

10.12.2019 | **A Tracker
Stable as a fixed tilt**

Agenda

1. Introduction
2. Technical Challenge
3. Product Development Targets
4. Technical Solutions
5. Product Features
6. Control System
7. Field Applications
8. Planning and Design
9. Summary / Discussion

1. Introduction

Former Schletter Activities

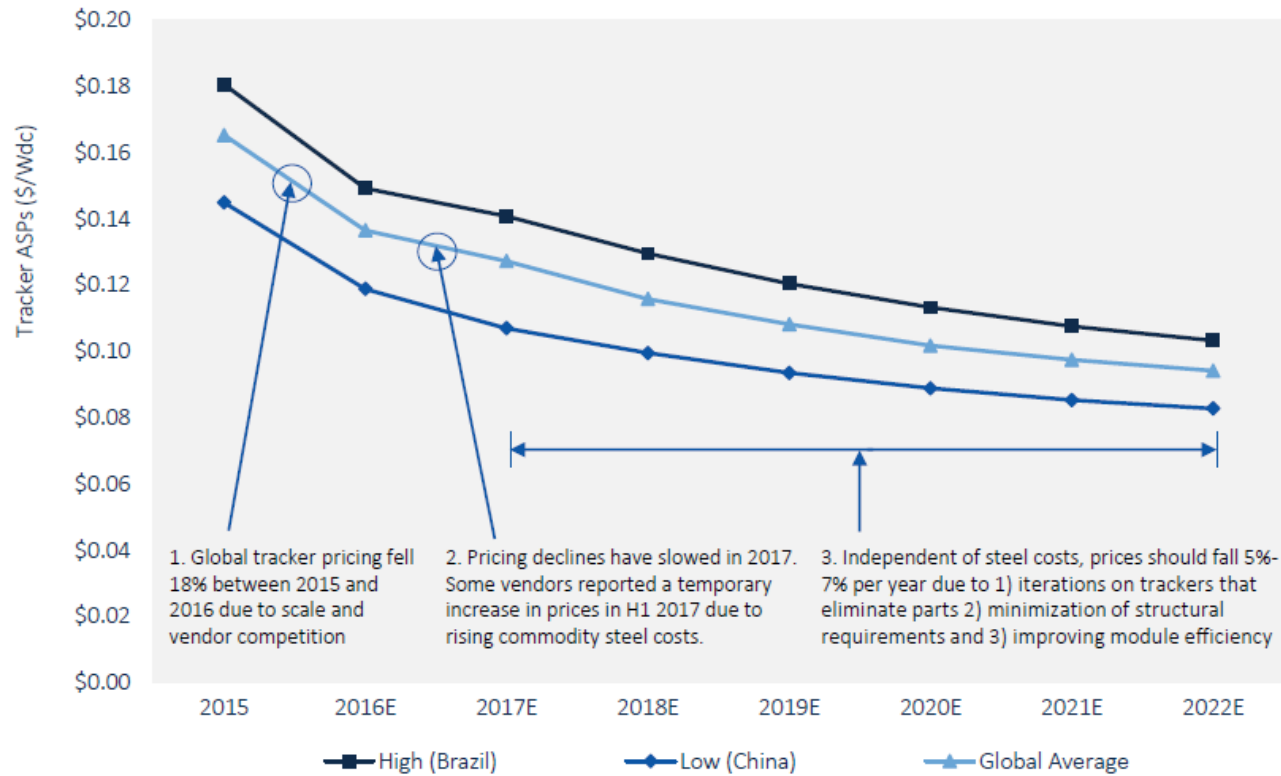
- 2012: 12 MW in Caceres (Spain)
(in cooperation with Clavijo)
- 2014: 55 MW in Ohad (Israel)
(in cooperation with Clavijo)
- 2016: 6 MW in Konya (Turkey)
(FS Track-II)
- 2016: 11 MW in Kayseri (Turkey)
(FS Track-II)
- 2016: Some small installations



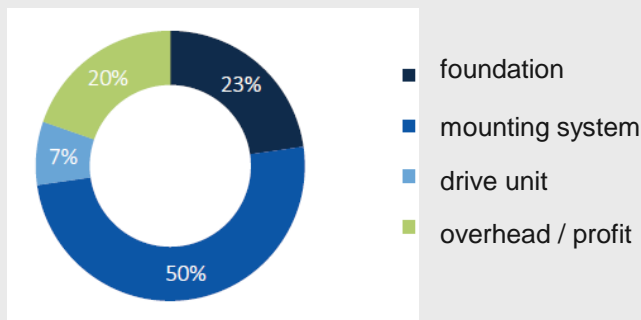
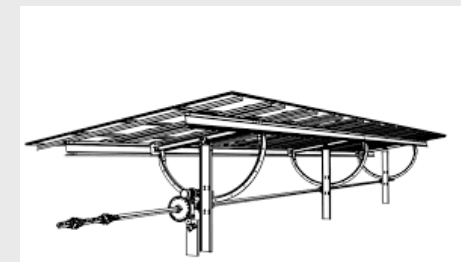
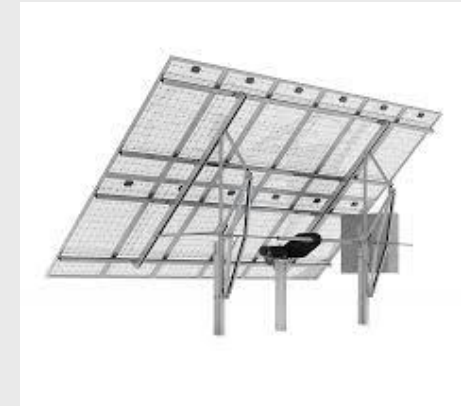
1. Introduction

