PIA solar

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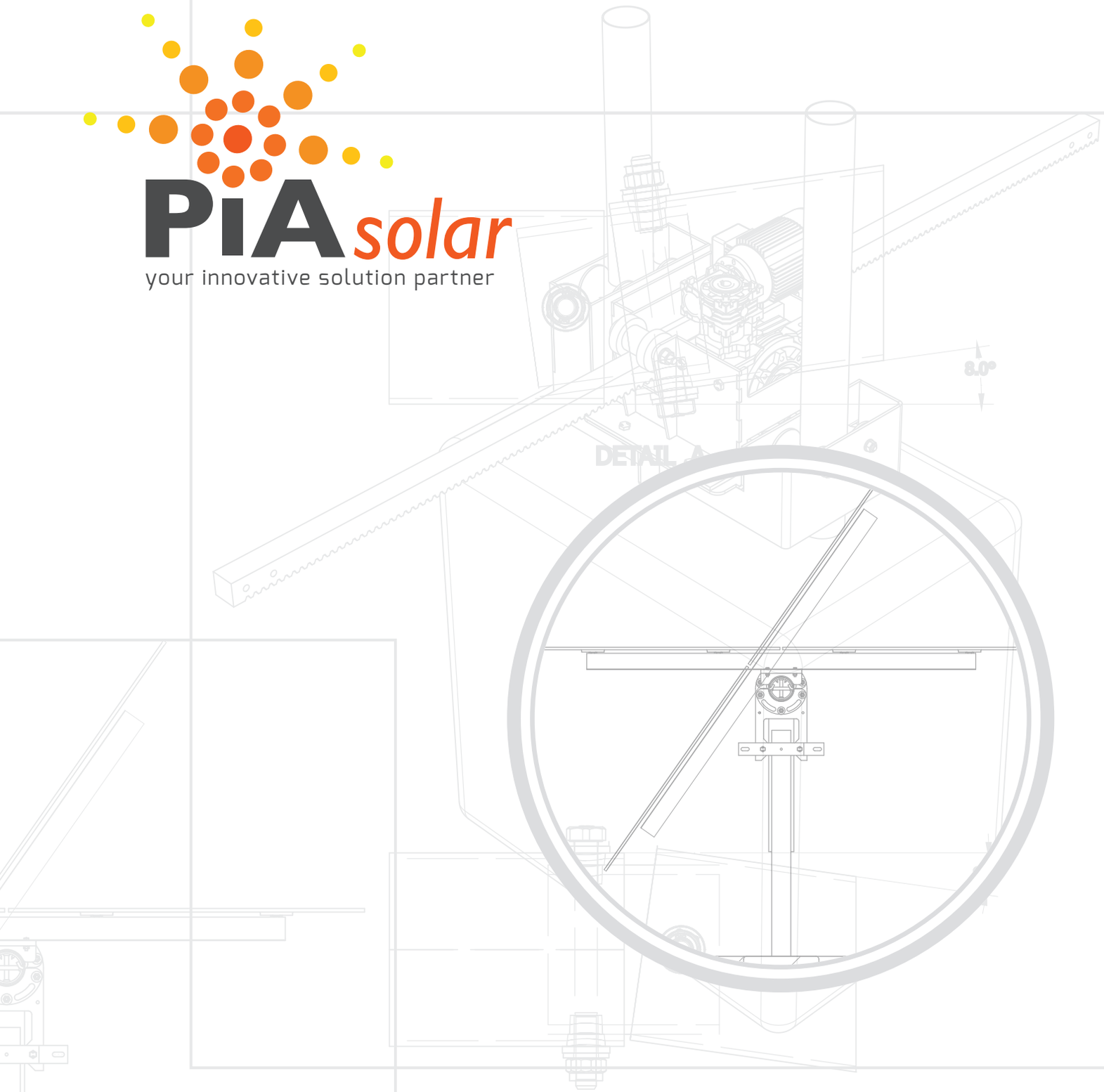

ContouR+ Tracker

Tracker Data Sheet

- Mechanical
- Electrical

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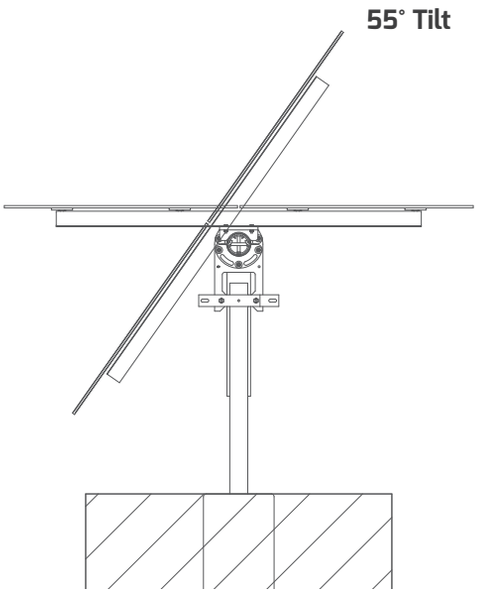
PIA CONTOUR+ HORIZONTAL AZIMUTH TRACKER

