APPLICATION SHEET

Industrial Sector: Renewable Energy
Application: Solar power production - Photovoltaic systems

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1. Application description

The technological development of recent decades has led to the exponential growth in the global energy consumption which is gradually running out the main sources of energy (oil, gas and coal); this results has taken to the increasing need to create a sources of renewable energy. In the last years the development of the research and innovation have increased the utilization of solar power as an alternative energy source and we are consequently seeing a steady growth of photovoltaic market. *Therefore it's necessary an efficiency increasing through technologies able to improve the energy production of photovoltaic modules, such as electromechanical and electronic systems which follow the trajectory of the sun as long as possible* ***(solar trackers)***.

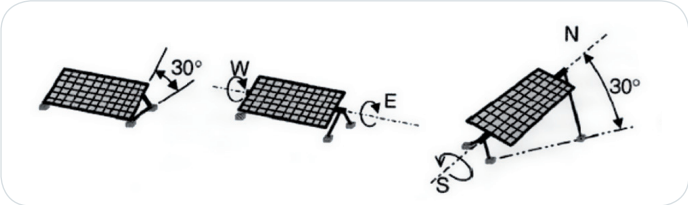
It's possible to classify the different types of solar trackers according to three main factors:

1. Positioning drive

- ***Active solar trackers***, if the movement is generated by electromechanical elements;
- ***Passive solar tracker***, if the movement is generated by physical events which not require electrical energy.

2. Movement freedom degrees

- ***Single Axis Trackers***: they have only one freedom degree and, therefore, rotate around a single axis.

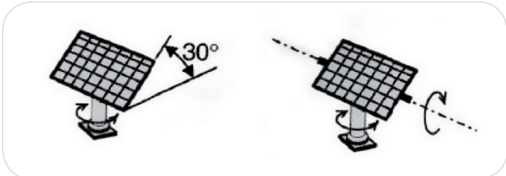


Type of movement of the single axis trackers

These equipments are classified into:

- *Tilt solar trackers*: the rotation axis is east-west
- *Roll solar trackers*: the rotation axis is north-south
- *Azimuthal Solar tracker*: the movement is around a vertical zenith-nadir axis
- *Polar axis Solar tracker*: these move along a single axis inclined to the ground and approximately parallel to the Earth rotation axis, giving the maximum efficiency which can be achieved with only one axis of rotation

- ***Dual axis solar trackers***: these have two degrees of freedom and are designed to align perfectly and in real time the solar tracker with the sun rays, but this also means a more complex design.



Movimenti degli inseguitori solari biassiali

They are classified into:

- *Azimuth-elevation solar trackers*: they follow the sun at any point in the sky through a PLC control; they have a altazimuth mounting formed by the primary axis vertical to the ground and the secondary axis normally perpendicular to the first one
- *Tilt-roll solar trackers*: they follow the sun at any point in the sky through a PLC control; they have the primary axis parallel to the ground and the secondary axis normally perpendicular to the first one.

3. Drive control

- ***Analog:*** the drive control is set on the information received from a sensor which identifies the position of the brightest point in the sky
- ***Digital:*** the drive control is set by a microprocessor which knows at any moment the position of the sun in the sky, using stored tables.

