Dale Power Solutions Ltd

User Manual

E400 Series UPS

E420

E430

E440

E460

E480

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Contents

Safety

WARNING! THIS EQUIPMENT MUST BE INSTALLED, COMMISSIONED AND MAINTAINED BY A QUALIFIED ELECTRICIAN

There are dangerous voltages and high temperatures inside the UPS. During installation, operation and maintenance please abide by local safety instructions, regulations and laws. Failure to do so may result in injury to personnel or damage to equipment. Safety instructions in this manual are supplementary to local safety instructions. Dale Power Solutions does not accept any liability caused as a result of failure to follow safety instructions. Please note the following:

Do not use the UPS for any other purpose than the one for which it was designed.

Do not exceed the rated load of the UPS.

Under no circumstances open the UPS. There are high voltages inside that can cause electric shock. If the UPS requires internal maintenance or battery replacement, contact Dale Power Solutions ltd.

Keep the UPS in a dry well ventilated location away from any area or situation in which there is a risk of fire, such as direct sunlight or other sources of heat.

If the UPS emits smoke, turn off immediately the input circuit breaker and battery circuit breakers, and contact Dale Power Solutions ltd.

WARNING! This is a product for commercial and industrial applications in the second environment. Installation restrictions or additional measures may be needed to prevent disturbances (as stated in EN620-40-2:2006).

Warning symbols

The safety symbols used in this manual are shown in table below. They alert you to important safety information that you need to be aware of when installing, operating and maintaining the UPS.

Safety Symbol	Indication
	Attention
	Static discharge sensitive
	Electric shock

Caution: A caution describes a situation in which there is a risk of damage to equipment.

WARNING!

A WARNING DESCRIBES A SITUATION IN WHICH THERE IS A RISK OF INJURY OR DEATH TO PERSONNEL

Conformity and standards

This equipment complies with CE directives 73/23 & 93/68 (LV Safety) and 89/336 (EMC), and the following product standards for Uninterruptible Power System (UPS):

- IEC 62040-1-1 General and safety requirements for use in operator access area
- IEC 62040-2 EMC requirements; Class C3 compliant
- IEC 62040-3 Performance requirements and test methods

Caution: Continued compliance requires installation in accordance with the instructions this manual and the use of manufacturer approved accessories only.

According to IEC62040, this is a low emission class C3 Uninterruptible Power System (UPS) product. In a residential environment, this product may nevertheless cause radio interference, in which case, you may be required to take additional measures.

Energy conservation and environmental protection

With an efficiency of greater than 97% in ECO mode the UPS meets the technical specifications for energy conservation. An input power factor of 0.99 results in minimum current contamination of the power grid. All the material and components comply with the ROSH standards, ensuring that no hazardous waste is produced.

Product description

Applications

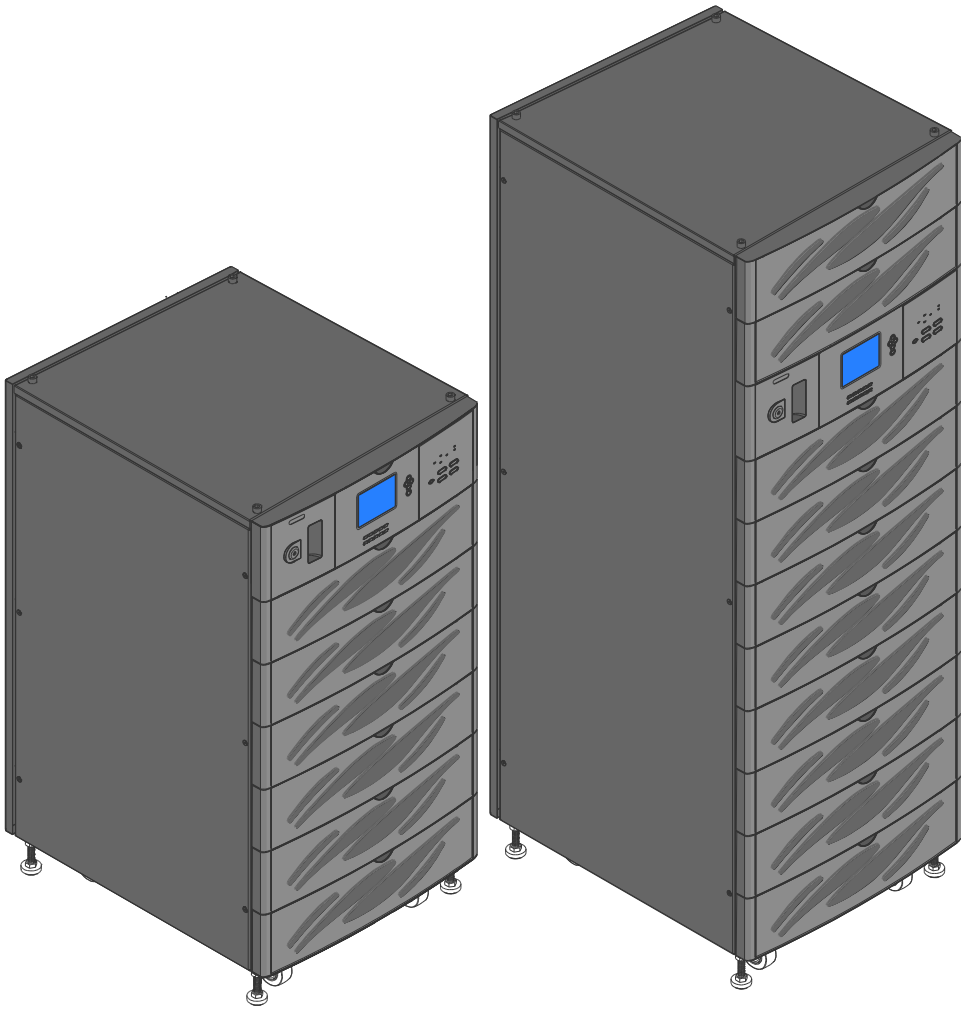
This UPS series provides reliable AC backup power to various types of equipment, for example computer centres, network management centres, auto control systems, and telecommunication systems.

