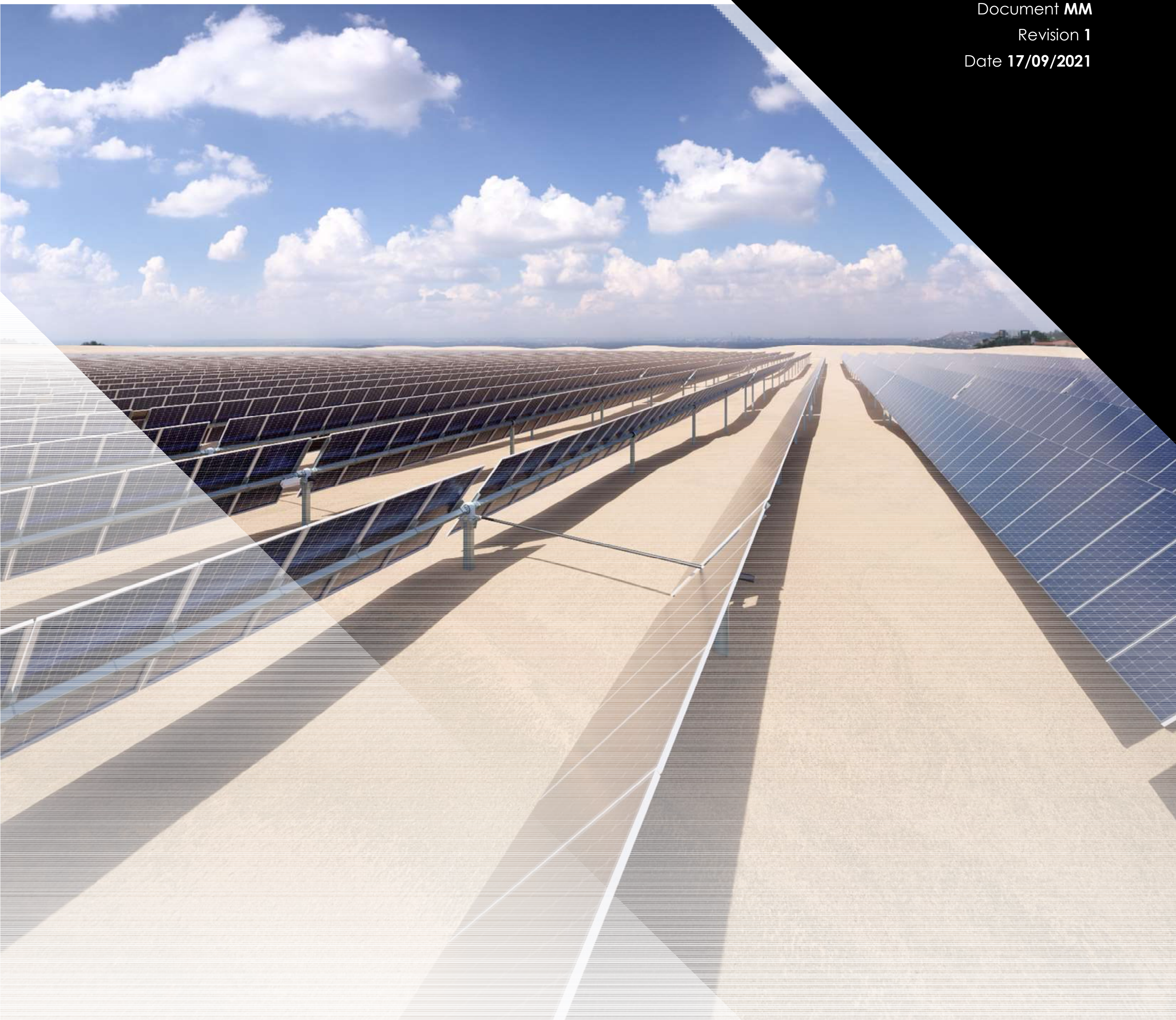
PRODUCT SPECIFICATION

Document **MM**
Revision **1**
Date **17/09/2021**



Maintenance Manual

Agile 1P

STANDARD MANUAL

ENGINEERING DEPARTMENT

REVISION CONTROL

REV	DATE (dd/mm/yy)	DESCRIPTION	ELABORATED	REVISED	APPROVED
1	23/07/21	INITIAL DOCUMENT	ILZ	 LGA	
2	17/09/21	- Update of torque values - Update of tolerances range	AVF	LGA	AGT

