

ScopeDome
sky observatory



ScopeDome 4M

Assembly Manual

Hereby user guide describes, step by step, all the operations to be accomplished for ScopeDome proper assembling. The manufacturer recommends to set-up the dome according to the procedure hereby referred. Mounting the dome in recommended sequence ensures efficient dome's operation and - at the same time - allows avoiding unnecessary steps and waste of time when fitting-up the dome.



Preliminaries

Before assembling you should:

- carefully read this manual and even before the assembly try to thoroughly understand and imagine the various stages of construction
- check that all dome's components were delivered
- carefully examine all the parts and make sure that you can identify and name them as they are called in the manual
- schedule work and allocate tasks for all people in various stages of assembly, so as to know what to do and what is their role in every stage
- obtain the necessary tools

Check out the pictures on our [WWW page](#).

The main stages of assembly

- S1 Embedding, mounting and adjustment of rotating ring
- S2. Assembly and sealing of the outer casing
- S3. Embedding and assembly of the panels of the dome base
- S4. Assembly and sealing of the side panels
- S5. Installation of the rear panel
- S6. Installation of the shutter's drive
- S7. The shutter and its handles assembly
- S8. Installation of the dome's automatics devices
- S9. Installation of the inner casing panels

Necessary tools

- drill
- a set of screwdrivers
- a set of drills with diameters from 4 to 15 mm
- a set of ordinary keys and sockets
- automatic screwdriver
- a set of hex keys
- electronic spirit level
- laser rangefinder

The time needed to perform assembly

Installation of the dome should take no more than 8 hours. Effective building team assemble the dome in 4 hours, the next four hours will be needed for the automatics installation. For the dome's installation there is a need of assistance of five people or three people and the crane.

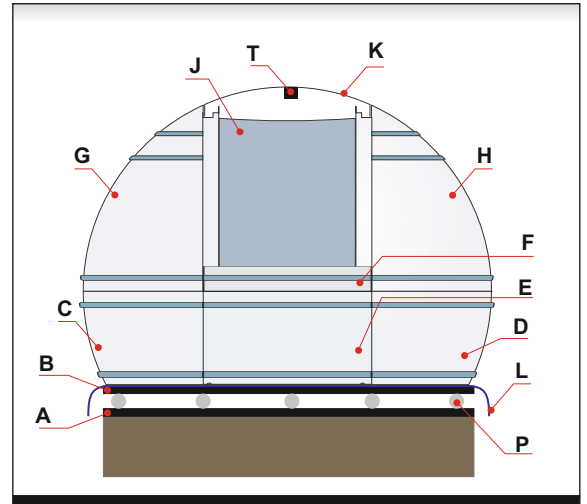


Fig. 1. Diagram of the dome - front view

Naming and components symbols

- A. The lower part of the rotating ring
- B. The upper part of the rotating ring
- C. The left panel of the base of the dome
- D. The right panel of the dome base
- E. The front panel of the base of the dome
- F. The top front panel of the dome
- G. The upper left side of the dome
- H. The upper right side of the dome
- J. The rear panel of the dome
- K. The shutter
- L. Outer casing panel of the dome
- M. Inner casing panel of the dome
- N. Motor of the rotation drive
- O. Motor of the shutter's drive
- P. The main rolls of the dome's rotation mechanism
- R. Side rolls of the dome's rotation mechanism
- S. Cog rim of the dome's rotation mechanism
- T. Cog rim of the shutter's drive mechanism
- W. Side support of the dome's rotation mechanism
- Q. Power contacts of the dome's movable section

