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SF45 TRACKERS FEINA

Index

1 - GENERAL PRODUCT AND COMPANY INFORMATION

1.1-The compan

Trackers Feina has made trackers since 1998, being one of the five most veteran companies in the world in this activity.
It is also one of the most veteran companies in concentration. Since 2003 it has developed trackers suitable for concentration.
In 2008 it provided trackers for the main plant in the world at that moment, CPV, with a nominal power of 800 kW, which is working with the expected precision and reliability.
Trackers Feina has supplied trackers to a large part of the CPV panel brands all over the world. With this experience it can be said that it is the company with the most experience in this technology in the world.
This company has several patents related to trackers and high precision tracking systems.

It should be noted that this company has supported the international crisis added to the Spanish photovoltaic crisis. This provides a very important security to business continuity and it ensures that replacements and consulting can be given in the coming decades.

1.2- Products

1.2.1- Trackers

SF4

SF9

SF20

SF28

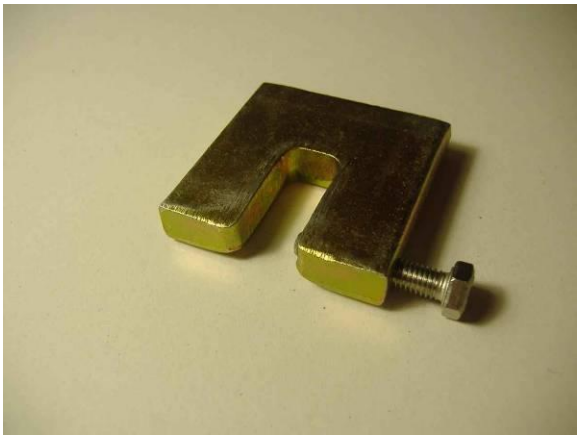
SF45

SF40

SF70

SF4: Tracker with an axis for 4 m2.
SF9: Trackers with two axles for 9 m2. Flat panel and concentration panel.
SF20: Trackers with two axles for 20 m2. Flat panel and concentration panel.
SF28: Trackers with two axles for 28 m2. Flat panel and concentration panel.
SF45: Trackers with two axles for 45 m2. Flat panel and concentration panel.
SF40: Tracker with a horizontal axle for 40 m2. Special for roofs.
SF70: Tracker with a horizontal axle for 70 m2. Special for large plants.

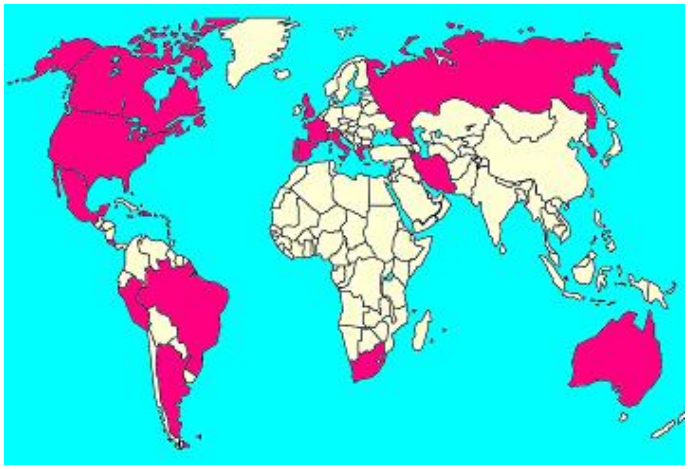
1.2.2- Others



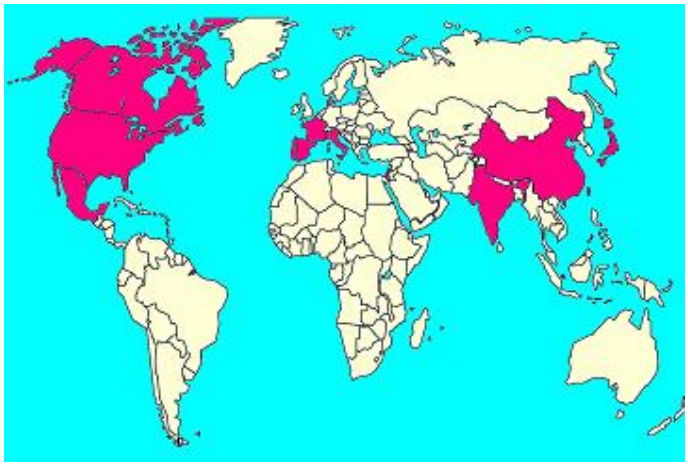
Alarm. Active security against theft.
Panel attachment braces. Passive security against theft.

