



Presentation on
"Advancements in PV Junction Boxes: Shaping the Future of Solar Modules".



INDIA'S LARGEST INTEGRATED PV JUNCTION BOX MANUFACTURER

63GW
MANUFACTURING

The DhaSh Giga Factory

63GW Manufacturing Capacity





DhaSh Group of Companies

DhaSh Group is a rapidly expanding, versatile business conglomerate with a global presence, spanning across India and beyond. Our diverse portfolio encompasses Renewable Energy, Automotive, Electric Vehicles, Medical & Pharma, Electricals & Electronics, Defence, and Home Appliances. We have fearlessly taken on formidable challenges, spearheaded ground-breaking initiatives, achieved numerous accolades & milestones, and grown organically to consistently deliver excellence across multiple domains.

DhaSh PV Technologies Ltd

DhaSh Engineering & Automation Pvt. Ltd

DhaSh Polymer Technologies Pvt. Ltd

DhaSh Foundation



About DhaSh PV

- ❑ DhaSh PV Technologies Ltd. is the manufacturer of high quality & high-performance PV Junction Boxes, Cables & Connectors with the State of Art Manufacturing facility of 40 GW at Bangalore, India.
- ❑ Robust in-house processes & systems, high grade testing equipment and stringent quality checks have catered enormous confidence among our clients worldwide.
- ❑ With our manufacturing excellence and worldwide supply chain, sales & distribution, we are the preferred choice for supplies & solutions.





63+

GW manufacturing
capacity by 2025

35+

GW deployed
Junction box on
field

200

+ Customers
globally

20+

Countries to
Export



World's Largest Non-Chinese-Owned PV Junction
Box Manufacturing Company

Mission:

"To be at the forefront of innovation and leadership in renewable energy and automation solutions, continuously expanding our portfolio to address the evolving needs of our global clientele while upholding unwavering standards of excellence."

Vision:

"Empowering a sustainable and technologically advanced world through our pioneering efforts in renewable energy and automation solutions. We envision a future where our contributions drive positive change, foster sustainable growth, and inspire advancements in every sector we touch."





Setting Benchmark in PV Industry

Dhash Group has garnered a series of remarkable accomplishments in the realm of PV (Photovoltaic) Junction box manufacturing and certifications, solidifying its position as an industry leader. These achievements are a testament to the company's dedication to innovation, quality, and sustainability in the renewable energy sector.



- ❑ 1st in India to start PV Junction box manufacturing
- ❑ 1st in India to get IEC Certification for PV Junction box and its accessories
- ❑ 1st in India to get UL Certification for its PV Junction box and its accessories
- ❑ 1st and only Indian PV Junction Box Manufacturer to Have Dual Certification.
- ❑ 1st Integrated PV Junction box manufacturer in India
- ❑ 1st Solar ancillary company to increase scalability of production to 40GW
- ❑ 1st to launch 2000VDC Junction box and Connectors and 35A Rated Junction box



Expansion Plan

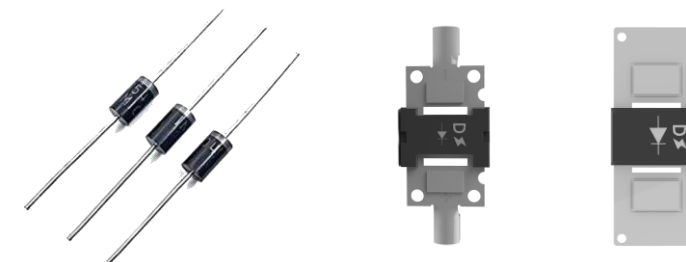
Renewable Energy:

DhaSh PV Technologies has penned out expansion plans to achieve a production capacity of 63GW by 2025 this will make us the **largest Non-Chinese-owned PV Junction box manufacturing company in the world.**



Semiconductor Manufacturing:

Semiconductor is used in everyday electrical and electronic devices. **DhaSh** bringing the technology from Taiwan to produce 1 Million semiconductors per day.



PV Ribbon Manufacturing:

We adding PV Ribbon and Bus bar in our product portfolio , starting with 6.3GW manufacturing capacity and aiming to 25GW in phase manner by end of this financial year.



In house AC/DC Cable Manufacturing with capacity of 1000Km/Day:

Cables in photovoltaic systems play a crucial role, serving as the vital link between system components. Their performance directly impacts the system's reliability, efficiency, and longevity. At DhaSh, we manufacture solar cables using **e-beam technology**, ensuring the highest standards of quality and performance.





