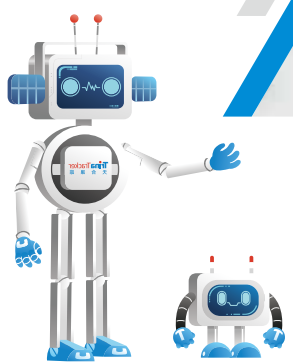
TrinaTracker

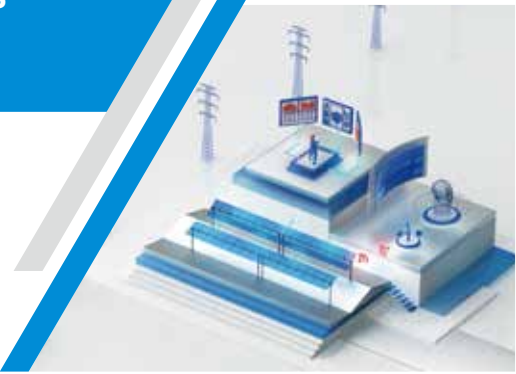
Add: No.2 Tianhe Road, Trina PV Industrial Park, New District, ChangZhou City, JiangSu Province
Email: sales_china@trinasolar.com

TrinaTracker

Boosting Power Beyond the Horizon

TrinaTracker Frequently Asked Questions (FAQ)





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Introduction

The solar tracker is a systematic structure involving engineering, structure, wind tunnel, communication, algorithm, service management, etc. Each part is interdisciplinary, systematic and independent at the same time. Therefore, it is difficult to gain a comprehensive knowledge of solar trackers. Recently, we have become aware that you have questions of different aspects and focuses, as well as some follow-up questions to existing ones. As a result, we put together your questions here in the form of an FAQ form to address your technical queries. TrinaTracker will continue to update the information every one to two quarters to grow together with our customers. Should you find any errors or omissions in this manual, please do not hesitate to provide your comments and corrections.

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Definition

IRR: Internal Rate Of Return

TCU: Tracker Control Unit

NCU: Network Control Unit

SCADA: Supervisory Control And Data Acquisition

DAF: Dynamic Amplification Factors

AC: Alternating Current

DC: Direct Current

STA: Smart Tracking Algorithm

SBA: Smart Back tracking Algorithm

HMI: Human Machine Interface

Definition

1. General questions about TrinaTracker

01 Q: Will the Tracker IRR better than fixed tilt' at present? What's the approximate ratio?

A: IIn general, trackers have a 5-25% higher rate of return than fixed tilt under equal circumstances. IRR is related to the energy yield in the first year and local electricity prices, and needs to be analyzed on a project-by-project basis.

02 Q: What are the bankability certificates of TrinaTracker?

A: TrinaTracker has been recognized twice in DNV-GL's technical validation report. Trina Solar has been rated as a brand with 100% bankability for six consecutive years by Bloomberg.

03 Q: How long has TrinaTracker been around and what are your core products?

A: TrinaTracker started with Trina Solar's acquisition of N-clave, a Spanish company founded back in 1961 as one of the earliest PV tracker R&D and manufacturing companies in the world. Currently our core products are flat single-axis solar trackers such as Vanguard-1P, Vanguard-2P, and Agile-1P.

04 Q: What are the technical and sales services provided by TrinaTracker and what are your distinctive capabilities?

A: 1. TrinaTracker has a strong technical team. The company has a R&D team in China and Spain. We also have teams for pre-sales, in-sales and delivery in Europe, Latin America, Asia Pacific, Middle East and Africa. The after-sales team responds around the clock and has established a comprehensive SCP after-sales service system. TrinaTracker is able to provide consistent services and quality based on Trina Solar's platform.

2. In terms of structure, TrinaTracker has the patented spherical bearing. In terms of control systems, Trina Solar has a self-developed control system, with TCU & NCU to control the tracker to adjust the operation status, as well as the self-developed intelligent algorithm to improve energy yield.

05 Q: Where are the main markets for TrinaTracker? What is the cumulative installed capacity? How are they distributed?

A: TrinaTracker's main markets are China, Latin America and Europe. We have also delivered a lot of projects in Asia Pacific, Middle East and North America, with a cumulative installation capacity of 8GW, all of which are solar trackers.

06 Q: What is the failure rate of core components of TrinaTracker? Are there any long-term statistics? How does it compare with competitors in the industry?

A: Because TrinaTracker products are being continuous upgraded, the failure rate of new products takes Jiangxi Power (tracking the data for one year) as an example. The failure rate of linear actuators is 3/10000, the failure rate of TCU is 0.0035%, and the motor and battery have not been detected any failure yet.

