



**mitsubishi
electric**

PHOTOVOLTAIC MODULE

Changes for the Better

T o p i n Q u a l i t y





**Japan – Leading the World in Photovoltaic Generation
Mitsubishi Electric is a leading manufacturer of reliable
clean-energy systems worldwide.**

The price of oil continues to escalate higher as fossil fuel reserves are depleted, further enhancing the importance of resolving the problem of future energy supply.

Mitsubishi Electric has brought the world many machinery breakthroughs in the new energy and energy conserving fields, in targeting the environment and energy issues. Among these advances are our photovoltaic power generation systems, which, riding the heightened global environmental awareness in recent years, are now in wide use not only in Japan but around the world as well.

Our photovoltaic power generation technology stems from the combination of artificial satellite technology inherited into solar cells and with power generation plant and semiconductor technology evolved into photovoltaic inverters, with numerous milestones having been achieved to date. Having accumulated extensive experience in the industry, we are now pleased to introduce our reliable photovoltaic systems, developed to provide superior performance.

**From solar cells, to inverters. At Mitsubishi Electric,
we independently integrate all of our development
and production operations.**

The shift to photovoltaic power, as the promised energy source of the 21st century, continues to gain momentum. With increased use, however, comes rising demands for reliability. To meet that challenge, Mitsubishi Electric has moved to integrated production of all system equipment, from solar cells to inverters, at its own plants. Complementing premier performance, the hallmark of all Mitsubishi Electric products, the stellar reliability of these systems ensures their introduction with full confidence, and total peace of mind. Photovoltaic power generation systems, from Mitsubishi Electric. When you're looking for the very best.



The plant is ISO 14001 certified for environmental management systems. Our environmental protection philosophy is reflected in all activities from development through to manufacturing and sales.



Mitsubishi Electric Corporation's Nakatsugawa Works is an ISO certified plant, having obtained both ISO 9001 Quality Management System and ISO 14001 Environmental Management System certification.

—— Fusing the Latest Advances in PV Cells technology and PV Inverters technology ——



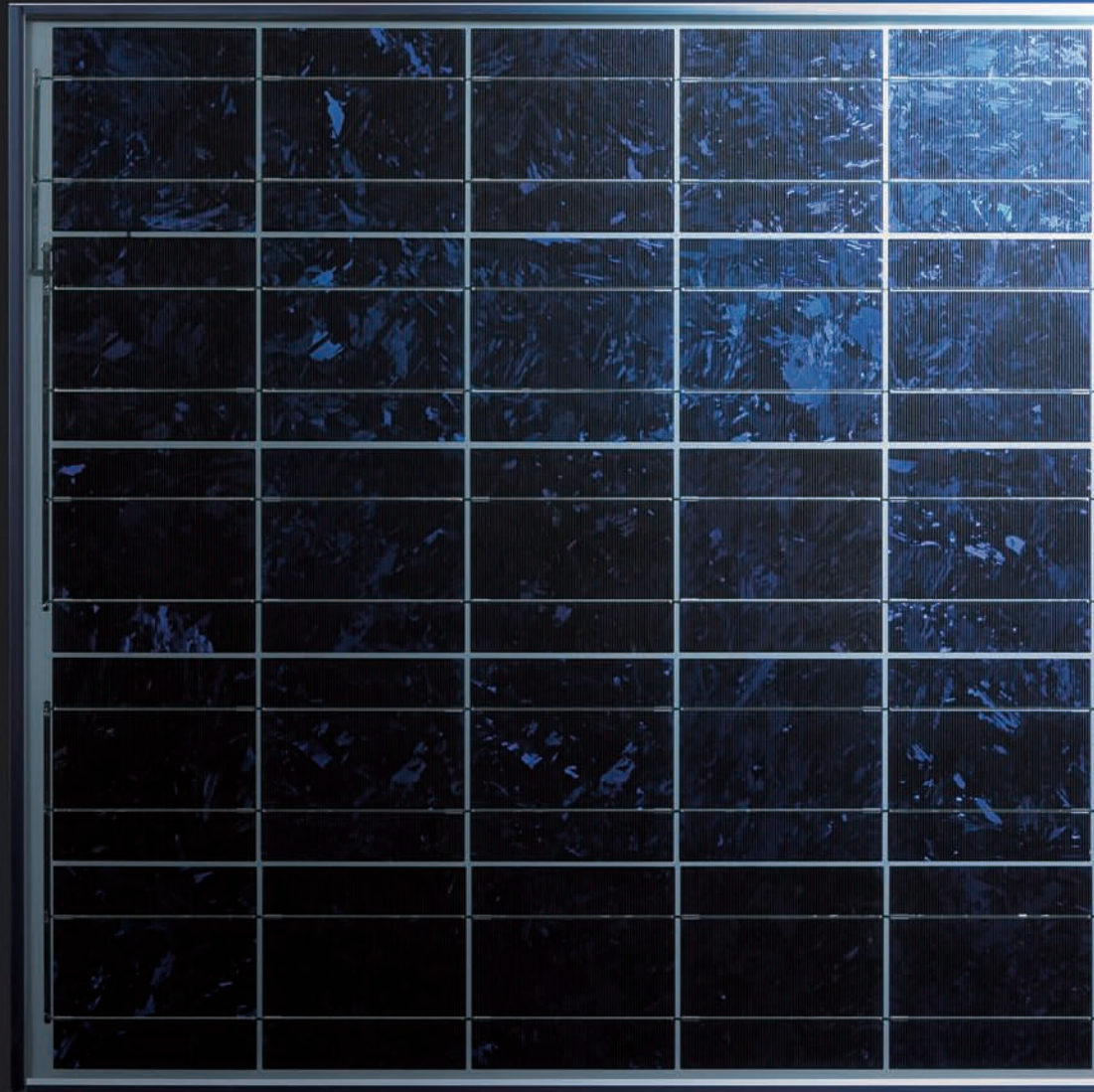
The Mitsubishi Electric standard artificial satellite, equipped with our in-house produced solar cell paddles.