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1 PREVENTIVE MAINTENANCE

The AGILE 1P bi-row tracker has been designed to reduce maintenance work to a minimum. Nonetheless, to ensure the correct operation and durability of the tracker, implement and record the following works on a regular basis (see Maintenance Checklist below):

Date: **Responsible person signature:** **Client:**

Activity	*Estimated time*	*Frequency*	*Tracker reg. (1)*	*Tracker reg. (2)*	*Tracker reg. (3)*	*Tracker reg. (4)*
1.1 Tightening torque	**10 min**	**Yearly**				
1.2 Check electrical and communication connection	**Annex I**					
1.3 Check posts heads	**2 min**	**Yearly**				
1.4 Inspection of galvanizing and structure	**10 min**	**Yearly**				
1.5 Check bearings	**5 min**	**Yearly**				
1.6 Check operational parameters	**10 min**	**Yearly**				
1.7 Slewing Drive Revision	**Annex II**					

(*) Time experessed in min/tracker

1.1. Verify tightening torques

Check that the tracker bolts are fastened correctly annually.

Admissible tolerances:

- Rigid joints tightening torque tolerances must be ±10%
- Noncontact joints without contact tightening torque tolerances must be +0/-10%

TrinaTracker reserves the right to modify the tolerance values described in this document.

If the tightening torque is not within the specified tolerances, adjust the tightening torques in accordance with the table below.

REFERENCE	Tightening Torque (Nm/ft. lb.) Quality 8.8	
	Quality 8.8	Quality 10.9
M4 (purlin & module joint for grounding and bonding) **/ If applies**	4 / 2.9	
M6 (purlin joint & modules) and (comm antenna)	(*) 10 / 7.3	
M8 (purlin joint & modules)	(*) 12 / 8.9	
M6 / M8 / M10 (Fixing TCU to the Tracker)	(**)	
M10 (screwed joint for **TRINA CLAMP**	25 / 18.4	
M10 (screwed joint for purlin-tube with **2 BOLTS**	30 / 22	
M10 (contactless joints between surfaces (Transmission Bar Joint))	20 / 14.7	
M12 (rigid joints)	77 / 57	
M12 (plastic joints)	40 / 29.5	
M16 (rigid joints)	190 / 140	250/185
M20 (rigid joints)	420/310	

(*) Subject to change depending on the modules manufacturer requirements.
(**) According to TCU model for each project

N.B. Consider the type of joint when searching for the correct tightening torque:

- Contact joints: are joints where the pieces are in contact, or the separation between them is so small that when tightened to the correct torque they are totally in contact.
- Noncontact joints: are joints where the pieces are not in contact after tightening to the correct torque. If they have been tightened excessively and as a result make contact they could break or deform.

Initial pre-tensioning strengths might be reduced due to possible variations in temperature, internal stress, friction or the effect of non-rigid elements between joints.

Procedure for bolt tightening:

1. Pre-tighten the bolts to 75% of the torque level in accordance with the tightening torque table above. Tighten the bolts crosswise starting with one of the top bolts. Tighten mechanically (with a torque wrench) or manually, in both cases use calibrated impact head tools to prevent erosion of the bolt head. Replace the tool head if damage is detected on the edges of the bolt.
2. Final tightening: Use a calibrated and certified torque wrench to apply the specified tightening torque within tolerances as specified in the table above. Once the torque is applied it is mandatory to mark the bolt(s) tightened with a permanent marker.