2. Questions related to Product Structure

Vanguard-1P

07 Q: How are the main aspects of reliability of Vanguard 1P?

A: 1. We work with top third party wind tunnel test labs for a full set of tests including aeroelasticity.

2. A targeted and optimized design for main structural components of solar trackers, as well as complete upgrade in their wind resistance. The bidirectional damper is able to reduce dynamic response and vibration amplitude, and increase the working wind speed by 20%.

3. Equipped with SCADA (Trina Smart Cloud) to effectively reduce the system failure rate and accurately identify the location of system failure for prompt risk elimination to ensure stable operation of the power station.

4. A full life cycle management concept for the product with strict quality control at all stages for the benefit of the customer.

08 Q: How are the main aspects of cost reduction and efficiency improvement measures of Vanguard 1P?

A: 1. First of all, Vanguard 1P has optimized structural design to reduce the average pile foundation consumption by 15%. Combined with TrinaTracker's patented spherical bearing and Trina clamp fast installation of large-size modules can be achieved, with 15% and 20% improvement in installation efficiency respectively, and installation quality issues caused by construction deviations can also be effectively minimized, which significantly reduces the construction cost for customers.

2. Secondly, Vanguard 1P, equipped with cleaning robots and TrinaTracker smart cloud platform, provides an intelligent operation and maintenance solution including remote monitoring, control, data acquisition, analysis and alarm functions, which can effectively improve O&M efficiency and reduce customers' O&M costs.

3. Finally, Vanguard 1P is equipped with SuperTrack smart tracking algorithm, which can further improve the customer's ROI by increasing energy gain by up to 8% as compared to traditional astronomical tracking.

09 Q: Different applicable scenarios of Vanguard 1P and 2P, whose LCOE is better?

A: With the increasing penetration of solar trackers, the application scenarios of trackers are also shifting from Gobi desert to mountain slopes, hills, and agricultural land. Different application scenarios have given rise to two different types of products, namely 1P and 2P.

Vanguard 2P has the best pile-saving ability on today's market and is suitable for challenging terrain conditions, with high piling and ramming costs, and is great for application scenarios including the combination of fishery/agricultural greenhouse and photovoltaic power generation.

Compared with 2P products, 1P products have better universality and maximized cost advantage on vast flat land (thanks to the length of the trackers).

10 Q: Terrain adaptability of Vanguard 1P

A: Vanguard 1P achieves an adaptation range of 15% in the east-west direction and 15% in the north-south direction.

11 Q: What is your take on longer trackers means stronger overall competitiveness?

A: 1. Regarding the length, the logic of multi-drive increasing the length is correct. But in terms of single drive, two strings are the most economical, as one string increases the motor cost and three strings increase the risk of motions for aeroelasticity and are not economical because the excessive torque cause the drive pile to be subject to higher bending moment, thus requiring a larger motor and a bigger main beam cross-section.

2. As for which is cheaper, it also depends on other optimizations, such as setting a suitable cross-sectional height which is very critical.

Questions related to Product Structure

12 Q: What kind of dampers do you use? How is the reliability?

A: We use a liquid linear viscous damper. It's designed to last 25 years. It has a hydraulic design & opening facing downward, resulting in lower impact from sand and wind to safeguard the internal structure.

13 Q: Will torque determine stability? Is the big R shape original?

A: Torque is a physical quantity. It is not directly related to stability. The large R angle is original, which is compatible with round and square tubes, and resistant to compression and torsion.

14 Q: How is the critical wind speed? How is the wind protection angle and wind speed? How is the pile spacing? How is the pile height?

A: According to different project conditions, the maximum critical wind speed can reach 55m/s, the wind protection angle is 30-60 degrees, the wind protection speed is 22m/s, and the column spacing is 9.2-9.6 meters. The column height is 1.2-1.5m.

15 Q: How does Vanguard 1P embody fast installation?

A: 1. For Vanguard 1P, fast installation is mainly realized through fast installation of spherical bearings and modules.

2. The spherical bearing is a global patent of TrinaTracker, which can improve the installation efficiency by 15% compared with the traditional cylindrical bearing system and can effectively avoid the common jamming issue when installing cylindrical bearings.

3. There are two installation methods for large-size modules. One is the more common clamping clip & screw preload installation, and the other is the innovative design of Trina Clamp for quick installation. Both approaches have their pros and cons and can be chosen according to project needs. The Trina clamp mounting components mainly consist of the upper connector, the lower support connector and a U-bolt, which require only two screws to be tightened per large assembly installation on average, saving half of the screw installation time and increasing the overall installation efficiency by 20%.

