

MITSUBISHI TANDEM PV MODULE : MT120T2 GENERAL INSTRUCTION GUIDE

Nov. 2009 edition

All instructions should be read carefully and understood before attempting to install, wire, operate and maintain the thin film photovoltaic module ("PV module").

(Note : MHI reserves the right to change the contents of this document without prior notice.)

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1 PREFACE

Please carefully read through this instruction guide before installing the PV module. The instruction must be followed correctly. MHI shall not be responsible for any damages of the PV modules that are not installed or operated in accordance with the instruction guide.

- A. The PV module is a DC power generator that converts sunlight to electricity. By connecting in parallel or series voltage and current complying with these conditions, power will be generated. Care should be taken to avoid "Electric Shocks" during the use.
- B. Glass is used for the front cover of the PV module, and a special care should be taken. Although PV module withstands the wind, hail etc, satisfying the international standards, the actions such as dropping or dropping tools onto PV module etc. may lead to damages of the PV module.

2 WARNING

 WARNING	
	When the surface of the PV module is exposed to sunlight, DC high voltage is generated at the output electrode terminal located on the back of PV module. Do not touch the electrode terminal located on the back of the PV module to avoid the electric shock.
	Do not disassemble or modify the PV module. Do not remove any parts and labels from the PV module. Do not open the terminal box cover of the PV module.
	Do not install the PV module where wind or snow load exceeds its specified limit.
	Do not use the PV module under water, gaseous or vacuum conditions. Do not use the PV module in the outer space or other extremely harsh environment.
	Do not install the PV module on the buildings or the structures where continuous vibration is expected.
	Do not use any light concentration devices such as lens or mirrors with the PV module. Do not use any light sources except for natural sunlight and general illumination with the PV module.
	Do not place objects on the PV module that may block the sunlight either completely or partially.
	Do not apply the PV module to any other purposes except for terrestrial power generation.
	Do not step on the PV module to avoid the possible accidents.
	Do not drop PV module or drop tools onto it. The back surface of the PV module is not protected by glass and vulnerable to sharp objects.
	Do not use the damaged or faulty PV module.
	Do not pull or bend the cables forcibly. Do not hang or carry the PV module by the cables.
	Do not step on the cables, connectors and end caps.

 **WARNING**



Do not cut the cables attached to the PV module nor connect another type of cable.



Do not apply a higher voltage to PV module than the specified system voltage.



Do not connect the PV module with another type of module.



Do not mount the PV module in such a way that the drain holes get blocked up.



Mount the PV module onto the specified mounting structure.
Be sure to tighten the bolts completely to avoid loosening.



Do not use any chemicals when cleaning the surface of the PV module.



Do not place the PV module on a place where its aluminum frame, glass surface, back sheet, cables or connectors may get damaged.
Do not handle the PV module in a way that their aluminum frame, glass surface, back sheet, cables or connectors may get damaged.
Do not give any shock to the PV module in a way that its aluminum frame, glass surfaces, back sheet, cables or connectors may be damaged.

3 INSTALLATION CONDITIONS

Output electricity yielded from the PV module may vary depending on the sunshine conditions. Following installation conditions should be considered in order to receive optimal solar radiation throughout a year.

- (a) South is the most suitable direction for the installation of PV module. Even if PV module is faced to east or west, decline in the electricity yielded will be slim. We do not recommend north.
(In case of the northern hemisphere)
- (b) Shading the PV module should be taken into consideration from the beginning of the planning. Installation at a location that trees or buildings or adjacent PV modules may shade the PV module should be avoided. When the PV module is shaded, power output declines and it possibly causes the PV module decoloration also.
- (c) Dust piling up on the PV module may cause power output to decline. We recommend 10 degrees of tilting angle if you expect the rain water to wash the dust off the PV module.
- (d) The PV module is designed for vertical mounting. Please mount the PV module longitudinally as shown in Fig.1.

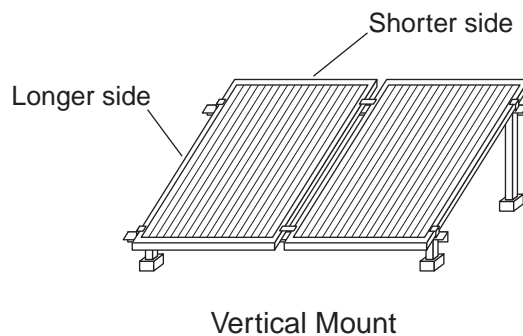


Fig. 1 PV Module Mounting Direction

4 LIMITATION OF THE INSTALLATION

It is impossible to install the PV module where the following conditions prevail. Make sure the location and its surroundings are free from below stated conditions.

- (a) Any roofs, buildings, etc. that is not designed to withstand the total weight of the PV modules installed.
- (b) Locations where wind load is anticipated to exceed the limitation of the PV module (both negative and positive pressure, see Table 1).
- (c) Locations where snow load is anticipated to exceed the limitation of the PV module (see Table 1).
- (d) Locations where inflammable materials etc. are used or stored.
- (e) Locations where corrosion may occur due to the exposure to the sea water, salty breeze, etc.
- (f) Locations where the PV modules may be exposed to corrosive substances (e.g: Chemical factory, hot spring or volcano areas emitting hydrogen sulfide or ammonia gas) shall be avoided.

Note: Special care shall be taken when installing the PV modules at domestic animal huts.

Except for pig huts and chicken coops, the PV modules can be installed.

In any case, please contact your sales representative for advice when attempting to install the PV modules near domestic animal huts.

- (g) Locations where the drain holes of the PV module could be clogged naturally. (Ex. heavy dust, moss, grass)
- (h) Locations near the ventilation emitting steam and oil vapor/mist. (Ex. restaurant)
- (i) Locations with high humidity. (Ex. marsh)

Table 1 Allowable Load of the PV Module

Type	Wind load	Snow load
MT120T2	2,400 N/m ²	1,300 N/m ²

5 MAINTENANCE

- (a) When the surface of the PV module gets dirty, power output may decline. When cleaning the PV module is necessary, soft damp cloth or sponge with water should be used. Wear rubber gloves to avoid the electrical accidents. Do not use any chemicals and do not uninstall the PV module from the PV array.
- (b) We recommend semiannual inspection to ensure that the PV module is free from any damages and connection errors. Protect yourself from any possible accidents (electric shock, etc.) during the maintenance. Correct any problems if found. (Please contact your installer or distributor of the PV module when the inspection is necessary.)

6 SPECIFICATION

A. DIMENSION AND WEIGHT

- Dimension : Length 1,414mm × Width 1,114mm × Thickness 35mm
- Weight : Approx. 21kg

B. ELECTRICAL CHARACTERISTICS

(a) Power output properties

Specified condition: Module temperature 25

Spectrum AM 1.5 Reference solar radiation

Irradiance 1000W/m²

	Stabilized (After the initial degradation)	Initial (At the shipping)
	MT120T2	
Maximum power	120W ± 5%	Approx. 8% higher than stable value
Maximum power voltage	101 V ± 10%	Approx. 3% higher than stable value
Maximum power current	1.19 A ± 10%	Approx. 5% higher than stable value
Open circuit voltage	131 V ± 10%	Approx. 1% higher than stable value
Short circuit current	1.42 A ± 10%	Approx. 2% higher than stable value

Stabilizing condition is in accordance with the IEC61646 Light-soaking.

