

Becquer Energy Company – Master Data Sheet

Integrated Roof and Ground Mounted Solar Assets – Large Industrial





Becquer Energy, with its roots in Singapore, has been pioneering the kW and MW range solar ground mount and roof assets with a precision in design and engineering, backed by the corporate sector and the financial world alike, to make the use of solar electricity more widespread in a predictable, genuine and integrated way through the use of material and process technologies that have all been developed in-house.

This has led to its plants having a better electricity output, higher warranty, and a flexibility to upgrade or shift in the future. The founding team and management personnel are all solar engineers. The team has a strong backing from HDFC and Citibank.

The following pages contain information on all the major components of a solar asset, the exact details of which may vary from site to site. The objective of this document is to standardize the design and make it simpler for the end customer to get a basic overview of the technical specifications of the raw materials and components that make up the solar asset. This document serves as a reference only.

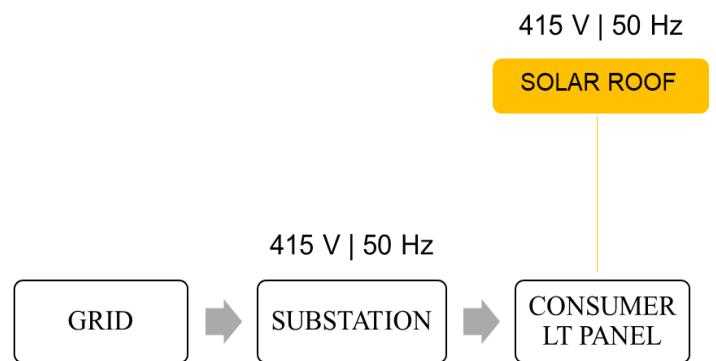
Overall Power Supply Architecture

The diagram below shows the architectural change to the power supply for the end customer whereby the solar asset is synchronized at the LT panel to work seamlessly with the existing sources of power

Now



Future

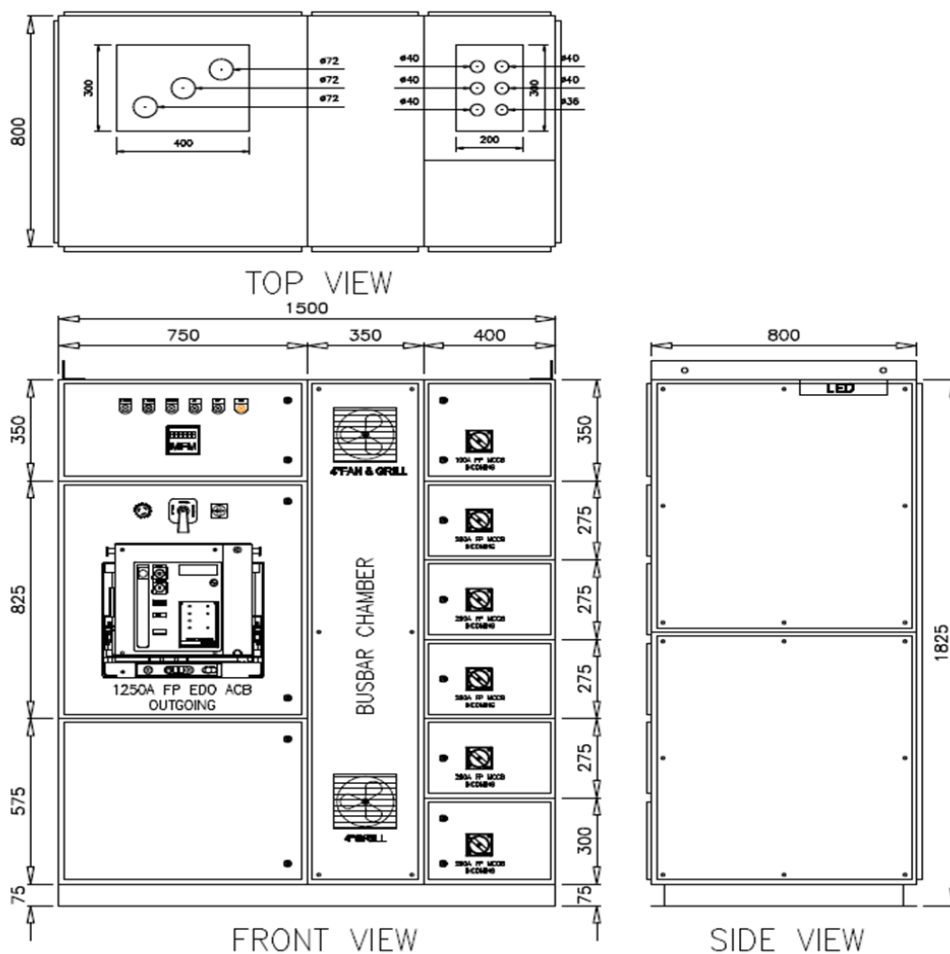


Alternating Current Distribution Box | ACDB

ACDB is a metal enclosed electrical combiner panel fabricated using high grade CRCA sheet coated with 7 tank treatment process paint. All the components inside the ACDB will be compartmentalized individually for ease of access and safety. The panel will be suitably sized and well ventilated to dissipate the heat quickly due to electrical losses without increasing the working temperature beyond permissible limits.