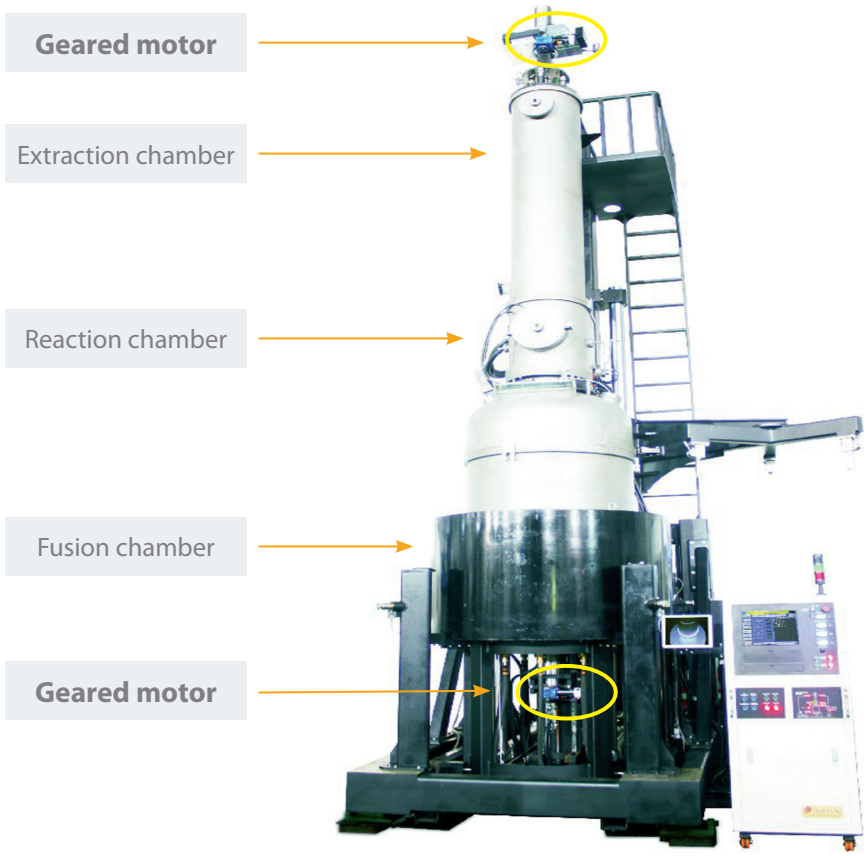
Most of solar trackers are driven by electric motors with DC or AC power supply; generally considering that the system has a low rotation speed, it is often required the use of a geared motor to reduce the speed at a value acceptable for the "tracking".

The *choice* of the tracking system depends on many factors, including the size and characteristics of the structure and of the installation site, the latitude, the weather and the climate.

2. Example of Motovario solution

As far as the energy production made by photovoltaic systems, Motovario is supplying ***worm geared motors*** for ***the silicon formation plant*** and for ***the movement of the single and dual axis solar trackers***.

- ***The formation and extraction plant of the monocrystalline silicon*** which composes a photovoltaic module is usually made of a fusion chamber, a reaction chamber and an extraction chamber; *the supplied geared motors regulate the rotation and hoisting movement of the monocrystalline seed of silicon*.



Formation and extraction system of silicon according to the Czochralski process

- For the rotation movement in the fusion chamber is used a **NMRV 040 worm geared motor**;
- For the hoisting movement in the fusion chamber is used a **NMRV 040 worm geared motor**;
- For the hoisting movement in the extraction chamber is used a **NMRV 040 worm geared motor**;
- For the rotation movement in the extraction chamber is used a double worm geared motor **NMRV 030 + NMRV POWER 063 worm geared motor**

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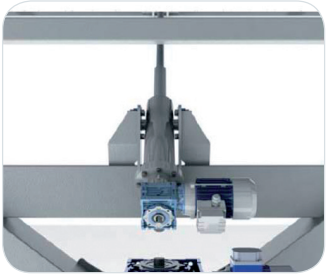
➤ For the ***movement of the roll solar tracker*** is used a **double worm geared motor NMRL 050 + NMRV-P 110**

Total transmission ratio (i)	600
Hollow Output Shaft Diam.	Ø42
Special design of the gearboxes	Torque limiter between the two reducers
Motor Size	080 - 4 poles
Motor Power	1,1 kW

➤ For the ***tilt movement of the dual axis solar tracker*** is used a **NMRV 040 worm geared motor**



Transmission ratio (i)	30
Hollow Output Shaft Diam.	Ø18
Motor Size	063 - 4 poles
Motor Power	0,25 kW

➤ For the ***azimuthal movement of the dual axis solar tracker***, in according to the dimensions of the tracker, are used:

- **Double worm gear reducer NMRV 040 + NMRV POWER 090**

Total transmission ratio (i)	1800
Hollow Output Shaft Diam.	Ø35
Motor Size	063 - 4 poles
Motor Power	0,18 kW

- **Double worm gear reducer NMRV 050 + NMRV POWER 110**

Total transmission ratio (i)	1800
Hollow Output Shaft Diam.	Ø42
Motor Size	063 - 4 poles
Motor Power	0,22 kW

The choice of this reducer type, especially as regards the solar tracker, is successful for the following factors:
- High transmission ratio with small dimensions to ensure a slow rotation of the tracker;
- Low backlash;
- Possibility to use a torque limiter;
- Irreversibility on the low speed shaft which doesn't allow the movement of the tracker in the opposite direction.