The UPS can be installed and operated as a single unit or it can be operated with other units of the same type in parallel N+1 redundant mode for additional reliability or in parallel capacity mode for increased output rating.

Product range

The following table lists the models available in the E400 series. Models with an E suffix are designed for operation with an external battery.

Capacity	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA
Model	E420	E430	E440	E460	E480
Battery location	External				



E420, E430, E440 **E460, E480**

System block diagram

The UPS is connected between the mains a.c. input source and the critical load to provide uninterruptible power free from disturbances on the mains supply such as voltage and frequency variations. This is achieved using high-frequency double-conversion pulse width modulation (PWM) and full digital signal processing (DSP) control.

As shown in Figure 1, input mains is converted to d.c., which in turn feeds a d.c./d.c. battery charger and an inverter. The inverter then converts the battery voltage to a clean a.c. source, output-independent of the input. The battery powers the load through the inverter in case of an input mains power failure.

If the inverter is unable to supply power for any reason the load is supplied via the bypass circuit, which includes the bypass input breaker and the static transfer switch (STS).

If maintenance or repair is necessary the UPS can supply the load via the internal and manually controlled maintenance bypass breaker. With the exception of the maintenance bypass breakers (internal and external) all the breakers shown are closed during normal UPS operation.

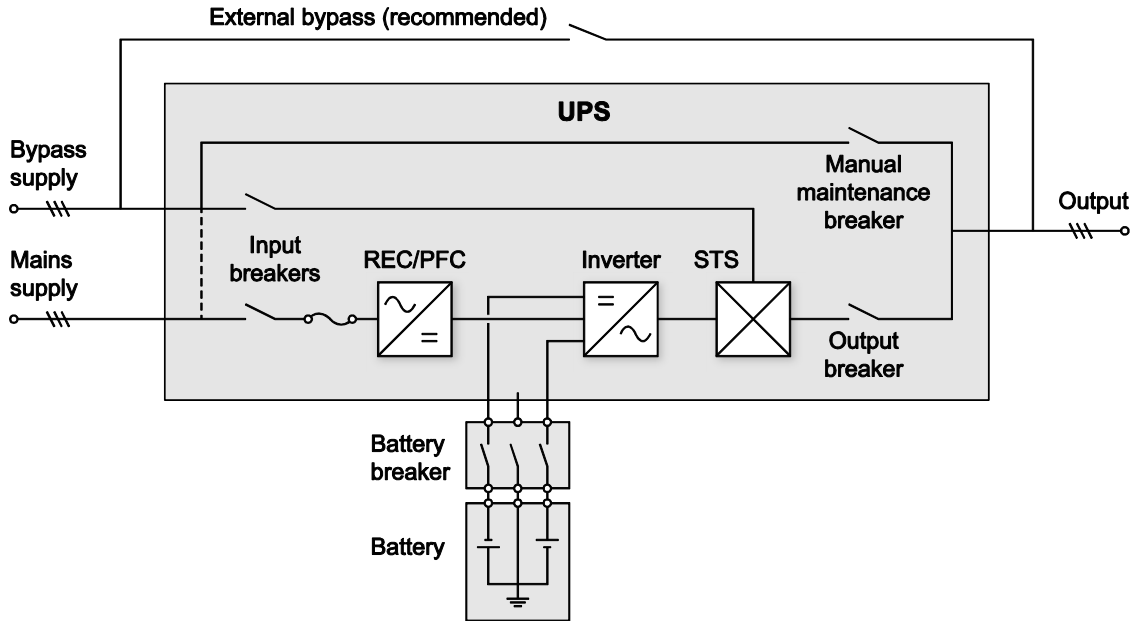


Figure 1 Single unit block diagram

An external bypass breaker enables a UPS to be replaced without interrupting the load and is recommended in most installations.

Split bypass input

Figure 1 shows the UPS in what is known as the ‘split bypass’ configuration, in which a separate input supply (the bypass supply) feeds the internal bypass circuits instead of the mains supply. In this configuration the link (dotted line) between mains and bypass supply is removed.

Static transfer switch

The static transfer switch (STS) is a power-electronic circuit. During normal operation the load is supplied via the inverter, however in the event of a UPS overload or inverter failure, the STS transfers the load automatically to the bypass circuit. To provide a clean (no-break) load transfer between the inverter output and bypass line, the inverter output is synchronized to the bypass supply during normal operating conditions.

Battery temperature compensation

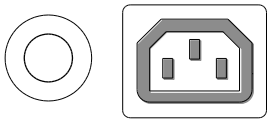
Using optional external battery temperature sensors the UPS is capable of optimising the battery charger output to enhance battery life and performance. This is a non-standard feature that must be purchased separately. Contact your distributor for details.

Redundant control power supply board

