E2001.E

GENERAL

TECHNICAL DATA

E2001.e – UPS GENERAL TECHNICAL DATA

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1 INTRODUCTION

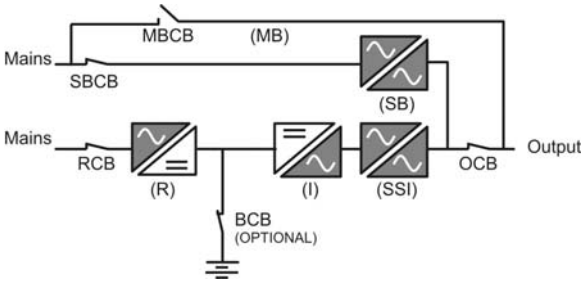
The UPS is the type “ON LINE DOUBLE CONVERSION” and is connected between main power and user loads (see picture 1). As far as architecture and layout is concerned, this project is optimised with particular care in order to make it suitable for applications where reliability and high performances are fundamental for critical loads.

The UPS operation is optimised by microprocessor digital control and the IGBT inverter is based on a high frequency PWM waveform.

The UPS operation is controlled by two DSP 16-bit microprocessors, one for the rectifier and one for the inverter. The control logics are interfaced to a microprocessor-based LCD panel, which can be easily programmed by means of a control software to modify the LED signalisations and the alarms available on the relay cards.

Procedures for power-on, switching to normal from bypass are described step by step on LCD display, in order to help the users to easily operate the UPS.

Results of electrical measurement, alarm, work condition, event log and battery status are displayed real time on the LCD front panel.



Picture 1 – UPS block diagram

With this configuration UPS guarantees high quality output, needed by loads requiring a stable and clean source of power. The main features are:

- Protection for black-out, in the limits of battery autonomy
- Complete filtering of main power noise
- High quality output power, provided under any condition of input power and loads
- Stable output frequency, independent from input frequency
- Full compatibility with every type of load
- Configurable with any neutral wire configuration (under request)
- Automatic control of battery, during both charging and discharging phases
- Easy to interface with user devices
- Auto-diagnostic feature and troubleshooting support
- Flexibility of complete bypass configuration
- Full access from the front and from the roof for maintenance

The block diagram shows the UPS subsystem that will be analysed in the following chapters:

- Rectifier/Battery Charger (R)
- Inverter (I)
- Battery (B)
- Static switch: Static inverter switch (SSI) and Static Bypass switch (SB)
- Manual Bypass (MB)

2 GENERAL DESCRIPTION

2.1 RECTIFIER BATTERY CHARGER

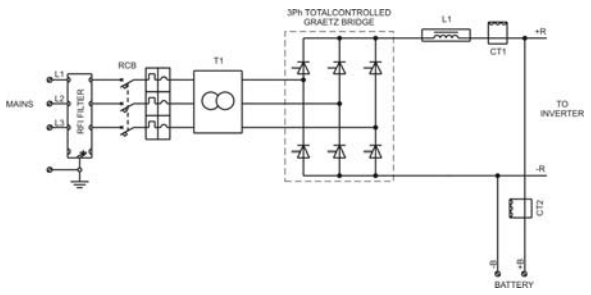
The rectifier converts the alternate voltage in the input, with frequency and amplitude variable according to the Technical Specification (ST), into a continuous output voltage that is stabilized in voltage and controlled in current, by means of a three-phase SCR rectifier bridge (6 pulses version) or a couple of bridges connected in parallel (12 pulses version).

The galvanic isolation of the input mains (when required by the ST) is carried out by means of a transformer. Additional protection against power surges, under and over voltage are included as a standard. Optionally a grounded screen between the primary and secondary windings and semiconductor fast transient protection devices (varistors) can be provided.

In “Manual Regulation” mode it is possible to set the output rectifier voltage by means of external potentiometers. In this modality a maximum current limitation (to be set) is also active.

The transfer command “AUTOMATIC/MANUAL” and vice-versa is activated by means of a selector on the front panel; it is also possible to carry out the same command through the remote PC.

The system can be interfaced with similar equipment through a digital link for parallel operation with equal sharing of the load (+/-5% tolerance) and automatic exclusion of the faulty unit.



Picture 2 – Rectifier

2.1.1 Automatic recharge of the battery

When selected the rectifier recharges the battery automatically, according to the predefined modalities. The recharging cycle begins consequently according to one of the following events (which are programmable):

- Mains failure for a period longer than the programmed value
- Intervention of the current threshold.
- Intervention of the voltage threshold.
- Timed boost charge

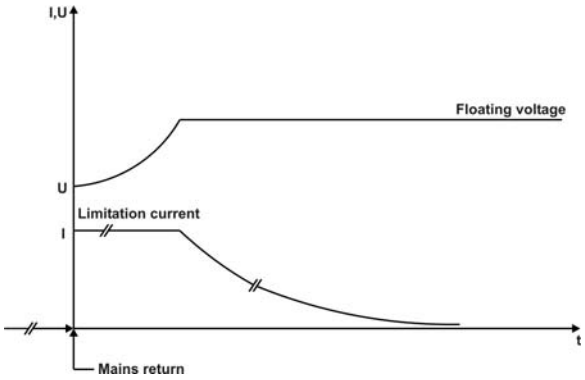
The predefined cycles can be programmed in the Menu Parameters.

2.1.1.1 Recharge IU according to the DIN 41773 standard

The recharge is divided in two different phases:

- Phase 1: the current is constant and the voltage increases.
- Phase 2: the current decreases and the voltage is constant.

When the recharging current goes below a certain value the battery is assumed fully recharged and the cycle ends. Consequently the output voltage is set at the floating level. During the floating the battery voltage is controlled as minimum value in order to avoid undesirable discharges, and as maximum value in order to avoid excessive heating of the electrolyte. The "thermal compensation" of the floating voltage in function of the battery temperature can be added as an option.



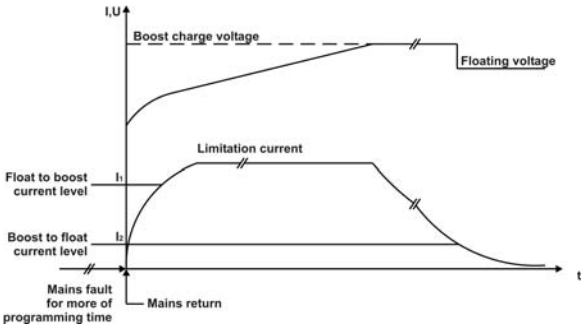
Picture 3 – IU recharge

2.1.1.2 I1 I2 U recharge

This recharge is used mainly for Ni-Cd batteries. During the recharge a boost charge of approx. 125% is provided, to compensate the losses in discharge and recharge of the battery (estimated in approx. 25%). The recharge works as follows:

If the mains fails for a time longer than the programmable threshold, when the mains returns the output voltage of the rectifier switches to a level higher than the floating, called boost charge and a safety timer is activated. If the recharging current exceeds the programmed threshold, normally a certain percent of C10, the voltage is maintained and a first phase of boost charge starts, where the current is constant and the voltage is increasing.

After a certain time the current starts to decrease and the voltage remains constant at the boost charge level. This is the second phase of the boost charge. Finally, when the current go down below the programmed level for the return in floating, the output voltage of the rectifier is taken back to floating. If this does not happen within the max. programmed time, the safety timer blocks the charge and the voltage is forced to floating. This event generates an alarm.



Picture 4 – I1 I2 U recharge

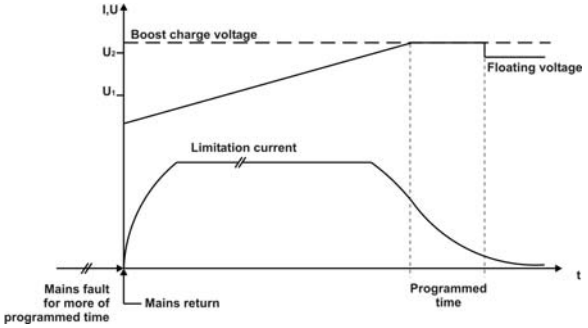
2.1.1.3 U1 U2 I recharge

This recharge is used mainly for Ni-Cd batteries. During the recharge a boost charge of approx. 125% is provided, to compensate the losses in discharge and recharge of the battery (estimated in approx. 25%). The recharge works as follows:

If the mains fails for a time which is longer than the programmable threshold, when the mains returns the output voltage of the rectifier switches to a level higher than the floating, called boost charge and a safety timer is activated.

