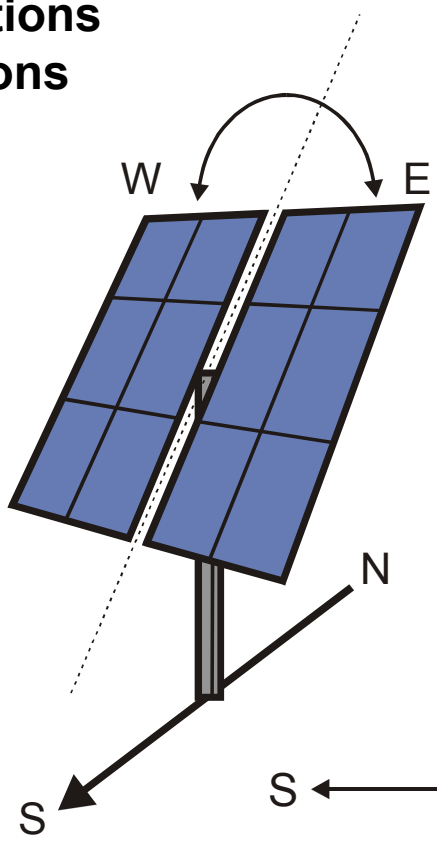
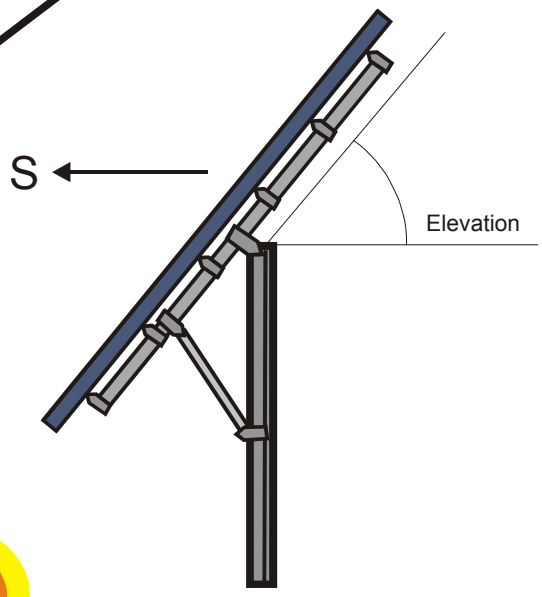
ETATRACK active 1500

Frequently Asked Questions for Solar Park Applications



System Description

- active single-axis tracking system for solar modules, with manually adjustable elevation angle (stepless 0 to 45°)
- mounting structure completely zinc-galvanised; module fixation by stainless steel clamps; total module surface max. 15 m², approx. 2.5 kWp
- available with concrete or with screw foundation
- static certified for wind speeds up to 150 km/h (wind force > 12 Beaufort) without wind sensor (DIN 18 800)
- with windsensor tracker can be driven into optimised position for higher wind speeds
- control for single installations or central control for solar parks of several MW
- designed for space-optimised arrangement avoiding output loss due to self-shadowing
- output increase against fixed installation by 20-40 %, depending on location