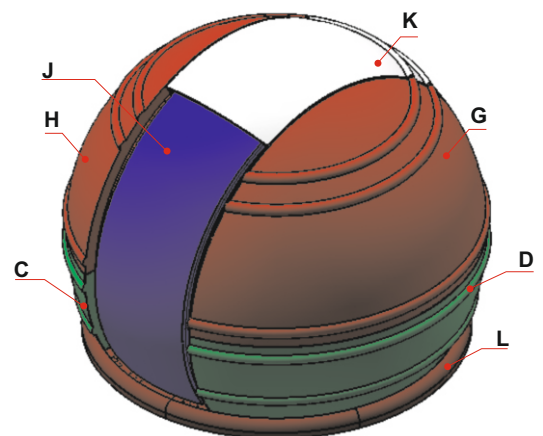


Fig. 2. Diagram of the dome – top/rear view

S1 Installation of the dome rotating ring

1. Assemble the bottom of the rotating ring on the observatory's crown. To combine elements of the ring, use the side supports of the dome rotation mechanism. Center the ring on the observatory's crown.
2. Attach the bottom of the rotating ring of the dome the observatory's crown using at least 16 x M12 bolts. The more mounting screws the better. First, use the holes next to the side supports. Note that these bolts are the only security elements protecting against removing the dome from the observatory's building in the case of very high winds. For fixing the rotation ring to the the observatory's crown, you can also use Hilti anchors.
3. Assemble the upper part of the dome rotating ring on the bottom part of the rotating ring. For connecting the upper ring segments, use countersunk screws. Please note that the ends of the bolts should not touch the side supports. Use a rubber hammer to align the joints of segments. Connections should be as smooth as possible. Uneven joints will cause rapid wear of the main rolls of the rotation mechanism. For connecting the segments, use the connectors mounted on their ends.
4. During the installation, please pay attention to the wires of the power contacts system between stationary and movable part of the dome's drive. Their failure will then be very troublesome to repair.
5. Adjust the height and location of the power contacts of the movable part so as to slightly touch the brass rolls supplying the power. Check the power supply contacts if they completely overlap with brass rolls and do not cause a short circuit between the rolls.
6. After this stage, the rotation drive mechanism is completely assembled.

The entire dome will be built on the rotation ring. At subsequent stages of assembly access to it will be very difficult. Before the next stages of assembling you should very carefully adjust it and test its performance.

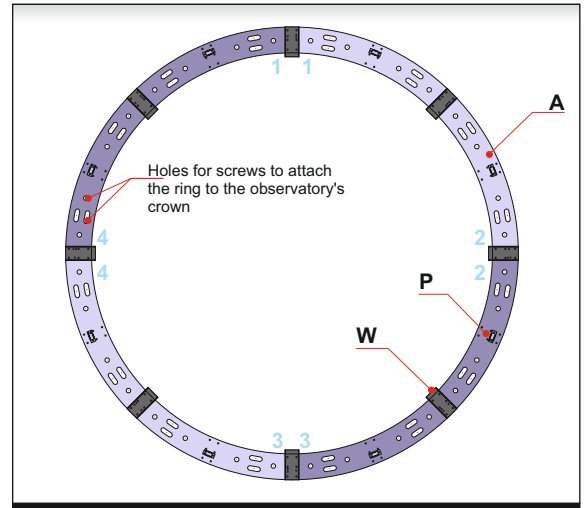


Fig. 3. The lower part of the rotating ring

- A. Segment of the ring base
- W. Ring's connection place
- P. The main roll of the base ring

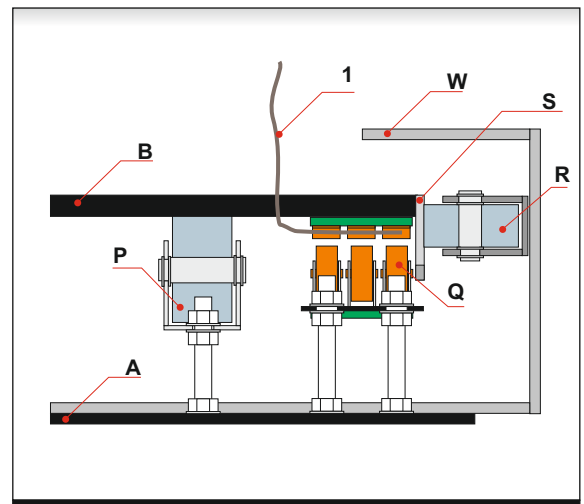


Fig. 4. Side support of the rotation mechanism

- 1. The power cord of the movable part of the dome

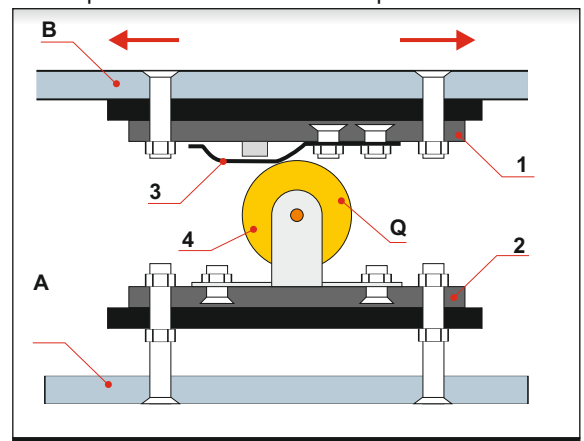


Fig. 5. Power contacts of the movable part of the dome

- 1. Mobile contacts set
- 2. Stationary contacts set
- 3. Resilient power contact
- 4. Brass contact roll

S1 Testing the rotating ring assembly

- a) In a few places measure the diameter of the rotating ring using the laser. The deviation of individual measurements should not be greater than $+ / - 3$ mm.
- b) Check that all the main rolls are well pressed into the upper ring of the drive. If not - it is necessary at this point, adjust their height.
- c) Check that the upper ring is well leveled. Electronic spirit level should show 0 degrees $+ / - 0.1$ degrees at every place of the ring. Measurements should be done at each of the eight puds of the lower ring.