1.3- Presence of Trackers Feina throughout the world

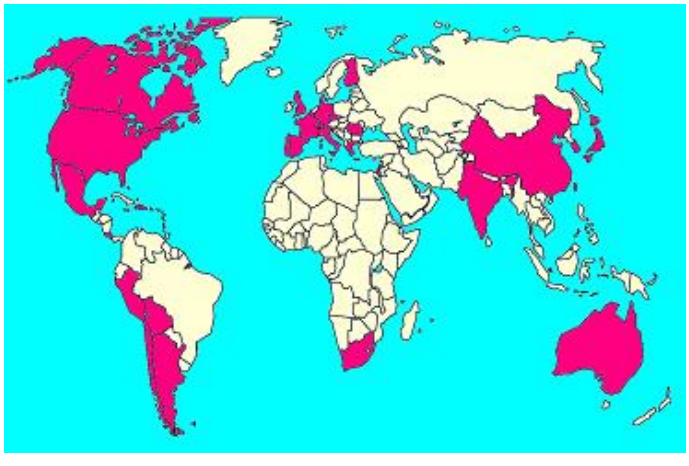
The characteristics of our products make them suitable for the whole world



Countries where Trackers Feina has distribution



Countries where Trackers Feina has CPV systems



Countries where Trackers Feina has trackers

1.4- Certificates

Trackers Feina has EC conformity certificates for all their trackers.

feina

DECLARACIÓ CE DE CONFORMITAT

EC Declaration of Conformity

L'empresa / *The company*: **FEiNA SCP**

amb adreça a / *with the address*: **C/ Era d'en Coma, 12**
08240 Manresa (Barcelona)
Tfno.: 00 34 3 8751001
feina@tracker.cat

Declara sota la seva única responsabilitat que la màquina:
Declares under sole responsibility that the product:

Denominació / *Name*:	**SEGUIDOR SOLAR DE DOS EIXOS**
Model / *Type*:	**SF45**
Pes propi / *Tare*:	**585 Kg.**
Any de fabricació / *Year of manufacturing*:	**2007**

ha estat fabricada de conformitat amb els requisits de seguretat i salut de les següents normes:
to which this declaration relates is in conformity with the essential health and safety requirements in accordance with the following norms:

Directives / *Directives*:

- Màquines / *Machinery*: 89/392/CEE, 91/368/CEE, 93/44/CEE, 93/68/CEE, 98/37/CEE, 98/79/CEE

Lloc i data / *Place and date*:

Manresa, 16 de març de 2007

Nom, càrrc i signatura / *Name , position and signature*:

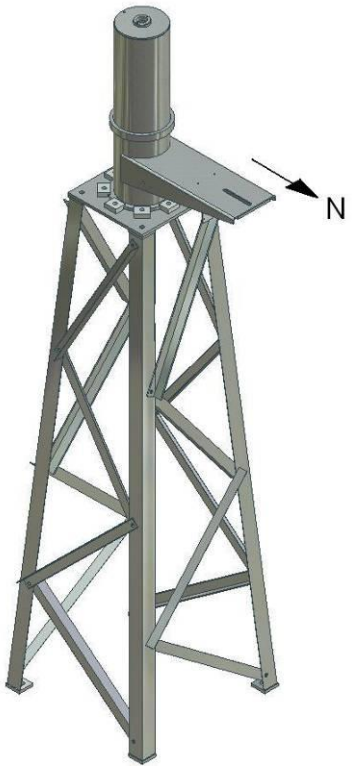
Ignasi Sivillà Llobet
Gerent

EC Declaration of Conformity for the SF45.

2 - INFORMATION ON THE TRACKER

2.1- Features

-Mast that is screwed on a iron or concrete column. (Galvanised)
-Moving tube that rotates around the mast (Galvanised and painted)
-Sprocket Module 10, Diameter 1000mm, clockwise movement (steel of high resistance).
-Sprocket Module 10, Diameter 1000mm, inclination movement (steel of high resistance).
-Axle, diameter 200 mm, L=3,400 mm, structure inclination. (Galvanised).
–Two motor sets with their gears, their headless nuts and turn counter switch and protection box (Galvanised and coated with zinc).

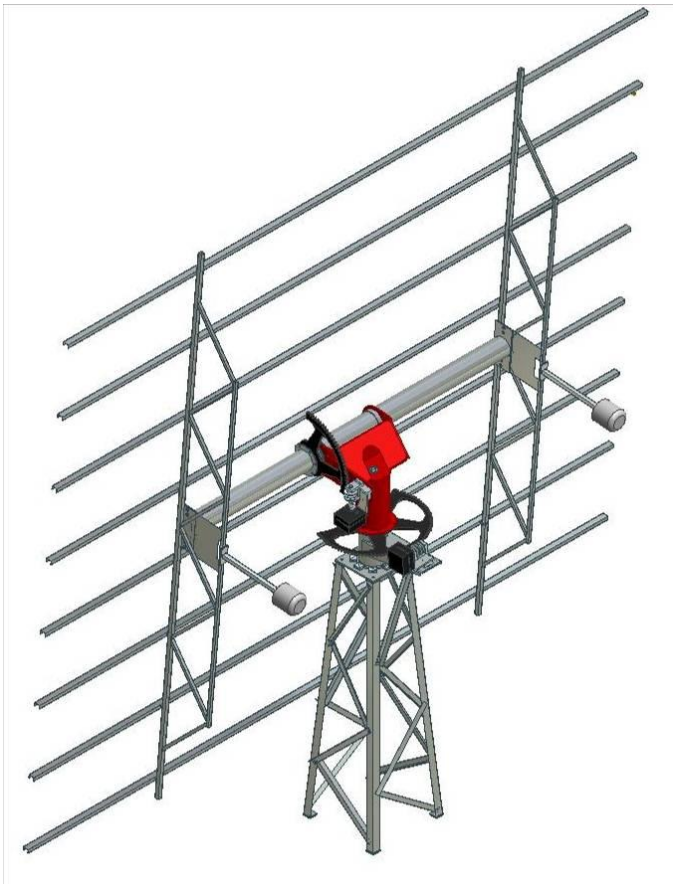


– Two cross swise bars of 7 metres for supporting the transversal bars (Galvanised)
-An electronic box with the connections for the motors and the micro contact breaker
It is designed for withstanding winds of 140 km/h with 45 m2 of panel surface.