The UPS is equipped with two identical and fully redundant control power supply boards. Each board is powered by the input a.c. and battery d.c. Therefore, if one of these sources or even if a board fails the UPS continues to operate normally. This feature further enhances the reliability of the system.

Single phase outlet

A 250 Va.c. 5 A single-phase fused outlet is provided on the front panel. This supply is generated from the battery, independent of other UPS power circuits, and can be used for ease of testing, commissioning, and servicing. This output is accessible when the cabinet door is open.



Multi-unit operation

Up to four units can be operated in N+X parallel mode to provide additional power or higher reliability. In this configuration the load is shared equally between the units.

It is also possible to operate with load bus synchronisation (LBS), which allows the load to be transferred seamlessly between two UPS systems. Each system can be a single UPS or a parallel group of units.

Multi-unit operation is enabled by:

- Hardware and firmware built into each UPS, controlled by software settings.
- Parallel control cables, connected in a ring to enhance reliability. Dual-bus control cables are connected between any two UPS modules of each bus. The intelligent paralleling logic provides the user with maximum flexibility. For example, shutting down or starting up UPS units in a parallel system can be done in any sequence. Transfers between **Normal** and **Bypass** modes of operation are synchronised and self-recovering.

The total load of a multi-unit system can be queried from each unit's LCD display.

Installation

Siting considerations

Before unpacking and installing the unit, consider the following:

- DO NOT expose the UPS to high temperatures, water ingress, flammable or corrosive gas, dust, direct sunlight or explosives.
- Locate the UPS indoors on a level surface as close as possible to the equipment it will be powering to minimise cable voltage drops. If required, allow enough spare cable to move the UPS after installation.
- Maintain a gap of at least 50 cm from walls or other equipment, and ensure the ventilation holes/slots at the front and rear of the units are not obstructed.
- For improved product reliability ensure cool air is available at the front of the unit.
- Battery location. We recommend you site batteries in a separate room to maintain the optimum working temperature of between 15°C and 25°C. As an approximation, battery life is halved for every 10K (10°C) rise in temperature.

Wiring considerations

To ensure a safe installation please follow these instructions and the local electrical code of the area or country in which you are installing the equipment:

- If the UPS is to be supplied from a local transformer, ensure the transformer kVA rating is at least 50% greater than the UPS output kVA rating and the output is 4-wire star configuration.
- Use circuit breakers and cables with the correct rating (see the next section).
- Always fit an MCB between the mains supply live lines only and the UPS input (see Figure 2).

Caution: Do not fit an MCB in the neutral line.

