




Technical description

Agile 1P

STANDARD DOCUMENT

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CONTROL REVISION

REV	DATE (dd/mm/yy)	DESCRIPTION	ELABORATED	REVISED	APPROVED
1	03/02/2021	INITIAL DOCUMENT	 LGA	JMG	
2	26/02/2021	TECHNICAL REVIEW	 LGA		
3	29/03/2021	MARKETING UPDATE	 LGA		

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1 GENERAL DESCRIPTION

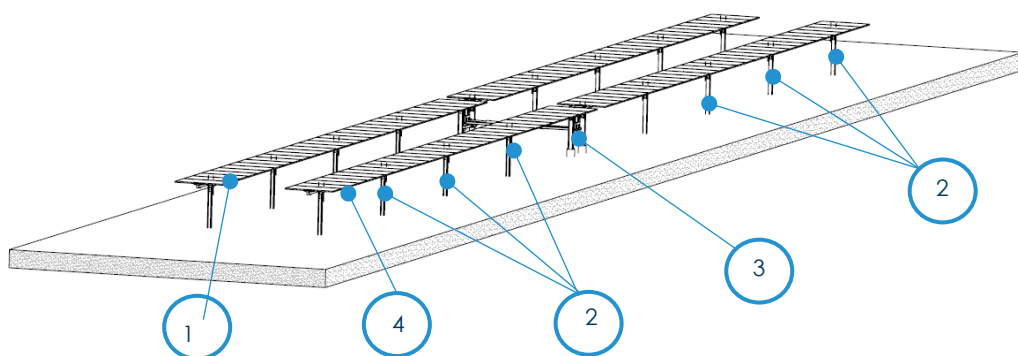
The Agile dual row single axis tracker is a descentralized tracker with a typical configuration 1P.

Typical configuration	1p x 60
Tracking range	+120° or less
Drive types	Slewing drive
Communication type	Communication between tcu and ncu: Wired: RS485 Wireless: zigbee, LoRa Communication between ncu and scada is wired
Motor power supply type	Self-powered External-powered String powered
Standards and regulations	Structural design according to local codes
Max. Wind speed in stow position	According to local regulation
Max. Wind speed in work position	60 km/h unless otherwise indicated
Stow position angle	45° unless otherwise indicated
Compatible solar modules	Framed, bifacial.
Pv module fixation	Bolts, rivets, Trina clamp
Cables fixation	Cable clips
Slope limitations	20% N-S 10% E-W (*)

(*)N-S: max 20%, for slopes higher than 10% consult with TrinaTracker. E-W: max 10%, for slopes higher than 5% consult with TrinaTracker

2 STRUCTURE

The main components of the Agile are the following:



CODE	ELEMENT		COATING	STEEL GRADE
1	TORQUE TUBE		HDG PREGALVANIZED ZM	S355 OR HIGHER
2	STANDARD PILES		HDG DUPLEX*	S355 OR HIGHER
3	MOTOR PILE		HDG DUPLEX*	S355 OR HIGHER
4	PURLINS		HDG ZM	S355 OR HIGHER
	FASTENERS		ZN-Ni sealed/ HDG	8.8 and 10.9
	PV MODULE FIXATION	Bolts	ZN-Ni sealed	8.8
		Rivets	Stainless Steel	A2 70
		Trina clamp	ZM310	S350GD or equivalent
	CABLE FIXATION- Cable clip		Carbon steel	NA

FOUNDATION		SIZE
STANDARD PILES		W, IPE, IPEA (*)
MOTOR PILES	Slewing drive	W, HEA, HEB

(*) C shape piles under request

2.1. Module fixation

The module fixation proposed will be realized by bolts or rivets.

Such solution will be validated by the module supplier once is defined the module model to be used in the project. In case of denegation for the validation, other solutions will be studied in order to adapt to the system.

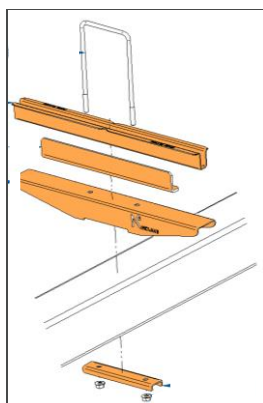


Illustration 1:
Trina clamp

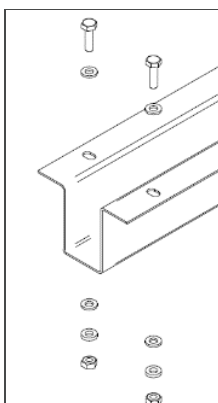
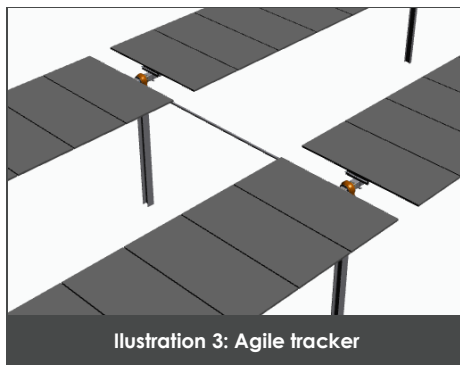