Functioning:

Once the date, time and location coordinates are entered into the screen, with the buttons, the sun tracker is set.

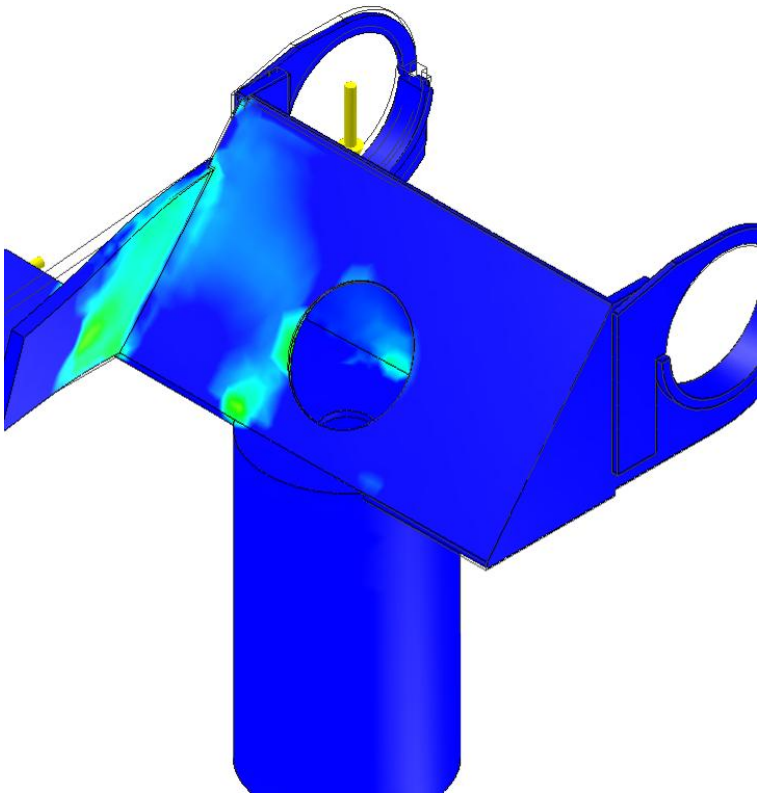
Form this moment on, the tracker is working. Each X amount of minutes (between 1 and 90, according to what has been programmed), it calculates the position and moves the tracker if necessary.
At the moment that the sun sets, in other words, when the inclination of the sun over the horizon is negative, the tracker returns to the east and sets near the horizon again (some 80 degrees regarding the vertical).



At the time that the sun comes up, the tracker goes back to an almost vertical position. From this moment on it carries out its normal daily movement.
Maximum load for SF45: 1300 kg

2.2- Load resistance

One of the main features of our trackers is that they have been strictly calculated to support all forces.
Although the calculation for finite elements are used for many parts, with as many parts as is possible (the majority), we use the traditional calculation for formulas, which is more accurate and does not lead to errors.



2.3- Wind resistance

Due to the different windstorms that our trackers have endured, we have a complete report which proves that they perfectly support the wind speeds by which we have designed them.
Feina trackers are guaranteed for gusts of 140 km/h. As can be seen, the first damages to the trackers turn up at 150 km/h, with some quite small repair costs.
A total accident does not result even near 180 km/h.
The evaluation of these results are good or bad, which is provided for potential clients and insurance companies that could make use of this data.
If you need references on all this data, please get in touch with us and we will give them to you.

2.4- Performance

The annual increase in performance of two-axle trackers with respect to fixed panels at optimum tilt ranges from 29% to 39% depending on the area of land and weather conditions of the site.

2.5- Profitability

Feina's trackers, due to their reliability, durability and low price, are highly profitable with respect to the fixed panels. As much as the price of panels lowers, they remain profitable.

2.6- Availability

The SF45 two-axle tracker has a coefficient of availability, if there is proper maintenance, of more than 99.5%.

2.7- Which are best, small, medium-sized or large trackers?

One might wonder whether it is better to use small trackers, like those measuring 20 m^2; medium-sized ones, such as those measuring 45 m^2 or large ones, like the trackers existing on the market of up to 200 m^2.
A solar energy power station is a facility that must be profitable, so the figures are decisive.

- The cost of large trackers per KW capacity is greater because the weight of the equipment shoots up (more than double the weight and price for double the capacity).
- The cost of the foundations also shoots up (more than three times as much concrete for a tracker twice the size).
- Contrary to the way it may appear, the amount of land used for a certain power is independent of the size of the trackers. If anyone tells you differently, they are deceiving you.
- Although it may be surprising, the kg of copper in the cables transporting the power from the trackers to the site of the inverters (assuming these are centralised) is independent of the size of the trackers for a certain drop in voltage. So small trackers mean more metres of cable but of a smaller section.
- The number of metres of trench does vary somewhat, but its cost is insignificant compared to that of plant.
- For any repair, some will need a crane and others will not.

If we analyse everything altogether we can see that the cost of a plant shoots up above a particular size of tracker.