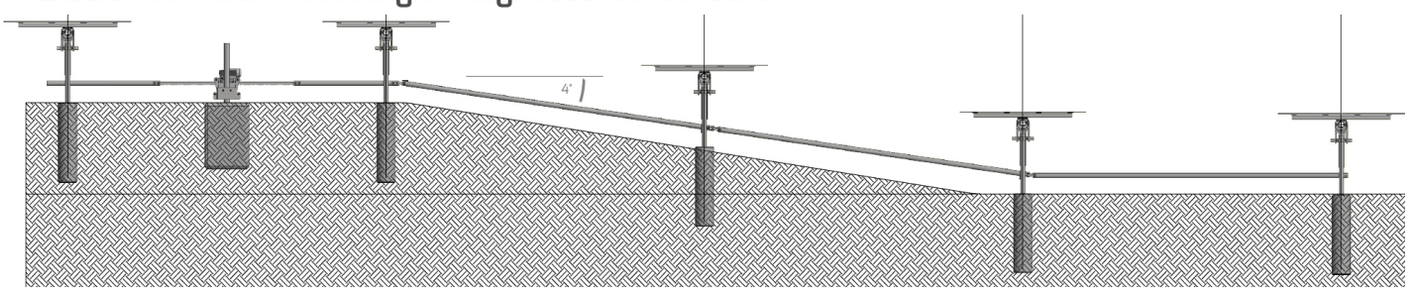
The PiA Solar ContouR+ single axis horizontal azimuth tracker is engineered and designed since 2012 for utility scale projects in South-Africa. The focus at any time along the development is on simplifying technology, the capability to follow the contour, eliminating ground risks and increasing the installation speed. The unique mass balanced design eliminates deviations in tilt within the rows, reduces the peak power requirements of the electrical drive system (push-pull system), the self consumption of the whole PV plant and oscillation of the system in strong wind. The PiA ContouR+ tracker is the perfect solution for fast installation and highest yield at lowest costs for the design life time of the PV plant.

HIGHLIGHTS

Single axis horizontal azimuth tracker



- Developed, tested and proven internationally
- Available from 50 to > 600kWp per tracker
- Certified to 3s wind gust at 38m/s (project specific higher)
- Compatible with dust and water, IP66 Rated, no “nests” where dust can build up
- Topographical Contour following up to 4° between rows
- Contour following along rows of 4° at each universal joint, 2° for the whole row
- Dual PUSH-PULL electric drive providing a constant tension drive beam
- Round beams for high torque & accuracy
- MASS BALANCE system reducing tilt deviation, self-consumption & oscillation of the system in strong wind
- Highest yield, up to ±55° tilt angle with backtracking
- Rapid Installation, no cutting, drilling or welding on site
- Design to accommodate all module types (crystalline, thin film)
- Infinite adjustment to ensure precision mechanical alignment
- Distributed manufacturing for highest local content



