for antenna rotator.

Precautions

! WARNING, never connect or disconnect rotor cable or RS232 connectors while power is on. This may results in electrical shock or burn.

Table of contents

Section 1:	Description;
Section 2:	Installation and use;
Section 3:	Principle of operation ;
Section 4:	Technical specifications;
Section 5:	CD
Appendix 1:	Declaration of conformity
Appendix 2:	Warning
Table:	
Note:	

Last up-date 6 October 2010

Section 1

The controller "D" version

1-1 Front panels description.



1 - POWER SWITCH (POWER)

Turns power ON and OFF

2 – Right lever: CW momentary switch

Pushing and holding this switch will make the rotator turn clockwise

If you have used the preset, or computer control to start rotation, you can over-ride those commands by momentarily depressing the switch.

3 – Left Lever: CCW momentary switch

Pushing and holding this switch will make the rotator turn anti-clockwise

If you have used the preset, or computer control to start rotation, you can over-ride those commands by momentarily depressing the switch.

4 - Display

The display will show the current bearing in degrees.

When the preset knob is turned, the display will show the preset bearing.

The decimal points on the LED display blink

* when you turn the target position knob on the front panel

* rotation begins and is in progress

* when rotation is complete. At that time the display will blink for the programmed delay time before further rotations are permitted. (Note - if the CW or CCW keys have been used, further rotations in the same direction are not subject to this delay time)

5 - Preset rotating encoder

To preset rotation, turn the knob to the desired bearing. 3 seconds later, rotation towards the preset position will start, with the display showing the bearing as it changes. "Err" is displayed if the preset knob is turned to a position outside the rotation limits.

1-2 Rear panel description.

1 - DB9, RS232 female connector

Enables connection to a PC RS-232 port for remote operation.

Pin 5 = computer ground

Pin 2 = serial data out (to computer data in)

Pin 3 = serial data in (from computer data out)

2 - Rotator control cable male connector.

Connect the rotator to the controller

3 – AC Main Power male socket (230Vac or 115 Vac)

4 – Fuse holder.

19x5mm, 1.6A fuse is required.

1-3 “D” Controller features.

Warning:

this is a complex controller, make sure you understand before using it.

This controller has several features settable via RS232 and some of such features are even settable manually. A four ways dip-switch allows manual selections.

Controller parameters settable in either modes:

- Soft start – Soft stop
- South stop or North stop
- Rotation range 360 or 500
- Calibration
- Off-set

Controller parameters settable via RS232 only:

- Reverse delay
- Preset delay
- PWM duty cycles
- Rotation range
- Optimizer
- Rotor chk

Controller display mode settable manually only:

- Absolute or relative display mode.

- **Entering in Absolute mode**

The controller uses an ADC which accepts 0-5V voltages. The antenna position voltage readout is mapped to be inside the 0-5V range. In the **absolute** mode the display shows directly the rotator position expressed in absolute degrees: you read values from 0 to 500. In the other operational modes (north/south-stop) the absolute readings are converted into different angular position numbers, but only for input/display purposes: internally the program works with absolute angles.

The **absolute** mode can be **only** entered turning-on the CBOX with the CW key pressed until the display shows a blinking “---” (three minus): now you can release the key and the **absolute** mode is entered. You can move the motor using CW and CCW keys between the rotation limits.

To exit from such a mode you must recycle CBOX power (forcing another mode by RS232 command isn't effective).

In the **absolute** mode the rotor can be only operated by the CW/CCW

The **absolute** mode is usefull for CBOX calibration (see **CALIBRATION** paragraph).

It is NOT recommended to turn big antennas which need to be started and stopped softly.

The bearing values in degree as shown by the display, are not absolute but relative, as show in the conversion tables:

		South stop		absolute values			
Vdc	000	070	160	250	340	430	500
Deg.	110 east side outrange	180 S	270 W	000 N	090 E	180 S	240 west side outrange

		North stop		absolute values			
Vdc	000	070	160	250	340	430	500
Deg.	290 west side outrange	000 S	090 W	180 N	270 E	000 S	070 east side outrange

That means when the VDC applied at ADC converter input is 000V or less, the ABS value is 000 and the display show **110** deg. if setted on South stop (default) while show **290** deg. if setted on North stop.

With an applied voltage of 2.50V the display will show **000** deg when in South stop and **180** deg when in North stop, while with an applied voltage of 5V the display will show **250** deg. when in South stop and **070** deg. when in North stop.

- **The on-board dip-switch**

There is an on-board dip-switch that allows the user to change some operating modes without using the supplied PC program.

Remember that the dip-switch status is read only at power-up and copied into the EEPROM: you must turn-off and turn-on the main power for a dip-switch change to be effective.

There are four switches:

- #1: select the source of the three following parameters: if ON the source is the other three switches status, otherwise the relative EEPROM contents modifiable through the **W** command
- #2: operating mode: if ON is north-stop, otherwise is south-stop
- #3: rotation range: if ON the rotation range is 0 to 500 absolute degrees, otherwise is 70 to 430 absolute degrees
- #4: PWM: if ON the PWM is enabled, otherwise is disabled

The above parameters (ENA_PWM, LOWLIM, UPLIM, MODE) are not modifiable by RS232 commands if the switch #1 is ON (dip-switch selected). LOWLIM and UPLIM change accordingly with the POS_OFFSET values.

- **Soft start and soft stop:**

A MOSFET controlled PWM is included. When it is in active it permits soft-start and soft-stop for the rotator.

Default value: included.

- **South stop or North stop:**

Via RS232 or on board dip-switch, it's possible to switch the display reading mode.

Default value: South stop.

- **Rotation range 360 or 500:**

500 degrees of travel is enabled as the default value. This allows 70 degrees travel past 360 degrees, in both directions. Some users may wish to limit travel to 360 degrees. There are two ways to do this

- By setting the on-board dip-switch as described above.

- By using the supplied software - which will allow any limits to be set, to one degree accuracy. Note - Absolute values must be entered in the input fields.

Default value: 0-500 Degrees

- **Calibration**

Two on board trimmers are provided to calibrate the controller.