And, if not, it is easy: work out the figures for a plant with small or medium-sized Feina trackers or large ones and compare them.

2.8- Plants and facilities

Our trackers have helped to increase efficiency in many small and medium sized plants around the world. In photovoltaic concentration as well as flat panel.
Specifically, the SF45, includes:

Concentration solar power plant of 440 kw, with OPEL panels, at Vilalba dels Arcs (200 km from Barcelona).
Trackers Feina is world leader in trackers for CPV.

Plant of600 kw, with flat panels, to Vilalba dels Arcs.

Plant of 50 kw, flat panel, to Vilanden, Catalonia

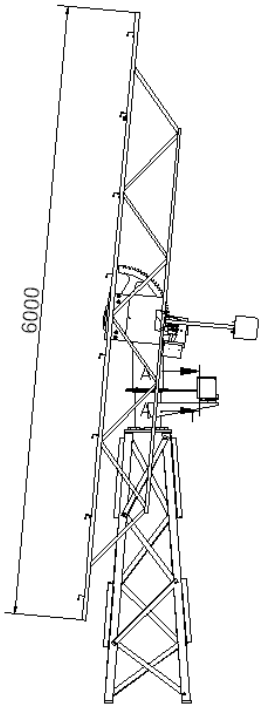
Plant of 60 kw, flat panel, to Saldes, Catalonia

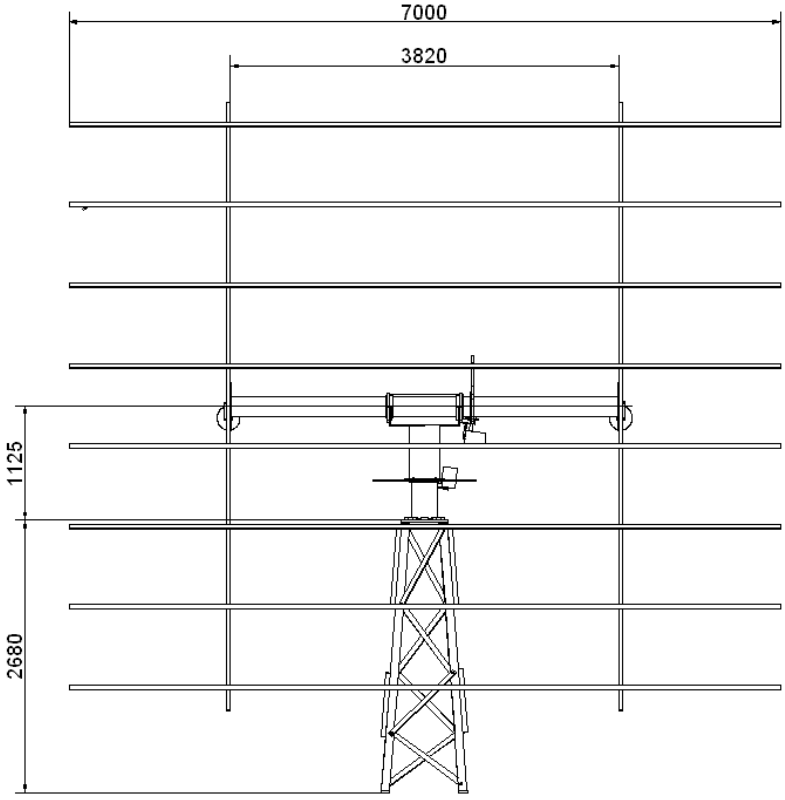
Plant of 200 kw to Wiskonsin, USA

Trackers SF45 for research with concentration panels Thermal-PV

3 - PRACTICAL ASSEMBLY

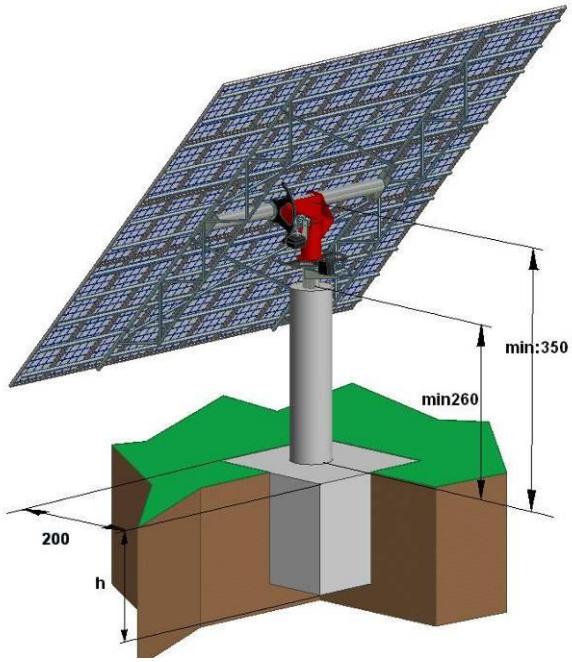
3.1- Main dimensions





3.2- Foundations

The values are valid for the heights shown in the drawings, for a panel surface of 45 m^2, for a wind speed of 140 km/h and a safety coefficient of 1.6.