Core components

Bearing

16 Q: Service life of spherical bearing, what is the failure rate?

A: For 25 years, due to the new generation of products, according to the 1-year tracking record of Jiangxi Power, the current failure rate of spherical bearings is 0.

17 Q: What is the working principle of the bearing? What are the mainstream bearing types? What are the advantages of TrinaTracker bearings over competitors?

A: The purpose of the bearings is to enable the solar tracker to rotate. The mainstream bearings on the market are straight cylindrical, while TrinaTracker uses spherical bearings capable of reducing installation error, adapt to uneven terrains and structural stress problems caused by settlement, and address manual installation time and cost issues. while reducing the failure rate.

18 Q: Will the spherical bearing have clearance due to long-term dynamic wear, and what is the service life of the spherical bearing?

A: As we use POM and PA6.6 GF30 for our spherical bearings, they have good mechanical, lubrication and anti-UV performance. At the beginning of the design, the service life of spherical bearings is designed to be 25 years. We are preparing relevant tests and will issue reports after the test.

19 Q: How is the performance of TrinaTracker spherical bearing in preventing sand?

A: First of all, TrinaTracker uses polymer materials with good wear resistance for the bearings. In addition, Trina has performed corresponding life tests on the bearings for sandy and windy environments.

Questions related to Product Structure

20 Q: How is the performance of spherical bearings on the ground installation fault tolerance rate, and can it be quantified?

A: Trina's spherical bearings can mitigate the stress concentration brought by local settlement of the foundation by more than 70% according to finite element analysis; and has a 20% slope adaptability.

Post/Pile

21 Q: How many types of cross-sections of piles are there? What are the advantages and disadvantages of the various types?

A: There are C- and W-shaped pile cross-sections. C-shaped piles are lighter, saves material weight, and are used on Agile 1P. W-shaped piles are more robust and currently being used on Vanguard 2P and 1P.

22 Q: What are the piling methods of the piles? Which terrains are each suitable for, and what are their advantages and disadvantages?

A: Piling methods include hydrostatic direct ramming, pre-drill, and Micropile. Hydrostatic direct ramming is used for more suitable land and pre-drilling is used on hard land. And the use of specific method is related to soil texture, construction time (seasonal influence), accuracy requirements, and price.

Torque Tube

23 Q: What are the advantages and disadvantages of the various types of torque tubes?

A: The square tube has better bending resistance and the round tube has better torsion resistance.

24 Q: Does the increase in torque tube dimension have any effect on the shading?

A: The effect is pretty small as the torque tube only affects the backside irradiation of the module. Such effect can be mitigated by increasing module spacing and purlin height for 2P, and by increasing purlin height for 1P.

Drive system

25 Q: Parameters of the driving motor.

A: DC brush planetary reducer motor, rated voltage 24V, rated current not more than 6.5A, rated output torque 280Nm, output speed 1.5rpm.

26 Q: What is the failure rate of the driver, how our design to support the rate is lower than competitors?

A: The most simple and mature single-drive slewing driver is used for the drive system, with failure rate no more than 0.2%; experienced suppliers are selected. More than 20 physical tests including the service life test are performed for validation.

27 Q: Drive mode: What are the advantages and disadvantages of the slewing drive and the linear actuator?

A: Simple slewing drive structure. The linear actuator provides higher holding force.

28 Q: How to ensure the synchronization of multi-point drives?

A: Synchronization is ensured by mechanical linkage. As the linkage and the output shaft have a high reduction ratio, the slight synchronization of the linkage will not affect the module's rotation shaft.

29 Q: Motor - What are the oil requirements when changing? Is it convenient to change?

A: The motor is designed to meet 25 years of use. At least 5 years warranty. Easy motor replacement in half an hour with one person, no need oil.

30 Q: Which Angle sensor do we currently use for Angle detection?

A: Electronic inclinometer.

Wind tunnel test

31 Q: Why the wind tunnel test is necessary in tracker design?

A: Existing building load codes are not fully applicable to the structural design of solar trackers, which is dominated by torsional modes. The increase in the module size also increases the flexibility of the tracker's structure, making it more susceptible to damage due to wind-induced vibration effects. Therefore, wind tunnel tests are needed to determine the parameters in the design of solar tracker structure and to examine the aerodynamic stability of the tracker array under different influencing factors such as incoming flow conditions, tracking angles, and layouts.