If the recharging voltage doesn't exceed the programmed crossing threshold, normally a certain percent of the floating, the voltage is maintained and a first phase of boost charge starts, where the current is constant and the voltage is increasing.

After a certain time the recharging voltage reaches the programmed level for the second phase of boost charge; a timer is started and the battery is kept under boost charge conditions for the time programmed. After this time has elapsed the output voltage of the rectifier is switched back to the floating value. If this does not happen within the maximum programmed time, the safety timer block the charge and the voltage is forced to floating. This event generates an alarm.

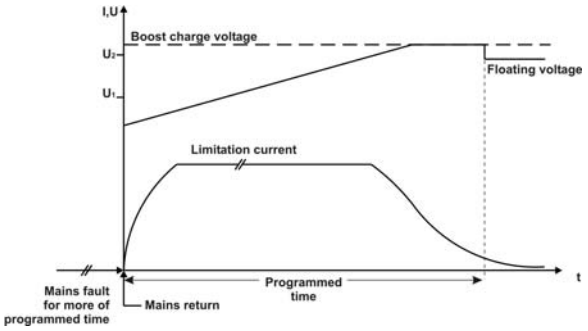


Picture 5 – U1 U2 I recharge

2.1.2 Timed boost charge

This recharge is used mainly for Ni-Cd batteries. During the recharge a boost charge of approx. 125% is provided, to compensate the losses in discharge and recharge of the battery (estimated in approx. 25%). The recharge works as follows:

If the mains fails for a time longer than the programmable threshold, when the mains returns the output voltage of the rectifier switches to a level higher than the floating, called boost charge for a pre-programmed time. The boost charge command can also be associated to an external command.



Picture 6 – Timed recharge

2.1.3 Manual recharge

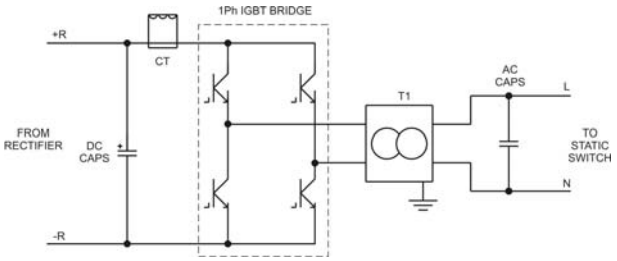
The manual recharge of the battery, called also of *forming* or of *equalizing* is a function offered by the rectifier that allows the operator to carry out a recharge under his own manual control. This modality of recharge can be used to *form* the battery after that it has been stocked for a long period, or after that the electrolyte has been filled up, in the case of batteries having been shipped dry, or in order to *equalize* the voltage of the battery cells after having been used for a certain period.

The manual recharge procedure is described in detail in the relevant menu of the **FRONT PANEL** chapter of the **Operating Manual**. Generally, when manual recharge is selected it is possible to change manually the output voltage by means of a **potentiometer** to vary the recharging battery current. Such current is however always limited to a pre-selectable maximum value.

2.2 INVERTER

The DC voltage is converted by the IGBT bridge, that uses four switches, controlled using PWM (Pulse Width Modulation) technology at high commutation frequency. The PWM generation as well as the control of the operating variables is completely managed by the microprocessor.

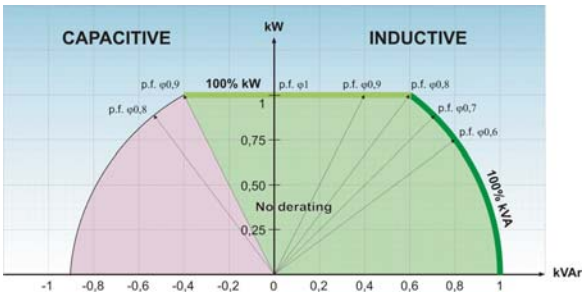
The DC current transducer CT provides for the monitoring of the inverter input current. Its feedback signal is managed by the microprocessor to activate the output short circuit current limitation (see 2.2.3) and the IGBT protection (see 2.2.4).



Picture 7 – Inverter

The output transformer provides the galvanic insulation between DC and AC side, as well as voltage adaptation. Its integrated inductance forms, together with the AC capacitors, a low-pass filter that provides to eliminate the high frequency ripple and keeps the total harmonic distortion of the inverter waveform (THD) lower than 2% (with linear load).

The inverter, thanks to its manufacturing technology and to the microprocessor control, is able to supply indifferently inductive or capacitive loads. The maximum apparent power varies slightly in case the load is highly capacitive (p.f. < 0,9) and a de-rating factor, according to the picture 5, must be applied. The data “100% kW” indicates the maximum active power that the UPS can supply to a resistive load (ex: for a 20kVA UPS Pmax=16kW).

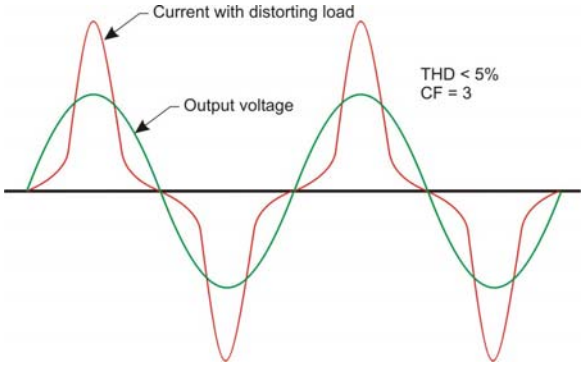


Picture 8 – Diagram of the power

2.2.1 Operation with non-linear load

A non-linear load is characterized by a high peak current versus its RMS value, that in normal condition would introduce a distortion on the output waveform.

The inverter is provided with an instantaneous voltage correction facility, completely managed by the microprocessor, that provides to vary the PWM generation according to the actual output waveform, in order to keep the THD within 5% even with loads having crest factor equal to 3.



Picture 9 – Operation with non-linear load

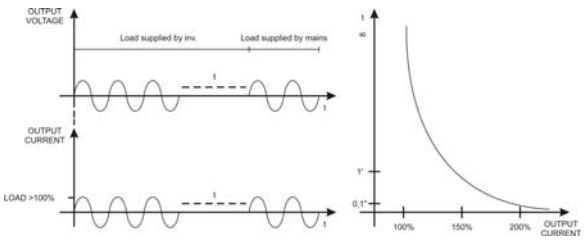
2.2.2 Overload management

Inverter can provide continuously 100% of nominal load and can tolerate overload conditions up to 125% for 10 minutes or 150% for 1 minute.

Peak conditions such as take-off of engines or magnetic parts are managed limiting the output current to 200% for 5 cycles, than reducing to 125%.

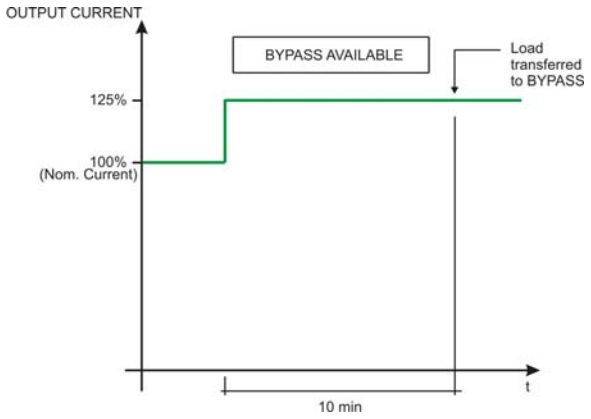
Any times output power grows above 100% the inverter keeps feeding the loads, while the microprocessor activates the “thermal image” algorithm (technical figure) to calculate thermal image based on output current and duration of the overload in function of the time.

User loads are powered by inverter output up to the end of maximum allowed time, and then the static bypass switches to emergency line without interruption of output power.