Renewable Energy Products

TRIO JUNCTION BOX



POTTED JUNCTION BOX



PV CONNECTORS



**SOLAR
BRANCH CONNECTORS**



**INLINE
FUSE CONNECTORS**



SOLAR CABLE



WIRE HARNESS



**BRANCH
FUSE CONNECTORS**



**PANEL
FUSE CONNECTORS**



PV CONNECTORS CAP





Current Market Scenario & Upcoming Trends

High efficiency PV Modules (700W+), Bi-facial GI/GI with use of Single Axis Trackers (SAT).

Higher capacity of string inverters & central inverters.

Bigger installations due to upscale in module Pmax.

Results in

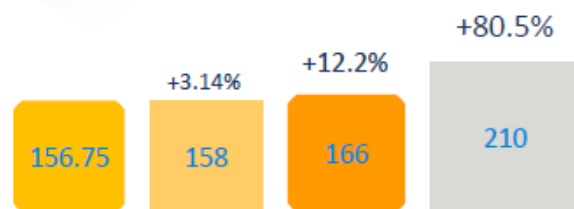
Improved ROI & LCOE (levelized cost of energy).

Reduced O&M activities, project execution times, etc.

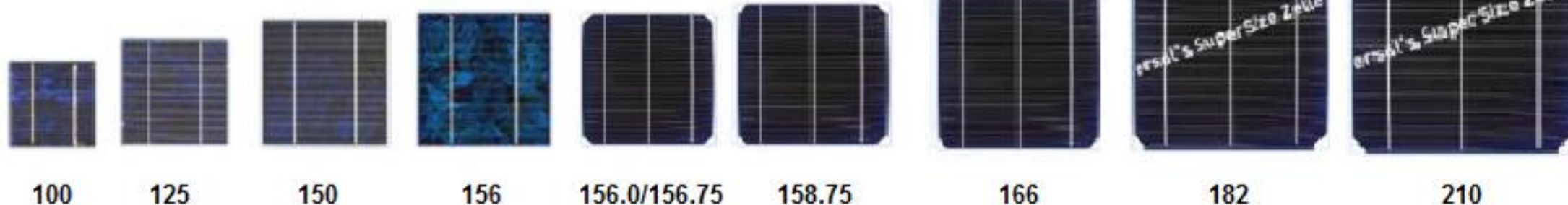
Boost in overall power generation.



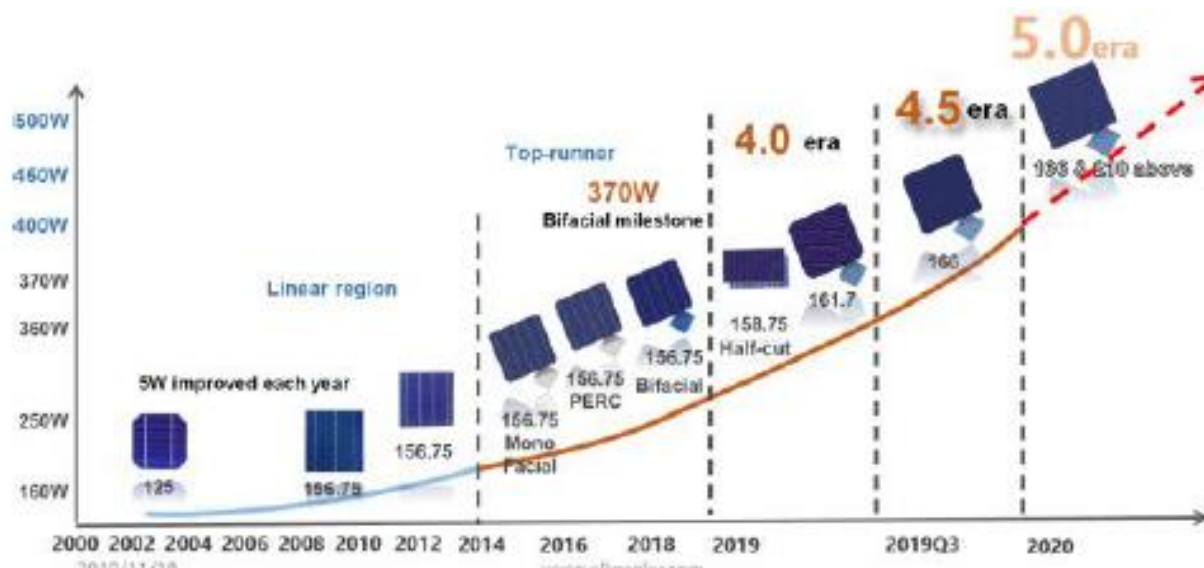
Solar cell dimensions development - Forecast