- 1974 **Started research & development of PV technology.**
- 1976 **Established space satellite business.**
- 1981 Commenced joint research of industrial-use photovoltaic inverter with New Energy and Industrial Technology Development Organization (NEDO) and electric power companies.
- 1982 Commenced shipments of industrial-use photovoltaic inverters.
- 1985 Delivered 1000kW Central photovoltaic inverters (Saijo City, Ehime Prefecture) (Delivery included one 200kW inverter, two 400 kW inverters)
- 1987 Commenced research on residential-use photovoltaic inverters.
- 1993 Delivered 750kW system (one of the largest of its in Japan) to Miyako Island, Okinawa Prefecture.
- 1996 **Started residential system business at Nakatsugawa-works.**
Commenced production and sales of residential-use photovoltaic inverters.
- 1997 Awarded New Energy Vanguard 21 prize for residential-use photovoltaic inverters.
- 1998 **Established a PV plant and started production of PV cells and modules at Iida factory.**
- 1999 **Awarded Good Design Award for roof-integrated modules.**
- 2000 Commenced sales of industrial-use photovoltaic inverter unit (10kW).
- 2001 **Expanded production capacity of solar cells to 25MW.**
Awarded the 6th New Energy Award by residential system for hip roofs.
- 2002 Commenced sales of residential outdoor-use photovoltaic inverters and booster units.
- 2003 **Expanded production capacity of solar cells to 35MW (January).**
Established a PV plant (Kyoto factory), and started production of PV modules.
Started production of "Lead-Free Solder" PV modules.
Expanded production capacity of solar cells to 50MW (September).
- 2004 **Expanded production capacity of solar cells to 90MW (July).**
Commenced sales of residential small-capacity and outdoor-use photovoltaic inverters.
- 2005 **Expanded production capacity of solar cells to 135MW (April).**
Commenced sales of industrial-use photovoltaic inverters with operation data monitoring system.
Established residential-use inverter assembly plant at Nagano factory.
- 2006 Commenced sales of photovoltaic inverters to European market.
Commenced production of larger PV cells (156 x 156mm).

