

**MITSUBISHI  
ELECTRIC**

PHOTOVOLTAIC INVERTER

*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.



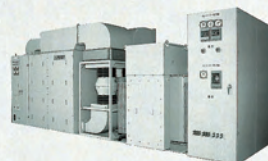
Mitsubishi Electric Corporation's Nakatsugawa Works is an ISO certified plant, having obtained both ISO 9001 Quality Management System and ISO 14001 Environmental Management System certification.

— 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 paddle.

- 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 400kW 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 cell and modules at Iida Works.
- 1999 Awarded Good Design Award for roof-integrated module.
- 2000 **Commenced sales of industrial-use photovoltaic inverter units (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 the 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 the production capacity of solar cells to 50MW (September).
- 2004 Expanded the production capacity of solar cells to 90MW (July).  
Commenced sales of residential small-capacity and outdoor-use photovoltaic inverters.
- 2005 Expanded the production capacity of solar cells to 135MW (April).  
Commenced sales of industrial-use photovoltaic inverter with operation data monitoring system.  
**Established residential-use inverter assembly plant at Nagano factory.**
- 2006 **Commenced sales of residential-use photovoltaic inverters with 95.5% efficiency, the highest in the industry.**  
**Scheduled to commence of sales of photovoltaic inverters to European market.**



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

## Photovoltaic Inverter

**Lavish in technology, elegant in form.  
The photovoltaic inverter with efficiency to spare.**

(Design application pending)





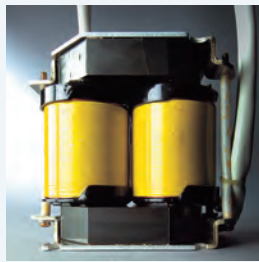
**Condensing more than 25 years of R&D experience and know-how, and the milestone technology of a leading electrical and electronic manufacturer. Photovoltaic inverters, from Mitsubishi Electric.**

**Mitsubishi Electric photovoltaic inverters – strategically condensing the latest breakthroughs in semiconductors, power**

■ H I G H E F F I C I E N C Y



Power modules delivering high efficiency, voltage and reliability.



High-power Low-loss ferrite reactor delivers outstanding efficiency.



Optimum control software  
1 High-speed switching control: DSP  
2 System total control: CPU

■ H I G H R E L I A B I L I T Y



Original derating design, for long-term reliability.



Cooling structure for long-term reliability and high efficiency.

**generation plants and other key fields.**

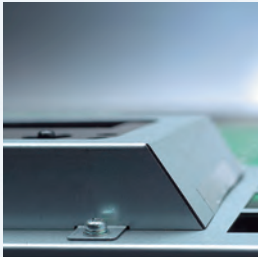
■ H I G H   S A F E T Y

■ U S E R -  
F R I E N D L Y

■ E C O -  
F R I E N D L Y



Drain structure engineered to prevent water penetration and satisfy the IP41 enclosure standard.



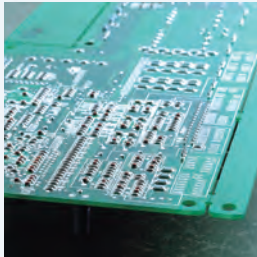
Metal cover enclosed structure built to excel in design and construction friendliness, while enhancing fire resistance and other safety features.