Note – adjustment of these trimmers which leads to a “fault” is not covered by the warranty. Please do not adjust them if you are not sure of the correct procedure.

If necessary, you can recalibrate your controller via RS232. See calibration procedure issue.

- **Off-set**

If the initial antenna direction it's not coincident with the geographic direction, you can fix it manually using an on board off-set trimmer as well via RS232.

Default value: 0

- **Reverse delay**

A reverse delay time is provided. This is to reduce stress on your rotator / tower and antenna systems caused by too-rapid reversal of direction. The default time is 3 seconds, but this may be altered in the software to suit your antenna system.

- **Preset delay**

A preset delay time is provided. This allows you time to finalise the preset position before the rotator starts to turn. The default is 3 seconds, which may be altered in the software.

- **PWM duty cycles**

This feature controls the acceleration / deceleration of the rotator between rest and full rotation speed. This feature is kind to your antenna system as it gives smooth starting and stopping of your antenna.

- **Rotation range**

This controller allows you to have 500 degrees of total rotor rotation range with 70 degrees of extra travel for each side. An on board dip switch allow you to choose between two rotations ranges, 0-500 degrees (default) or 0-360 degrees.

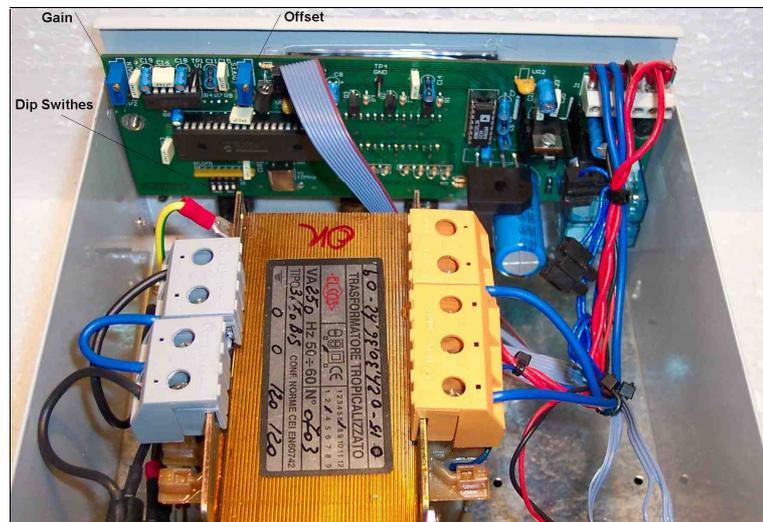
- **Optimiser**

If you select rotation by preset knob or computer control, the optimiser will determine the shortest direction to target.

- **Rotor chk**

If implemented, if you select a target with preset or computer control, the CPU will check the feedback signal from the rotator, and within 5 seconds will prevent the rotator from turning in the event of an abnormality.

- **Controller internal view**



- **Calibration procedure.**

Initial calibration is carried out in the factory.

Note – adjustment of these trimmers incorrectly may require service attention by your dealer. THIS IS NOT COVERED BY THE WARRANTY and your dealer may raise a time and labour charge for the work.

To use the on-board OFFSET trimmer to perform subsequent calibration

1. Turn the antenna to a known position if the true position differs from the controller display.
2. Adjust the on-board OFFSET trimmer until they are the same.

Note

The Calibration potentiometer will only permit a minor amount of adjustment. If your antenna position is grossly incorrect, you will need to correct it by repositioning the antenna on the mast.

The complete calibration procedure is the **RS232philosophy.pdf file (for expert only)**

1-4 The rotator

The rotator has a unique design. The motor is located on the side of the machine.

The motor output shaft terminates on a flange, where different kinds of mast clamp, available from us, may be fixed with bolts. Users may also supply their own clamp.

On the motor side is located a five-contact connector for motor power supply and potentiometer terminals.

The potentiometer, used as the antenna position reader, is located inside the foot plate, and driven by the transmission output shaft.

PST 110 - 71 - 61

PST2051 - 641



Rotator cable ends

Rotators end



110-71-61



2051-641 controllers end



Section 2

Installation and connections

2.1 Unpacking

After unpacking, immediately report any damage to the delivering carrier or dealer. Keep the shipping carton.

2.2 Power supply connection

Connect the power cable and switch power on, display will show PHH and 110. Switch power OFF.

2.3 Rotator control cable preparation & connection

Before installing the rotator inside a tower, you need to prepare male connector for remote control cable, make all connections and test rotator operation throughly on the ground, as described below.

Connect the rotator and control box with a 5-core control cable. Two cores are used for the motor DC power supply, and three for the position reading potentiometer. If the diameter of the control cable is too thin, it will limit the voltage and reduce the torque.

Do not use cable with less than 0.5 mm² of section area.

Before connecting rotator and controller, make sure that power switch is OFF.

Cable plug		Motor terminals board
Wire no. 1	must be connected to	1 (VDC motor power) $\geq 1\text{mm}^2$
Wire no. 2	must be connected to	2 (VDC motor power) $\geq 1\text{mm}^2$
Wire no. 3	must be connected to	3 (P to pot central lead)
Wire no. 4	must be connected to	4 (+5 Vdc pot lead)
Wire no. 5	must be connected to	5 (0 Vdc pot lead/GROUND)

Warning: Improper wiring can result in damage to the rotator circuitry when the power is swiched on.

THIS IS NOT COVERED BY THE WARRANTY.

2.4 Rotator cable inspection

Ensure the cable is correctly wired before connecting it to the controller.

Checking the rotor cable you need a digital multimeter.

Rotator truth table

Pins 1 and 2 (DC motor resistance = 4 ~19 ohm)

Pin 1 and 2 to ground = open

Pins 1-2 to pins 3-4-5 = open

Pins 3 and 4 = ~ 2.06K (positive wiper to potentiometer)

Pins 3 and 5 = ~ 7.65K (negative wiper to potentiometer)

Pins 4 and 5 = ~ 10K (entire potentiometer)

Pins 3-4-5 to ground = open

Those values are valid when rotator is pointing North, a small tollerance is acceptable. If you don't see these values, check your cable connections.

Use truth table each time you notice something wrong on your controller.