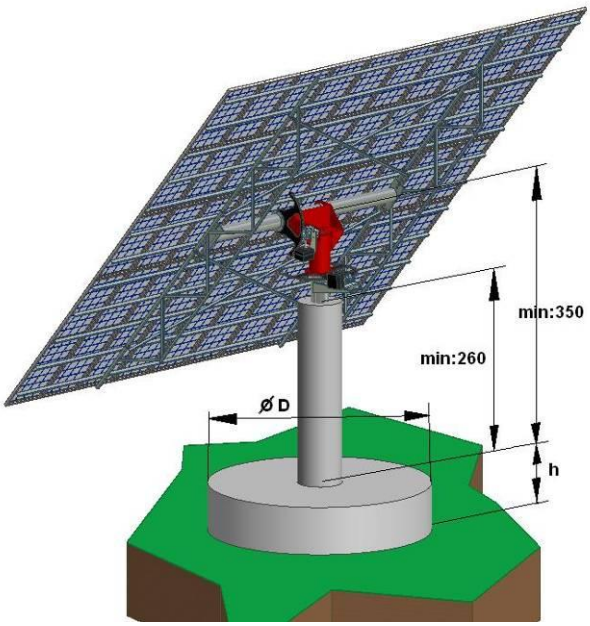
3.2.1- Buried foundations

For a foundation width of 200 cm, in not very hard ground (2 kg/cm^2), the depth would have to be 160 cm.
To minimise the dimensions of the foundations, it is a good idea to measure the resistance of the ground. We can calculate the optimum foundations based on the data we are given.

In this case, the column measures 60 cm.

3.2.2- Gravity foundations

For the 60 cm column (or 60 x 60) the height of the base depends on the diameter.
For a diameter of 3.3 metres, the height would have to be 0.50 metres. For 2.5 m diameter, the height would be 1 metre.
We can calculate the optimum value depending on the dimensions of the panel platform, the heights, etc.
Buried foundations are usually slightly cheaper for many units, and have less visual impact.



3.3- Column

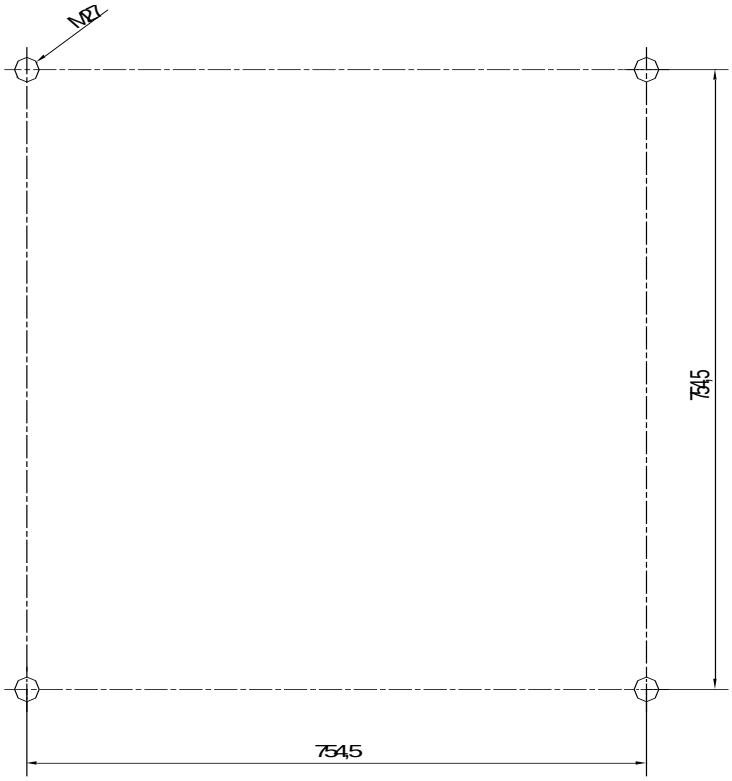
The trackers may have different column types.

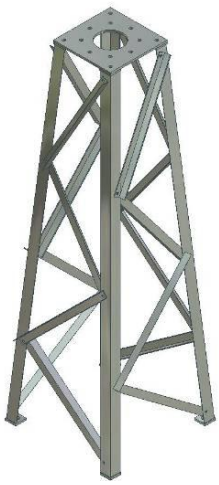
A) concrete, following the very foundation of the tracker

B) iron pipe (It can be supplied)

C) iron structure (It can be supplied)

3.3.1- In the case of column structure:



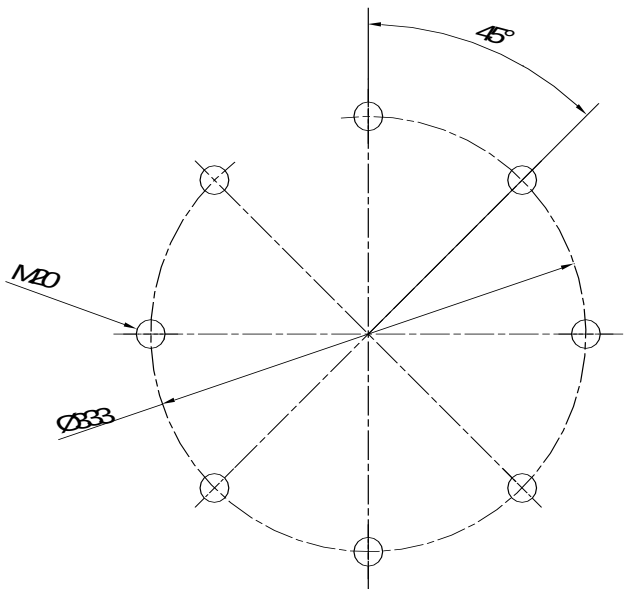


Make a concrete foundation , with four M27 threaded rods. They must extend 70 mm out of the concrete. The image shows the distance between the rods. We can provide a template to ensure these measurements.