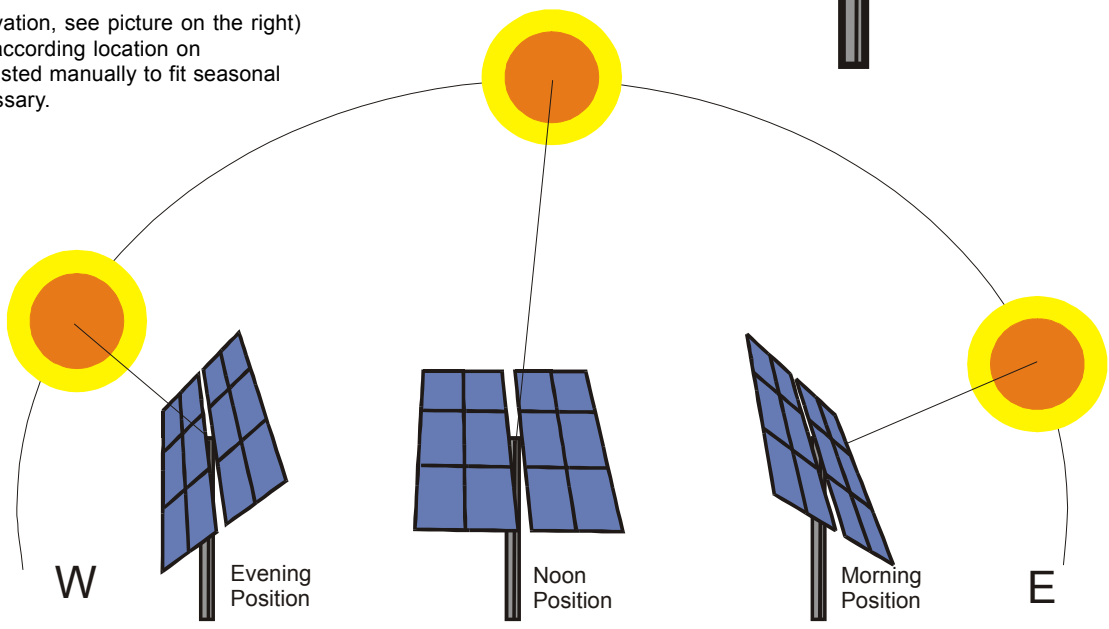


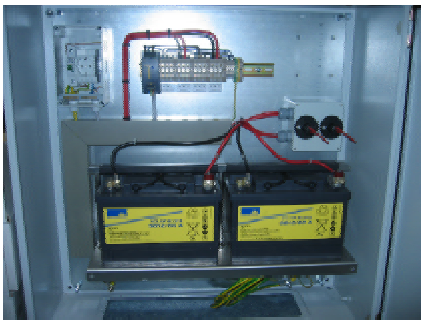
Tracking Movements

How does the tracking take place?

Tracking takes place in twelve steps (thirteen positions). This number of tracking steps has shown to be the best compromise between tracking precision and output increase on the one hand, and the life-expectancy of the linear drive on the other hand. If necessary, the given 2 x 45° tracking movements can be freely subdivided into as many steps as wished.

The second axis (elevation, see picture on the right) is fixed. It is chosen according location on installation and readjusted manually to fit seasonal requirements if necessary.





LCU (Local Control Unit)

Tracking Control

What control options are available for solar installations of different size?

1. Local Control

Each tracking unit is controlled by its own, autonomous control unit. One module is connected in parallel to the control unit and functions as sensor to gather the information needed on the times of sun dawn and sun set, and on the length of day. It also supplies power to the drive and the control unit and charges a battery to ensure tracking at times of low or no sun irradiation.

The control unit autonomously calculates the optimum tracking movements according to the length of day, and automatically adjusts to variations in irradiation conditions, e.g. summer/winter differences, every day.

2. Central Control

Dependent on the size of the solar park, tracking units can be organised in groups (up to 100 trackers per group). All tracking units of one group are connected to a Local Control Unit (LCU). Each tracker is identifiable by an individual code and can be individually addressed.

The LCUs supply power (operating voltage 24 VDC) and positioning information to the trackers. The maintenance-free solar batteries of the LCUs are charged by grid power (230 VAC). All LCUs are connected to the Central Control Unit (CCU) by a data line.

The CCU calculates the tracking movements on the basis of astronomical data, with regards to location and individual tracking demands. The CCU sends control signals to each LCU which then transfers these to each tracker of its respective groups. The CCU also functions as an interface for software updates. Remote diagnosis, remote maintenance and control and visualisation are optional. Power supply through the grid (230 V).

Each tracking unit automatically indicates problems in operation to the LCU, from where the information will be processed to the CCU for further diagnosis.

Each CCU can handle up to 20 LCUs, and each LCU up to 100 Trackers. Solar parks of up to 2,000 Tracker (approx. 5 MW) can be operated by a single CCU.

Dependent on the space left between the trackering units shadowing can occur when the sun is in a very low position. The control concept offers the possibility of flexible adjustment to reduce the shadowing to a minimum. Tracking will be reduced or stopped until the position of the sun leaves the trackers shadow-free. Energy output of the panels during this time will be at least as high as that of PV modules on a fixed mount, and is guaranteed to be higher than that of tracked PV modules with partial shadowing.