Mechanical Specifications

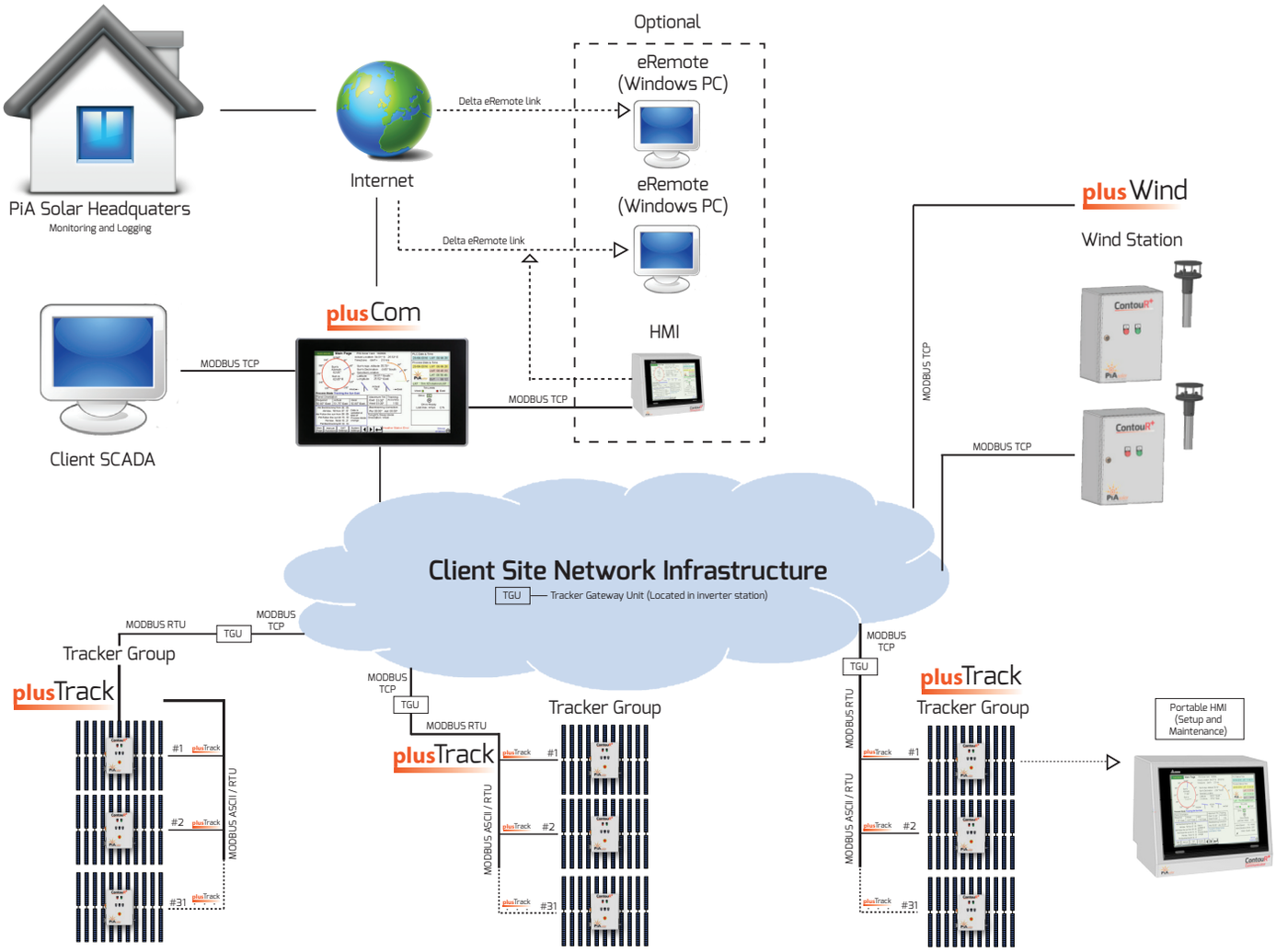
Tracking methodology	Single axis horizontal East/West azimuth Tracker
	GPS based astronomical algorithm, adjustment based on 1 inclinometer per tracker
	Tracking accuracy 1 degree
Tracker block design crystalline	Up to 30 rows
	From 5 to 60 modules per row, 72 cell / 60 cell modules, framed or Double Glass
	Standard system crystalline: 1 Portrait (Option: 2 L)
Tracker block design Thinfilm (FS)	Up to 30 rows
	160 modules per row
	Standard system thin film (FS): 4 Landscape
Round Tube bearer beams (torque tubes)	Better torque management, eliminates manufacturing risks (compared to square tubes)
	Each table/bearer beam to accommodate 5, 6 or 7 crystalline, 20 thin film modules
	Connection between bearer beams with universal joints in undulated terrain
	Rigid connections between bearer beams in flat terrain
Drive beam	Drive beam system with universal joints at each connection point, rigid connections in flat terrain
	Round Tubes
Contour following	Priority: building the tracker flat, levelling contours, adjustability of posts -150 mm and +350 mm in height
	Inside Rows: Contour following capability at every universal joint by up to 4°
	Between Rows: Follows contour between inner rows by up to 4°
Motor drive	Dual BMG 3-Phase electric motor (400V), 250W
	Floating drive system, the power always points in the right direction
	Motors located on both ends of the tracker, dual drive creates constant tension drive beam
	Inverted rack and gear mechanics, self locking
	Varvel gear-boxes sealed for design life time, maintenance free
Posts	Standard system: posts embedded in concrete for perfect alignment, tension free systems, independency of ground conditions
	Installation tolerance in height -150mm, +350mm
	Alternative options: Ramming, PiA Earth Screw
Material	Tracker structure HDG (Hot-dipped galvanized to ISO 1461) mainly S350 and S355
	Purlins S350, pre-Galvanized Z275 (HDG optional)
	Bearing and roller parts - WB230BK1000 PP, 30% Glass fiber reinforced, heat and UV stabilizer
Installation tolerances	Bearer Posts ±50mm, drive-line posts ±10mm, 2° in verticality
	Bearer beam bearing ±55mm in all directions (xyz)
	Universal joint angle for bearer beam and drive beam = 4°
	Drive arm adjustment - no restrictions
	Module tilt installation adjustment - ±4° (no shimming)
Tilt Angles	Up to 55° East/West
Back Tracking	Adjustable for terrain slope (Parameter morning/afternoon), row spacing and module size
	Detachable for thin film (FS) modules
Wind Speed	20m/s standard tracking, Certified for basic 28m/s wind speed, Certified to 38m/s for a 3s wind gust
	Automated activation of stow position at wind speeds > 20m/s, reinforced versions for higher wind speed on request

