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All information and data in this manual correspond to the momentary state of technology which applies at time of press.

We reserve the right to implement modifications without prior notice in line with technical developments and/or manufacturing techniques.

While every effort is made to ensure the information contained within this operating guide is correct we cannot take any responsibility for errors or omissions therein. This does not alter the manufacturer's guarantee on the products.

Version 3.8

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1. PREFACE

Dear Customer

Thank you for purchasing a product from ETPS Ltd.

This manual contains detailed information about the device you have purchased. It describes the features, basic functions, various applications and offers solutions in case of failure. Instructions on installation, storage and shipping are also included.

Please note that this manual contains the description of to the INV-P product family. This contains 500VA, 1kVA & 2kVA models. A separate manual is available for the 4kVA model. Please check your order and/or device label in order to refer to the corresponding information given in this manual.

This manual addresses mostly to chief operators and system supervisors, to electrical consultants and installation electricians. Our devices may only be installed by qualified personnel, according to the following instructions as well as to national and international regulations where applicable.

Our products' technology meets all requirements of telecommunications, electric power supply, industry and others. Our product line ranges from small power inverters to large inverter systems.

State of the art circuit design delivers high efficiency. This allows long term operation at low temperature stress. The devices need no servicing.

2. ACCEPTANCE TEST

2.1 GOOD INWARDS INSPECTION

These products are manufactured and shipped according to strict quality control standards. If a product proves to be defective in material or workmanship, the warranty will be granted (refer to our "Terms of Warranty").

Before unpacking the unit, please ensure that the packing box that the unit is shipped in is free of damage. If external damage is found it is important that you record what you have seen. It is vital that the packing box be kept safe in case a claim has to be made. If no damage is found you should still retain all packaging materials to ensure the unit is adequately protected in case it needs to be transported in the future.

Your unit left the factory in perfect condition and was thoroughly inspected and fully tested prior to dispatch. However, upon delivery of the unit, it must be checked to ensure that the unit was not damaged during transit. Such damage may take the form of loose or broken control knobs and bent or broken connectors. Do not use the unit if any physical damage is apparent. Please inform the carriers and a representative of ETPS Ltd immediately. If the damage is not reported immediately on or after delivery any transit insurance may become invalid.

The manufacturer will not be liable for any injury, loss or damage, arising directly or consequentially out of the improper use this product. It is mandatory to read this manual. Please observe all printed instructions, especially the safety advice.



Please note:

If you need to contact us about your product please ensure you have information such as serial number, the models number and input and output voltages close to hand. This information can be found on the type label of the device.

3. INSTALLATION

Note:



The electrical planning and installation of the device must only be undertaken by qualified personnel. The work must comply with all local legislation and regulations.

The installation instructions must be followed carefully. If the advice is neglected personnel health & safety may be threatened and injuries or death may result. Please refer to your country's regulations.

Caution:



Do not operate the inverters in explosive areas. Operation of the inverters in such an environment constitutes a safety hazard. Furthermore, the inverters must not to be operated in hermetically sealed cabinets.

3.1 OPERATIONAL ENVIRONMENT

All the requirements concerning environment described in this chapter must be fulfilled. When planning a location to install the device, the following points must be considered:

- + For correct function and optimal life span avoid temperature and humidity peaks (non-condensing environment).
- + Make sure that proper ventilation is guaranteed.
- + With forced cooling devices, ensure that cooling air is able to flow unhindered through front side and rear side of the inverter (clearance between front side and rear side min. 150 mm).

Upon disregard of the above guidance, ETPS Ltd can neither guarantee the safety of personnel involved nor a correct function of the power supply.

3.2 SAFETY REQUIREMENTS

Explanation of the safety symbols used in this manual:



Warning



Caution



Warning
Explosion

The electrical planning and installation of the device may only be undertaken by qualified personnel. It must comply with all local legislation and regulations. The installation instructions must be followed carefully. If neglected, safety and health of the personnel involved are threatened and injuries or fatality may be caused. Furthermore, the device or connected load may be damaged. All wiring must be done in a voltage free state in order to avoid any damage to life and equipment. Make sure that wiring diameters meet the specified system current from/to the device, if applicable. Please refer to your country's regulations.



Warning:

Do not open the device! Some components inside carry high voltages. Disregard threatens the safety and health of personnel involved and may cause injuries or even fatality. There are no maintenance points inside the inverter.

3.3 EXTERNAL FUSING

For maintenance and especially for safety reasons, external fusing for DC supply, AC supply and AC output must be provided. It is strongly recommended to use 2-pole circuit breakers for both DC and AC fusing.

3.4 ELECTRICAL CONNECTIONS

When connecting the inverter, ensure the correct cable size and diameters. Please find additional information printed in section 3.7 Control elements and connections.

3.5 DEVICE PROTECTION

It is recommended using additional mounting rails to support the sub-rack inside the frame / cabinet. Please contact your cabinet manufacturer for a suitable rail.

3.6 GROUNDING

Ensure a correct ground connection. The ground contact (PE) must be connected to the DC input of the device, using the largest possible diameter. Furthermore, for all wall mounted devices, connect PE to the ground bolt.

The inverter has a galvanic isolation between DC input and AC output. The generated AC output voltage [$230V_{AC}/50Hz$] is electrically isolated from the DC input and the protective earth (PE) / mechanical housing.

The only connection is a capacitive connection via the EMC Y-capacitors to the mechanical housing. These capacitors are necessary to fulfil the EMC requirements. The leakage current is $<3.5mA$. The inverter fulfils international norms and is marked with the CE label.

If the inverter is used in an application, where no N-wire is connected to the unit, voltage between the single phases and PE can be measured to approx. $115V_{AC}$. This voltage comes from the capacitive EMC voltage divider. It is uncritical because of the low capacitance of the Y-capacitors.

For above mentioned applications, the user can do a "classical grounding" at any time by connecting one of the phases to PE. One pole is defined as neutral (N) wire in this case and the remaining one is the phase (L1). See figure 1 for reference.