Do not proceed to step 2 until step 1 has been applied to all the bolts in the joint. Bear in mind, symmetrical joints have their own specific tightening sequence.

1.2. Check electrical and communication connections

Perform preventive equipment maintenance one year after its installation, and then every three years thereafter.

Maintenance check list:

- Check that all the mechanical connections of the TCU are adequately adjusted, if they are not, tighten with the appropriate tools. The specific connections may differ from one project to another (for instance, externally powered Vs Self-powered and/or different control suppliers):
  - Auxiliary module for battery charging
  - Tracker control box
  - Network communication box
  - Sensors
  - Panel connection and cleaning (self-power model)
- Check the performance and visual aspect of the TCU, there should not be any signs of corrosion or damage.
- Simulate abnormal behaviour such as wind, axle lock, etc. and verify that the alarms activate as expected

TCU maintenance shall only be performed by trained and qualified personnel.

ⓘ **For further details see Annex I in this document**

1.3. Post heads within design tolerances

Due to soil settlement it must be checked that the posts heads are within the design tolerances. If necessary, carry out the adjustment on the bearing support keep bearing within tolerances. Please refer to Assembly Manual values.

1.4. Inspection of galvanized and hardware

Check for any evidence of rust or corrosion annually.

If a component has rust, repair it immediately in order to prevent further rusting. To repair rusted areas, follow the following instructions:

- Eliminate the rust particles
- Apply zinc-rich paint to protect the surface.
- Check all parts and members for damages especially the most exposed areas, such as
- The upper side of the piles where the bounding straps are fixed.
- Large parts and members that are at greater risk of being bumped or scratched.
- Dents or scratches produced during transportation.
- Bolt coating damage due to assembly or maintenance works (tightening torque).

Verify to the greatest extent possible the most exposed areas of the installation such as:

- The upper side of the posts due to the driving works.
- Large part due to the possibility of them being knocked or scratched.
- Knocks or scratches produced by the transport elements used in each project.
- Bolt heads, nuts and threads coating damaged due to assembly works (tightening torque).

1.5. Plastic Bearing inspection

Check the plastic bearing annually.

Visually check the status of the plastic components of the bearing that allow rotation of the different rows.

If there are cracks and / or excessive wear or misalignment, proceed to replace the affected components.

1.6. Operational parameters

Check the operational parameters annually.

The procedures to check the following parameters are:

1.6.1. TCU Tilt angle calibration test

Check the tilt angle using a digital level on the face of the module, see figure below,. Take the measurement from the module closest to the drive unit.

Next, compare the value of the digital level with the value given by the control handy (only for TCU SS) or the application. The value reading difference tolerance is ±1 degree (for TCU SS or ST) and ±1.256 degrees (for TCU SP).

If the difference in values between the digital level and the TCU is greater than the specified tolerance, proceed to adjust the inclinometer following the *step Inclinometer angle adjustment* in the commissioning manual.

Illustration 1: Piledriving works

1.6.2.Anemometer signal

Check the correct operation of the different wind alarms and the thresholds specified on each project:

- Low wind
- Average wind
- High wind

Perform a wind simulation by triggering the wind sensor, check that all the trackers move to the specified position for each alarm.

Check that when the wind alarm is activated that the automatic tracking mode stops for programmed 10 minutes. If the wind alarm is activated again within this stop period, the 10 minutes timer will restart from the beginning.

1.6.3.Backtracking

Verify backtracking parameters by visually inspecting the adjacent tracker shadows.

1.6.4.UTC Time synchronization

Review and synchronize depending on the TCU type supplied at each plant:

- Manual Method: Using the control display.
- Scada: If there is a communication line.

All trackers must remain on the same UTC time to ensure movement synchronization.