Environment	Designed to operate in high dust environment
	Motor and gear boxes IP66 rated
	Electrical control box IP65 rated
	Dome bearings to prevent dust settlement
Stow Position	Stow position at 2° wind facing,adjustable with parameter
	Sleep mode is adjustable to e.g. 30° for overnight to assist with cleaning, alternates each day / or wind facing
Certifications/Reports	Project specific certifications according to country specific requirements (e.g. SANS)
	TUV design verification report
	Wind channel test report (ifi institute Germany)
	Independent 3rd party Due Diligence Report by ARUP

ELECTRICAL DATA OF ContouR+ Tracker

PIA ContouR+ Tracker Network System

This tracker network document is to give an understanding of PiA Solar's ContouR+ Tracker control product range and its integration overview on a typical solar farm.



plusTrack

Part No. PIA500002A

The PiA plusTrack (Tracker Control Panel) is an industrial grade controller installed on each CountouR+ tracker block of up to >600 kWp. Each plusTrack features a Delta™ PLC that runs the PiA Solar Advanced Single Axis tracking algorithm. The tracking algorithm is based on built-in GPS control.

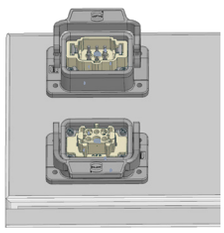
The dual hybrid motor control system allows for highest reliability at lowest energy consumption. It controls 2 synchronized motors, realizing the push-pull system for ease of ContouR+ following.

Provided that wind data is available and the UPS is not running in battery mode, plusTrack operates in a standalone mode throughout the year, independent of the availability of SCADA or remote control.

At high wind speed, running on battery power (UPS) or missing information thereof, plusTrack drives the tracker into Safety Stow mode to eliminate the risk of damage.

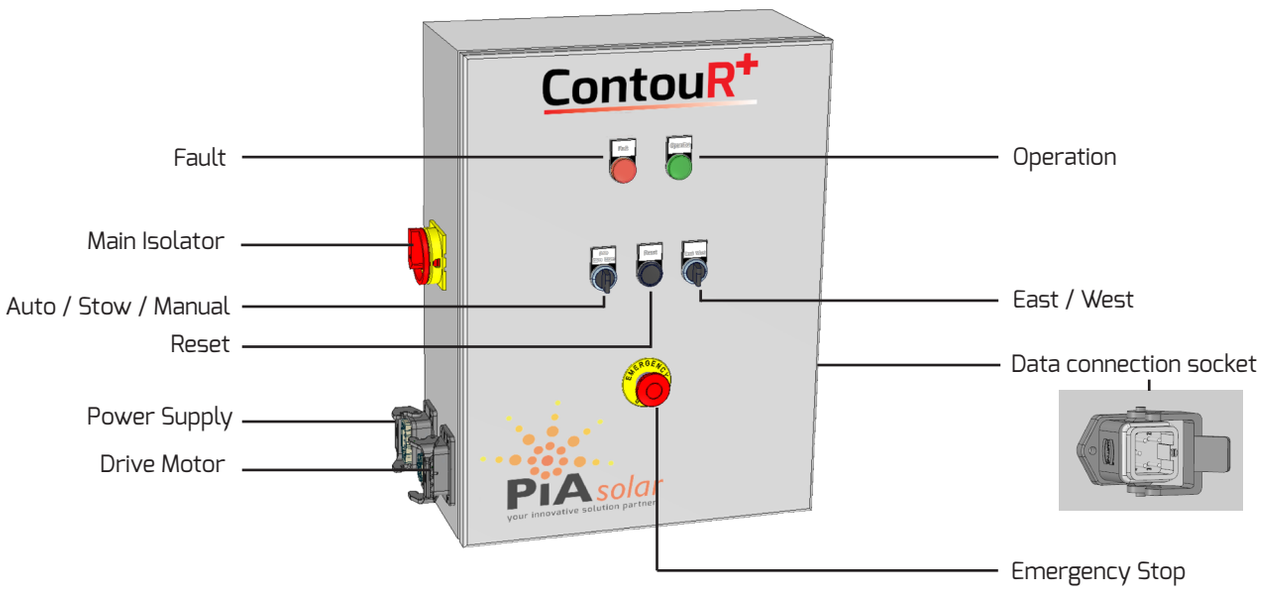
The plusTrack Housing features control switches for local, manual control. The tracker can manually be brought in any required position for maintenance, ground works and cleaning. LED indicators provide a general overview of the tracker fault status and operation mode.