Standard Features

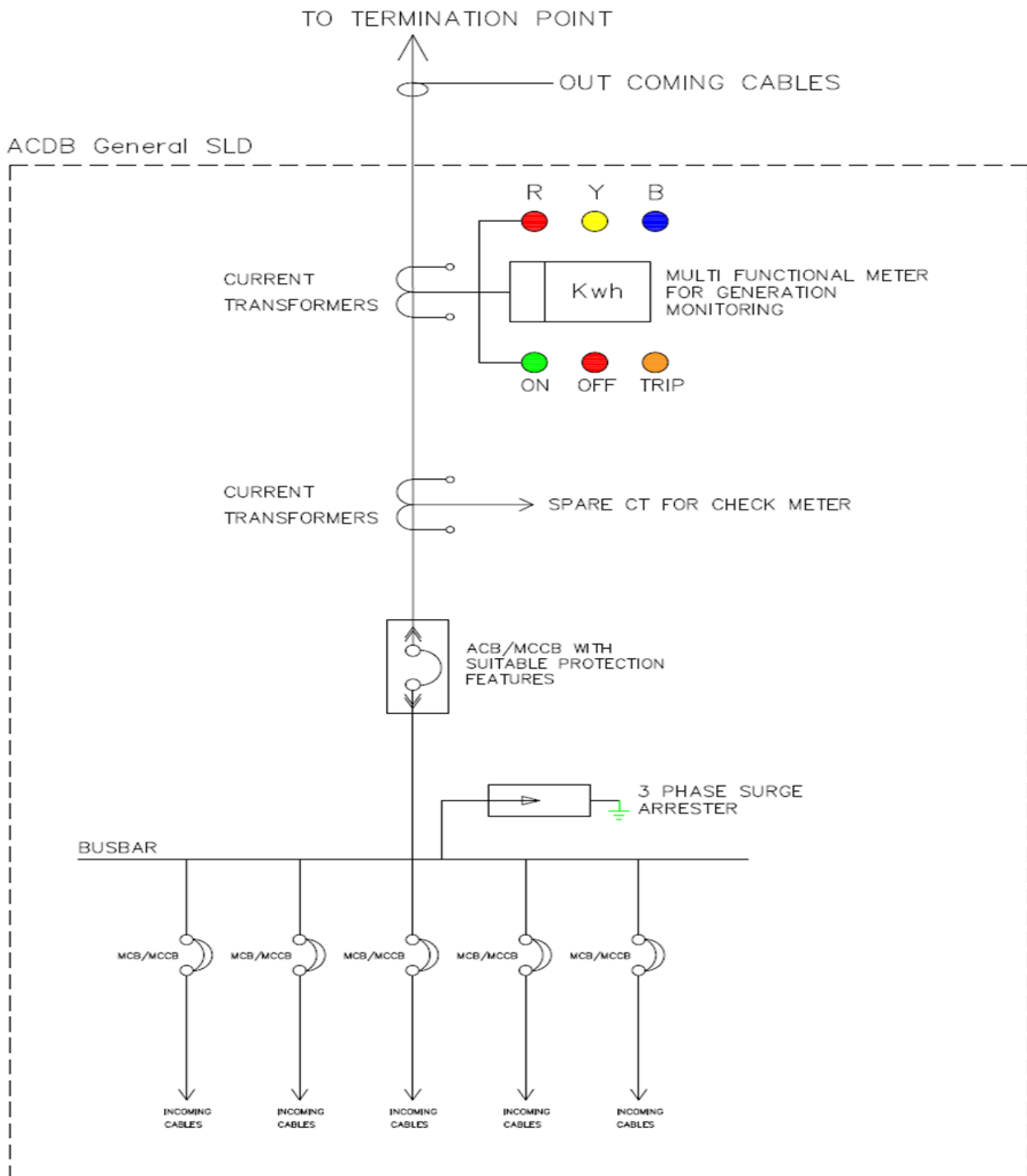
Parameter	Description
Ingress rating	Outdoor/Indoor
Cable entry	Top/Bottom
Metering cabinet	Separate
Ventilation	Forced/Natural
Mounting	Floor mounted
Access Safety	With locking system
Color	Sky grey
Multifunction Meter	Yes



This diagram and dimensions above are only representational, the exact dimensions would vary from mentioned which would be decided by the Becquer team as per the project design



Typical Single Line Diagram of the ACDB:



Non-Puncture Module Mounting Bases

Since the structure is like the backbone of the solar ground mount plant, it has been made ground up using customized channels that are suitable for the location in terms of rust protection, wind loading and flexibility to add cleaning systems in the future. The Becquer structure is capable of being mounted at any height, altitude, or terrain without having to puncture the foundation surface.

Raw Material: Hot Dip Steel, Aluminum, Galvalume with Superior Rust Protection
 Bonding Technique: Mechanical + Civil + Chemical

Precast Structure for Metallic Roofs:

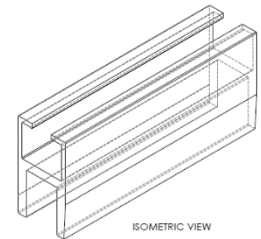
Depending on whether the roof is a seam type roof or a trapezoidal or any other shape, the clamping structure varies accordingly as shown below:

Seam Roof:

Standard Features	
Parameter	Description
Roof Drilling	None
Roof Chipping	None
Base Metal	Al Steel
Rusting Protection	Anodized Zinc Based Hot Dip 120 GSM
Ventilation	Natural
Mounting	Wrap and Clamp Adhesive
Safety	With locking system
Channel Color	Metallic Grey or Black