The flexible adjustment strategy will be calculated upon the location data, the special arrangement of the tracking units, and the size of installed solar panels.

What control concept is used for what solar park size?

1. Local control is best for solar parks with up to 30 tracking units.

2. Central control is best for solar parks with more than 30 tracking units; additional charge for installations with fewer than 500 tracking units.

Which controller is used in the central control unit?
What about its reliability and availability?

Standard SPS by Siemens, common industrial standard, available in specialised retail

How high is the output surplus as compared to fixed mounting and other tracking systems?

For locations Southern Germany approx. 25-30 %, Southern Spain 35-40 % (cf. simulation results by PV-Sol software).

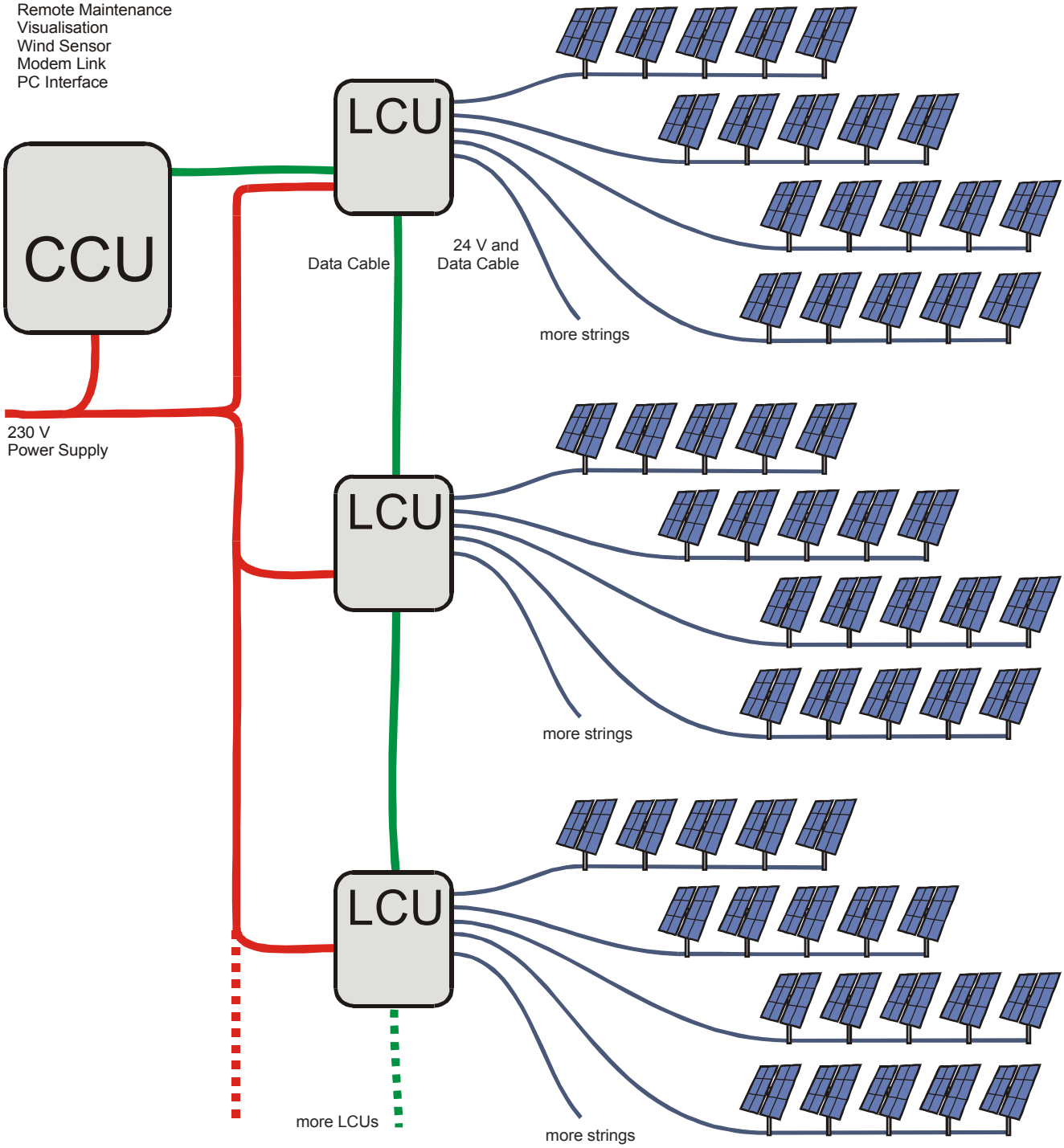
Installation Scheme Central Control

Central Control Unit
SPS Control Processor
Control Electronics
for up to 20 LCUs
230 V