Note :

Values may change during operation according to climate condition. Generally, energy conversion efficiency tends to decrease in winter season and cold climate.

Note :

Each module has its own power output properties within the ranges shown in the table. For the PV plant design, use the actual values of delivered modules, that are shown in the attached inspection record.

(b) Temperature coefficients

	Temperature coefficient
Maximum power	- 0.28 % /
Maximum power voltage	- 0.33 % /
Maximum power current	+ 0.06 % /
Open circuit voltage	- 0.32 % /
Short circuit current	+ 0.06 % /

(c) Maximum system voltage

600V

(d) Diode

- Bypass diode : None
- Blocking diode : Included

	Rated value
Repetitive peak reverse voltage	600 V
Average rectified forward current	2 A

⚠ • No voltage at 600V or more shall be applied to PV module.

C. LIMITATION OF TEMPERATURE

	Temperature	Humidity
Ambient	- 20 ~ + 50	—
Working	- 20 ~ + 85	—
Storage	- 20 ~ + 50	~ 85%

D. APPLICABLE STANDARD

- IEC 61646 Ed. 1
- Safety class

E. APPEARANCE

See Appendix 1

Note:

Some small decolorations, which do not affect the power output performance, may occasionally appear at the corner or the edge of the module inside.

F. LABELING

See Appendix 2

G. DRAWING

See Appendix 3

7 STORING AND UNPACKING

A. STORING

The PV module is glass-made and fragile. Handle the transportation box and the PV module as follows:

- (a) Store the PV module in the transportation box before installation.
- (b) Only one transportation box can be stacked on top of the other box during a storage in warehouse.
- (c) Keep the transportation box dry.
- (d) Keep the transportation box standing flat. Do not place sideways or upside down.
- (e) Keep the transportation box away from a vibration or a shock.
- (f) Do not cut the polyethylene bands until the installation because the transportation box may collapse without these bands. Do not move the box after the polyethylene bands are cut. If the polyethylene bands are cut unintentionally, be sure to tie the box with appropriate band that are as durable as the polyethylene band.

B. TRANSPORTATION BOX SPECIFICATION

- Number of products : 25 units / Box
- Box external dimensions : Length 1,450mm x Width 1,150mm x Height 1,110mm
- Box weight : 590kg
- Stack limitation : 2

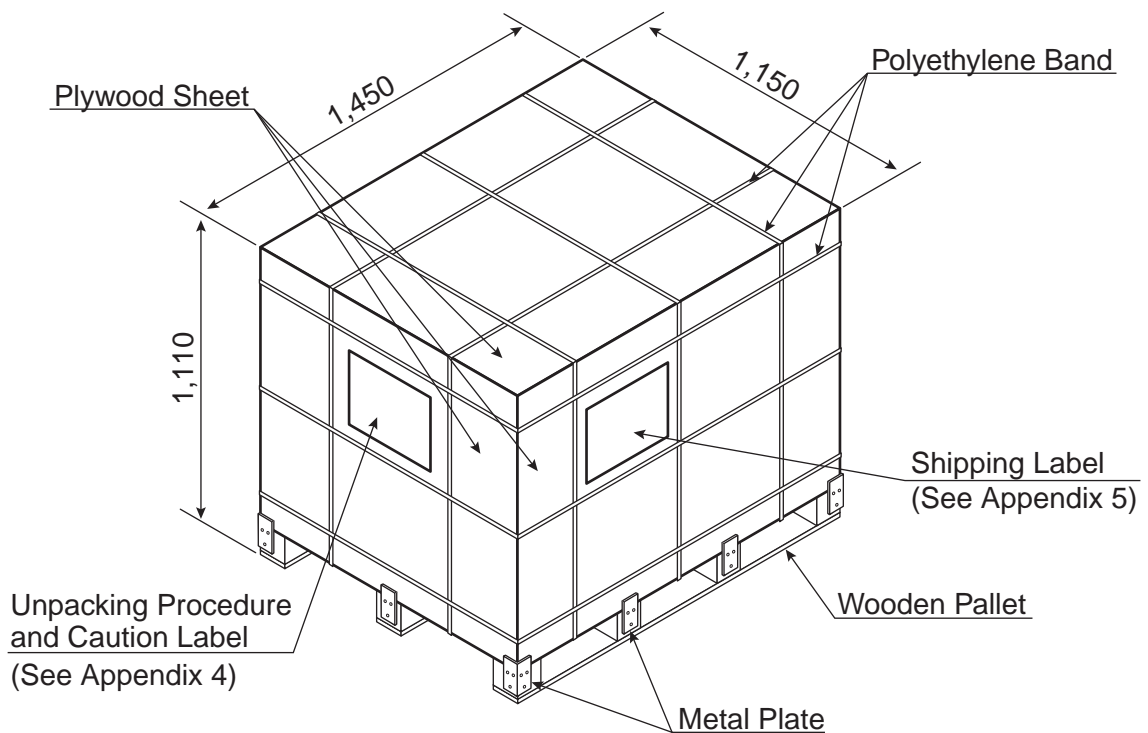
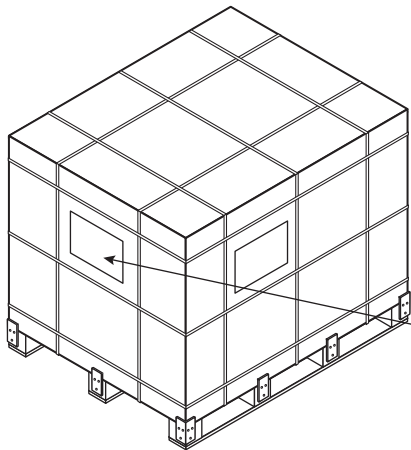


Fig.2 Transportation Box

C. UNPACKING PROCEDURE



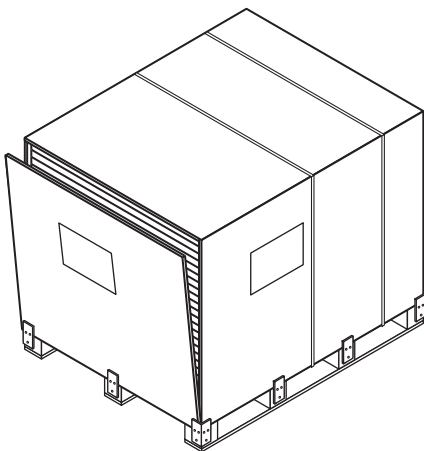
External appearance at arrival

! CAUTION

Place the transportation box on flat ground.

~ are polyethylene bands.

“ Unpacking Procedure Label ”

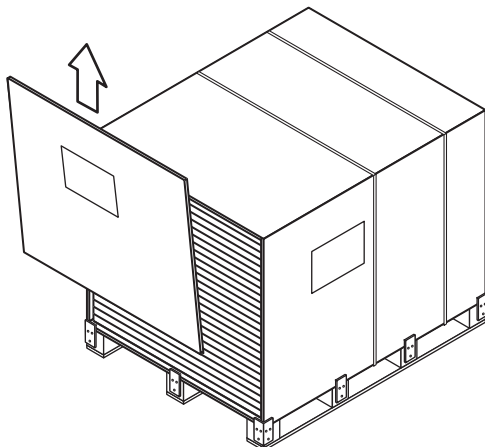


Step 1

Cut , , , , and .