PLAN



ISOMETRIC VIEW



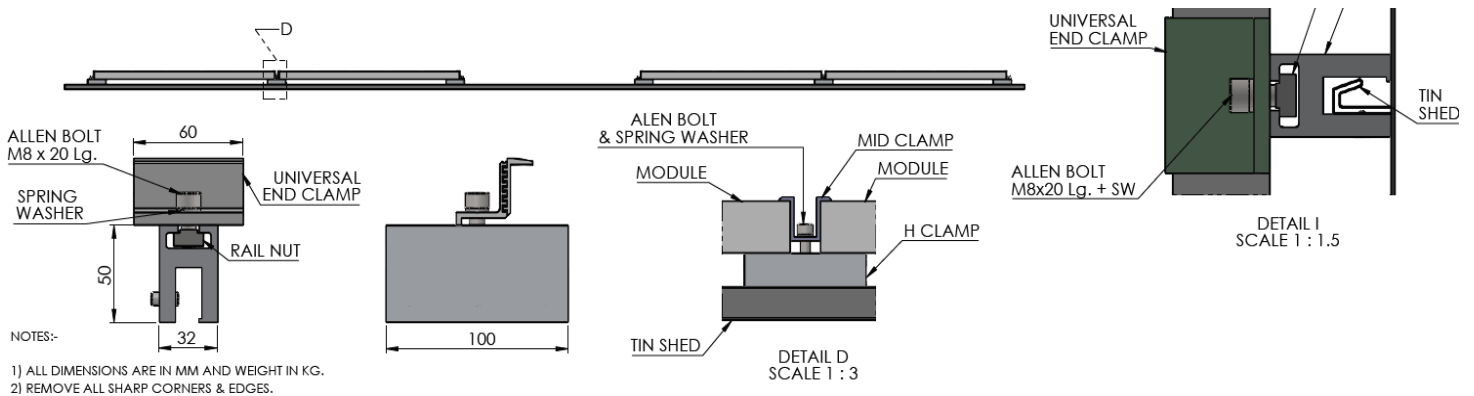
ELEVATION



SIDE VIEW

The exact dimensions of the main channel and its accessories will be decided by Becquer as per its design

Cross Section View of the Clamps and Accessories:



This diagram and dimensions above are only representational, the exact dimensions would vary from mentioned which would be decided by the Becquer team as per the project design

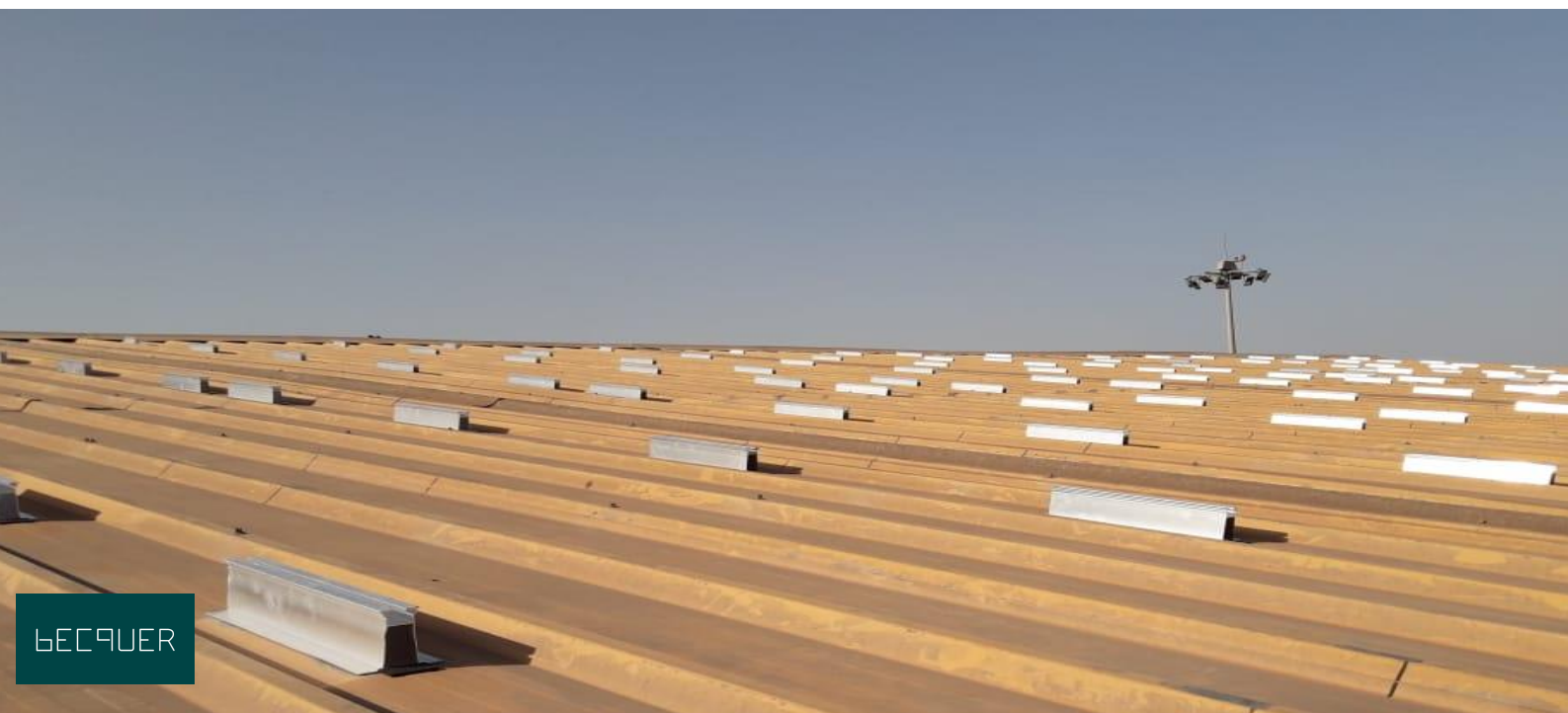
Trapezoidal Roofs:

In case the clamping is not possible, a base rail with an adhesive layer underneath it is attached to the base of the roof to provide the secondary roof for the module assembly

General Adhesive Features	
Working Times	15-18 minutes
Fixture Time	30-35 minutes
Full Cure	24 hours
Gap Filling	Up to .375 inches
Shore Hardness ASTM D 2240	72 - 78D
Elongation DIN 53283	7-18%
Modulus, Psi	75,000 -100,000
Tensile Strength, Psi ASTM D 638	3,100 – 3,300 psi
Service Temperature	-40 0F to 250 0F
	-40 0C to 121 0C