Expectations for development of costs

Global PV Tracker Price Forecast, 2015-2022E (\$/Wdc)



Source: GTM Research



2. Technical Challenge

Phenomenon



wind introduced vibrations with FS Track II



fatigue failure



hydraulic damper




mass dampers

2. Technical Challenge

Problems arising from accumulated torsional loads

- Limited torsional stiffness of rows
- Vibration-prone system
- Danger of harmonic aerodynamic stimulation (Galloping-Effect)
- Dampers are required
 - Additional costs
 - Additional maintenance
- Limitation of module area per motor at approx. 200 m²
 - Limitation in length and
 - Limitation in width of module area
- High torsional loads at actuator
 - High amount of material needed

System immanent problems have to be solved

 Increase of costs

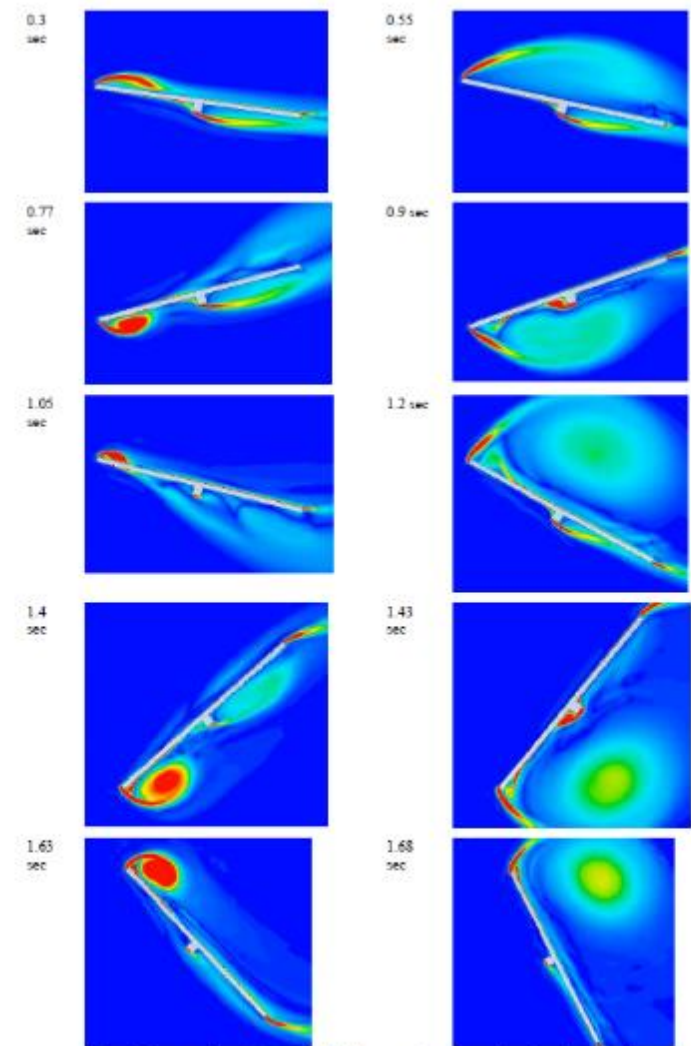


Figure 2. Contours of vorticity. On the left, the vortex is strong, on the right, there is no longer reattachment.