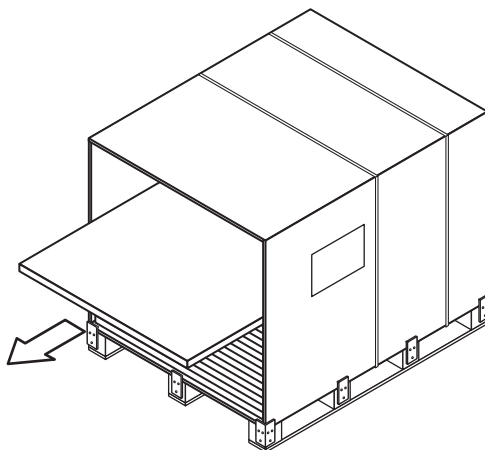
! CAUTION

Don't cut and until you finish removing the products.



Step 2

Remove the plywood sheet with "Unpacking Procedure Label".



Step 3

Withdraw the products one by one horizontally.

8 CHOICE OF BALANCE OF SYSTEM

A. INVERTER

Please consider the following items when choosing the inverter.

- (a) Confirm the voltage and feed-in phases of the inverter match with your utility grid.
- (b) Choose the inverter capable to cover the power output of the PV array.
- (c) Confirm that the open-circuit voltage of the PV array is higher than the start-up voltage of the inverter.
- (d) Confirm that the open-circuit voltage of the PV array does not exceed the allowable input voltage of the inverter considering the variation of open-circuit voltage by temperature. If exceeded, may cause the inverter to break down.
- (e) Confirm that the operating voltage of the PV array is within the operating voltage of the inverter.
- (f) Choose the inverter with isolation transformer, and ground the DC negative pole of the inverter.

B. CONNECTION BOX

Please consider the following items when choosing the connection box.

- (a) Confirm that the input current capacity of the connection box is enough for the expected maximum current of the PV string or array.
- (b) If the fuse is required, confirm that the current capacity of each device is enough for the expected maximum current of the PV string or array.

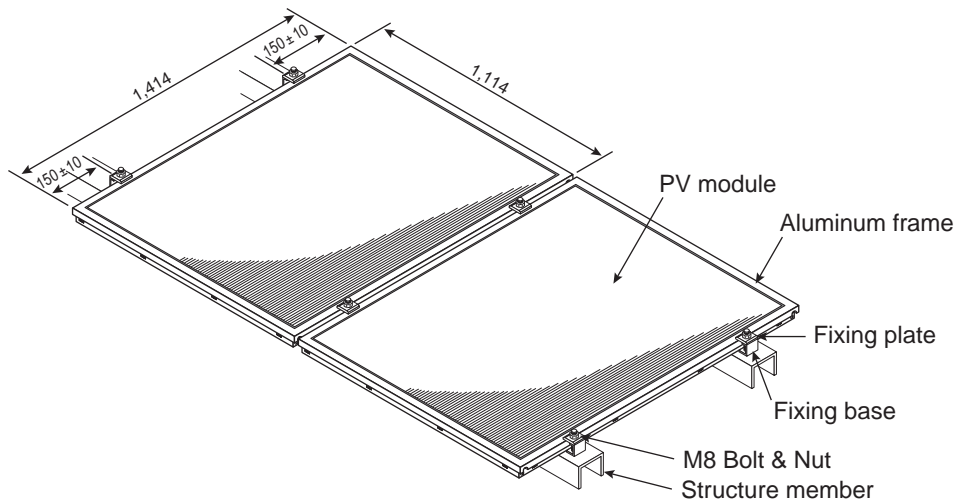
9 MOUNTING

A. MOUNTING STRUCTURE

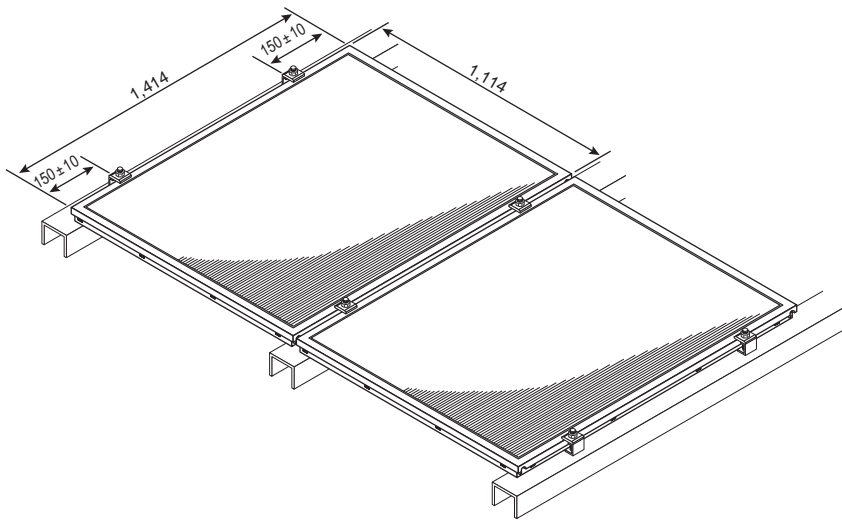
Tighten PV module with M8 bolt, nut and fixing plate onto the structure member of array structure according to Fig.3. Make sure to tighten bolts and nuts completely and lock in order not to loosen.

B. FIXING PARTS

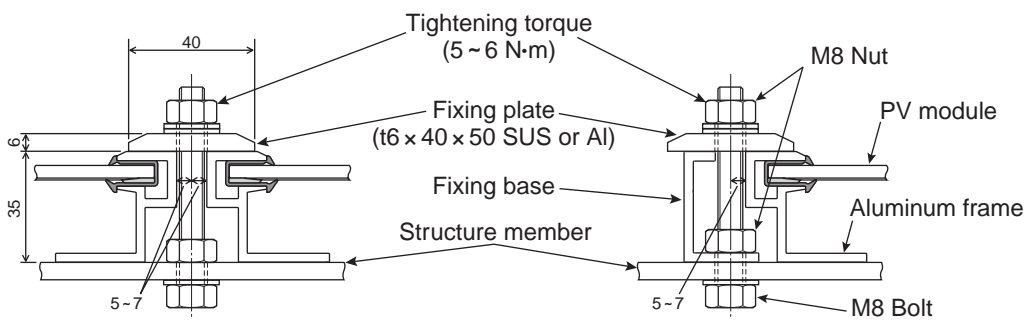
Fixing parts are available if required. (see Appendix 6 in detail)



a. Mounting Structure A



b. Mounting Structure B



c. Fastening Structure

(Unit : mm)

Fig.3 Mounting Structure

- ⚠ • The PV module has drain holes in its frame. Do not clog these holes with structure member.
- Take care of deformation of aluminum frame during handling PV module.
- Tighten the bolts and nuts properly with the stipulated torque.

10 WIRING

A. ELECTRIC CIRCUIT DIAGRAM

Fig. 4 shows the circuit diagram of the PV module.

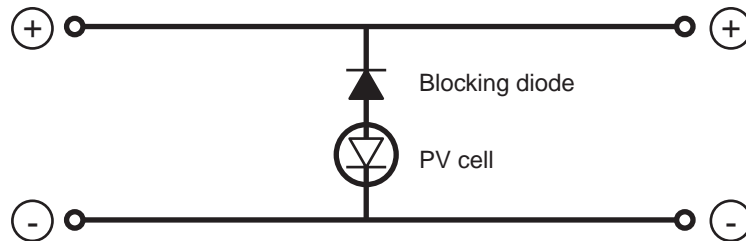


Fig.4 PV Module Circuit Drawing

As shown in Fig. 4, module has 2 positive terminals and 2 negative terminals. One blocking diode is equipped in the PV module.