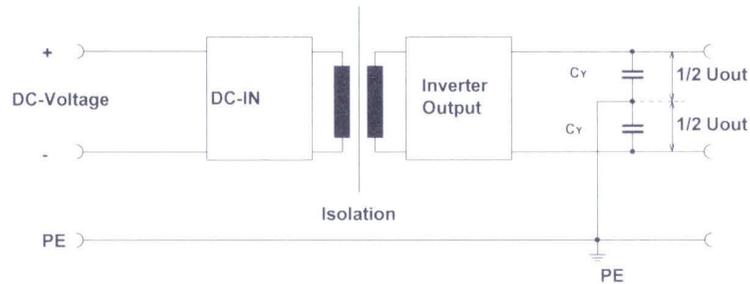


FIGURE 1

Notes on the operation of an external bypass switch for manual load switching between inverter and mains voltage.

The inverters from ETPS Ltd are self-commutated, designed for island operation, e.g. as an energy source in UPS applications. For applications requiring inverter operations in parallel to the mains (e.g. load supply simultaneously provided by the mains and by an inverter) or assigned to feed energy into the mains, it is necessary to use so-called 'line-commutated' inverters. Such inverters are not included in our product range.

Inverters from ETPS Ltd are equipped with output stages not protected against reverse current. It must strictly be avoided that a reverse current supplied from the mains or from other inverters can flow back through the connected load into the inverter's AC output. When installing the system, it must therefore be ensured that a manual bypass switch provided by the customer (where applicable) separates the load from the inverter AC voltage **first** and **then** establishes the connection to the mains voltage. An interruption-free switchover is **not** possible, so-called MAKE-BEFORE-BREAK relays inevitably lead to the destruction of the inverter output stage.

An exception is possible with ETPS INV-BL inverters, if the DC supply of the inverter is interrupted **first** (i.e. **before** the load is bypassed manually from inverter supply to mains supply or vice versa). INV-BL inverters are equipped with an internal bypass switch for automatic load switching from DC supply to mains supply (or vice versa). If the DC supply of the inverter is interrupted first, this internal bypass is forced to disconnect the inverter's output stage and to switch over to the mains – even before switching over to the mains via an external, manually operated bypass switch. For this external switchover, a multistage, interlocked changeover switch needs to be provided by the customer. The release of that switch must already trigger a switching procedure disconnecting the inverter's DC supply. Now it is possible to switch over the AC line from inverter operation (internally bypassed¹) to mains operation (manually bypassed²) without interruption. Thus, it is, for example, possible to replace an inverter without interrupting the load supply.

An interruption-free switch-over to mains operation [manually bypassed] is not possible with ETPS INV-W and INV-PL inverters. INVIW and INV-PL inverters are designed for stand-alone operation, INV-PL inverters for parallel operation as well. They are not provided with an internal bypass switch.

¹ The internal bypass has switched to the mains.

² Load is supplied by the mains, externally bypassing the inverter.

3.7 PRODUCT DESCRIPTION

**Please note:**

The following chapters describe technical features and data that may depend on power version, voltage version or options ordered. If not otherwise mentioned, any information given in these chapters refer to all the series' products. Please check your order and/or device label in order to refer to the corresponding information given.

**Warning:**

Do not open the device! Some components inside carry high voltages. Disregard threatens the safety and health of personnel involved and may cause injuries or even fatality. There are no maintenance points inside the inverter.

The inverters of the INV-P Series are described as follows:

Power rating and voltage version:

PRODUCT	POWER RATING	DC INPUT VOLTAGE	AC OUTPUT RATING
INV-P 500	500VA/400W	24, 48/60, 110, 220V _{DC}	230V _{AC} , 50Hz 115V _{AC} , 60Hz
INV-P 1000	1000VA/800W	24, 48/60, 110, 72, 220V _{DC}	230V _{AC} , 50Hz 115V _{AC} , 60Hz
INV-P 2000	2000VA/1600W	24, 48/60, 110, 220V _{DC}	230V _{AC} , 50Hz

TABLE 1

The inverters of the INV-P series have an integrated paralleled module. Up to five inverters can be connected in parallel. The inverters are operated by the control bus according to the master-slave principle. By paralleling inverters, the user can achieve either a higher AC output power or an N+1 redundancy. The inverters of the INV-P series are fan cooled. [The speed of the internal fan is depending on the internal inverter temperature and the AC output power.]

Our inverters offer the following protective functions:

- Overload and short circuit protected output
- DC UVP (under voltage protection) and DC OVP (over voltage protection) with adjustable hysteresis parameters
- AC UVP/OVP at the inverter's output [displayed in the LCD]
- Protection against excess temperature
- Protection from reverse connection of DC input

3.8 CONTROL ELEMENTS AND CONNECTIONS

Inverter INV-P 500	[with Input: 24, 48/60, 110 or 220V _{DC}]
Inverter INV-P 1000	[With Input: 24, 48/60, 72, 110 or 220V _{DC}]
Inverter INV-P 2000	[With Input: 24 and 48/60V _{DC}]

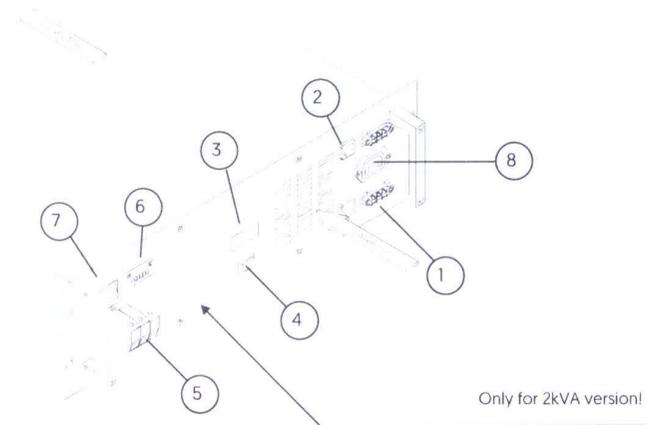


FIGURE 2

NO.	DESCRIPTION	TYPE
1	Parallel AC output, 1-phase	Phoenix Power CombiCon, 3 pole, 2,5mm ²
2	Data/control bus	CAT 5 standard data con. [master/slave bus]
3	LCD dot matrix display	2x8 characters
4	Control push button	Push button for setup and control settings
5	DC input voltage	Phoenix HDFK 16 screw clamps, 16mm ²
6	Potential free alarm contact	Phoenix Mini CombiCon, 1 pole, turn over contact, 300V _{DC} /0,4A; 140V _{DC} /0,5A; 80V _{DC} /1A; 250V _{AC} /1A, 1mm ²
7	Battery main switch	Turns the inverter ON/OFF
8	AC output	IEC appliance connector, 1,5mm ²

