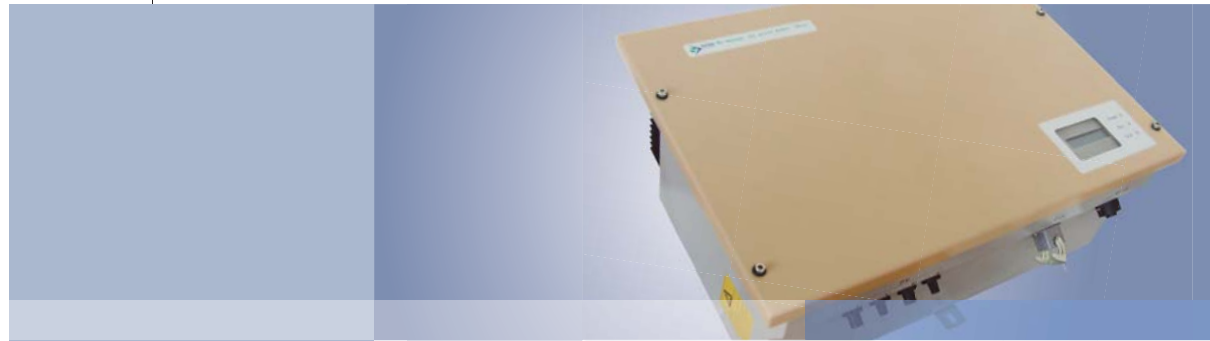


HR-INV-X01 Grid-Connected PV Inverter

User's Manual



Shanghai Aero-Sharp Electric Technologies Co., Ltd

Add: 6629 Zhongchun Rd., Minhang District,
Shanghai 201101, China

Tel : (+)86-21-64781785-708

Fax : (+)86-21-64781799-700

Website: www.aero-sharp.com.cn

Emai: sales@aero-sharp.com.cn



User's Manual

Version 1.0

Signs Used in this Manual



This sign indicates that the instructions next to it must be read and observed. Fail to do so could lead to the consequences of fire, injury or even death.



This sign indicates that the instructions next to it must be read and observed. Fail to do so could lead to the consequences of property damage.



This sign indicates that the instructions next to it should be read and observed. By doing so the work in question can be done in a more correct and efficient way.



This sign indicates that the instructions next to it should be read and followed. By doing so the subject in question can be covered in a more complete and detailed way.

Important Safety Instructions

Please read this manual thoroughly before starting installation and follow the instructions during installation, operation and maintenance service.



The installation and service of HR-INV-X01 inverters can only be performed by qualified personnel. The installers must be certified by the local energy or public utility authority and/or electricity supplier.



All electrical installation shall be done in accordance with the local and national electrical codes.



Disconnect all plugs from the enclosure before perform any service. There are energy storage capacitors inside the enclosure, residual high voltage may exist even without any external connection.



Do not touch the enclosure while the inverter is operating. The temperature of any part of the enclosure may exceed 60°C.



The inverter shall be mounted on solid concrete or brick wall. The HR-INV-X01-020 (2kW) and HR-INV-X01-030 (3kW) inverters weigh over 30 kg, shall be lifted by two persons.



Do not disconnect the plugs from the enclosure while the inverter is operating. Doing so may damage the inverter.

SAVE THESE SAFETY INSTRUCTIONS

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Part-1 Product Information

1.1 Product description



HR-INV-X01-006/010

HR-INV-X01-020/030

The HR-INV-X01 series PV inverters are specially designed for the application of small to medium power size roof-top grid-connected PV generation systems.

Features of the HR-INV-X01 series grid-connected inverters:

- Sealed stainless steel enclosure designed and certified for IP65 protection level. Suitable for both outdoor and indoor installation.
- Isolation transformer between the inverter electronics and the utility grid for safety and reliability yet maintains very high conversion efficiency.
- Plug-in connection for all DC input, AC output and communication cables, very easy field wiring.
- Independent MPPT channels for PV module strings of different characteristics to maximize the yields of a system.
- Proper power size and input voltage range for each input MPPT channel, very easy system integration with a single string for each MPPT channel.
- Transient voltage suppressor at both input and output terminals to protect the inverter from transient high voltages induced by lightning or other sources.