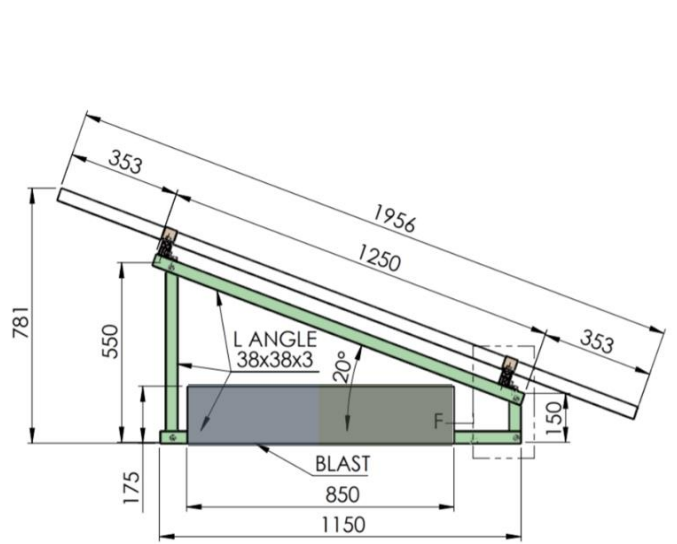
Adhesive Component Features	Resin	Activator
Appearance	Off-White	Amber
Viscosity @ 25 0C, Brookfield RVT	40, 000 – 60,000	40,000 – 60,000
Flash Point (TCC) 0F	51	51
Density	8.07	8.05
Mix Ratio by Volume	1	1

The picture below shows a real-world application of the same for reference purposes



Precast Structure for Concrete Roofs:

Standard Features	
Parameter	Description
Roof Drilling	None
Roof Chipping	None
Rusting Protection	Zinc Based Hot Dip 120 GSM
Ventilation	Forced/Natural
Mounting	Floor / Roof Mounted
Safety	With locking system
Channel Color	Metallic Grey or Black
Counterweight blocks	Marble Stone Brick Concrete



The exact size will be decided by the Becquer team as per the site conditions

The picture below shows a real-world application of the same for reference purposes



Solar Cells and Modules

The solar modules used are selected keeping in mind the following factors:

Highest Space Efficiency

5 – 6 sq meter per kW

Highest Cell Efficiency

18% - 22%

Lower Material Weight

17 tons per MW lesser

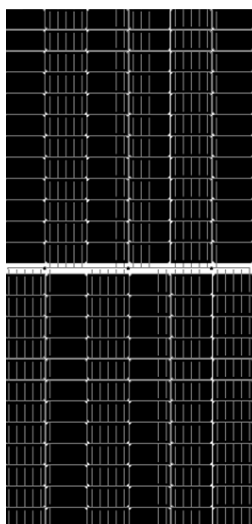
Strongest Chemical Resistant Glass

2-3 mm | tempered

Standard Safety Features

Parameter	Description
Operating Temperature	-40 – 85 Deg Celsius
Power Output Tolerance	0 - +5 W
Voc and Isc Tolerance	+/-3%
Maximum System Voltage	DC 1500 V
Maximum Series Fuse Rating	20 A
Nominal Cell Operating Temperature	45 +/-2 Deg Celsius
Safety Class	Class II
Fire Rating	UL type 1 or type 2
Salt and Ammonia Resistance	Yes
Dust and Abrasion Resistance	Yes

The modules are made with various mixtures of cells, that leads to different looks, power outputs per module, and busbar arrangement on the modules that carry the generated solar current



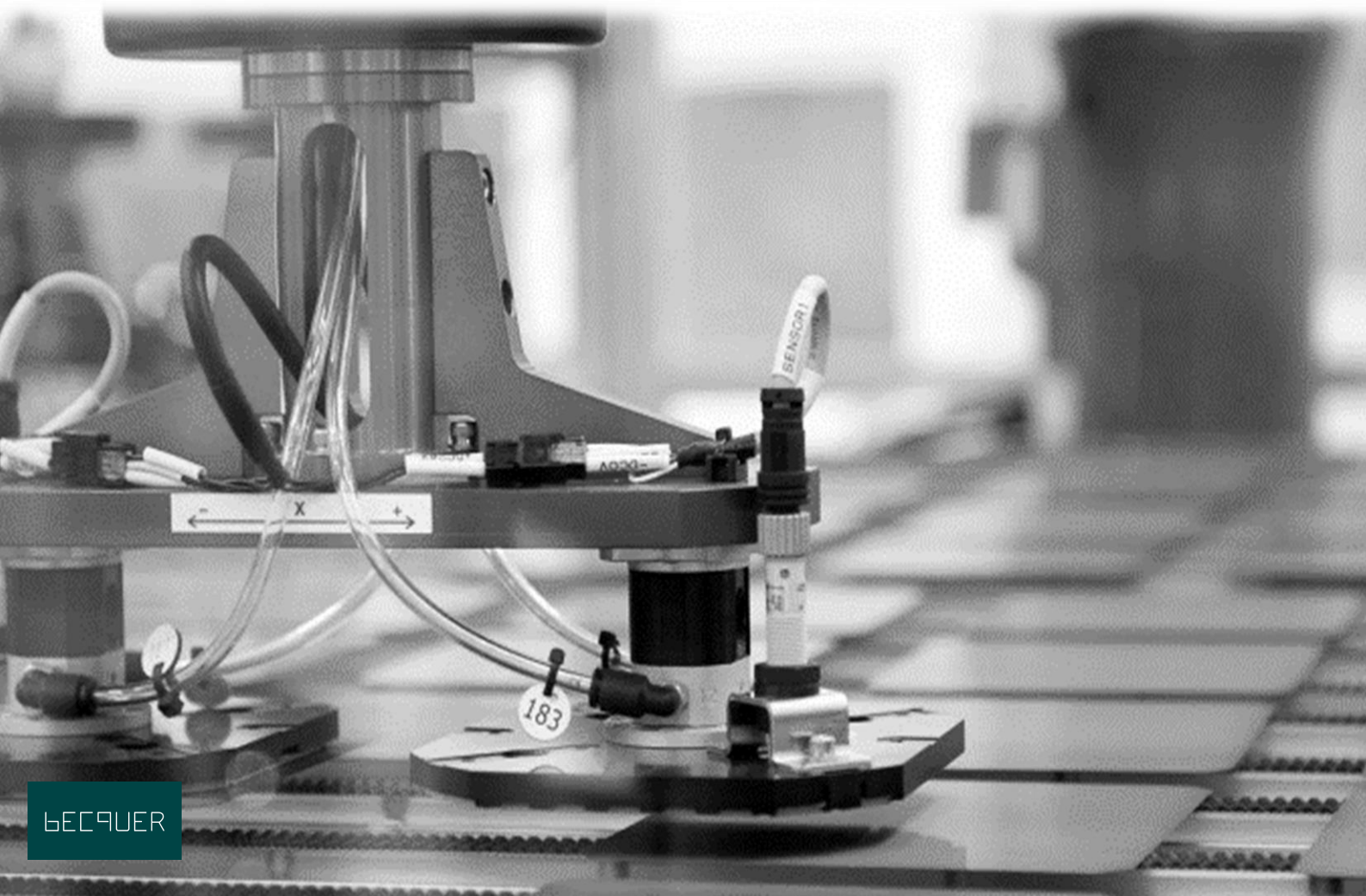
Each module piece will carry the capacity details obtained under standard testing conditions
The shape, size, wattage class may vary according to the raw material availability