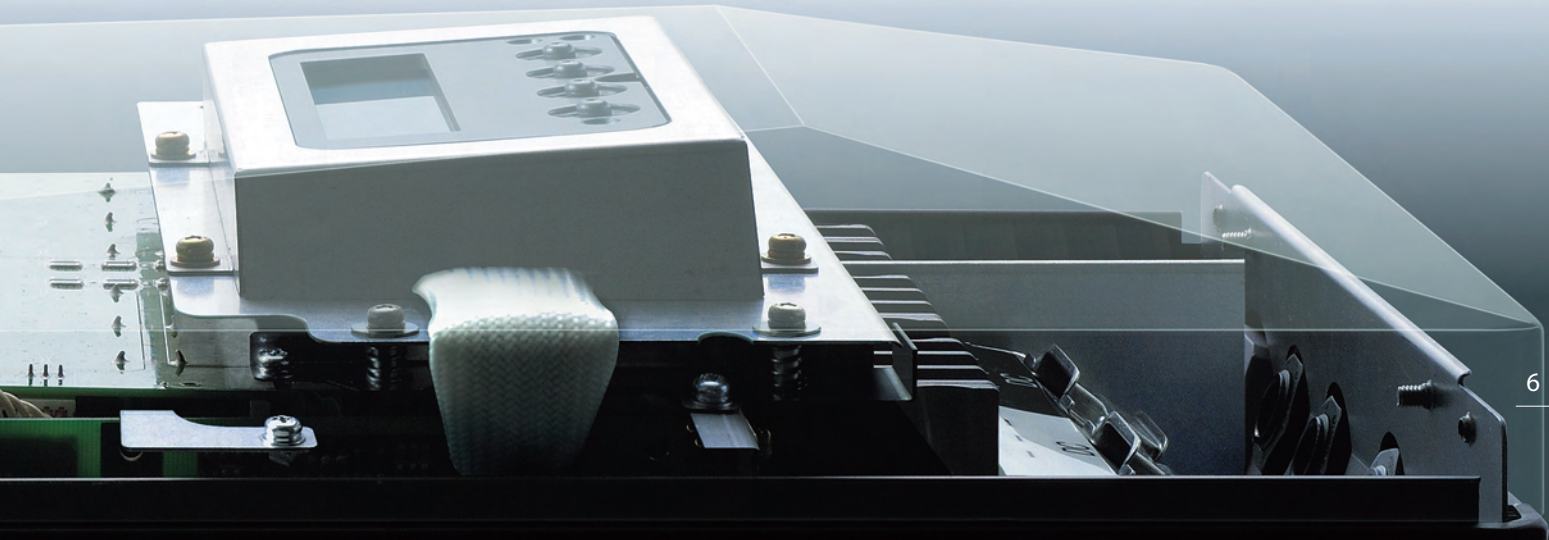
Terminal block connecting style inside inverter, for high safety, long-term reliability and easy installation.



Large-size displays, enhanced by multiple-indicators with green colored backlight.

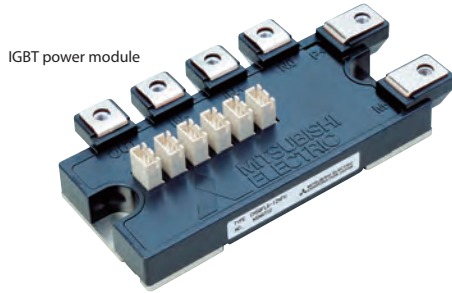


Lead-free solder circuit board for eco-friendly products.

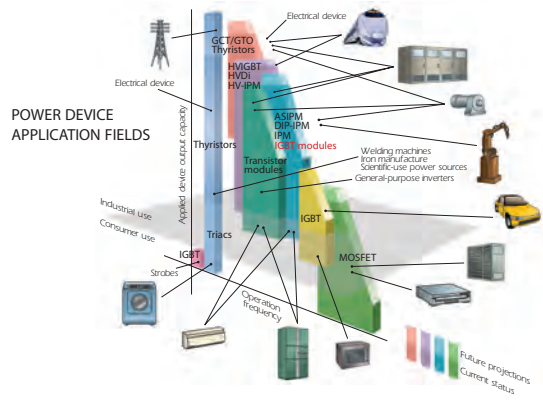


High-efficiency inverters convert greater amounts of power from solar modules, raising the level of economical and environmental satisfaction for the customer. At Mitsubishi Electric, particularly keen efforts have been channeled into enhancing the efficiency of the actual use environment. Experience the stellar caliber of efficiency available only from Mitsubishi Electric – the company renowned for its long history of excellence and independently integrated production.