TABLE 2

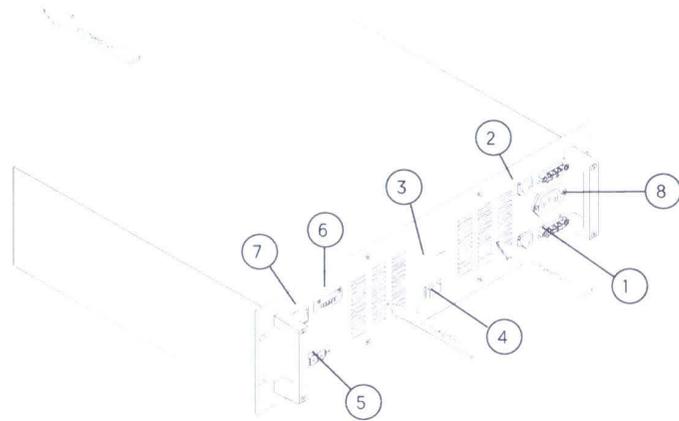


FIGURE 3

NO.	DESCRIPTION	TYPE
1	Parallel AC output, 1-phase	Phoenix Power CombiCon, 3 pole, 2,5mm ²
2	Data/control bus	CAT 5 standard data con. (master/slave bus)
3	LCD dot matrix display	2x8 characters
4	Control push button	Push button for setup and control settings
5	DC input voltage	Phoenix Power CombiCon, 3 pole, 4mm ²
6	Potential free alarm contact	Phoenix Mini CombiCon, 1 pole, turn over contact, 300V _{DC} /0,4A; 140V _{DC} /0,5A; 80V _{DC} /1A; 250V _{AC} /1A, 1mm ²
7	Battery main switch	Turns the inverter ON/OFF
8	AC output	IEC appliance connector, 1,5mm ²

TABLE 3

The inverter INV2000-24 for rear connection is equipped with a Phoenix PC35 connector as DC input connector.

The design for rear connection is also available for all other voltage versions, with similar positioning of the connectors.

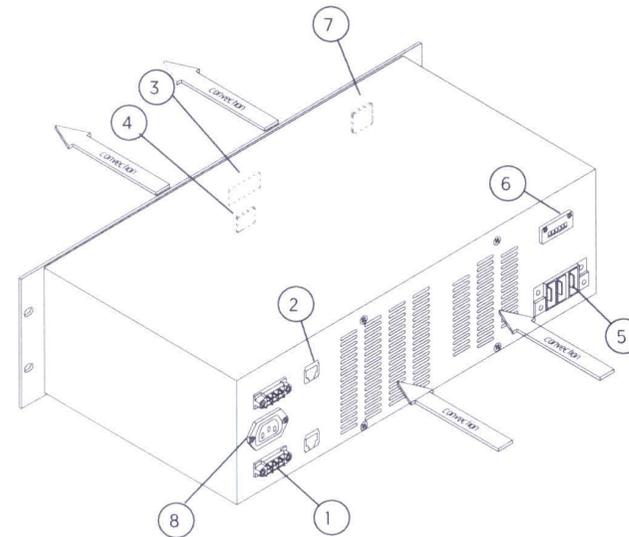


FIGURE 4

NO.	DESCRIPTION	TYPE
1	Parallel AC output, 1-phase	Phoenix Power CombiCon, 3 pole, 2,5mm ²
2	Data/control bus	CAT 5 standard data con. (master/slave bus)
3	LCD dot matrix display	2x8 characters
4	Control push button	Push button for setup and control settings
5	DC input voltage	Phoenix PC35, 3 pole, 35mm ²
6	Potential free alarm contact	Phoenix Mini CombiCon, 1-pole turn over contact, 1mm ² , contact load: 140 V / 0.5 A
7	Battery main switch	Turns the inverter ON/OFF
8	AC output	IEC appliance connector, 1,5mm ²

TABLE 4

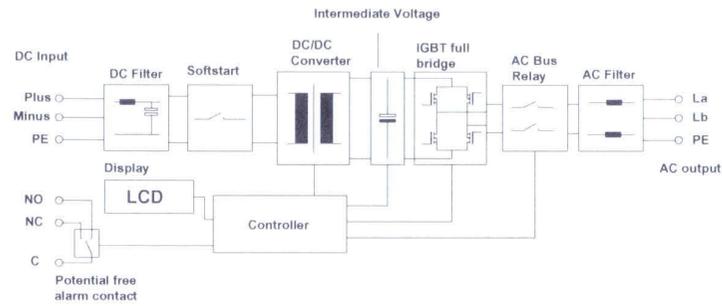


FIGURE 5

3.10 FRONT PANEL CONNECTION MODELS

3.10.1 DC INPUT

- Inverter INV-P 500 (with input: 24, 48/60, 110 and 220V_{DC})
- Inverter INV-P 1000 (with input: 24, 48/60, 72, 110 and 220V_{DC})
- Inverter INV-P 2000 (with input: 24 and 48/60V_{DC})

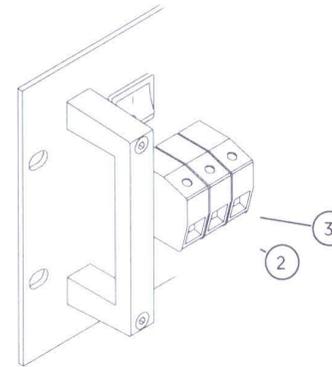


FIGURE 6

Inverter INV-P2000 (with input: 110 and 220V_{DC})

PIN	FUNCTION	ABBREVIATION
1	Input voltage reference	0V U _{IN}
2	Ground wire	PE
3	Input voltage positive	+ U _{IN}

TABLE 5

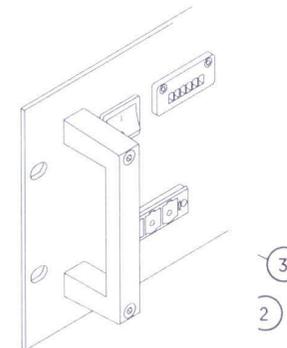


FIGURE 7

PIN	FUNCTION	ABBREVIATION
1	Input voltage reference	0V U _{IN}
2	Ground wire	PE
3	Input voltage positive	+ U _{IN}