If the rotating upper ring is not well leveled, adjust the height of the rolls so that the ring was perfectly horizontal, while not wiped on the side supports. The distance between the ring and side handles should be about 5 mm. During the adjustment you should pay attention to whether the cog rim of the rotation mechanism fits the cog wheel of the motor.

- d) Check that the side rolls of rotation mechanism are not unduly pressed against the cog rim. Between the side roll and the cog rim there should be a slight gap of about 0.5mm. If the rolls are squeezed too tight, adjust the position of the side supports.
- e) A well adjusted ring should be able to rotate freely and effortlessly with the force of one hand.
- f) Before further installation stages you should repeatedly rotate the upper ring left and right, noting that it does not touch anywhere on the elements of the lower ring and the rotation takes place smoothly and without resistance.
- g) If the motor blocks the movement of the base ring, try to loosen the bolt mounting the cog wheel and move it slightly to the center of the ring so that the cog wheel will not be in contact with the cog rim.
- h) If the ring drive works properly, you are ready for further stage of the dome's assembly.

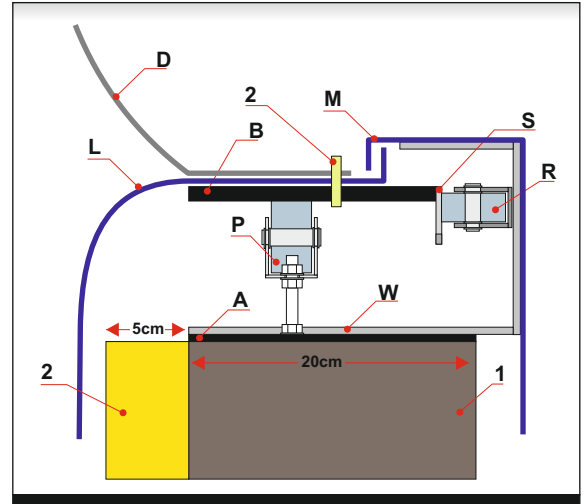


Fig. 6. Side casings and the rotating ring

- 1. Observatory's crown
- 2. The space for the power cord exit of the movable part of the dome

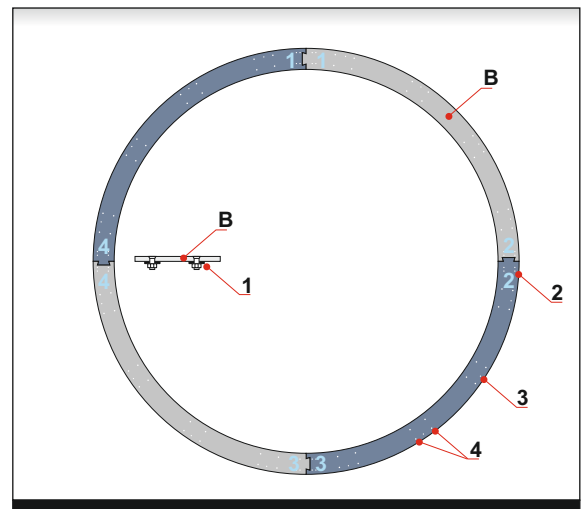


Fig. 7. The upper part of the rotating ring

- 1. Ring connectors
- 2. Connectors holes
- 3. Holes for fastening the outer casing
- 4. Holes for fastening the the dome base panels

S2 Assembly and sealing of the outer casing panels

Installation of the dome we start from installing four panels the outer casing on the top of the rotating ring.

The key issue for the integrity of the dome and its protection from the rain is to seal all threaded outer casings. This casings help to drain the water out of the dome.

You should seal:

- the connector between the casing and the upper ring
- joints between sections of the outer casing

Each of the four parts of the outer casing should be tighten by the countersunk screws M8x20 into the upper part of the ring. The holes - previously prepared in the manufacture should be used to do it. Screw heads should not protrude above the plane of the outer casing. During the assembly of the casing you should pay attention whether it is centrally mounted on the ring. At the end, the inner edges of the outer casing you should tighten by the M6x25 screws.