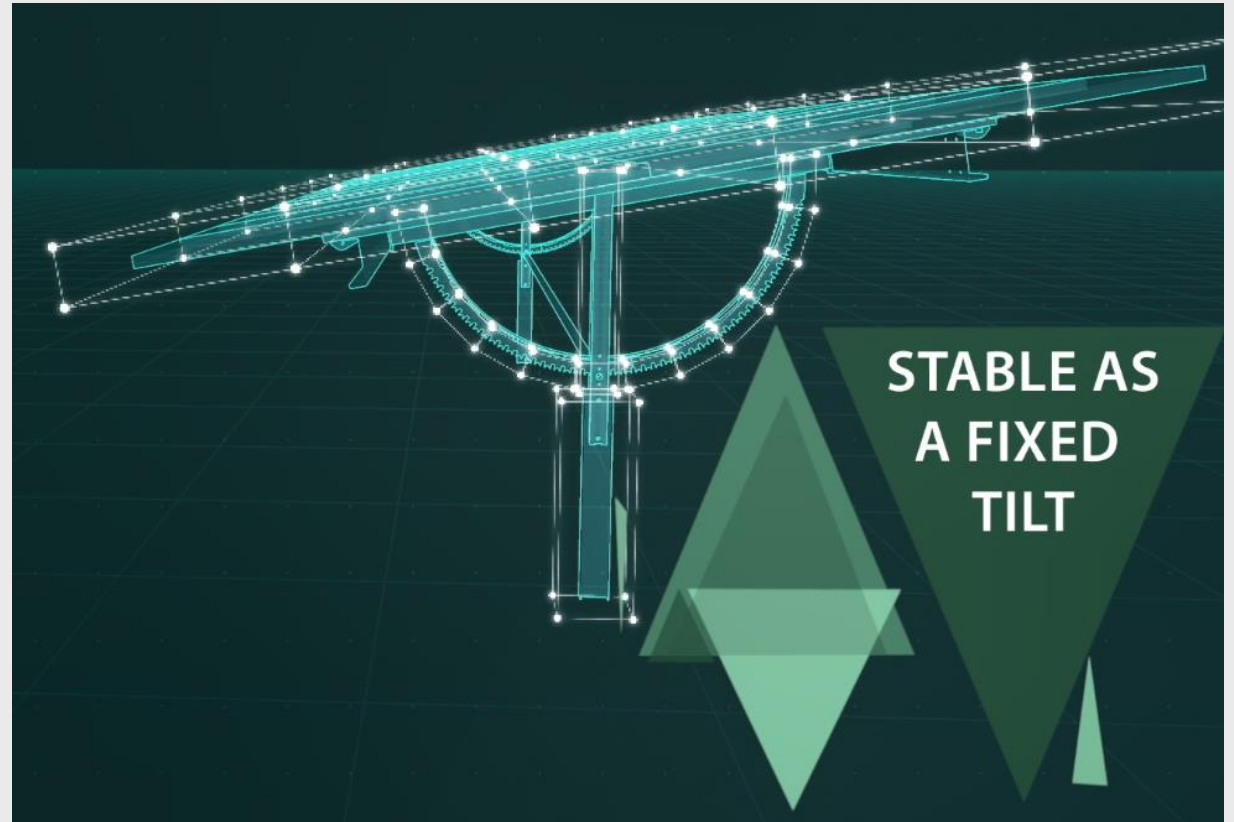
14th International Conference on Wind Engineering – Porto Alegre, Brazil – June 21-26, 2015


3. Product Development Targets

New System to avoid the problems

How would the perfect Tracking-System look like?

- Single row System
 - Each row can be adjusted separately
 - Easy installation
 - Free passage between rows
- Large module area per motor
 - Rack is cheaper for 2V than for 1V (see Fixed Tilt Systems)
 - GCR can be increased
- No accumulation of torsional loads
 - Loads are transmitted directly into the ground at every post
 - Galloping-Effects are excluded



 Don't cure the problems, avoid them!

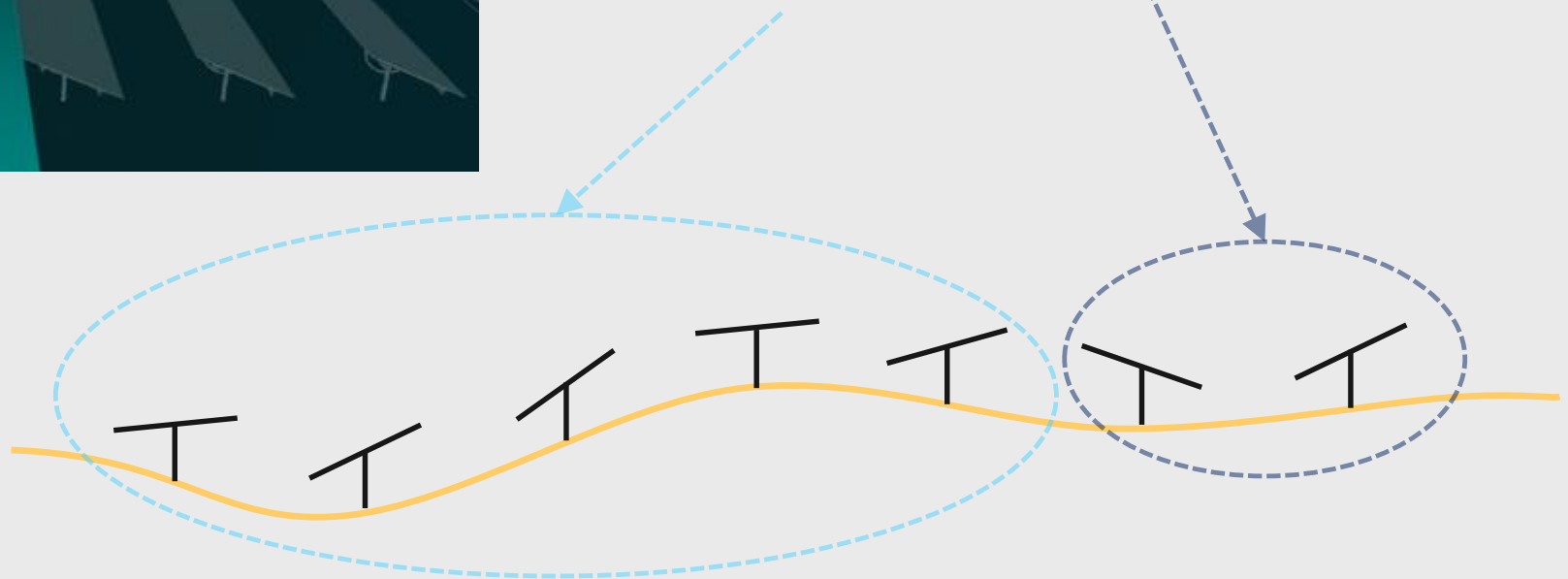
The new Schletter-Tracking-System combines all these features in an unprecedented way