# High Efficiency

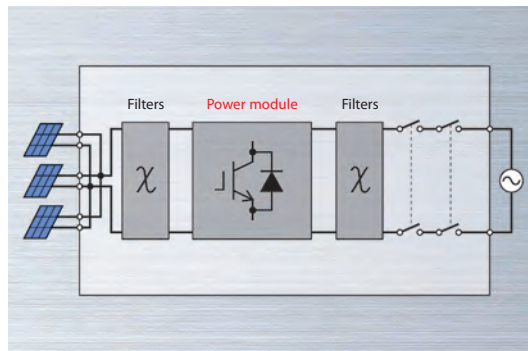


IGBT power module

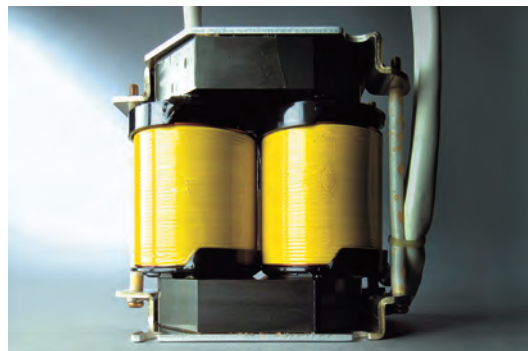


Photovoltaic inverters with our independently customized high-speed 5th generation trench gate IGBT.

Mitsubishi Electric is a leading manufacturer in the power module industry. As evidence, our power modules are playing frontline roles in a growing range of cutting edge technology fields.



3-level inverter system (patent pending), mounted with our independently crafted customized power module.



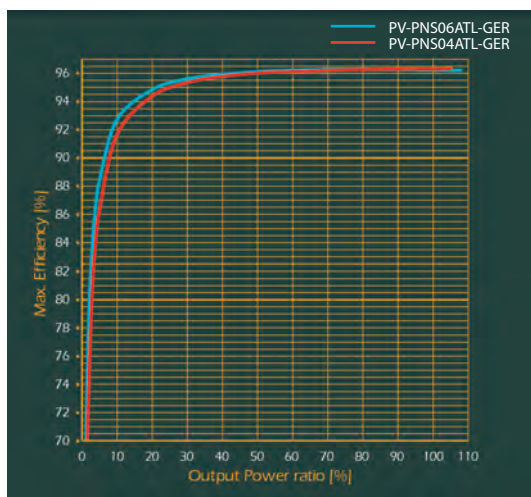
High-power Low-loss ferrite reactor



Optimum control software

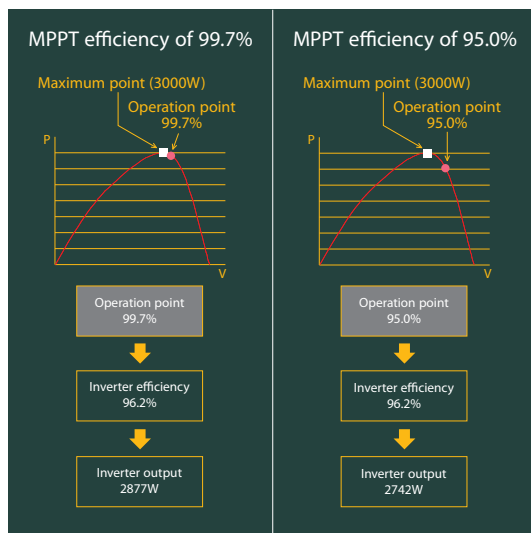
- 1 High-speed switching control: DSP
- 2 System total control: CPU

Triple combination achieving high efficiency, high input voltage and compact dimensions (low volume and weight) at the industry's cutting edge.



Industry top-class Max. efficiency of 96.2%, Euro. efficiency of 95%

Our broad-ranging output sphere realizes high conversion efficiency. The result is highly efficient and waste-free conversion of generated electricity, even during low-sunlight morning and evening hours or on cloudy days.

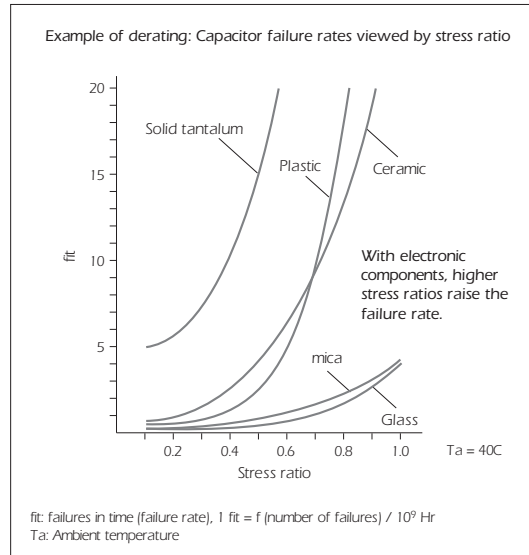


MPPT\* efficiency 99.7%

\*Maximum Power Point Tracking

Photovoltaic inverters are electronic devices used on a constant basis over extended periods of time, making long-term reliability essential. 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 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.

