MASTER GUARD
A Chloride Group Company

Secure Power Always

Series D from 60 to 200 kVA

UPS Catalogue

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The technical data enclosed is for general information. Please note that the operating instructions and references indicated on the products are for installation, operation and maintenance.

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Person to contact

MASTER GUARD
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Uninterruptible Power Supply Systems

UPS Catalogue • 2007

Series D from 60 to 200 kVA

1 Scope

This specification describes a continuous duty three-phase, solid state, full IGBT (Insulated Gate Bipolar Transistor), double conversion uninterruptible power supply (UPS) system. The UPS shall automatically provide continuity of electrical power, within defined limits and without interruption, upon failure or degradation of the commercial AC source.
The continuity of conditioned electric power shall be delivered for the time period defined by the battery system. The rectifier, the inverter, and other mission critical converters within the UPS, are driven by vector control algorithms (covered by patents 95 P3875, 95 P3879 and 96 P3198) running on dedicated digital signal processor (DSP) systems.

2 System Description

The single line diagram of the UPS is shown in Figure 1. The systems shall operate on two DSP-driven IGBT converters. The vector control technology will enhance the performance of these converters. In order to increase system redundancy, an independent electronic static bypass shall be integrated into the UPS. By adding system components, such as parallel kits, CROSS switches, safety and disconnecting devices, system bypass switches, in addition to software and communications solutions, it shall be possible to set up elaborate systems to ensure the complete protection of the loads.

2.1 The system

The UPS shall provide high quality AC power for electronic equipment loads and shall offer the following features:

- Increased power quality
- Full input Power Factor Correction (PFC) and very low THDi
- Full compatibility with any installation and/or any standby power generator
- Full compatibility with all types of loads
- Power blackout protection
- Full battery care
- Energy saving features.

The UPS shall automatically provide continuity of electrical power, within defined limits and without interruption, upon failure or degradation of the commercial AC source. The duration of autonomy (i.e. back up power time) in the event of network failure shall be determined by the battery capacity.

2.2 Models available

The Series D range shall include the following three-phase input/output models:

MODEL	Rating (kVA)
Series D/60	60
Series D/80	80
Series D/100	100
Series D/120	120
Series D/160	160
Series D/200	200

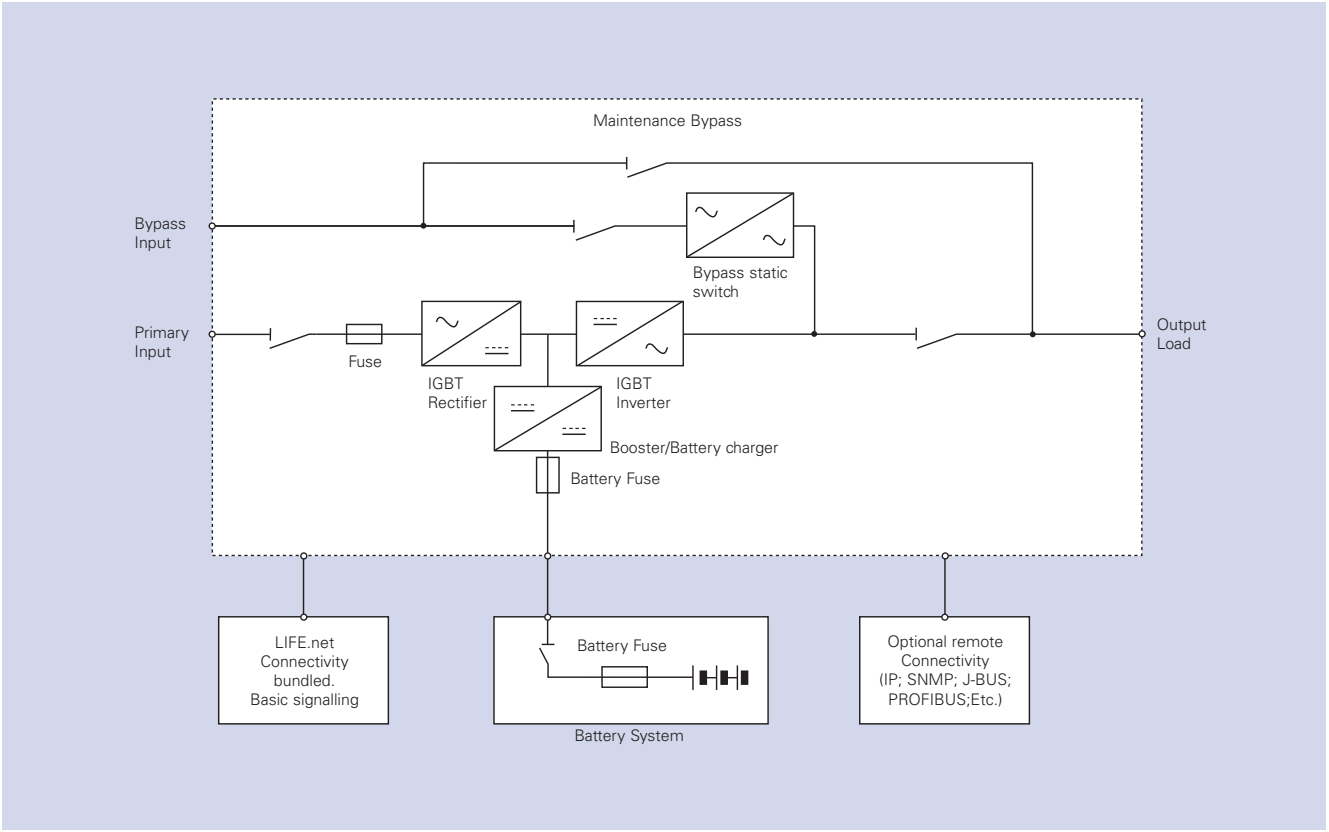


Figure 1. Series D single block system

3 Device Description

Series D is the result of an innovative research and development programme designed to offer users the most reliable power supply at a minimum cost and the highest possible energy conversion efficiency.

3.1 Components

The UPS shall consist of the following major components:

- IGBT Rectifier
- IGBT Battery Charger / Booster
- IGBT inverter
- Dedicated digital signal processor (DSP) control systems for each IGBT converter
- Electronic static switch and bypass supply
- Manual maintenance bypass switch
- Matching battery cubicles

3.2 Microprocessor control and diagnostics

Operation and control of the UPS shall be provided through the use of microprocessor-controlled logic. Indications, measurements and alarms, together with battery autonomy, shall be shown on an illuminated, forty character liquid crystal display (LCD). The procedures for start up, shutdown and manual transfer of the load to and from bypass shall be explained in clear step-by-step sequences on the LCD display.

3.3 Intelligent double conversion operating modes

Series D shall adopt intelligent double conversion technology which allows the UPS to operate in double conversion or digital interactive mode according to the selected priority.
The UPS will operate as follows:

3.3.1 Double Conversion Mode (DCM)

3.3.1.1 Normal (DCM)

The UPS inverter continuously supplies the critical AC load. The rectifier derives power from the commercial AC source and converts it into DC power for the inverter and the battery charger. The Battery Charger keeps the Battery in a fully charged and optimum operational condition. The inverter converts the DC power into clean and regulated AC power which is supplied to the critical load (conditioned line). The static switch monitors and ensures that the inverter tracks the bypass supply frequency. This ensures that any automatic transfer to the bypass supply (due to an overload etc.) is frequency synchronised and does not cause interruption to the critical load.

3.3.1.2 Overload (DCM)

In the event of an inverter overload, manual stop or failure, the static switch shall automatically transfer the critical load to the bypass line without interruption.

3.3.1.3 Emergency (DCM)

Upon failure or reduction of the commercial AC source (see the Technical Data table for tolerances) the inverter shall supply the critical load, drawing power from the associated battery through the battery Booster. There shall be no interruption to the critical load upon failure, reduction or restoration of the commercial AC source. While the UPS is powered by the batteries, indications shall be provided of actual autonomy time remaining as well the duration of the mains failure.

3.3.1.4 Recharge (DCM)

Upon restoration of the commercial AC source, even where batteries are completely discharged, the rectifier shall restart automatically, 'walk in' and gradually take over both the inverter and battery charger. This function shall be fully automatic and shall cause no interruption to the critical load.

3.3.2 Digital Interactive Mode (DIM)

If priority has been set to digital interactive mode, intelligent double conversion technology shall allow Series D to continuously monitor the condition of the input supply including its failure rate to ensure maximum reliability for critical users. On the basis of the analysis performed, it shall decide whether to supply the load through the direct line or the conditioned line.
This operational mode, which allows significant energy savings by increasing the overall AC/AC efficiency of the UPS, is primarily intended for general purpose ICT applications. However, it does not provide the same output power quality as when the UPS operates in double conversion mode. Therefore it will be necessary to verify whether this mode is appropriate for special applications. Digital interactive mode is not available for parallel systems.