S3 Embedding and assembly of the dome base panels

On the ring with mounted and sealed outer casing we put the dome base panels and screw them on together.

Installation is best to start from the left panel of the base. Then we combine the left side of the base panel with the front panel of the base. At the end attach to them, right panel base.

These three elements together we screw on into the upper ring of the drive using the prepared holes and the hex bolts M10x25. Under the bolts that connect the base panels with the upper drive ring, please use washers M10.

During installation you should use the markings on the elements and the upper part of the base ring, matching them to each other in such way: 1-1, 2-2, 3-3, etc.

When installing panels and the outer casings you should pay attention to the power cord connected to the movable contacts. The cable should be piped to the inside of the dome. Route the cable using the prepared holes.

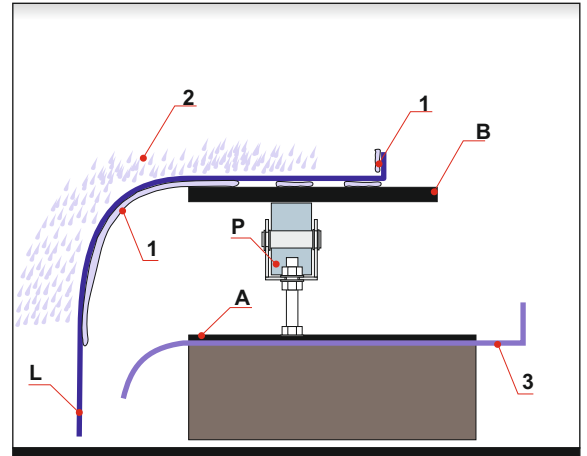


Fig. 8. The outer casing panel - sealings

1. Seals or silicone
2. Rain or moisture
3. Sheet facing (additional tin shield that should be done by any roofer from zinc coated sheets)

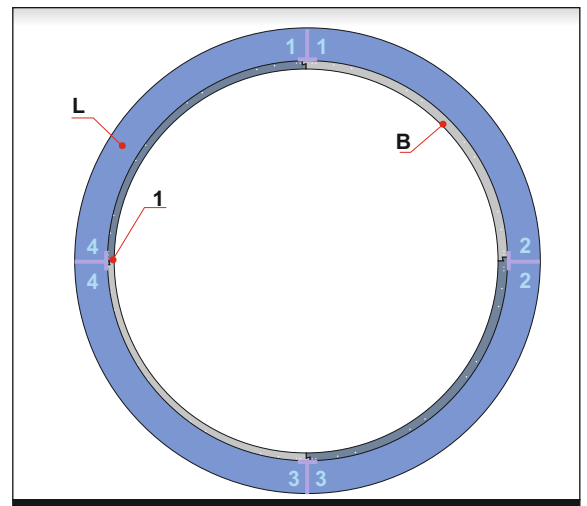


Fig. 9. The outer casing panels – sealings and segment numbering

1. Seal or silicone

S4 Assembly and sealing of the side panels

Appropriate panels of the dome we screwed on to the panels of the base. We screwed on the left panel of the dome to the left panel of the base, and the right panel of the base to the right panel of the dome. At the end, the upper front panel of the dome should be screwed on to the front panel.

During installation you should use the markings on the elements matching them to each other in such way: 1-1, 2-2, 3-3, etc.

The edge connecting the panels with the main base of the dome panels should be sealed around the perimeter by the rubber seal.

S5 Installation of the rear panel of the dome

After this stage, we will have screwed on all the panels except the rear panel of the dome and the shutter. The next step is to screw on the rear panel of the dome which crowns this building phase of a sphere of the dome. Then we should just install the shutter drive and mount it on the dome.

S6 Installation of the shutter drive

The shutter drive we screwed on the top of the dome to its sides using five hex screws M10x30 on each side of the dome. The steel bar of the drive should be additionally screw on to the gutter of the dome on each side using two countersunk screws. Distance between the outermost edges of the shutter must be adjusted so that was 140 cm (+ / - 1 cm) around the entire perimeter of the dome windows.

S7 Embedding the shutter and the shutter handles assembly

Before mounting the shutter we should declutched the cog wheel of the drive by screwing off the four screws fixing it to the flange mounted on the drive axle. If he will mount the shutter with a crane, we can skip this step. Disengaged the gear helps in mounting the flap. This makes it easier to match the holes in the cog rim with the cog wheel of the shutter drive.

Note the correct front-rear orientation of the shutter. Embed it in accordance with the ribbing on the sides of the dome.