Picture 10 – Thermal image characteristic

2.2.2.1 Overload with Bypass available



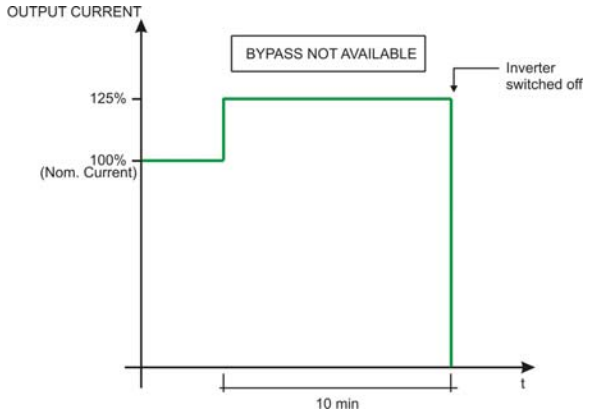
Picture 11 – Overload with bypass available

As soon as an overload is detected the algorithm starts to calculate the increment of the energy. When the limit is reached the load is transferred to bypass.

To allow a safe cooling of the inverter power components (IGBT’s, transformer) the inverter is switched off for **30 minutes**.

When this time has elapsed the inverter is switched on again and the load transferred back to the primary supply.

2.2.2.2 Overload with Bypass NOT available



Picture 12 – Overload with bypass not available

As soon as an overload is detected the algorithm starts to calculate the increment of the energy. When the limit is reached the inverter is switched off to avoid severe damages to the power components.

As soon as the bypass is available again the load is supplied by the bypass static switch.

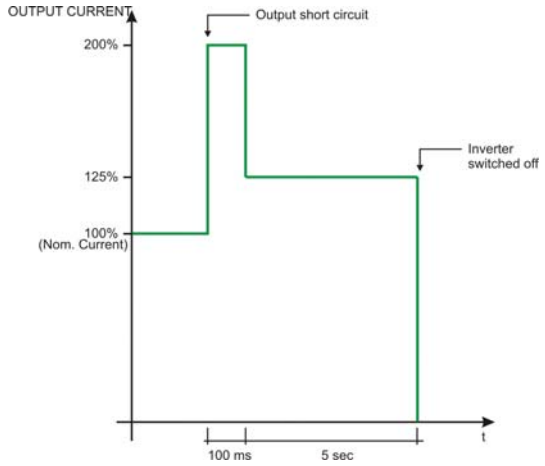
After **30 minutes** the inverter is switched on again and the load re-supplied.

WARNING: this operation causes the loss of the supply to the load

2.2.3 Short circuit operation

As soon as an output short circuit is detected (alarm A25) the load is transferred immediately to the emergency line that provides to eliminate the fault thanks to its higher short circuit current.

In case the bypass is not available the inverter reduces its output voltage and limits its output current to 200% for 100ms, and then to 125% for 5 seconds, after that it's switched off (according to EN 62040-3 / EN 50091-3).



Picture 13 – Short circuit characteristic (By-pass not available)

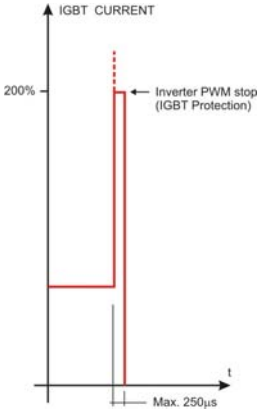
2.2.4 IGBT bridge protection

The inverter current is monitored by the DC current transducer connected upstream the inverter bridge. Therefore the control logic is able to distinguish an output short circuit from an IGBT short circuit.

The behaviour of the inverter in case of short circuit on the load has been described at 2.2.3; the output current is limited and the IGBT bridge current doesn't reach the protection threshold.

In case of short circuit in the inverter bridge the DC input current increases immediately and there's no possibility of limitation but stopping the PWM.

In this case the alarm A24 – Current stop is activated and must be reset manually after having verified the status of the semiconductors.

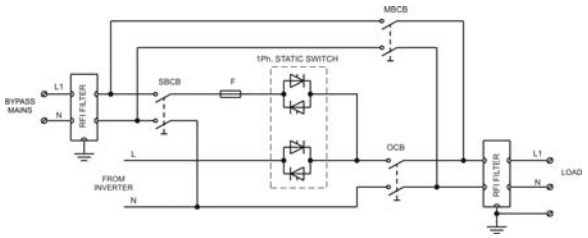


Picture 14 – IGBT bridge protection

2.3 STATIC SWITCH

Static switch is based on power semiconductor (thyristors), rated to work continuously at 150% of nominal output power.

The thyristor connected to the main power is protected by a fast-acting fuse.



Picture 15 – Static switch and Manual by-pass

Thanks to the transfer logic integrated in the control, the load is supplied by the bypass static switch even in case of microprocessor failure.

Overload capability: 150% continuously
200% for 1 minute
2000% for 1 cycle

2.3.1 Inverter → Emergency Line transfer

The transfer (in less than ¼ cycle) is activated only if emergency line is in tolerance, for the following reasons:

- Output short circuit
- Fault of the inverter
- DC over-voltage or under-voltage (inverter OFF)
- Over-temperature
- Thermal image shutdown
- Forced commutation by "BYPASS SWITCH"

2.3.2 Emergency Line → Inverter transfer

As soon as inverter is correctly working and synchronized, the unit automatically switches to inverter in less than 1 msec. If the system switches back and forth more than 6 times in two minutes, an alarm is generated to inform the user, and the load is blocked to emergency line until a manual reset will clear the faulty condition.

2.4 MANUAL BY-PASS

In order to allow safe maintenance and repair of the unit, the inverter is provided with a manual bypass switch.

In bypass mode all the repair and test activities to verify the efficiency of the whole unit can be carried out safely. Manual by-pass can be inserted by following the relevant instructions. During manual by-pass operation there's no interruption of the supply to the load.

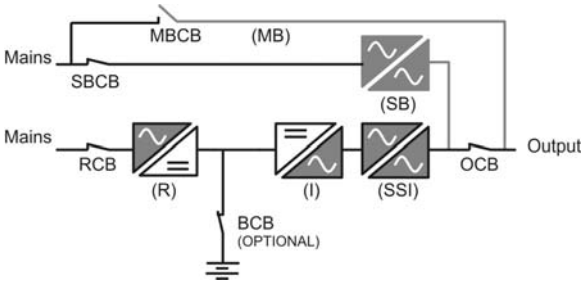
3 OPERATING MODES

3.1 NORMAL OPERATION

During normal operation all the circuit breakers/switches are closed except MBCB (maintenance bypass).

The three-phase input AC voltage feeds the rectifier via the isolation transformer; the rectifier supplies the inverter and compensate mains voltage fluctuations as well as load variation, maintaining the DC voltage constant. At the same time it provides to keep the battery in stand-by (floating charge or boost charge depending on the type of battery).

The inverter converts the DC voltage into an AC sine-wave, stabilized in voltage and frequency, and provides to supply the load through its static switch SSI.



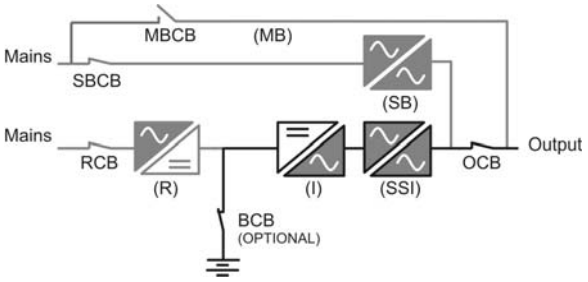
Picture 16 – Normal Operation

3.2 BATTERY OPERATION

In the event of mains failure, or rectifier failure, the inverter is no longer supplied by the rectifier, so the battery, that is connected to the DC intermediate circuit, is called up immediately and without interruption to supply the load. The battery voltage drops as a function of the magnitude of the discharge current. The voltage drops has no effect on the inverter output voltage since it is kept constant by varying the PWM modulation.