3.3.2- If it is concrete column:

A concrete column can be used instead of an iron one. In this case, it should have M20 rods that come out some 60 mm.

You can find the measurements in the attached drawing. We can supply a template.



3.4- Distances between trackers in a solar plant

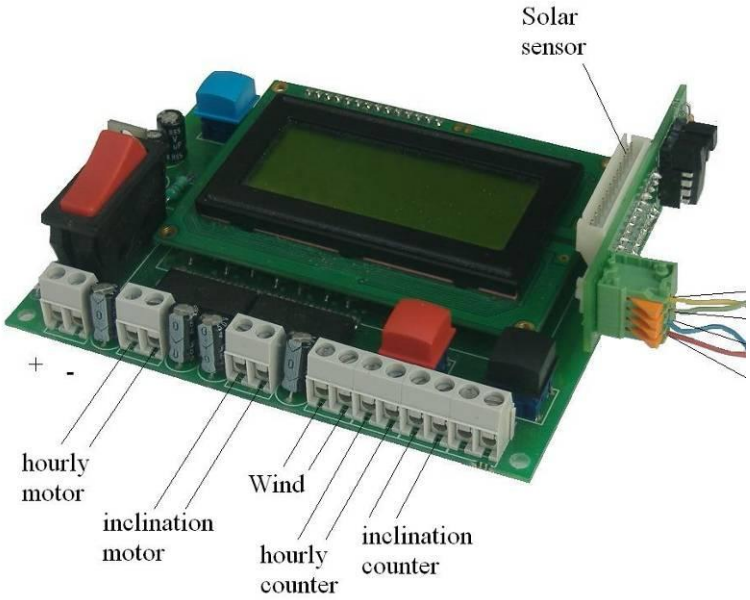
The distance so they do not cast shadows depends on the dimensions of the panel platform and the latitude of the site.

By way of example, if the panel platform is 7 metres wide and 5.7 metres high, and we have it at a latitude of 40º, the North-South distance so that they do not cast shadows in winter should be 16.8 metres. The East-West distance is a compromise distance, as there will always be days and times during the year when they cast shadows. If, for example, we put it at 17 metres, we will have a loss of energy during the year due to shadows of between 2.5 and 3%.

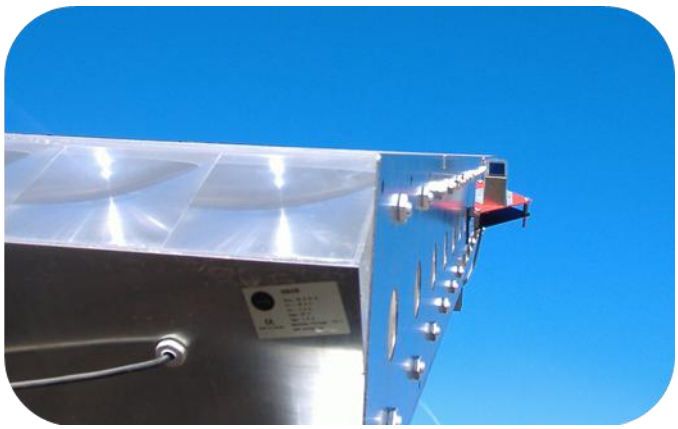
In this case, with normal panels (neither high nor low performance) we will have installed 0.190 kw/hectare.
Calculating this is quite complex, but we have developed some software which allows us to do it. In this way, we can optimise the available land.
We must bear two important things in mind: all over the world, the increase in energy with a double-axis tracker compared to fixed panels is between 28% and 38%. If someone claims better performance they are trying to mislead you. It must also be borne in mind that the need for land for a solar plant with trackers is independent of the dimensions of the tracker.

3.5- Electronic

This is the electronic control of the tracker, with its inputs and outputs.