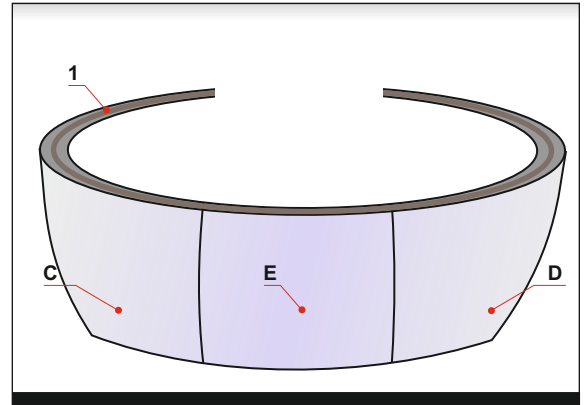


Fig. 10. Sealing of the side panels

1. Seal or silicone

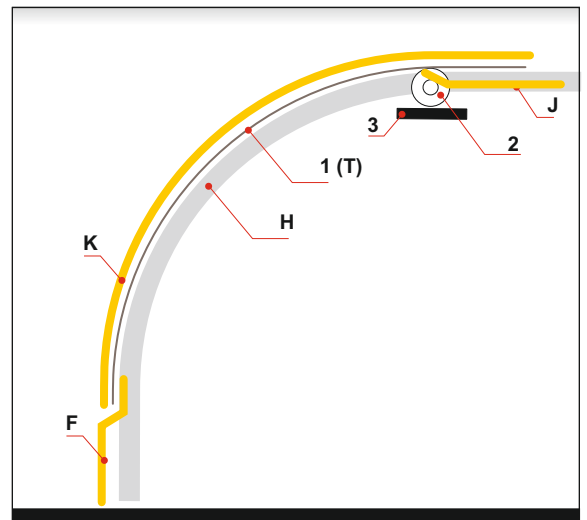


Fig. 11. The shutter drive

1. Cog rin of the shutter drive
2. Cog wheel of the shutter drive
3. Steel bar fixing the shutter drive

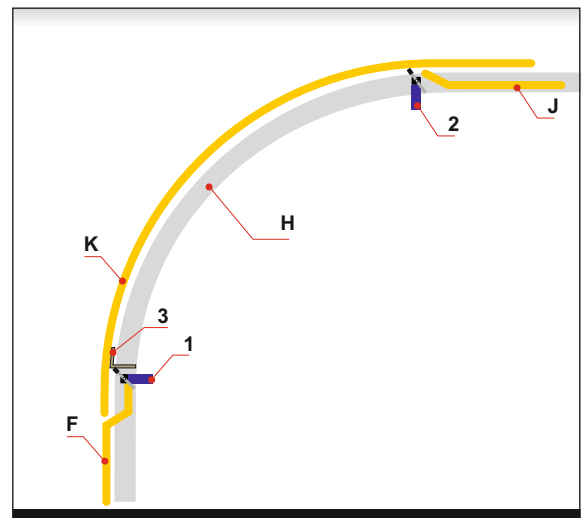


Fig. 12. Location of the limit switches

1. Limit switch Close
2. Limit switch Open
3. Pressure plate of the limit switches

S7

The easiest way to install the shutter is to do it manually by applying the shutter from the back of the dome. It can also be installed by crane by embedding it on the bottom of the dome rear panel.

To hold the shutter in the back end position there will be need of support at least three persons, because the shutter is quite heavy. Doing it manually there will be a need of support at least five people - two on each side and one with long enough bracket to sustain the shutter on the center.

All the drives and the individual elements they consist of are preassembled and initially adjusted during the final test in our manufacture. They do not need any further adjustments. There is only a need to take care of equal separation between the shutter rails those are mounted on the both sides of the observational window.

Note: When you place the shutter on the dome it could be unstable. It should be locked on the teeth of the cog wheel. The cog wheel must be secured by screwing it on to the flange mounted on the drive axle using the four screws.

When mounting the drive we should pay special attention to the cog rim and the cog wheel of the drive. The cog rim around the entire perimeter of the dome should be closely pressed against the cog wheel. In particular, note the extreme (open-closed) position of the shutter.

All adjustments of the shutter drive (motoreducer's height, handles location) should be done in such way to have the cog wheel heavily pressed to the cog rim of the shutter.