2.5 Preinstallation check

! Warning, use only CW and CCW switch while preinstallation check is in progress. Switch power ON, display will show PHH and after than the rotator position. If display shows 110. or 250, check the connection cable.

Fully depress the CW lever switch for 1-2 seconds. the rotator should start to move in the CW direction. Release the switch and try the same test for CCW. The opposite rotation will be a little delayed by the preset delay time, which is normal. Note the controller display during this test. The readout should increase for CW and decrease for CCW. If these tests give incorrect results, refer to the troubleshooting section of this manual. If the results are correct, test full rotation to the electronic limits in both CW and CCW directions. When this test has been performed turn the rotator to 000 degrees with the lever switches. Then test the preset feature by setting a new direction with the preset knob. Observe that the rotator will turn to that position and stop. The optimiser feature will ensure that travel to the preset position is always in the shortest manner.

2.6 Troubleshooting

- Power

- Check the presence of the house power at power outlet;
- Check that the power cable plugs is correctly connected.
- Check the fuse. If it's blown, replace it with one of the correct value and switch power on. If it blows again, the user contacts the local service agent.

- Motor turns in the wrong direction

- If while you were pushing CW switch the rotator started in counter clock wise sense, then the motor is getting reversed DC polarity. Change over the motor wires.

- Rotator follows the right CW and CCW commands but display shows the opposite.

- With a digital voltmeter, check the presence of +5Vdc on the motor board, lead no. 4. If +5Vdc is not there, check the rotator cable connections/continuity.

- Display shows 110. and rotate only CW.

First carefully check the cable connections. If the connections are OK, the Potentiometer is misaligned. Check the resistance in the "truth table" If the resistance value is lower than what it should be, then rotate the rotator CCW till you get the right resistance value.

- Display shows 250. and rotate only CCW.

First carefully check the cable connections. If the connections are OK, the Potentiometer is misaligned. Check the resistance as in the "truth table" if the resistance value is higher than what it should be, then rotate the rotator CW till you get the right resistance value.

Note – to turn the rotator to the position where the controller can interpret the resistance readings correctly, you may need to unplug the control box cable connector and apply an external DC source (13.8V DC) to pins 1 and 2 of the control cable connector, while monitoring the resistance values on pins 3,4, and 5. Reverse the DC if the rotator appears to be rotating in the wrong direction. Be sure you do not short the DC voltage to pins other than 1 or 2. The resistance values to reach are shown in the truth table in para 2.4 above for North stop.

2.7 Rotator installation

Before drilling holes in the mounting plate, place the rotator inside the tower and adjust its position so there will be no interference between rotator body and tower.

Put the antenna mast inside the mast clamp and lock centrally. The centre axis line must be within 0.5° of true.

By a pen, mark the position of the mounting holes on the mounting place, remove the rotator, and drill the holes .

Use the four bolts with washers and self-locking nuts to secure the rotator on the mounting plate.

Before tightening the bolts, insert the antenna mast in mast clamp, turn the rotator for 1 revolution and adjust its position until the central axis line is within 0.5° . Now tighten the bolts.

Note: Keep you rotator base dry, make sure that your tower rotator plate has enough drainage holes. Your rotator could get moisture in the base bell from the water standing on the plate. If your tower rotator plate doesn't have drainage holes and you can't drill some, than put some washers between the rotator base and the tower rotator plate.

2.8 Antenna direction adjustment

Antenna rotator alignment is mechanical. After the antenna is installed on the mast, turn rotator to the desired bearing. Unlock the bolts on mast clamp and with a magnetic compass turn the antenna mast until the antenna beam direction is like that shown on the rotator control box. Lock the antenna mast with the mast clamp bolts. The antenna beam direction now is fixed. If you want to change it, you must rotate the antenna clamp on antenna mast. See Calibration Offset issue.

2.9 Rotator maintenance

The worm-gearred motors are lubricated for life and no maintenance is required. If you live in an industrial zone or sea area, after a time you may have some corrosion to the outer casing. Rotators are coated with anticorrosive paint at the factory and if repainting is necessary, use ordinary anticorrosive paint for ferrous metal.

Section 3

Principles of operation

3.1 Rotator

The rotator is manufactured with a worm-wheel geared motor driven by a high torque dc motor. This method, normally used in heavy duty industrial and professional machinery, permits a very high reduction ratio, with high power torque with both low power motor drive and high brake torque, due the self-braking property of the worm-wheel geared motor.