As the battery approaches the discharge limit an alarm is activated. In case the power is restored (even using a diesel generator) before the limit is reached the system switches automatically back to normal operation, if not, the inverter shuts down and the load is transferred to the bypass (bypass operation). If the bypass mains is not available or outside the tolerance range the complete system shuts down as soon as the lowest battery level is reached.

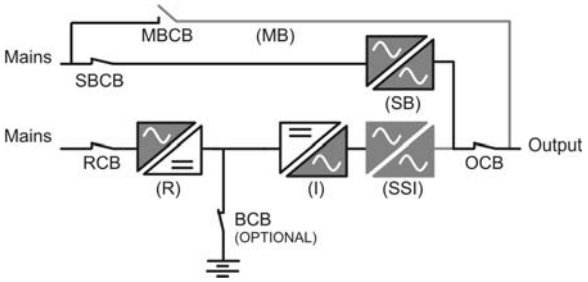
As soon as the power is restored the rectifier charges the battery, and, depending on the depth of the discharge, the charging current is limited by means of the battery current limitation.



Picture 17 – Battery operation

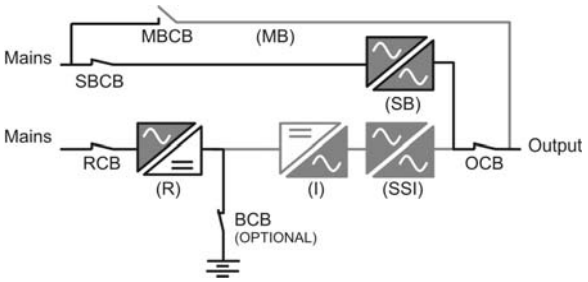
3.3 BYPASS OPERATION

Bypass operation may occur for both manual or automatic change-over. The manual transfer is due to the BYPASS SWITCH, that forces the load to bypass. In the event of a bypass failure the load is transferred back to inverter without interruption.



Picture 18 – Bypass operation (manual change-over)

The automatic change-over occurs for the reasons explained in the UPS technical description (see paragraph 2.4.1); basically when the power supply to the load within the specified tolerance cannot be assured by the inverter.



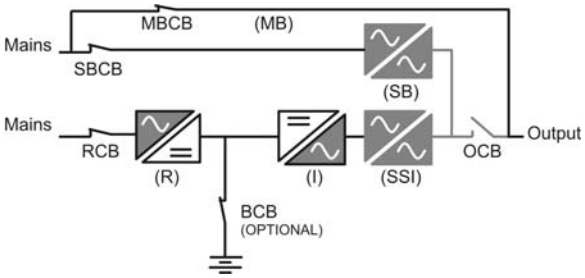
Picture 19 – Bypass operation (automatic change-over)

3.4 MANUAL BYPASS

The manual bypass operation is necessary every time the functionality of the UPS needs to be checked or during maintenance or repair works.

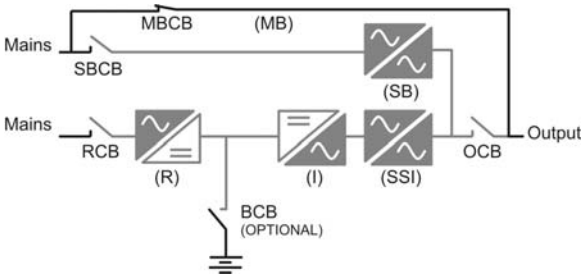
The manual bypass procedure is described in the UPS operating manual and must be followed carefully in order to avoid damages to the UPS.

During the functional check of the UPS, all the breakers can be closed, except for the output breaker OCB, and the full functionality can be tested.



Picture 20 – Manual Bypass for functional tests

During the manual bypass operation for repair or maintenance, the UPS is completely switched off and the load is supplied directly by the bypass mains.



Picture 21 – Manual Bypass for repair or maintenance works

4 TECHNICAL CHARACTERISTICS

For technical characteristics see the attached data sheets (chapter 11).

5 PROGRAMMING AND PARAMETER SETTING

The “setting” menu on the front panel allows to adjust the most important operating parameters for the rectifier, inverter and static bypass.

In alternative the programming can be carried out by a PC connected to the serial port RS232 of the front panel, using the dedicated interface software. At the end of the setting the modified parameters must be memorized in the non-volatile memory (EEPROM).

Another software suite, specifically designed for the front panel, allows the programming of the signalization LED’s and alarm relays.

6 ALARMS, STATUS AND SIGNALS

The alphanumeric display offers a complete diagnostic of the system. Each alarm and status is associated to a code; the alarm codes are stored in the events history.

The display management for the alarms and status, including the history log, is described in the chapter **FRONT PANEL** of the **Operating Manual**.

List of the status

Code	*Description*
S1	Rectifier OK
S2	Rectifier ON
S2-1	Floating charge
S2-2	Boost charge
S2-3	Manual charge
S3	Battery OK
S4	Inverter OK
S5	Bypass OK
S6	Inverter synchronised
S7	Inverter feeds load
S8	Inverter ON

List of the alarms

Code	*Description*
A1	Mains fault
A2	Rectifier fuses blown
A3	Rectifier high temperature
A4	Rectifier overload
A5	Maximum DC voltage
A6	Minimum DC voltage
A7	Charging fault
A8	Rectifier input CB open
A9	Battery CB open
A10	Battery discharge
A11	Battery low
A12	Battery in test
A13	Battery fault
A14	Inverter input voltage wrong
A15	Inverter high temperature
A16	Inverter out of tolerance
A17	Max. current stop
A18	Inverter not synchronised
A19	Overload
A20	Bypass not available
A21	Bypass feeds load
A22	Bypass switch activated
A23	Retransfer blocked
A24	Fans failure
A25	UPS output CB open
A26	Manual bypass CB closed
A27	EPO activated
A28	Thermal image
A29	Short circuit
A30	Rectifier control loop error
A31	Output voltage out of tolerance
A40	DC earth fault (option)
A41	Rect. output CB open (option)
A42	Inv. input CB open (option)
A43	Bypass CB open (option)
A44	QIRA open (option)
A50	*Programmable*
A51	*Programmable*
A52	*Programmable*
A53	*Programmable*
A54	*Programmable*
A55	*Programmable*
A56	*Programmable*
A57	*Programmable*
A58	*Programmable*
A59	*Programmable*
A61	Communication fault
A62	Rectifier critical fault
A63	Inverter critical fault
A64	Common alarm

The alarms and status can be remotely transferred by means of SPDT (Single Pole Double Throw) voltage-free relay contacts (OPTION).

ARC #1

RELAY	MEANING
RL1	Mains fault
RL2	Rectifier OK
RL3	Floating charge
RL4	Boost charge
RL5	Battery CB open
RL6	Charging fault

ARC #2

RELAY	MEANING
RL1	Battery low voltage
RL2	DC earth fault
RL3	High temperature
RL4	Inverter OK
RL5	Inverter synchronized
RL6	Inverter feeds load

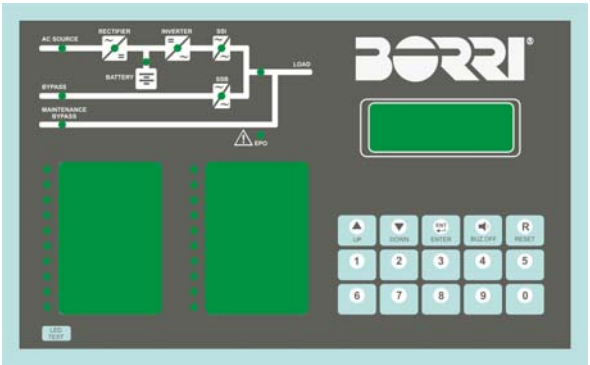
ARC #3

RELAY	MEANING
RL1	Bypass OK
RL2	Bypass feeds load
RL3	Overload
RL4	Retransfer blocked
RL5	Fans failure
RL6	Common alarm

7 FRONT PANEL

The front panel of the UPS, consisting of a four-row alphanumeric display plus 15 function keys, allows the complete monitoring of the UPS status.

The power flow diagram helps to understand the operating status of the UPS.