TABLE 6

3.10.2 ALARM CONTACT

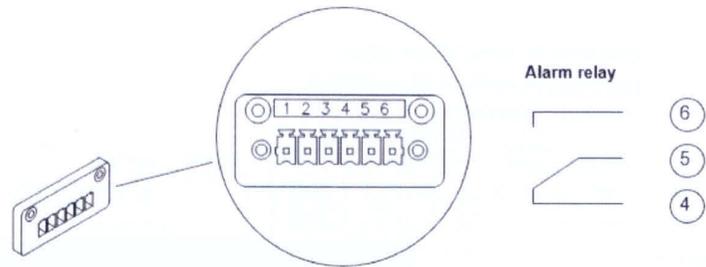
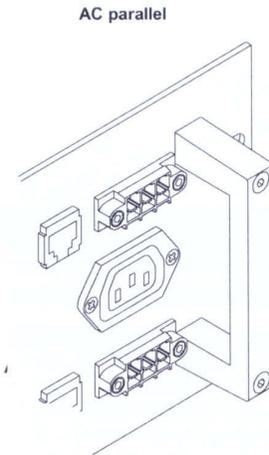


FIGURE 8

PIN	FUNCTION	ABBREVIATION
1	Not connected	n.c.
2	Not connected	n.c.
3	Not connected	n.c.
4	Inverter: Alarm (Normal Open)	NC
5	C (Common)	C
6	Inverter OK (Power Good)	NO

TABLE 7

3.10.3 AC OUTPUT



Note:



In parallel inverter systems the connectors "AC parallel" can be used for the AC power bus connection (refer to section 4 Parallel operating). The "AC Out" outputs are not used for the load connection in this configuration. In standalone applications, the load can also be wired to the "AC parallel" outputs, the advantage of these connectors is the interlock function (screws).

Warning:



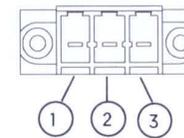
If in parallel operating inverter systems the "AC out" outputs of more than one inverter are used and they are wired to an intermediate distribution rail, the opposite connector carries high voltage when disconnected from the inverter panel!

This wiring is not recommended.

FIGURE 9

AC parallel

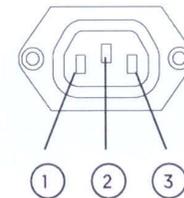
AC parallel



PIN	FUNCTION	ABBREVIATION
1	ACout, 20A	LA
2	Ground wire	PE
3	ACout, 20A	LB

TABLE 8

AC out



PIN	FUNCTION	ABBREVIATION
1	ACout, 10A	LA
2	Ground wire	PE
3	ACout 10A	LB

TABLE 9

FIGURE 10 + 11

Note: The inverters of the INV-P series can operate either as stand alone or parallel operating units. The inverters' output is floating. For an L/N/PE configuration of the output, one of the pins (LA or LB) must be connected to the protective earth contact PE (classical grounding).

The AC outputs (AC parallel and AC out) are symmetrically wired.

3.11 REAR PANEL CONNECTION MODELS

3.11.1 DC INPUT

Inverter INV-P 500 [with input: 24, 48/60, 110 and 220V_{DC}]
 Inverter INV-P 1000 [with input: 24, 48/60, 72, 110 and 220V_{DC}]
 Inverter INV-P 2000 [with input: 48/60V_{DC}]

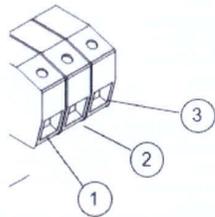


FIGURE 12

PIN	FUNCTION	ABBREVIATION
1	Input voltage reference	0V U _{IN}
2	Ground wire	PE
3	Input voltage positive	+ U _{IN}

TABLE 10

Inverter INV-P2000 [with input: 110 and 220V_{DC}]

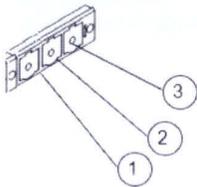


FIGURE 13

PIN	FUNCTION	ABBREVIATION
1	Input voltage reference	0V U _{IN}
2	Ground wire	PE
3	Input voltage positive	+ U _{IN}

TABLE 11

Inverter INV-P2000 [with input: 110 and 220V_{DC}]

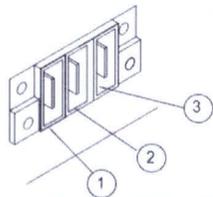


FIGURE 14

PIN	FUNCTION	ABBREVIATION
1	Input voltage reference	0V U _{IN}
2	Ground wire	PE
3	Input voltage positive	+ U _{IN}

TABLE 12

3.11.2 ALARM CONTACT

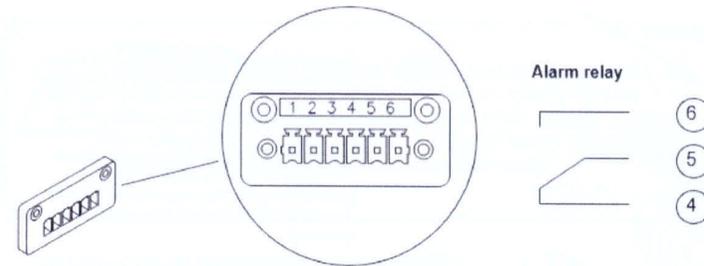
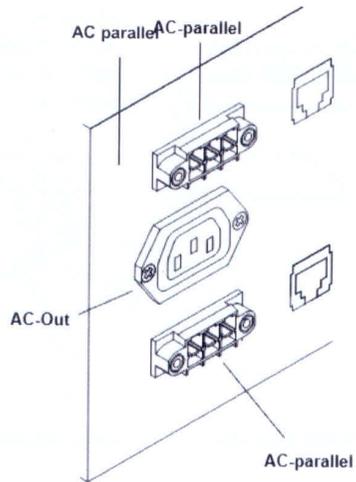


FIGURE 15

PIN	FUNCTION	ABBREVIATION
1	Not connected	n.c.
2	Not connected	n.c.
3	Not connected	n.c.
4	Inverter: Alarm (Normal Open)	NC
5	C (Common)	C
6	Inverter OK (Power Good)	NO

TABLE 13

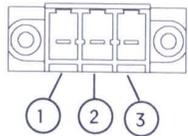


Note: In parallel inverter systems the connectors "AC parallel" can be used for the AC power bus connection (refer to section 4 Parallel operating). The "AC Out" outputs are not used for the load connection in this configuration. In standalone applications, the load can also be wired to the "AC parallel" outputs, the advantage of these connectors is the interlock function (screws).