3.2 Electrical configuration

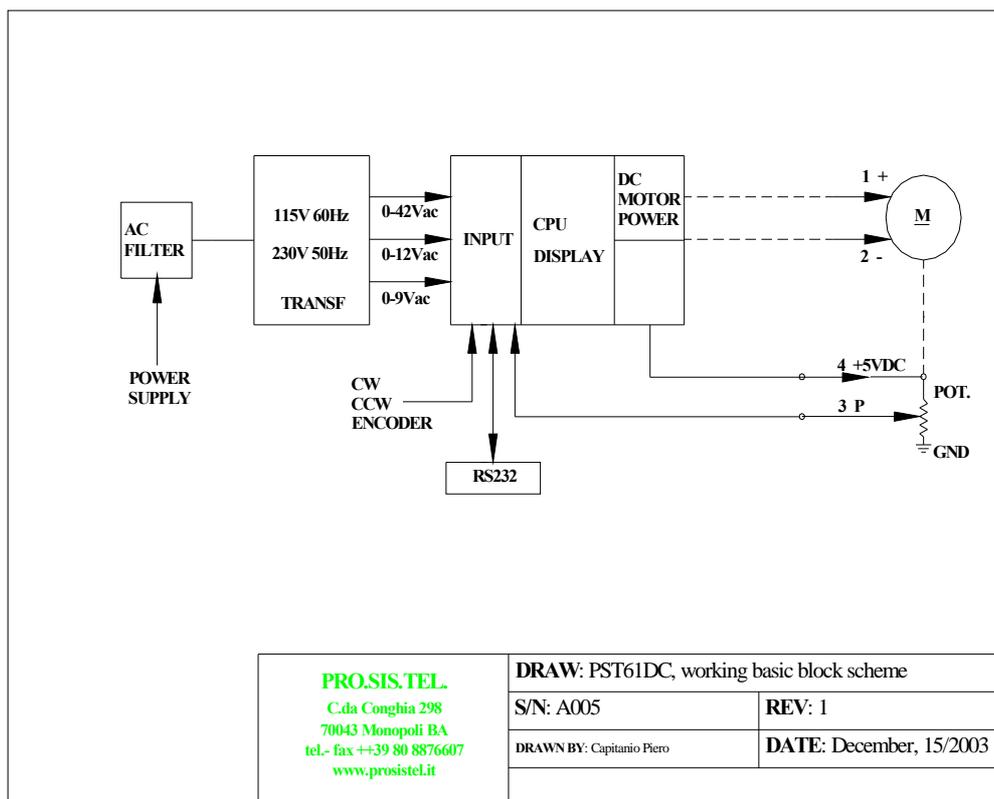
3.2.1 Indicator circuit

Three digit, 7 segments led display are used for the direction indicator and the antenna direction is displayed in degrees.

A 10 turns 10K potentiometer is used as position reading, only 1 turn of the 10 turns is used to read antenna heading. See truth table.

3.2.2 Motor power switch

The motor is powered through two 10 Amps long life relays.



Section 4

Specifications

4.1 Worm gear box

The worm gear box has a waterproof aluminium case conforms to the CEE 89/392/CEE standard.

4.2 Motor

The DC motor, take place in an a cast alluminum waterproof case..

4.3 Control unit

Microprocessor controlled digital readout display having RS232 built inside. The controller has ferrous parts painted. Conform to CE and FCC class B rules.

Rotators Specifications

METRICS

Model	Wind area m2	Motor torque Kg/cm	Brake torque Nm	Vert. load Kg	Rotor speed 360°	Variable speed	Rotation range	Motor Volts	Wires N.	Redout	RS232	Preset	Kg
PST 641D	1.2	1.000	400	450	± 60°	yes	500	12 Vdc	5	digital	yes	yes	10
PST 2051D	2.5	2.000	600	650	± 60°	yes	500	12 Vdc	5	digital	yes	yes	14
PST 61D	3.9	3.800	1.180	850	± 90°	yes	500	12 Vdc	5	digital	yes	yes	25
PST 71D	8.8	6.000	2.172	1.000	± 120°	yes	500	24 Vdc	5	digital	yes	yes	35
PST 110D	10	6.000	3.400	1.200	± 150°	yes	500	24 Vdc	5	digital	yes	yes	45

US/UK

Model	Wind area Sq.ft	Motor Torque Lbs ft	Brake torque Lbs ft	Vert. load Lbs	Rotor speed 360°	Variable speed	Rotation range	Motor Volts	Wires N.	Redout	RS232	Preset	Lbs
PST 641D	12	73	703	990	± 60°	yes	500	12 Vdc	5	digital	yes	yes	22
PST 2051D	25	147	1.000	1.430	± 60°	yes	500	12 Vdc	5	digital	yes	yes	31
PST 61D	39	280	2.100	1.870	± 90°	yes	500	12 Vdc	5	digital	yes	yes	55
PST 71D	88	1.032	4.032	2.200	± 120°	yes	500	24 Vdc	5	digital	yes	yes	77
PST110D	100	1.032	6.050	2.200	± 150°	yes	500	24 Vdc	5	digital	yes	yes	110

Note:

It is a good practice do to not overpass the 50% of the maximum rotator wind load.

Section 5

With this user's manual a CD is provided.

CD contains several folders in which there are some files with some extra informations about your antenna rotator, as a copy of this manual as well.

Please take note of the information on the CD, but also please note that the software routines contained in the .exe file are for expert users, and you should not attempt to change your rotators settings with the CD software unless you are familiar with configuration routines.

- **RS232 philosophy.pdf**

This file contains extensive informations about the RS-232 door, as communication protocol/instructions, full calibration procedure and more, as well.

If you are software expert with such informations you can develop a rotator software drive by yourself.

If your favorite log software still doesn't have a drive for your new D controller, copy this file to your log software writer, asking him to write a D drive in his log software.

Please read it carefully.

- **RotorVxxx.exe** (tool software)

This executable software allows you to change your rotator parameters to suit your personal choice. It is intended as a tool rather than a program to control the rotator remotely. Be very careful using the program and ensure that you are competent to make changes before making them. If running it you get all windows filled with question marks, means that software missed the COM door, fix it before to continue. Insert the CD in your computer, open folder named "setup", run "set up" file and follow instructions step by step.

Service issues raised by incorrect use of the software are not covered by the warranty

- **RotorVxxxReadme.pdf**

This file contains extensive information and instruction about the use of the "RotorVxxx.exe" tool software.

Please read it carefully.

- **Rotor.ini**

This file contains the COM port number. If you need to use a COM port number that is not included in the software tool, open this file, overwrite in there the COM port number and save it.

Dear customer,

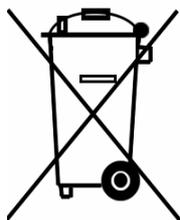
thank you for purchase a **Pro.Sis.Tel./BigBoyRotators**, if you are happy with it please talk to everybody, if you are unhappy with it please talk with us.

Your feed back and suggestions, will be very appreciated, to improve our products.

**Annamaria Fiume
IK7MWR**

MADE IN ITALY

**Protect your environment,. When this unit has reached the end of its working life,
consign it to specialized metal waste collector.**



DICHIARAZIONE DI CONFORMITA'

DECLARATION OF CONFORMITY

according to EN45014: 1998

CE

Si dichiara che il prodotto: Rotore d'antenna mod. PSTD è conforme ai requisiti essenziali delle seguenti direttive comunitarie:

This product: Antenna rotator model PST.....D is fully conforms to the council directives:

- 89/336/CEE
- 92/31/CEE
- 93/68/CEE marcatura CE per prodotti destinati ad essere utilizzati entro taluni limiti di tensione
- 93/97/CEE
- 73/23/CEE

recepite dai seguenti decreti legislative as amended by italian law.