B. WIRING PRINCIPLE

(a) Parallel connection

The PV modules can be connected in parallel by fastening together adjacent positive cables, and together adjacent negative cables, as shown in Fig.5. Please surely confirm that each terminal is connected firmly with lock device. The voltage of one parallel string is equal to the voltage of one PV module, however the current increases with the increase in the number of connected modules. Please consider the current capacity of the input of connection box or inverter.

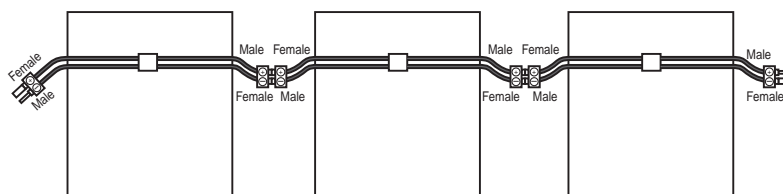


Fig.5 Parallel Connections

(b) Series connection

The PV modules can be connected in series by fastening the positive cable of one parallel string and the negative cable of another parallel string, as shown in Fig. 6. Please surely confirm that each terminal is connected firmly with lock device. The voltage of series connections increases consequently by the number of parallel strings, however the current remains equal to the current of the parallel string.

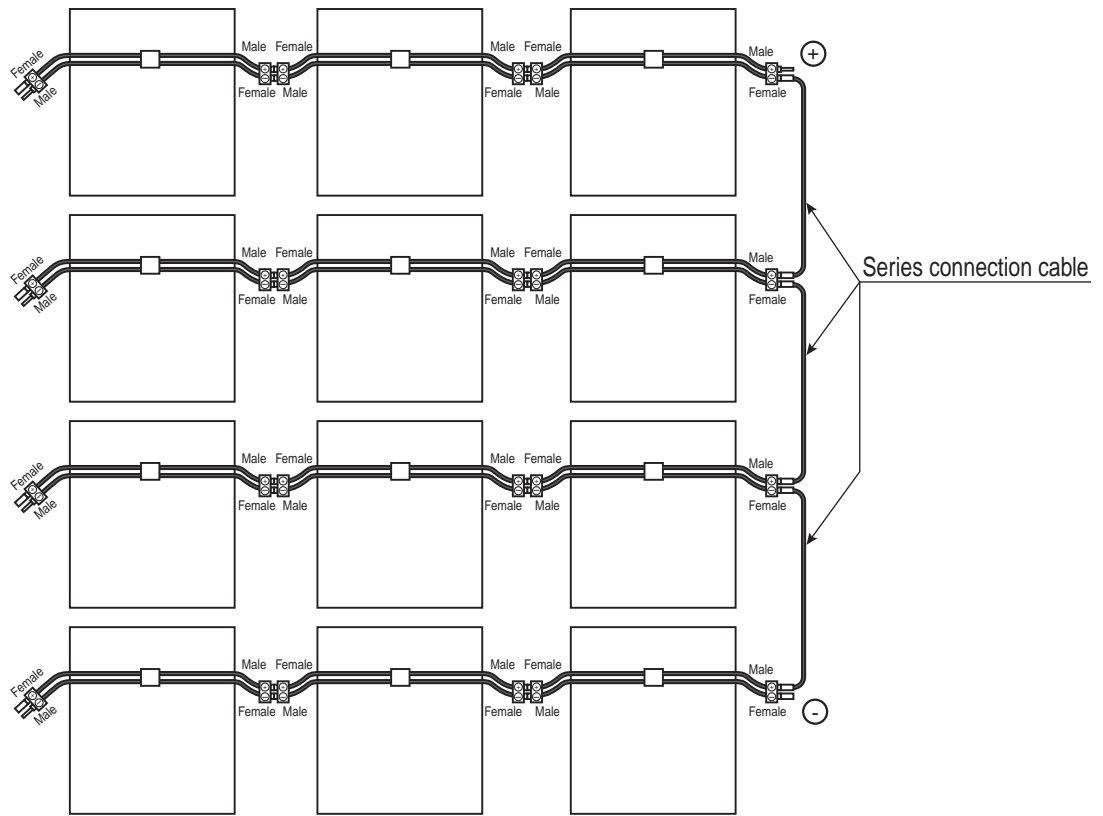


Fig.6 Series Connections

(c) Detail of connection

A clamp (small black parts with key) is mounted on a pair of connectors to avoid making incorrect wiring.