1.2 Technical specifications

Model Type	HR-INV-X01-006	HR-INV-X01-010	HR-INV-X01-020	HR-INV-X01-030	HR-INV-X01-050
Norminal Power Rating (kVA)	0.6	1.0	2.0	3.0	5.0
Input					
Recommended Input PV Power (W)	750	1250	2500	3750	6250
Max. DC Input Power (W)	700	1200	2350	3500	5750
Max. Input Voltage (Vdc)	400	400	400	400	400
Norm. Input Voltage (Vdc)	280	280	280	280	280
Min. Input DC Voltage (Vdc)	150	150	150	150	150
MPPT Voltage Range (Vdc)	150 ~ 400	150 ~ 400	150 ~ 400	150 ~ 400	150 ~ 400
Max. Input DC Current (A _{dc})	4.5	6	6 + 6	10 + 10	20 + 20
Input Connection	Plug	Plug	Plug	Plug	Plug
Number of Input Connectors (pair)	1	1	2	2	4
Number of MPPT Channel	1	1	2	2	2
Input Transient Voltage Suppression	Yes	Yes	Yes	Yes	Yes
Earth Fault Detection and Indication	Yes	Yes	Yes	Yes	Yes
Opposite Polarity Protection	Yes	Yes	Yes	Yes	Yes
Input Current Limitation	Yes	Yes	Yes	Yes	Yes
Output					
Max. Output AC Power (VA)	660	1100	2200	3300	5500
Norm. Output AC Power (VA)	600	1000	2000	3000	5000
Power Factor	>0.99	>0.99	>0.99	>0.99	>0.99
Output Current THD	<4%	<4%	<4%	<4%	<4%
Norm. Grid Voltage (Vrms)	220 / 230 / 240 50Hz, 120 / 240 60 Hz	220 / 230 / 240 50Hz, 120 / 240 60 Hz	220 / 230 / 240 50Hz, 120 / 240 60 Hz	220 / 230 / 240 50Hz, 120 / 240 60 Hz	220 / 230 / 240 50Hz, 120 / 240 60 Hz
Grid Voltage Range (Vrms)	88%~110% of norm grid voltage by default, adjusted to local regulation	88%~110% of norm grid voltage by default, adjusted to local regulation	88%~110% of norm grid voltage by default, adjusted to local regulation	88%~110% of norm grid voltage by default, adjusted to local regulation	88%~110% of norm grid voltage by default, adjusted to local regulation
Rated Output AC Current (Arms)	2.6	4.3	8.7	13.0	21.8
Max. Output AC Current (Arms)	3.0	5.0	10.0	15.0	24.0
Norm. Grid Frequency (Hz)	50	50	50	50	50
Grid Frequency Range (Hz)	49.5 ~ 50.5 by default, adjusted to local regulation	49.5 ~ 50.5 by default, adjusted to local regulation	49.5 ~ 50.5 by default, adjusted to local regulation	49.5 ~ 50.5 by default, adjusted to local regulation	49.5 ~ 50.5 by default, adjusted to local regulation
Transformer Isolation Between System and Grid	Yes	Yes	Yes	Yes	Yes
Grid Connection Wiring	Plug	Plug	Plug	Plug	Plug
Grid Disconnection	Relay	Relay	Relay	Relay	Relay
Output Short Circuit Protection	Yes, current control	Yes, current control	Yes, current control	Yes, current control	Yes, current control
Output Transient Voltage Suppression	Yes	Yes	Yes	Yes	Yes
Non-islanding	Yes, comply with UL 1741 / IEEEE1547 / VDE0126-1-1	Yes, comply with UL 1741 / IEEEE1547 / VDE0126-1-1	Yes, comply with UL 1741 / IEEEE1547 / VDE0126-1-1	Yes, comply with UL 1741 / IEEEE1547 / VDE0126-1-1	Yes, comply with UL 1741 / IEEEE1547 / VDE0126-1-1
Electromagnetic Compatibilly	Comply with EN 61000-3-2 / 3-3 / 6-1 / 6-2 / 6-3 / 6-4 FCC Part 15 class B	Comply with EN 61000-3-2 / 3-3 / 6-1 / 6-2 / 6-3 / 6-4 FCC Part 15 class B	Comply with EN 61000-3-2 / 3-3 / 6-1 / 6-2 / 6-3 / 6-4 FCC Part 15 class B	Comply with EN 61000-3-2 / 3-3 / 6-1 / 6-2 / 6-3 / 6-4 FCC Part 15 class B	Comply with EN 61000-3-2 / 3-3 / 6-1 / 6-2 / 6-3 / 6-4 FCC Part 15 class B
Power Efficiency (with isolation)					
Max Efficiency	>93.0	>93.5	>94.0	>94.5	>95.5
European Efficiency	>91.0	>91.5	>92.5	>93.0	>94.5
Packaging					
Enclosure	IP65, for indoor and outdoor installtion	IP65, for indoor and outdoor installtion	IP65, for indoor and outdoor installtion	IP65, for indoor and outdoor installtion	IP32, for indoor installtion
Weight (kg)	16	22	28	33	70
Dimension (H x W x D, mm)	326x375x202		395x525x222		520x400x350
Environment					
Operation Ambient Temperature (°C)	-25 ~ +40	-25 ~ +40	-25 ~ +40	-25 ~ +40	-25 ~ +40
Storage Ambient Temperature (°C)	-40 ~ +70	-40 ~ +70	-40 ~ +70	-40 ~ +70	-40 ~ +70
Elevate Above Sea Level (m)	4000 (Max. Temp +30°C)	4000 (Max. Temp +30°C)	4000 (Max. Temp +30°C)	4000 (Max. Temp +30°C)	4000 (Max. Temp +30°C)