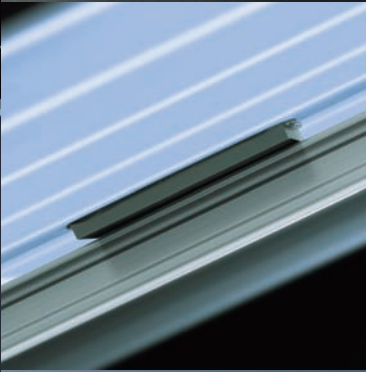
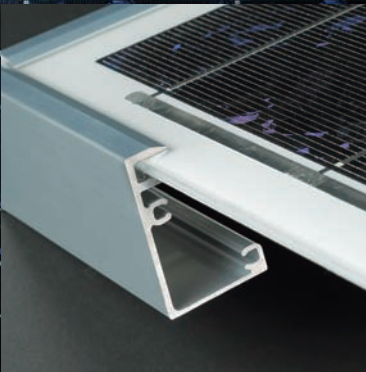
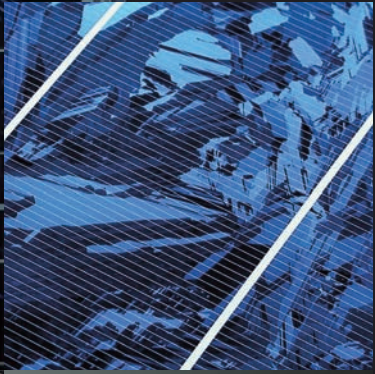
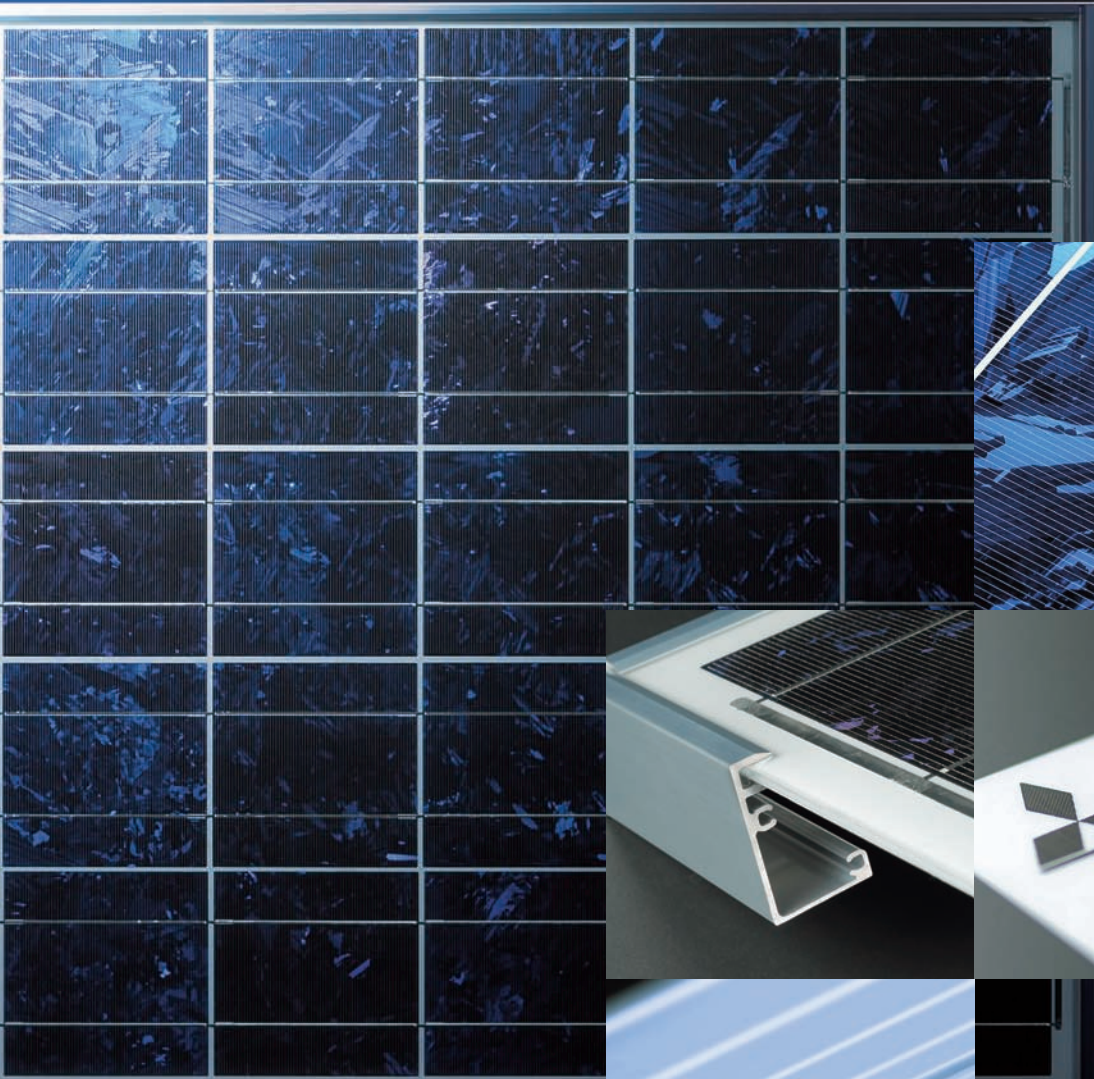


The central photovoltaic inverter (400kW) delivered for the 1000kW system in Saijo City, Ehime Prefecture.