Optional:
Remote Maintenance
Visualisation
Wind Sensor
Modem Link
PC Interface

Local Control Units
Control Electronic
24 VDC Battery Station
charged from AC grid (230 V)

Groups of Tracking Units
up to 100 Tracking Units per LCU
Connected in Strings of five
Tracking Units
Power Supply through the LCU



Alignment / Required Floor Space

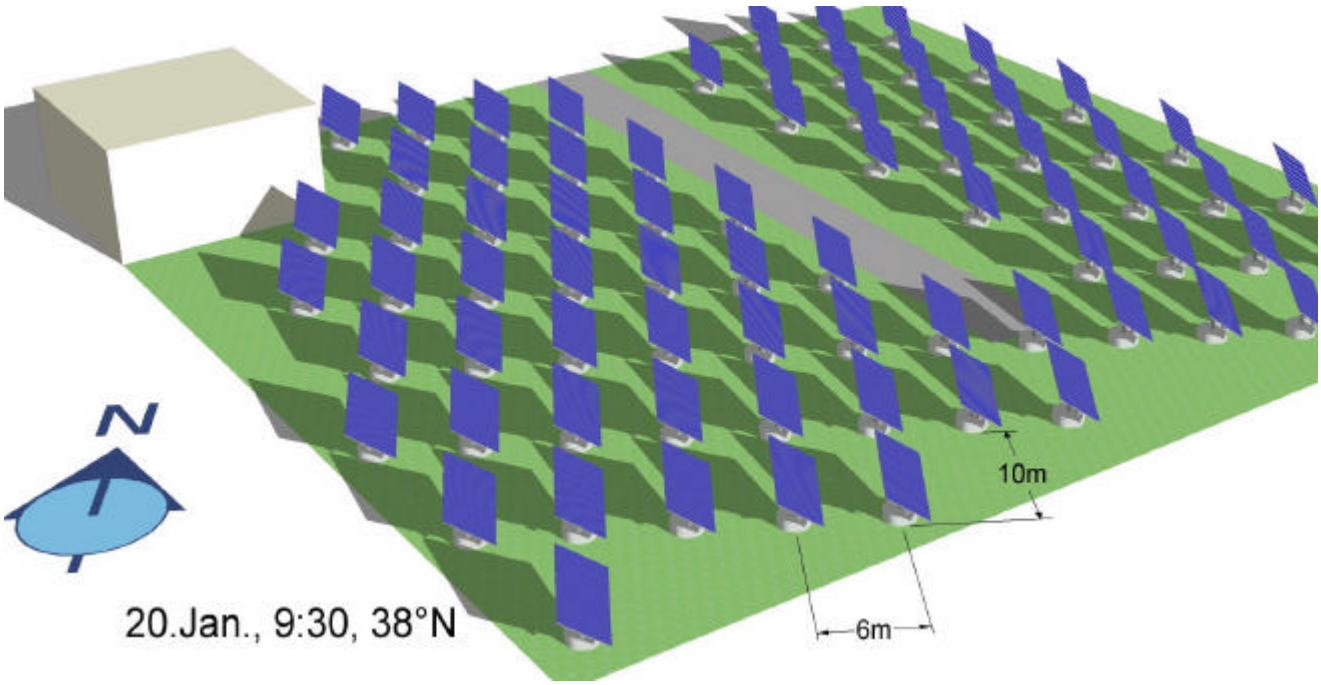
for locations Spain, Korea (38° North):

space-optimised alignment without self-shadowing

Distance mast to mast (with standard total module surface of 3.4 x 4.8 m):

direction North-South	10 m
direction East-West	6 m

Required floor space for one tracking unit c. 60 m²



Frame and Mount

What is the design of the frame and the mount?