Accessories

To attach the components together in a seamless and secure way multiple accessories are needed as listed below. During the assembly work, the Becquer team may add more components at its discretion.

Component	Standard Feature
MC4 Connectors	Tinned copper, weather-proof
Ferrules	Flexible, UV resist
Cable ties	Nylon, UV resist
Cable glands	Double compressed, Heavy duty
Control wiring	Flexible, Copper, PVC
Long barrel Cable lugs	Bimetallic / Aluminum
Cable trays	Black, 80 Microns thick galvanized, Rust free
Fire extinguishers	Dry powder type, ABC type protection
Cable conduits	HDPE Black Metallic
Zinc spray	Pressurized zinc spray
Heat sleeves	High density PVC insulating sleeve
Anchor fasteners	SS 304 grade, Rust free
Nut & Bolt	SS 304 grade, Rust free



Metering architecture – Energy recording & monitoring

The Energy generation from the Solar Power plant must be monitored accurately to quantify & assess performance of plant on timely basis. Becquer chooses state of Art metering infrastructure in terms of smart meters with high accuracy class as per requirements. Various meters for energy include ETV based uni directional , Bi-directional meters, Dual source meters, ABT based meters, Digital multifunctional meters etc. All meters are equipped with RS485 communication module for remote monitoring using SCADA systems.

Standard Features

Parameter	Description
General Dimensions	180 mm X 252 mm X 118 mm
Weight	2 kgs
Enclosure Mater	Fire Retardant Polycarbonate
Sealing Provisions	Terminal Cover Meter Main Cover
Display	8 character alphanumeric with backlight
Connection Type	3 phase, CT operated
Positioning	Inside ACDB
Accuracy Class	0.2s
Ingress Protection	IP 53
Insulation Class	Protection class II
Operating Temperature	-10 – 60 deg Celsius
Remote Communication	2G / 3G SIM based



The exact specifications may be modified by Becquer based on local laws

Power Conditioning Unit – Fuse Less Inverters

Inverters are power electronic converters which convert DC power generated from Solar Arrays into standard 3 Phase or 1 phase AC power to synchronize with Power grid for safe operation. All inverters are up to date upgraded with latest technology for increased conversion efficiency & other salient features.