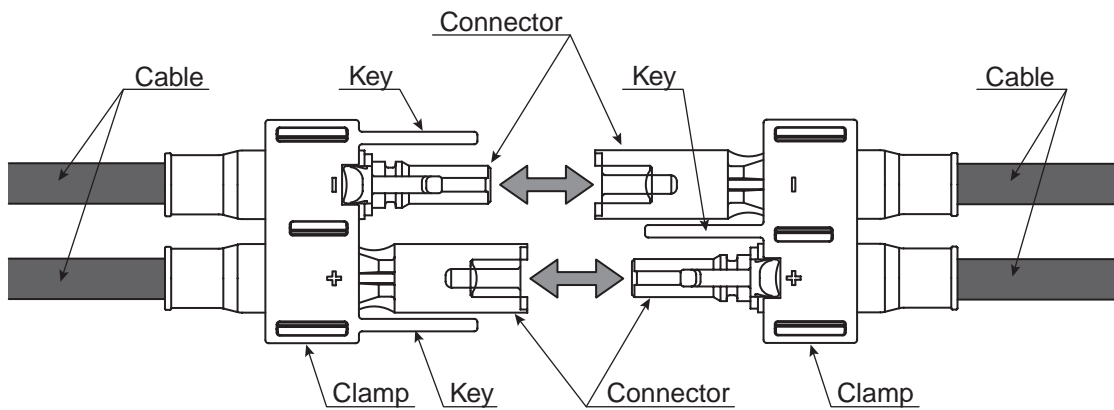


Fig.7 Parallel Connection

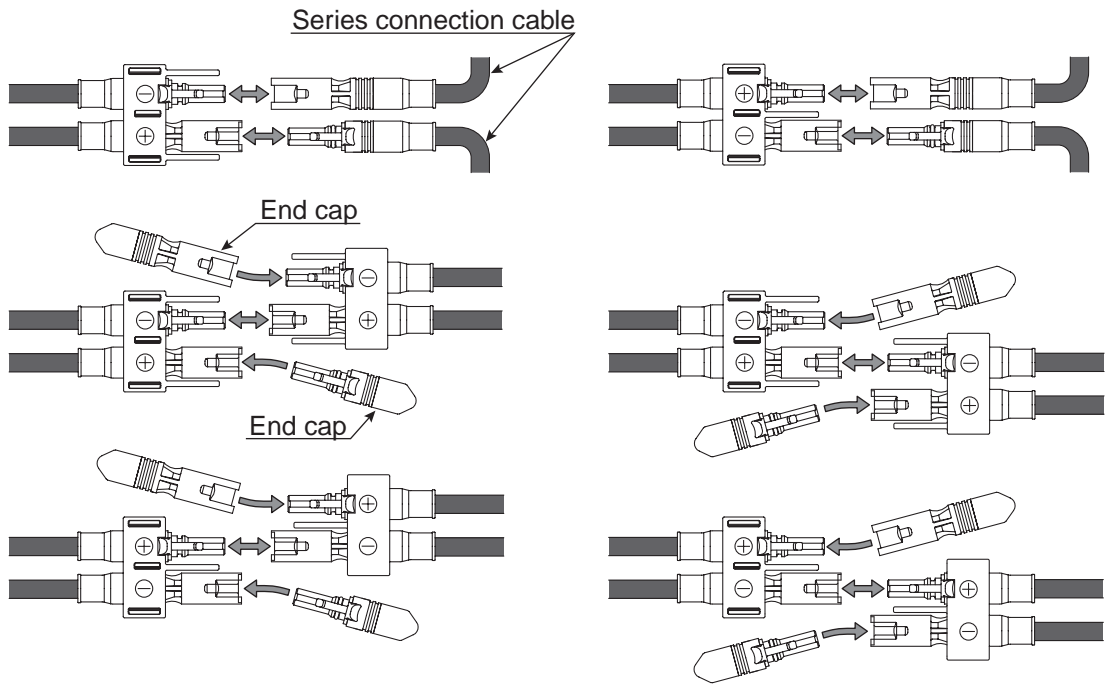


Fig.8 Series Connection

(d) Limitation of connection

Systems up to maximum current 20A per 1 string, maximum voltage 600V can be used for the PV module. Considering sunshine condition or temperature condition, please make parallel number and series number as shown in Table 2.

When series connection is adopted, make number of each parallel connection be same. (see Fig.9 and 10)

⚠ • The device to protect the PV module against the current over 20A shall be installed for each string.

Table 2 Maximum Connection Number of the PV Module

Model	Parallel	Series
MT120T2	11 per 1 string	4

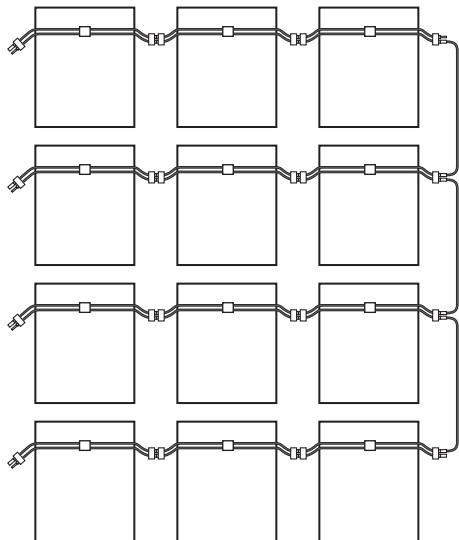


Fig.9 Example of Correct Connection

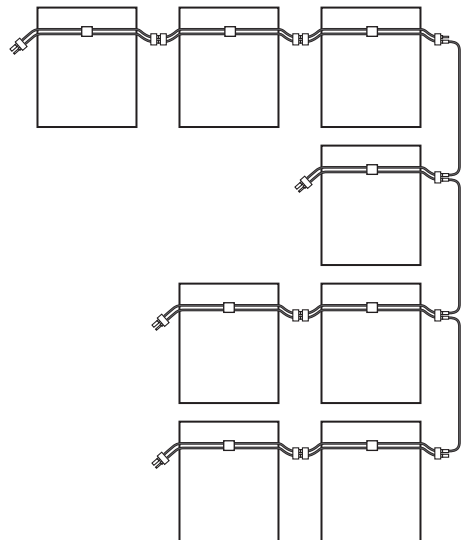


Fig.10 Example of Wrong Connection

C. COMBINATION OF STRINGS

When you want to combine many strings in one connection box or inverter, it is only necessary to consider voltage matching. For example, in Fig.11, the string on the left consists of 12 module, 3 in parallel and 4 in series, and the string on the right consists of 4 module, 1 in parallel and 4 in series. Both strings have 4 series connection and the voltages are same.

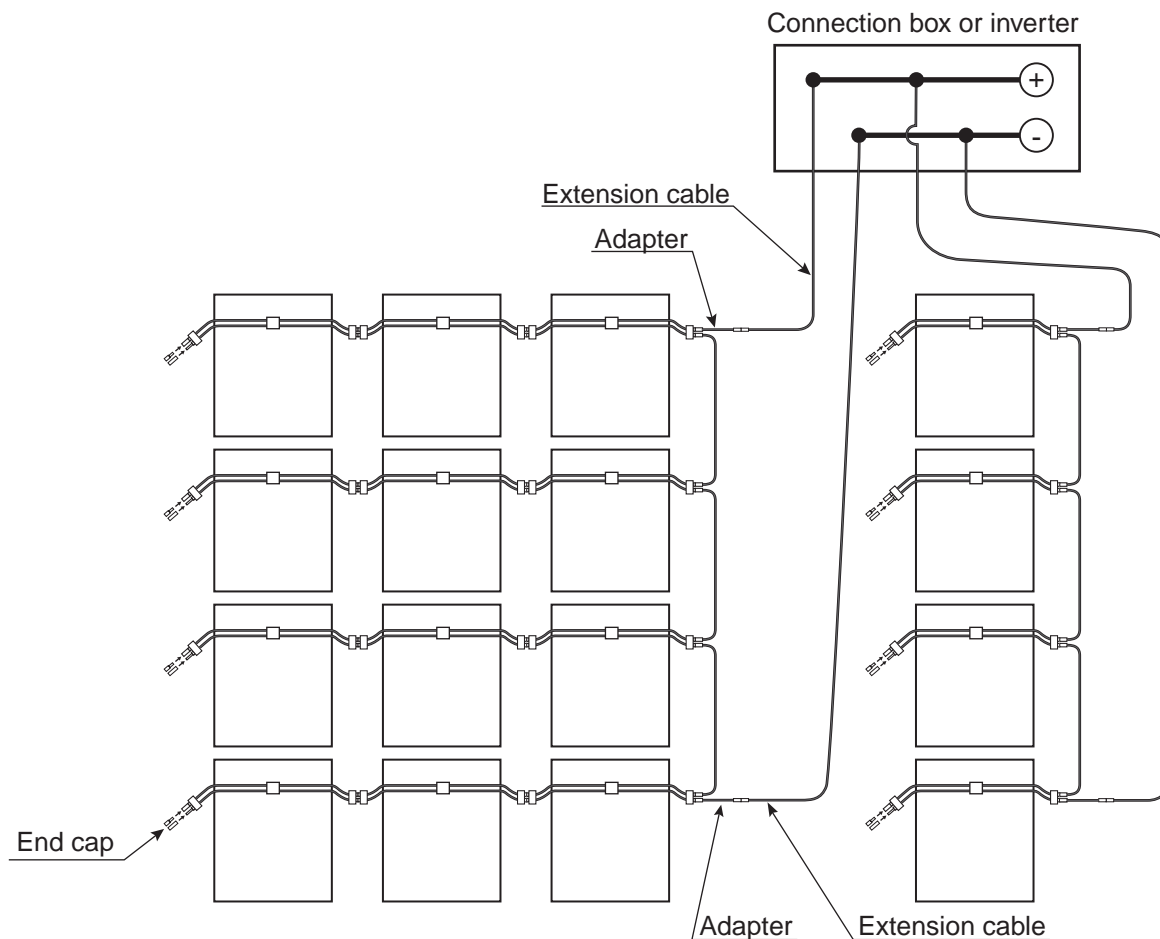


Fig.11 Example of Wiring Combination

D. CABLE OPTIONS

For safety, terminate the unused connector with the end cap supplied by MHI. Please order the end caps with the PV module.