**Technologically advanced, beautiful in form.
The photovoltaic module with optimal efficiency.**

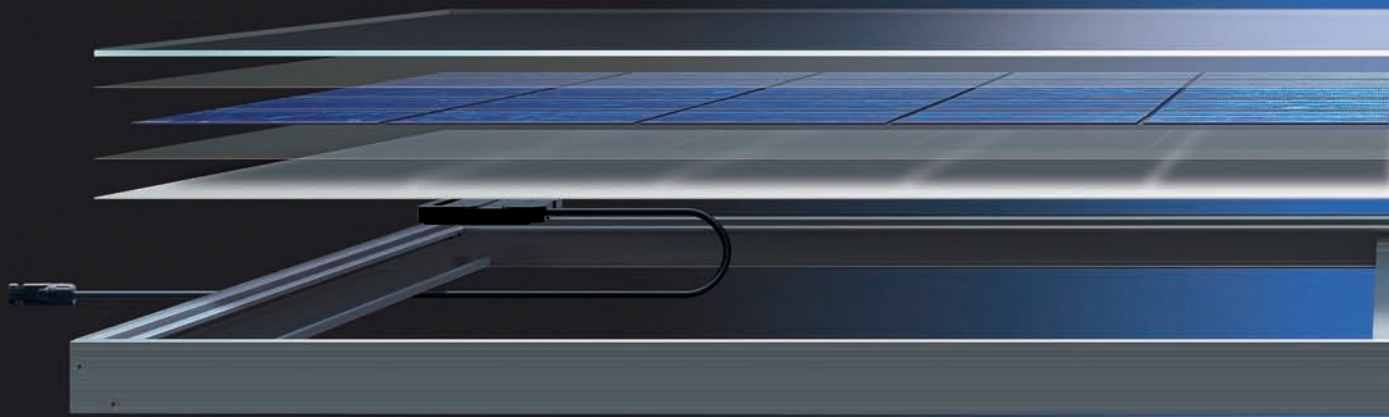


Photovoltaic Module



Condensing more than 30 years of R&D experience and know-how, and the milestone technologies of a leading electrical and electronic manufacturer. Photovoltaic modules from Mitsubishi Electric.

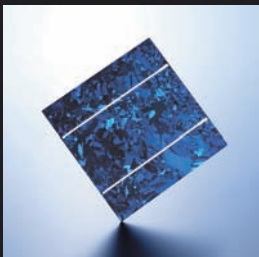
Mitsubishi Electric photovoltaic modules – strategically condensing the latest breakthroughs in space satellites, semi



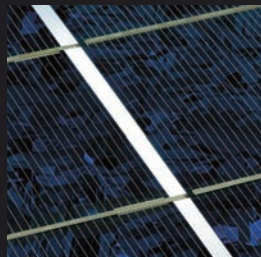
■ HIGH EFFICIENCY

■ HIGH RELIABILITY

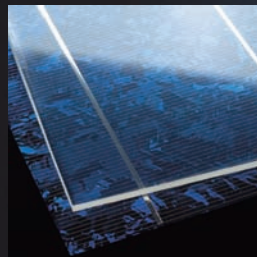
Solar cell



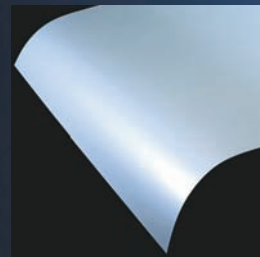
String of cells (c)



Tempered glass (a)



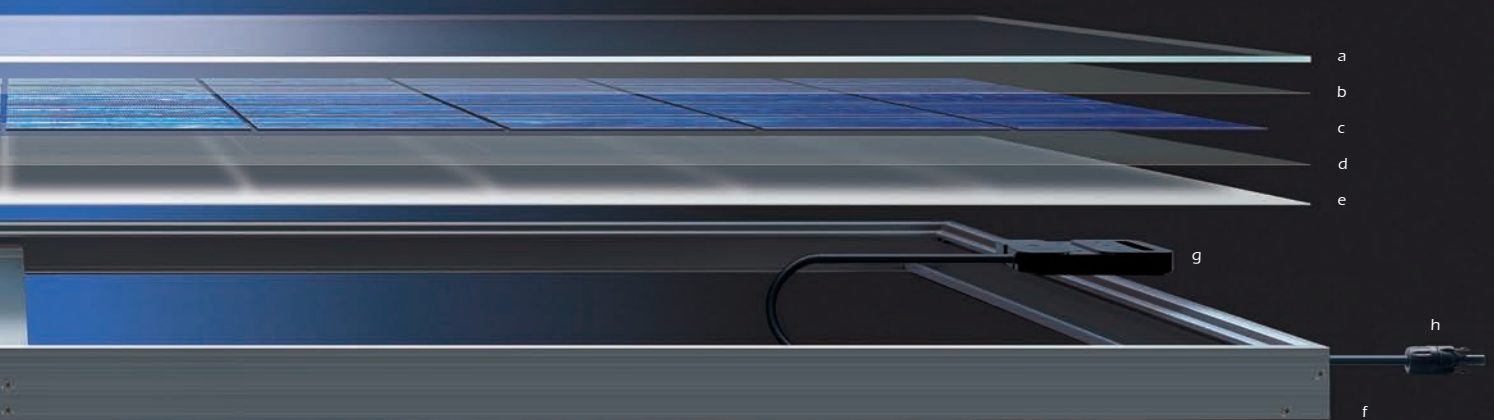
Backfilm (e)



EVA (b, d)



conductors and other key fields.