- Nr. 791 del 18/10/1977 attuazione 73/23
- Nr. 615 del 12/11/1996 recepimento direttive 92/31/CEE, 93/68/CEE, 93/97/CEE
- Nr. 626 del 25/11/1996 attuazione della direttiva 93/68/CEE
- Nr. 277 del 31/07/1997 modifiche alla Nr. 626 del 25/11/96

E' conforme ai requisiti di prodotto indicati dalle seguenti norme armonizzate:

It is conforms to product's requirements as indicate in the following armonized rules:

- CEI EN 50082-1 Compatibilità elettromagnetica, norma generica sull'immunità. Ambienti residenziali, commerciali ed industria leggera.
- CEI EN 50081-1 Compatibilità elettromagnetica, norma generica sull'emissione. Parte 1, ambienti residenziali, commerciali e dell'industria generica.
- CEI EN 60335-1 Sicurezza degli apparecchi elettrici d'uso domestico e similare. Parte 1, norme generali.

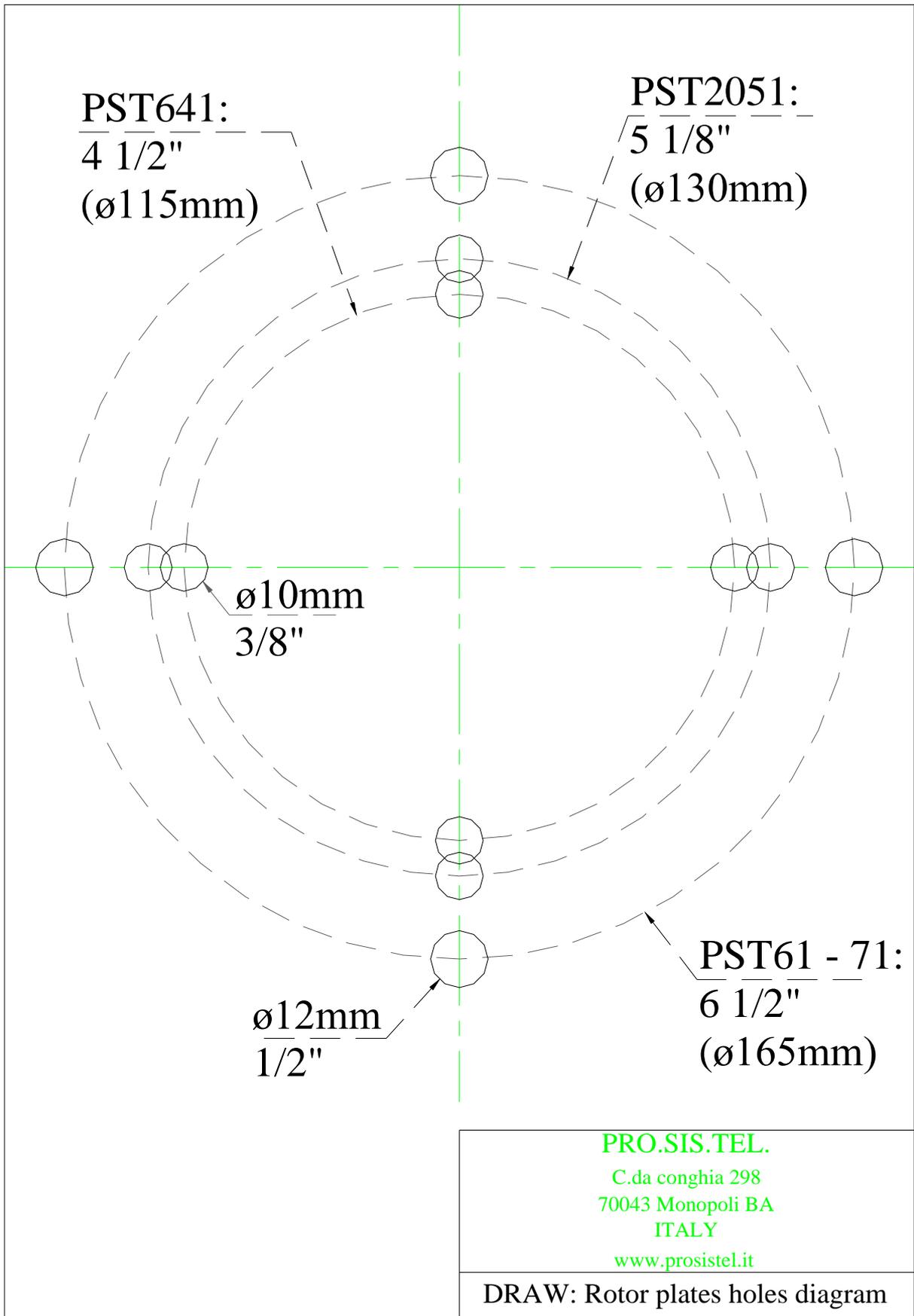
Esso è certificato FCC classe B.

It is class B FCC certified.

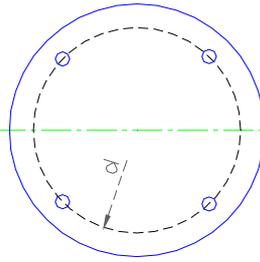
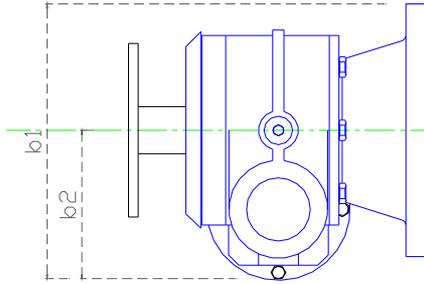
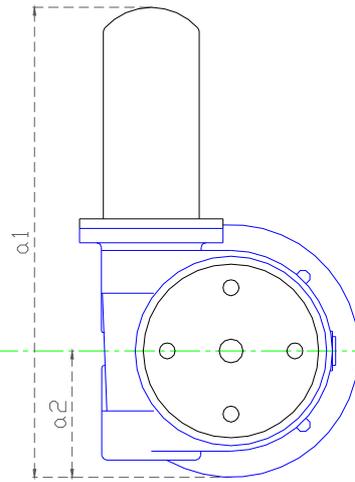
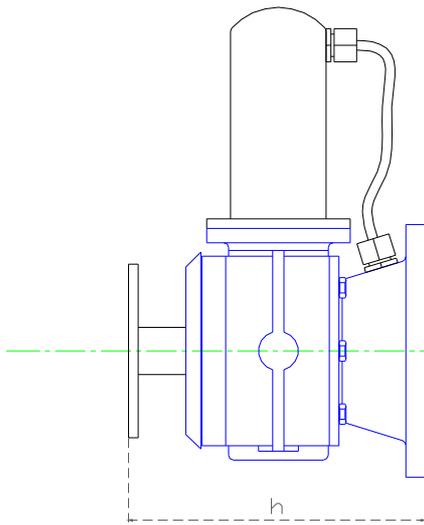
In fede