4. Technical Solutions

General approach



- Single Row System
- Easy installation in uneven terrain
- Free Servicing
- Can be installed in difficult terrain
- Higher GCR at nonrectangular properties
- Inclination of every row can be adjusted separately
 - Benefit for service and
 - Benefit for backtracking



4. Technical Solution

Self Locking “Sun-Stepper-Technology”



- Self-locking mechanism at every post
- Every 3° the Tracker is in locking position
- Stable as a Fixed Tilt

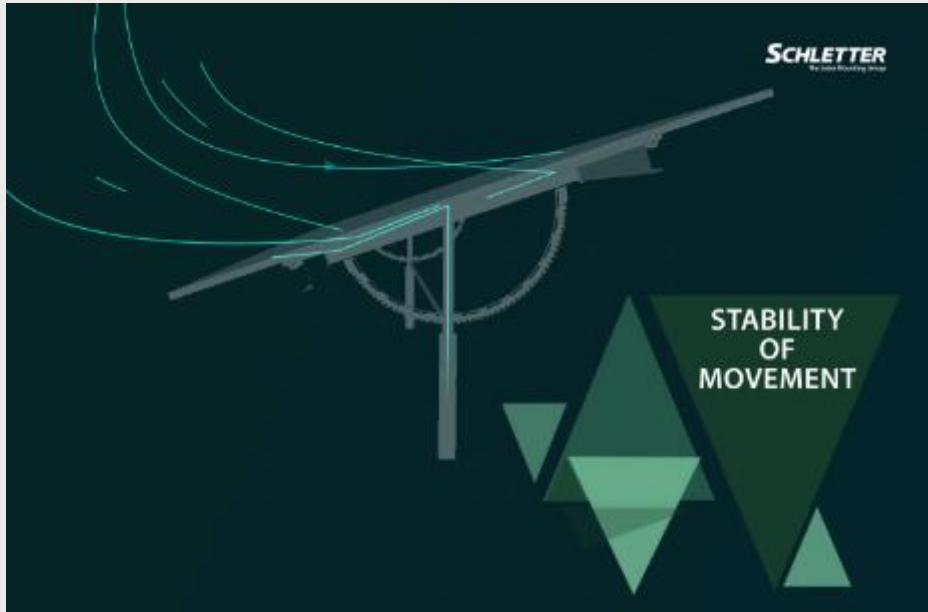
- Adapting an existing principle
 - Engineered for harsh environment
 - Open system
 - No lubrication
 - Low maintenance
 - High reliability

- Testing: Laboratory test simulation 26 years
 - Fatigue
 - Wear and tear
 - Abrasion
 - Deformation
 - Lifetime



4. Technical Solution

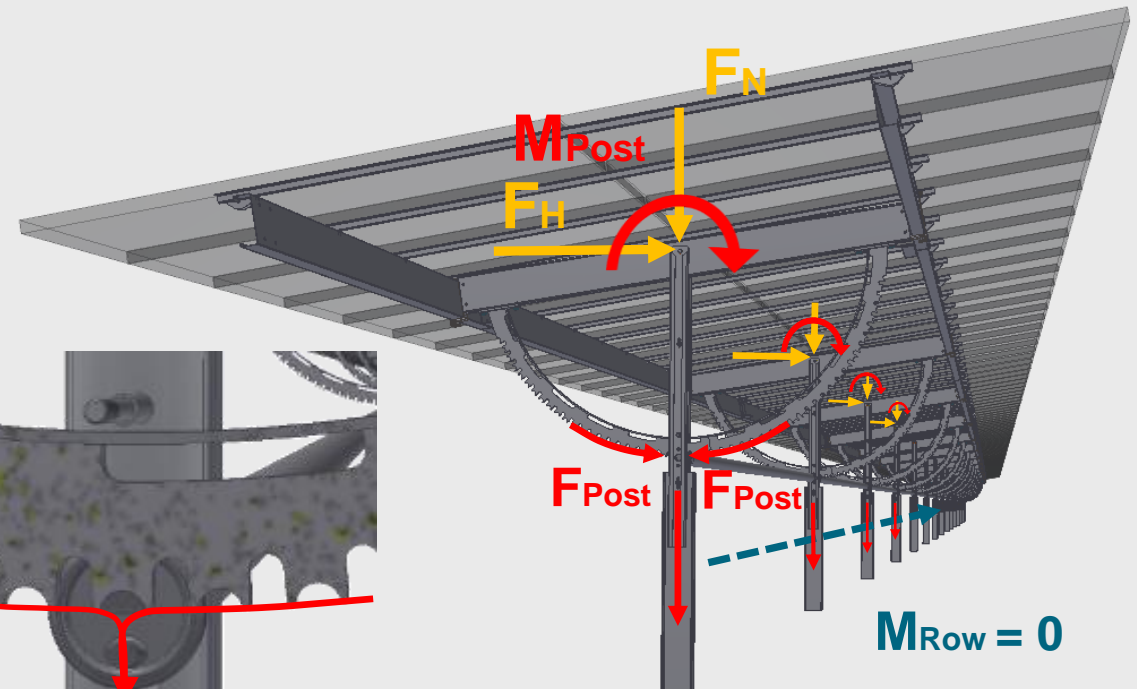
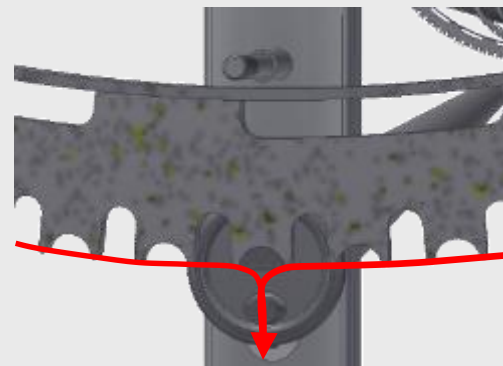
Structural Principle