Current transitions



- MBB (10/12/16/18/20) cells in use.
- Improved cell efficiency up to ~25.5% in n-TOPCon (210(G12)/210R(G12R)) from ~21% in p-mono perc cells.
- Conversion efficiencies of up to ~23% (module efficiency)



1 2 3 4 5 6 7 8 9 10 11 12

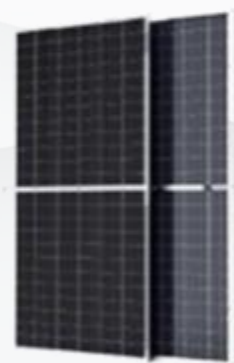


MBB(Multi-Bus bar):

Multiple bus bar match large size wafer perfectly



Solar Cell Size vs Module Pmax Trend



Mono Perc (p-type)
TOPCon (n-type)
HJT





Increased Module Isc vs Junction box rated Current

According to IEC 61215/61730:

JB Rated Current IR > Module Isc*1.25, for mono-facial module, at STC

JB Rated Current IR > Isc*(1+30%*Ø)*1.25, for bifacial module, at STC, where Ø=bifaciality (normally between 65%~75%)

Below table explains recommended specifications for Junction Boxes based on module Isc:

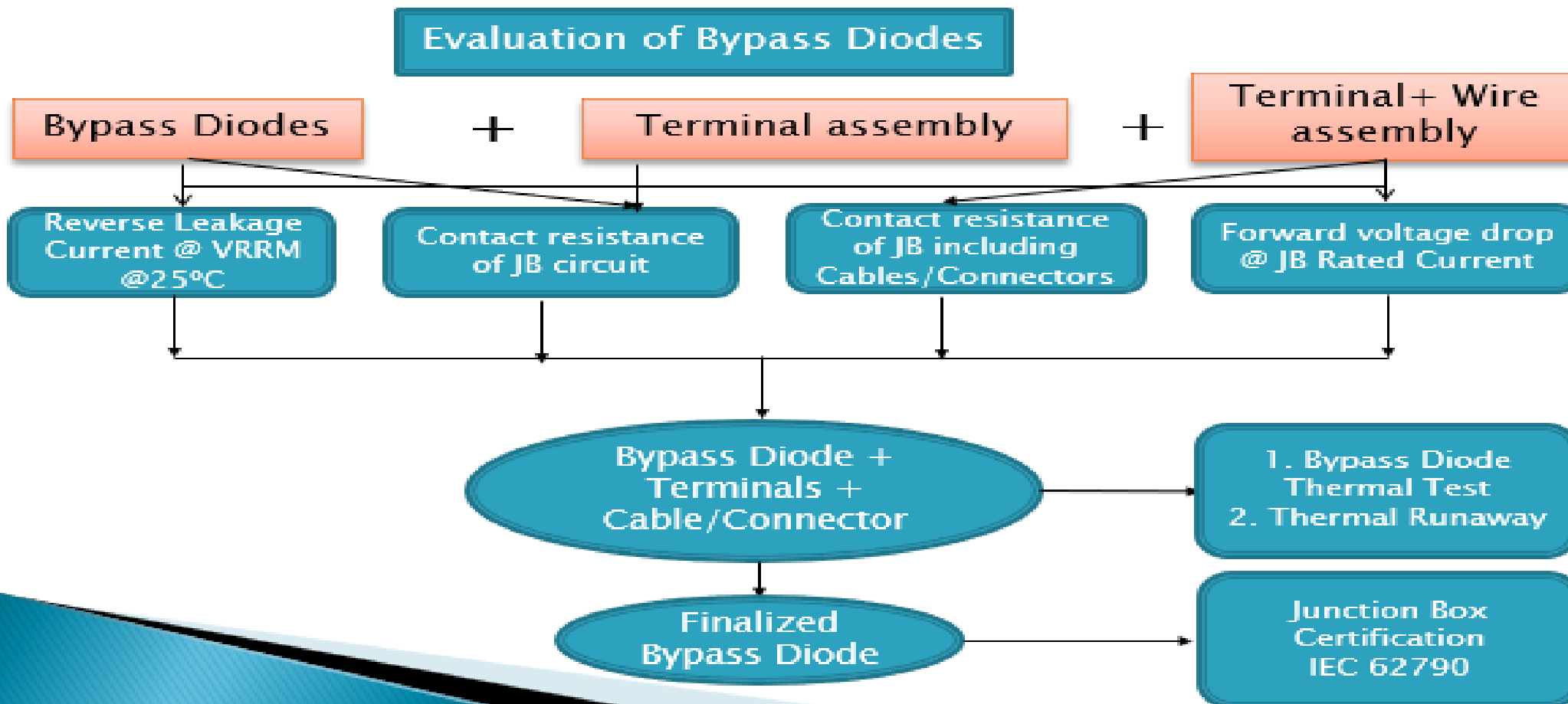
| Cell Size | Cell Type | Approx Module Isc limit (A) (front) | Bifaciality + Irradiance + Safety Factor component (1+30%*75%)*1.25 (STC/25deg.C) | Worst case module Isc (STC/25deg.C) | Worst case module Isc (elevated temp./75deg.c) | JB Rated Current (A) (IR) | Ratio IR/Isc(worst/elevated) | Safe Operation % (at elevated temp.) |
|-----------|-----------|--|--|---|---|---------------------------------|---------------------------------|---|
| M10 | Half Cut | 14.5 | 1.53 | 22.20 | 22.76 | 25 | 1.10 | 10% |
| G12R | Half Cut | 17 | 1.53 | 26.03 | 26.68 | 30 | 1.12 | 12% |
| G12 | Half Cut | 19 | 1.53 | 29.09 | 29.82 | 35 | 1.17 | 17% |