Power and communication connections are provided via heavy duty industrial connectors allowing for rapid replacement resulting in minimal down time, lowest installation risks.



plusTrack is delivered to site with predefined, localized parameters for fast installation.

In depth analysis is provided locally via the portable maintenance HMI (see pg 9). SCADA and remote control connects through plusCom (PiA Communication Center) to each Tracker Control Panel for ease of communication setup.



Technical Specifications of plusTrack

PHYSICAL CHARACTERISTICS	
Height	570mm
Width	430mm
Depth	200mm
Weight	20kg
Material	3CR12 Stainless Steel
Surface finish	Powder coated to RAL7035 Grey
Mounting method	Post mount on Tracker
Protection Index	IP65
Temperature range	Within enclosure -10°C to +55°C Components 0°C to +55°C
Relative Humidity	< 50% to 95% RH
Operating Environment	10% ~ 90% RH (0 ~ 40oC) 10% ~ 55% RH (41 ~ 50oC) Pollution Degree 2
ELECTRICAL CHARACTERISTICS	
Supply Voltage	400VAC 3 phase
Average Daily Power Consumption (dual motor drive)	Idle Power - 14W Peak Power - 524W
Idle Power	27W
Peak Power	533W
Motors	2 x 400VAC 3 phase 0.25kW
Motor Protection Level	IP66
Motor Control	Phoenix Contact Hybrid Motor Starter (PN: 2900414) Safety level according to IEC 61508-1: SIL3, ISO 13849: PL e
Motor Connections	Panel mount Heavy Duty IP65 Multipole connector, Contacts rated for 16A/690V
Motor Cable	1.5mm^2 4 core UV resistant cable
Temperature Range	-20°/+50°
Power Connection	400VAC (3P + N) up to 2.5mm^2, IP65 multiple panel mount heavy duty connector Contacts rated for 16A/690V
Maximum allowable voltage drop	3%
DC Power Supply	PN: DRP-24V48W1AZ, IEC/EN/UL 60950-1, EN 61000-6-2, EN 55011, UL 508
UPS Status	Option 1: Dry contact required on UPS for input (24VDC) into <wind station>. UPS data is distributed to <tracker control panel> with wind data via MODBUS. Option 2: Extra core in supply cable to each tracker. 220VAC (VLN) signal Optional RS485 isolator/repeater - PN: IFD8510
PROTECTION & SAFETY	
Motor Protection	Adjustable Thermal Overload Short Circuit Protection Supply Phase monitoring Independent motor current monitoring with adjustable warning level
Software defined protection	Inclinometer error proofing Tilt angle without command detection Tilt/movement timeout detection Auto phase (3ph) rotation correction
Electrical supply	Fault current protection: 10kA External panel mount mains isolator with lock-out feature
Emergency Stop	Mushroom with twist release (optional Key Release available)

Surge protection	Input/incoming supply: Class 2 Surge Protection Device (Optional) SANS/IEC 61643-1 ,IEC 60634-4-443 category 1 SPD Part Number: CPT PSM4-40/400 TT , Replacement cartridge Part Number: PSM-40/230 Imax: 40kA per phase 1 x SPD on input
	Output/Motor connections (optional): Class 2 Surge Protection Device SANS/IEC 61643-1 ,IEC 60634-4-443 category 1 SPD Part Number: CPT PSM4-40/400 TT , Replacement cartridge Part Number: PSM-40/230 Imax: 40kA per phase 2 x SPD (1 x per motor)

COMMUNICATION

Communication interface	RS485 MODBUS (via heavy duty IP65 industrial connector)
Number of PCT per RS485 line	Maximum 32 devices on one loop. Up to 1200m cable length without a repeater
CPU	Delta DVP-12SE PLC
Other optional interfaces	Ethernet(MODBUS TCP):DeviceNet Wireless (24ghz)

INCLINOMETER SENSOR SPECIFICATIONS

Type Inclination sensor	1-axis
Measurement range	0 ... 360 °
Absolute accuracy	≤ ± 0.5 °
Response delay	≤ 20 ms
Resolution	≤ 0.1 °
Repeat accuracy	≤ ± 0.1 °
Temperature influence	≤ 0.027 °/K
Ambient temperature	-40 - 85 °C
Degree of protection	IP68 / IP69K
Approvals and certificates	UL approval cULus Listed, Class 2 Power Source CSA approval cCSAus Listed, General Purpose, Class 2 Power Source