3.3.2.1 Normal (DIM)

The operating mode will depend on the quality of the mains supply in the short-term past. If the line quality has remained within permitted tolerance parameters in this timeframe, the direct line will provide continuous supply to the critical AC load through the bypass static switch. The IGBT inverter control will remain in constant operation and synchronisation with the direct line without driving the IGBT. This ensures that the load can be transferred to the conditioned line without any break in supply where there is a deviation from the selected input power tolerance levels. If the direct line failure rate has been outside permitted parameters, Series D shall supply the load from the conditioned line. The battery charger supplies the energy necessary for maintaining maximum charge to the battery.

3 Device Description

3.3.2.2 Inverter stop (DIM)

If the inverter is stopped for any reason there is no transfer to the conditioned line and the load continues to be supplied by the direct line. The mains voltage and frequency values must be within the tolerance limits specified.

3.3.2.3 Overload (DIM)

In the event of an overload with a duration in excess of the maximum capacity specified for the bypass static switch, the load is maintained on the direct line and a warning message on the LCD display will appear (F52) to warn the user about the potential risk related to this condition. This default behavior can be changed (via a Service accessible firmware setting) to force a load transfer to the conditioned line (similar to that described below) even if the bypass source is available. In the event of an overload in conjunction with an unsuitable bypass mains supply, Series D shall transfer the load from the direct line to the conditioned line (assuming Series D was operating from the direct line) and the inverter shall continue to supply the critical load for a period dependant on the degree of the overload and the UPS features. Visual and audio alarms alert the user to the problem.

3.3.2.4 Emergency (due to mains supply failure or variance beyond tolerance limits, DIM)

If Series D is supplying the load via the direct line and the bypass mains supply varies beyond tolerance levels (adjustable using the software), the load will be transferred from the direct line to the conditioned line. The load is powered from the mains via the rectifier and inverter, (provided the input mains remains within the tolerances stated in tables 11 and 12). Should the input mains falls below the lower limit the batteries shall be used to power the load via the inverter. The user is alerted to the battery discharge by visual and audio alarms and the remaining autonomy is displayed on the LCD. During this process, it is possible to extend the remaining autonomy by switching off non-essential loads.

3.3.2.5 Return to normal conditions (DIM)

When the mains supply returns to within tolerance limits, Series D will continue to supply the load via the conditioned line for a period of time dependant on the direct line failure rate (the conditioned line draws power from the mains not the battery).
When the direct line has stabilised, Series D returns to normal operation. The battery charger automatically begins to recharge the battery, so that maximum autonomy is guaranteed in the shortest possible time.

3.3.3 Maintenance bypass

If for any reason it is necessary to take the UPS out of service for maintenance or repair, the UPS shall be fitted with an internal maintenance bypass switch which enables a load transfer to a bypass supply with no interruption to power to the critical load. Bypass isolation shall be complete, all serviceable components such as fuses, power modules etc. shall be isolated. Transfer/retransfer of the critical load may be accomplished by automatic synchronisation of the UPS to the bypass supply and paralleling the inverter with the bypass source, before opening or closing the bypass switch as appropriate.

3.3.4 Operation without battery

If the battery is taken out of service for maintenance, it has to be disconnected from the UPS by means of an external switch (e.g. situated in the battery cabinet).
The UPS will continue to operate and meet the performance criteria specified with the exception of the battery backup time.

3.4 Control and diagnostics

Control of the power electronics modules shall be optimised in order to provide:

- optimum three-phase supply of the load
- controlled battery charging
- minimum phase effects upon the supply network.

By using digital signal processors (DSP) Series D shall implement the most advanced digital control.

3.4.1 Vector control

To ensure the quick and flexible processing of measuring data, special arithmetic algorithms shall be implemented in DSP, rapidly generating controlled variables as a result.

This will thus render possible the real-time control of the inverter electronics, resulting in obvious advantages concerning the performance of the power components. These advantages will be:

- Improvement of short circuit behaviour, as individual phases can be more quickly controlled
- Synchronism or phase angle precision between UPS output and bypass supply even in the case of a distorted mains voltage
- High flexibility in parallel operation: parallel blocks may be housed in separate rooms.

Several algorithms included in the Vector Control firmware are covered by patents owned by MASTERGUARD (95 P3875, 95 P3879 and 96 P3198).

3.4.2 Redundancy, preventive monitoring

In order to maximise the reliability of the system, the control unit shall monitor a wide number of operating parameters for the rectifier, inverter and battery. All vital operating parameters, such as temperatures, frequency and voltage stability at the system input and output, load parameters and internal system values shall be constantly monitored and controlled for irregularities at all times. The system shall react automatically before a critical situation arises either for the UPS or the load, in order to ensure the supply of the load even in these difficult conditions.

3.4.3 Telediagnosis and telemonitoring

In all the above modes of operation, the UPS may be monitored and controlled from a remote location such as a service centre, in order to maintain the reliability of the system at nominal levels. Even during complete shutdown of the UPS, information relating to the operating parameters shall not be lost thanks to non volatile RAMs, which will store the information for up to 10 years.

4 General Requirements

4.1 Applied standards

MASTERGUARD operates a Quality Management System which complies with BS EN ISO 9001-2000 for the design, manufacture, sales, installation, maintenance and service of uninterruptible power supply systems. The MASTERGUARD Environmental Policy and Management Systems comply with EN ISO 14 001 and MASTERGUARD is committed to implementing a policy of continuous improvement to production processes and pollution reduction. Series D shall carry the CE mark in accordance with the Safety and EMC Directives 2006/95 (superseding the 73/23 and successive amendments), 89/336, 92/31 and 93/68. Series D is designed and manufactured in accordance with the following international standards:

- IEC/EN62040-1-1 general and safety requirements
- EN50091-2 EMC requirements
- IEC/EN62040-3 operating requirements.
- Classification according to IEC/EN 62040-3: VFI-SS-111

4.2 Safety

In terms of general and safety requirements, the UPS conforms to standard IEC/EN 62040-1-1 governing use in unrestricted access locations.

4.3 EMC and surge suppression

Electromagnetic effects shall be minimised in order to ensure that computer systems and other similar electronic loads shall neither be adversely affected by nor affect the UPS. The UPS shall be designed to meet the requirements of EN 50091-2, class RS. The manufacturer and customer in partnership agree to ensure the essential EMC protection requirements for the specific resulting installation.

4.4 Neutral connection and grounding

The Series D output neutral shall be electrically isolated from the UPS chassis. The input and output neutral connections are the same, i.e. they are solidly tied together.
Therefore the UPS shall not modify the state of the upstream neutral, in any operating mode, and the neutral state of the distribution downstream from the UPS is imposed by the mains one. Series D shall be used in installations with grounded neutral; for further details please contact MASTERGUARD Technical Support.

4.5 Materials

All materials and components comprising the UPS shall be new and of current manufacture.

5 AC/DC IGBT Converter (Rectifier)

5.1 Primary input

The three-phase current taken from the commercial AC source shall be converted to a regulated DC voltage by an IGBT rectifier. In order to protect the power components within the system each phase of the rectifier input shall be individually fitted with a fast-acting fuse. As shown in Figure 1, the IGBT rectifier shall provide DC power to the DC/AC output converter (IGBT inverter) and to the DC/DC battery converter (booster / battery charger) when the latter is working in battery charger mode.

5.2 Total Input Harmonic Distortion (THD) and Power Factor (PF)

The maximum voltage THD (THDV) permitted on the rectifier input (either from the utility or generator) shall be 15% (normal operation is guaranteed up to 8%). The maximum current THD injected into the mains (THDI) shall be less than 3% at maximum input power and input voltage THDV < 1% (nominal input voltage and current). Under these conditions the input power factor (PF) will be > 0.99. Under other input conditions and with other output load fractions the THDI will be < 5%. This means that the Series D in double conversion mode shall be seen by the primary mains sources and distribution as a resistive load (i.e. it will absorb only active power and the current waveform will be practically sinusoidal), thus ensuring total compatibility with any power source. Series D includes all the performances offered by load active filtering devices as standard.

5.3 Operation with diesel generator

In order to obtain the required THD on input voltage, the coordination between diesel generator and UPS shall be based on the generator's sub-transient reactance, as opposed to its short-circuit reactance.

5.4 Soft start

With the UPS logic properly powered, after applying the input voltage the rectifier starts an additional programmable current soft start (1-90 seconds). This procedure results in a gradual and soft walk-in of the current taken from the input voltage supply network. This ensures that any standby generator is gradually introduced into the UPS input, as shown in Figure 2. To avoid the simultaneous start-up of different rectifiers, it is possible to programme a hold-off dedicated start delay (1-180 seconds) for each unit. In addition, the UPS includes an 'on generator' function which, when activated via floating contact, provides the possibility of inhibiting either battery charging, synchronisation of the inverter to the direct line supply or transfer to the direct line.