Stable as a Fixed Tilt

- All loads are transmitted directly at every post
- No torsional flexibility in the system
- No load on motor in locking position

➔ $\sum M_{\text{Post}} = M_{\text{Row}} = 0$



4. Technical Solution

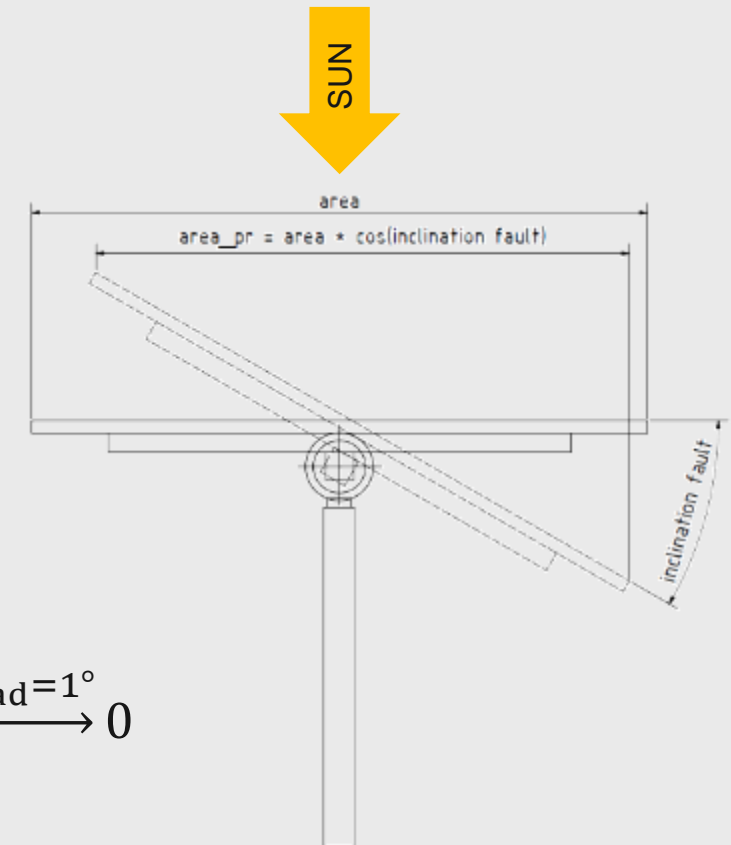
Influence of stepping on yield



MONTH	DAY	HOUR	DIFFUS	DIRECT	TOTAL	SLOPE	ASPECT	ROTA
"1"	"0"	"7,06"	"0,00"	"0,00"	"0,00"	"0,00"	"0,00"	"0,00"
"1"	"0"	"7,08"	"0,00"	"0,00"	"0,00"	"0,00"	"0,00"	"0,00"
"1"	"0"	"7,10"	"0,00"	"0,00"	"0,00"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,12"	"0,00"	"0,00"	"0,00"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,14"	"0,00"	"0,00"	"0,00"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,16"	"0,00"	"0,00"	"0,00"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,18"	"0,00"	"0,00"	"0,00"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,20"	"0,00"	"0,01"	"0,01"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,22"	"0,00"	"0,04"	"0,04"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,24"	"0,00"	"0,14"	"0,14"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,26"	"0,01"	"0,38"	"0,40"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,28"	"0,04"	"0,87"	"0,90"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,30"	"0,08"	"1,69"	"1,76"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,32"	"0,15"	"2,92"	"3,07"	"60,00"	"90,00"	"-60,00"
"1"	"0"	"7,34"	"0,25"	"4,65"	"4,90"	"60,00"	"90,00"	"-60,00"

Steps of 3°

- Every 3° the Tracking System is in locking position
- No loss of earnings due to step of 3°



$$P_{\text{Loss}} \sim 1 - \cos(\alpha_{\text{ad}}) \xrightarrow{\alpha_{\text{ad}}=1^\circ} 0$$