Verify that the following information is updated and has not been altered:

- Date
- UTC time

If the trackers have different times to one another, resynchronize all trackers to UTC time.

- Check date and UTC time and replace if it´s necessary.

1.7. Check of slewing drive

Points to check:

3. Absence of structural damage, due to deformed, cracked or broken components.
4. Absence of grease leaks.
5. Presence of grease / degreasing plugs.

6. The connecting screws between the gearmotor and the worm gearbox are tight and no free play is found.
7. See Annex III in this document

Actuator maintenance details refer to Annex II of this document.

1.8. Battery maintenance for self powered trackers

1.8.1. Battery life preservation

The state of health (SoH) of batteries depends on the charge/discharge cycle amount and the charge/discharge depth (DoD). Deep charges and discharges can reduce battery life, so the tracker´s TCU tries to maintain an intermediate state of charge (SoC). The best state of charge region for this type of battery depends on the TCU model used 30%-75% (TCU SP) or 35%-80% (TCU SS). The TCU is programmed to maintain the state of charge (SoC):

- It stops the charging process if the upper limit is reached with some exceptions: when the system is first installed, the battery must be charged to 100% so that the measurement of its state of charge (SoC) is adjusted. This operation shall be repeated periodically.

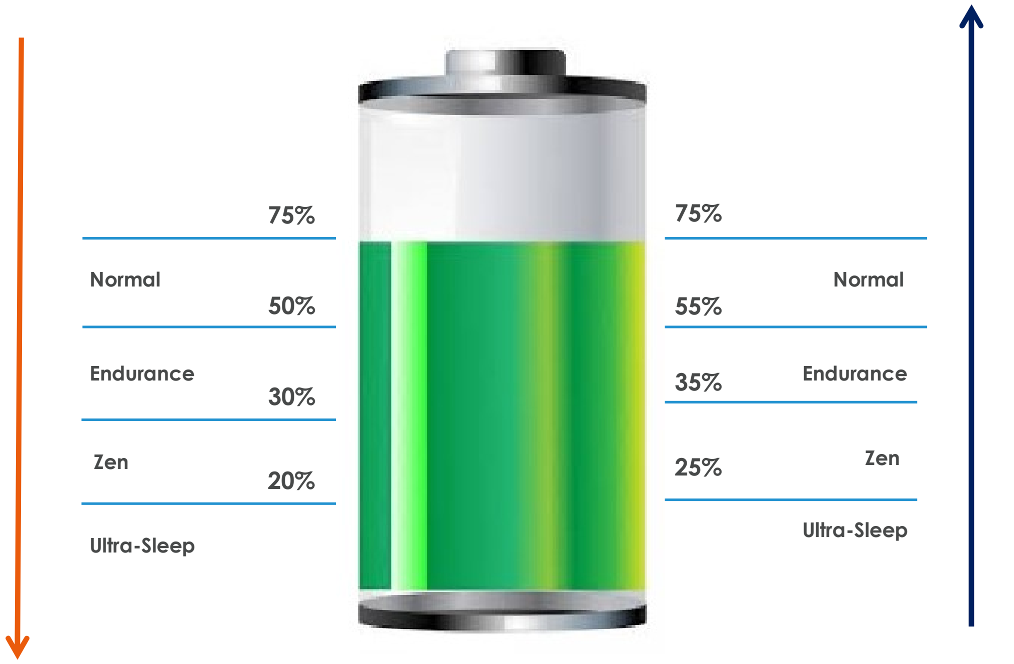
- It moves the tracker to the stow position when it detects that the state of charge (SoC) is not enough to keep operating in the recommended range. Once the tracker is stowed the TCU reduces the battery consumption by turning off the system.