32 Q: What is your evaluation of dynamic and aeroelastic effects and how to define coefficients

A: Dynamic effects have obvious amplification effect on the equivalent static wind load of flexible structures, and therefore cannot be ignored in the tracker's structural strength verification. Aeroelastic effects, such as flutter, vortex vibration, etc. may have destructive effects on the tracker's structure, and need to be suppressed or circumvented by certain methods and strategies. To sum up, both dynamic and aeroelastic effects have important impact in the structural design of solar trackers, and can pose a great challenge to tracker's safety, stability and economics.

How to define coefficient: Dynamic Amplification Factor (DAF): (average response + background response + resonance response) / (average response + background response)

33 Q: What is the impact of torsional stiffness on the trackers' stability?

A: An increase in structure torsional stiffness will increase the aeroelastic critical wind speed, thereby improving the wind stability of solar tracker. Therefore, in general, we need to ensure that the torque tube section of the solar tracker has a sufficiently large profile size and thickness. With a series of 120, 130, 150 and 170 torque tube designs, TrinaTracker allows a comprehensive optimization of safety and cost effectiveness in light of the existing wind and snow pressure conditions, of which safety is always the first priority.

34 Q: Which wind stow position strategy is adopted by 1P and 2P respectively? How long will it take them to return back to the stow angle? What are their strengths and weaknesses compared to their competitors?

A: Vanguard 1P is designed with a single-point drive mechanism. At 0°C, Vanguard 1P has a relatively low aeroelastic critical wind speed and adopts a large angle (30°-60°) stow strategy in general along with bilateral dampers. Vanguard 2P is designed with a multi-point drive mechanism with sufficient torsional stiffness. Vanguard 2P has a sufficiently high aeroelastic critical wind speed at any tilt angle, thus adopting a 0 degree stow strategy.

Vanguard 1P returns to the stow angle in no more than 7 minutes (-60° to 30°). And Vanguard 2P returns to the stow angle in no more than 5 minutes (55° to 0°). The wind resistance strategy adopted by Vanguard 1P is the best solution for single-drive products in the industry at present, minimizing the effects of flutter that has a destructive effect on the structure. It can effectively suppress vortex shedding and significantly improve the capacity of solar tracker to withstand a hurricane. Meanwhile, the large tilt angle stow strategy can reduce the load-bearing capacity requirements for the drive system on the one hand, and reduce the snow resistance design requirements for solar tracker on the other hand. However, the large tilt angle stow strategy has also set very high standards on the design of purlins and pole strength. Thanks to targeted design enhancements and systematic optimization, Vanguard 1P offers the best combination of low cost and high level of safety.

The 0° stow strategy adopted by Vanguard 2P can virtually eliminate the impact of horizontal lateral force on poles and foundation, and has obvious advantages for high solar trackers. However, the leveling strategy has intensified the requirements on torsional resistance design of the torque tube, and will result in big snow loads on the solar tracker.

35 Q: What are the test contents of the wind tunnel test?

A: The wind tunnel tests mainly include the rigid pressure test (for system coefficient, torque factor and DAF) and the full aeroelastic test (for critical instability wind speed).

Questions related to Product Structure

36 Q: Specific data for the wind tunnel test, what are the adjustments?

A: The wind tunnel data will be reflected in the product's calculation sheet, which is mainly used for the calculation of wind loads and wind torsion on structural components, and the verification of aeroelastic instability. Wind tunnel data, as the core information of the company, is generally not disclosed to the public.

37 Q: We need evidence that our tracker's design can overcome the harmonic oscillations caused by wind resistance

A: TrinaTracker works with two top wind tunnel test labs, CPP & RWDI. Wind tunnel tests were conducted for Agile 1P, Vanguard 1P and Vanguard 2P, covering single drive, multi-drive; 1P, 2P; single row, double row, etc. Therefore, TrinaTracker has accumulated considerable experience in wind engineering studies for solar trackers of various types, in-depth research into wind-induced vibration effects on trackers, and is capable of providing corresponding solutions to overcome the potential risks.

Take Vanguard 1P for example. It is a single-row single-drive 1P product with a length about 100m. There's a greater risk that Vanguard 10 degrees of protection will have a greater risk of flutter instability when stowed at 10 degree. That is why we set the stow angle at 30 degree when wind-induced vibration instability is mainly caused by vortex vibration. Adding the damper is a very effective way to suppress vortex vibration. Therefore, Vanguard 1P is designed with bidirectional dampers. The wind tunnel test results from CPP show that Vanguard 1P can reach a critical instability wind speed of up to 60m/s or more at the stow position, which is sufficient to meet the wind resistance requirements for trackers in most areas.