- ✓ With increase in cell wafer sizes, sufficient care to be taken on JB rating as well, for safe operation with increased module current.
- ✓ DhaSh Trio is rated in such a way that there are always sufficient safe margin of operation over worst case module Isc. DhaSh Trio fulfils all the requisites of all types of PV Modules, especially the ones manufactured with G12R & G12 solar cells having very high level of Isc.
- ✓ The operating current of the module will not exceed the rated current of the Junction Box in any of the above cases stated.



Critical BOM Selection Process

Critical BOM like "Bypass Diode" has to undergo stringent test & trials before considering for Product Certification





Key Changes in PV Junction boxes, Connectors and Cable

DhaSh Trio JB gradually replacing traditional 4-Rail JBs in higher wattage modules (double glass/twin type pv module assemblies).



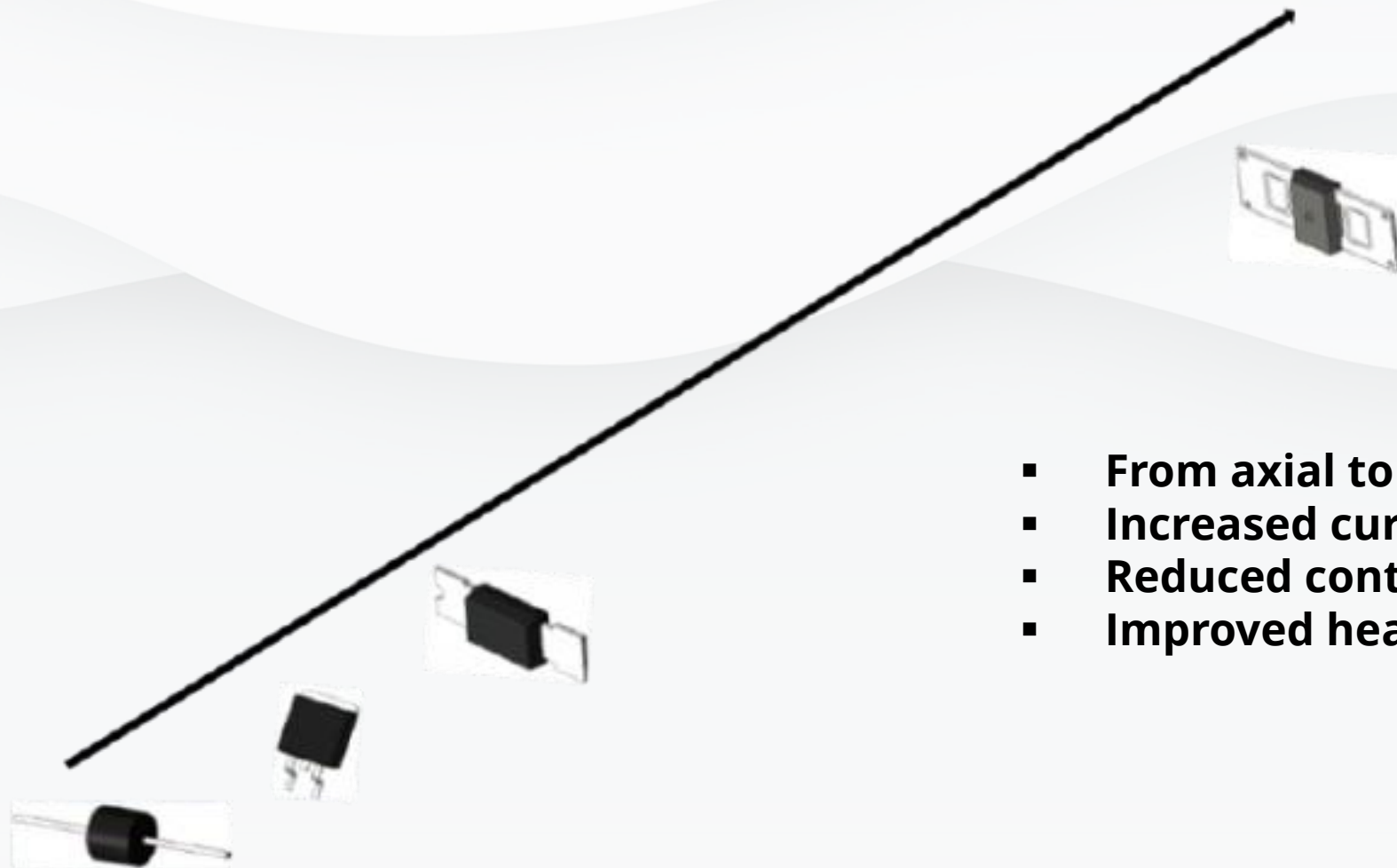
4-Rail (Conventional) DhaSh JB

1. Increased rated current for **DhaSh Trio JB (35A Rated)** as well as for the bypass diodes to meet higher current requirement of **PV Module (Isc - up to 19A)**.
2. Enhanced current carrying capacity for PV Connectors.
3. Increased insulation thickness for Solar Cables.

DhaSh Trio JB (Current Transition)



Evolution of Schottky Diode Packages



- From axial to integrated module
- Increased current handling capacity