1.8.2. Power modes

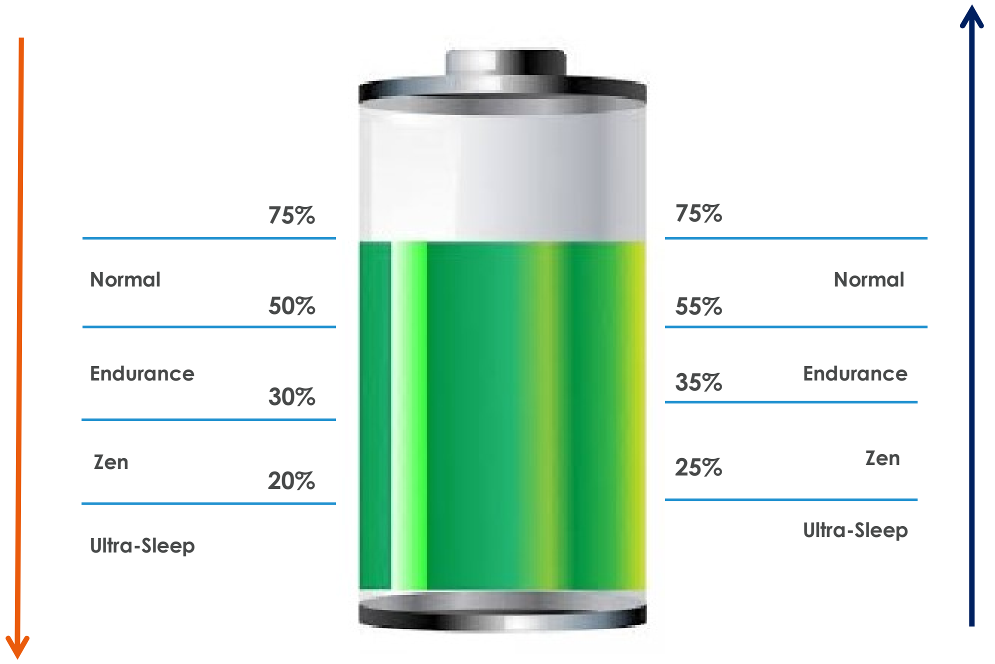
1.8.2.1. TCU SP

The system operates in 4 different power modes depending on the battery's state of charge (SoC). Some of these modes involve stowing the tracker. However, when the TCU is being controlled manually, with the West/East buttons on the TCU interface or a connected computer, the requests to stow and power reduction procedures are ignored, therefore the user is responsible if the battery is discharged.

⚠ **If manual control is active the battery could discharge as stow commands and power reduction procedures are deactivated. Remember to change the mode back to automated settings after finishing with manual operations.**