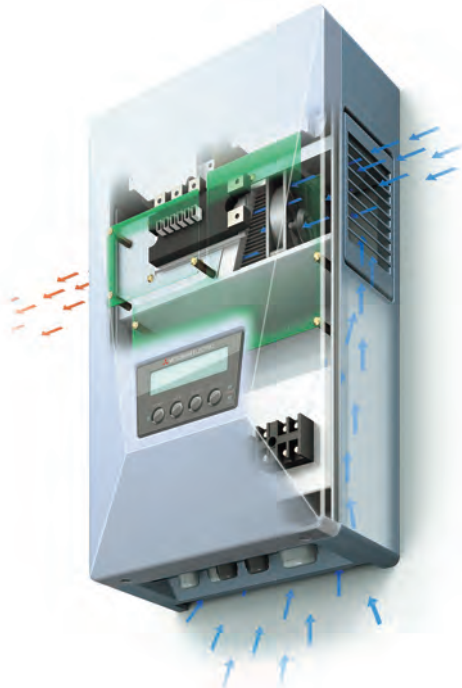
With adoption of our original derating design concept, the very first Mitsubishi Electric photovoltaic inverter (400kW) delivered continues to operate today, more than two decades after its installation in 1985.



Mitsubishi Electric photovoltaic inverter (400kW, installed in 1985)

## Original Cooling and Clean structure

Use of the high-speed temperature control ventilator to minimize the output suppressed by temperature increases inside the inverter. Based on the Mitsubishi Electric original cooling and heat radiation structure, a breakthrough perfected from long years of experience, the wind introduced from the fan cools only the power module component, blocking excessive flow to the substrate. This maintains cleanliness in the substrate section, a feature that contributes to superb and unwavering reliability. Based on this cooling structure, installation is possible over a broad range of use environment temperatures (-25°C to +60°C).



## Original Drain Structure of Housing

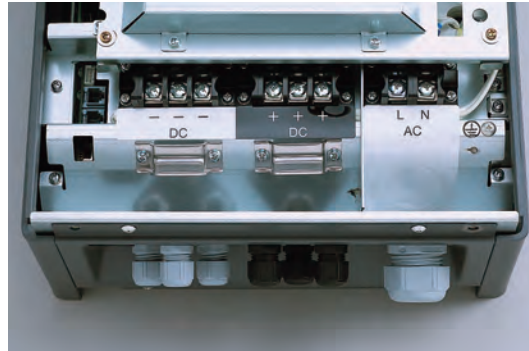
Based on know-how cultivated through the solar module construction method, a unique drain structure is adopted on the inverter cover connection component. This arrangement keeps water out of the inverter interior by flushing it outside, and in doing so satisfies the IP41 enclosure standard.



IP: International Protection

Photovoltaic inverters are utilized under conditions of high voltage and other fierce environments, over extended periods of time. Malfunctions, meanwhile, depending on the degree of trouble, harbor the threat of smoking. At Mitsubishi Electric, each product is designed with safety as the top priority, ensuring customer peace of mind for as long as that inverter remains in service.

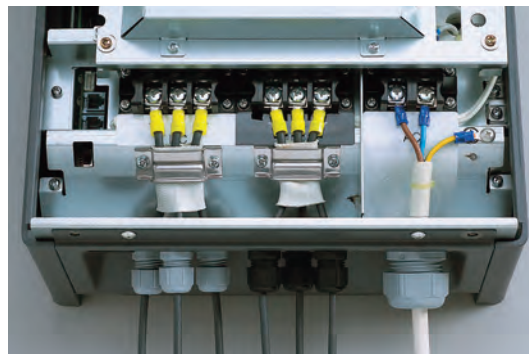
# High Safety



Terminal block connecting method with ring tongue terminals

Connecting with ring tongue terminals raises the connection reliability, with faulty connection prevention plate installed between the DC and AC input terminals to avert faulty cable connections. This also generates cost savings by eliminating the need for specialized tools to connect ring tongue terminals and cables from solar modules.