Part-3 Installation Instructions

3.1 How to choose installation site

The HR-INV-X01 series inverters can be installed indoors and outdoors. In both cases, the following instructions shall be followed:

- Do not let sunshine shed on the inverter enclosure directly.
- The inverter shall be installed on a thick concrete or brick wall. The wall shall be vertical or tilt backwards. The tilt angle shall not be large than 30°.



WARNING!

Do not install the inverter in explosive or flammable environment. Risk of fire or explosion!

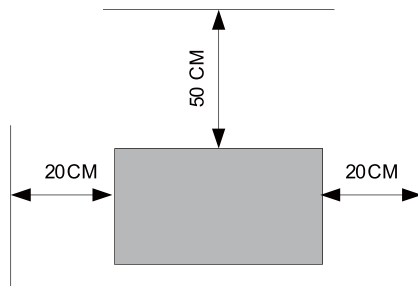
- The site of installation shall be dry, clean and has enough room to allowed free air circulating.



WARNING!

The site of installation shall be free of frequent human or pets' activities. Do not touch the enclosure while the inverter is operating. The temperature of any part of the enclosure may exceed 60°C. Risk of burning injury!

- The height of the installation shall be between 1.2 M to 1.4 M (the bottom edge of the enclosure). Or follow the national electrical code.
- The free spacing shall be at least 50CM above the inverter and 20CM on both sides of the inverter, as indicated in the drawing below.