Picture 22 – Front panel

The front panel main functions are:

- Show all the relevant input and output current, voltage and frequency measures
- Show all the alarms and status of the UPS
- Show the events history

The following remote connections are also available:

1. Through an RS232 protocol
2. Through a ModBus RS485 protocol

The relay cards and the signalisations by LED's can be programmed by a dedicated software interface.

The front panel can also be set in "transparent" mode to connect a PC to the rectifier or inverter microprocessors in order to check and/or adjust all the operating variables.

The following table show the standard Led's signalizations:

LED	Signalling	Color
10	Mains Fault	RED
11	Rectifier fuses blown	RED
12	Rectifier high temperature	RED
13	Rectifier Overload	ORANGE
14	Maximum DC voltage	RED
15	Battery discharging	ORANGE
16	Battery CB open	RED
17	Battery OK	GREEN
18	Floating Charge	GREEN
19	Spare	-
20	Inverter OK	GREEN
21	Inverter feeds load	GREEN
22	Inverter synchronized	GREEN
23	Bypass Ok	GREEN
24	Bypass feeds load	ORANGE
25	Overload	ORANGE
26	Fans Failure	ORANGE
27	DC Voltage out tol	RED
28	High Temp	RED
29	Retransfer block	RED

8 PARALLEL REDUNDANT OPERATION

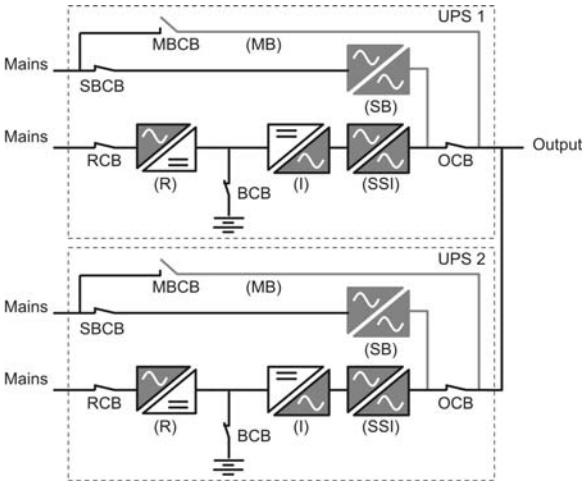
The parallel system consists of "n" (up to 4) units, which are equipped like standard units. Only the manual bypass can be external and unique for all the units (on request).

On each inverter one extra PCB (RPI-BUSCAN), that provides the parallel redundant functions, is installed.

In addition to the standard functions as uninterruptible power supply, total power control and protection of the load from mains distortion, the parallel redundant system guarantees an uninterrupted power supply even in case of an internal failure in one of the inverters. This is possible because all units are constantly in operation and feed the load in parallel at "total load / n", where "n" is the number of the UPS.

The AC automatic current sharing control equalizes the currents of the "n" inverters and reduces the total unbalance to less than 10%, under all load conditions. The load is supplied by the inverters in parallel for an instantaneous overload up to "n x 200%" of the nominal load of a single unit.

In case of failure in one unit, the other units supply the load. The load is supplied by the static bypass only when the redundancy logic, that can be set by a dedicated software program, is no longer satisfied.



Picture 23 – Parallel redundant configuration (double battery)

In case of parallel redundant system with single battery bank (common DC bus) the rectifiers can be equipped with an additional parallel board that controls the current sharing on the DC bus.

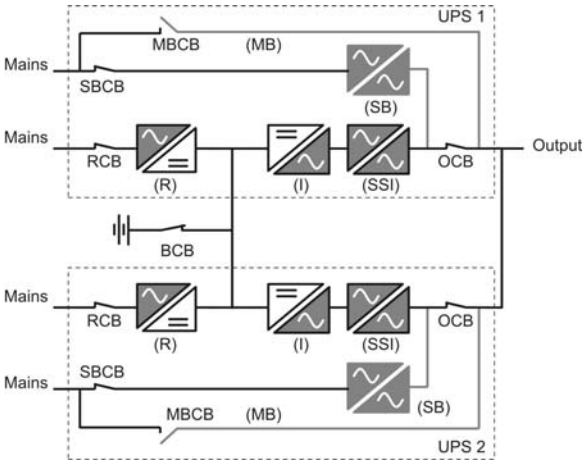
In this case the rectifiers are connected by means of a communication cable, through which all the information necessary for the current sharing and the alarms management are exchanged.

During the floating charge each rectifier supplies the 50% of the total load (Active Current Sharing), therefore in case of failure of one unit the load is supplied by the remaining rectifier without affecting the DC bus-bar.

During a mains failure the batteries supply the necessary energy.

The battery charging cycle is automatically started upon the mains return; during the current limitation phase (operation as current generator) the current is completely supplied by the rectifier #1, whereas the rectifier #2 follows the DC bus-bar voltage without supplying any current. In case of failure of the rectifier #1 the load is supplied by the rectifier #2, still operative, without affecting the DC bus-bar. At the end of the current limitation phase the Active Current Sharing control is restored.

In case two batteries are connected to the DC bus-bar the recharge is carried out limiting the battery that absorbs the highest current.



Picture 24 – Parallel redundant configuration (single battery)

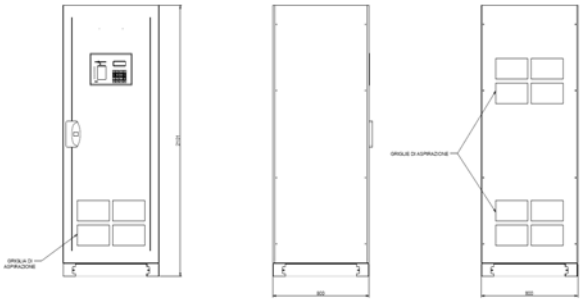
9 DESIGN STANDARDS

Quality / Environment	:	ISO 9001:2000
Inverter basic standard	:	EN 62040
EMC standard	:	EN 61000-6-2 EN 61000-6-4
Performances	:	EN 62040-3
Power transformers	:	IEC 60076
Low voltage switchgear	:	IEC 60439 CEI 60947-2
Cables	:	CEI 20-38 CEI 20-22 CEI 20-14
Safety	:	EN 50178 EN 62040-1
Protection degree	:	IEC 60529
Mechanical	:	EN 60439-1 EN 62040-1
Semiconductors	:	EN 60146
Protection devices	:	EN 60127
Contactors	:	EN 60947-4
Lamps	:	EN 60945-5

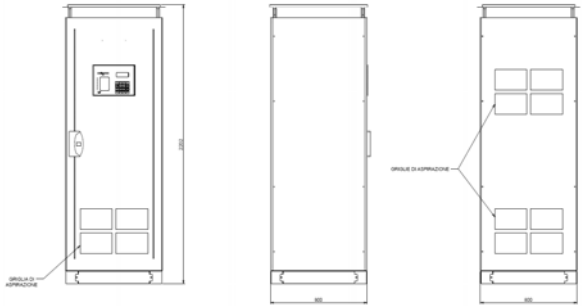
10 MECHANICAL LAYOUT

The following drawings are given as examples of mechanical layout for the inverter series E2001.e. Width and depth varies according to the voltage and current ratings; further details are given in the datasheet.