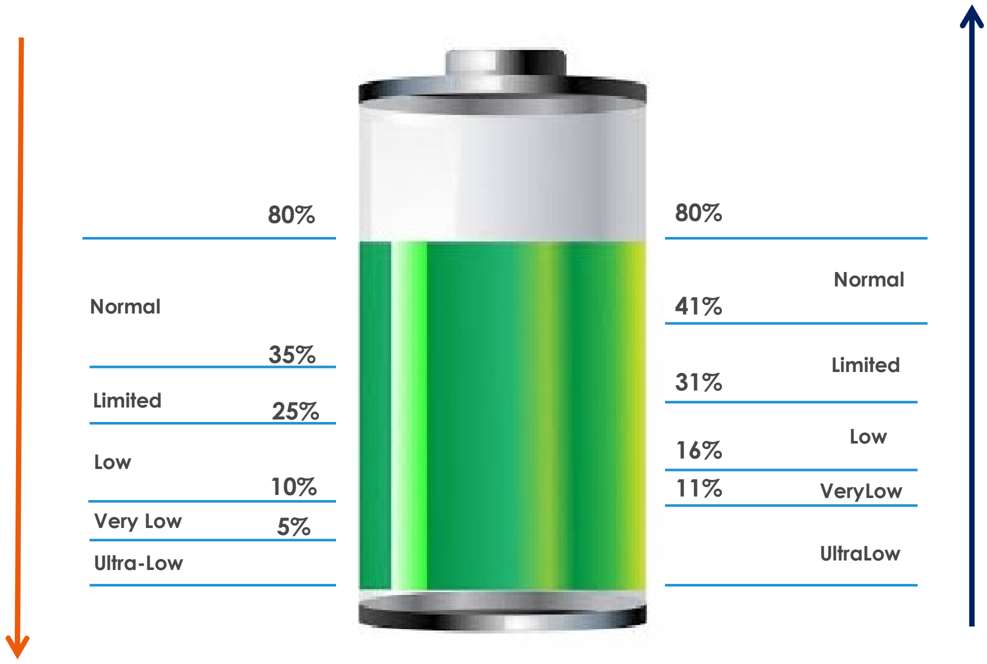
NORMAL OPERATION (POWER MODE 3)	The system does not reduce power consumption. It keeps moving as usual. It monitors the state of charge (SoC) to detect if it needs to change the power mode.
ENDURANCE (POWER MODE 2)	When charge reaches 50% the TCU enters Endurance power mode. It keeps operating in a similar way to the normal operation power mode, but it tries to reduce motor starting, as it uses a different dead band. This dead band must be configured to a wider value than the one used for normal operation. In this mode it can also decide to stow the tracker if it detects that the charge is not enough to ensure the minimal value of 40%. This means that it needs to estimate how much charge it needs to go back to stow position and take the decisions to stow when charge is 40%+estimated charge to stow to ensure that, once the system is stowed, charge will still be above or equal to 40%. The system changes the operation mode back to normal operation when the charge is above 55%.



ZEN (POWER MODE 1	When charge reaches 40% the TCU enters Zen power mode. In this mode the tracker keeps stowed or it stows if it was not already stowed. The TCU turns off the system, and it periodically turns it on, to maintain communication, and to verify if the operation mode should be modified due to changes in power levels. The system changes operation mode back to endurance operation when charge is above 45%.
ULTRA-SLEEP (POWER MODE 0)	When charge reaches 20% the TCU enters Ultra- Sleep power mode. In this mode the tracker keeps stowed or it stows if it was not already stowed. The TCU turns off the system, and it only turns it on if an increase in battery voltage is detected. If the charge is still too low, it turns the system off again and waits for an increase of voltage. The system changes operation mode back to Zen operation when charge is above 25%.