LOCAL CONTROLS

Inputs	Mode Selector Switch	Mode Selector Switch: Auto - Automatic tracking mode Stow - Send tracker to Stow mode Manual - Manually set tilt angle for maintenance/grounds work
	Manual Tilt Control	Move East - Rotate tracker East in Manual mode Move West - Rotate tracker West in Manual mode
	Fault Reset	Fault Reset - Used to clear/acknowledge faults on the tracker
	E-Stop	E-Stop used to disable motor/tracker movement. Push to activate; twist release or key release available
Outputs	Indicator lamps	Fault Lamp - Indicates warnings and errors on the tracker. Operation Lamp - Provides local operation indication
Supplementary interface	Local HMI input	Allows portable HMI input for advanced diagnostics and configuration on the tracker
	Mode Selector Switch	Automatic (or remote) tracking mode

plusWind

Part No. PIA500003A

The PiA plusWind (Wind Station) provides important wind speed data to the Tracker Control Panels to ensure tracking under safe conditions.

plusWind is located anywhere in the network and communicates directly with each plusTrack, eliminating failure risks of additional computer components like SCADA.

Uptime is critical, this is why plusWind can be setup in redundant mode.

Each plusWind features a marine grade wind sensor manufactured by Gill Instruments and a Delta™ PLC to provide a MODBUS TCP interface. The WindSonic wind sensor is a solid-state device that has no moving parts and features a self-diagnostic mode to ensure the wind speed data is always correct.

Technical Specifications of plusWind

PHYSICAL CHARACTERISTICS		
Enclosure	Height	450mm
	Width	300mm
	Depth	220mm
	Weight	15kg
	Material	3CR12 Stainless Steel
	Surface finish	Powder coated to RAL7035 Grey
	Mounting method	Outdoor Post mount or wall mount
	Protection Index	IP65
	Temperature range	0° to 55°C
	Relative Humidity	< 5% to 95% RH
Wind Sensor	Device	Gill Instruments WindSonic Solid State (Ultrasonic) wind sensor
	Construction	LURAN S KR 2861/1C ASA/PC
	Size	142 x 160mm
	Protection Index	IP65
	Temperature range	-35° to 70°C
	Relative Humidity	< 5% to 100% RH
Operating Environment		10% ~ 90% RH [0 ~ 40oC] 10% ~ 55% RH [41 ~ 50oC] Pollution Degree 2
ELECTRICAL CHARACTERISTICS		
	Supply Voltage	85 - 264VAC (phase1)
	Average Power Consumption	<10W
	Communication interfaces	Ethernet/RS485
PROTECTION & SAFETY		
	Electrical supply	Fault current protection: 10kA

WIND SENSOR PERFORMANCE		
Wind Speed	Range	0 - 60 m/s
	Accuracy	±2% @ 12 m/s
	Resolution	0.01 m/s
	Response time	0.25 seconds
Wind Direction	Range	0 - 359° (No dead band)
	Accuracy	±3° @ 12 m/s
	Resolution	1°
	Response time	0.25 seconds
	Operation and reliability	MTBF: 15 Years Maintenance Free - Solid-State/no moving components self-diagnostic program with error codes.
COMMUNICATION		
Communication interfaces		Network: Ethernet (MODBUS TCP) Optional : RS485 (for small applications)
CPU		Delta DVP-12SE PLC
Other		UPS status signal input