5. Product Features

- Range of movement: +/- 60°
- Stow position / Night position: 10°
- Inclination Steps: 3°
- Tracking according to astronomical calculations
- PV-Modules per Motor (up to 480 m²): up to 240
- Configuration: 2V or 4H
- Bifacial PV-Modules: in 4H and 2V-Configuration
- High GCR, wider module area and smaller distance for servicing
- Flooding clearance for electrical components: 1.2 m
- Piles: SRF7-Piles and W6x7 applicable
- Ground slope: up to 10° E-W and 10° N-S
- Certifications: UL / CE / Bankability Study
- Warranty: 10 years for structural components
5 years for electrical components
- Patent



Empfangsbescheinigung

Hiermit wird bestätigt, dass Ihr im folgenden bezeichneter Antrag auf Bearbeitung einer internationalen Anmeldung nach dem Vertrag über die internationale Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) bei uns eingegangen ist:

Eingangsnummer	8170268
PCT-Aktenzeichen	PCT/EP2018/057495
Eingangsdatum	23. März 2018
Anmeldeamt	Europäisches Patentamt, Den Haag

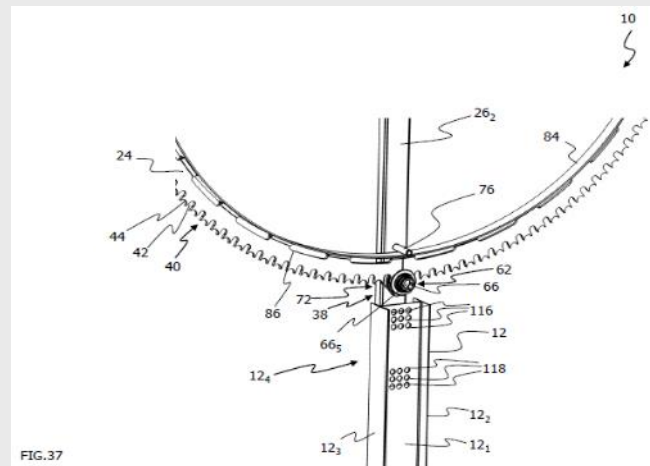


FIG.37

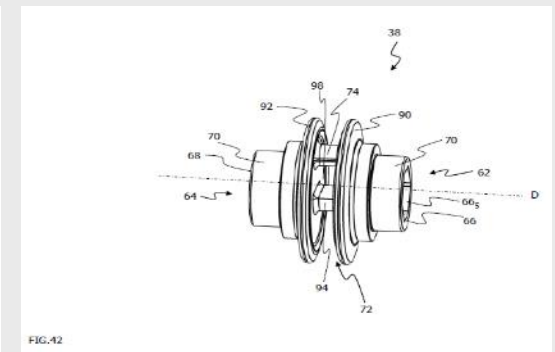
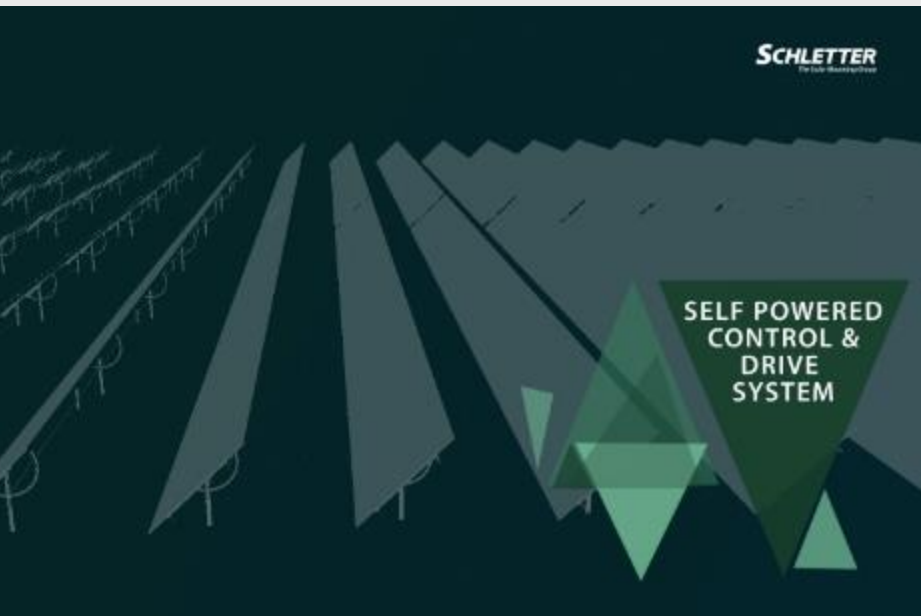