3.6- Solar probe

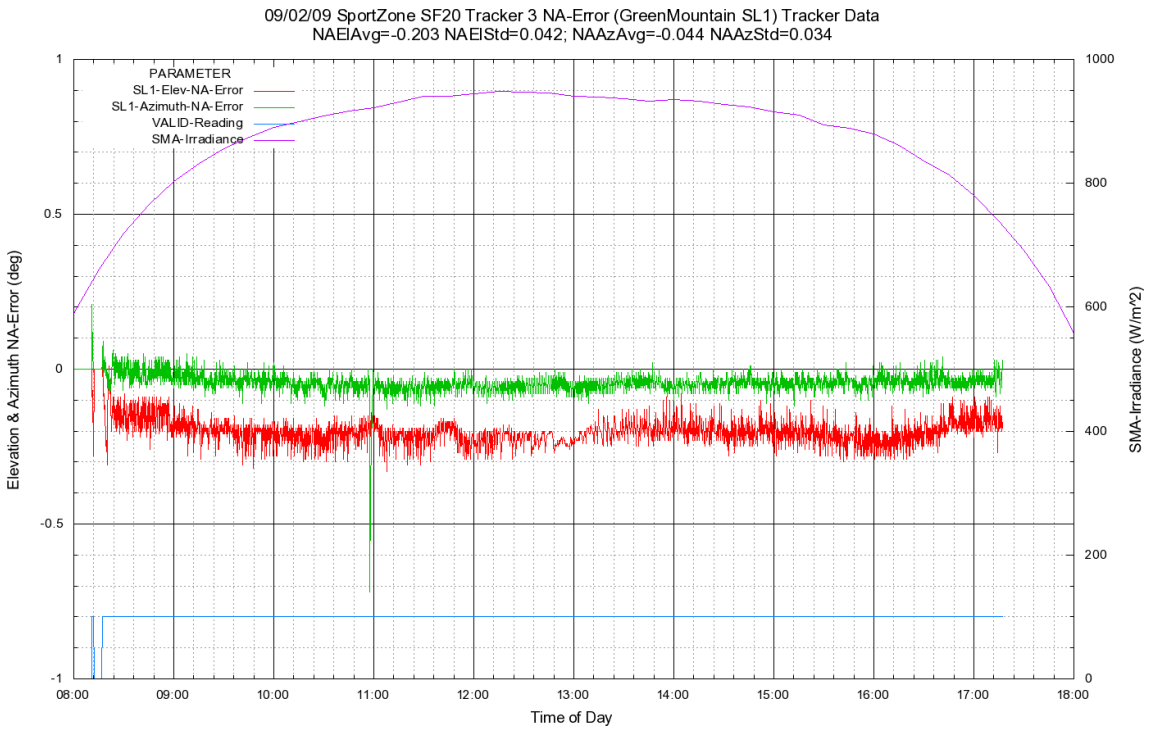


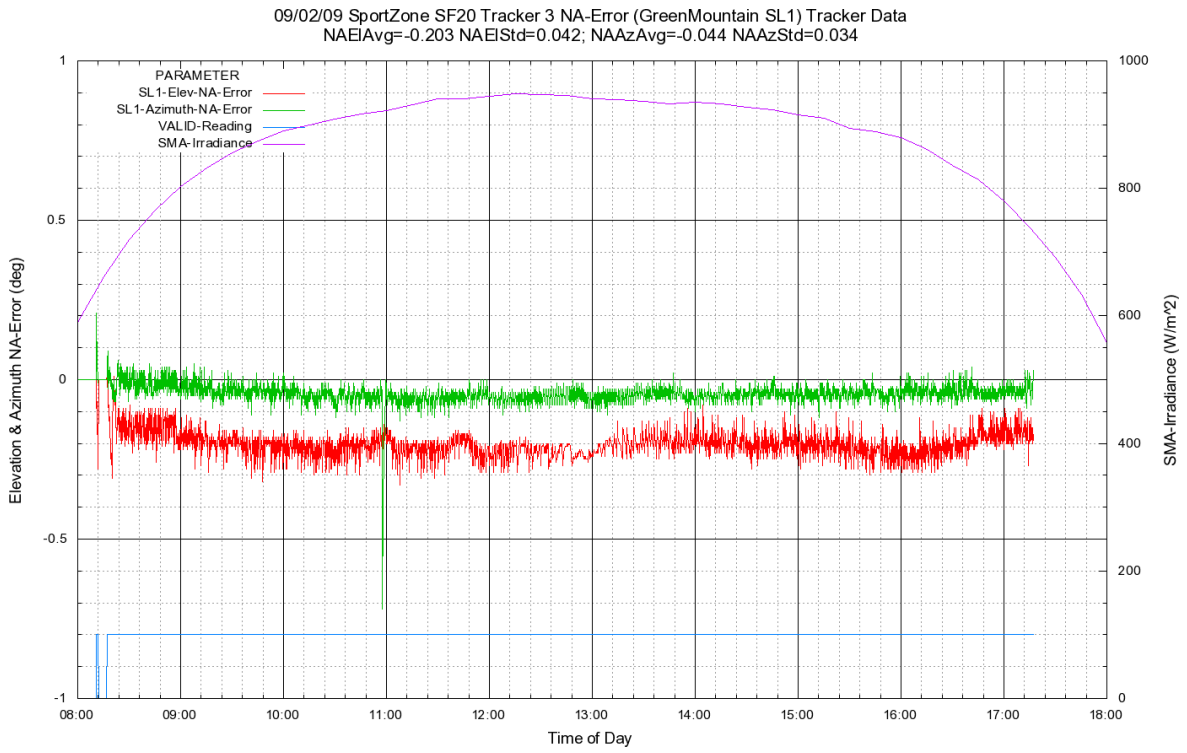
The probe is used to give the precision necessary for concentration. It is not necessary for flat panels.
The SF45 achieves a tracking error of less than 0.08 degrees.

This probe is attached to the structure of the tracker and plugged into its control box.

3.7- Accuracy data

The accuracy shown by Feina trackers is very high. These are not theoretical but real values with standard trackers, taken from panels and the outdoors. The two images shown are for the SF20. For the SF45, the data is even slightly better.