3.2 How to mount the inverter

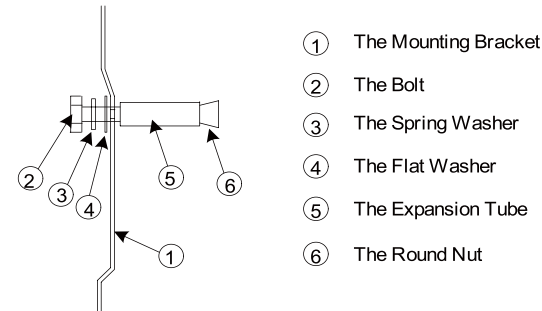


WARNING!

Do not mount the inverter on flammable construction materials. Risk of fire!

Please follow these steps to mount the inverter:

- Use the two mounting holes of the mounting bracket to mark the drilling points on the wall.
- Use drilling machine to drill two holes on the wall with a $\Phi 12$ mm drilling tool. The depth of the holes shall be between 7 and 8 CM.
- Arrange parts of the expansion bolt set with the mounting bracket in the way shown in the following drawing and slightly tighten the bolt and the round nut.



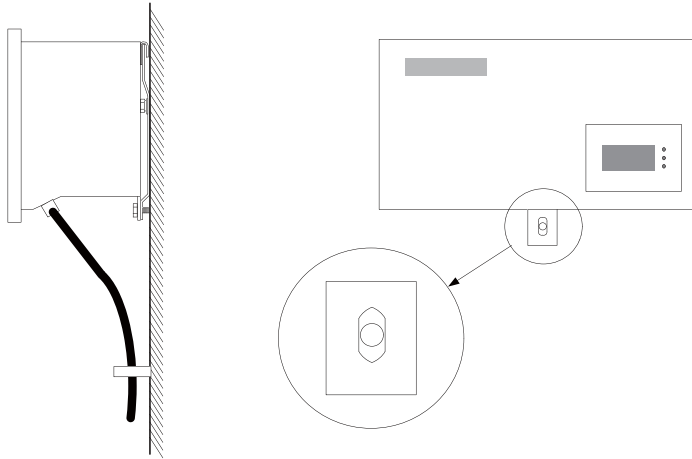
- ① The Mounting Bracket
- ② The Bolt
- ③ The Spring Washer
- ④ The Flat Washer
- ⑤ The Expansion Tube
- ⑥ The Round Nut

- Push the two expansion bolts into the holes on the wall, alternatively and slowly knock them into the holes until the mounting bracket evenly and closely touches the wall surface.
- Turning the bolt until it is well fastened.
- Lift the inverter and hang it on the mounting bracket as shown in the drawing below, left. Pay attention that you can see the positioning hole on the lower position of the bracket through the hole on the positioning ear on the bottom of the inverter enclosure as shown in the drawing below, right.



WARNING!

The HR-INV-X01-020 (2kW) and HR-INV-X01-030 (3kW) inverters weigh over 30 kg, shall be lifted and handled by two persons. Risk of personal injury and property damage!



- Fasten the positioning bolt. Do a final check of the mounting work.

3.3 Electrical Wiring



Before connect PV string and the AC grid to the inverter, check the Name Plate item by item for the compatibility on both DC input and AC output sides with the DC source and the AC grid. Fail to do so could damage the inverter or cause malfunction of the inverter.



Check the compliance of the Grid Connection Protection with the standards mandated by local energy and public utility authority. Fail to do so could violate the local regulation.

3.3.1 DC input connection

The type of DC input connectors used in HR-INV-X01 series inverters are Multi-Contact 3mm panel mounting sockets. To connect DC source cable to the inverter, the following types of cable side plug are needed:

Multi-Contact female plug: 3mm PV-KBT3I or 4mm PV-KBT3II

Multi-Contact male plug: 3mm PV-KST3I or 4mm PV-KST3II

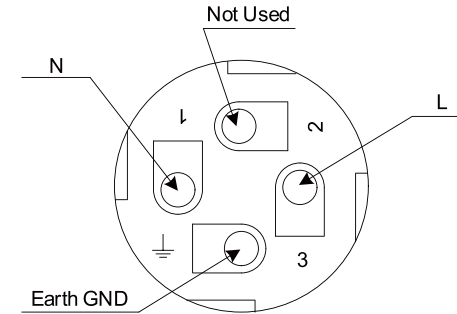
3.3.2 AC output connection

For the AC output connection, the cable side plug is provided with the inverter. The AC cable used for wiring should be:

For HR-INV-X01-006 and 010 (0.6kW and 1kW): three-wire cable, wire section area 1.5 mm² cable diameter 8.5 ~ 9.3 mm.