- Reduced contact resistance
- Improved heat dissipation ability



Enhanced Reliability Factors of DhaSh Trio

- **3xIEC 62790:2020** compliant for longer duration tests like Thermal Cycling & Damp Heat, in addition to regular single round of tests covered under IEC 62790:2020.
- India's first integrated JBox manufacturer to be compliant with **UL 3730** for Junction Box & **UL 6703** for Connectors, especially for the US Market clients.
- JB Rated Current till 35A.
- DhaSh Trio JBox Rated for **Reverse Current of 50A**, workable with **fuses/over-current protection devices rated till 35A**
- DhaSh Connectors (1500V DC) qualified to sustain IP68 test conditions for the **duration of 500hours** & at an immersion depth of 1.2mtr





2000V DC Products – Future ready Solutions

➤ *High performance products designed to meet higher rated voltage requirement on system side (invertors & similar components):*

- **2000V DC Connectors (DS01a):**

- a) Higher Rated Current (45A with 4sq.mm & 55A with 6sq.mm)
- b) Robust material grade with improved RTI (up to 120deg.C)
- c) Sleek design, Compatible with 30x30mm frame of pv module
- d) Corrosion free, IP68 Rated, UV resistant and flame retardant.
- e) Compliant under UL 2KV & other international standards.

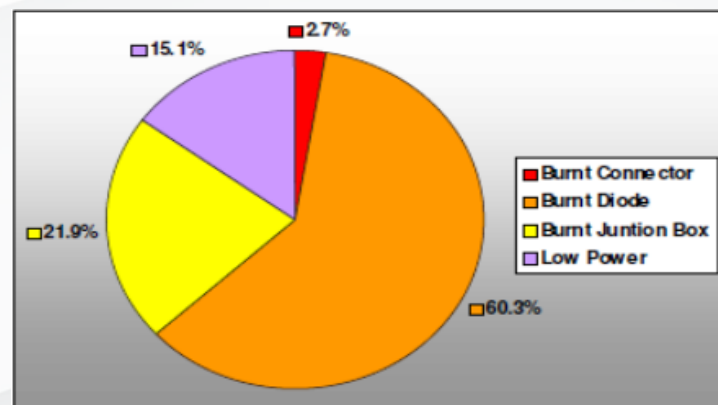
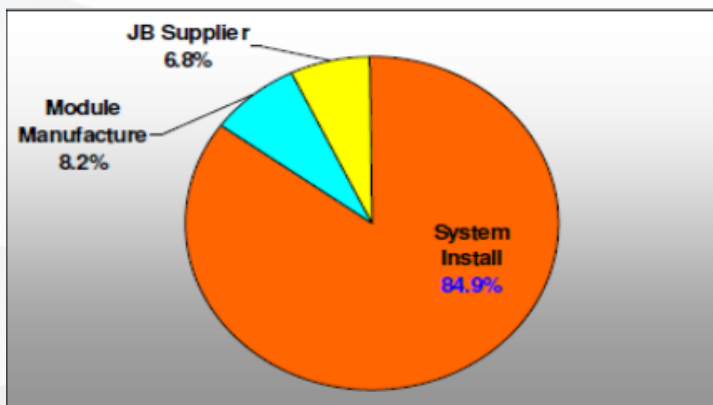
- **2000V DC Junction Box (DSJB18y):**