Annmaria Fiume

Monopoli li, 01/07/2005



Note – this drawing is not to scale



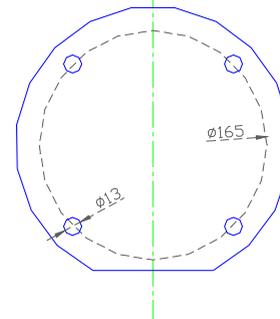
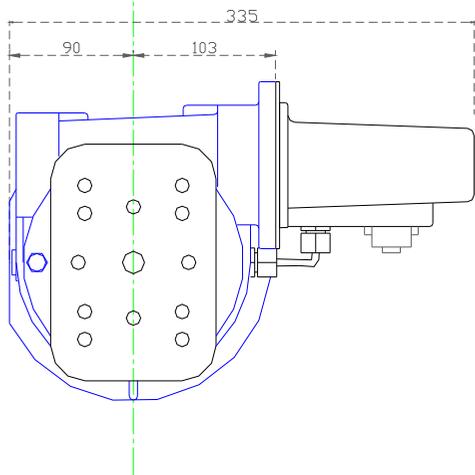
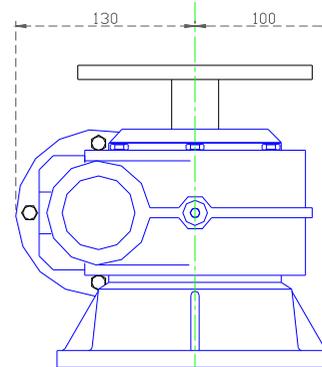
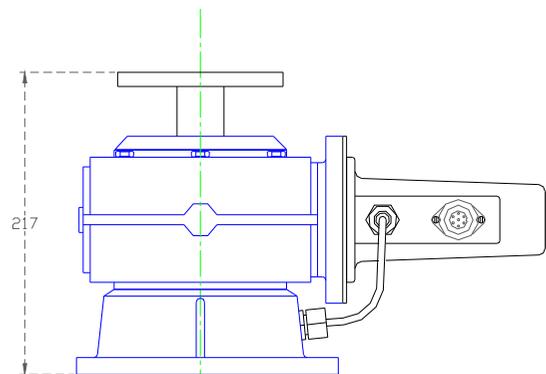
Fixing plate
down view

	a1	a2	b1	b2	d	h
PST641	280	70	150	90	115	170
PST2051	298	80	175	95	130	186

PRO.SIS.TEL.
 C.da Conghia 298
 70043 Monopoli BA ITALY
 tel. ++39 080 8876607
 www.prosistel.it

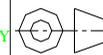
Draw: PST641-2051 general dimensions
 Scale: E1
 Date: May 05/2004
 Drawn by: Capitani Pietro
 Checked by: Rev:

Note: measurements in mm

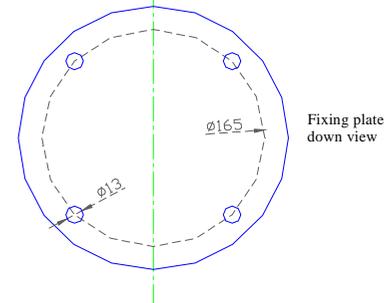
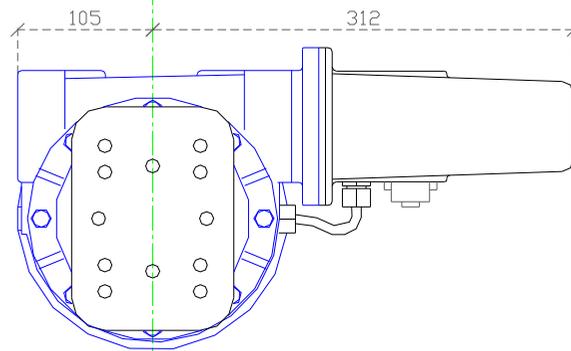
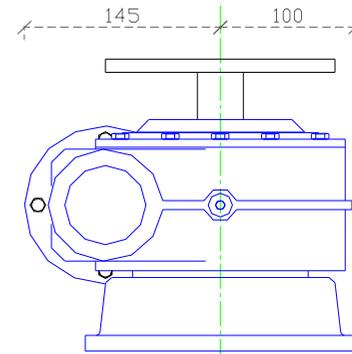
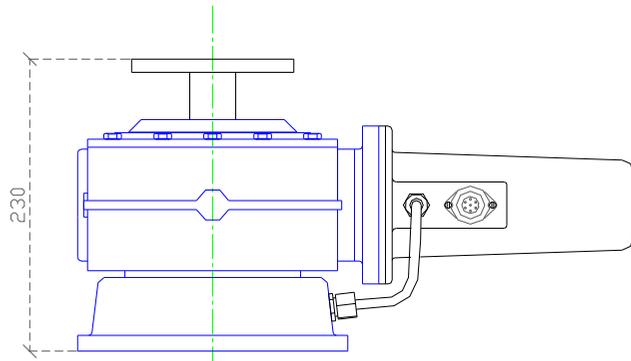