- 1) Before connecting the cable
- 2) After connecting the cable



1

2



Metal cover enclosed structure

Placing the connecting point inside the inverter prevents smoke generated from faulty connections or other problems from getting outside. The metal cover-based enclosed structure also keeps any smoke from spreading to the house.

- 3) Interior: a metal cover also protects the display circuit board.
- 4) Exterior

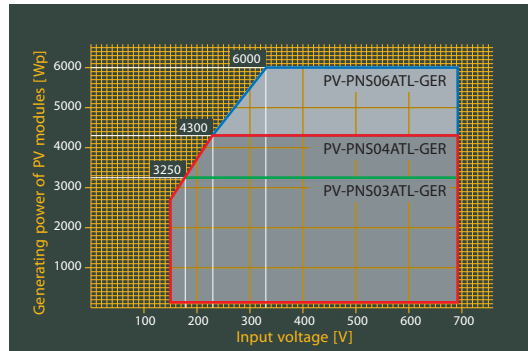
3



4

Photovoltaic inverters are installed at locations ranging from cellar of private house to garages, farms and various other sites, where they are connected with monocrystalline silicon, polycrystalline silicon, amorphous silicon and other solar cells. To best respond to the demands of installation firms, Mitsubishi Electric devotes keen consideration to the key points of: (1) simple system design, (2) application and system compatibility, and (3) easy installation.

# Easy Installation



Wide range input voltage

Mitsubishi Electric solar inverters have a broad 150 – 700V DC input voltage range (MPPT voltage range: 260V – 650V). The three models in the current range already cover the needs of the great majority of customers, with ratings of 2.5kW, 3.3kW and 4.6kW.



Planning systems with solar modules from all leading manufacturers is quick and easy with the Mitsubishi Electric configuration software (around 1,000 models from 100 manufacturers, with search function).



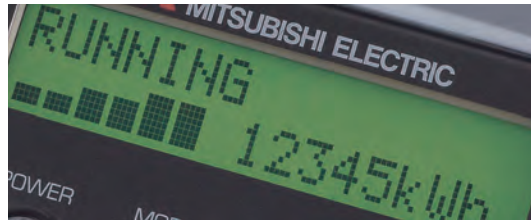
The compact design of the inverters enables installation in almost any location. Identical dimensions for all models and simple installation round off the benefits of the Mitsubishi Electric PV components.



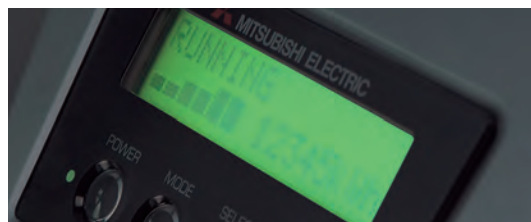
The identical size of the 3.3kW and 4.6kW models enables installation alongside different models, realizing the optimum system for each customer's requirements.

Determined to make photovoltaic power generation systems a more familiar presence and pleasant to use, Mitsubishi Electric has channeled particularly strong efforts into enhancing product design and visibility.

# User Friendly



Large-size LCD display as standard equipment. Generous dimension figures and characters make this display eye-friendly indeed.



Backlight-equipped for easy visibility in dark locations too.



Use the "Simple-Search Multi-Function Button Bank" for ready access to a rich range of information, viewed in your language of choice.

- 1) Multiple-indicators display
- 2) Error code indications





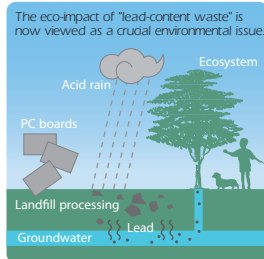
Mitsubishi Electric photovoltaic inverters reflect a proactive approach to environmental regulations, and the determination to supply outstanding "Eco-products." The policy is that eco-friendly photovoltaic power generation systems help ensure that our products are also gentle on the environment.

# Eco-Friendly

## The "Mitsubishi Triple Eco-Approach"

### Eco-Products

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



In recent years, the acid-rain-triggered dissolving of "lead" contained in solid waste into soil or groundwater has emerged as a major dilemma, due to the impact of residual lead on the human body and the ecosystem.