■ H I G H S A F E T Y

■ E C O - F R I E N D L Y

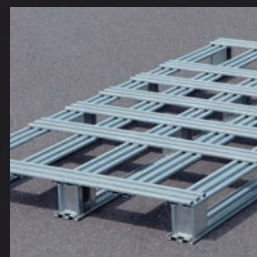
Frame (f)

Junction box (g)

Connectors (h)

Recyclable steel pallet

Eco-factory



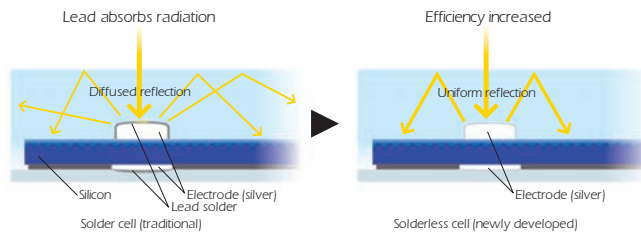
High-efficiency modules not only make effective use of limited space, but also contribute to lowering system cost by reducing the number of modules in use. At Mitsubishi Electric, particular keen efforts have been channeled into enhancing the efficiency of the actual use environment. Experience the stellar caliber of efficiency available only from Mitsubishi – the company renowned for a long history of excellence and an independently integrated production.

High Efficiency

High Efficient cells

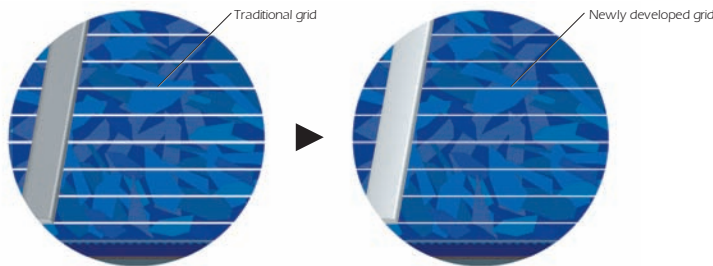
Solder-coatingless cells

For the silver electrodes formed on the solar cell surface, we have succeeded in developing a composition and manufacturing process that excels in environmental resistance. Our process has paved the way to an industry-first with the introduction of mass-produced “solder-coatingless cells.” As the name suggests, solder-coatingless cells require no solder coating. This removes lead, which is harmful to the human body, while the expanded light reflection effects with the solderless status improve cell efficiency.



Fine Grid Electrodes

We have developed fine grid electrodes for the solar cell manufacturing process, an advance that has effectively expanded the solar cell light receiving area to realize high-efficiency cells.

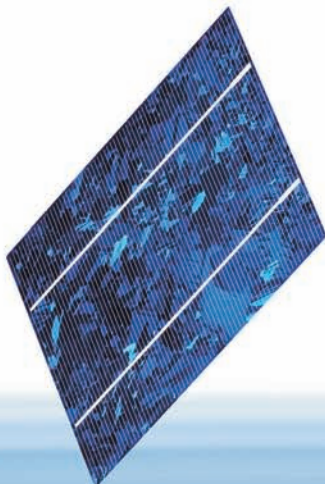


BSF (Back Surface Field) Structure

Adoption of an optimal BSF structure has broadly improved solar cell efficiency.

Anti-Reflective Coating

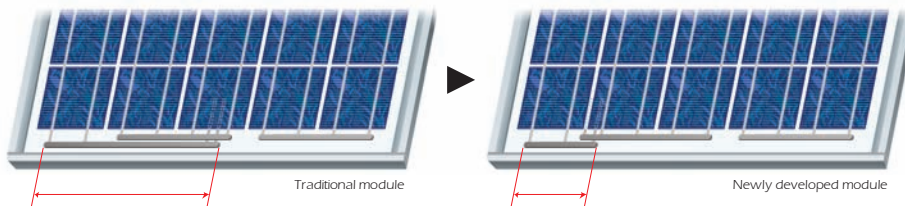
Use of anti-reflective coating shuts out solar rays that reflect off solar cells, thereby heightening cell efficiency.



High Efficient modules

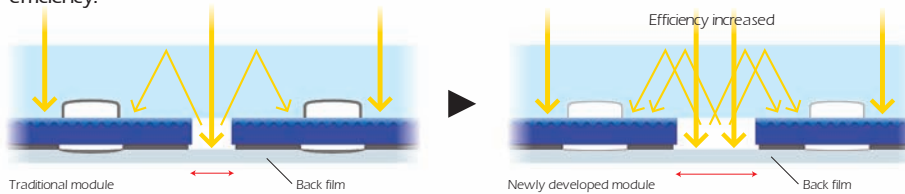
Unique Bus Bar design: TD Series **** NEW ****

We changed the bus bar design. Our unique design dramatically improves module efficiency by reducing bus bar series resistance.



Back Film Reflected Light

Solar cell string pitch have been expanded, with back film reflected light mobilized to raise module efficiency.



High Reflectance Back Film **** NEW ****

The newly developed high reflectance back film improves module efficiency by increasing reflection power from 80%* to 90%*. (*evaluated by Mitsubishi Electric)

Cerium-Free/High-Transmittance Glass

Use of glass that is cerium-free and high in transmittance has defined a new dimension in high efficiency, free of initial deterioration.