Version 1 : **IP20**



Version 2 : **IP31**



11 DATASHEETS

11.1 UPS 110VDC / 115VAC

E2001.e 110Vdc/115Vac - SIZE (kVA)		5	10	15	20	30	40	50
ELECTRICAL DATA – GENERAL								
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%						
Input frequency (Hz)		50-60 (selectable) +/- 10%						
Output voltage (Vac)		110 – 115 – 120 (selectable) +/- 1%						
Output frequency (Hz)		50-60 (selectable) +/- 4% (programmable)						
Output power @ p.f. 0,8 (kVA)		5	10	15	20	30	40	50
Output power @ p.f. 1 (kW)		4	8	12	16	24	32	40
Efficiency at nominal load	**25%**	≥ 54	≥ 55	≥ 56	≥ 57	≥ 57	≥ 58	≥ 59
	50%	≥ 62	≥ 63	≥ 63	≥ 71	≥ 71	≥ 73	≥ 74
	75%	≥ 68	≥ 68	≥ 69	≥ 74	≥ 74	≥ 75	≥ 78
	100%	≥ 76	≥ 77	≥ 77	≥ 79	≥ 81	≥ 81	≥ 82
Heat dissipation @ nominal load - Kw		1,40	2,67	4,01	4,80	6,30	8,44	9,82
Parallel redundant configuration		Active load sharing (CAN-BUS connection) Up to 4 units						
ELECTRICAL DATA – RECTIFIER								
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%						
Input frequency (Hz)		50-60 (selectable) +/- 10%						
Input short circuit current (kA rms) (@ 400Vac, IEC standard)		≤ 16 (other on request)						
Max. Input power (kVA) (@ 100% load, nominal input)		8,4	16,9	25,3	33,3	48,9	65,2	80,6
Input current distortion (THD) (@ 100% load, nominal input)		≤ 27% with 6 pulses bridge (standard) ≤ 12% with 12 pulses bridge (on request) ≤ 6% with 12 pulses plus input THD filter (on request)						
Input power factor (@ 100% load, nominal input)		≥ 0,75 (No manual charge provided)						
Output voltage (Vdc) **- Nominal** **- Floating charge** **- Boost charge** **- Manual (equalizing) charge**		110 2,2÷2,3 V/cell for Lead acid battery (Adjustable) 1,4÷1,5 V/cell for NiCd battery (Adjustable) 2,4÷2,45 V/cell for Lead acid battery (Adjustable) 1,5÷1,65 V/cell for NiCd battery (Adjustable) up to 2,7 V/cell for Lead acid battery up to 1,7 V/cell for NiCd battery Forced boost push button (on request) Thermal compensation for lead acid battery (on request)						
Output ripple (% rms)		≤ 2 (other on request)						
Rated output current (A)		50	100	150	200	300	400	500

E2001.e 110Vdc/115Vac - SIZE (kVA)		5	10	15	20	30	40	50
ELECTRICAL DATA – INVERTER								
Input voltage range (Vdc)		90 ÷ 160						
Output voltage (Vac)		110 – 115 – 120 (selectable) +/- 1%						
Output frequency (Hz)		50-60 (selectable)						
Output frequency stability (Hz) **- Free running quartz oscillator** **- Inv. Synchronized with mains**		+/- 0,001 +/- 2 (programmable)						
Output current @ 115Vac (A)								
	- p.f. 1	34	69	104	139	208	278	347
	- p.f. 0,8	43	86	130	173	260	347	434
Output harmonic distortion (THD) **- Linear load** **- Not linear load (75% Pn, CF=3:1)**		< 2% < 5%						
Overload capability (p.f. 0,8)		125% Pn for 10', 150% Pn for 1', 200% In for 100ms						
Short circuit current (A)		68	136	208	276	416	554	694
Short circuit protection		200% In for 100ms, then 125% In Inverter stop after 5 seconds (according to EN62040-3)						
Output voltage static stability		+/- 1%						
Output voltage dynamic stability	**0 - 50%**	+/- 5% With recovery at +/- 1% within 40ms						
	0% - 100%	+/- 8% With recovery at +/- 2% within 40ms						
ELECTRICAL DATA – STATIC BYPASS								
Automatic static bypass		Electronic thyristor switch						
Nominal input voltage (Vac)		110 – 115 – 120 (selectable) +/- 20%						
Input frequency (Hz)		50-60 (selectable) +/- 4% (programmable)						
Overload capability (p.f. 0,8)		150% Pn continuous, 200% Pn for 10', 2000% In for 1 cycle						
Static bypass protection		Fast acting fuse						
Transfer INV → BYPASS **- Sensing and transfer time** **- Commutation time**		< ¼ cycle < 1ms						
Retransfer INV → BYPASS **- Sensing and transfer time**		0 seconds (controlled) Block on mains after 6 commutation in 2 minutes						
Manual bypass		With electric security and without interruption (Make Before Break type)						

E2001.e 110Vdc/115Vac - SIZE (kVA)	5	10	15	20	30	40	50
ENVIRONMENTAL DATA							
Acoustic noise level (according EN 50091) - dB	< 67		< 70			< 72	
EMI	EN 61000-6-2 /EN 61000-6-4						
Operating Temperature (°C)	-10 .. +40						
Storage Temperature (°C)	-20 .. +70						
Relative Humidity (non condens.)	< 95% (with tropicalization on request)						
Ventilation	Forced (redundant fans on request)						
Altitude (mt. above see level)	< 2000 (de-rating according EN62040-3)						
MECHANICAL DATA							
Protection degree (IEC60529)	IP 20 (other on request)						
Painting colour and type	RAL 7035, ≥ 60μm (others on request)						
Dimensions (mm)							
- W	800			1400		1800	
- D	800			800		800	
- H	2100			2100		2100	
Weights (Kg)	450	500	600	650	820	900	1000
Input/output cable connection	Bottom Side (Top Side on Request)						
Transport	Base provided: for forklift handling (for lifting belts and load balancing hooks -on request)						
Transport mechanical stress	According to EN 62040-1 Restricted						
Installation	30 cm from ceiling Air inlet from the front. Air outlet from the top and rear						
Accessibility	Front (rear for fans access)						

11.2 UPS 110VDC / 230VAC

E2001.e 110Vdc/230Vac - SIZE (kVA)		5	10	15	20	30	40	50
ELECTRICAL DATA – GENERAL								
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%						
Input frequency (Hz)		50-60 (selectable) +/- 10%						
Output voltage (Vac)		220 – 230 – 240 (selectable) +/- 1%						
Output frequency (Hz)		50-60 (selectable) +/- 4% (programmable)						
Output power @ p.f. 0,8 (kVA)		5	10	15	20	30	40	50
Output power @ p.f. 1 (kW)		4	8	12	16	24	32	40
Efficiency at nominal load	**25%**	≥ 54	≥ 55	≥ 56	≥ 57	≥ 57	≥ 58	≥ 59
	50%	≥ 62	≥ 63	≥ 63	≥ 71	≥ 71	≥ 73	≥ 74
	75%	≥ 68	≥ 68	≥ 69	≥ 74	≥ 74	≥ 75	≥ 78
	100%	≥ 76	≥ 77	≥ 77	≥ 79	≥ 81	≥ 81	≥ 82
Heat dissipation @ nominal load - Kw		1,40	2,67	4,01	4,80	6,30	8,44	9,82
Parallel redundant configuration		Active load sharing (CAN-BUS connection) Up to 4 units						
ELECTRICAL DATA – RECTIFIER								
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%						
Input frequency (Hz)		50-60 (selectable) +/- 10%						
Input short circuit current (kA rms) (@ 400Vac, IEC standard)		≤ 16 (other on request)						
Max. Input power (kVA) (@ 100% load, nominal input)		8,4	16,9	25,3	33,3	48,3	65,2	80,6
Input current distortion (THD) (@ 100% load, nominal input)		≤ 27% with 6 pulses bridge (standard) ≤ 12% with 12 pulses bridge (on request) ≤ 6% with 12 pulses plus input THD filter (on request)						
Input power factor (@ 100% load, nominal input)		≥ 0,75 (No manual charge provided)						
Output voltage (Vdc) **- Nominal** **- Floating charge** **- Boost charge** **- Manual (equalizing) charge**		110 2,2÷2,3 V/cell for Lead acid battery (Adjustable) 1,4÷1,5 V/cell for NiCd battery (Adjustable) 2,4÷2,45 V/cell for Lead acid battery (Adjustable) 1,5÷1,65 V/cell for NiCd battery (Adjustable) up to 2,7 V/cell for Lead acid battery up to 1,7 V/cell for NiCd battery Forced boost push button (on request) Thermal compensation for lead acid battery (on request)						
Output ripple (% rms)		≤ 2 (other on request)						
Rated output current (A)		50	100	150	200	300	400	500