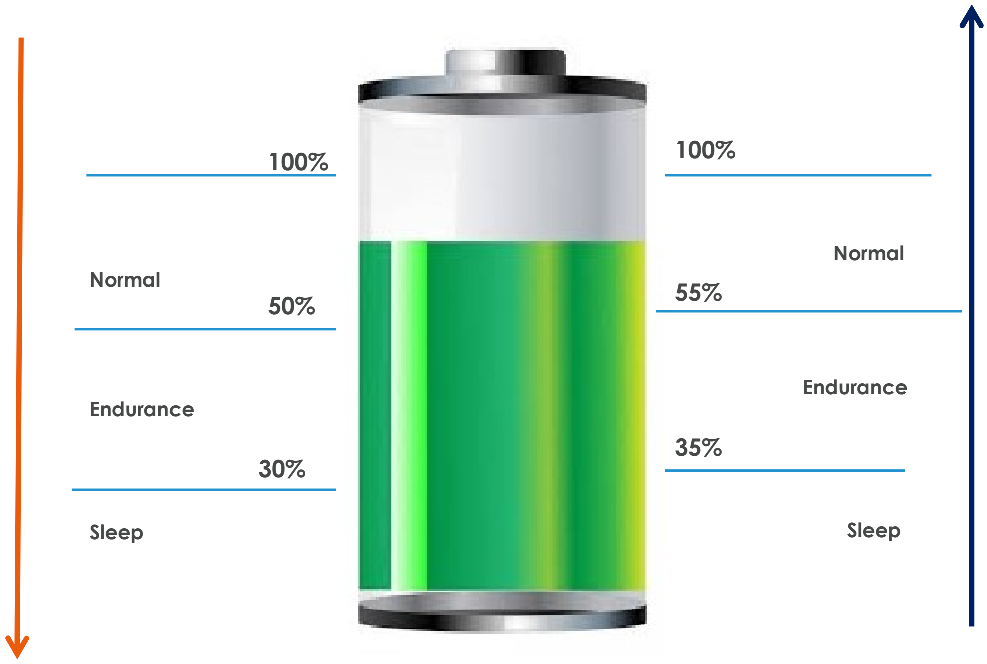
1.8.2.2. TCU SS

All automatic mode states of the TCU are subject to the energy level available, taking into account both, energy generated by PV panels and the energy stored in the battery. If the available energy is limited, the system will reduce tracker functions until the charge level is high enough for optimal operation.



NORMAL STATE	Normal functioning for all operating modes.
Limited energy	Tracking with inclination limit of 15º.
Low energy 1	The tracker moves to the stow position with the rotation speed limited, in order to save energy. All control and supervision functions remain active in the TCU.
VERY LOW ENERGY	CU functions limited. Only PV panel energy management and battery charge remain active
ULTRA LOW ENERGY	System hibernates. Battery disconnected to preserve its integrity

1.8.2.3. TCU ST



NORMAL	The battery has sufficient power and can work normally. TCU moves according to the set Angle, and monitors the charging status to detect whether the power mode needs to be changed.
ENDURANCE	When the power reaches 50%, TCU enters the power saving mode. This mode indicates that the power of the device is limited. Limit the TCU's maximum rotation Angle to allow enough margin for the tracker to return to a safe position. When the c harge is only 30%, the TCU will return to a safe position. When the charge is higher than 55%, TCU will return the operation mode to the normal mode.
SLEEP	When the battery reaches 30%, the TCU will go into sleep mode. In this mode, the TCU will run to a safe position and wait for the power to increase. When the power is higher than 35%, TCU changes the operation mode back to the power saving mode.

As with the available energy, all automatic mode states of the TCU are subject to the temperature registered by the system. The presence of extreme temperatures, both high and low, negatively affect the battery life.

The controller manages the following temperature limitation states:

- High temperature discharge:

  Battery energy consumption at high temperatures can reduce the battery life. In order to avoid this, the controller limits the tracker rotation speed to reduce power consumption until the temperature level decreases and reaches normal values.

- Low temperature discharge:

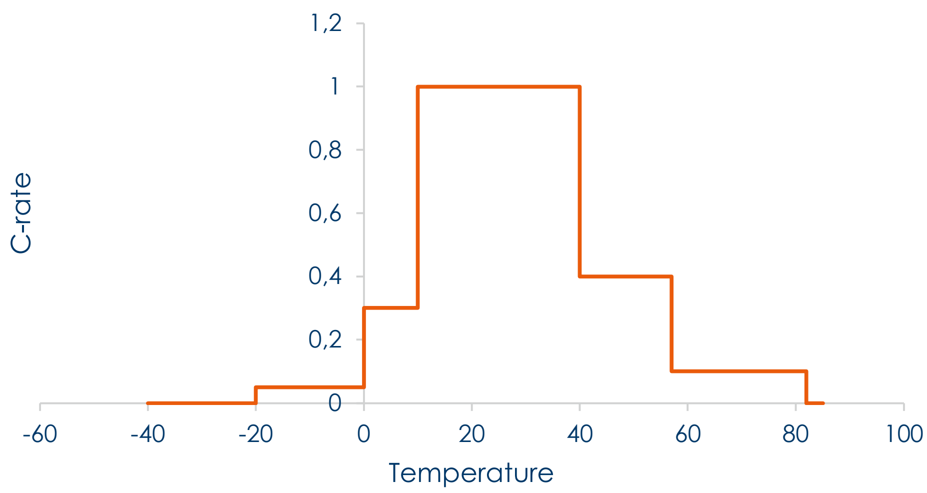
  Battery energy consumption at low temperatures can reduce the battery life. In order to avoid this, the controller limits both the tracker rotation speed and also the maximum inclination to reduce power consumption, until the temperature level increases and reaches normal values.