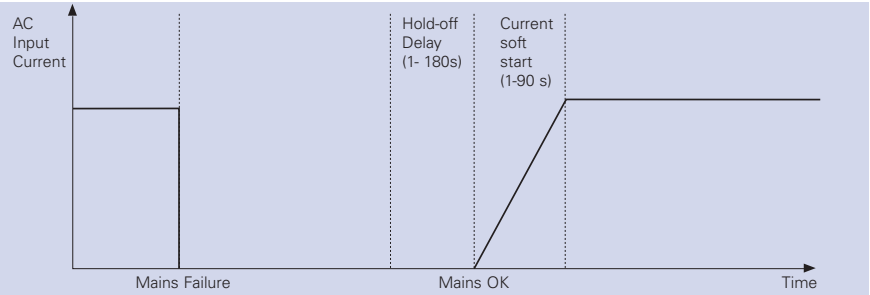


Figure 2. Rectifier soft start

6 DC/DC IGBT Converter (Booster / Battery Charger)

6.1 Booster / Battery Charger

As can be seen in Figure 1, this bidirectional IGBT DC/DC converter shall have the following functions:

- To recharge the batteries taking the power from the DC bus, when the primary input mains is within the given tolerances
- To provide the suitable full DC power, taken from the batteries, to the IGBT output inverter if the primary mains is unavailable.

6.2 Battery charger mode

This converter shall be operable with the following types of batteries:

- Sealed Lead Acid (VRLA)
- Lead Acid
- Ni - Cd

The selection of the optimum charging method shall be completely managed by the microprocessor. Several different charging methods are available.

6.3 Voltage regulation, temperature compensation

In order to ensure optimum battery charging, float voltage shall be automatically adjusted to the ambient temperature. The IGBT rectifier shall be capable of supplying the battery charger with DC voltage at rated power, even if the UPS input AC voltage is below the nominal voltage specified. A further reduction of the input AC voltage (within specified limits) will inhibit the battery charger but will not require the discharging of the batteries. See Figure 3 for details.

6.4 Residual ripple filtering

The battery charger output shall have a residual voltage ripple of <1% RMS.

6.5 Capacity and charging characteristics

When the primary mains is not suitable to supply the rectifier, the DC/DC converter (booster mode) will provide the required power to the inverter using the energy stored in the battery. After the discharge of the battery and when the input AC power is restored, the rectifier will power the inverter and recharge the batteries through the DC/DC converter in battery charger mode. The following charging methods

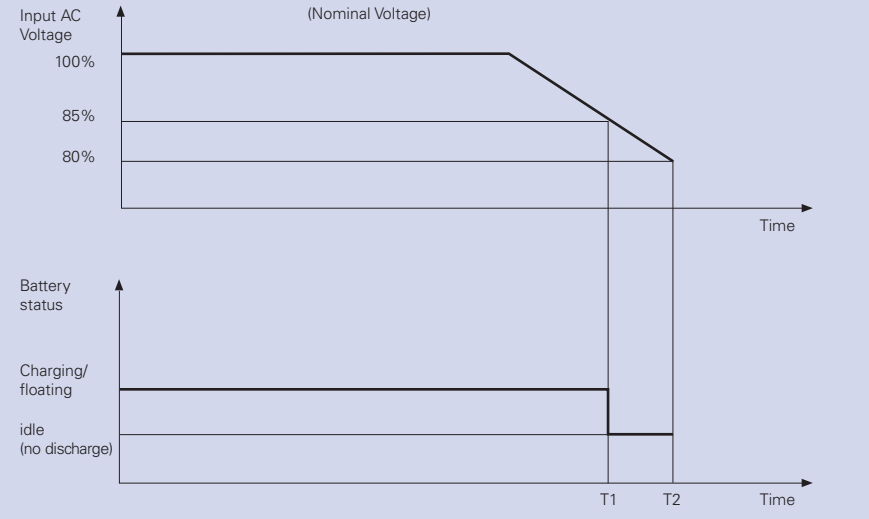


Figure 3. Battery status during reduction of the commercial AC source.

are an example of the several methods available, giving the possibility of matching the different types of accumulators:

6.5.1 Sealed, maintenance-free lead acid accumulators:

Charging is at constant current up to the maximum floating voltage level. Thereafter the voltage shall be kept at a constant level within narrow limits (single-step charging method).

6.5.2 Sealed, low-maintenance lead acid accumulators or NiCd accumulators:

Charging is at increased charging voltage and constant charging current (boost charge phase). When the charging current falls short of a lower threshold value the battery charger shall automatically return to floating voltage level (two-step charging method).

6.6 Overvoltage protection

The battery charger shall automatically switch off if the DC battery voltage exceeds the maximum value associated with its operational status.

6.7 Battery management

Using advanced battery care (ABC) the Series D series shall increase battery life by up to 50%. The main battery care features are described as follows.

6.7.1 Operating parameters

When operating with a maintenance free, valve regulated lead acid battery (VRLA), the parameters per cell shall be as follows:

- End of discharge voltage (V) 1.65
- Shutdown imminent alarm (V) 1.75
- Minimum battery test voltage (V) 1.9
- Nominal voltage (V) 2.0
- Battery discharging alarm (V) 2.20 @ 20°C
- Float voltage (V) 2.27 @ 20°C
- High voltage alarm (V) 2.4

6.7.2 Automatic battery test

The operating condition of the batteries shall be automatically tested by the control unit at selectable intervals, e.g. weekly, fortnightly or monthly. A short-time discharge of the battery will be made to confirm that all the battery blocks and connecting elements are in good working order.
In order to preclude a faulty diagnosis the test will be launched 24 hours after the latest battery discharge at the earliest. The battery test shall be performed without any risk to the load, even if the battery is completely defective. Users shall be alerted to a detected battery fault. The battery test shall not cause any degradation in terms of the battery system life expectancy.

6.7.3 Ambient temperature compensated battery charger

The float voltage shall be automatically adjusted as a function of the temperature in the battery compartment (-0.11% per °C) in order to maximise battery operating life.

6 DC/DC IGBT Converter (Booster / Battery Charger)

6.7.4 Time compensated end of discharge voltage

When the discharge time exceeds one hour, the shutdown voltage shall be automatically increased, as shown in Figure 4 for VRLA, to avoid prolonged battery discharge as a result of a light load.

6.7.5 Remaining battery life

Series D uses sophisticated algorithms to determine the battery life remaining based on real operating conditions such as temperature, discharge and charging cycles, and discharge depth.

6.7.6 Operations with shared battery bank

Although this configuration is not recommended, it is possible to share a common battery bank between a maximum of two UPS connected in parallel (see chapter 14 for details about parallel systems). The automatic battery test (see 6.7.2) will be significant if the total system load (of the 2xUPS in parallel) is equal to or greater than 20% (based on the UPS default battery recharging values). In any case this configuration is not recommended due to the negative impact on the overall system reliability caused by the lack of redundancy of the battery banks.

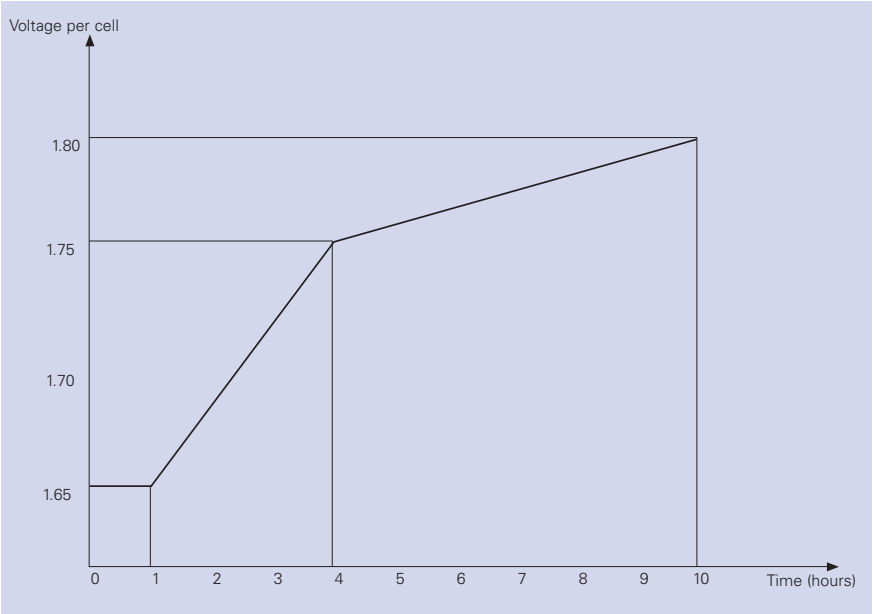


Figure 4. End-of-discharge voltage in relation to discharge time

7 DC/AC IGBT Converter (Inverter)

7.1 AC voltage generation

From the DC voltage of the intermediate circuit the inverter shall generate sinusoidal AC voltage for the user load on the basis of pulse-width modulation (PWM). By means of the digital signal processor (DSP) of the control unit the IGBT of the inverter shall be controlled so that DC voltage is divided up into pulsed voltage packets. Thanks to a low-pass filter the pulse-width modulated signal shall be converted into sinusoidal AC voltage. No isolation transformer is needed for the IGBT inverter, with the great benefits of: energy conversion efficiency, physical size and weight of the modules.

7.2 Voltage regulation

The inverter output voltage on the three phases shall be individually controlled to achieve the following performances:

7.2.1 Steady state

The inverter steady state output voltage shall not deviate by more than ±1% in a steady state condition for input voltage and load variations within the quoted limits.

7.2.2 Voltage transient response

The inverter transient voltage shall not exceed Class 1 limits when subjected to application or removal of 100% load as defined by IEC/EN62040-3.