- Because of the high leakage current (see **Error! Reference source not found.** below), permanently hard wire all the a.c. cables.
- Fit ring terminal crimps on the ends of all cables that fasten to studs (see **Error! Reference source not found.** on page **Error! Bookmark not defined.**).
- Fit a 3 pole MCCB, with a suitable d.c. voltage rating and breaking capacity, between the battery and the UPS (see Figure 2).

Caution: The UPS is designed to work with a centre-tap battery only.

- Although it may not be absolutely necessary, we recommend you fit an MCB between the UPS and the load to protect the output load and cables in the event of a fault (see Figure 2). You may also wish to connect the UPS output to your load via a power distribution unit (PDU).
- Ensure correct phase rotation in the 3-phase wiring.

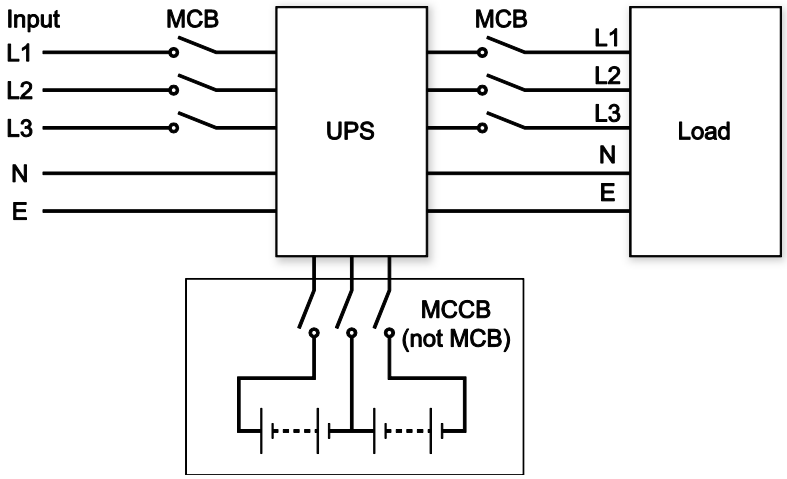


Figure 2 Power cable wiring configuration for a single UPS

Units in parallel

A group of paralleled units behave as if it were one large UPS. To ensure units share the load equally and the system complies with relevant wiring regulations, follow these requirements:

- Use units of the same rating only and connect them to the same bypass source.
- Reference the Bypass and the Main input sources to the same neutral potential.
- Ensure that any RCDs (residual current devices) are appropriately set and located (see Earth leakage current below).
- Connect the outputs of all units to a common output bus.
- Ensure the length and specification of power cables including the bypass input cables and UPS output cables of each unit is the same. This ensures load sharing when operating in bypass mode.

Note: Optional isolation transformers are available for applications where sources do not share the same neutral reference or where the neutral is not available.

Earth leakage current

The residual earth current introduced by the RFI suppression filter inside the UPS is between 3.5 mA and 1000 mA. We recommend that you verify the selectivity of the residual current detector (RCD) with all other differential devices both upstream of the input distribution board and downstream (towards the load).

Caution: To avoid false alarms, locate earth leakage monitoring devices upstream of the common neutral point when used in systems with split bypass input or when used in paralleled UPS configurations. Alternatively use the device to monitor the combined 4-wire rectifier and split bypass input currents.

Ensure that an RCD upstream of the UPS has these characteristics:

- Sensitive to d.c. unidirectional (class A) pulses
- Insensitive to transient current pulses
- Average sensitivity adjustable between 0.3 and 1A

Such residual current circuit breakers (RCCB) are identified by the symbols:

Operation from a generator

As a guide we recommend that the load capacity should be less than 30% of the generator capacity, and the generator rating should be 1.5 to 2 times the rating of the UPS, depending on the type of generator used.

Caution: Ensure that the neutral line from the generator is permanently connected to the mains neutral line. Do not use an MCB or any other type of switch in this line.

Cable sizes

Use the following sizes of cables to connect the UPS between mains power, batteries and the load.

UPS rating	AC input / output (mm^2)	DC input ($mm^{2)}$)	Ground ($mm^{2)}$)	Busbar stud size	Torque (Nm)
20	10	25	6	Bolts: M6, holes: 6mm [1]	5
30	16	35	6		
40	25	50	10		
60	35	70	25		
80	50	95	35		

[1] Most connections are made to terminal blocks, however some neutral and battery cable connections are made to studs.

Caution: Size the ground (earth) conductor for the a.c. supply fault rating, cable lengths and type of protection.