Warning: If in parallel operating inverter systems the "AC out" outputs of more than one inverter are used and they are wired to an intermediate distribution rail, the opposite connector carries high voltage when disconnected from the inverter panel! **This wiring is not recommended.**

FIGURE 16

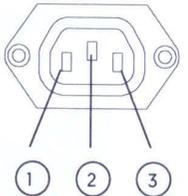
AC parallel



PIN	FUNCTION	ABBREVIATION
1	AC _{Out} , 20A	L _A
2	Ground wire	PE
3	AC _{Out} , 20A	L _B

TABLE 14

AC out



PIN	FUNCTION	ABBREVIATION
1	AC _{Out} , 10A	L _A
2	Ground wire	PE
3	AC _{Out} 10A	L _B

TABLE 15

FIGURE 17 + 18

Note: The inverters of the INV-P series can operate either as stand alone or parallel operating units. The inverters' output is floating. For an L/N/PE configuration of the output, one of the pins (L_A or L_B) must be connected to the protective earth contact PE (classical grounding).

The AC outputs (AC parallel and AC out) are symmetrically wired.

4. PARALLEL OPERATION



Please note: The following chapter describes technical features and data that may depend on power version, voltage version or options ordered. If not otherwise mentioned, any information given in this chapter refers to all the series' products. Please check your order and/or device label in order to refer to the corresponding information given.

4.1 PARALLEL OPERATING CONCEPT

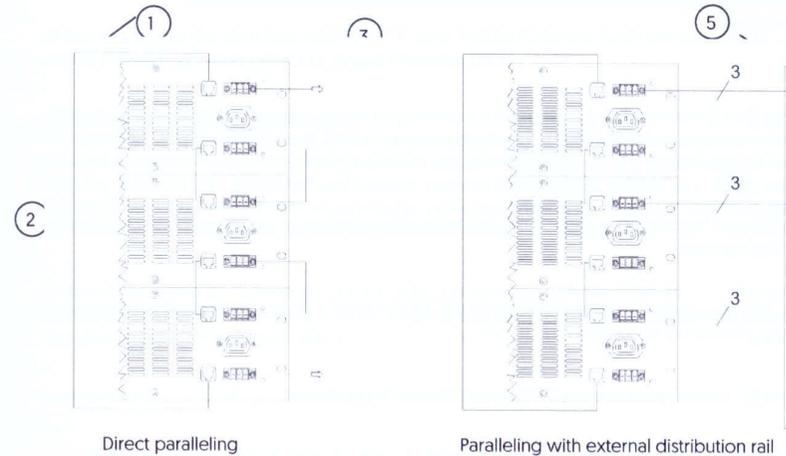


FIGURE 19

NO.	FUNCTION
1	CAT 5 feed-back cable of the communication and data bus
2	CAT 5 short communication and data bus cable (inverter interconnection)
3	AC output wired to the load or distribution
4	Short power cable (inverter interconnection)
5	External distribution rail

TABLE 16



Caution: Make sure the bus connections [CAT5 cables] have been connected **before** the AC connections are made, in order to assure synchronization of the outputs. The feedback cable is mandatory for the function of the system. Omitting the feedback cable might result in permanent damage of the devices.

4.2 EXPANSION OF THE SYSTEM

An inverter system, based on the INV-P Series inverter, can consist of up to 5 parallel working inverters, to achieve the requested power needs of the connected loads or to ensure an N+1 redundancy. Additional inverter modules can be integrated without interrupting the connected loads. Because of the current capability of the electrical connectors used, the user needs to pay attention to the following restrictions for directly parallel connected inverters:

INVERTER INV-P...	OUTPUT VOLTAGE	DIRECT PARALLEL
500-xx-230	230V _{AC}	5 inverters
500-xx-115	115V _{AC}	5 inverters
1000-xx-230	230V _{AC}	5 inverters
1000-xx-115	115V _{AC}	2 inverters
2000-xx-230	230V _{AC}	2 inverters

xx = voltage version

TABLE 17

To parallel more than the above listed inverters, it is necessary to use an external distribution (distribution rails) where the inverter outputs are wired to (as single units or in pairs). Even though the IEC Appliance outlet can be used for the paralleling, it is recommended to use Phoenix Power-CombiCon connectors for safety reasons.

To install an additional inverter into a system, the following steps need to be maintained (see also chapter 4.1 Parallel operating concept):

- + Make sure, that the external DC circuit breaker of the *new inverter* is switched off and the battery main switch of the inverter's is in position OFF [0 – OFF].
- + Connect the DC supply to the inverter's DC input. (Chapter 3 Installation)
- + By using the CAT5- cable provided, connect the PARALLEL IN RJ45-jack of the new inverter to the PARALLEL OUT RJ45-jack of the last inverter of the system stack and the PARALLEL OUT RJ45-jack of the new inverter to the feedback cable of the system.
- + Connect the PARALLEL IN Phoenix-Contact of the new inverter with the PARALLEL OUT Phoenix-Contact of the last inverter of the system stack – or use the external distribution rail to connect the new inverter. **Warning, the distribution carries high voltage!**
- + Switch on the external DC circuit breaker of the new inverter [1 – ON].
- + Switch on the new inverter by using the battery main switch. The inverter will log on automatically to the master-slave bus. Do not use the control push button in the middle of the inverter front panel; the inverter will start on its own. Under certain conditions, the control push button can switch off the whole system.
- + The new inverter is running in the system now, the load sharing happens dynamically.

4.3 EXCHANGE OF INVERTERS DURING PARALLEL OPERATION

Analogous to the above described expansion of the system, an inverter may be exchanged for maintenance purpose or reparation without interrupting the connected loads.

To exchange an inverter, the following steps need to be maintained:

- + Switch off the inverter to be exchanged by using the battery main switch. (Do not use the control push button which can switch off the whole system!)
- + Make sure that the external DC circuit breaker of the inverter *to be exchanged* is switched off [0 - OFF].
- + At first disconnect the data bus cables (CAT5-cable PARALLEL IN and OUT) and then the AC connection cables (Phoenix contacts PARALLEL IN and PARALLEL OUT).
- + Install the new inverter into the system.
- + By using standard (not crossover) CAT5-cables connect the PARALLEL IN RJ45-jack of the new inverter to the PARALLEL OUT RJ45-jack of the last inverter of the system and the PARALLEL OUT RJ45-jack of the new inverter to the PARALLEL IN RJ45-jack of the next inverter in the system.
- + Connect the PARALLEL IN Phoenix contact of the new inverter with the PARALLEL OUT Phoenix contact of the last inverter of the system – or use the external distribution rail to connect the new inverter. **Warning, the distribution carries high voltage!**
- + Switch on the external DC circuit breaker of the new inverter [1 - ON].
- + Switch on the new inverter by using the battery main switch. The inverter will log on automatically to the master-slave bus. *Do not use the control push button, the inverter will start on its own. Under certain conditions, the control push button can switch off the whole system.*
- + The new inverter is running in the system now, the load sharing happens dynamically.