Optional cables are also available if required. Do not cut the cable attached on the PV module.

11 GROUNDING

The PV module has 8 of 3.5mm holes in its frame for grounding. (Etched Earth symbol "⏏") Ground the PV module electrically with those holes. Grounding means should comply with laws or electrical regulations of your states or countries.

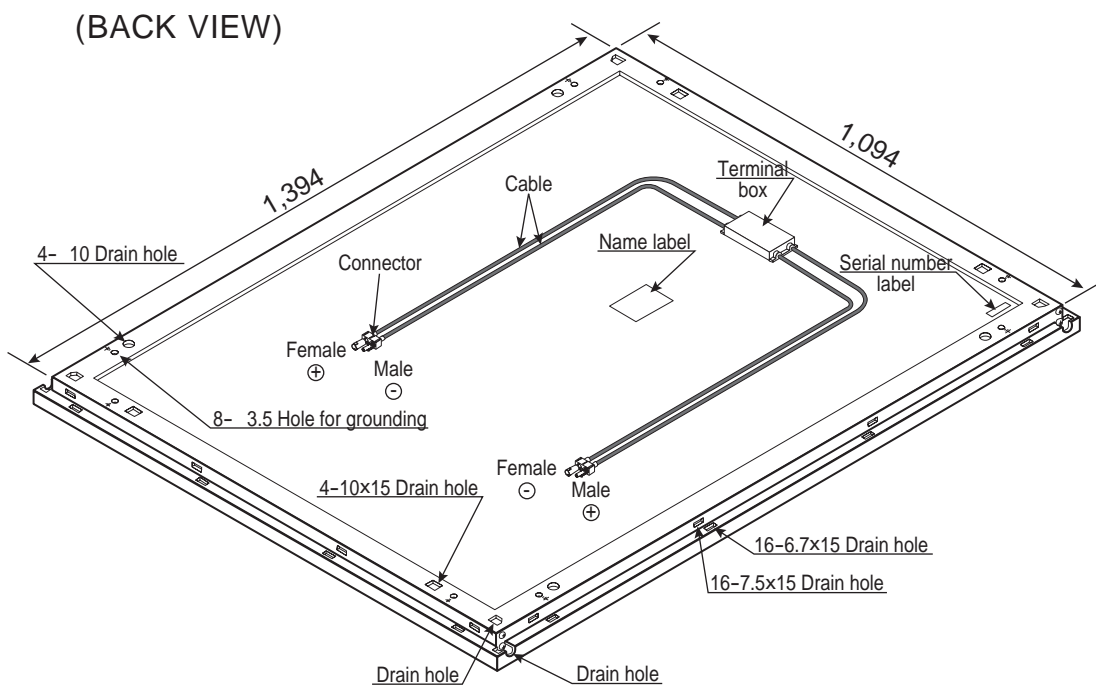
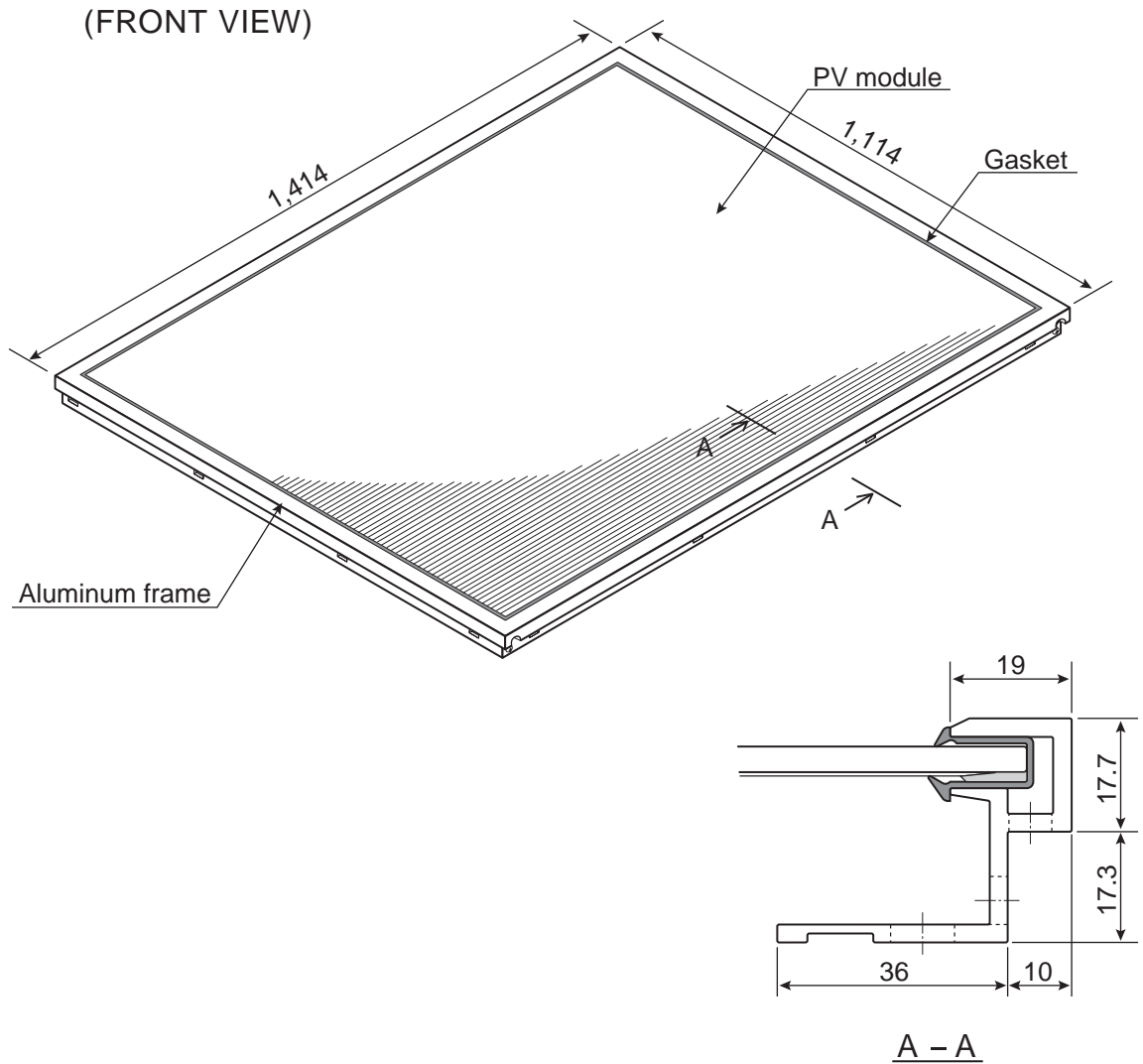
MITSUBISHI HEAVY INDUSTRIES, LTD.