External bypass and battery breakers are specified at the time of purchase.

Unpacking the UPS

To unpack the UPS:

1. Cut off the shrink wrapping carefully from around the unit.
2. Cut the straps securing the unit to the pallet, and remove the corner protection strips, disposing of them correctly.
3. Remove and retain the documentation, CD and leads from inside the door of the UPS.
4. Dispose of packets of desiccant correctly.
5. Using a forklift truck or similar, move the UPS off the pallet.

   WARNING!

   TAKE CARE WHEN MOVING THE UPS OFF THE PALLET. IT WEIGHTS IN EXCESS OF 186 KG AND COULD FALL.
6. Check the appearance of the UPS to see if is damaged. If any damage is found, do not switch on the UPS and contact your distributor.
7. Check the packing list. Contact your distributor if any of the accessories are missing.

Internal layout (door open)

Figure 3 shows the internal layout with the door open and all protective covers removed.

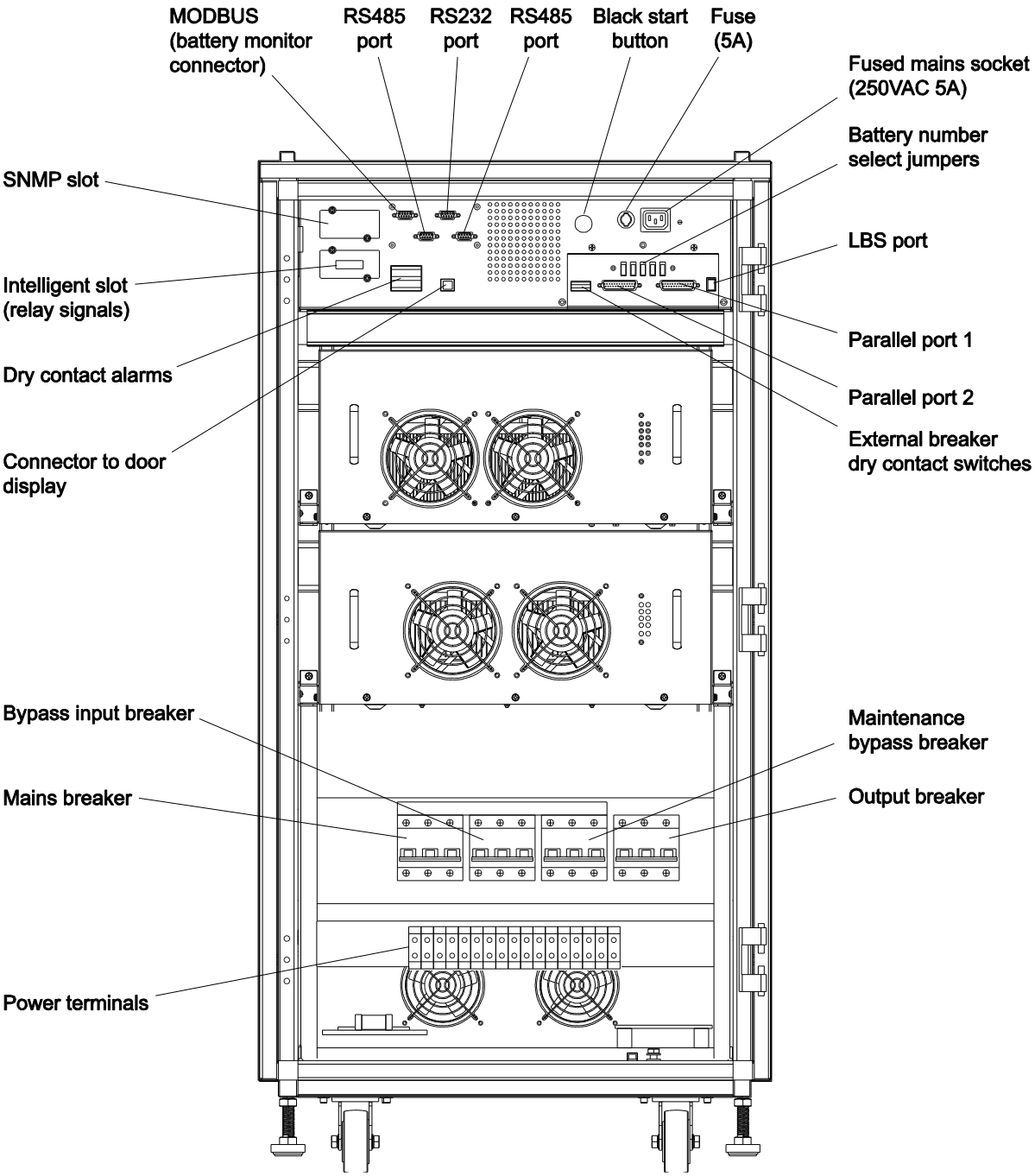


Figure 3 E420, E430 and E440 internal layout

Note: E460/E480 units are taller and the E480 is fitted with larger breakers and terminals in the lower part of the cabinet. Terminal and battery connections vary from those shown above.