38 Q: How do you calculate the damping ratios?

A: The damping ratios were obtained through free vibration tests performed on site or by professional calculation and analysis. TrinaTracker, in collaboration with CPP and RWDI, conducted a professional evaluation on the damping ratio of Vanguard 1P and Vanguard 2P based on the results of comprehensive free vibration tests and theoretical analysis calculations.

39 Q: How are modules load tested? What is the maximum module size that our current product can fit?

A: Wind loads on modules can be quantified from wind tunnel tests, which are applicable to different module sizes. Load test shall be performed on modules. When used with purlins, matching test shall be performed on modules. At present, the product can be matched with the biggest 182mm and 210mm modules.

40 Q: What parameter has a largest impact on the tracker stability: DAF, damping, or frequencies?

A: What parameter has a largest impact on the tracker stability: DAF, damping, or frequencies?

DAF reflects the dynamic amplification effect of the wind load, but not the stability level of the structure. The aerodynamic stability of the solar tracker is mainly determined by damping, stiffness (frequency), and tile angle of modules. The solar tracker has relatively good stability at large angles. In this case, the aeroelasticity issue is mainly caused by vortex vibration and galloping vibration. An increase in structural damping can effectively suppress vortex vibration and improve aerodynamic stability. The solar tracker has relatively poor stability at 0° tilt angle. At this time, the aeroelastic instability issue is dominated by flutter. An increase in structural stiffness can improve stability, but a change in damping has little effect on it.

41 Q: For high wind/cyclonic zones (basic wind speed 30m/s, gusts: 50m/s) what is your view on using larger modules (such as 660w) in comparaison to modules of 540w?

A: Use of large-format modules will result in a bigger wind load on solar tracker structure and a higher tracker cost, but the overall cost effectiveness of the power station can be optimized. Whether to choose large-format modules or not shall be subject to the specific requirements of the customer and structural design calculations. During the design phase and in wind tunnel tests, TrinaTracker's tracker products have taken into consideration of the compatibility of large-format 210mm modules and can perfectly adapt to the extreme gust wind speed of 50m/s.

42 Q: Do you perform different tunnel tests to match different site characteristics, particularly for the ones with difficult and complex conditions?

A: Structural design based on the results of existing standard wind tunnel tests is sufficient to ensure the wind resistant safety of solar tracker system. The wind tunnel test for specific project sites is costly and time-consuming, and it is not practical to scale down thousands of arrays of trackers and perform wind tunnel tests on them. In case the project site has a very complex terrain, TrinaTracker can perform additional computational fluid dynamics simulation studies based on customer needs, but it will significantly increase the project cycle and cost.

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A: Wind loads on modules can be quantified from wind tunnel tests, which are applicable to different module sizes. Load test shall be performed on modules. When used with purlins, matching test shall be performed on modules. At present, the product can be matched with the biggest 182mm and 210mm modules.

44 Q: Have you tested the tracker stability in a real project to analyse the tracker behaviour under specific and real wind circumstances?

A: During the new product development phase, in addition to theoretical calculations and alpha testing, TrinaTracker will also arrange beta tests on a megawatt-level outdoor site, followed by long-term follow-up observations. A new product will only be used in Trina projects after it reaches its plateau phase for more than 6 months. Additionally, the satisfactory wind resistance performance of our solar tracker structure has been verified by the smooth operation of several existing projects after a long period of observation.

45 Q: How do you consider different terrains in the WTT?

A: A number of tilt angle tests and wind direction tests were performed on solar tracker arrays at different locations on a slope with an inclination of 15° to obtain additional topographic adjustment factors for wind loads.

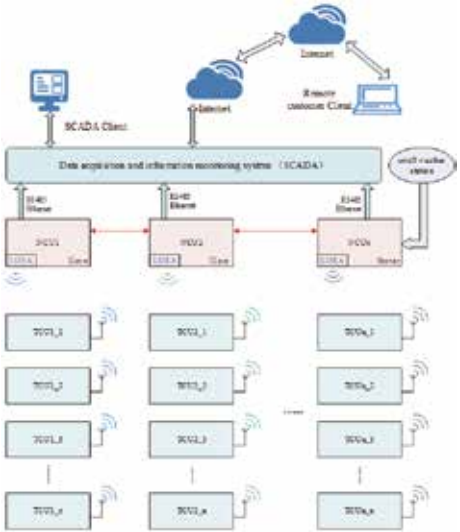
3. Smart control system and O&M system

Trina controller

46 Q: What is NCU and TCU relations and work flow, function?

A: The NCU communication controller is responsible for managing the TCU tracking controller and information interaction with the superior data management system.