Illustration 2:
Srew fixing

3 DRIVE SYSTEM

Agile tracker is designed with slewing drive system,



Slewing drive

Max. Dynamic Torque	9 KNm
Holding Torque	30 KNm
Ratio of Gear	1045.5:1
Operation temperature	-40° to +80°
Rated Voltage	24VDC
Protection Class	IP65
Noise Level	<65 dB

Tracker consumption Information

Data	Value
Energy necessary per tracker for move to stow position	12,57Wh/día
Peak Power per each tracker for transformer & UPS sizing	220 VA

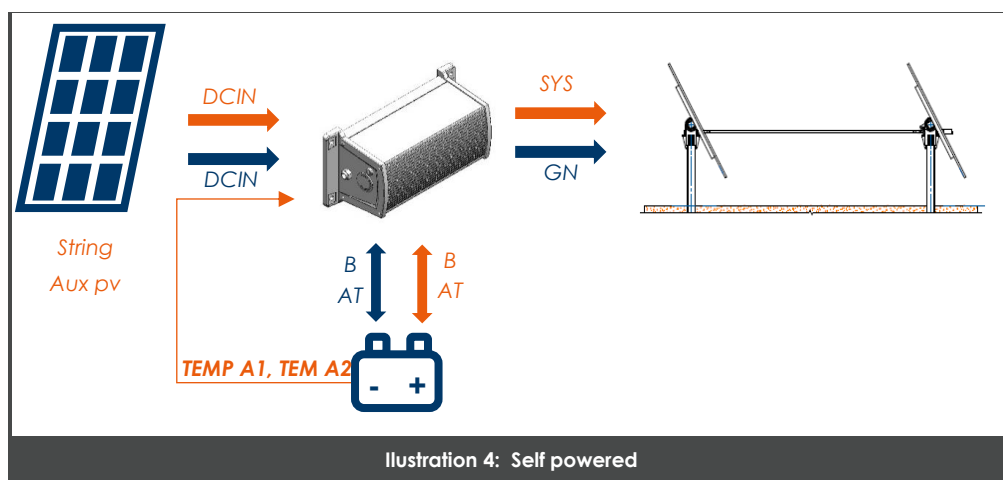
4 POWER SUPPLY OPTIONS

4.1. External powered

Power Supply Information	
Data	Value
Maximum Input Current	1.565 A @ 115VAC ; 1.44 A @ 230VAC
Nominal AC Input Voltage	100 VAC ~ 240VAC
AC Input Frequency	50 Hz ~ 60Hz
Efficiency	> 87% @ 230VAC, > 86% @ 115VAC
Nominal Power supply	100W
Peak Power supply	200VA

4.2. Self-powered

Power Supply Information	
Data	Value
Maximum Input Current	1.6 A, 60 W @ 3Ah
Nominal AC Input Voltage	26 Vdc ~47 Vdc
Efficiency	> 87% @ 3.0 Ah
Nominal Power supply	3.0 Ah
Peak Power supply	6 A



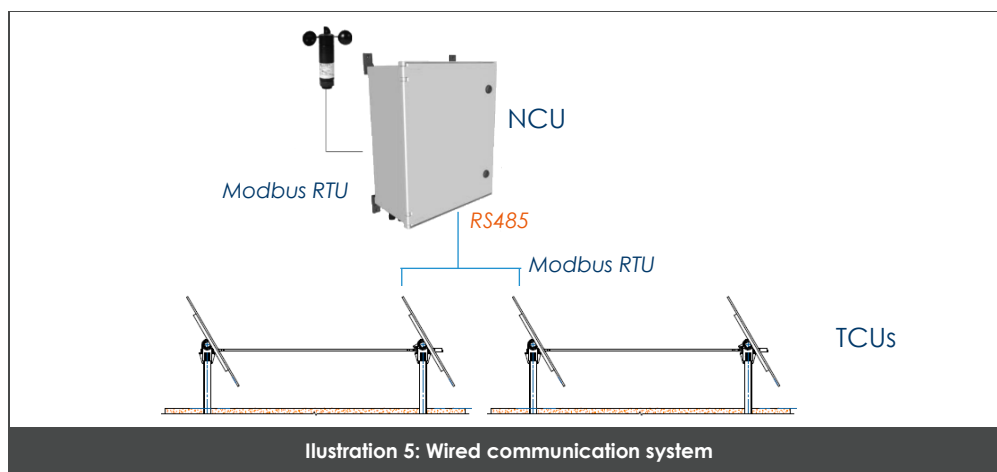
5 MONITORING AND CONTROL

5.1. Communication system

The communication between NCU (Network Control Unit) which receives the information (status, position, alarm) and the TCU (Tracker Control Unit) which is the control and power supply of each tracker can be using RS485 cable or well using Zigbee or LoRa Wireless.