- a) Compact rectangular design with increased creepage to meet international standard guidelines.
- b) Bypass diodes protected against thermal runaway with superior heat dissipation & lower junction temperature.
- c) JB rated till 35A.
- d) Corrosion free, IP68 rated, UV resistant and flame retardant.
- e) Provision of outer lid locking mechanism.
- f) Optimal usage of glue & potting compound.
- g) Compliant with UL 2KV & other international standards.



How Junction box is Critical Component ?

- Burnt bypass diodes & Junction Boxes (due to EOS/lightening strikes, ground imbalances between earth pits & other secondary surge impacts)

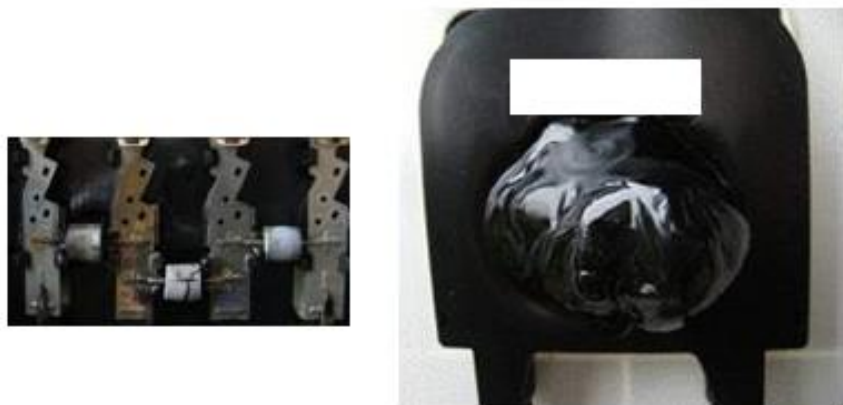


Sources: Reliability Investigation of PV Junction Boxes based on 1GW worldwide field database

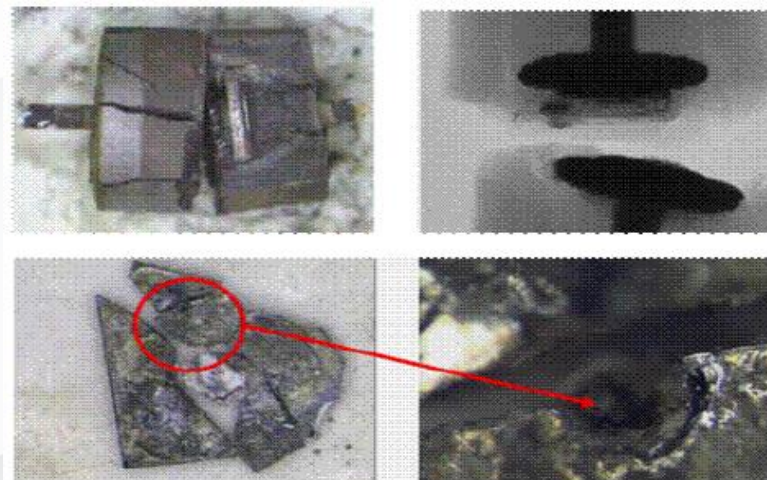
- Burnt PV Junction box (due to poor crimping out of unauthorized & manual rework at installation site)
- Burnt PV connectors (due to partial/incomplete mating of pv connector counterparts during commissioning)
- Cross mating of PV connectors (leads to high contact resistance)
- Improper connector nut tightening during site rework (overtightening – stress , under-tightening – IP issues)
- Absence of fuses in DCDB/DC Combiner Boxes, resulting in high surges flowing to module side from system side
- Solar cable damages out of sharp edges
- Ground arc fault