7.3 Frequency regulation

The inverter output frequency shall be controlled to achieve the following performances:

7.3.1 Steady state

The inverter steady-state output frequency, when synchronised to bypass supply, shall not deviate by more than ±1% adjustable to ±2%, ±3%, ±4%.

7.3.2 Frequency slew rate

The frequency slew rate shall be <1 Hz per second.

7.3.3 Frequency slew rate

The output frequency of the inverter shall be controlled by a quartz oscillator which can be operated as a free running unit or as a slave for synchronised operation with a separate AC source. The accuracy of the frequency control shall be ±0.1% when free-running.

7.4 Total Harmonic Distortion

The inverter shall provide harmonic neutralisation and filtering to limit the THD on the voltage to less than 3% with a linear load. For reference non-linear load (as defined by IEC/EN62040-3) the THD shall be limited to less than 5%.

7.5 Neutral sizing

The sizing of the inverter neutral shall be oversized on all ratings in order to cope with the combination of harmonics on the neutral wire when driving single-phase reference non-linear loads. The inverter neutral is sized x 1.7 in relation to the phase.

7.6 Overload

The inverter shall be capable of supplying an overload of 125% for 10 minutes and 150% for one minute of the nominal power.

7.7 Inverter shutdown

In the event of an internal failure the inverter shall be immediately shut down by the control unit. The UPS device or the parallel-operated UPS systems shall continue to supply the load from the bypass supply without interruption, if it is within permissible limits.

7 DC/AC IGBT Converter (Inverter)

7.8 Output voltage symmetry

The inverter shall guarantee the symmetry of the output voltages at ±1% for balanced loads and ±3% for 100% unbalanced loads.

7.9 Phase displacement

The phase angle displacement between the three-phase voltages shall be:

- 120° ± 1° for balanced loads
- 120° ± 3° for unbalanced loads (0, 0, 100%)

7.10 Short circuit

The inverter short circuit capacity of Series D for the first 10ms shall be >200% for any short circuit configuration. After the first 10ms, it shall limit the current to >150% for not more than 5s, then it shall shut down.

7.11 Automatic upgrade of inverter rated power

The inverter shall automatically upgrade its power as a function of ambient and operating temperatures, as shown in Figure 5. In the most common conditions (25°C) Series D shall provide 10% more power than nominal. In these conditions the battery charge will be reduced correspondingly.

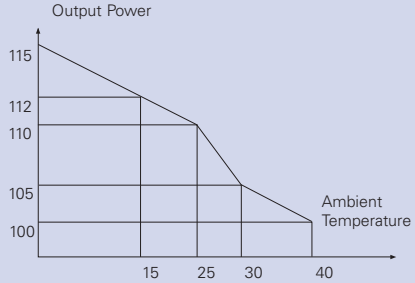


Figure 5. Automatic power upgrade

8 Electronic Static Switch (Bypass)

8.1 General

The bypass static switch shall be a fully rated, high speed, solid-state transfer device and rated for continuous duty operation.

The following transfer and retransfer operations shall be provided by the electronic static switch:

- Uninterrupted automatic transfer to the bypass supply in the event of:
  - inverter output overload
  - battery voltage outside limits in backup mode
  - over-temperature
  - inverter failure
- If inverter and bypass supply are not synchronised at the time of a necessary transfer, a switching delay can be set to protect the critical load. This prevents possible damage to the load by unintentional phase shift. A delay of 20ms will be preset as a standard value.
- Uninterrupted manual transfer/ retransfer to and from the bypass supply shall be initiated from the control panel.
- Uninterrupted automatic transfer/ retransfer to and from the bypass supply by activation of the digital interactive mode
- Uninterrupted automatic retransfer from the bypass supply, as soon as the inverter regains the capacity to supply the load
- The uninterrupted transfer from the inverter to the bypass supply shall be inhibited in the following situations:
  - bypass supply voltage outside limits
  - failure of electronic bypass switch
- The uninterrupted automatic retransfer may be inhibited in the following situations:
  - manual switching to bypass supply via the maintenance switch
  - UPS output overload.

8.1.1 Voltage

The nominal voltage of the bypass line shall be 230/400 VRMS. Any transfer from inverter to bypass line will be inhibited if the voltage is beyond a limit of ±10% (standard setting) of the nominal voltage.

8.1.2 Transfer time (double conversion)

The switching time for a transfer from the inverter to the bypass supply or vice versa shall be less than 0.5ms when synchronised. The system shall ensure that the inverter is stable and operating normally before permitting a retransfer of the load back to inverter. The transfer time when out of synchronisation shall be 20 milliseconds to prevent damage to the load by phase reversal.

8.1.3 Overload

The bypass static switch shall be capable of supporting the following overloads:

125%	for	10 minutes
150%	for	1 minute
700%	for	600 milliseconds
1000%	for	100 milliseconds

8.1.4 Manual maintenance bypass

It shall be possible to implement a manual uninterrupted bypass of the complete system in order to enable maintenance work to be carried out on the system. The bypass supply will continue to feed the load. In this case the UPS will be voltage-free as it will be disconnected from the supply networks. In this case, maintenance work on the UPS can be carried out without affecting the connected electric load.

8.2 Backfeed protection

This feature shall prevent any potential risk from electric shock on the UPS bypass input AC terminals in the event of failure of the bypass static switch SCR. The control circuit shall include a contact (available for the user) which activates an external isolating device, such as an electromechanical relay or a tripping coil, upon backfeed detection. The external isolating device is not included in the UPS, in compliance with IEC/EN 62040-1. The external isolating device shall be a 4 pole (3 phases plus neutral) air gap isolator, and shall be defined according to clause 5.1.4 of the previously cited standard.

9 Monitoring and Control, Interfaces

9.1 General

The UPS shall incorporate the necessary controls, instruments and indicators to allow the operator to monitor the system status and performance, and take action where appropriate. Furthermore, interfaces allowing extended monitoring and control, in addition to service functions, shall be available.

9.2 Mimic panel

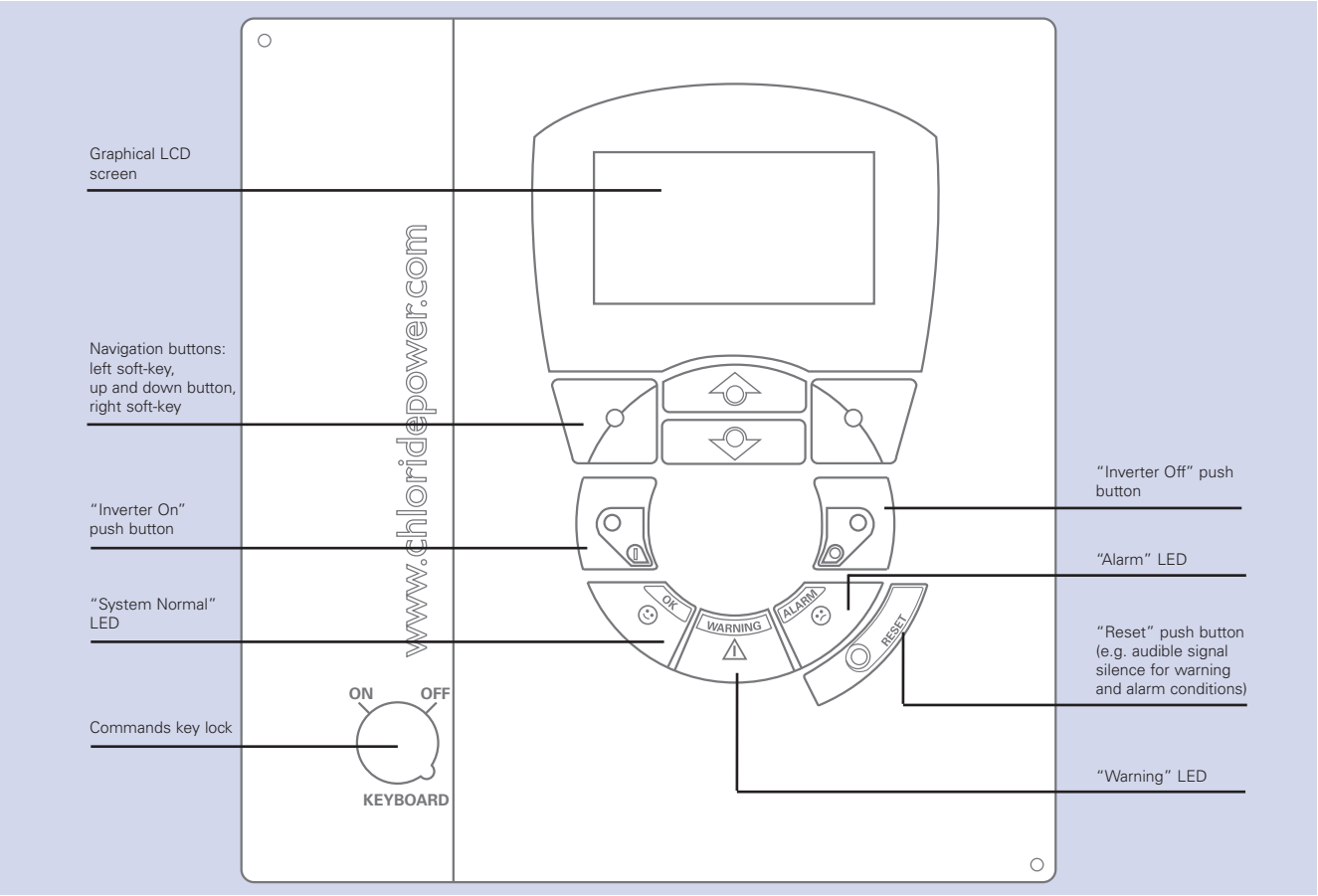
The control panel of Series D includes a back-lit Liquid Crystal Display (LCD of eight lines x 12 characters, displaying graphic diagrams and symbols) for complete UPS monitoring and control. Complete access to all LCD menus is possible through navigation push buttons located below the screen.