Solar Power System Business Unit

3-1, Minatomirai 3-chome, Nishi-ku, Yokohama 220-8401, Japan

Tel: +81-45-200-7922 Fax: +81-45-200-7738






Appendix 1 APPEARANCE



(Unit : mm)

Appendix 2 LABELING

- Name Label (75mm × 110mm)

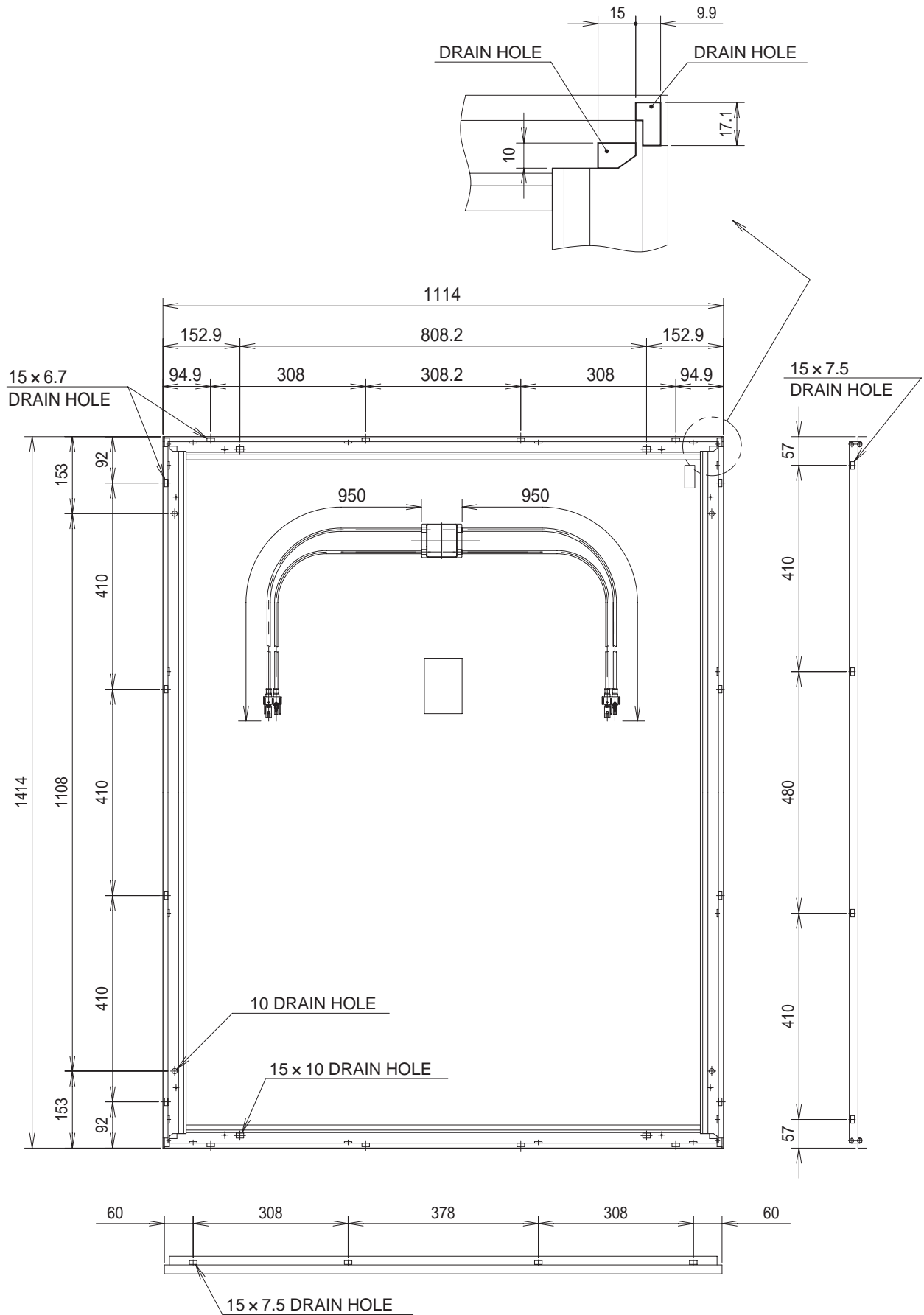
 MITSUBISHI HEAVY INDUSTRIES, LTD.	
MITSUBISHI TANDEM PV MODULE	
Model Type :	MT120T2
Serial No. :	Indicated on upper right corner
Maximum Power (Pmax) :	120 W ±5%
Voltage at Pmax :	101 V
Current at Pmax :	1.19 A
Open Circuit Voltage :	131 V
Short Circuit Current :	1.42 A
Maximum System Voltage :	600 V
<small>Electrical ratings at STC : 1kW/m², AM1.5, 25°C</small>	
Weight :	21 kg
MADE IN JAPAN  	
WARNING !! - ELECTRICAL HAZARD -	
	<i>PV module produces high voltage when exposed to sunlight. There is risk of electric shock or electrical hazard. Read instruction manual before installation.</i>
	<i>Do not disconnect under load.</i>
	<i>Do not disassemble PV module.</i>
	<i>Do not remove any parts or labels.</i>

- Serial Number Label (45mm × 20mm)

Sample



Appendix 3 DRAWING



(Unit : mm)

Appendix 4 UNPACKING PROCEDURE AND CAUTION LABEL

Mounting advice:

Follow these instructions for mounting the PV module:

Mounting of the module has to be performed in a way that the round and square holes in the frame are not blocked in any way.

Product Removal Instruction

Open this side and pull out the product.
(Please, refer the opening instruction certainly)

- Opening Procedure -

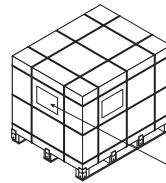
External appearance at arrival

⚠ CAUTION

Place the transportation box on flat ground.

~ are polyethylene bands.

“ Unpacking Procedure Label ”

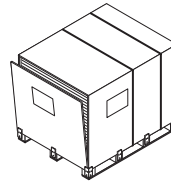


Step 1

Cut , , , , and .

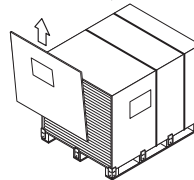
⚠ CAUTION

Don't cut and until you finish removing the products.



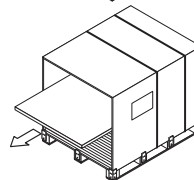
Step 2

Remove the plywood sheet with “ Unpacking Procedure Label ”









Step 3

Withdraw the products one by one horizontally.