Few Examples of Potential Failure Mode



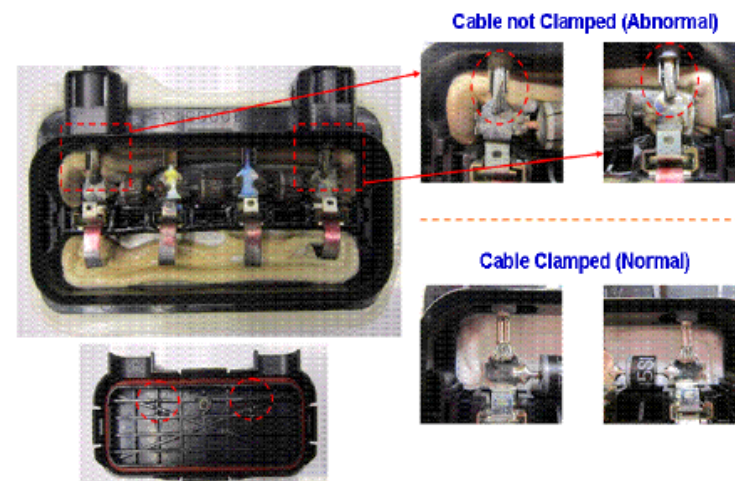
The faulty example for burnt bypass diode junction box



Visual and X-ray inspection for burnt bypass diode.

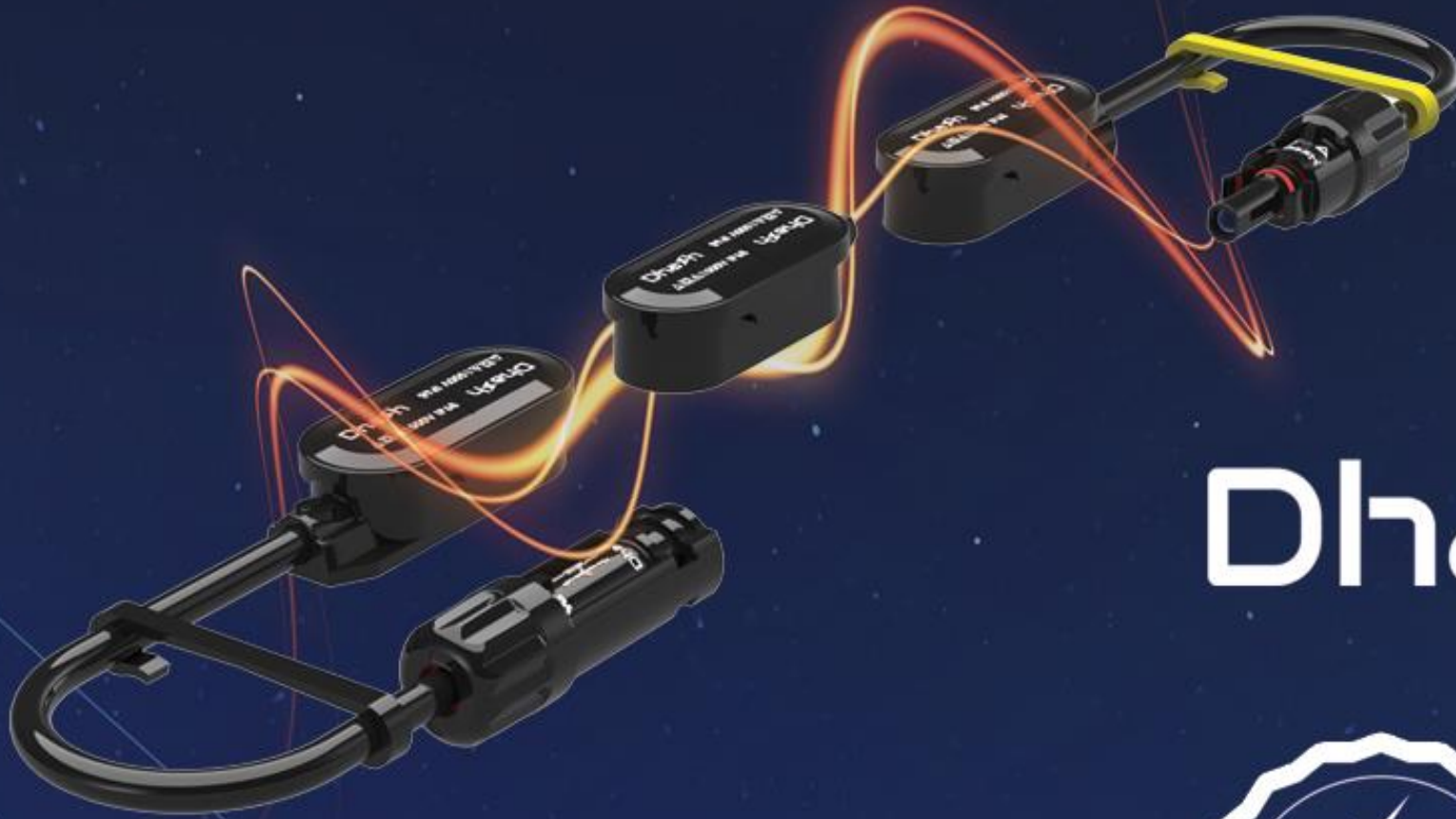


The faulty examples for rework cable of junction box.