Fixing plate
down view

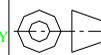
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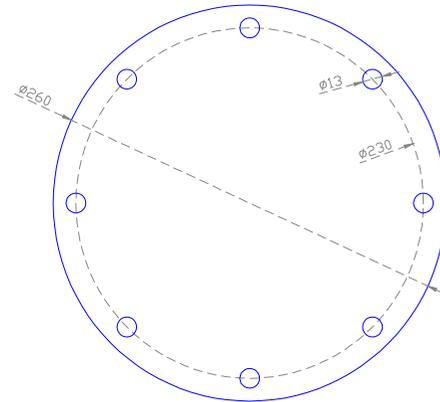
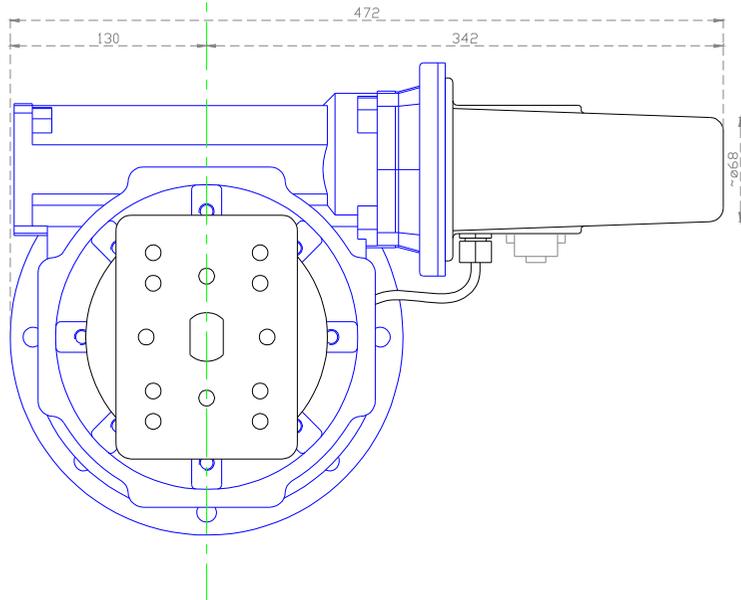
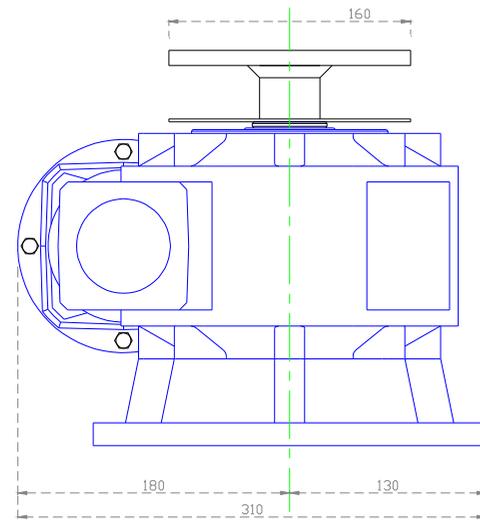
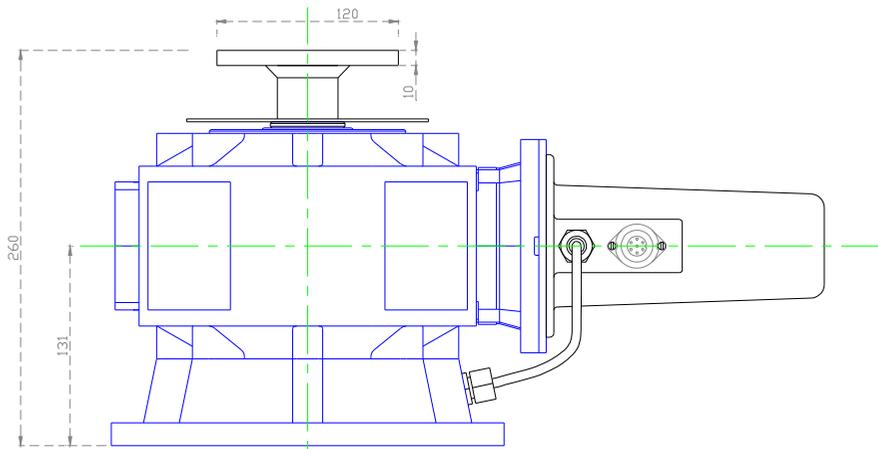
Draw: PST61D, general dim.		
Scale: 1:1	Drawn by: Capitano Ptero	Serial number:
Date: Feb 02/2007	Checked by:	Rev:
Note: measurements in mm		