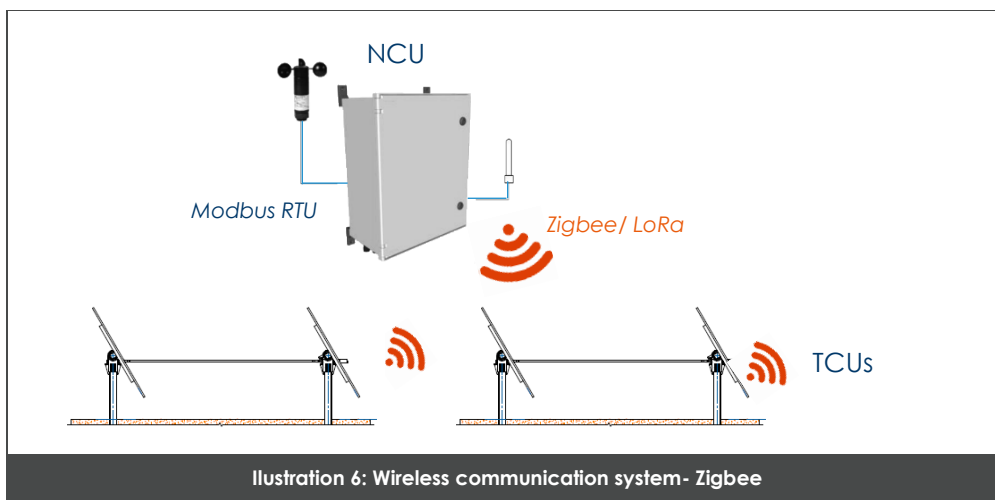
- **Wired**

Solution based on RS485 communication port through modbus RTU protocol.



- WIRELESS

Zigbee system communication uses 2,4 Ghz band and an external antenna. LoRa is also an type of communication



The most commons combinations between the communication system and the power supply options on the Agile are the following

Tracker Communication Information

Communication system	Power supply
Wired (RS485)	External powered
Wireless (Zigbee)	External powered
Wireless (Zigbee)	Self-powered
Wireless (Zigbee)	String powered
Wireless (LoRA)	External powered
Wireless (LoRA)	Self-powered
Wireless (LoRA)	String powered

5.2. Environmental

Item	Description/value	Unit	Comments
Internal temperature estimated under 1000W/m2 radiation	Not designed for direct sun exposure		UV protection enclosure
Maximum operating temperature	60	°C	50% load derating on SL-TCU variants at 70 °C
Minimum operating temperature	-20	°C	
RH	60±25	%	
Storage Temperature	[20,35]	°C	
IP/NEMA	IP65/NEMA35		No rain, hail nor dust ingress
Maximum Altitude for controller installation	<3.500	m	Standard reference altitude

5.3. Tracking required elements

For the communication of the trackers, alarm detection and tracker control the following elements are required:

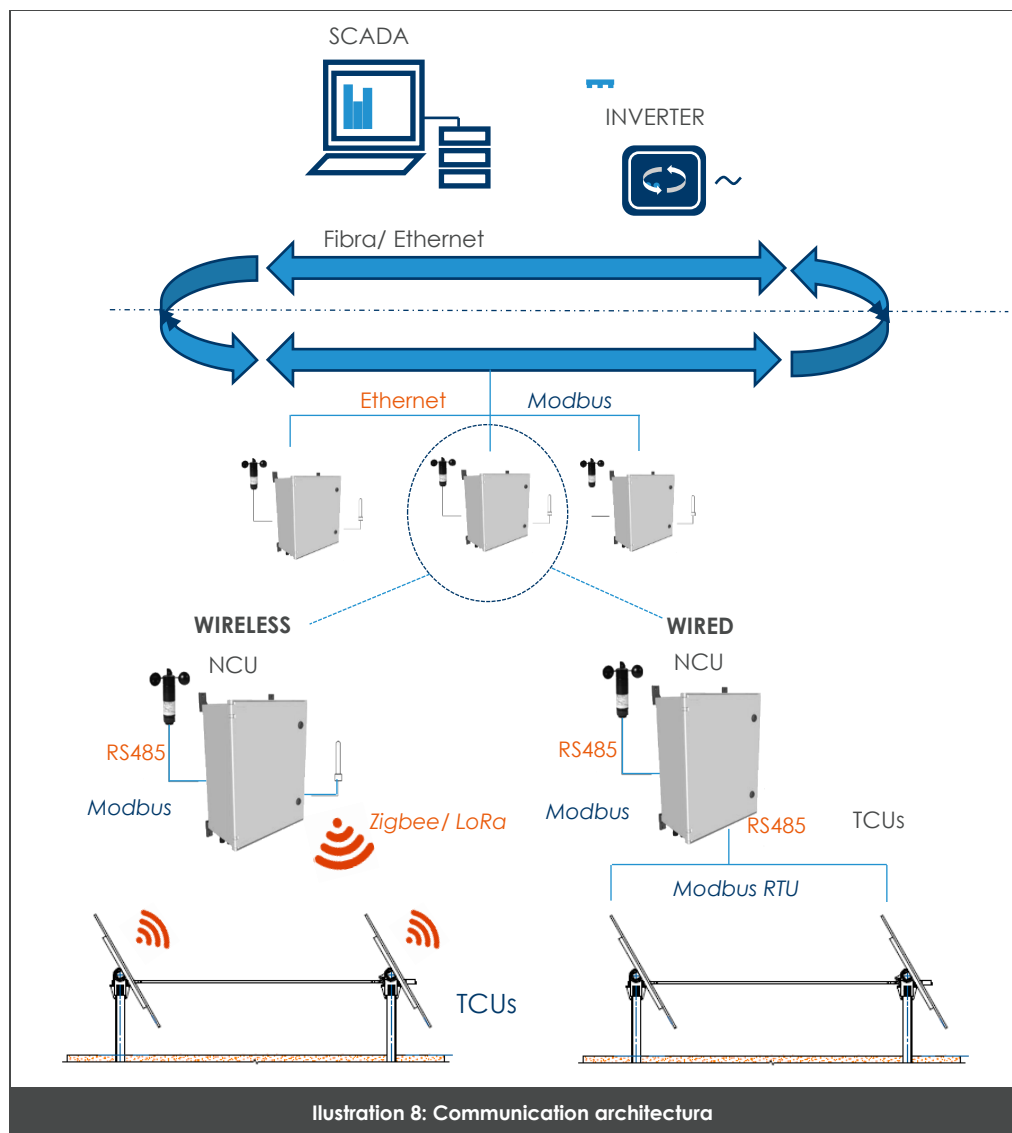
- **ANEMOMETER:** The anemometer measures the wind speed and activates the tracker alarm in order to move the position according the alarm identified. For this case, one anemometer per Power Station has been considered. The wind is measured 10 m high.



Illustration 7: Anemometer

- NCU (Network Control Unit): The NCU receives the anemometer signal. It relates to tracker Group and receives the information (status, position, alarms) of each tracker of this Group. In case of wind alert, send the signal to all the trackers which are connected. The communication between the tracker Group can be using RS485 cable or well using Zigbee/LoRa Wireless.
- TCU (Tracker Control Unit): The TCU is the control and power supply board of each tracker. It is feeder with Monophasic 220Vac tension, or well in case of self-powered, using a specific PV module for it, or in case of string powered , using a module string. This board is included in the tracker and it is communicated with the rest of trackers with the NCU, using of RS485 cable through modbus RTU protocol or using wireless though zigbee protocol or LoRa.

The components schema for the the communication of the trackers is the following:



The functionalities of the TCU are the following:

- > Calculation of the solar position using an algorithm of high accurate astronomical calculation with error $< 0.0015^\circ$.
- > Tilt control of the tracker using an analog inclinometer.
- > Backtracking control to avoid shadows over the modules
- > Data Exchange using RS485 communication ports as well Zigbee or LoRa Wireless communication. The protocols used are modbus RTU and modbus TCP/IP. Modbus RTU is used between the NCU and TCU or the sensors. modbus TCP/IP protocol is used between the NCU and the client's system.
- > Integration of the control system within SCADA plant through modbus variable map by the client.

The assembly of the electrical board is done as follows:

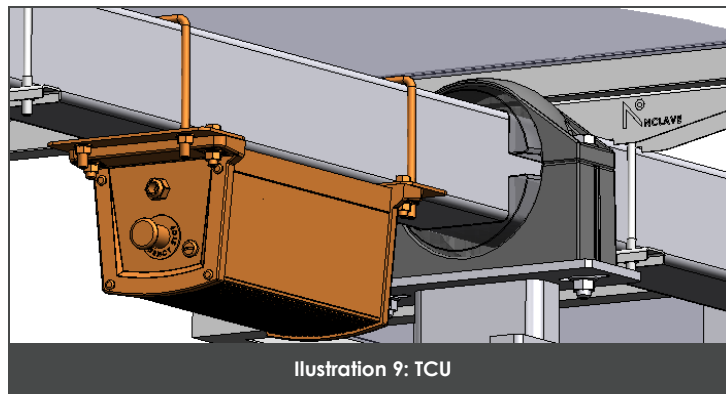
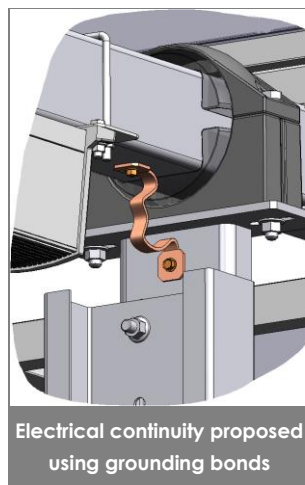
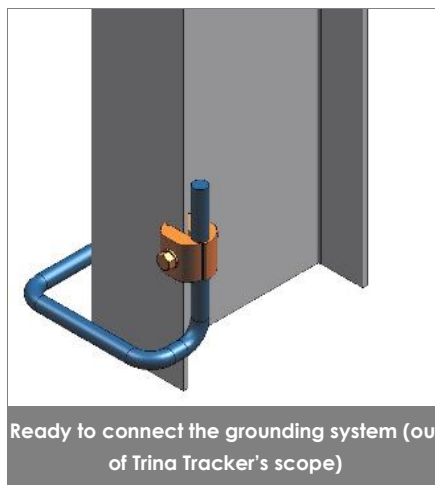