The faulty example for cable without clamping in JB.

INTERNATIONAL
CERTIFICATIONS



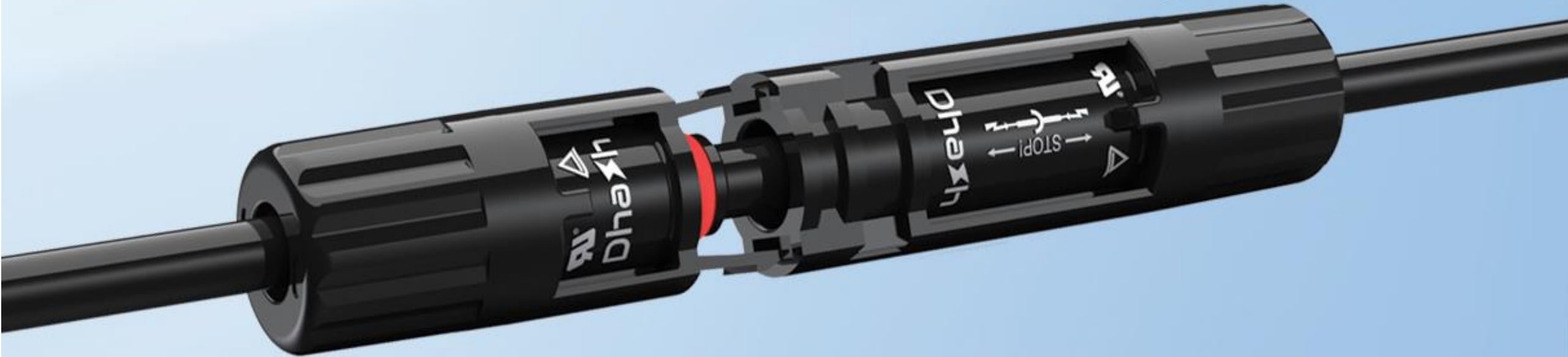
DhaSh-TRIO[®] PRO

FOR PEAK SOLAR PERFORMANCE



DhaSh PV Technologies, after unfolding its caliber in the conventional products, again steals the show with it's show-stopper, the "DhaSh TRIO" JB, coming as a set of three!

Built Tough for Maximum Efficiency





200+ Clients In Renewable Energy Sector

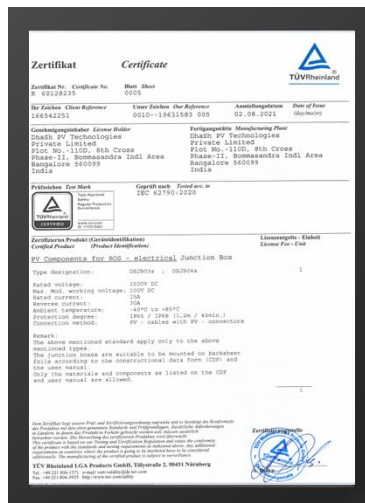
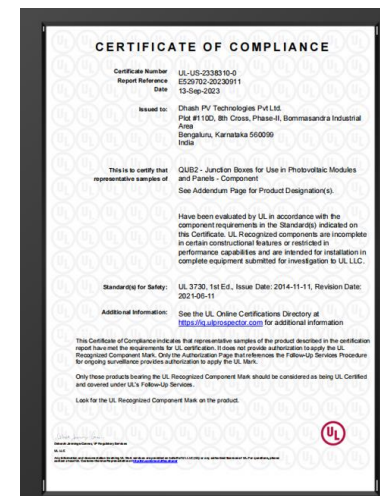
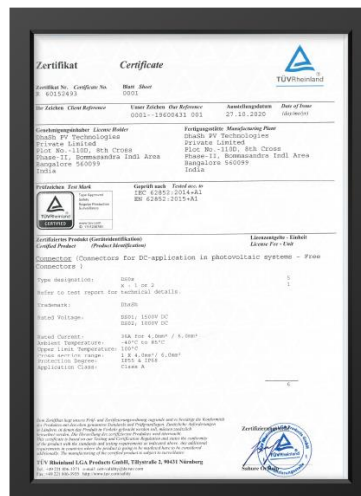
Domestic Customers



to name a few.



International Certification





Awards & Recognitions



startupindia

Startup India Recognized



2020 Module Company of the
Year: Component (PV Junction
boxes and Connectors)



2022 Module Company of the
Year: Component (PV Junction
boxes and Connectors)



Equipment Manufacturer
of the year 2023



Presented to
Mr. Manjunath N Reddy



THANK YOU!

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