For HR-INV-X01-020 and 030 (2kW and 3kW): three-wire cable, wire section area 2.5 mm² cable diameter 8.5 ~ 9.3 mm.

The connection of the wires to the plug is indicated in the following drawing.



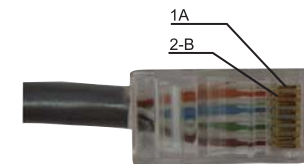
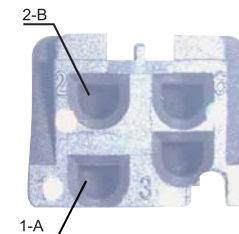
3.3.3 Communication cable connection

Pictures below shows the connection of USB-RS485 and the system, insert the plugs into the location where arrows indicates.



The connecting wires between USB and RS485 can be provided by the customers themselves. This wire should be Twist-Pair with the length of no longer than 1km.

The connection method see the picture below: 1-A with 1-A, 2-B with 2-B.



3.4 Commence Operation and Stop Operation

3.4.1 Commence Operation

After completion of installation and final checking, the inverter may enter the operation status by doing following step by step:



CAUTION!

Check that the voltage of the DC input source is not higher than 400Vdc and the correctness of the polarity. Check to see that the AC switch gear is at OFF position and there is no AC voltage on the AC cable side plug. Fail to do so may damage the inverter.

- After checking that there is no Voltage on the AC plug, connect the AC plug onto the 'Grid' socket on the inverter enclosure.
- After checking that the voltage of the DC source is not higher than 400Vdc and the correctness of the polarity, connect the DC source plugs into the 'PV' sockets one by one.
- Check to see the LCD display reads 'Grid Volt Error, Grid Freq Error'.



REFERENCES

Go to section 4.3 for the definition of the LCD display contents.

- Turn on the AC switch gear.
- The inverter will take about a minute to check all the DC source and the AC grid conditions, then starts to feed power into the grid, i.e., it enters into the MPPT mode.
- Check the operation status by read through the rolling LCD displays one by one, make sure the system now is in normal operation mode.



REFERENCES

Go to section 4.2.2 for the definition of the LCD display contents..

3.4.2 Stopping Operation

Whatever operating mode is the inverter in, to stop the operation, please follow the following steps:

- Turn off the DC switch gear if it is provided in DC source side of the system. If there is no DC source switch gear in the system, go on to next step.
- Disconnect the DC source plugs from the 'PV' sockets of the inverter.
- Turn off the AC switch gear on the AC grid side of the system.
- Disconnect AC plug from the 'GRID' socket of the inverter.

Part-4 The Contents of the LED Indication and the LCD Displays



4.1 Description of LED Lamp Indication

As shown in the diagram, there are three indicator lamps on the panel which are in turn from above power indicator lamp, run indicator lamp, fault indicator lamp.

When the system is energized, the power indicating lamp is on (green), otherwise it will be off.

When the system is operating normally and goes into the phase of power generation, the run indicator lamp is on (green), otherwise it will be off.

When the system has fault, the fault indicator lamp is on to indicate two categories of faults.

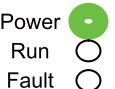
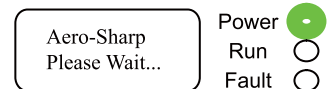
Red light means CAT I fault with the system, and green light means CAT II. For details of the two categories of faults, see the section of LCD indication description. The lamp turns off when the system is operating normally.