Illustration 9: TCU

- Grounding system:



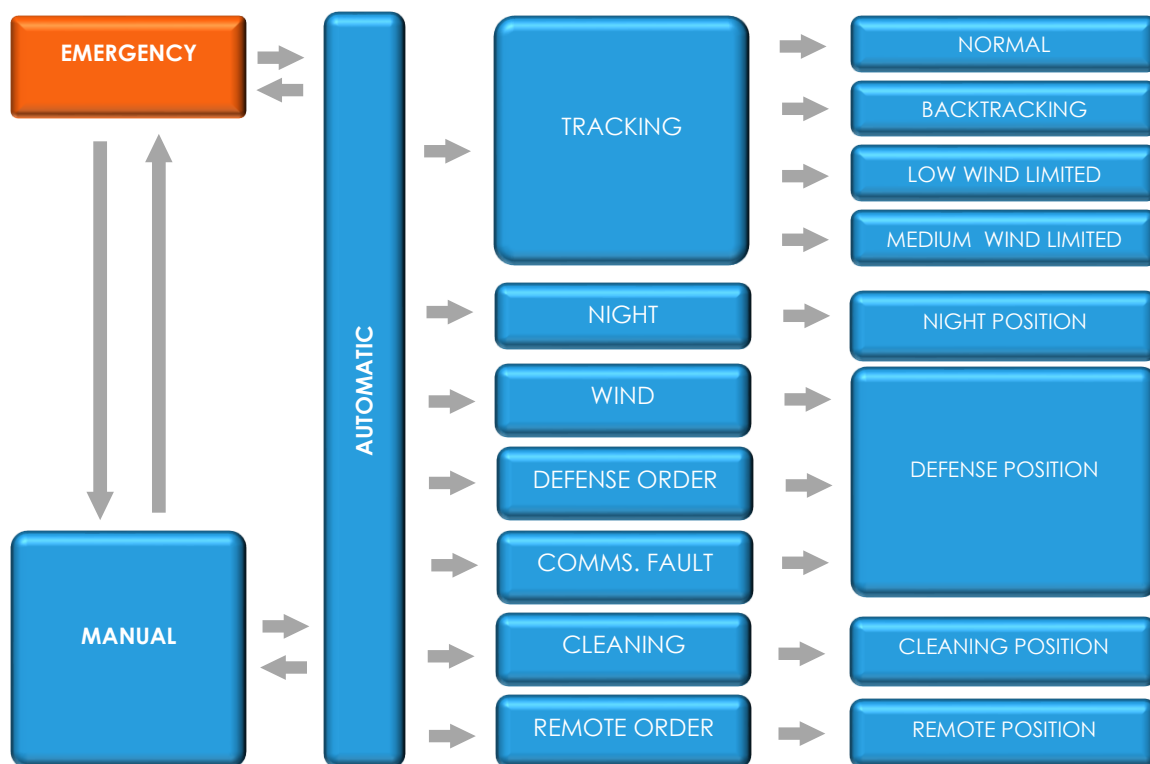
Electrical continuity proposed using grounding bonds



Ready to connect the grounding system (out of Trina Tracker's scope)