This navigation group includes two buttons - "up" and "down" - for menu scrolling and two software-assigned push buttons: the function linked to these two buttons is displayed on the lower right and lower left corners of the LCD during navigation.

A single-line diagram of the UPS is continuously displayed on the default page (for reference see figure 1). The main functional blocks and power paths of the UPS are displayed using simple universal technical symbols, instantly communicating the overall status of the UPS. The same screen also permanently displays the output load percentage measurement, using three histograms (one for each output phase). In the case of the UPS not in normal functioning mode, it is possible to access the "Warning and Alarm" summary page directly from the default page. Warnings and alarms shall be identified by text strings and codes. In battery operation, the display shall switch between warning code and estimated backup time in minutes.

After 30 seconds of inactivity (i.e. without buttons being pressed) the display reverts to the default page.

The text displayed by the LCD shall be available in English, Italian, French, German, Spanish, Portuguese, and Turkish, selectable by the user.



9.3 Start and Stop inverter push buttons

The Start and Stop push buttons are integrated into the mimic panel board, and have the following predefined functions:

	Start inverter operation
	Stop inverter operation

The control shall incorporate a safety feature to prevent inadvertent operation yet still allow for rapid shutdown in the event of an emergency. To stop the inverter the user must press and hold the Stop button for two seconds. An audio alarm shall be activated during this delay time.

9 Monitoring and Control, Interfaces

9.4 Keyboard lock

The mimic panel shall be equipped with a front panel key that allows users, once the lock is set in the Off position, to disable any command which may be entered through the mimic panel. In this state, if the operator attempts to perform any of the following actions, a message reading "COMMANDS DISABLED" will be appear on the LCD:

Start Inverter	Stop Inverter	Reset Fault
Set/reset Battery Test	Set/reset Autonomy Test	Set/reset Boost Charge
Set/reset Service Input	Set/reset I/O Configuration	LIFE Manual Call
Reset Delay Call		

9.5 General Status LED

Three LED indicators shall render it possible to obtain a quick and general understanding of the status of the UPS, as described below:

OK LED (green)	**Normal Operation** When this light is on (not flashing), the system is running normally and neither warnings nor alarms are present. During mains failures (all other conditions being at nominal level), this LED will flash.
Warning LED (yellow)	**Warning Condition(s) present** This indication shall be activated by the presence of anomalous conditions, which could affect the nominal functioning of the UPS. These conditions are not originated with the UPS, but may be caused either by the surrounding environment or by the electrical installation (mains side and load side). It shall be possible to read the description of the active warning(s) by browsing the relevant LCD display menus.
Alarm LED (red)	**Alarm Condition** When this light is on, immediate attention should be given to the severity of the alarm, and service should be called promptly. It shall be possible to read the description of the active alarm(s) by browsing the relevant LCD display menus.

9.6 LCD display menus description

By using the appropriate push buttons it shall be possible to browse the following menus:

IGBT Rectifier and Booster/Battery Charger converter
This menu shall display rectifier status, booster/charger status, alarms, voltage, total DC current, battery current with polarity and battery temperature. When the output inverter is supplied by the battery, the module shall display remaining autonomy time. A change in load shall cause the autonomy indicator to display the new autonomy time.

IGBT Inverter
This menu shall display alarms, phase to neutral voltages, frequency measurements, inverter heatsink temperature and cooling air temperature.

Bypass Supply
This menu shall display alarms, phase to neutral voltages and frequency measurements.

Load/Bypass Static Switch
This menu shall display alarms, current per phase, frequency measurements, load percentage capacity per phase and the peak factor Ipk/Irms for each phase of the load current. It shall be possible to display the total time the load has been supplied by the inverter, and by bypass, the number of mains failures and the total duration of these failures.

For a complete list of the messages and menu descriptions, please refer to the Series D User Manual.

9 Monitoring and Control, Interfaces

9.7 Interface

9.7.1 Slot card bay

Series D shall be equipped with two slot bays, available for communication card options. One of the slots shall be equipped with the LIFE.net slot modem, fitted as standard (user removable).
The other slot shall be available for connectivity options. Please refer to MASTERGUARD Connectivity Solutions for further details about the available slot expansion cards. If no cards are fitted into the slots, the DB9 ports described in sections 9.7.3 and 9.7.4 can be used for other connectivity applications.

9.7.2 Computer relay interface (X7)

Volt-free contacts shall be incorporated conforming to the requirements of IBM AS/400 and other computer types. This interface shall be via a 9-pin D socket wired as follows:

Pin	Signal	Explanation
1	BYPASS ACTIVE (NC)	Bypass mode: contact between pin 1 and pin 5 is closed
2	LOW BATTERY (NC)	Just before end of discharge (in battery mode): contact between pin 2 and pin 5 is closed
3	SUMMARY ALARM (NC)	UPS alarm, contact between pin 3 and pin 5 is closed
4	AC FAIL (NC)	Mains failure: contact between pin 4 and pin 5 is closed
5	COMMON	Common connection for all floating contacts
6	BYPASS ACTIVE (NO)	Bypass mode: contact between pin 6 and pin 5 is open
7	LOW BATTERY (NO)	Just before end of discharge (in battery mode): contact between pin 7 and pin 5 is open
8	SUMMARY ALARM (NO)	UPS fault, contact between pin 8 and pin 5 is open
9	AC FAIL (NO)	Mains failure: contact between pin 9 and pin 5 is open

The voltage-free contacts shall be rated at 24V, 1A.

9.7.3 RS232C Service port (X3)

Series D shall be equipped with one D type connector with 9 pins for serial RS232C communication. The connector has the following pin functions:

Pin	Signal	Explanation
1	EARTH	Shield
2	TxD	Send RS232
3	RxD	Receive RS232
4	Not used	
5	RS232 GND	Signal ground for receive and send
6	Not used	
7	RTS	Clear to send RS232
8	Not used	
9	Not used	

This RS232 port cannot be used simultaneously with the corresponding slot bay as described in section 9.7.1.

9.7.4 LIFE.net (X6)

Series D shall be fitted with a slot modem for LIFE.net connection as standard. If this slot modem is removed, this port may be used for other connectivity applications.

Pin	Signal	Explanation
1	SHIELD	Cable shield
2	SST2_TRS232	Send RS232 (Tx)
3	SST2_RRS232	Receive RS232 (Rx)
4	Not used	
5	Not used	
6	Not used	
7	M_BT	Signal ground
8	Not used	
9	Not used	

This RS232 port cannot be used simultaneously with the corresponding slot bay as described in section 9.7.1.

9 Monitoring and Control, Interfaces

9.8 Available signalisations and control signals

The UPS handles 6 Input/Output digital control signals (4 inputs, 2 outputs) that can be programmed via the display and/or PPVIS (service software tool) for a wide set of functions. The inputs are opto-isolated and can be driven by external dry-contacts (e.g. relay contacts); the outputs are relay contacts rated 1A, 230V AC/DC. Emergency Power Off (EPO) is programmed as standard: this command electronically shuts down the rectifier, the inverter and the bypass switch. The backfeed protection control (see paragraph 8.2) command is associated with a dedicated contact output terminal (refer to the User Manual for further details).

Listed below are the most significant functions; the exhaustive list is published in the User Manual:

Fan (On-Off) In Battery Compartment	Battery Fuse Monitor
Battery Compartment Overheated	Generator On
Hydrogen Present	Remote Inverter Stop
SBS Bypass Switch Closed	Air conditioning failure
SBS Output Switch Open	

9.9 LIFE.net

In order to increase the overall reliability of the system, Series D will be delivered with the LIFE.net communication kit, providing connection to MASTERGUARD's LIFE.net diagnostic service.
LIFE.net shall allow the remote diagnosis of the UPS through telephone lines or GSM link in order to ensure maximum reliability of the UPS throughout its operational life. The monitoring shall be a real 24-hour, 365 day service thanks to a unique feature that allows trained Service Engineers to remain in constant electronic contact with the service centre, and therefore the UPS. The UPS shall automatically dial up the service centre at defined intervals to provide detailed information that shall be analysed in order to predict near term problems. In addition, it shall be possible to control the UPS remotely.
The communication of UPS data to the MASTERGUARD LIFE Command Centre shall take be transmitted via the integrated modem at the following intervals:

- ROUTINE: settable at intervals of between five minutes and two days (typically once a day)
- EMERGENCY: when a problem occurs or parameters are beyond tolerance limits
- MANUAL: following a request from the command centre

During the call the command centre shall:

- Identify the UPS connected
- Request the data stored in the UPS memory since the last connection
- Request real-time information from the UPS (selectable)

The service centre shall analyse historical data and issue a regular detailed report to the customer informing him of the UPS operational condition and any critical states.
The LIFE.net centre allows the possibility of activating the LIFE-SMS delivery system option, where the customer may receive SMS notification which will be activated in the event of one of the following:

- Mains power failure
- Mains power recovery
- Bypass line failure
- Load supplied by reserve.