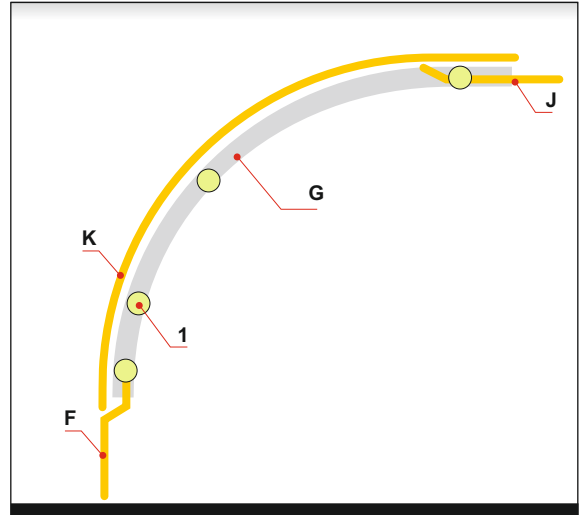


Fig. 13. Location of the shutter rolls
1. Shutter rolls

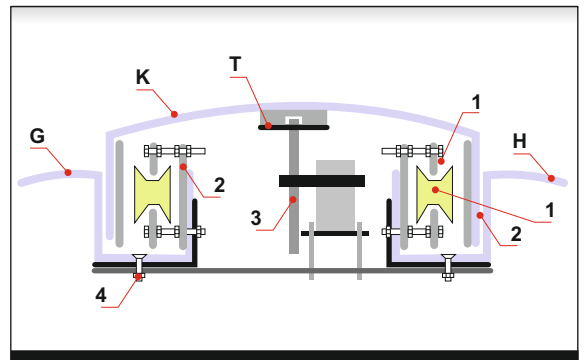


Fig. 14. The shutter drive scheme

1. The shutter main rolls
2. The shutter rails
3. The cog wheel of the drive
4. Screws fixing the steel bar of the shutter drive

S9 Installing the inner casing panels

At the end (after the installation of automatics), we screw on the inner casing panels to the side supports of the lower drive ring.

During the assembly it should be noted that the inner casing do not wipeth anywhere on elements of the dome.

The inner edges of the casing we screw on using screws M6x25. And this is the end of the dome assembly. Please follow only the final test to see if the dome continues to rotate freely.

Properly assembled dome should be able to be rotated by hand with little effort in both directions around the entire perimeter, with no audible effects of friction and jams.

To verify the correctness of the dome assembly please (manually or by using the rotary drive motor) rotate it several times in both directions.

S8 Assembly of ScopeDome USB Card ver 2.0 automatics

Complete ScopeDome automation system consists of following components:

1. main part of the card (Main)
2. movable part of the card (Rotate)
3. dome's position encoder
4. home sensor
5. rotation drive inverter
6. rotation drive motor
7. the shutter drive inverter
8. the shutter drive motor
9. two limit switches (Open-Close)
10. power contact supplying the movable part of the dome

Optionally, the card can be connected to:

- hygrometer
- two thermometers (internal and external)
- the shutter's position encoder
- the second set of the shutter drive

To be able to take full advantage of the opportunities ScopeDome 2.0 card it be equipped with:

- VRLA battery of 12V/60 Ah
- integrated 12V/230VAC inverter and battery charge (to maintain the power of a moving part of the dome at a time when it is not in the Home position)
- UPS of 2200 Watt
- cloud cover sensor, eg. Boltwood Cloud Sensor or AAG Cloud Sensor
- rain sensor