Illustration 4: Grounding system

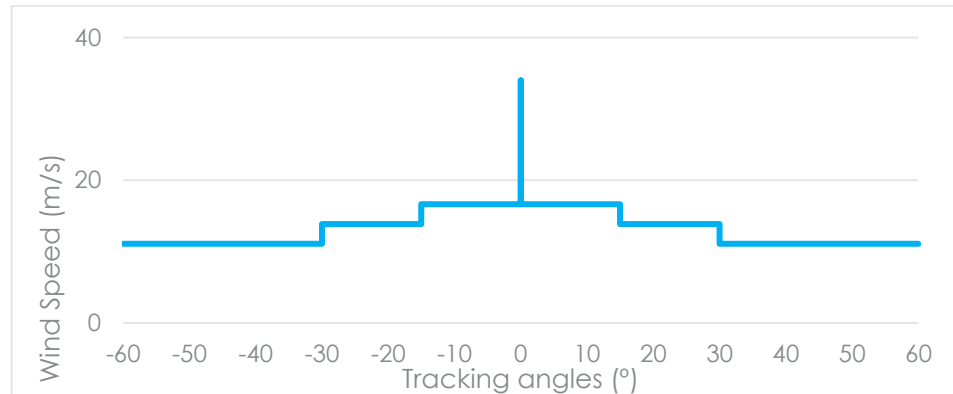
5.4. Wind alarm - slow tracker position



The tracker is designed to follow the position of the sun during the day, from East to West. The motor at the center of the row moves all the solar modules using a torque tube to which the panels are fixed. The maximum tilt of the tracker is $\pm 60^\circ$ unless otherwise specified. A control system operates the tracker according to variables for example wind conditions. The system has a specific wind profile which causes the tracker to respond, depending on the wind speed:

Advanced wind alarms management considers maximum structural design wind speed limits to manage tracking operation angles for each tracker and project avoiding any risk for each location and weather conditions.

On the following example curve, it is shown a generic graphic of the tracking wind speed and the angle limits for a project location and type of tracker.

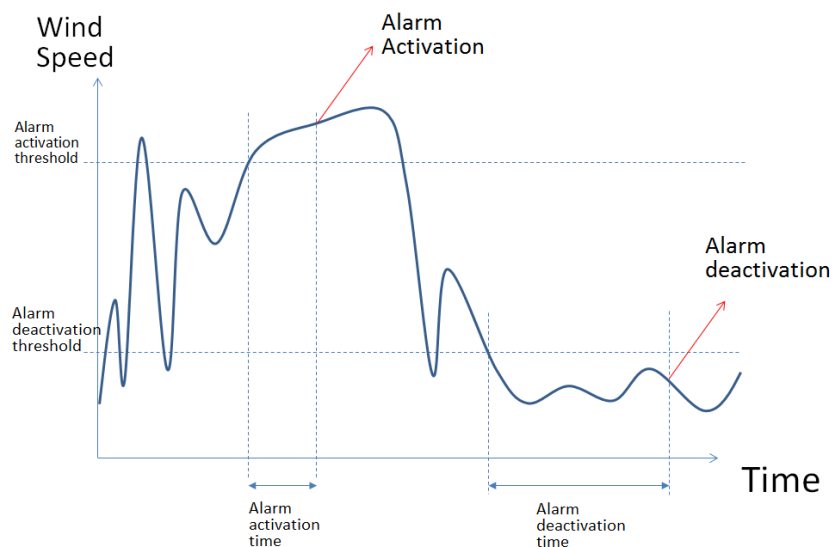


New advanced wind management curves take in consideration more detailed angles and wind zones that improves the tracking area for each specific tracker design at any wind speed maximizing the tracking and best radiation position.

Anemometer information is managed by the controllers to ensure the proper maximum tracking angles for each condition allowing tracking always under safe conditions.

When the admissible wind speed is exceeded the tracker's angle will adjust to withstand the wind speed in accordance to the wind profile.

Therefore, when the wind speed reached the mentioned values with 3s gust, the tracker limits the working tilt and keep on such limit up to the wind speed decrease below of the alarm value. The desactivation time is higher than the activation one.

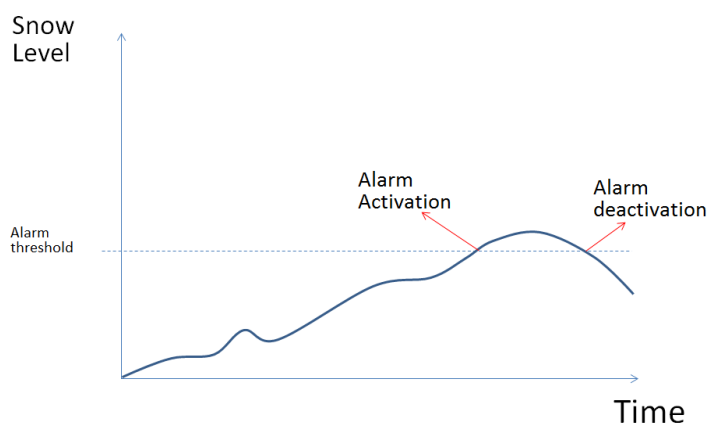


5.5. Positioning time to stow position

Time to Stow position from 0°		
Current input	Range	Value
Self-powered & string powered	Min time	450 seg
	Max time	900 seg
Grid powered	Min time	350 seg
	Max time	600 seg