Refers to solder lead content with installation of 24 solar modules (lead content reduction 864g).

### 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.



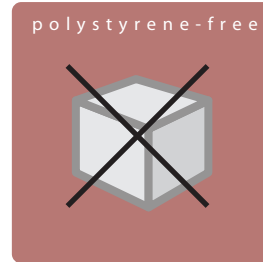
Employees assemble for wastepaper collection work.



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 upon receiving.



Eco-friendly polystyrene-free packing designs.



Adoption of reusable steel pallets.

## Approach to Photovoltaic Inverters

### Compliance with European RoHS Directive\*



Adoption of lead-free solder for substrates, power modules and other products in compliance with the European RoHS Directive (governing chemical substance content in products).

[\*] RoHS Directive: EU Directive on Restriction of use of certain Hazardous Substances in electrical and electronic equipment. This decree is structured to regulate the use of six specified hazardous substances in all electrical and electronic equipment sold in European Union member countries from July 2006.

### Compliance with European WEEE Directive\*

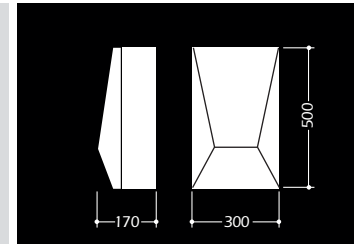


Targeting eco-friendly processing of our photovoltaic inverters after the end of their service lives, Mitsubishi Electric labels these products with the WEEE Mark (based on the European WEEE Directive\*).

[\*] WEEE Directive: European Directive on Waste Electrical and Electronic Equipment, rendering producers liable for the recovery and recycling of used electrical and electronic equipment.

## Specification Sheet

Three-model lineup addressing a long list of user needs.



Manufacturer		MITSUBISHI ELECTRIC		
Model	PV-PNS03ATL-GER	PV-PNS04ATL-GER	PV-PNS06ATL-GER	
<b>Input</b>				
Recommended generator power	3250W	4300W	6000W	
Max. DC voltage	700V DC			
Min. DC voltage	150V DC			
PV-voltage range, MPPT	160V – 650V DC			
Max. input current	12A DC	18A DC		
Max. numbers of strings	2	3		
Surge voltage protection	varistors, surge absorbers			
Personnel protection	ground fault monitoring / isolation			
<b>Output</b>				
Max. AC power	2500W	3300W	4600W	
Rated AC power	2500W	3300W	4600W	
Max. AC current	13.0A	15.2A	21.7A	
Rated AC current	10.9A	14.3A	20.0A	
THD of grid current	< 5%			
Possible range of AC voltage	184V – 265V			
AC frequency	47.5Hz – 50.2Hz			
Phase difference (cos phi)	approx. 1			
Connection to utility	Terminal block			
Internal consumption in stand-by	< 0.35W			
<b>Efficiency</b>				
Max. efficiency at maximum voltage	96.1%	96.2%		
European weighted efficiency	94.6%	95.1%		
MPPT efficiency	99.7%			
<b>Enclosure</b>				
Protection degree (DIN EN 60529)	IP41 <Indoor>			
Cooling	controlled forced ventilation			
Ambient temperature	-25°C – +60°C			
Relative humidity	30% – 90%			
Dimensions (W x H x Dmm)	300 x 170 x 500			
Weight	approx. 19kg		approx. 20kg	
Connection with PV cable	Terminal block			
Noise level	< 45dB			
Display	integrated			
Display language	3 languages (German, English, Italian)			
Insulating style	Transformerless			
External communication	RS485 interface			
<b>Protection devices</b>				
DC-isolation monitoring	integrated			
Over temperature protection	integrated			
Reaction at DC-overload	shift of operating point			
ENS / fault-current monitoring	integrated			
Regulation / Certificate	CE conforming			
	DIN EN50178			
	DIN EN61000-6-2			
	DIN EN61000-6-3			
	DIN EN61000-3-2			
	DIN EN61000-3-3			
	DIN VDE0126-1-1			
	WEEE regulations			
	RoHS regulations			
Warranty term (standard/option)	5 years / 10 years			



 **mitsubishi electric CORPORATION**

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

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