The TCU controller is electrical equipment that controls the trackers to run according to certain rules to obtain the maximum electric output. The TCU controller is mainly composed of switching power supply, CPU, a motor drive, communication modules, an emergency stop switch and various protection circuits.



47 Q: TrinaTracker Communication type, mechanism and method.

A: The NCU communication controller is responsible for managing the TCU tracking controller and information interaction with the superior data management system. Communication between NCU and TCU ① RS485–wire ②ZigBee–wireless ③Lora–wireless.

48 Q: Does TrinaTracker controller have functions or performance significantly different from competitors?

A: 1. Low temperature battery, working temperature at -30 to 60.

2. Equipped with Trina's proprietary SuperTrack intelligent algorithm to reach a maximum energy gain of 3%-8%.

49 Q: What power supply modes does TrinaTracker support?

A: String-powered, self-powered and grid-powered.

50 Q: What are the advantages and disadvantages of different communication and their applicable scenario?

A: Communication through Lora can reach a maximum distance of 7 km, has strong interference rejection, low power consumption, while too many devices will cause spectrum interference. ZigBee can achieve ad-hoc networking, but has a lower transmission distance than LORA. RS485 has a stable communication but higher price and labor costs.

In terms of applicable scenarios, Lora is suitable for vast & flat terrains over long distances, ZigBee for uneven terrains, and wired RS485 for areas with low labor costs and special customer requirements.

51 Q: After the failure of NCU, can human intervention be made to adjust the Tracker to a certain fixed angle?

A: After NCU fails and TCU does not detect a communication command from the NCU within five minutes, the tracker will move to stow position. Tracker angle may be adjusted in manual mode if human intervention is required, but the limit angle will still be in place.

52 Q: What is the reaction time of various protection strategies? Do both TCU and NCU have batteries? What's the battery strategy?

A: If it's not specifically required by the customer, the reaction time of stow strategies is set based on Trina simulation and empirical research database, project location conditions, etc. and is generated in seconds, for instance 3s for wind protection reaction time. Reaction time can also be set according to the customer's requirements. TCU has battery and NCU does not. NCU usually uses AC power supply.

53 Q: Are the communication interfaces of TCU and NCU open? Can they be connected to inverters, or can they be interfered by human beings?

A: The NCU communication interface can be open to connect to the inverter, but this method is not used for acquiring inverter data.

54 Q: What is the recommended working voltage range of TrinaTracker controllers?

A: Power supply range for TCU with string-powered option: DC 250V-DC 1500V, DC 800V recommended. Power supply range for TCU with module-powered option: DC 0-55V.

55 Q: What is the connection mode for the AC powered TCU?

A: It gets power from grid, and also can get power from the inverter.

56 Q: What are the key steps of debugging the controller? What are the assessment indicators for the success of debugging?

A: Controller debugging includes: 1.TCU installation, NCU installation (including accessories and sensors) 2. debugging environment set up 3. use of the upper computer software

Successful controller debugging means: 1.The TCU itself is installed correctly and can be used to test upper computer software for operation in the manual mode. 2. Network communication with NCU is OK. NCU can obtain operation status of TCU. TCU can correct and execute the command issued by NCU.

57 Q: When one of the NCUs has failure with the subordinate TCU, what can we do?

A: Firstly, the NCU will try to connect TCU for 3 times, if over 3 times, will start to give alarm.

58 Q: How many TCU will the NCU connect?

A: The maximum number is 150, but the actual number according to different project. Different layout has different number.

59 Q: Is it possible for the next generation design to use IoT sensors to achieve predictive maintenance ... That is to say, warn customers of the impending failure of motors, TCU, etc. before the actual failure of components?

A: There is the motor monitoring functionality, which will be provided in the next version together with SuperTrack.

Smart Algorithm

60 Q: What is the quantitative impact of SuperTrack on the return on investment and electricity cost of Tracker system?

A: For every 1% increase in energy yield with SuperTrack, IRR improves by 0.2%. When IRR remains the same and power generation improves by 1%, the total project investment cost decreases by RMB 0.04/W.

61 Q: How does STA distinguish between typical cloudy days and 15-minute cloudy days?

A: Based on the ratio between direct and & diffuse irradiation, as the proportion of direct irradiation on an overcast day is very low to even no direct irradiation; but on a cloudy day the ratio of direct irradiation is relatively low at about 20%.