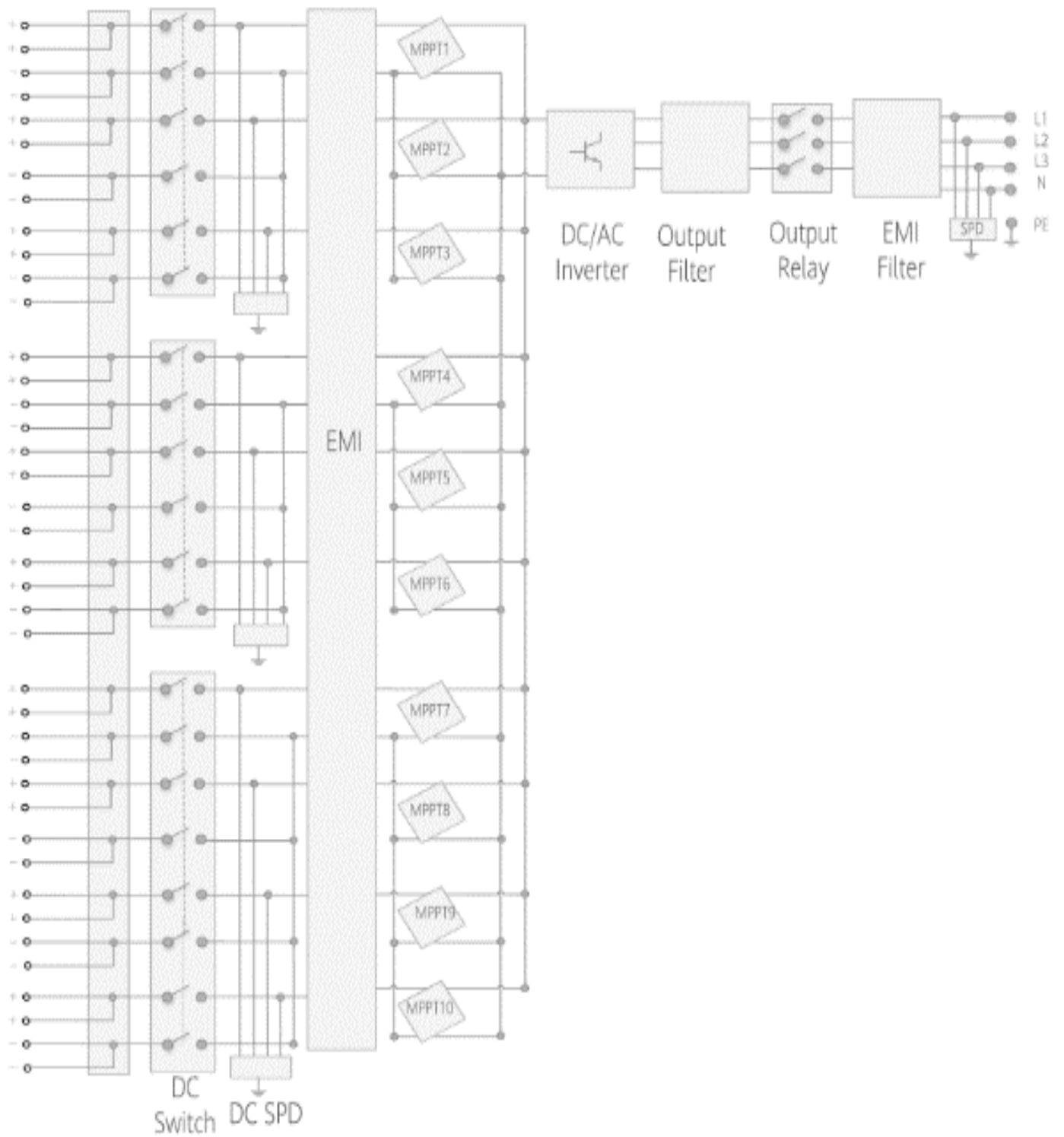
The premium features of modern inverters are as follows:

Standard Features

Parameter	Description
Efficiency	98.%
Management	String Level
MPPT Tracking	5-10 per inverter
Display	LED
Mounting	Floor / Wall Mounted
Grid Code	IEC 61727
Body Color	Metallic Grey / White / Black
Anti-Corrosion	Yes



The diagram below shows the internal architecture of the inverter:



The following 4 features are a must for all inverters or power conditioning units