Wiring the UPS

Before connecting the UPS, read the siting considerations above and check you have selected breakers and cables with the correct ratings.

WARNING!

BEFORE ATTEMPTING TO WIRE THE UPS ENSURE ALL BREAKERS ARE IN THE OFF POSITION AND WHERE POSSIBLE LOCKED OFF.

Caution: DO NOT mix batteries from different manufacturers or mix different types of batteries. DO NOT use old and new batteries together.

Caution: Ensure correct phase rotation in the 3-phase wiring.

To connect the UPS to your system:

1. Unlock and open the front door of the UPS.
2. Check the external battery as follows:
   a. Ensure that the number of 12 V blocks in each string (positive and negative) is equal and matches the number specified in your order.
   b. Remove the cover plate below the black start switch and check that the correct combination of battery jumpers is fitted for the number of batteries in the system.

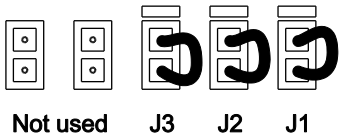


Figure 4 Example showing links fitted for 40 batteries

No of batteries	J3	J2	J1
32	Not fitted	Not fitted	Not fitted
34	Not fitted	Not fitted	Fitted
36	Fitted	Not fitted	Fitted
38	Not fitted	Fitted	Fitted
40	Fitted	Fitted	Fitted

   c. Measure the battery voltage in each string, which should be approximately 192 Vd.c. for 16 batteries, 204 Vd.c. for 17 batteries, 216 Vd.c. for 18 batteries, 228 Vd.c. for 19 batteries and 240 Vd.c. for 20 batteries.
3. Remove the lower cover to gain access to the breakers and terminals.
4. Feed all cables through the bottom of the unit, moving the securing plate as needed. If the unit is part of a parallel system, fit the parallel cables before the main power cables.

Caution: Where terminal blocks are not available for connections, fit ring crimps to the ends of cables. This is the case for the E480 battery cables.