10 Mechanical Data

10.1 Enclosure

The UPS shall be housed in a space-saving modular enclosure with front doors and removable panels (protection as standard to IP 20). The enclosure shall be made of zintec coated sheet steel. The doors shall be lockable.

10.2 Ventilation

Forced redundant air cooling will ensure that all the components are operated within their specification. Airflow shall be controlled according to load demand. The UPS shall also be capable of preserving normal operations even with one cooling fan stopped (due to a failure) with 70% of the output nominal load @ 25°C ambient temperature.

If these conditions are not met (with one fan failed), the UPS shall supply the load through the static bypass if an overheating of the converters occurs. The failed fan condition will be immediately notified by the UPS through all the user interfaces and through the LIFE.net service. The cooling air entry shall be in the base and the air exit at the top of the device. The enclosure shall be installed with at least 500 mm of free space between the device and roof of the enclosure in order to allow cooling air to exit unhindered.

10.3 Cable entry

Cable entry shall be from the bottom or bottom-side of the cabinet. Top cable entry shall be available as an option.

10.4 Enclosure design

All surfaces of the enclosure shall be finished with an electrostatically applied epoxy coat. The coating shall have a thickness of at least 60 microns. Standard colour of the enclosure shall be RAL 7035 (light grey).

10.5 Access to integrated subassemblies

All internal subassemblies shall be accessible for typical and most frequent maintenance from the front of the unit via hinged doors. Rear access shall not be required for installation or servicing. The UPS shall be forkliftable from the side after the removal of the bottom trim panels.

11 Environmental Conditions

The UPS shall be capable of withstanding any combination of the environmental conditions listed below. It shall operate without mechanical or electrical damage or degradation of operating characteristics.

11.1 Ambient temperature

0° to 40°C
Maximum average daily temperature (24 hr) 35°C
Maximum temperature (8 hr) 40°C

11.2 Relative humidity

Up to 90% (non condensing) for temperature of 20°C.

11.3 Altitude

The maximum altitude without derating shall be 1000 metres above sea level (for higher altitudes Series D complies with IEC/EN 62040-3).

12 Technical Data (60 to 200 kVA)

UPS Unit		60	80	100	120	160	200
12.1 Primary input							
Nominal voltage[1]	(V)	400 (3Ph + N[1])					
Voltage range	(V)	340 to 460					
Minimum voltage without battery discharge	(V)	320					
Nominal frequency	(Hz)	50 (60 selectable)					
Frequency range	(Hz)	±6%					
Maximum input current @ ambient temperature within the range 0°C to 40°C	(A)	94	125	156	185	250	312
Power factor @ nominal load & nominal input conditions[2]		≥0.99					
Input current distortion @ nominal input conditions[2] & nominal output power[3]	(%)	<3					
Input current distortion[3] [11]	(%)	≤5					
Walk in/Soft start	(seconds)	10 (1 to 90 selectable)					
Rectifier Hold-Off	(seconds)	1 (1 to 180 selectable)					
Inrush current / Imax input[4]		≤1					
Rectifier efficiency without charging current @ nominal input conditions[2] with resistive load: Half load[7]	(%)	≥94.9	≥96.2	≥95.9	≥96.2	≥96.1	≥95.9
Full load[7]	(%)	≥96.5	≥97	≥97	≥97	≥97	≥97
12.2 Battery							
Permissible battery voltage range	(V)	396 to 700					
Recommended no. of cells: - VRLA[5]		240					
- WET		240					
- NiCd		375					
Float voltage for VRLA @ 20°C[6]	(V/cell)	2.27					
End cell voltage for VRLA	(V/cell)	1.65					
Float voltage temperature compensation		-0.11% per °C					
DC ripple current in float mode for a 10 min autonomy as per VDE0510[5]		$<0.05C_{10}$					
Float Voltage stability in steady state condition	(%)	≤1					
DC ripple voltage without battery	(%)	≤1					
Optimum battery temperature	(°C)	15 to 25					
Battery recharge current setting range for 240 cells @ 400V input voltage & nominal load	(A)	0-23	0-31	0-39	0-44	0-62	0-77
Battery recharge current setting range for 240 cells @ 340V input voltage & nominal load	(A)	0-6	0-8.5	0-10.5	0-10.5	0-17	0-21
Battery output power in discharge mode with nominal output load	(kW)	50.2	67	83.7	100.5	134	167,5
End battery voltage for 240 cells	(V)	396					
End battery current for 240 cells with nominal load	(A)	127	169	211	254	338	423

12 Technical Data (60 to 200 kVA)

UPS Unit			60	80	100	120	160	200
12.3 inverter output								
Nominal apparent power @40°C ambient		(kVA)	60	80	100	120	160	200
Nominal active power		(kW)	48	64	80	96	128	160
Nominal output current		(A)	87	116	145	174	232	290
Maximum active power up to 100% of nominal apparent power			Conditions apply[10]					
Overload at nominal output voltage for 10 minutes		(%)	125					
Overload at nominal output voltage for 1 minute		(%)	150					
Short circuit current for 10ms/<5s		(%)	200/150					
Nominal output voltage		(V)	400 (380/415 selectable, 3Ph+N)					
Nominal output frequency		(Hz)	50 (60 selectable)					
Voltage stability in steady state condition for input (AC & DC) variations and step load (0 to 100%)		(%)	±1					
Voltage stability in dynamic condition for input variation (AC & DC) and step load (0 to 100% and vice versa)		(%)	Complies with IEC/EN 62040-3, Class 1					
Voltage stability in steady state for 100% load imbalance (0, 0, 100)		(%)	±3					
Output frequency stability:	- synchronized with bypass mains	(%)	±1 (2, 3, 4 selectable)					
	- synchronized with internal clock	(%)	±0.1					
Frequency slew rate		(Hz/sec)	<1					
Output voltage distortion with 100% linear load		(%)	<3					
Output voltage distortion @ reference non linear load as for IEC/EN 62040-3		(%)	<5					
Load crest factor handled without derating the UPS		(Ipk/Irms)	3:1					
Phase angle precision with balanced loads		(degrees)	1					
Phase angle precision with 100% unbalanced loads		(degrees)	<3					
Inverter efficiency @ nominal input conditions[2] with resistive load:	Half load[7]	(%)	≥94.9	≥96.2	≥95.9	≥96.2	≥96.1	≥95.9
	Full load[7]	(%)	≥96.5	≥97	≥97	≥97	≥97	≥97
Neutral conductor sizing			1.7 nominal current					
Output power upgrading with ambient temperature:	At 25°C	(%)	110					
	At 30°C	(%)	105					
	At 40°C	(%)	100					

12 Technical Data (60 to 200 kVA)

UPS Unit			**60**	**80**	**100**	**120**	**160**	**200**
12.4 Static bypass								
Nominal bypass voltage[1]		(V)	400 (380/415 selectable, 3ph+N)					
Nominal frequency		(Hz)	50/60 (selectable)					
Frequency range		(%)	±1 (2, 3, 4 selectable)					
Voltage range		(%)	±10					
Maximum overload capacity:	For 10 minutes	(%)	125					
	For 1 minute	(%)	150					
	For 600 milliseconds	(%)	700					
	For 100 milliseconds	(%)	1000					
SCR	I^2t @ T_{vj}=125°C; 8.3-10ms	(A^2s)	80000		125000		320000	
	I_{TSM} @ T_{vj}=125°C; 10ms	(A)	4000		5000		8000	
Transfer time with inverter synchronous to bypass: Inverter to Bypass and Bypass to Inverter			no break					
Transfer time with inverter not synchronous to Bypass		(ms)	<20					
12.5 System data								
Maximum input current with ambient temperature range 0°C to 40°C		(A)	94	125	156	185	250	312
AC/AC efficiency without charging current @ nominal input conditions[2] with resistive load:								
	25% load[7]	(%)	82.8	86.0	87.0	88.0	88.0	87.0
	50% load[7]	(%)	90.0	92.5	92.0	92.5	92.3	92.0
	75% load[7]	(%)	92.7	93.0	93.4	93.8	93.4	93.0
	100% load[7]	(%)	93.0	94.0	94.0	94.0	94.0	94.0
	Digital interactive[7]	(%)	98	98	98	98	98	98
Heat dissipation								
	Float mode	(kW)	3.6	4.1	5	6	8	10
	Recharge mode	(kW)	3.6	4.8	6	7.2	9.6	12
	Digital interactive mode	(kW)	1	1.3	1.6	1.9	2.6	3.2
Noise @ 1 metre as per ISO 3746		(dBA ± 2dBA)	65		68		70	
Protection degree with open doors			IP20					
Mechanical dimensions:	Height	(mm)	1780					
	Width	(mm)	580		845		1120	1245
	Depth[9]	(mm)	858					
No. of cabinets			1					
Frame colour		(RAL scale)	7035					
Weight		(kg)	290		390		500	600
Floor area		(m^2)	0.47		0.70		0.96	1.07
Floor loading		(kg/m^2)	617		557		520	560