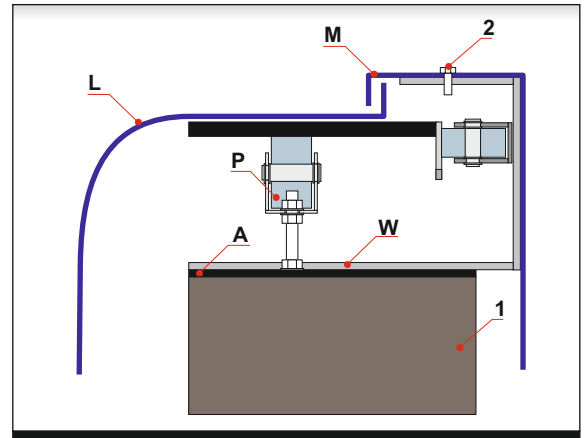


Fig. 15. Side casings and the rotation ring

1. Observatory's crown
2. Screw fixing the inner casing panel

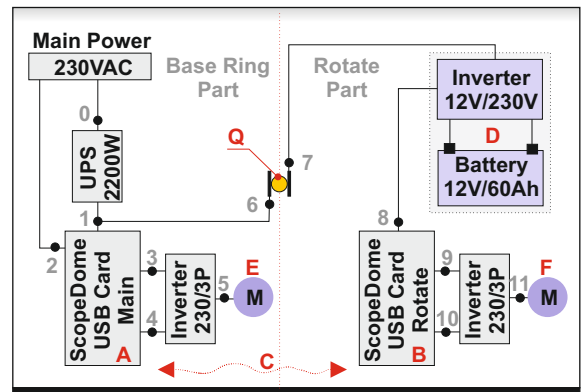


Fig. 16. Automatics devices and ScopeDome USB Card V2.0 powering scheme

- A. ScopeDome v2.0 Card Main Part
- B. ScopeDome v2.0 Card Dome Part
- C. Radio connection
- D. Optional powering movable part of the card
- E. Rotation drive motor
- F. The shutter drive motor
- Q. Power contact powering the movable part of the dome
1. The main slot of power supply (230/110VAC)
2. UPS 230V input on the card
3. Line 230V input on the card (powering failure sensor)
4. Inverter L/N/PE output on the card - powering 230V/3Phase inverter
5. Inverter Com/CW/CCW output on the card – movement direction control
6. UVW inverters output - rotation drive motor control
7. Slot of stationary part of power contacts powering the dome
8. Slot of movable part of power contacts powering the dome
9. UPS 230V input on the stationary part of the card
10. Inverter L/N/PE output on the card – powering 230V/3Phase inverter
11. Inverter Com/Open/Close output on the card – the shutter movement direction control
12. UVW inverter output – the shutter drive motor control

S8 Automatics installation sequence

A. Controlling the rotation drive motor

- attach the stationary part of the ScopeDome USB card to the pier
- attach the rotation motor inverter close to the motor
- connect the card with the rotation motor inverter according to the scheme
- connect the inverter with the dome rotation motor
- connect the power (230VAC) paying attention to the order of the wires L / N / PE.

Proper connection of the phase (hot) power supply wire is crucial for the correct functioning of the automation. Due to security reasons, do not forget under any circumstances connect the security cable PE.

- turn on 230VAC power on the card
- press the CW and CCW buttons to check the dome drive.

B. Installation of encoder

- on one of the dome side supports attach the dome position encoder so that the cog rim passes through the fork of the encoder.
- adjust the encoder's position so that the end of its fork was in the middle of the cog rim teeth
- connect the encoder and the card
- very slowly rotate the dome and make sure that the encoder does not touch the cog rim teeth during the dome's rotation

In new domes we install Encoder Module on motor axis in special box attached to the motoreducer.

The speed of the dome can be adjusted by a potentiometer on the front panel of the inverter.

The encoder is a very delicate and easy to be damaged during assembly and adjusting the drive.

From 2011, we introduced for sale a new encoder module, mounted on the rotation drive cog wheel axis (shaft) (behind the motoreducer). It allows you to avoid the difficulty of adjustment of the sensor and is much more resistant to inaccuracies in assembly and dust. It is slightly more expensive than the standard solution - but we believe its benefits and durability compensates slightly higher price for the item.

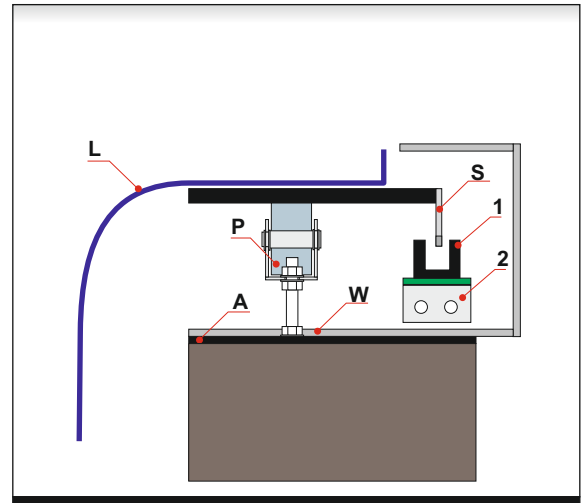


Fig. 17. Installation and positioning the encoder
 1. Encoder
 2. Encoder's bracket

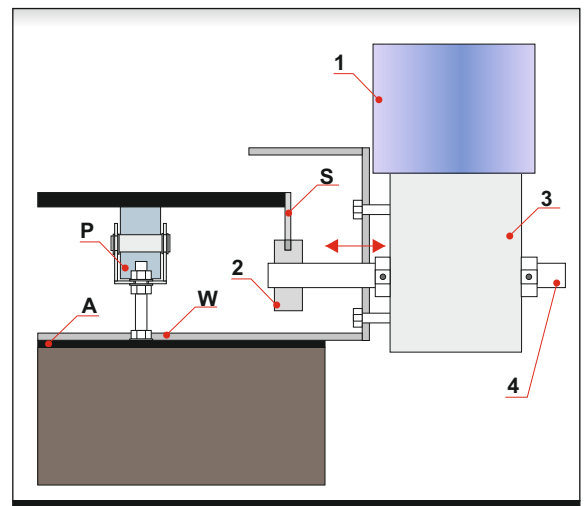


Fig. 18. Rotation drive
 1. Rotation drive motor
 2. Rotation drive cog wheel
 3. Motoreducer (gear)
 4. Rotation drive axis (shaft)