62 Q: Is the smart tracking controller already available for the market now?

A: Yes.

63 Q: Can you explain in detail why STA can reduce the number of Tracker rotations?

A: Under typical overcast conditions, based on the Trina's bifacial irradiation model, STA will keep trackers at a small angle to obtain more diffuse irradiation, which both improves power generation in high diffuse irradiation weather and reduces the number of tracker rotations compared to traditional astronomical algorithms.

64 Q: How does SuperTrack judge whether there is shadow and how does it adjust to the certain angle?

A: SuperTrack is a backtracking optimization solution with self-sensing, self-training, self-decision-making capabilities. Self-sensing is the identification of tracker shading based on sensor devices and system operation data. Then self-training enables the optimization of tracker's tracking angle. Finally, the backtracking angle group is obtained through self-decision-making. Usually shading can be avoided by reducing the angle of the shaded tracker. However, in some scenarios, reducing tracker angle until shading disappears may not be the optimal adjustment. The patented "micro-shading" model takes into account the irradiation loss and power generation loss corresponding to each possible adjustment angle, and determines the optimal output angle for energy yield through sophisticated calculation.

65 Q: What are the procedures for the configuration of SuperTrack? Please include the input parameters.

A: SuperTrack integrated in the control system and the SuperTrack platform. Main input parameters include project location information (latitude and longitude), irradiation information, inverter power generation information, basic array information (array spacing, array height, module size), etc.

66 Q: What is the difference between the bi-facial module tracker angle and the single module tracker angle?

A: The biggest advantage of bifacial modules is power generation from backside of the module. In general scenarios, e.g. with 0.2 ground reflection rate, and 0.7 bifacial rate, the optimized angle of bifacial modules will not have much difference with mono-facial modules, as power generation from backside of the module is very low. However, as the ground reflection and bifacial rate increase, the share of energy yield from backside of the module becomes higher, when there will be a difference of tracker angle between bifacial modules and mono-facial modules. Therefore, we need to take into account the overall radiation from the front and back side of the modules to determine the best tracker angle for optimal energy yield.

67 Q: In the debugging stage, what is the difference between SuperTrack and traditional algorithms? How to get the data of debugging stage?

A: SuperTrack has added more tasks in addition to traditional algorithm debugging steps, such as irradiator debugging, debugging of energy yield data access to the SuperTrack platform, etc. The SuperTrack platform can display meteorological data, tracker operation data, etc.

68 Q: At present, horizontal single-axis trackers are basically configured in the north-south direction. In the northern hemisphere, if there will be a situation of high in the south and low in the north, does SuperTrack intelligent tracking technology have this consideration?

A: SuperTrack's Smart Backtracking Algorithm (SBA) reduces the loss of energy yield caused by shading and improves power generation by tracking angle optimization for shading caused by east-west terrain difference. In areas where the south side is higher than the north side, the shadow caused by shading is slanted, thus SBA will further optimize topography of high south and low north causes the shading to be skewed, and SBA will further optimize the algorithm to ensure the maximum output of PV strings.

69 Q: Can SuperTrack still play a role in multi-row trackers? How to achieve angle optimization?

A: SuperTrack is still effective for multi-row trackers to increase energy yield. For example, in high diffuse weather conditions, the STA algorithm will adjust all multi-row trackers to a small angle to receive more diffused irradiation and improve power generation. Usually multi-row trackers are used on flat terrains and the SBA algorithm will uniformly fine-tune the backtracking angle during the backtracking stage, to balance shading loss and reduce to inverse the tracking angle, balance the shading loss and reduce the angular irradiation loss through the micro-shading model, and finally provide an optimal backtracking angle for overall energy yield.

70 Q: How can SuperTrack and traditional algorithms benchmark the power generation gain in a power station configuration? Do you need to install trackers for some conventional algorithms?

A: There is no need to install traditional algorithm trackers. You just need to switch off SuperTrack Smart Algorithm for appropriate tracker arrays. Solar trackers will rotate based on the traditional astronomical algorithm after SuperTrack is switched off, to be used as a benchmark for power generation comparison.

71 Q: Is SuperTrack suitable for water surface PV projects?

A: Yes. SuperTrack is used along with solar trackers, it is suitable for any projects where solar trackers can be used.

72 Q: What sensors are applied in STA and SBA phases respectively?

A: SuperTrack recommends making full use of the power station's generation data to optimize tracking angles and reduce sensor usage. If power generation data is not available from some power stations for some reasons, irradiator can be used to determine weather conditions in the STA phase, and drones can be used in the SBA phase to determine shading conditions.