12 Technical Data (60 to 200 kVA)

UPS Unit			**60**	**80**	**100**	**120**	**160**	**200**
Cable entry			Bottom/Side					
Access			Front					
Cooling[8]			Forced Ventilation with redundancy					
12.6 Environmental								
Temperature:	Operating	(°C)	0-40					
	Max Average daily (24hrs)	(°C)	35					
	Maximum (8hrs)	(°C)	40					
Maximum relative humidity @ 20°C (non condensing)		(%)	up to 90					
Max altitude above sea level without derating		(m)	1000 (for higher altitudes complies with IEC/EN 62040-3)					

(1) In case of a split input configuration, the primary input and the bypass input must have a common neutral. The neutral conductor could be connected only to the bypass or primary mains but it must be present (bypass and primary neutrals are solidly connected within the UPS).
(2) At nominal voltage and nominal frequency.
(3) With input voltage at nominal value and with voltage distortion THDv $\leq$ 1%.
(4) "Imax input" parameter can be calculated using the maximum input power @ 400V in battery recharge mode.
(5) Permitted number of cells = 240 – 300. Special battery cabinets needed for more than 240 cells.
(6) There are several possible charging methods. See chapter 6 for details.
(7) For tolerances see IEC/EN 60146-1-1 or DIN VDE 0558.
(8) Redundant cooling system. With one fan OFF the UPS can supply continuously 70% of the nominal output power in typical conditions.
(9) including front handle; without handle 830m
(10) Nominal apparent power loads with PF > 0.8 can be supplied with marginal limitations to other performances. Please contact MASTERGUARD Technical Support for further details.
(11) Output load > 25% of nominal output power.

General conditions for the Technical Data table:
The data shown are typical and not definable in other ways; furthermore the data refer to 25°C ambient temperature and PF= 1 where not specified.

Not all the data shown apply simultaneously and may be changed without prior warning.
Data apply to the standard version, if not otherwise specified.
If the options described in chapter 13 are added, the data shown in the Technical Data Table may vary.
For test conditions and measurement tolerances not specified refer to the Witness Test Report procedure.

13 Options

Where options described in this chapter are added to the UPS, the data presented in the standard technical data tables may vary. Some options may not be available contemporarily on the same UPS.

13.1 Parallel configurations

See chapter 14.

13.2 Remote alarm unit

A remote alarm panel shall be available to display important individual messages from the UPS. Upon request, it shall be possible to display up to four UPS systems. The length of the connecting cable must not exceed 300m.

13.3 External battery circuit breaker

This option shall include a fully rated circuit breaker and an additional auxiliary contact for monitoring its position by the UPS (via a dedicated input contact). The circuit breaker shall be housed in a wall-mounted box and designed for battery systems which are mounted on racks. Furthermore, the circuit breaker shall serve as a safety element for the cross section of the power cable between the UPS and the remotely placed battery system.

13.4 Battery management modules (only upon request)

With measuring modules connected to the battery blocks, enhanced battery management shall be possible offering the following features:

- Measurement of the condition of each individual battery block by means of separate battery measuring modules (BMM)
- Analysis of each battery block with measurement of the minimum and maximum voltage values.

13.5 Top cable entry

This option shall allow power cable entry from the top of the UPS.

13.6 Dust filters

This option shall improve the protection degree of the air entrance from IP20 to IP40 for specific applications such as a dusty environment. The filter shall be housed in the UPS cubicle (IP20).

13.7 Empty battery cubicle

Matching empty battery cubicles shall be available including:

- Cubicle
- Disconnecting device
- Fuses
- Safety screen
- Connection terminals
- UPS/battery connection cables (available on request)

Two cubicle sizes shall be available:

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
Type A	820	858*	1780	220
Type B	1020	858*	1780	250

*including front handle; without handle 830 mm

13.8 Empty options cubicle

A matching cubicle shall be available for customised applications such as:

- Isolation transformers
- Input/Output voltage matching transformers
- Customised distribution boards
- Customised applications.

Two cubicle sizes shall be available:

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
Type A	820	858*	1780	180
Type B	1020	858*	1780	200

*including front handle; without handle 830 mm

13.9 Use as frequency converter

Series D may be programmed for use as a frequency converter (50Hz in -60Hz out or 60Hz in -50Hz out) for operations with or without a battery bank connected.
In this operational mode, the data shown in the Technical Data table may vary (e.g. output overload capability). Please contact MASTERGUARD Technical Support for details.

13.10 Telephone switch for LIFE.net

The installation of the telephone switch for LIFE.net shall allow the user to use a telephone line normally reserved for other purposes (e.g. fax or telephone).

13.11 MopUPS shutdown and monitoring software

The main function of MopUPS software shall be the safe shutdown of the operating system in the event of a power failure. Other functions include:

1. Automatic communications for events; e-mail, SMS, etc.
2. Saving to file of event log and status information
3. Viewing and monitoring of UPS in real time
4. Programmed system shutdown
5. Remote monitoring of UPS connected to network server using Named Pipes or TCP/IP

13.12 ManageUPS adapter

This option shall include a complete package (including slot card adapter) to ensure monitoring and control of the networked UPS through TCP/IP protocol. The adapter permits:

- UPS monitoring from NMS via SNMP
- UPS monitoring from PC via a Web browser
- Dispatch of e-mail messages on occurrence of events

ManageUPS, in conjunction with MopUPS, shall also permit safe shutdown of the operating systems.

13.13 J-Bus protocol

An optional kit shall ensure the compatibility of Series D with the J-Bus protocol on RS485 port.

13.14 Profi bus protocol

By installing a Profibus-DP connection Series D shall be linked up to higher level automatic systems.
The Profibus - DP bus system enables very fast cyclical data exchange between higher-level systems such as Simatic S5, S7, Symadyn D, PC/PG and field units.

The following information shall be transmitted by Series D:

- Status of the unit
- Alarm information, information on faults
- Voltage levels at UPS output
- Control information

14 Parallel Configuration

14.1 Paralleling principle

The Series D series of uninterruptible power supply systems shall be connectable in parallel for multi-module configurations between units of the same rating. The maximum number of UPS in parallel configuration shall be eight. The parallel connection of UPS shall increase reliability and power.

Reliability.
If the installation requires more than one unit in redundant configuration the power of each UPS should not be lower than $P_{tot}/(N-1)$ where:

P_{tot} = Total load power
N = Number of UPS units in parallel
1 = Minimum coefficient of redundancy

Under normal operating conditions, the power delivered to the load shall be shared between the number of UPS units connected to the parallel bus. In case of overload the configuration may deliver $P_{ov}xN$ without transferring the load onto the reserve, where:

P_{ov} = Max overload power of a single UPS
N = Number of UPS units in parallel

In the event of failure by one of the UPS units, the faulty unit shall be disconnected from the parallel bus and the load shall be supplied from the remaining units without any break in supply continuity.

Power.
It shall be possible to increase the power of the system using a non-redundant parallel configuration (redundancy coefficient = 0). In this case all connected UPS units shall deliver the rated power and, in the event of a unit failure or overload, the system shall transfer the load to reserve. A maximum of eight UPS may be connected in parallel.

Performance features.
The performance features of the parallel system are related to the UPS systems employed. The distribution of the load is divided equally between the individual UPS systems.