5. Wire the input and output earth cables to the PE (protective earth) terminals. Ensure that both connections are made.

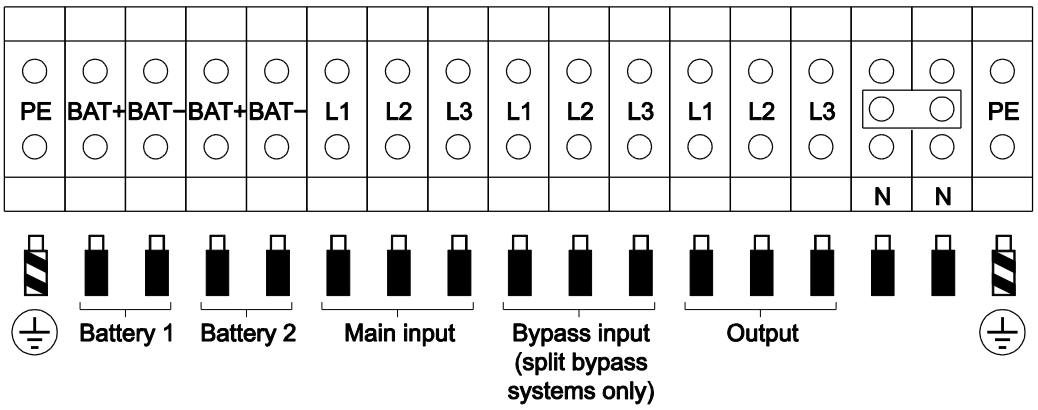


Figure 5 Cable connections for E420, E430, E440 and E460 units

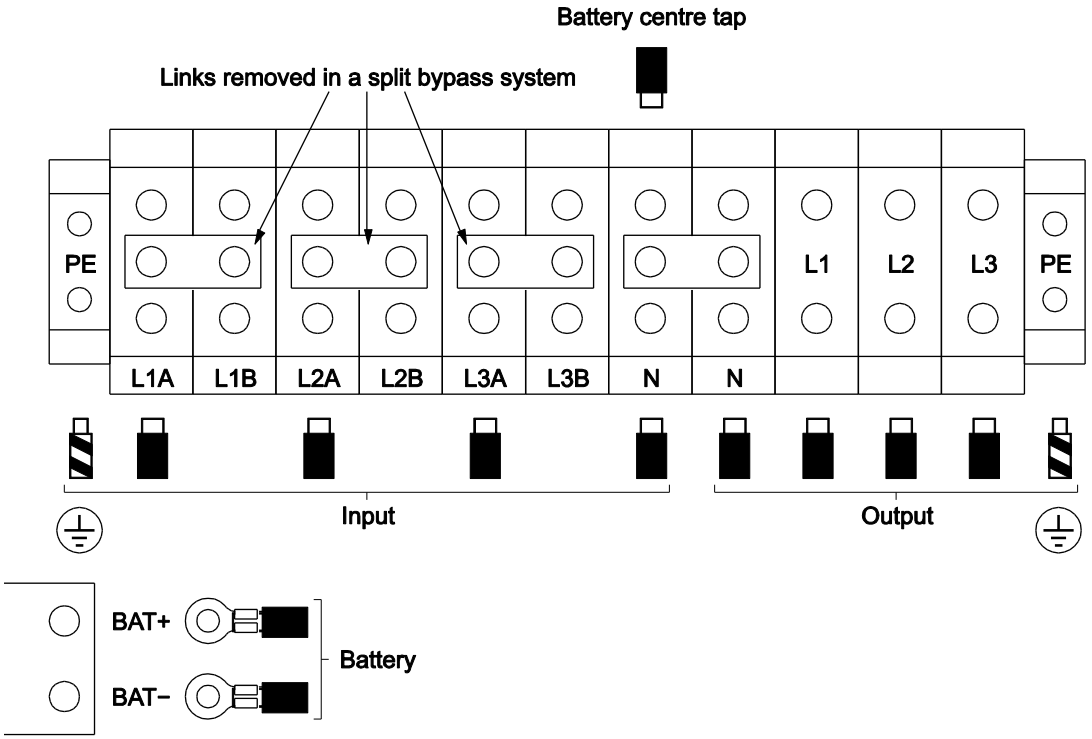


Figure 6 Cable connections for E480 units

6. Wire output and battery cables to the terminals as shown in the appropriate diagram above. On E480 units, feed the battery centre-tap cable round the back of the terminal block and wire it to the top of the left-hand neutral terminal as shown above.
7. Wire the input as follows: E420/E430/E440/E460: to **Main input** (Figure 5)

   E480: to **L1A**, **L2A**, **L3A** (Figure 6)
8. Secure all cables to the punched plate in the bottom with cable ties.

9. If your UPS is configured for split bypass operation:

   a. Check the following: E480: that the links in Figure 6 have been removed.

   E420/E430/E440/E460: that the short breaker links are fitted (Figure 7).

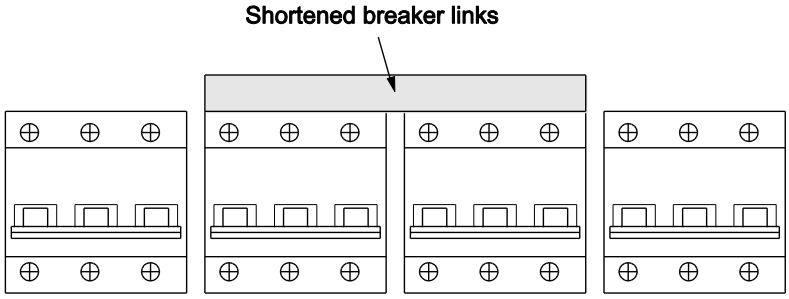


Figure 7 E420, E430, E440, E460 breakers linked for split bypass operation

   b. Wire the split bypass input as follows:

   E420/E430/E440/E460: to **Bypass input** (Figure 5)

   E480: to **L1B**, **L2B**, **L3B** (Figure 6)

WARNING!

CHECK THAT ALL CABLES ARE WIRED TO THE CORRECT TERMINALS. DO NOT REVERSE THE INPUT LIVE AND NEUTRAL CONNECTIONS OR THE POLARITY OF ANY OF THE BATTERY CABLES.

10. If your unit has an SNMP card fitted or you plan to use the RS232 port or other standard signals, see **Error! Reference source not found.** on page **Error! Bookmark not defined.**.