5. OPERATION OF THE INVERTER

The following parameters refer to an INV-P xxxx-48-230 version. [Please refer to chapter 7.5 Factory defaults and chapter 7.4 Battery diagram for parameters of other versions.]

48 230 SCAN BUS	Switch on the DC supply of the inverter with the battery main switch (I – ON). The battery main switch does not activate the AC output of a single inverter (if there are no other paralleled units in the system)! The inverter's display shows the message 'SCAN BUS', while the unit is searching for other inverters.
48 230 STANDBY	Once the display shows the message 'STANDBY', the inverter is ready to activate the AC output.
48 230 WAIT	Press the control push button to switch on the AC output. The inverter shows the message 'WAIT' during initialization.
48 230 PWR 80 %	When the inverter has finished the boot sequence, the display shows DC input voltage and AC output voltage in the first row, the supplied AC output power in percent in the second row.
48 XXX OVERHEAT	OVERHEAT: The internal temperature of the inverter is exceeded.
48 230 OVERLOAD	OVERLOAD: The inverter's AC output is overloaded.
48 XXX AC UVP	AC UVP/OVP: The inverter indicates overvoltage [OVP] or undervoltage [UVP] at its AC output.
48 230 DC UVP	DC UVP/OVP: The inverter indicates overvoltage [OVP] or undervoltage [UVP] at its DC input.
48 0 STANDBY	STANDBY: To switch off the inverter's AC output, press the control push button. The display shows 'STANDBY'. To switch off the entire unit, use the battery main switch.

6. OVERLOAD BEHAVIOUR AND TROUBLE SHOOTING

6.1 OVERLOAD BEHAVIOUR



Please note:
Permanent overload operation will considerably reduce the life span of the inverter.

The chart below shows the dynamic overload behavior of the inverter AC output. Temporary overload peaks, e.g. through start-up currents of capacitive loads, are tolerated within a certain load depending time frame, before the inverter automatically shuts down.

Even though it is possible to overload the inverter, it is strictly recommended to extend the AC output power with an additional inverter in parallel when there is permanent load excess. With the additional inverter, the necessary power reserve can constantly be provided.



FIGURE 20

6.2 TROUBLE SHOOTING

FAILURE	MEASURES
Display is dark	Check if the battery main switch is switched on (I – ON)
Display shows DC UVP	Check if the DC supply is connected and the external DC circuit breaker is switched on.
Display shows DC OVP	Check if the DC input voltage is within the operating parameters.
Display shows OVERLOAD	Reduce the connected load to $P < P_{NOM}^*$.
Display shows OVERHEAT	Check proper ventilation [fan operating, is the fan blocked, are the ventilation gaps blocked]. Let the inverter unit cool down. It will restart automatically, once the operating temperature is reached again.
Display shows AC OVP	Switch off the inverter and disconnect the unit from the DC supply for minimum 10 sec. Reconnect the inverter and switch on. It will start up.
Display shows AC UVP	Use the closed-loop-cable between last and first inverter to prevent an interruption of the communication bus.
Inverter system shuts down during installation of an additional inverter.	Never switch on the new inverter in the system with the control push button – always use the battery main switch.
None of above reactions work	Please contact the supplier or the factory.

TABLE 18

* The inverter's type label will detail the maximum output power.

7. SETUP

**Caution:**

Setup mode changes the parameters of the inverters. The factory defaults comply with standard conditions and/or the parameters ordered by the customer. Alteration by qualified personnel only!

Damage to the inverter or connected devices or financial losses due to down times are the sole responsibility of the customer.

7.1 ENABLING SETUP MODE

1. Make sure the battery main switch is set to 0 [OFF]
2. Press and hold the push button and set the battery main switch to I [ON]
3. The inverter is now in setup mode

7.2 ALTERATION OF PARAMETERS

The setup is a two dimensional menu, with the different options on the first level and the possible parameters for each option on the sublevel.

1. You can step through the options by pressing the button for less than 2 seconds
2. By pressing it for more than 3 seconds, you select the currently displayed option for alteration
3. By pressing the Control Push Button less than 2 seconds, you can step through the different parameters available for the option chosen. The value or state is saved to memory as soon as it is displayed. To restore the original value, step through the parameters until the original value is displayed again (pls. refer to 7.5 Factory defaults).
4. To change more than one option, press the control push button for more than 3 seconds to get back to the option level. Continue at step one above.

OR

5. Finish the setup mode after altering all desired values by setting the battery main switch to 0 [OFF].

7.3 SETUP MODE OPTIONS AND PARAMETERS

The following parameters refer to the factory defaults of the 48/60 voltage version. [Please refer to chapter 7.5 Factory defaults and chapter 7.4 Battery diagram for parameters of other versions.]

FREQ. 50 HZ	Output frequency: 50Hz or 60Hz
AC UVP 15 %	AC undervoltage, at this threshold the inverter shuts down to protect the connected load. Adjustable: 10% or 15%
AC OVP 10 %	AC overvoltage, at this threshold the inverter shuts down to protect the connected load. Adjustable: 10% or 15%
DC RESET 33 . 5	DC Reset: (Please refer to 7.4 Battery diagram)
DC UVP 37 . 0	DC UVP: (Please refer to 7.4 Battery diagram)
DC FIRST 41 . 0	First Start: (Please refer to 7.4 Battery diagram)
DC RES L 48 . 0	DC Restart Low (Please refer to 7.4 Battery diagram)
DC RES H 72 . 0	DC Restart High (Please refer to 7.4 Battery diagram)
DC OVP 75 . 0	Shutdown OVP (Please refer to 7.4 Battery diagram)
DIAG DISABLED	Diagnosis: ENABLED: Special display layout (for test purposes only) DISABLED: Standard display layout
CONTRAST 15 . 5	Contrast: Changes the contrast value of the LCD
Options b 0 0 0 0	Optional defaults: b - 0 to 1 AC UVP disabled 0 to 1 10 sec. overload (up to 150%) 0 to 1 30 sec. after a failure the inverter restarts 0 to 1 interlock: control push button is disabled (inverter switch off is not possible)

Note: The options "restart 30s after a failure" and "control push button interlock" are reserved for special versions not supporting parallel operation. It is not allowed to activate these options in parallel operation of several inverters.