5.6. Snow alarm

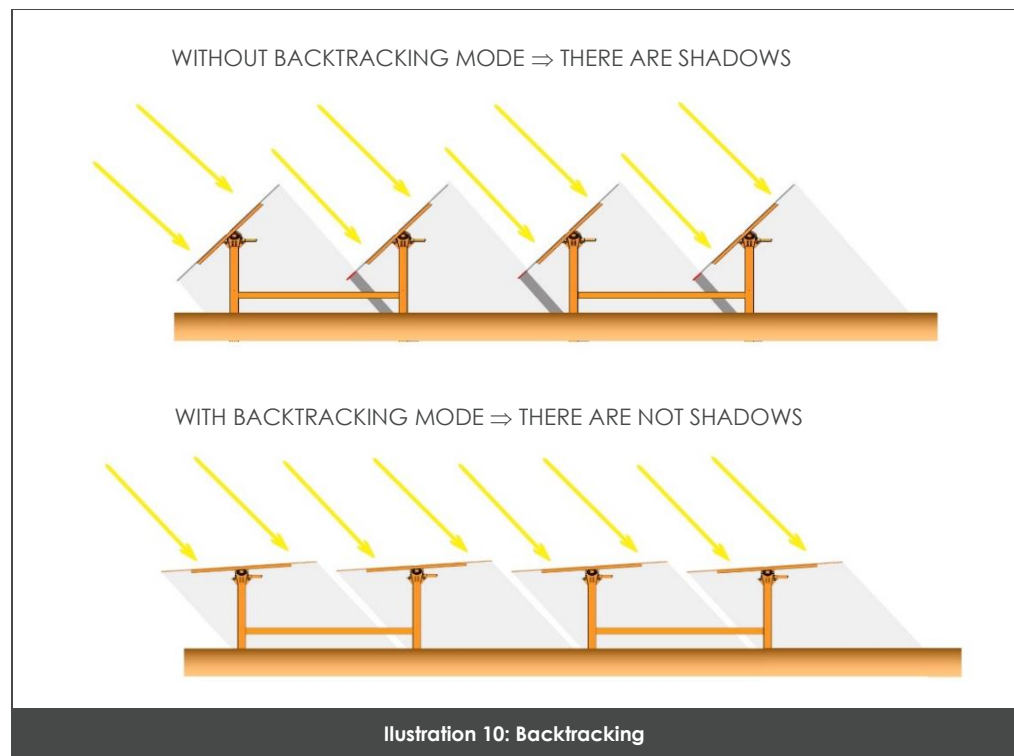
The tracker control system contains snow alarm to move the tracker in order to avoid overload by snow. NCU gets the snow level and the snow alarm from the RSU. Snow level measurement is set up to allows to the controller to activate the alarm. On this case, the tracker goes to stow Position but if the load is higher than 800 Pa, the tracker goes to maximum tracking angle ($\pm 60^\circ$). Once the snow level is decreased, the tracker returns to the initial position according tracking system.

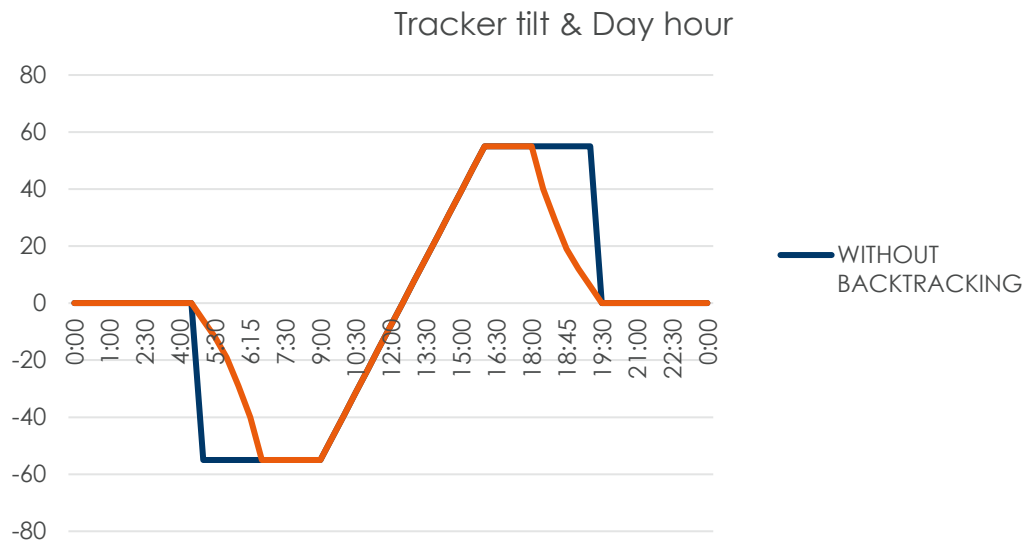


5.7. Backtracking

At sunrise and sunset, tracker controller determines the tilt angle which avoids the shadow among panels and therefore positions the tracker accordingly. The procedure assumes, and is specially useful, when losses due to a deviation angle are lower than losses due to a shadow in the panels.