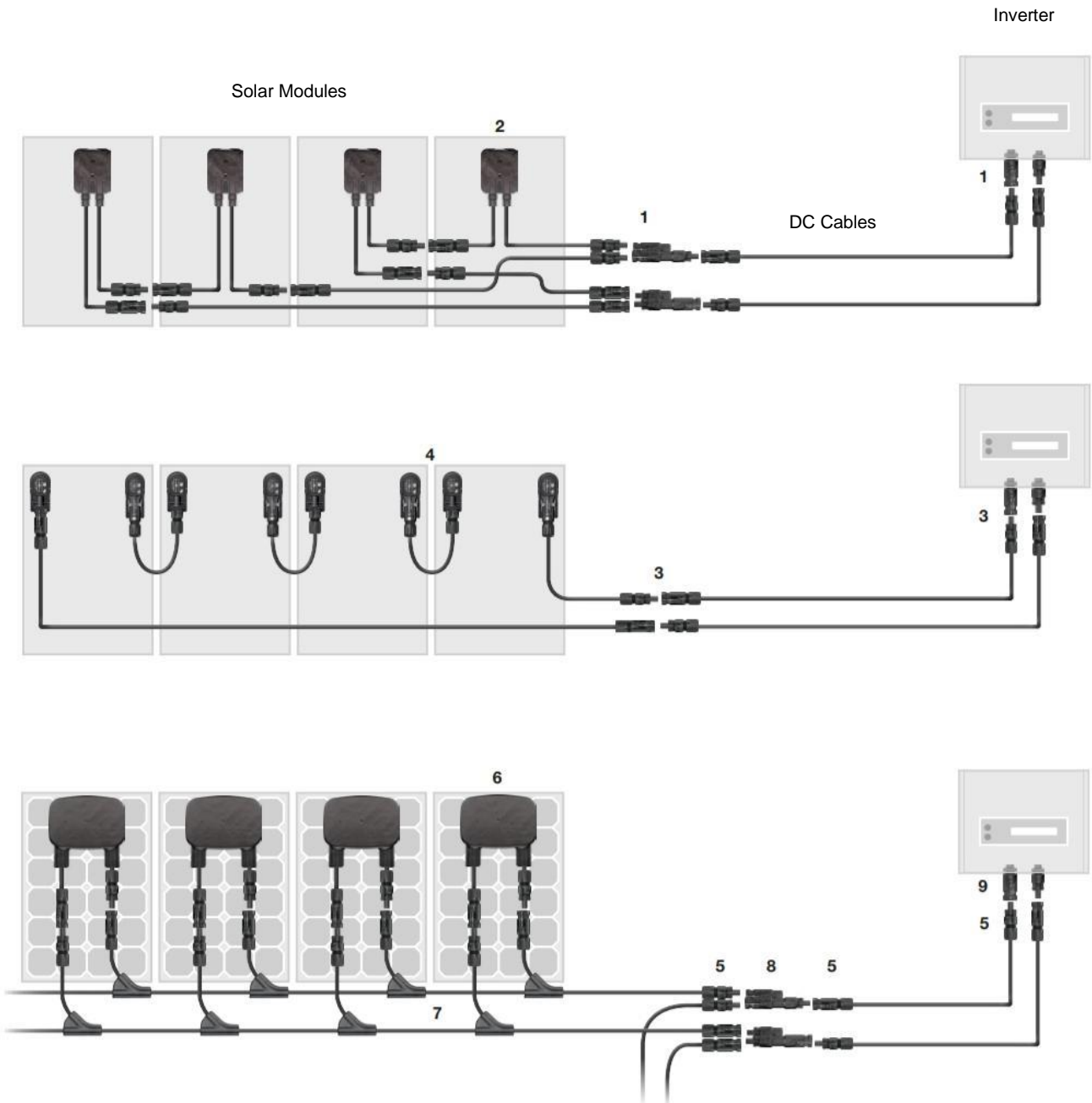
Standard Features

Parameter	Value
Max. Efficiency	98.8% @480 V; 98.6% @415V
European Efficiency	98.6% @480 V; 98.4% @415V
Max. Input Voltage	1,100 V
Max. Current per MPPT	26 A
Max. Short Circuit Current per MPPT	40 A
Start Voltage	200 V
MPPT Operating Voltage Range	200 V ~ 1,000 V
Nominal Input Voltage	620 V @415 V; 720 V @480 V
Number of Inputs	20
Number of MPP Trackers	10
Nominal AC Active Power	100,000 W (415 V / 480 V @50°C)
Max. AC Apparent Power	110,000 VA
Max. AC Active Power (cosφ=1)	110,000 W
Nominal Output Voltage	240 / 415 V, default 3W + N + PE; 277 / 480 V, 3W + PE
Rated AC Grid Frequency	50 Hz / 60 Hz
Nominal Output Current	139.2 A @415 V; 120.3 A @480 V
Max. Output Current	154.6 A @415 V; 133.7 A @480 V
Adjustable Power Factor Range	0.8 LG ... 0.8 LD
Max. Total Harmonic Distortion	<3%
Input-side Disconnection Device	Yes
Anti-islanding Protection	Yes
AC Overcurrent Protection	Yes
DC Reverse-polarity Protection	Yes
PV-array String Fault Monitoring	Yes
DC Surge Arrester	Type II
AC Surge Arrester	Type II
DC Insulation Resistance Detection	Yes
Residual Current Monitoring Unit	Yes
Display	LED Indicators, Bluetooth/WLAN + APP
USB	Yes
MBUS	Yes (isolation transformer required)
RS485	Yes
Dimensions (W x H x D)	1,035 x 700 x 365 mm (40.7 x 27.6 x 14.4 inch)
Weight (with mounting plate)	90 kg (198.4 lb.)
Operating Temperature Range	-25°C ~ 60°C (-13°F ~ 140°F)
Cooling Method	Smart Air Cooling
Max. Operating Altitude without Derating	4,000 m (13,123 ft.)
Relative Humidity	0 ~ 100%
DC Connector	Staubli MC4
AC Connector	OT Terminal
Protection Degree	IP66
Topology	Transformer less
Certificate	EN 62109-1/-2, IEC 62109-1/-2, EN 50530, IEC 62116, IEC 62910, IEC 60068, IEC 61683
Grid Code	IEC 61727

Based on the roof specific factors, the stringing of the DC cables, that is designing the current flow from the solar modules to the inverter in the most optimized way is done using the below 3 architectures.

The overall objective is to reduce the current losses, minimize the heat loss due to current and maintain balancing amongst the current flows between inverters.

3 Architectural Options:



Solar Cables – Direct and Alternating Current Carriers

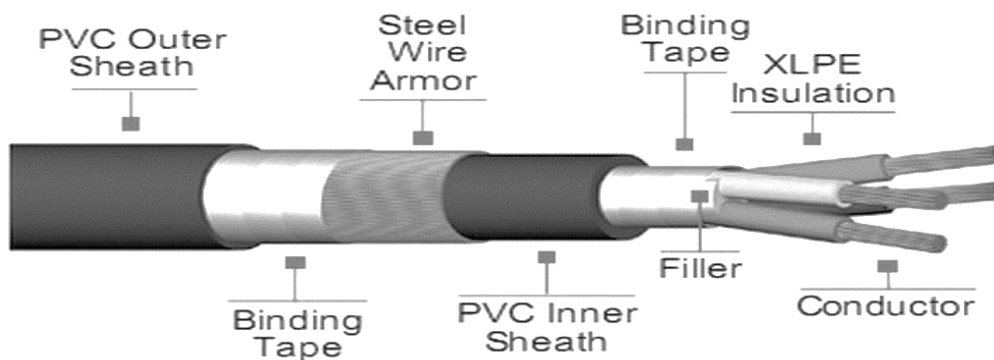
Cables are the electrical links connected between various stages in Solar PV power plant to carry the power to required premises safely and reliably. All cables are tested for performance in globally accredited laboratories.

Standard Features:

- Electron beam cross linked extrusion
- UV, Ozone, Temperature & Hydrolysis resistant
- Flame Retardant, Low Smoke
- Excellent Encapsulation
- Very long / Service life > 25
- Standards / Material Properties
- Fire performance: IEC 60332-1-2
- Smoke emission: IEC 61034/ EN 50268-2
- Halogen Free: EN 50267-2-1/-2, IEC 60754-2
- Toxicity: EN 50305, ITC – Index <3
- Ozone Resistant: EN50396
- Weathering UV: HD 605/A1 or DIN 53367
- Approvals : EN 50618; H1Z2Z2-k



The cross-sectional view below shows the various layers of the cable outer covering and the inner cores. On the DC side generally 4 sq. mm thick cables are used and on the AC side, it depends on the inverter distribution, distance to the LT panel , etc.



Cable Tray & Accessories

Cable Tray accessories guide the cables in an ordered and safe manner. They give mechanical support for support to cables and protect them from various conditions such as mechanical stress, moisture, fire, UV exposure etc. Cable trays will be fabricated using high quality Hot Dip Galvanized iron material or FRP as per the design decision of Becquer with suitable thickness and sizes.