All components of the frame and the mount are manufactured of thick-walled steel. Durable protection against corrosion by hot-dip zinc coating (> 20 years).

Bearings of the pivot-axle: maintenance-free, weather resistant slide bearings of special plastic by IGUS (globally leading manufacturer in the market of plastic slide bearings)

Fixation of the solar modules by stainless steel clamps. The aluminium frame of the solar modules has no contact with the galvanised steel parts.

Foundation: regular concrete foundation or KRINNER screw foundation which needs only 20 minutes set up time per tracking unit.

What wind speeds can the tracker withstand?

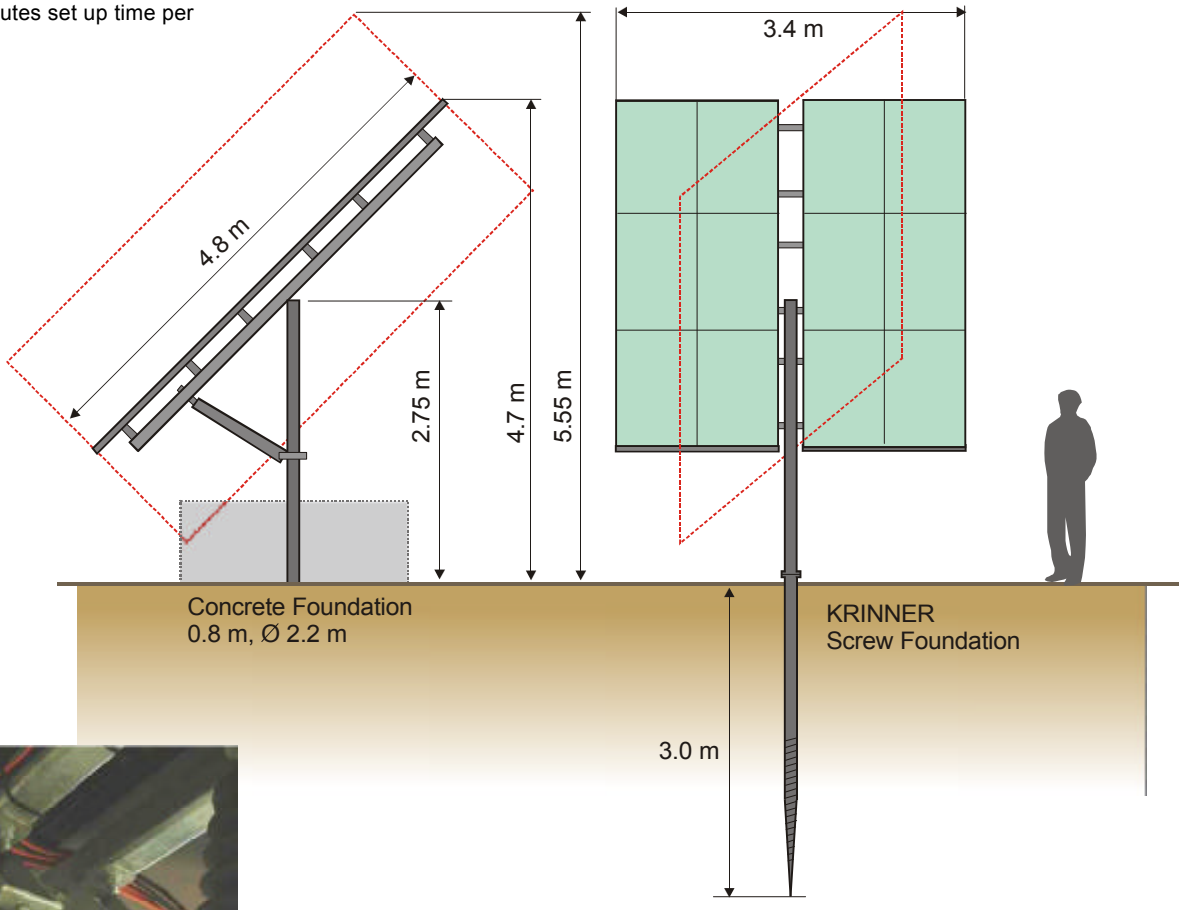
Frame and mount are designed to resist wind speeds up to 150 km/h (wind force larger 12 Beaufort) without wind sensor (DIN 18 800). Static certificates available.