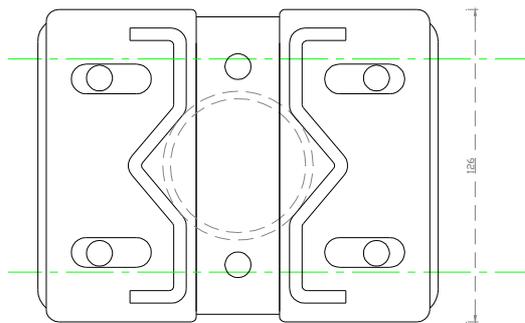
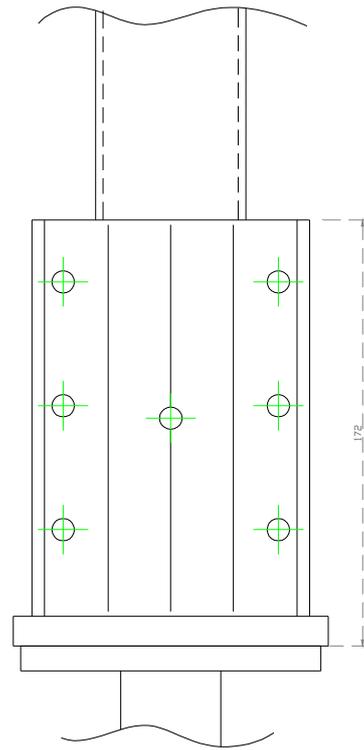
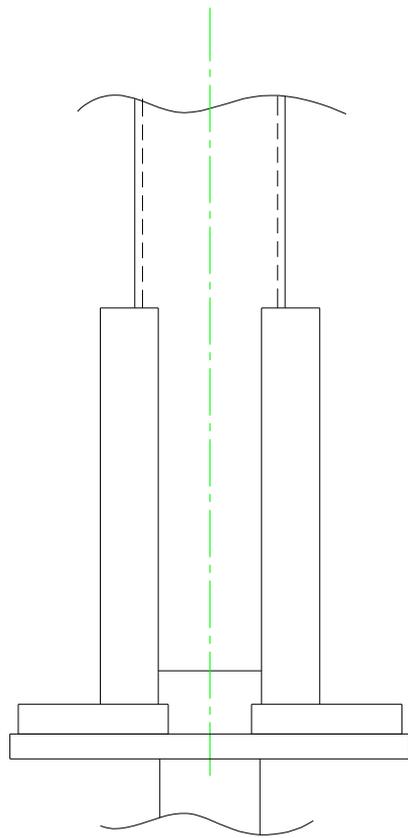
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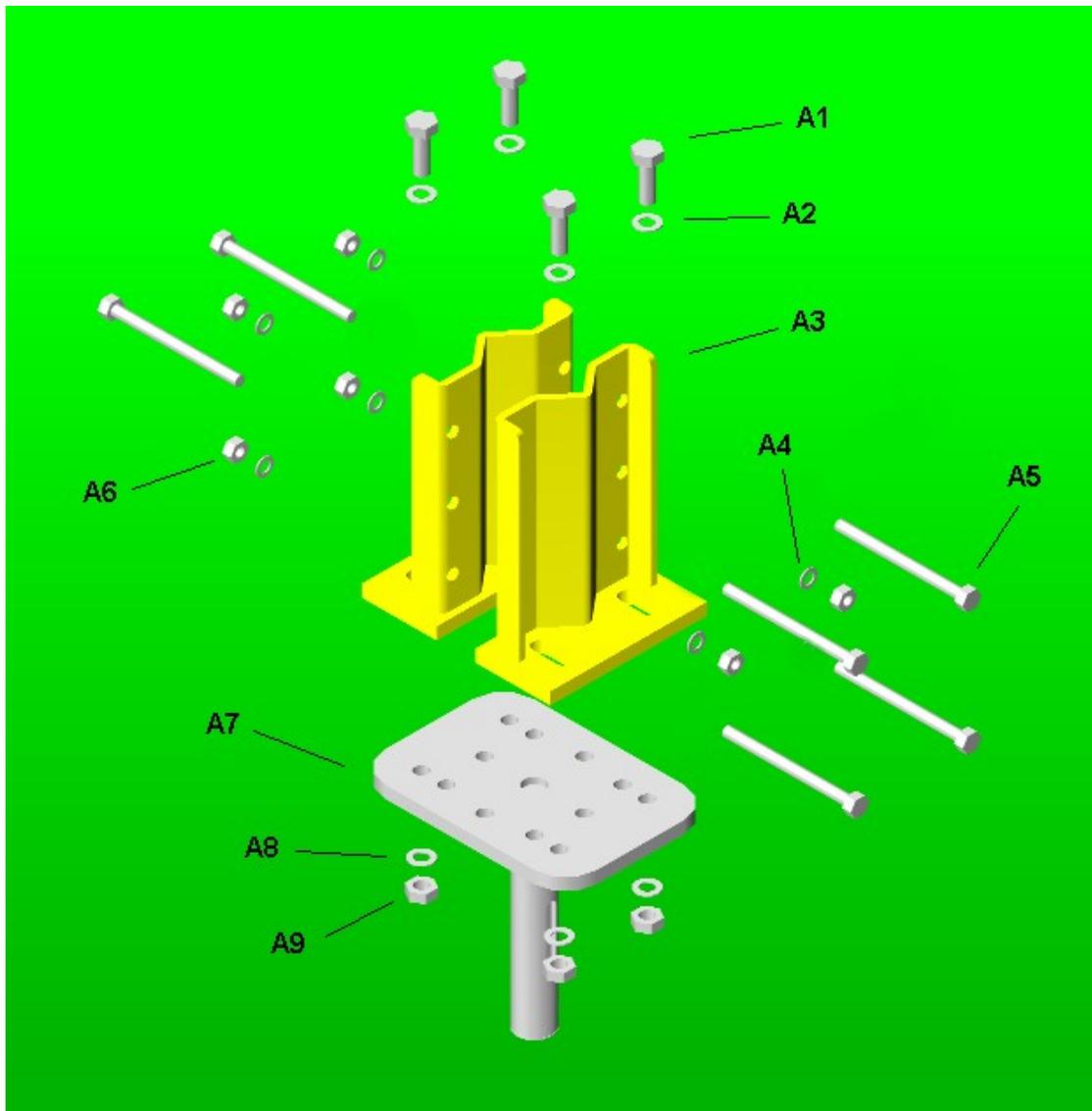
Draw: PST71DC general dimensions		
Scale: 1:1	Drawn by: Capitano Piero	Serial number:
Date: April 09/2008	Checked by:	Rev:
Note: measurements in mm		



	Company: Pro.Sis.Tel.
	Draw: PST110D-Dimensions
	Date: Sept. 03/2010
	Rev:
	Note: Quotes in millimeters



COMPANY: PRO.SIS.TEL.
DRAW: MastClampConfiguration
MATERIAL: Fe360 zinc plated
DATE: Sept. 03/2010



A1- Bolt, stainless steel, M10x40mm	x 4
A2- Washer ø10mm, stainless steel	x 4
A3- Mast clamps 3", zinc galvanized steel	x 2
A4- Split washer ø8mm, stainless steel	x 6
A5- Bolt, stainless steel, M8x100mm	x 6
A6- Stainless steel nut, M8	x 6
A7- Rotator shaft with plate, zinc galvanized steel	x 1
A8- Split washer ø10mm, stainless steel	x 4
A9- Nut M10, stainless steel	x 4

Warning

Protect your equipment

The rotator and controller are electronic devices containing sensitive components that could be damaged from lightning, heavy electrostatic charges or electric fields.

Make sure to disconnect rotator cable from the controller and controller power cord when not used as you do with your coax cables when a tunder storm is approaching.

Pay attention, **Protect your equipment** because if happens it isn't covered by the warranty.