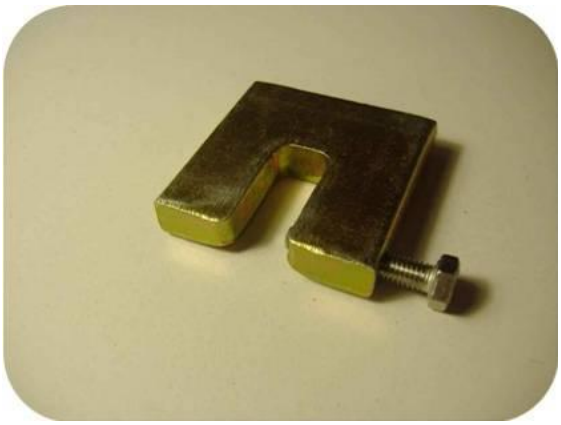


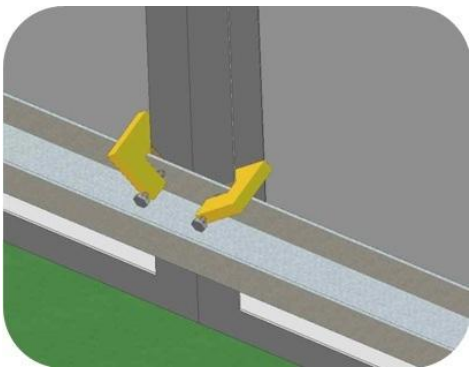


3.8- Quick fixing system for panels and anti-theft devices

The clamps patented by FEiNA make it possible to place photovoltaic panels on fixed structures or on FEiNA trackers much more quickly and easily than with bolts or any other kind of fixing.

4 or 6 pieces are enough for each panel.





They are held firmly. We do not know of any of the 100,000 clamps on many installations all round the world coming loose. When the whole installation is complete, the head is cut off the screw holding it with a pair of pliers, which means it cannot be taken out except by cutting the whole piece. This makes it practically impossible to steal the panels. Noisy tools and a great deal of time are needed for each panel. It is also a reversible system, if you want to remove the panels, this can be done with a little patience.
If this system is also combined with our anti-theft alarm, security is almost total.
If a solar plant with many panels is to be assembled, a piece of equipment for drill assembly can be supplied to help fix the pieces quickly.

3.9- Communications

The trackers are commanded from a central command.
Alongside this central command are an anemometer and a GPS. The anemometer is used for knowing the wind speed and arranges all the trackers that are put in place if the wind exceeds a certain speed (programmable by the user). The GPS is used at the beginning of the installation to send ground coordinates to all the trackers and the exact time each day.
From this control several things can be ordered to one particular tracker (they are numbered) or all trackers simultaneously move to a certain position, calibrate, stop, reboot, etc. You can also request the most important information from the trackers, such as knowing their position, time, if it has a position error, if the tracker was too slow, etc.
Simultaneously, all the information and commands that can be made from the master and also through a modem can be done from a website on the Internet.

3.10- Capacity according to the wind

Usable surface area according to the wind speeds that it must withstand:

	140km/h	175 km/h	205 km/h
SF45	45 m2	37 m2	31 m2

All these areas are square and slightly oblong (a little wider than taller). If you are outside of these characteristics you must calculate for each support.

In areas that might experience hurricanes, (130 mph) since there might be a sufficient warning, you can make better use of the trackers by putting four

anchors into the ground, putting the tracker horizontal, and tying it down for safety. In this way you could put up to 90% of the nominal surface of the tracker.

3.11- For shipping:

Weight: 610 kg
Volume for packaging : 1,9 m3
Container 40 feet: 15 units (for many units, 20 units/container)

3.12- Guarantee

Feina trackers have, by default, a 3-year warranty, extendable to 10 years, with a small surcharge of 6% of the price.
The warranty covers all parts of defective material or if there has been damage in normal use.

3.13- Production capacity:

Trackers Feina has an estimated production capacity for the SF45 of:
40 units after the first 3 months of an order.
100 units at 4 months
200 units at 5 months
400 units at 6 months
1000 units at 8 months
3000 units in a year

3.14- Maintenance

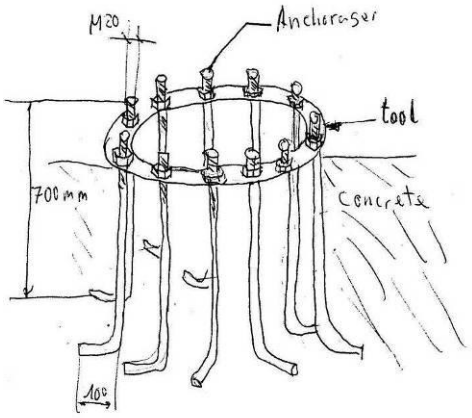
3.14.1- Scheduled maintenance:

Just grease the gears and friction parts once every 6 months. This may take 20 minutes for one person per tracker.

3.14-2- Non-scheduled maintenance:

After a few years it may be appropriate to review the possible occurrences of rust so as to apply an anti-rust treatment.
Control, repair and replacement of damaged and parts failures.
Trackers Feina can take care of the maintenance for a small annual cost.

3.15- Assembly example:



When the foundation has been completed, install the anchor as shown to attach the column

When mounting the panels, it is practical to mount them on the ground or on some columns of straw, as the image shows ...

Or on several columns of bricks

No matter if the truck is new or it already is a few years old.

The crane raises the platform...

And the rest of the tracker is installed.

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