S8

C. Installation of Home Sensor

- Put the dome in such position to make the power contacts (on stationary and movable part of the dome) connected. Stationary power contacts should be on the middle position regarding to movable power contacts mounting on the rotation ring.
- Attach the Home Sensor to one of dome side supports
- Mount the Home Sensor diaphragm in such way to let its end passes through the Home Sensors' fork. Mounting position of this device should be chosen to have the power contacts connected when the diaphragm covers the Home Sensor.
- Connect the Home sensor to the ScopeDome card according to the scheme.

D. Controlling the shutter drive motor

- attach the movable part of the card to the dome's side wall
- attach the shutter inverter close to the movable part of the card
- install the shutter limit switches
- install the limit switches pressure plates
- connect the inverter with the card, the limit switches and motor according to the scheme
- connect powering the movable part of the card with power contacts on the drive ring
- connect 230VAC to the stationary part of the power contacts
- put the dome in such position to make all the power contacts (stationary and movable) connected
- reduce to a minimum the speed of the shutter motor
- test and adjust the limit switches so that the shutter would stop by about 1.5 cm before the complete closing or opening
- limit switch arm has a small hex screw on the axis which allows you to adjust its angle

We recommend to connect some voltage sensor (eg. LED light) which indicates when the power contacts are connected.

E. Connecting the card to PC

To connect the card to the computer use a **shielded USB cable** with a length of about 1.5m. Before connecting the card to the computer make sure it is properly 230VAC powered.

Pay attention to the L / N / PE wiring - reversal of their order can damage the computer.

Tracking the position of the telescope dome is made via a PC running the telescope control software based on the ASCOM platform.

Install the software controlling the card - ScopeDome USB Driver. Set up it and configure in accordance with the software installation instructions.

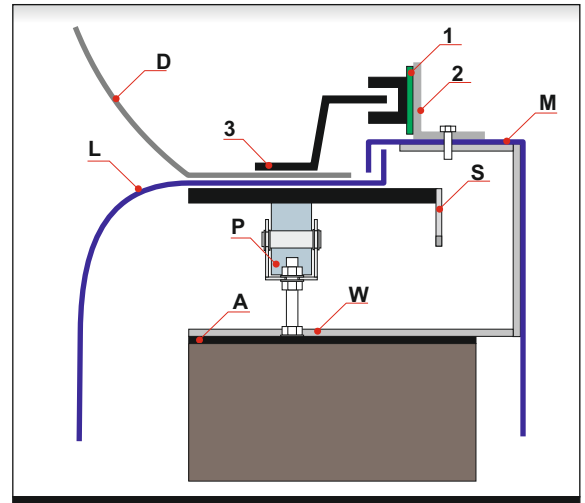


Fig. 19. Installation and positioning the Home Sensor

1. Home Sensor
2. Home Sensor bracket
3. Home Sensor diaphragm

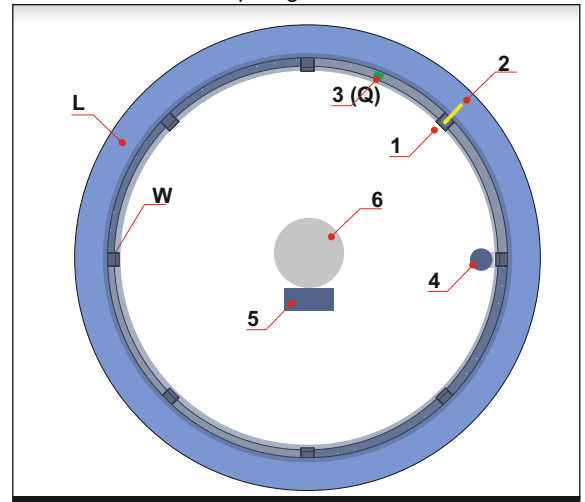


Fig. 20. Example localization of the Home Sensor

1. Home Sensor
2. Home Sensor diaphragm
3. Power contacts powering the movable part of the dome connected
4. Rotation drive motor
5. ScopeDome USB ver. 2.0 card
6. Pier