Tightest tolerance: TD series **** NEW ****

Mitsubishi Electric's state-of-art production management system can provide the tightest tolerance of module output power ($\pm 3\%$) in the industry. This innovation can be expected to higher output power in your PV system by reducing module string losses.



High Power Output in Actual Use

We conduct the output measurement of our photovoltaic modules by using calibrated modules at JRC, a leading European testing institute. We also exercise meticulous controls in the production line, working to ensure that factory shipment test values exceed the nominal output power for each carton (two modules per carton). These efforts combine to realize high power generation performance in actual use.

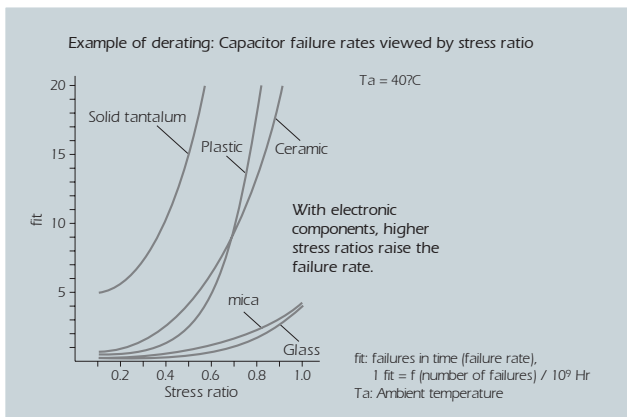


Photovoltaic modules are high-tech products engineered for extended installation and use in high temperature and humid, cold and snowy areas and under other harsh environmental conditions. At Mitsubishi Electric, we have mobilized our long years of experience and know-how to introduce design and structural improvements in the quest for such long-term reliability. We believe that the supply of malfunction-free products is the greatest service of all, and we continue to set our sights on this vital goal.

High Reliability

Original derating designing concept

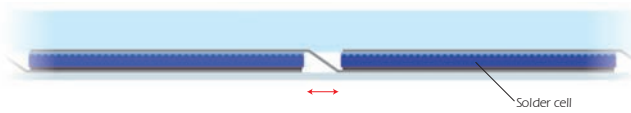
At Mitsubishi Electric, an original derating design concept reduces the electrical stress of each electrical component by the rated value for actual use time, lowering the product failure rate and ensuring reliability for the long term.



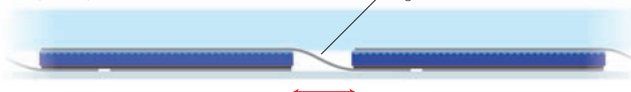
Straight Tabs

Expansion of solar cell string pitch and adoption of newly developed straight tabs combine to eliminate stress on the tab wiring, ensuring stellar dependability over the long term.

Traditional module

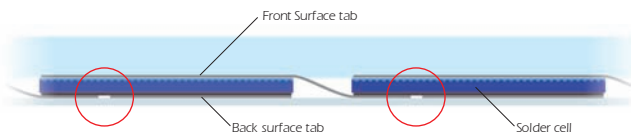


Newly developed module



Double-Sided Independent Tabs

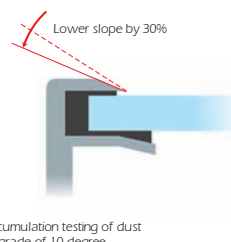
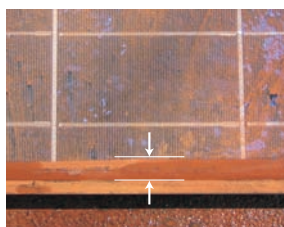
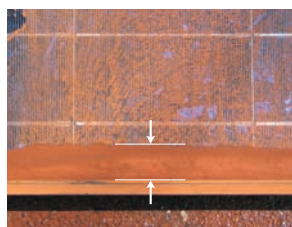
With our solar cells, we have separated connecting tab wiring between the front and back sides. This is an effective step toward optimizing connecting conditions, while curving cell warp to support the move toward thinner solar cells.



Lower slope of module frame

Our module frames have been designed with lower slope by 30% than traditional model. This innovation can provide larger generation power in case that the modules are installed at lower angle by preventing dust from accumulating in the frame area.

The distance of accumulated dust is reduced 30%



Protection Bar: TD series **** NEW ****

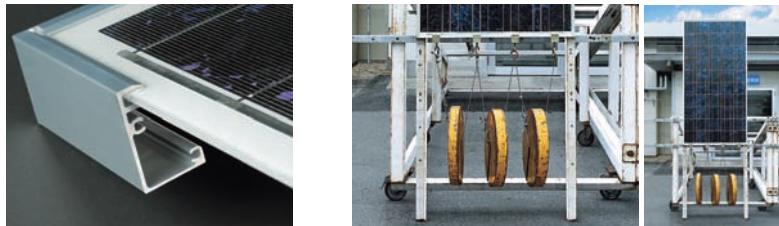
Mitsubishi Electric has developed a unique bar (Protection Bar) back side module. The combination of high-strength glass and protection bar can pass the static load test 5400 Pa of IEC61215 2nd edition. The Protection Bar also easily meets the requirements of 1.18 pound (545 grams) steel ball drop testing from a height of 51 inches (1.295 meters).