FIG.42

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6. Control System

Self powered System



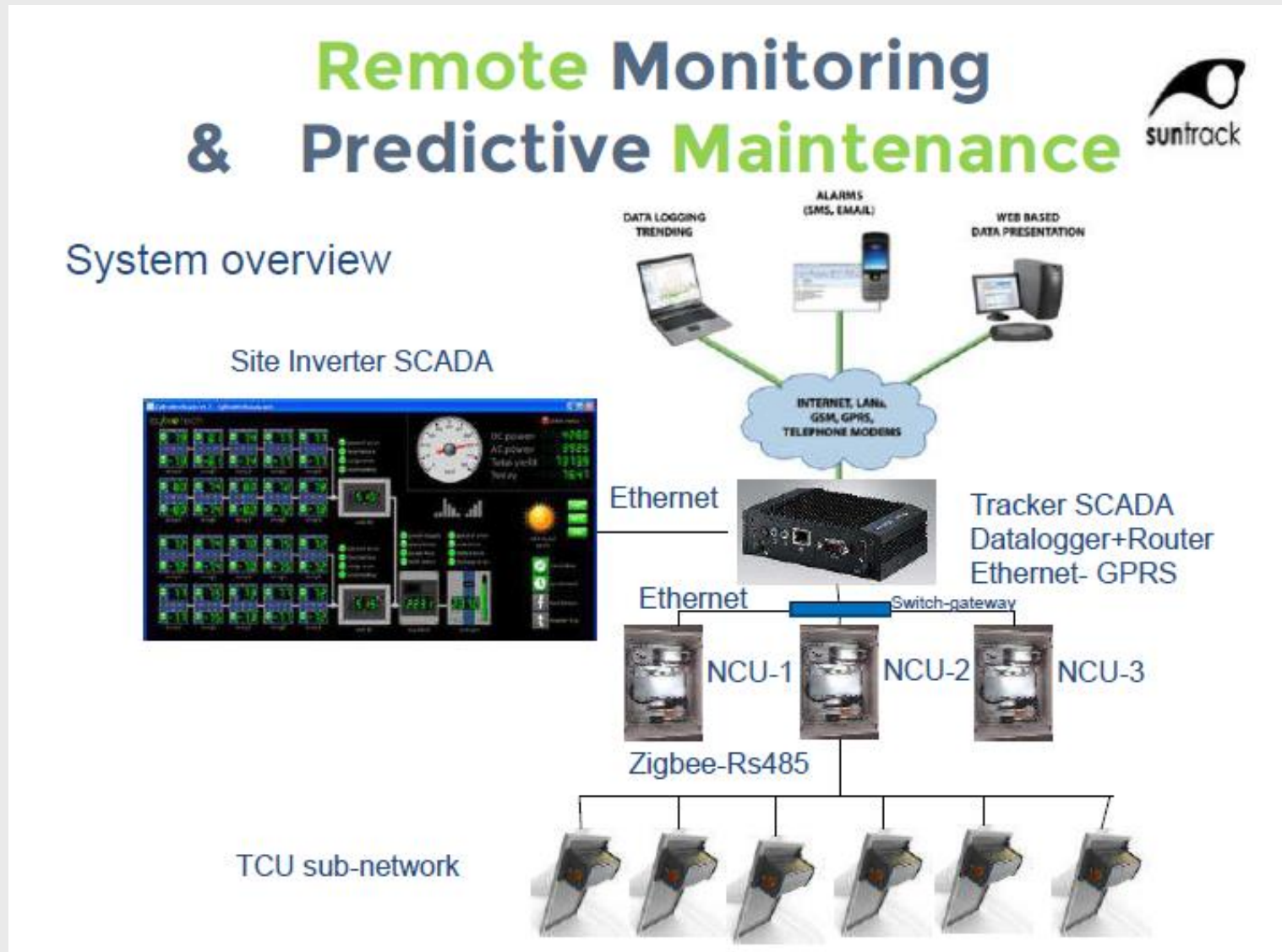
- Motor and Control powered from extra PV-Module
- No cabling between rows for motor
- No cabling between rows for control unit
- Easy installation
- Easy commissioning
- Grid Powered version available

- 1 Wireless Communications**
Robust, cheap & easy to install wireless communications are now available.
- 2 Quick Commissioning & Backtracking tools**
Parametrization and commissioning are now easy to perform. Offsets set-up
- 3 Self Powered systems**
Li FePO4 chemistry long life & safe battery for Self powered from PV or parasitic
- 4 Remote Monitoring & Predictive maintenance**
Avoids stops & increases availability



6. Control System

Remote Control



6. Control System

Monitoring Devices

Remote Monitoring & Predictive Maintenance

Site & TCUs status -Alarms

1 Availability
Any time sites availability report from anywhere
Radiation reference

2 Site & TCUs status -Alarms

3 Key parameters monitor
Motor current vs tracker angle can be used as a behaviour pattern..
Battery load, temperature etc can be monitored and predicted

suntrack

P4Q PROFESSIONALS FOR QUALITY

7. Field Application

Freihung (Germany)