73 Q: Can SuperTrack's power generation forecast be simulated by PVsyst? If not, what simulation software can be used?

A: The SEB (SuperTrack Energy Boost Simulation Software), developed by TrinaTracker is complemented/refined and modified for PVsyst to simulate the SuperTrack power boost, including the pure cloudy day scattering gain. And the back tracking optimization of uneven terrain.

74 Q: How much empirical data does SuperTrack have and how much is verified by the third party?

A: Currently, SuperTrack technology has been applied at the Tongchuan 30MW mountain project (May 2020-present), the Changzhou empirical study site (2020-present), and the Nangong 400MW project (June 2021-present), among which the Tongchuan empirical study project has been running continuously for one year (September 2020-August 2021), with results showing a 3.06% increase in power generation from the smart algorithm array. CGC has monitored the entire empirical project and authoritatively appraised the accuracy and validity of the data, fully recognizing SuperTrack's advancement and reliability.

Trina Smart Cloud

75 Q: What are the functions of SCADA developed by TrinaTracker?

A: Trina Smart Cloud tracker side monitoring platform integrates real-time monitoring, fault alarm, precise control, meteorological data sharing, log data recording, and data forwarding functions, enabling the power station to reduce cost and increase efficiency. In particular, the meteorological data sharing function can effectively reduce the number of meteorological sensors, realize the sharing of key data between NCUs, improve the reliability of the tracker, and avoid the loss of power generation caused by the occasional failure of a sensor. In the process of sensor O&M, the tracker can track normally to reduce the loss of power generation.

76 Q: What are the basic hardware and software configurations included in Trina Smart Cloud?

A: Trina Smart Cloud provides PC computer server, and related display, keyboard, mouse and other accessories; And provide a set of software monitoring platform interface, can be displayed in detail: Power plant information, NCU digital map information & NCU, TCU digital maps, NCU details, intelligent automatic protection switching algorithm & heavy snow, TCU parameters, TCU work mode & group control, TCU work mode & single control, equipment state statistics & alarm information, alarm list, submatrix level availability, full Power Station level availability, real-time irradiation and wind speed, Target Angle & actual Angle, etc.

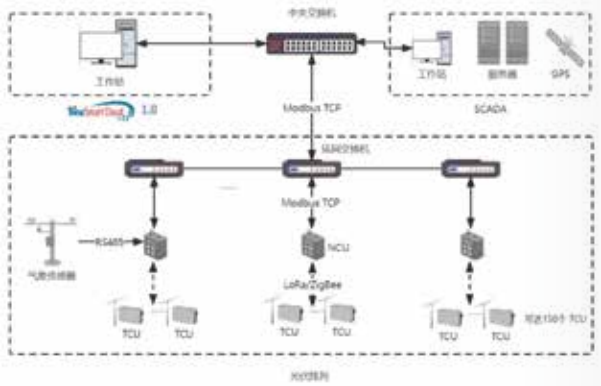
77 Q: Is the current SCADA capable of remote control? How is it done technically?

A: This feature is currently under development and is expected to be available for remote monitoring and control in the year 2023-Q1. In the case of abnormal tracker operation, operation maintenance personnel can receive abnormal status alert from the remote HMI interface. Trina Smart Cloud will send remote control instructions to tracker NCU in time to adjust the individual tracker TCU operation mode, and promptly adjust the tracker angle to the target position, achieving remote and precise control of the power station.

78 Q: How does Trina Smart Cloud address cybersecurity issues to ensure its security?

A: Cyber security can be protected using isolated firewall devices; and data encryption through vertical encryption devices, to ensure security of all the data storage and transfer throughout the entire power station.

79 **Q: What is the network architecture of Trina Smart Cloud?**



80 **Q: What is the deployment process of Trina Smart Cloud? How many man-hours for 100MW?**

A: From pre-project survey, demand analysis, system design, hardware procurement to final deployment and commissioning. Trina Smart Cloud is pre-configured at the factory, and the software is tested and pre-installed for fast onsite installation and debugging.

For example, for a 100MW project, the working hours for on-site hardware installation and software testing are calculated at 45 days per person.

Survey	Analysis	Design	Develop	Commissioning
• Pre-project survey • Field exploration	• Customer demand analysis • Project data collection	• Syatem design and configuration • Hardware and software architecture, functional models, algorithm logic	• Hardware procurement • Pre-configured • Test and pre-inatalled software	• Installation and commissioning onsite