Is it possible to adjust the tracker position in case of stronger winds as to reduce the wind load on the panel surface?

Centrally controlled solar parks with wind sensors for speed and direction (optionally) can be programmed to move all trackers into the optimum position in case of stronger winds. In this position the effective area facing the wind and hence the wind load are smallest.

How many solar modules can be installed?

This depends on the dimensions of the specific solar module. The total surface of all modules should not exceed 15 m². The available surface measures 3.4 x 4.8 m. A fully equipped tracker would hold twelve modules (three rows of four modules) of a standard size of c. 1.6 x 0.8 m.



Hinges of the tracked frame

Drive

What kind of drive is used?

DC linear drive, industrial standard in large series; main field of application: drive for satellite dishes

Maintenance-free, tough design, ballscrew, operating voltage: 12 VDC (low voltage)

Weight: c. 11 kg
Dimension: 1.3 m

Materials of the housing: steel (galvanised, powder-coated), plastic

Note: the LCU supplies 24 VDC to each tracking unit which the tracker electronics reduces to 12 VDC to operate the linear drive.

Does the linear drive operate to the limits of its maximum capacity with regard to force, range, and speed?

No, not even close.

The linear drive's operating range is 900 mm, of which merely 700 mm are used.

The linear drive's rated load is 2.2 kN. The maximum operating force moving the tracker is only one tenth hereof (= 0.2 kN is required to move the tracker fully to East or West position).

The maximum speed of the linear drive is reached at 36 VDC. Under regular operating voltage of 12 VDC the drive will be operated at one third of its maximum speed.

The drive has been designed to have sufficient power reserves to ensure maximum life-expectancy (mean time between failures, MTBF).

What design has been chosen for drive screw and bearings to guarantee maintenance-free operation?

The drive screw is designed as ballscrew which has proven to be a maintenance-free solution in numerous industrial applications, also under changing or swelling loads (e.g. gusts).

The bearings are also designed to suffice industrial standards.

Due to the short daily time of operation of the drive (< 16 minutes per day) the abrasion of the DC drive's brushes is negligible, hence a life expectancy of more than 20 years seems realistic.

Could the drive possibly get overloaded when strong winds (up to 150 km/h, wind force larger 12 Beaufort) bear against the solar module surface?

The solar modules are arranged symmetrically as to balance the wind forces. Consequently the force needed for the tracking movements is comparatively small, much smaller than the force of the linear drive.

Do swelling wind loads or snow loads influence the precision and hence – through aberration from the optimum position – the output increase of the solar installation?

The drive is equipped with a rotary encoder. The measured impulses will be transferred to the control unit at the tracker for diagnosis. Thanks to the ball-screw, aberration from optimum tracking is smaller than 1 mm and the output of the solar array is not influenced.

Will the drive be damaged in case of blocked hinges?

No, the drive will not be damaged. The control unit at the tracker detects that the linear drive is not moving and shuts the tracker off automatically.

In case of a central controller operated solar park, an error message is sent via the LCU to the CCU where the error and the address of the tracker are displayed.

Can climatic influence weather down the drive after some years?

The drive has been especially designed for outdoor use. All moveable parts are weatherproof enclosed. Lorentz looks back on ten years experience in solar tracking for stand-alone tracking solutions. Supplementary rubber coverings offer additional protection in humid climate and against dust and fine sands in desert areas. High life expectancy is hence ensured.

What is the mean time between failures (MTBF)?

On the basis of the drive's average operation time of 16 minutes per day, continuous endurance testing has shown the drive's MTBF to be way beyond 50 years. As this testing methods does not account for material ageing, an MTBF of ten years seems a proper, yet conservative estimation.

What is the mean time to repair (MTTR)?

The drive is installed externally and hence easily accessible. After loosening three screws, the drive can be exchanged (including installation and connecting of a new drive) within 20 minutes. Neither special tools nor special skills by the person in charge are required.

Are replacement drives easily available?

The used drive is industrial standard produced by numerous manufacturers in large series of more than 100,000 pieces per year and sold globally. Thus the drive will be long-term available independent of manufacturer.

What is the price of the drive in retail?

The price is approx. EUR 85 / US$ 100 in single unit quantities.