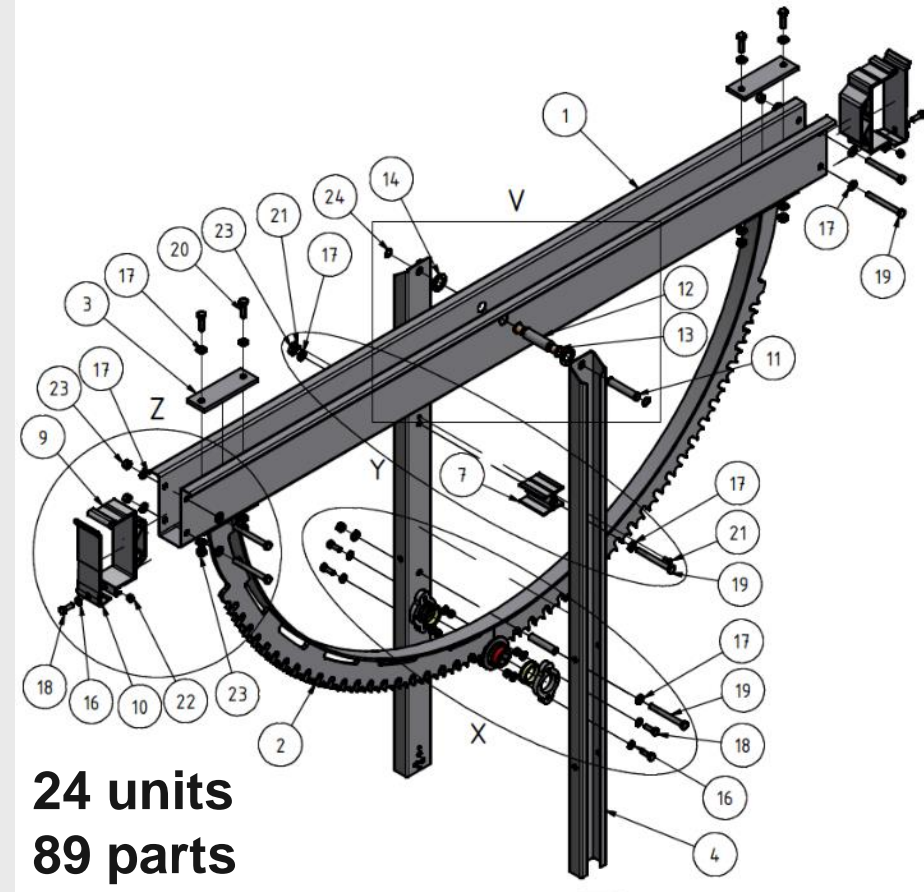


Sunmodule[®] Bisun protect 290

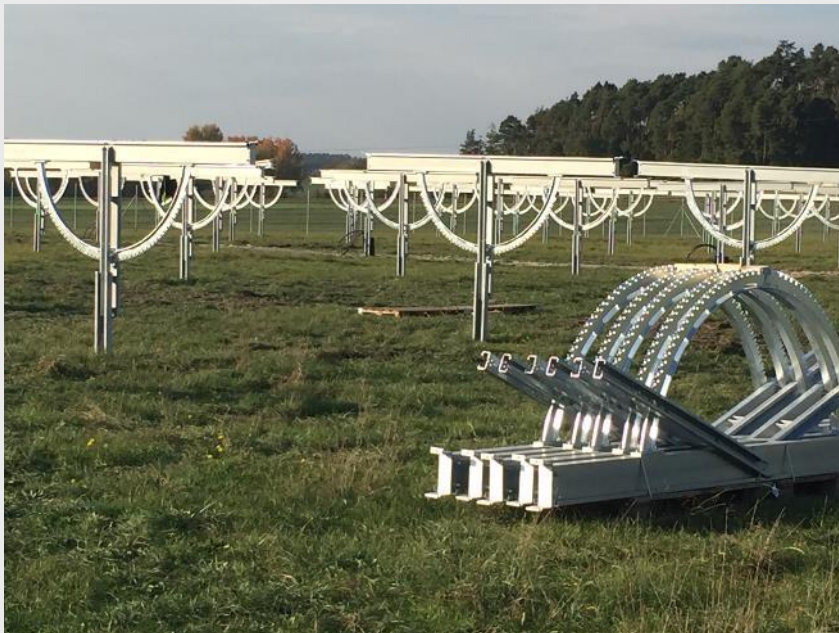


7. Field Application

Pre-Installed Girder-Assembly



24 units
89 parts



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7. Field Application

40 % Saving on installation time



7. Field Application

Operation



8. Planning and Design

FS calculator v5.44.7209.23997

SCHLETTER
The Solar Mounting Group

File Language Tools Options Info

Start Customer Solar module **Location** Configuration Bill of materials / parts list

Location

Location

Google Earth

Country: Brazil

Postal code or Town/City: Rio de Janeiro

Provinz: Rio de Janeiro

20000 Rio de Janeiro

Street:

Degree of latitude: -22.9201

Degree of longitude: -43.3307

Terrain

I II III

IV V

Lakes or area with negligible vegetation without obstacles

Terrain formation: Flat/plane

Distance to the coast: 20.0 km

Info

Dead load

$g = 0.110 \text{ kN/m}^2$

Wind load

Standard: NBR 6123

Wind zone: 2

$v_{ref} = 30.0 \text{ m/s}$

$q_{ref} = 0.56 \text{ kN/m}^2$

$q_{(z)} = 0.00 \text{ kN/m}^2$

Snow load

Standard:

Snow load zone:

Shape factor $\mu_1 = 0.80$

$s_k = 0.00 \text{ kN/m}^2$

$s = 0.00 \text{ kN/m}^2$

Corrosivity class

Corrosivity class: C4 (Severe)

Change load assumptions Logo: Dr. Zapfe GmbH Print

Wind zone map

- Structural Design based on local Technical Standards
- Durability Check according to the local Corrosivity Class
- Customized Design

9. Summary / Discussion

- Lessons learned in terms of resonance vibrations
- New Tracker with innovative Sun-Stepper-Technology
- Pre-assembly allows fast mounting
- Structural design for most countries in the world





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