1) Static load testing
2) Impact testing

Higher Tensile Strength Structure **** NEW ****

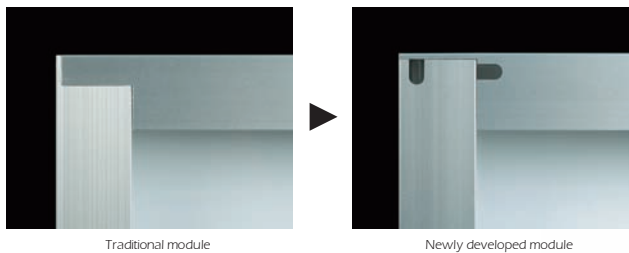
This newly developed frame dramatically improves snow load resistance by enhancing tensile strength between the laminate and module frame.



Tensile strength testing

Better Water Drainage Structure **** NEW ****

In order to have better water drainage, we added holes on the edge of the frame back. Thanks to this improvement, the potentiality of moss or dirt accumulation and damage by water is spectacularly improved.



Traditional module

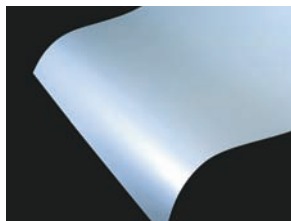
Newly developed module

High-Corrosion Resistant Frame

The module frame features anodized aluminum with clear coating – two pivotal steps toward high-corrosion resistance and reliable use even under truly severe environmental conditions.

Four-Layer Structure Back Film: TD, TE series **** NEW ****

The newly developed PET type back film offers four-layer construction. This design greatly achieves maximum system voltage 1000V, further improving the environmental characteristics of the module.

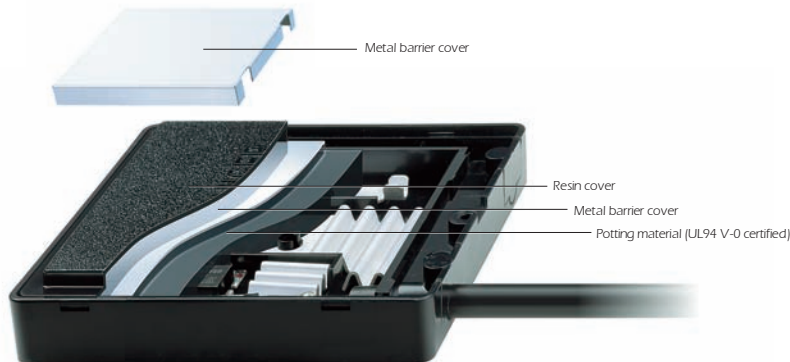


Photovoltaic modules are utilized under conditions of high voltage and severe environments over extended periods of time. Malfunctions, meanwhile, depending on the degree of problem, harbor the threat of fire. At Mitsubishi Electric, each product is designed with safety as the top priority, ensuring customer peace of mind for as long as the modules remain in service.

High Safety

Triple-Layer Structure Junction Box (patent pending)

Introducing the world's first triple-layer structure junction box, which also includes a metal cover, ensuring waterproofing and incombustibility in the module charging section.



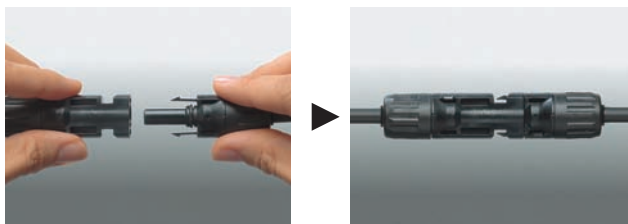
Highly Reliable Bypass Diode **** NEW ****

The bypass diode has been built right into the junction box, preventing shaded cell temperature from rising. The newly developed bypass diode complies with the IEC61215 2nd edition bypass diode thermal test.



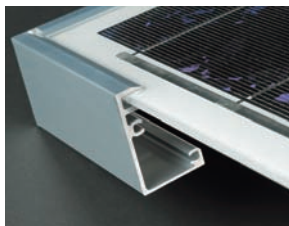
Lock Mechanism Equipped Connectors

We have adopted the lock mechanism equipped connector produced by Multi-Contact (models: PV-KST4/II, PV-KBT4/II) – a major stride toward simpler and more reliable installation work.



Lighter Weight: TD Series **** NEW ****

The newly developed protection bar can lose the module weight with 2.5 kg per module (19.5 kg to 17.0 kg) by reducing the thickness of glass. This improvement will help transportation and installation work.



Conformity with U.S. and European safety standards (UL1703, TÜV Safety Class II).