4.2 Description of LCD Indication

LCD can indicate two lines with 16 characters in each line. The LCD screen has a backlit light, which will turn on and last for 30 seconds when knocking the inverter case. The LCD screen can display three categories of information: system initialization, normal operation, system operating mode (included in the normal operation) CAT I fault and CAT II fault.

4.2.1 Information of System Initialization

When the system is energized, LCD module starts initialization.



4.2.2 Information of Normal Operation

Information of normal operation consists of many items which can be divided into operating status information, statistic information and system operating mode information. The operating status information is used to display main operating parameters of PV inverter while the statistic information is used to display operating time and total amount of power generation. The display is shown by six times on the screen in a rolling mode with an interval of 5s.

When the system starts power on, LCD module starts initializing and will display.

Vgrid 230V Pout 600W	Power
	Run
	Fault

In a few seconds, the system will enter the rolling indication stage of operating information.

Vgrid: Value range: 0 to 499, unit: V
Pout: Value range: 0 to 3999, unit: W

Vgrid 230V Pout 600W	Power
	Run
	Fault

Vpv1 (Voltage of Battery Group 1):

Value range: 0 to 499; unit: V

Vpv2 (Voltage of Battery Group 2):

Value range: 0 to 499; unit: V

If Vpv2 is provided, there will be display; otherwise there will be no display.

Vgrid 200V Pout 300W	Power
	Run
	Fault

E-Today (Electric power generated today):

Value range: 0.0 to 99.9; unit: kWh

E-Total (Electricity power generated total):

Value range: 0 to 300000; unit: kWh

E-Today 1.2kWh E-Total 32kWh	Power
	Run
	Fault

T-Today (Electricity power generation time today):

Value range: 0.0 to 24.0; unit: h

T-Total (Total electricity power generation time):

Value range: 0 to 99999; unit: h

T-Today 1.2h T-Total 32h	Power
	Run
	Fault

Internal Tmp (Temperature of the system):

Value range: -100 to 100; unit: °C

Mode is used to indicate what operating mode the system is currently in.

Internal Tmp 30C Mode Max.P.P.	Power
	Run
	Fault

Display real time: Year/month/date hour: minute

Aero-Sharp 2008/08/08 08: 08.	Power
	Run
	Fault

4.2.3 Information of System Operating Modes

There are four operating modes: 1. Stand By; 2. Interrupted; 3. Power-Limiting; 4. Maximum. Power. Point.:

4.2.3.1 Stand By Mode

The system is energized, but hasn't met the requirements of electricity power generation; or the equipment has not entered electricity generation process while waiting for restart after shutdown.

Internal Tmp 30C Mode Stand By	Power
	Run
	Fault

4.2.3.2 Interrupted Mode

The system is shut off because of faults.

Internal Tmp 30C Mode Interrupted	Power
	Run
	Fault

4.2.3.3 Power-Limiting Mode

The system reduces power output when overheated or overloaded.

Internal Tmp 30C Mode P-Limiting	Power
	Run
	Fault

4.2.3.4 Maximum. Power. Point. Mode

The system operates at maximum power.

Internal Tmp 30C Mode Max.P.P.	Power
	Run
	Fault

4.3 Fault display

Fault is divided into two categories: CAT I fault and CAT II fault. When CAT I fault occurs, the inverter will stop operating while it can work continuously when CAT II fault occurs. There are also two categories of displays.

4.3.1 Display of CAT I fault

Only fault information, but not operating information, will be displayed. If the faults are more than one, the display is rolling with an interval of 5s.

CAT I fault has five types:

1. BIT Failure
2. Ground Fault
3. PV1 Over Volt
4. PV2 Over Volt
5. System Error

BIT Failure	Power
	Run
	Fault

The system will stop operating upon occurrence of the 3rd and 4th faults and will restore operating automatically upon disappearance of faults. The system stops upon occurrence of 1st, 2nd and 5th faults and requires manual repair to eliminate the faults.