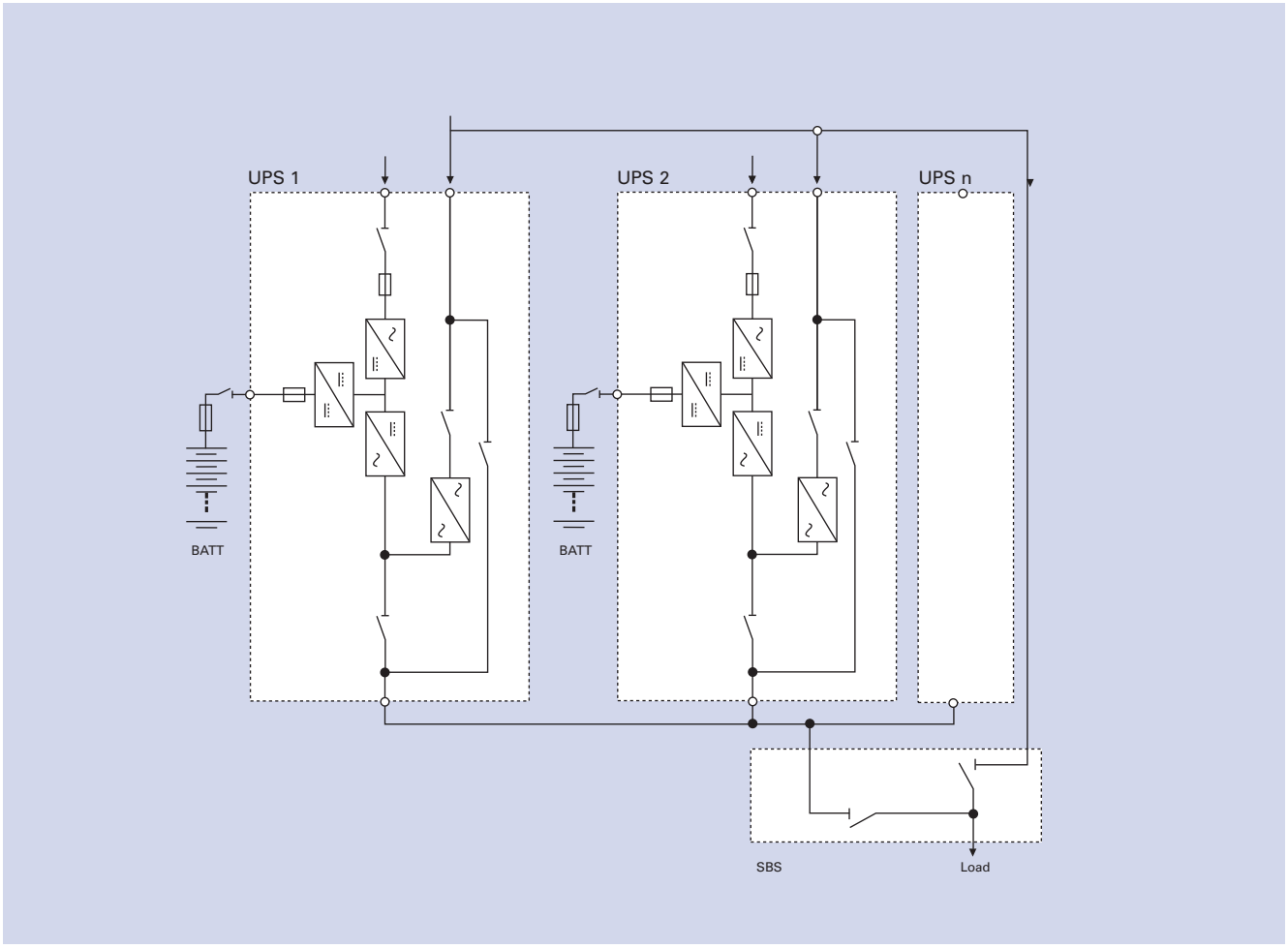


Figure 6. Modular parallel systems

14 Parallel Configuration

14.2 Modular

The UPS systems of the Series D series shall be capable of operating in parallel modular configuration. For this purpose UPS systems of the same rating shall be connected in parallel to form multi-module configurations.
The parallel connection of UPS shall either improve reliability, the total output power, or both. Provided that Series D is purchased with the parallel kit option, up to eight equal UPS units can be operated in parallel for power upgrade or increase of redundancy. This option can also be added on at a later date. The option shall consist of one subassembly POB (Parallel Operation Board) and screened data cables to the neighbouring UPS modules (closed loop ring bus).

A multi-module system shall be controlled and monitored automatically by controlling the individual UPS systems. The parallel system control is distributed among the units (no master/slave architecture).
The bypass lines and inverters included in each UPS share the load. The load sharing among the UPS parallel system ("load on inverter" mode) shall be achieved with a tolerance of less than 5% at any system load fraction (0 - 100%). The loop ring bus shall allow the parallel to share the system load also with an interruption in the data cable (first failure proof system).

14.3 System Bypass Switches (SBS)

A system bypass switch shall be available as an option for the modular parallel configuration. For parallel systems including more than two UPS, a system bypass switch must be provided within the installation, including two power disconnect switches.

The ratings available shall be:

	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
400 A	1780	620	858*	300
800 A	1780	620	858*	400
1600 A	1780	1020	858*	500
2500 A	1780	1020	858*	600

*including front handle; without handle 830 mm

Appendix: Planning and Installation

Installation site

Pay attention to the following conditions when selecting an installation site:

- This UPS must only be installed in closed operating areas. If the area contains, or if there is present in the area, any equipment containing in excess of 25 litres of inflammable fluids, refer to HD 384.4.42 S1 A2, chapter 42 (corresponds to DIN VDE 0100, Part 420), it must be ensured that burning fluids or their combustion products cannot spread through the building.
- The ambient temperature should be between 0°C and +40°C for UPS devices. For continuous operation at temperatures up to a maximum of +50°C, reduce the max. load by 12 % of the nominal load per 5°C.
- The ambient temperature should be between +15°C and +25°C for battery cabinets.
- Be sure to provide sufficient cooling of the installation room so that the ambient temperature remains within the stated limits. The heat emission ratings of the UPS are given in the Technical Data Tables. Be sure also to provide sufficient ventilation for the type of batteries used in the UPS.
- When operating the 80-NET UPS at altitudes above 1000m a.s.l., the load must be reduced accordingly (see User Handbook). If the ambient temperature remains less than +30°C, no load reduction is necessary for altitudes up to 2000 m.
- Ensure that the load carrying capacity of the floor is sufficient for the UPS and batteries. The floor must be even and level

Avoid harmful agents such as:

- vibration, dust, corrosive atmospheres and high humidity

Allow the following min. distances:

- 50 cm between the top of the cabinet and the roof
- no wall-distance is required, unless the cables are routed from above, in which case the wall-distance must be at least equal to the bending radius of the cables in use. The distance between covering parts and floor is 150 mm.
- no limits on either side of device

Dimensions with packaging

Rating (kVA)	Width (mm)	Depth (mm)	Height (mm)*
60/80	810	1010	2000
100/120	1010		
160	1610		
200			

* Includes pallet.

- Use a suitable lifting truck to transport UPS and battery cabinets to the storage or installation site on the pallet in the original packaging. The equipment must be kept upright at all times and handled with care, damage may be caused if dropped or subjected to severe impact. When moving the equipment with a forklift, secure it against tilting.

Max. spacing for fork-lift bars (side)

	UPS (kVA)	
	60/80	**100/120**
max. (mm)	500	775
	160	**200**
max. (mm)	1050	1175

Installation data

Refer to the User Handbook and the Technical Data tables.

External dimensions - UPS

Rating (kVA)	Width (mm)	Depth (mm)[1]	+ Front panel [2] (mm)	Height (mm)
60/80	570	858	1400	1780
100/120	845		1675	
160	1120		1400	
200	1245		1490	

1 Including handle and front panel - without handle: 830 mm

2 Space required to open front panel; Front panel opens through 180°

Weight

- 60/80 kVA = 290 kg
- 100/120 kVA = 390 kg
- 160 kVA = 500 kg
- 200 kVA = 600 kg

Figure 1 - Footprint 60/80kVA

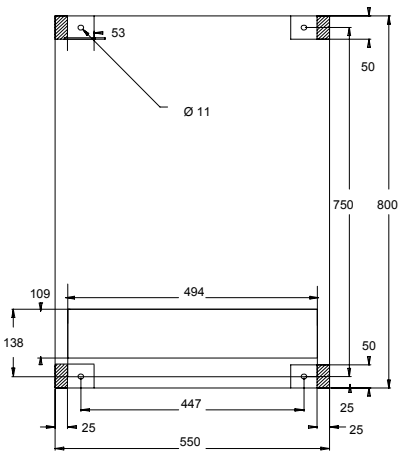
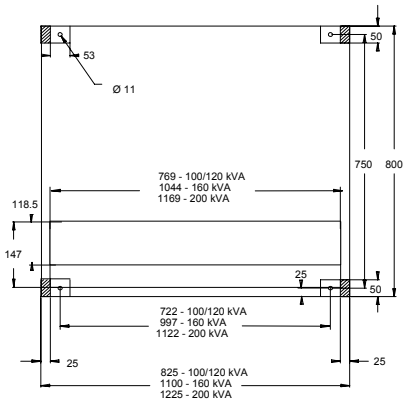


Figure 2 - Footprint - 100/120/160/ 200kVA



Appendix: Planning and Installation

UPS current ratings and cable cross sections

Description	UM	Rating (kVA)					
		60	**80**	**100**	**120**	**160**	**200**
I_{in} max.	**A**	94	125	156	185	250	312
Suggested wire size(1)	**mm²**	35	50	70	95	120	2 x 70
Wire socket screw size	**mm**	M8		M10			
I_{nom} OP/Res @400V	**A**	87	116	145	174	232	290
Suggested wire size(2)	**mm²**	35	50	70	95	2 X 50	2 X 70
Wire socket screw size	**mm**	M8		M10			
$I_{batt.\ in}$ (disch. @1.8V/cell)	**A**	117	155	194	233	310	388
Suggested wire size	**mm²**	50	70	95	120	2 x 70	2 x 95
Wire socket screw size	**mm**	M10					
Suggested earth wire size	**mm²**	35		50	70		95
Wire socket screw size	**mm**	M8		M10			

In the case of a split bypass configuration, the primary input and bypass mains must have a common earth. The Neutral conductor may be part of either the bypass or the primary mains, but it must be present.

1 With cable lug according to DIN46235.

2 For non-linear loads, the neutral cable dimension must be 1.7 times the recommended dimension.

Refer to the User Handbook for suggested IP/OP/BYP protection devices.

Notes

Notes

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