Mitsubishi Electric photovoltaic modules reflect a proactive approach to environmental regulations and the determination to supply outstanding Eco-products. The policy is that eco-friendly photovoltaic power generation systems help ensure that our products are also gentle on the environment.

Eco-Friendly

Lead content: 0 g.* A new form of photovoltaic power generation, even friendlier to the environment.

Eco-Products

Launching Japan's first domestic mass production of lead-free solder solar modules. Promoting more eco-friendly product creation.

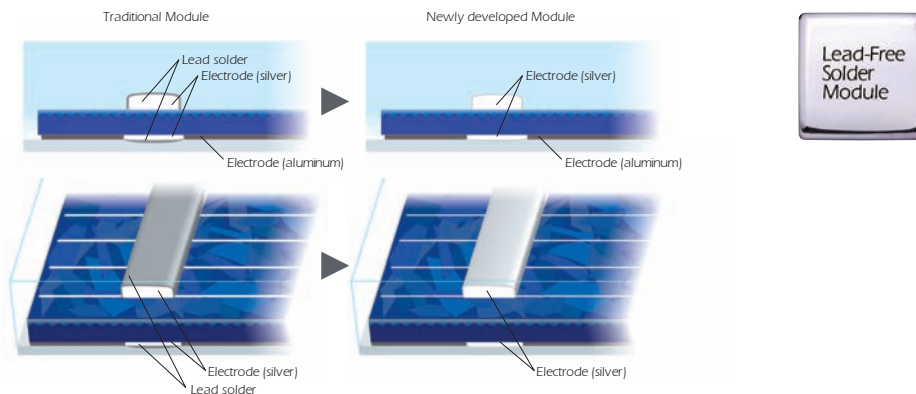
Lead content: 0g.* A new form of photovoltaic power generation, even friendlier to the environment. *Lead volume used in soldered parts.

Previously, the total amount of lead used in the photovoltaic modules required providing power to a single residence (using a 3 kw system) was around 864 g. The new lead-free solder modules use no lead whatsoever.



No solder coating required for cells-for higher PV module conversion efficiency.

Using newly developed silver electrodes that offer superior weatherproofing, we have perfected a technology for producing photovoltaic cells that does not require solder coatings. We have even achieved higher PV module conversion efficiency, taking advantage of new product ability to more uniformly reflect the sun's rays.



Eco-Factory

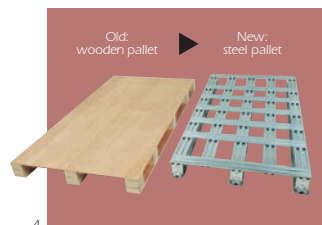
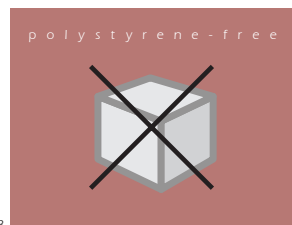
Plant certified under the ISO 14001 environmental standard, also featuring comprehensive water-conservation and recycling measures. Advancing production operations with meticulous care for the environment.



1) Employees assemble for wastepaper collection work.
2) Caring for apple trees.

Eco-Logistics

Introduction of simplified packing for major reductions in waste to help care for our precious resources. Boosting the ease of package opening work for receiving.



3) Eco-friendly polystyrene-free packing designs.
4) Adoption of recyclable steel pallets.



Renowned for stellar function and reliability, Mitsubishi Electric solar modules have come to be mobilized in a rich range of applications around the world. Today, and over the years to come, Mitsubishi Electric photovoltaic power generation systems are designed and built to support superbly clean, eco-friendly lifestyles.

Installation Examples

Europe

Austria (400kW system)



Small power plant

Italy / Savona (14kW system)



School

USA

USA / California (116kW system)



Gas station

Holland / Amsterdam (15kW system)



Office

Italy / Alps (50kW system)



Hotel

USA / California (2kW system)



Private residence

Switzerland (23kW system)



School

Italy / Mantova (15kW system)



School

USA / California (30kW system)



Winery

Germany (5kW system)



Private residence

Italy / Vigevano (3kW system)



Private residence

Africa

Gambia (3kW system)



Hospital

South East Asia

Cambodia / Phnom Penh (330W system)



Solar home system

Indonesia / Kalimantan (13kW system)



Remote telecom base station

Korea / Gongju (3kW system)



Private residence

Thailand / Bangkok (3kW system)



Private residence

Singapore / Pulau Ubin Island (1kW system)



Public restrooms

Japan / Gunma (200kW system)



Platform

East Asia

Papua New Guinea (480W system)



Private residence (rural home system)

China / Tibet (50kW system)



Small power plant

Japan / Iwate (8kW system)



Private residence

Philippines / Zamboanga del Sur (440Wp system)



Village hall

China / Chinhai (30kW system)



Small power plant

Japan / Nagano (200W system)



Street light



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<http://Global.MitsubishiElectric.com/solar>