plusCom

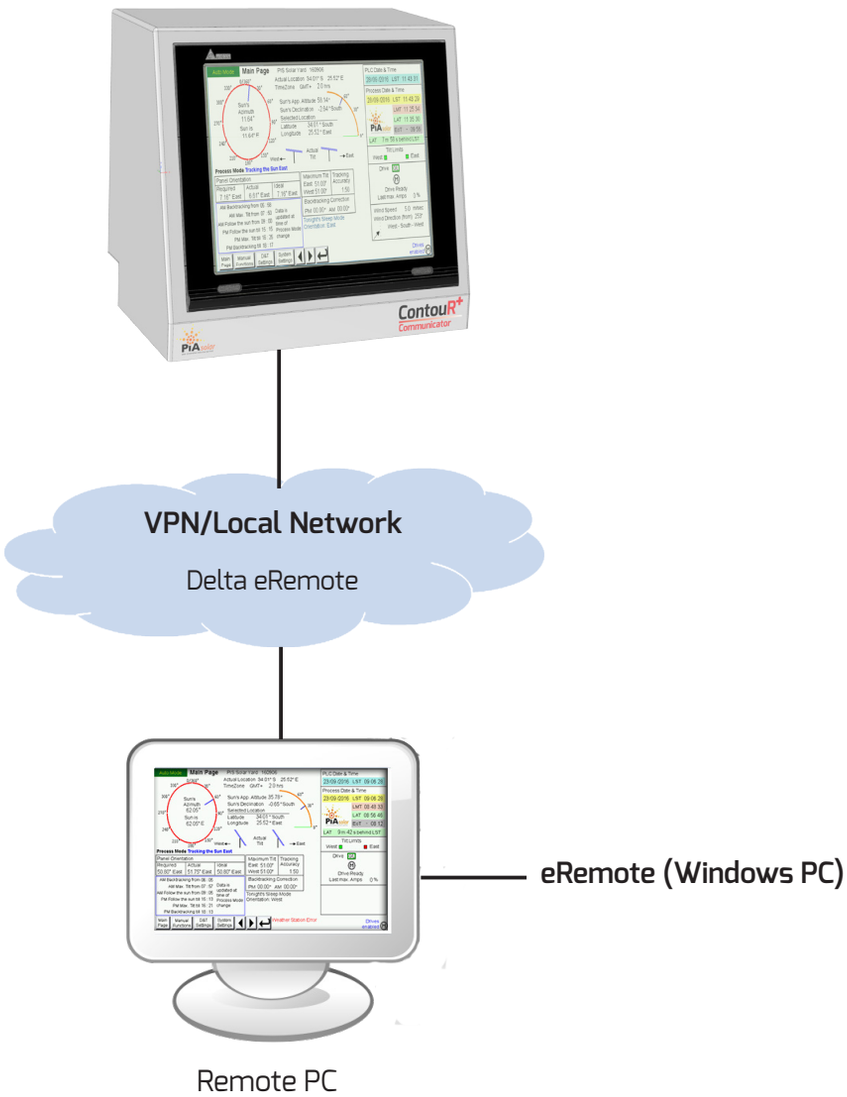
Part No. PIA500004A

The PiA plusCom (Communication Center) acts as a data concentrator for client SCADA interfacing and remote monitoring (e.g. PiA Solar VPN). It is logically connected to each plusTrack and the single connection point for SCADA and remote interfaces. plusCom features a powerful dual-core Delta™ PLC. Typically plusCom is located in the site control room / maintenance building.

The PiA HMI (15 inch) will be connected to plusCom, in parallel to the clients SCADA system. The HMI provides basic functionality for the tracker health status, parameter adjustment and remote control.

plusCom is intended to be used in the client control room, however the Ethernet interface allows the device to be placed anywhere on the client network during installation.

For added convenience, Delta ™ eRemote Software allows the user to view and control the HMI on the plusCom interface via a Windows PC or laptop either locally or remotely via VPN.



Technical Specifications of plusCom

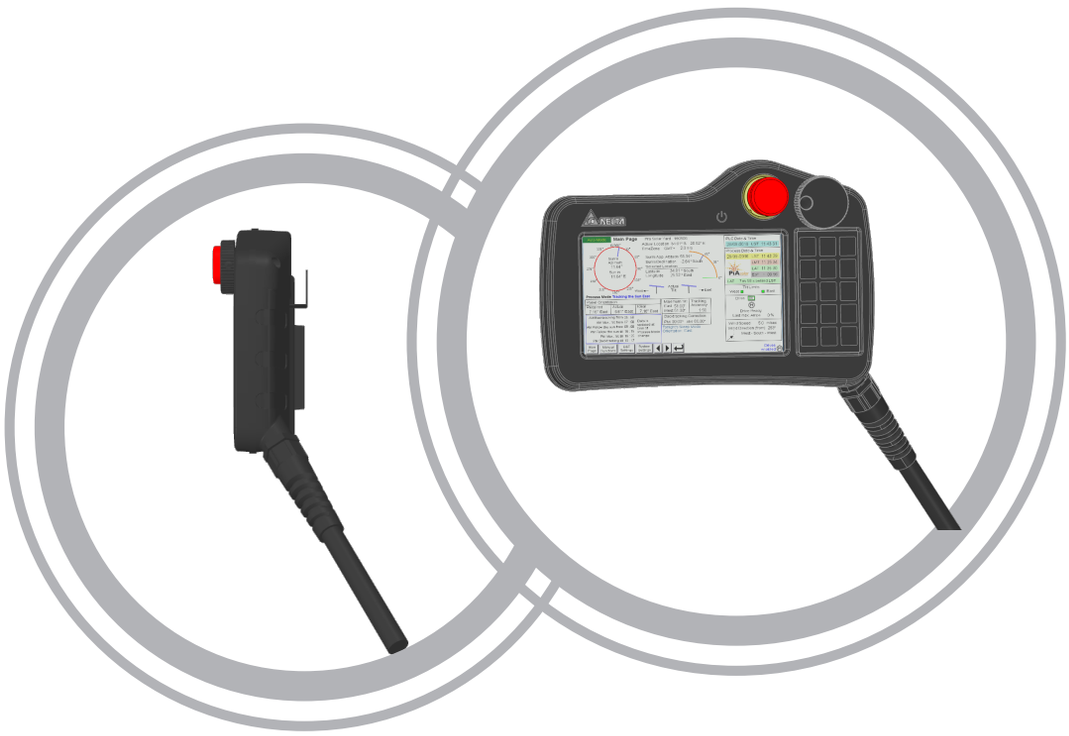
PHYSICAL CHARACTERISTICS		
Enclosure	Height	400mm
	Width	500mm
	Depth	350mm
	Weight	+-15kg
	Material	3CR12 Stainless Steel
	Surface finish	Powder coated to RAL7035 Grey
	Mounting method	Desktop
Protection Index		IP65
Temperature range		0°C to 55°C
Relative Humidity		< 5% to 95% RH
ELECTRICAL CHARACTERISTICS		
Supply Voltage		100-240VAC (1 phase)
Average Power Consumption		<30W
COMMUNICATION		
Communication interfaces		Network: Ethernet MODBUS TCP Delta™ eRemote