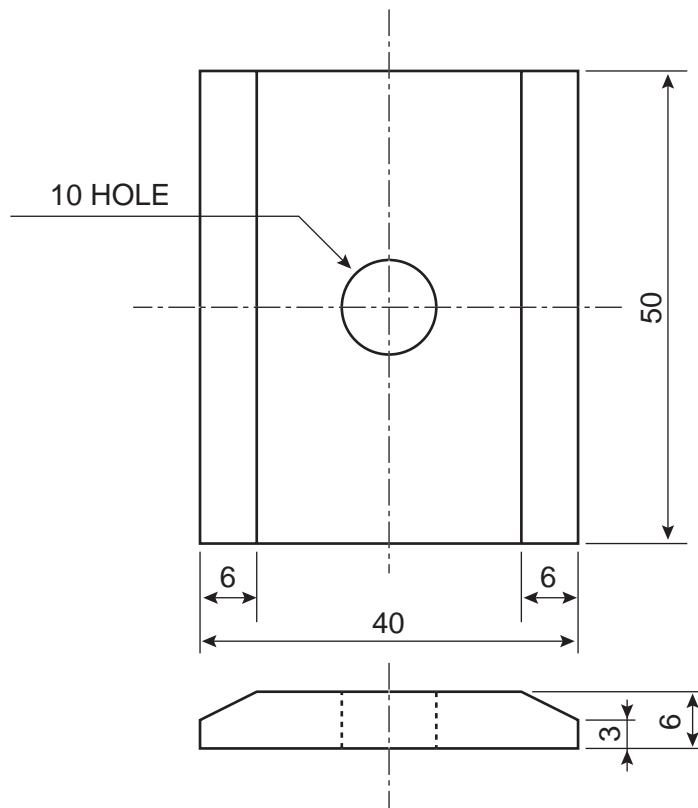


GB01

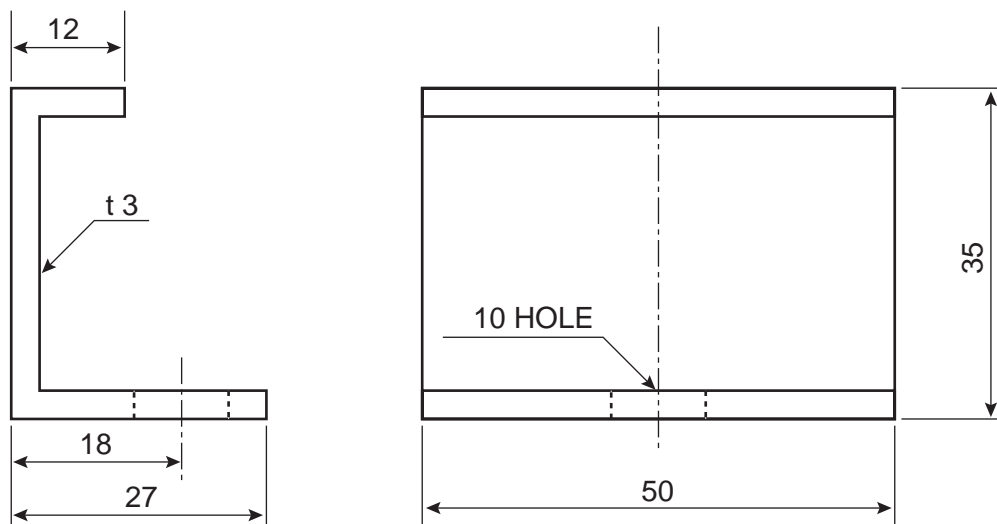
Appendix 5 SHIPPING LABEL

<p>三菱タンデム太陽電池モジュール 製造者；三菱重工業株式会社</p> <hr/> <p>内容物数量； 25 枚 梱包重量； 590 kg</p> <hr/> <p> 取り扱い注意  ガラス製品・割れ物注意  水濡れ厳禁  天地無用・斜め置き厳禁  踏みつけ厳禁  積み重ね厳禁 (<input checked="" type="checkbox"/> 但し、倉庫保管時・海上輸送コンテナ) (<input type="checkbox"/> では1梱包だけ積み重ねてもよい) 急ブレーキ厳禁 振動・衝撃厳禁</p>	<p>Product Name ; Mitsubishi Tandem PV Module Product Code No. ; MT120T2 Manufacturer ; MITSUBISHI HEAVY INDUSTRIES, LTD.</p> <hr/> <p>Number of units ; 25 Sheets Total Weight ; 590 kg</p> <hr/> <p> HANDLE WITH CARE  GLASS PRODUCT / FRAGILE  KEEP AWAY FROM WATER  THIS WAY UP, KEEP FLAT  NO STEP ON THE TOP  DO NOT STACK (Exception: <input checked="" type="checkbox"/> Only 1 package may be stacked during <input type="checkbox"/> storage in warehouse / marine container) NO SUDDEN BRAKE NO HEAVY VIBRATION / SHOCK GB18</p>
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Appendix 6 FIXING PARTS



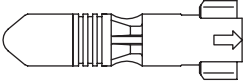
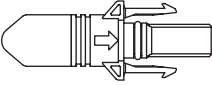
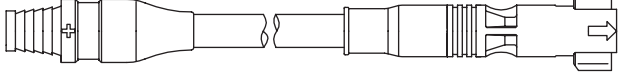
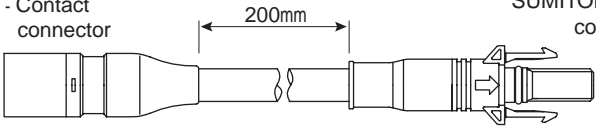
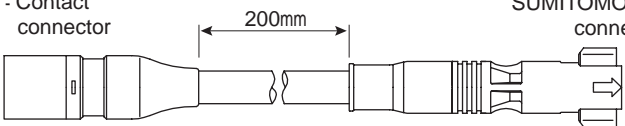
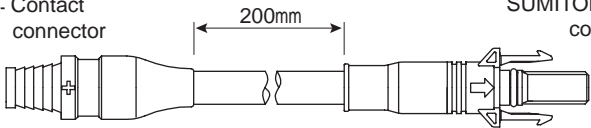
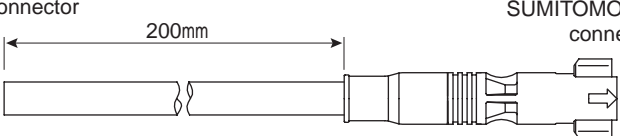
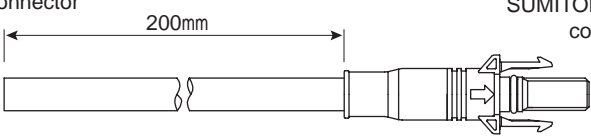
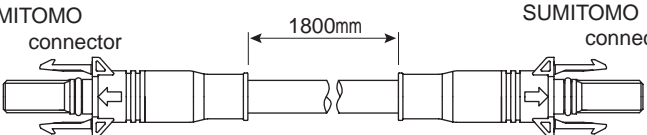
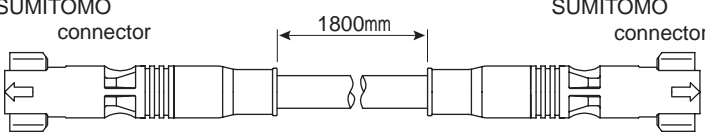
a. Fixing plate



b. Fixing base

(Unit : mm)

Appendix 7 END CAP, ADAPTER AND SERIES CONNECTION CABLE

<p>End Cap A</p>	
<p>End Cap B</p>	
<p>Adapter A</p>	<p>Multi - Contact connector 200mm SUMITOMO connector</p> 
<p>Adapter B</p>	<p>Multi - Contact connector 200mm SUMITOMO connector</p> 
<p>Adapter C</p>	<p>Multi - Contact connector 200mm SUMITOMO connector</p> 
<p>Adapter D</p>	<p>Multi - Contact connector 200mm SUMITOMO connector</p> 
<p>Adapter E</p>	<p>nonconnector 200mm SUMITOMO connector</p> 
<p>Adapter F</p>	<p>nonconnector 200mm SUMITOMO connector</p> 
<p>Series connection cable A</p>	<p>SUMITOMO connector 1800mm SUMITOMO connector</p> 
<p>Series connection cable B</p>	<p>SUMITOMO connector 1800mm SUMITOMO connector</p> 
<p>Series connection cable C</p>	<p>SUMITOMO connector 1800mm SUMITOMO connector</p> 