7.4 BATTERY DIAGRAM

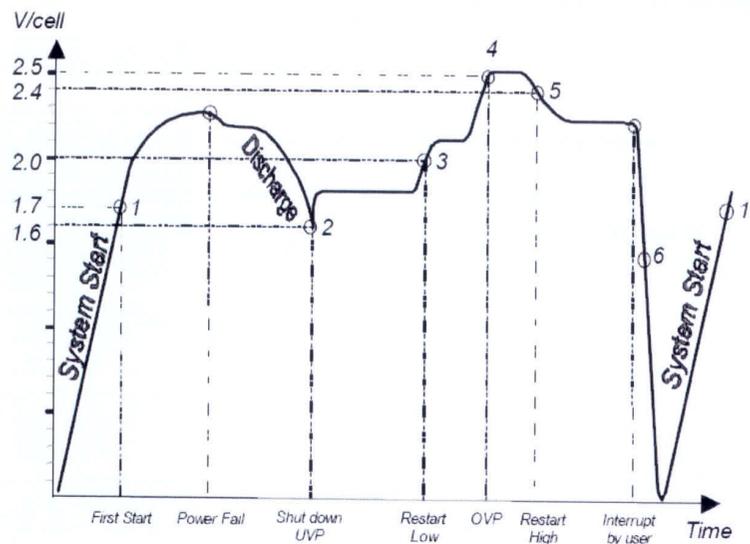


FIGURE 21

First Start (1):

To start up the inverter, the First Start limit has to be reached and exceeded at the battery terminals.

UVP (2):

When an under voltage limit is reached, the inverter shuts down in order to avoid a total discharge of the battery cells.

Restart Low (3):

After an inverter shut down due to UVP, the DC level has to reach Restart Low to restart.

OVP (4):

At overvoltage level, the inverter shuts down [over voltage protection].

Restart High (5):

If the inverter has shut down due to OVP, it will restart after a DC voltage decrease to the Restart High level.

Reset (6):

If the main switch is turned off or the inverter is no longer connected to DC supply and terminal voltage decreases below Reset limit, the inverter will only restart after reaching First Start level again.

Changing of the DC input hysteresis parameters:

The parameters are logically linked with each other and can be changed by the user within reasonable limits only. For example the value of the parameter DC Reset can be adjusted to maximum 36.5V, if the parameter DC UVP is set to 37V. If the value of DC UVP is set to 38V, the DC Reset value can be adjusted up to 37.5V.

Please consider the factory defaults.

7.5 FACTORY DEFAULTS



Please note:

The given values below only apply to the factory defaults. If a different set-up was requested on order the values will not match.

PARAMETER	24V _{DC}	48/60V _{DC}	110V _{DC}	220V _{DC}
FREQ.	according to purchase order			
AC UVP	-15%			
AC OVP	+10%			
DC RESET	16.75V _{DC}	33.5V _{DC}	77V _{DC}	154V _{DC}
DC UVP	18V _{DC}	37V _{DC}	86V _{DC}	172V _{DC}
DC FIRST	20.5V _{DC}	41V _{DC}	94V _{DC}	188V _{DC}
DC RES L	24V _{DC}	48V _{DC}	110V _{DC}	220V _{DC}
DC RES H	31V _{DC}	72V _{DC}	132V _{DC}	264V _{DC}
DC OVP	33V _{DC}	75V _{DC}	138V _{DC}	276V _{DC}
DIAG	DISABLED			
CONTRAST	contrast adjustment due to tolerances			

TABLE 19

The tolerance range of the specified parameters is ±IV.

8. MECHANICAL DIMENSIONS

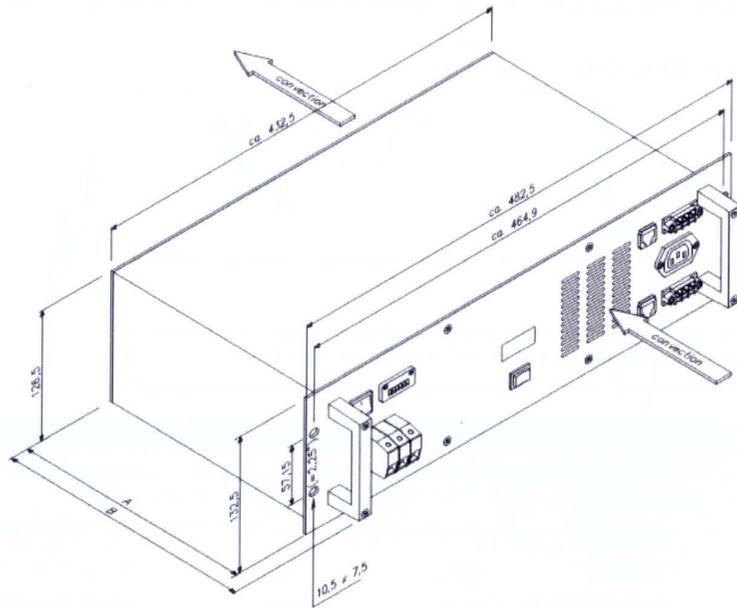


FIGURE 22

PRODUCT	A [MM]	B [MM]
INV-P 500-xx-230	240	280
INV-P 500-xx-115	240	280
INV-P 1000-xx-230	240	280
INV-P 1000-xx-115	240	280
INV-P 2000-xx-230	360	400
INV-P 2000-xx-230-2	360	400

TABLE 20

9. WIRING CONVERSION

A. CONVERSION TABLE AWG TO MILLIMETRE

AWG	Ø MM	MM²
7	3.665	10.5510
8	3.268	8.3870
9	2.906	6.3200
10	2.588	5.2620
11	2.304	4.1680
12	2.052	3.3080
13	1.829	2.6270
14	1.628	2.0867
15	1.450	1.6513
16	1.290	1.3070
17	1.151	1.0387
18	1.024	0.8171
19	0.912	0.6504
20	0.813	0.5153
21	0.724	0.3959
22	0.643	0.3217
23	0.574	0.2624
24	0.511	0.2043
25	0.455	0.1590
26	0.404	0.1257
27	0.363	0.1018
28	0.320	0.0804