1.8.3.TEMPERATURE DEPENDENt OPERATION

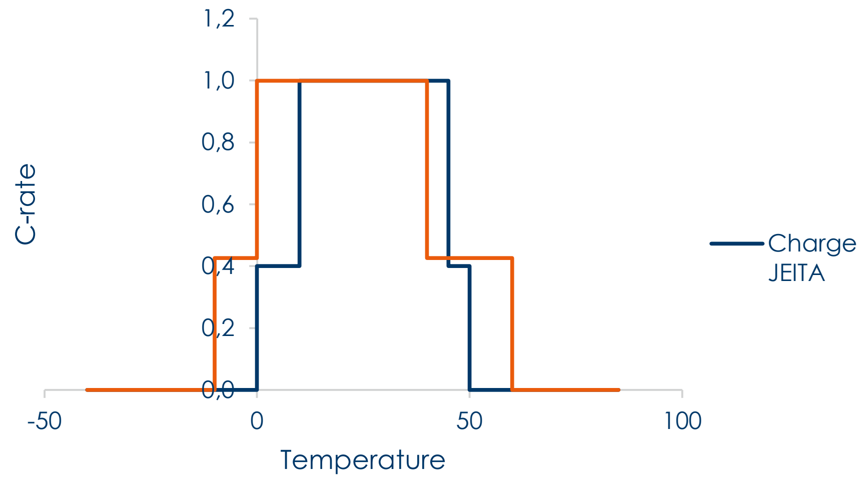
The Self-Powered tracker TCU variant offers temperature dependent current drain and charging current limitations. This allows installations to function correctly in harsh environmental conditions.

The configurable software has temperature pre-sets available to make the device JEITA compliant. As a result, batteries will continue to work efficiently even in suboptimal temperatures.

1.8.3.1. TCU SP



1.8.3.2. TCU SS



1.8.4.Battery life expectancy

Estimated battery life expectancy based on testing:

1.8.4.1. TCU SP

DoD	#of cycles at 0.2 C	# of cycles at 1C
100%	1000	800
80%	1200	1000
50%	2500	2000
20%	5000	4000

1.8.4.2. TCU SS

DoD	#of cycles at 0.2 C	# of cycles at 1C
100%	1000	800

The cycles are the number of times that the battery is discharged at the DoD level, not necessarily the number of motor cycles.

The client will have to estimate the number of discharge cycles that may occur over the lifetime.

This is determined by the number of cloudy days, cold days etc... In other words, unless there are 2 or 3 cloudy days in a row, the battery will not discharge to 20%.

This increases the number of motor cycles available over the life time of the battery.

2 EMERGENCY MAINTENANCE

In cases of acts of god or accidental damage:

- Check that the tightening torques are correct. If necessary, correct the tightening torques to avoid any future damage to the tracker. Please refer to *1.1 TIGHTENING TORQUE*
- Check the foundations to verify correct alignment and performance of the tracker. If there is any misalignment please refer to *1.5 BEARING SUPPORTS PLASTIC*.
- A general inspection must be performed on the joints, and if there is damage to any structural element, replace them with new parts. Please refer to *1.6 OPERATIONAL PARAMETER, 1.4. GALVANIZED PROTECTION INSPECTION, 1.6. OPERATIONAL PARAMETERS* and *1.7. INSPECTION SLEWING DRIVE*

ANNEX1: TCU MANTEINANCE MANUAL

ANNEX 2: DRIVE SYSTEM MANTEINANCE MANUAL