Furthermore, If tracker is placed in an area with slopes, the tracker control system can be setup to manage the rotation angle about the Z axis tracker, the North-South (N-S) slope and two different East-West (E-W) slope.





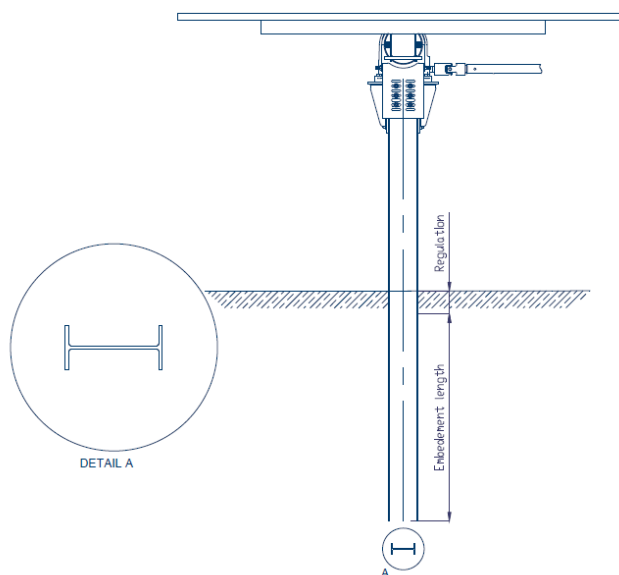
5.8. Foundation engineering

Depends on the terrain, at first is required a survey which indicates the ramming capacity of the terrain.

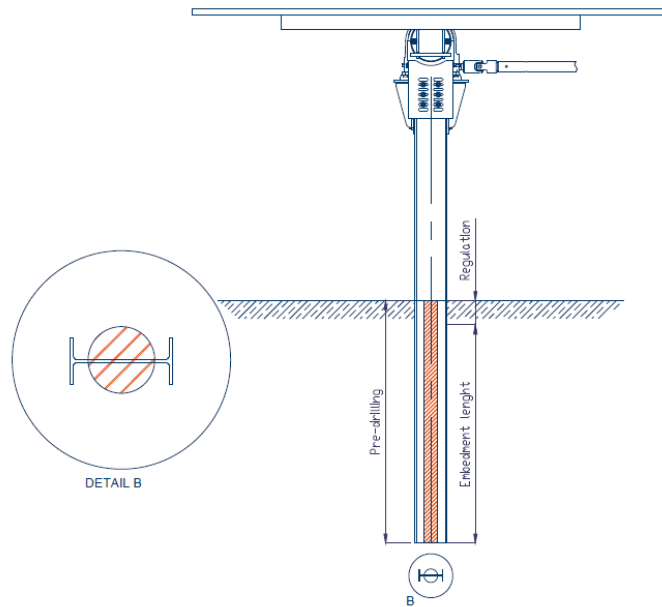
Prior to foundation supply, during the engineering phase, it will be carried out pull-out testing on site to verify the correct design of the foundation and/or the optimization of it.

The typical foundation used by Trina Tracker are:

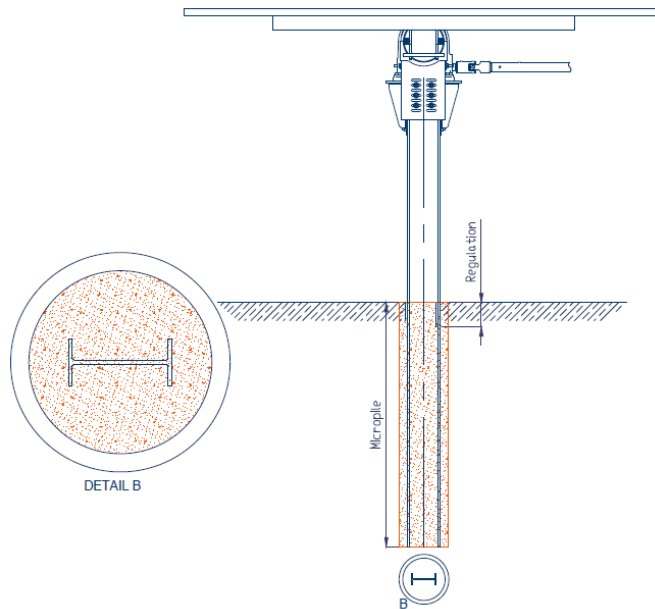
- Direct ramming



- Pre-drilling + Ramming



- Micropile



6 CERTIFICATIONS



ISO 9001

Quality management systems

ISO14001

Environmental management systems



UL 2703*

Standard for mounting systems, mounting devices, clamping/retention devices, and ground lugs

UL 3703*

Standard for solar trackers



EN 1090-1*

Execution of steel structures and aluminium structures



BANKABILITY*

Bankability report



IEC 62817*

Photovoltaic systems - Design qualification of solar trackers

* In progress