Standard Features:

- High quality HDG trays with minimum of 80 Microns thick | Fibre Glass Reinforced Plastic substrate
- All standard sizes were available
- Most ergonomic design for ease of installation
- Direct plug-in type approach
- Effective Heat transfer process
- All fitting accessories are of SS 304 rust free material
- Channels available in 2.5 – 3 meter long for better transportation and handling
- Channels can be mounted on galvalume sheets, RCC ceilings, Side walls etc.
- Standard thickness available in 1.6 mm, 2 mm, 2.5 mm, 3 mm

Cable conduits

In addition to Cable trays, cable conduits were used to route the cable where cable tray laying is not possible such as on top of RCC roofs, narrow underground tunnels etc. The cable conduits are available in both rigid & flexible units as demanded by the application.

Standard Features:

- Heavy duty PVC conduits for internal applications
- HDPE conduits for external applications due provide protection against UV rays from exposure to direct sunlight
- End cap sealing arrangement to avoid water clogging
- Threaded mouth design for quick & efficient installation
- Suitable “L” & “T” Bends for required turns without additional mechanical stress on cables

Cable Lugs – Terminating Accessories

Lugs are constructed from high-quality materials made with electrolytic copper for high conductivity and tin-plated for corrosion resistance. The Lugs are designed, manufactured, tested and comply with International Standards like BS, DIN, UL and IEC.



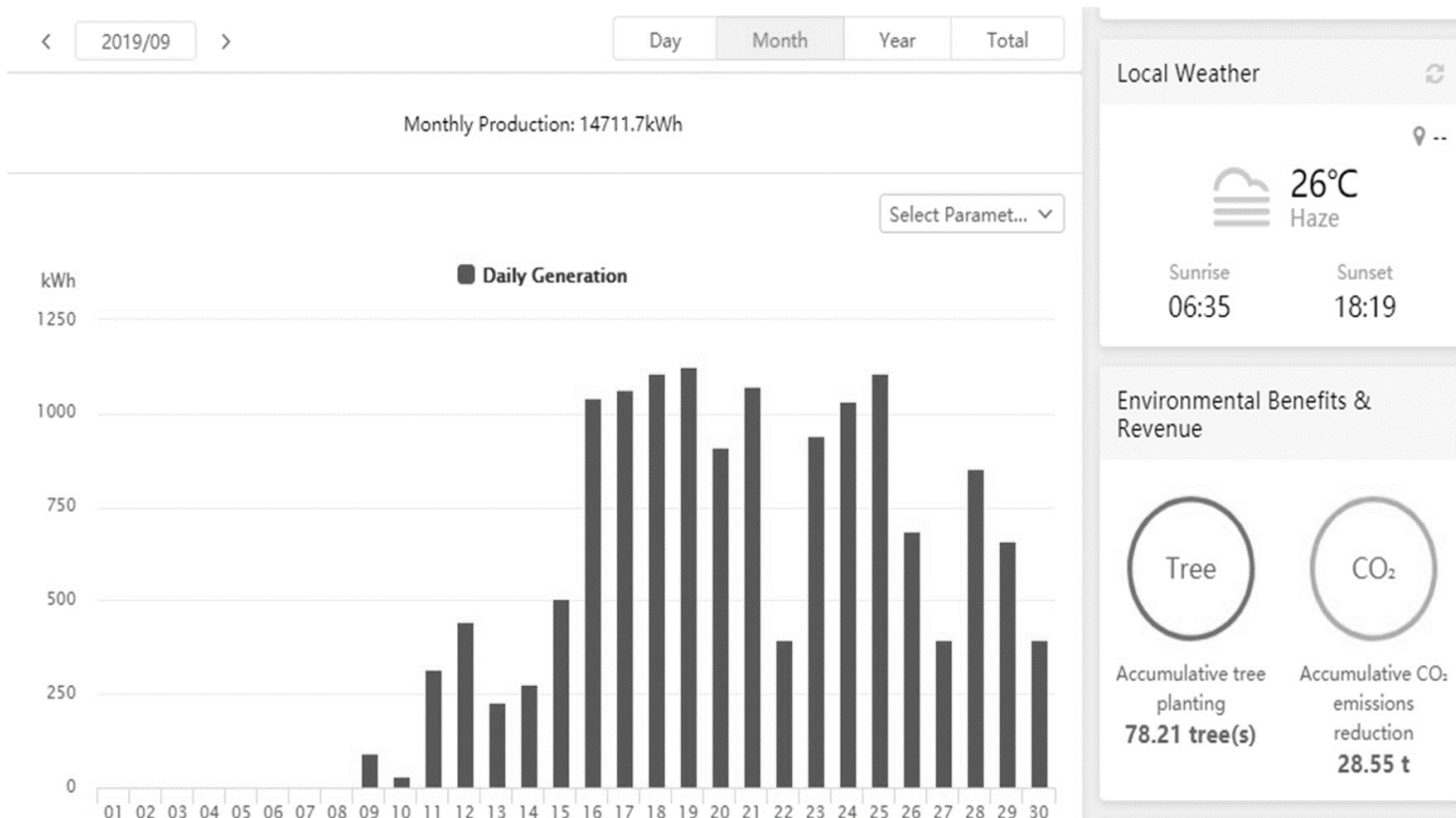
Live Plant Monitoring – RMU

The entire solar plant would be digitalized for its power flow and all key geographical and electrical parameters would be tracked on a continuous basis for 25 years in the following architecture. The night light would be installed for safe and emergency access.

Standard Features	
Parameter	Description
Communication Method	SIM based
SIM Type	2G / 3G / 4G
Output Data View Types	Daily Monthly Annual
Error Log	Monthly
Mounting	Inside ACDB Inverter

All the data would be accessible to the end customer for all the days, with an easy toggling on the online platform that would allow for any historical data to be accessed at the click of a button.

Sample View of the Platform:



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