E2001.e 110Vdc/230Vac - SIZE (kVA)		5	10	15	20	30	40	50
ELECTRICAL DATA – INVERTER								
Input voltage range (Vdc)		90 ÷ 160						
Output voltage (Vac)		220 – 230 – 240 (selectable) +/- 1%						
Output frequency (Hz)		50-60 (selectable)						
Output frequency stability (Hz) **- Free running quartz oscillator** **- Inv. Synchronized with mains**		+/- 0,001 +/- 2 (programmable)						
Output current @ 230Vac (A)								
- p.f. 1		17	34	52	69	104	139	173
- p.f. 0,8		21	43	65	86	130	173	217
Output harmonic distortion (THD) **- Linear load** **- Not linear load (75% Pn, CF=3:1)**		< 2% < 5%						
Overload capability (p.f. 0,8)		125% Pn for 10', 150% Pn for 1', 200% In for 100ms						
Short circuit current (A)		34	68	104	138	208	278	348
Short circuit protection		200% In for 100ms, then 125% In Inverter stop after 5 seconds (according to EN62040-3)						
Output voltage static stability		+/- 1%						
Output voltage dynamic stability	**0 - 50%**	+/- 5% With recovery at +/- 1% within 40ms						
	0% - 100%	+/- 8% With recovery at +/- 2% within 40ms						
ELECTRICAL DATA – STATIC BYPASS								
Automatic static bypass		Electronic thyristor switch						
Nominal input voltage (Vac)		220 – 230 – 240 (selectable) +/- 20%						
Input frequency (Hz)		50-60 (selectable) +/- 4% (programmable)						
Overload capability (p.f. 0,8)		150% Pn continuous, 200% Pn for 10', 2000% In for 1 cycle						
Static bypass protection		Fast acting fuse						
Transfer INV → BYPASS **- Sensing and transfer time** **- Commutation time**		< ¼ cycle < 1ms						
Retransfer INV → BYPASS **- Sensing and transfer time**		0 seconds (controlled) Block on mains after 6 commutation in 2 minutes						
Manual bypass		With electric security and without interruption (Make Before Break type)						

E2001.e 110Vdc/230Vac - SIZE (kVA)	5	10	15	20	30	40	50
ENVIRONMENTAL DATA							
Acoustic noise level (according EN 50091) - dB	< 67		< 70			< 72	
EMI	EN 61000-6-2 /EN 61000-6-4						
Operating Temperature (°C)	-10 .. +40						
Storage Temperature (°C)	-20 .. +70						
Relative Humidity (non condens.)	< 95% (with tropicalization on request)						
Ventilation	Forced (redundant fans on request)						
Altitude (mt. above see level)	< 2000 (de-rating according EN62040-3)						
MECHANICAL DATA							
Protection degree (IEC60529)	IP 20 (other on request)						
Painting colour and type	RAL 7035, ≥ 60μm (others on request)						
Dimensions (mm)							
- W	800			1400		1800	
- D	800			800		800	
- H	2100			2100		2100	
Weights (Kg)	450	500	600	650	820	900	1000
Input/output cable connection	Bottom Side (Top Side on Request)						
Transport	Base provided: for forklift handling (for lifting belts and load balancing hooks -on request)						
Transport mechanical stress	According to EN 62040-1 Restricted						
Installation	30 cm from ceiling Air inlet from the front. Air outlet from the top and rear						
Accessibility	Front (rear for fans access)						

11.3 UPS 220VDC / 115VAC

E2001.e 220Vdc/115Vac - SIZE (kVA)		5	10	15	20	30	40	50	60	80	100
ELECTRICAL DATA – GENERAL											
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%									
Input frequency (Hz)		50-60 (selectable) +/- 10%									
Output voltage (Vac)		110 – 115 – 120 (selectable) +/- 1%									
Output frequency (Hz)		50-60 (selectable) +/- 4% (programmable)									
Output power @ p.f. 0,8 (kVA)		5	10	15	20	30	40	50	60	80	100
Output power @ p.f. 1 (kW)		4	8	12	16	24	32	40	48	64	80
Efficiency at nominal load	**25%**	≥ 55	≥ 56	≥ 58	≥ 58	≥ 58	≥ 60	≥ 60	≥ 60	≥ 61	≥ 61
	50%	≥ 63	≥ 64	≥ 65	≥ 65	≥ 66	≥ 74	≥ 74	≥ 75	≥ 75	≥ 76
	75%	≥ 69	≥ 70	≥ 72	≥ 72	≥ 72	≥ 77	≥ 77	≥ 78	≥ 79	≥ 81
	100%	≥ 79	≥ 80	≥ 81	≥ 81	≥ 81	≥ 83	≥ 83	≥ 84	≥ 86	≥ 87
Heat dissipation @ nominal load - Kw		1,22	2,29	3,29	4,38	6,57	7,74	9,67	10,74	12,39	14,12
Parallel redundant configuration		Active load sharing (CAN-BUS connection) Up to 4 units									
ELECTRICAL DATA – RECTIFIER											
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%									
Input frequency (Hz)		50-60 (selectable) +/- 10%									
Input short circuit current (kA rms) (@ 400Vac, IEC standard)		≤ 16 (other on request)									
Max. Input power (kVA) (@ 100% load, nominal input)		8,4	16,7	25	33,3	50	65,9	82,4	97,8	128,9	159,4
Input current distortion (THD) (@ 100% load, nominal input)		≤ 27% with 6 pulses bridge (standard) ≤ 12% with 12 pulses bridge (on request) ≤ 6% with 12 pulses plus input THD filter (on request)									
Input power factor (@ 100% load, nominal input)		≥ 0,75 (No manual charge provided)									
Output voltage (Vdc)											
- Nominal		220									
- Floating charge		2,2÷2,3 V/cell for Lead acid battery (Adjustable) 1,4÷1,5 V/cell for NiCd battery (Adjustable)									
- Boost charge		2,4÷2,45 V/cell for Lead acid battery (Adjustable) 1,5÷1,65 V/cell for NiCd battery (Adjustable)									
- Manual (equalizing) charge		up to 2,7 V/cell for Lead acid battery up to 1,7 V/cell for NiCd battery									
		Forced boost push button (on request) Thermal compensation for lead acid battery (on request)									
Output ripple (% rms)		≤ 2 (other on request)									
Rated output current (A)		25	50	75	100	150	200	250	300	400	500

E2001.e 220Vdc/115Vac - SIZE (kVA)		5	10	15	20	30	40	50	60	80	100
ELECTRICAL DATA – INVERTER											
Input voltage range (Vdc)		180 ÷ 300									
Output voltage (Vac)		110 – 115 – 120 (selectable) +/- 1%									
Output frequency (Hz)		50-60 (selectable)									
Output frequency stability (Hz) **- Free running quartz oscillator** **- Inv. Synchronized with mains**		+/- 0,001 +/- 2 (programmable)									
Output current @ 115Vac (A)											
- p.f. 1		34	69	104	139	208	278	347	417	556	695
- p.f. 0,8		43	86	130	173	260	347	434	521	695	869
Output harmonic distortion (THD) **- Linear load** **- Not linear load (75% Pn, CF=3:1)**		< 2% < 5%									
Overload capability (p.f. 0,8)		125% Pn for 10', 150% Pn for 1', 200% In for 100ms									
Short circuit current (A)		68	136	208	276	416	554	694	834	1112	1390
Short circuit protection		200% In for 100ms, then 125% In Inverter stop after 5 seconds (according to EN62040-3)									
Output voltage static stability		+/- 1%									
Output voltage dynamic stability	**0 - 50%**	+/- 5% With recovery at +/- 1% within 40ms									
	0% - 100%	+/- 8% With recovery at +/- 2% within 40ms									
ELECTRICAL DATA – STATIC BYPASS											
Automatic static bypass		Electronic thyristor switch									
Nominal input voltage (Vac)		110 – 115 – 120 (selectable) +/- 20%									
Input frequency (Hz)		50-60 (selectable) +/- 4% (programmable)									
Overload capability (p.f. 0,8)		150% Pn continuous, 200% Pn for 10', 2000% In for 1 cycle									
Static bypass protection		Fast acting fuse									
Transfer INV → BYPASS **- Sensing and transfer time** **- Commutation time**		< ¼ cycle < 1ms									
Retransfer INV → BYPASS **- Sensing and transfer time**		0 seconds (controlled) Block on mains after 6 commutation in 2 minutes									
Manual bypass		With electric security and without interruption (Make Before Break type)									