TABLE 21

AWG: American Wire Gauge

B. TECHNICAL DATA

Product series INV-P:

INV-P 500 [500VA/400W], INV-P 1000 [1kVA/800W], INV-P 2000 [2kVA/1600W]

General

Electrical safety	EN 60950, VDE 0805
Efficiency	>88% at nominal load
Galvanic isolation	3.75kV _{DC}
EMC (emission)	EN 61000-6-4
EMC (immunity)	EN61000-6-2
Operating temperature	-5 to +45°C non condensing

Input DC Voltage Ranges

INV-Pxxxx-24	24 [19-31] V _{DC}
INV-Pxxxx-48/60	48/60 [38-72] V _{DC}
INV-Pxxxx-110	110 [88-132] V _{DC}
INV-Pxxxx-220	220 [178-264] V _{DC}

Output AC

Voltage	230V _{AC} , +/-5%
	[500VA and 1KVA with 115V _{AC} output upon request]
Frequency	50Hz/60Hz, sine wave processor controlled
Power factor	0.8
Load range	0-100%
Crest factor	>2.5
Harmonic distortion	<2%

Signals

Visual	LCD dot matrix display
Signal output	voltage free alarm contact, 1 pole turn over contact

Operation

control push button, battery main switch

Warranty

24 months

Housing

19"-rack mounting case

Size

3U, 240mm depth (INV-P2000: 360mm)

Weight

app. 7.5kg (INV-P2000: app. 11kg)

Classification

IP 20

Ventilation

internal fan

Electrical connections

front (rear connectors upon request)

DC input

INV-P500/INV-P1000 terminal blocks HDFK, 16mm²

INV-P2000 24, 48/60V_{DC} terminal blocks HDFK, 16mm²

INV-P2000 110, 220V_{DC} Phoenix Power CombiCon, 4mm²

INV-P2000 24V_{DC} Rear Phoenix PC35, 3-pole, 35mm²

Parallel AC output 2x Phoenix Power-Combicon

AC output 1x IEC appliance

Parallel signal RJ45 S-UTP

Alarm Phoenix MiniCombiCon, 1 pole, turn over contact, 140V_{DC}/0,5A

We must reserve the right to modify technical specifications without notice.

C. FIELDS OF APPLICATION

The galvanic isolation between input and output of the inverters is realised by a high frequency clocking. It allows a small design at light weight. The INV-P series inverters have very small output impedance. They supply non-linear loads (for example switching power supplies, capacitive and inductive loads). Temporary peak loads only cause a slight distortion of the output sine curve. The inverters are built with a robust IGBT-full bridge at the AC voltage output.

The inverters' construction is designed for resistance to shock or vibration which also facilitates mobile applications.

D. APPLICATIONS

- Industrial DC-supply networks
- Power plants
- Telecom applications
- Solar energy applications
- With additional ruggedisation: Off-shore-applications, DC networks on board of vessels, trains and other vehicles

E. SHIPPING AND STORAGE

 The inverters are packed individually for shipping and storage purposes. Handle with care. In case of reshipment use the original packing. Make sure that the filling material of the packaging does not enter into the convection area.

 The recommended temperature for shipping and storage of the inverters is:
-20°C to +60°C non-condensing.

Attention!
 inverters are not installed on arrival, please store in original packaging.

 Protect the inverters against moisture.

F. TERMS OF WARRANTY

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Dear customer,

In case your product needs service, please contact your distributor, or ETPS Ltd. In order to avoid any unnecessary inconvenience, we suggest reading the user and installation manual carefully before contacting us.

Your guarantee

ETPS Ltd guarantees the product to be free of defects in material and workmanship for a period of two years from the time of its original purchase. If, during this period of guarantee, the product proves defective due to improper material or workmanship, the manufacturer will repair or (at manufacturer's discretion) replace the product or its defective parts free of charge, corresponding to terms and conditions set out below. The manufacturer reserves the right (at its sole discretion) to replace spare parts of defective products or to replace low cost products with either new or recycled spare parts or products.

Conditions

1. This guarantee will be granted only when the original invoice or delivery note (indicating the date of purchase, appliance type, serial number and name of distributor) is presented together with the defective product. ETPS Ltd reserves the right to refuse free-of-charge guarantee service if the above document cannot be presented or if the information contained in it is incomplete or illegible.
2. This guarantee will not reimburse nor cover the damage resulting from adaptations or adjustments which may be made to the product without the prior written consent of ETPS Ltd in order to conform to the national or local technical or safety standards in force in any country other than the ones for which the product was originally designed and manufactured.
3. This guarantee will not apply if the type or part/serial number on the product has been altered, deleted, removed or made illegible.
4. This guarantee covers none of the following:
 - 4.1. Periodic maintenance and repair or replacement of parts due to normal wear and tear;
 - 4.2. Any adaptation or changes to upgrade the appliance from its normal purpose as described in the user manual without the prior written consent of ETPS Ltd;
 - 4.3. Transport costs and all risks of transport relating directly or indirectly to the guarantee of the product;
 - 4.4. Damage resulting from:
 - 4.4.1. Misuse, including but not limited to failure to use the product for its normal purpose or in accordance with manufacturer's instructions on the proper use and maintenance and installation or use of the product in a manner inconsistent with the technical or safety standards in force in the country where it is used;
 - 4.4.2. Repair done by non-authorized service stations or distributors or the customer himself;
 - 4.4.3. Accidents, lightning, water, fire, improper ventilation or any cause beyond the control of ETPS Ltd;
 - 4.4.4. Defects in the system to which the product has been connected or into which it has been incorporated.
 - 4.4.5. IN NO EVENT SHALL ETPS LTD BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES OR COLLATERAL DAMAGES OF ANY KIND OR NATURE ALLEGED TO HAVE RESULTED FROM ANY BREACH OF WARRANTY. ETPS LTD DOES NOT WARRANT THE MERCHANTABILITY OF THE PRODUCT(S) OR THEIR/ITS FITNESS FOR ANY PARTICULAR PURPOSE. ETPS LTD MAKES NO WARRANTY, EXPRESS OR IMPLIED OTHER THAN THOSE SPECIFICALLY SET FORTH HEREIN.
5. This guarantee does not affect the consumer's statutory rights under applicable national laws in force or the consumer's rights against the distributor arising from their sales/purchase contract.

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