4.3.2 Display of CAT II fault

There will be two lines of displays. The upper one displays fault information. If the faults are more than one, the display will be rolling with an interval of 5s. The other line displays information of operating status and statistic information. The method of rolling display will be used with an interval of 5s.

Fault information: Grid Volt Error

Operating information: Vgrid: Value range 0 to 499; unit: V

CAT II fault has five types:

1. PV Over Power
2. Grid Volt Error
3. Grid Freq Error
4. TVS1 Failure
5. TVS2 Failure

Grid Volt Error Vgrid 230V	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

When the 1st, 4th and 5th faults happen, the system will still operate normally, while there will be advice that TVS1 or TVS2 be replaced. The system will top operating upon occurrence of the 2nd and 3rd faults and will operate automatically if the grid gets normalized after detection.

Grid Volt Error
Pout: Value range: 0 to 3999, unit: W

Grid Volt Error Pout 600W	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
Vpv1: Value range: 0 to 499, unit: V

Grid Volt Error Vpv1 200V	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
Vpv2: Value range: 0 to 499, unit: V

Grid Volt Error Vpv2 200V	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
E-Today: Value range: 0.0 to 99.9, unit: kWh

Grid Volt Error E-Today 1.2kWh	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
E-Total: Value range 0 to 300000, unit: kWh

Grid Volt Error E-Total 32kWh	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error T-Today:
Value range: 0.0 to 24.0, unit: h

Grid Volt Error T-Today 1.2h	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
T-Total: Value range: 0 to 99999, unit: h

Grid Volt Error T-Total 32h	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
Internal Tmp: Value range -100 to 100, unit: °C

Grid Volt Error Internal Tmp 30C	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

Grid Volt Error
Mode is used to indicate what operating mode the system is currently in.

Grid Volt Error Mode Max.P.P.	Power <input checked="" type="radio"/>
	Run <input type="radio"/>
	Fault <input checked="" type="radio"/>

4.4 Description of electricity power generation record in all periods and record of fault information

In addition to system operating information as above displayed on LCD, the system also keeps power output in all periods including daily output in the last 30 days (or month), hourly output in the last 30 days (or month) and monthly output in the last 12 months (including that month). The system can record 1000 pieces of fault information which includes fault character with 10 significant bits indicating fault category and what fault in that category and fault time (date, hour and minute). The records are to be saved in a rolling mode. When records exceed 1000 pieces, the 1001st piece of information will be stored at the place where the first one is. And the former first one will be deleted. The rest may be deduced by analogy. All the above operating information and record can be read via system communication interface.

4.5 Connection of the communication interface

The system provides RS485 communication interface. The user may detect and read the above data via the interface. The connection is shown in the following picture. This system uses one-to-one mode, i.e. one PC can only read one system. The PC port interface is RS232 serial port or USB port (USB virtualized as RS232 serial port).



Part-5 Field Service



WARNING!

There is no user serviceable component inside the enclosure. The field service of HR-INV-X01 inverters can only be performed by qualified service personnel. Risk of electric shock!

The TVS (Transient Voltage Suppressor) components inside the inverter may be worn out after certain number of times functioning. The replacement of the TVS components is the only supposed field service. When the LCD display reads 'TVS failure', please call your installer or service person for service. To replace the TVS component, please follow the following steps:

- Stop the inverter from operating by following the instructions given in section 3.4.2.



REFERENCES

Go to section 3.4.2 for the instructions of how to stop operation.

- Wait 10 minutes for the capacitors inside the inverter to discharge.



WARNING!