E2001.e 220Vdc/115Vac - SIZE (kVA)	5	10	15	20	30	40	50	60	80	100
ENVIRONMENTAL DATA										
Acoustic noise level (according EN 50091) - dB	< 67			< 70				< 72		
EMI	EN 61000-6-2 /EN 61000-6-4									
Operating Temperature (°C)	-10 .. +40									
Storage Temperature (°C)	-20 .. +70									
Relative Humidity (non condens.)	< 95% (with tropicalization on request)									
Ventilation	Forced (redundant fans on request)									
Altitude (mt. above see level)	< 2000 (de-rating according EN62040-3)									
MECHANICAL DATA										
Protection degree (IEC60529)	IP 20 (other on request)									
Painting colour and type	RAL 7035, ≥ 60μm (others on request)									
Dimensions (mm)										
- W	800			1200	1400		1600	1800	2400	
- D	800			800	800		800	800	800	
- H	2100			2100	2100		2100	2100	2100	
Weights (Kg)	450	500	600	650	750	830	920	1050	1190	1350
Input/output cable connection	Bottom Side (Top Side on Request)									
Transport	Base provided: for forklift handling (for lifting belts and load balancing hooks -on request)									
Transport mechanical stress	According to EN 62040-1 Restricted									
Installation	30 cm from ceiling Air inlet from the front. Air outlet from the top and rear									
Accessibility	Front (rear for fans access)									

11.4 UPS 220VDC / 230VAC

E2001.e 220Vdc/230Vac - SIZE (kVA)		5	10	15	20	30	40	50	60	80	100
ELECTRICAL DATA – GENERAL											
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%									
Input frequency (Hz)		50-60 (selectable) +/- 10%									
Output voltage (Vac)		220 – 230 – 240 (selectable) +/- 1%									
Output frequency (Hz)		50-60 (selectable) +/- 4% (programmable)									
Output power @ p.f. 0,8 (kVA)		5	10	15	20	30	40	50	60	80	100
Output power @ p.f. 1 (kW)		4	8	12	16	24	32	40	48	64	80
Efficiency at nominal load	**25%**	≥ 55	≥ 56	≥ 58	≥ 58	≥ 58	≥ 60	≥ 60	≥ 60	≥ 61	≥ 61
	50%	≥ 63	≥ 64	≥ 65	≥ 65	≥ 66	≥ 74	≥ 74	≥ 75	≥ 75	≥ 76
	75%	≥ 69	≥ 70	≥ 72	≥ 72	≥ 72	≥ 77	≥ 77	≥ 78	≥ 79	≥ 81
	100%	≥ 79	≥ 80	≥ 81	≥ 81	≥ 81	≥ 83	≥ 83	≥ 84	≥ 86	≥ 87
Heat dissipation @ nominal load - Kw		1,22	2,29	3,29	4,38	6,57	7,74	9,67	10,74	12,39	14,12
Parallel redundant configuration		Active load sharing (CAN-BUS connection) Up to 4 units									
ELECTRICAL DATA – RECTIFIER											
Nominal input voltage (Vac)		380 – 400 – 415 (selectable) +/- 10%									
Input frequency (Hz)		50-60 (selectable) +/- 10%									
Input short circuit current (kA rms) (@ 400Vac, IEC standard)		≤ 16 (other on request)									
Max. Input power (kVA) (@ 100% load, nominal input)		8,4	16,7	25	33,3	50	65,9	82,4	97,8	128,9	159,4
Input current distortion (THD) (@ 100% load, nominal input)		≤ 27% with 6 pulses bridge (standard) ≤ 12% with 12 pulses bridge (on request) ≤ 6% with 12 pulses plus input THD filter (on request)									
Input power factor (@ 100% load, nominal input)		≥ 0,75 (No manual charge provided)									
Output voltage (Vdc) **- Nominal**		220									
- Floating charge		2,2÷2,3 V/cell for Lead acid battery (Adjustable) 1,4÷1,5 V/cell for NiCd battery (Adjustable)									
- Boost charge		2,4÷2,45 V/cell for Lead acid battery (Adjustable) 1,5÷1,65 V/cell for NiCd battery (Adjustable)									
- Manual (equalizing) charge		up to 2,7 V/cell for Lead acid battery up to 1,7 V/cell for NiCd battery									
		Forced boost push button (on request) Thermal compensation for lead acid battery (on request)									
Output ripple (% rms)		≤ 2 (other on request)									
Rated output current (A)		25	50	75	100	150	200	250	300	400	500

E2001.e 220Vdc/230Vac - SIZE (kVA)		5	10	15	20	30	40	50	60	80	100
ELECTRICAL DATA – INVERTER											
Input voltage range (Vdc)		180 ÷ 300									
Output voltage (Vac)		220 – 230 – 240 (selectable) +/- 1%									
Output frequency (Hz)		50-60 (selectable)									
Output frequency stability (Hz) **- Free running quartz oscillator** **- Inv. Synchronized with mains**		+/- 0,001 +/- 2 (programmable)									
Output current @ 230Vac (A)											
- p.f. 1		17	34	52	69	104	139	173	208	278	347
- p.f. 0,8		21	43	65	86	130	173	217	260	347	434
Output harmonic distortion (THD) **- Linear load** **- Not linear load (75% Pn, CF=3:1)**		< 2% < 5%									
Overload capability (p.f. 0,8)		125% Pn for 10', 150% Pn for 1', 200% In for 100ms									
Short circuit current (A)		34	68	104	138	208	278	308	418	556	696
Short circuit protection		200% In for 100ms, then 125% In Inverter stop after 5 seconds (according to EN62040-3)									
Output voltage static stability		+/- 1%									
Output voltage dynamic stability	**0 - 50%**	+/- 5% With recovery at +/- 1% within 40ms									
	0% - 100%	+/- 8% With recovery at +/- 2% within 40ms									
ELECTRICAL DATA – STATIC BYPASS											
Automatic static bypass		Electronic thyristor switch									
Nominal input voltage (Vac)		220 – 230 – 240 (selectable) +/- 20%									
Input frequency (Hz)		50-60 (selectable) +/- 4% (programmable)									
Overload capability (p.f. 0,8)		150% Pn continuous, 200% Pn for 10', 2000% In for 1 cycle									
Static bypass protection		Fast acting fuse									
Transfer INV → BYPASS **- Sensing and transfer time** **- Commutation time**		< ¼ cycle < 1ms									
Retransfer INV → BYPASS **- Sensing and transfer time**		0 seconds (controlled) Block on mains after 6 commutation in 2 minutes									
Manual bypass		With electric security and without interruption (Make Before Break type)									

E2001.e 220Vdc/230Vac - SIZE (kVA)	5	10	15	20	30	40	50	60	80	100
ENVIRONMENTAL DATA										
Acoustic noise level (according EN 50091) - dB	< 67			< 70				< 72		
EMI	EN 61000-6-2 /EN 61000-6-4									
Operating Temperature (°C)	-10 .. +40									
Storage Temperature (°C)	-20 .. +70									
Relative Humidity (non condens.)	< 95% (with tropicalization on request)									
Ventilation	Forced (redundant fans on request)									
Altitude (mt. above see level)	< 2000 (de-rating according EN62040-3)									
MECHANICAL DATA										
Protection degree (IEC60529)	IP 20 (other on request)									
Painting colour and type	RAL 7035, ≥ 60μm (others on request)									
Dimensions (mm)										
- W	800			1200		1400		1600	1800	
- D	800			800		800		800	800	
- H	2100			2100		2100		2100	2100	
Weights (Kg)	450	500	600	650	750	830	920	1050	1140	1300
Input/output cable connection	Bottom Side (Top Side on Request)									
Transport	Base provided: for forklift handling (for lifting belts and load balancing hooks -on request)									
Transport mechanical stress	According to EN 62040-1 Restricted									
Installation	30 cm from ceiling Air inlet from the front. Air outlet from the top and rear									
Accessibility	Front (rear for fans access)									