PORTABLE HUMAN MACHINE INTERFACE (HMI)

Delta's DOP-H07S425 portable HMI is used as a commissioning tool and as well as local maintenance aid for onsite technicians. The portable HMI is connected directly to the plusTrack when required to provide local adjustments of the tracker configuration including backtracking, tracking accuracy and other tracking parameters.

Technical Specifications

PHYSICAL CHARACTERISTICS	
Dimension	257.4 x 170.3 x 71.8
Weight	750g
Operating Environment	10% ~ 90% RH (0 ~ 40oC) 10% ~ 55% RH (41 ~ 50oC) Pollution Degree 2
Vibration	Conforms to IEC61131-2; Continuous: 5 Hz ~ 8.3 Hz 3.5 mm, 8.3 Hz ~ 150 Hz 1 G
Shock	Conforms to IEC60068-2-27: 11 ms, 15 G Peak , X, Y, Z direction for 6 times
Protection Index	IP55
Cable length	5m
Supply Voltage	24VDC
Average Power Consumption	5.6W
Communication interfaces	SD Card USB RS485



TRACKER GATEWAY UNIT (TGU)

The Tracker Gateway Unit (TGU) is the device used as a converter between MODBUS RS485 and MODBUS TCP communication protocols.

Typically it is used for every RS485 network (maximum 32 units plus-Track) in the inverter station for the connection to the client network.

Technical Specifications

ELECTRICAL CHARACTERISTICS	
Power voltage	24VDC (-15% - 20%)
Power consumption	3W
Insulation Voltage	500V
Optinal PSU	PN: DRP-24V48W1AZ 85 - 264VAC (1 phase) IEC/EN/UL 60950-1, EN 61000-6-2, EN 55011, UL 508
PHYSICAL CHARACTERISTICS	
Length	111mm
Width	71mm
Depth	33mm
Mounting	DIN/Panel mount
Weight	140g
Operating Environment	0°C ~ 55°C (temperature) 50 ~ 95% (humidity)
ENVIRONMENTAL CHARACTERISTICS	
Noise Immunity	ESD (IEC 61131-2, IEC 61000-4-2): 8KV Air Discharge EFT (IEC 61131-2, IEC 61000-4-4): Power Line: ±2KV, Digital Input: ±2KV, Communication I/O: ±2KV RS (IEC 61131-2, IEC 61000-4-3): 80MHz ~ 1GHz, 10V/m. 1.4GHz ~ 2.0GHz, 10V/m Conducted Susceptibility Test (EN61000-4-6, IEC61131-2 9.10): 150KHz ~ 80MHz, 3V/m Surge Test (Biwave IEC61132-2, IEC61000-4-5): Power line 0.5KV DM, Ethernet 0.5KV CM, RS-485 0.5KV CM
Certificates	IEC 61131-2, UL508
ETHERNET COMMUNICATION	
Interface	1 x RJ-45 with Auto-MDI/MDIX
Transmission speed	10/100 Mbps Auto-Detection
Protocols	ICMP, IP, TCP, UDP, DHCP, SMTP, Modbus TCP, Ethernet/IP
RS485 COMMUNICATION	
Interface	10 pin feed-through terminal
Transmission distance	1200m max
Transmission baud rate	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Communication protocol	MODBUS
Max RS485 stations	32 devices

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Note: Some images and specifications may vary from what is displayed in this document.