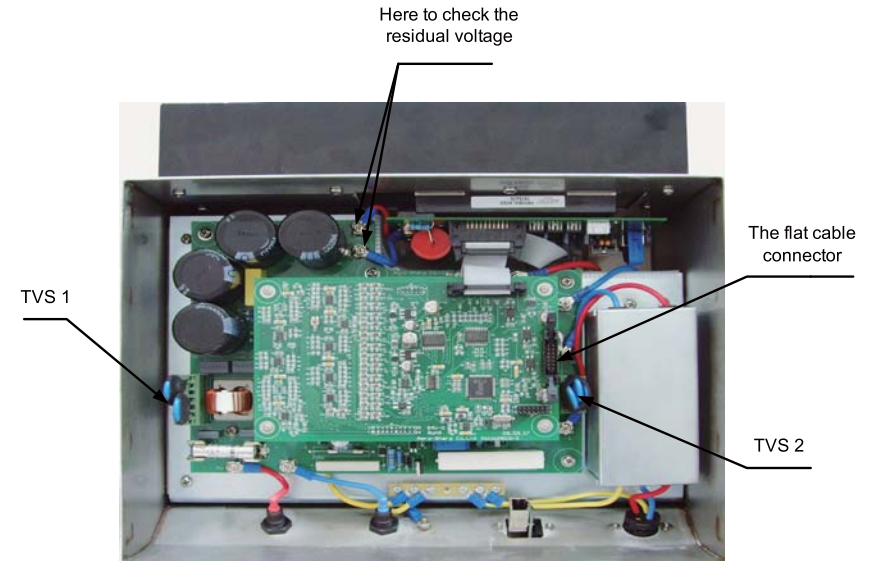
There are energy storage capacitors inside the enclosure, residual high voltage may exist even without any external connection. Risk of electric shock!

- Open the cover of the enclosure. Carefully disconnect the flat cable connector indicated in the picture below. Disconnect the yellow/green earth wire from the cover.
- Check the residual voltage with a DC voltage meter at the points indicated in the picture below.
- Replace both TVS1 and TVS2, no matter which one is in failure condition, with spare parts.
- Reconnect the earth wire and the flat cable connector.
- Replace the enclosure cover.
- Let the inverter recommence operation by following the instructions in section 3.4.1

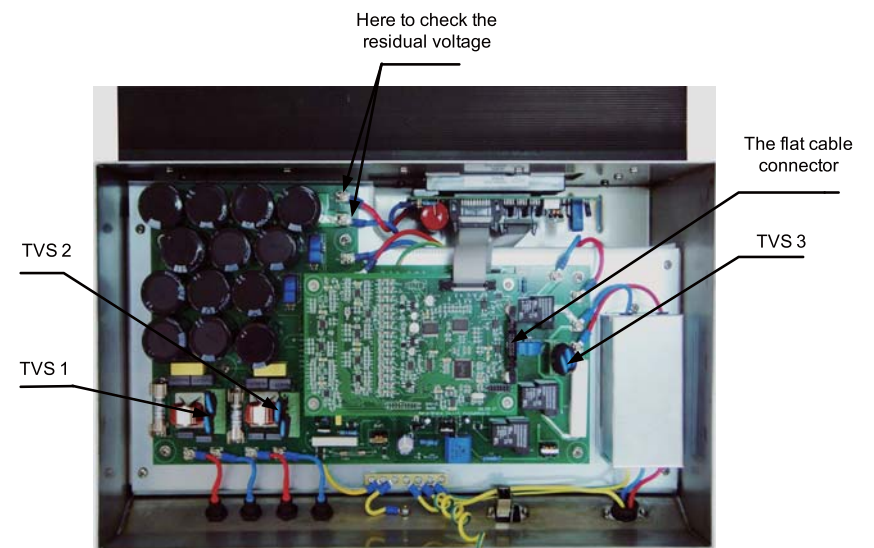


REFERENCES

Go to section 3.4.1., Commence Operation, for the instructions of how to let the system re-commence operation.



HR-INV-X01-006/010



HR-INV-X01-020/030

**The content of these documents is continually checked and amended, where necessary. However, discrepancies cannot be excluded. No guarantee is made for the completeness of these documents.*