11. Close and lock the front door.

Wiring units in parallel

You can operate 2, 3 or 4 units in parallel.

Caution: Each unit requires its own battery bank. You cannot use a common battery bank for more than one unit working in parallel mode.

When operating units in parallel you must not use the built-in bypass as it is rated for one unit only. If you need a bypass for the parallel system it must be wired as an external item.

WARNING!

BEFORE ATTEMPTING TO WIRE THE UNITS, ENSURE ALL BREAKERS ARE IN THE OFF POSITION.

To connect two or more units in parallel:

1. Wire the power cables and optional signals as described above.
2. If a system bypass is required, wire in a separate MCB capable of carrying the total system load current as shown below. This is not required if you have only two units working in N+1 mode and the load never exceeds the rating of a single unit.

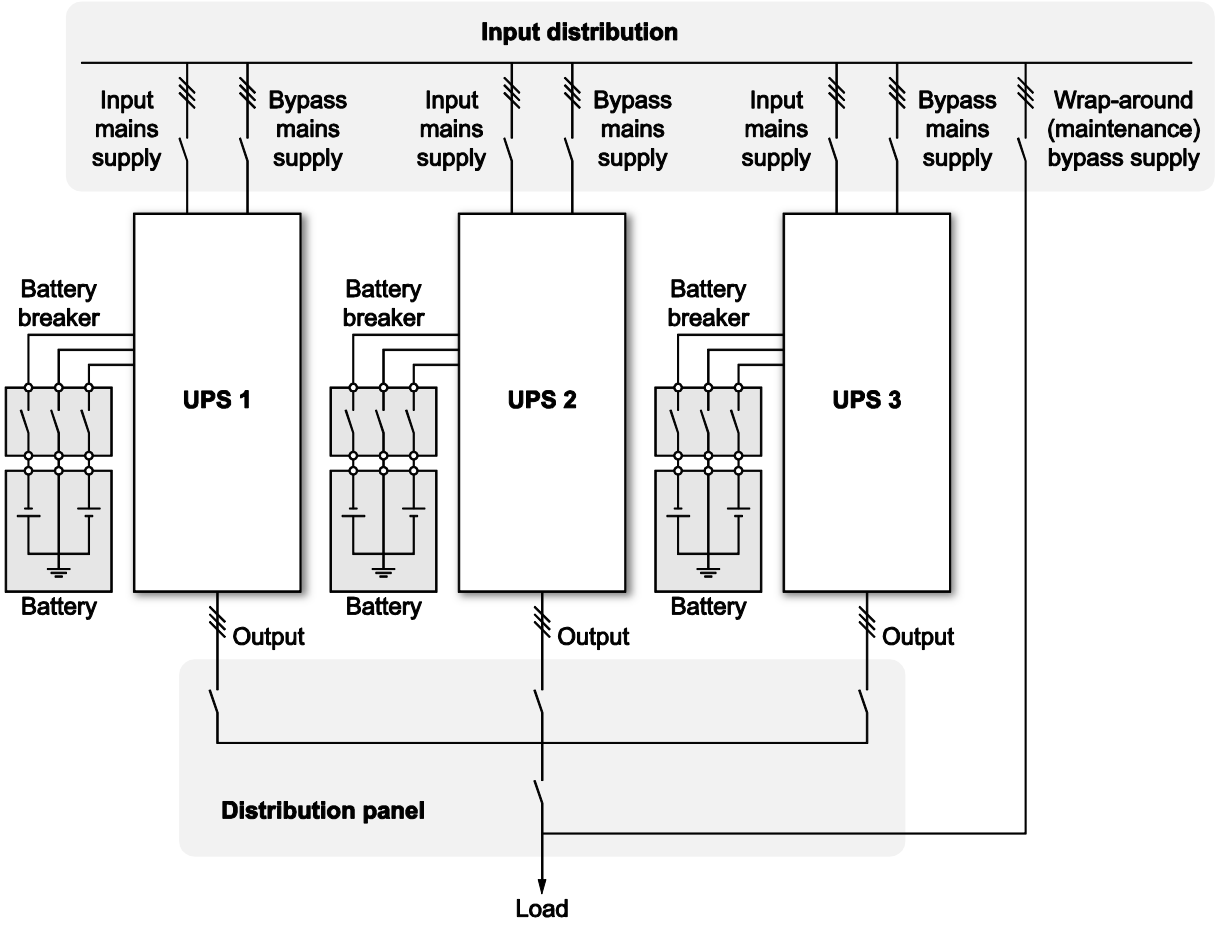
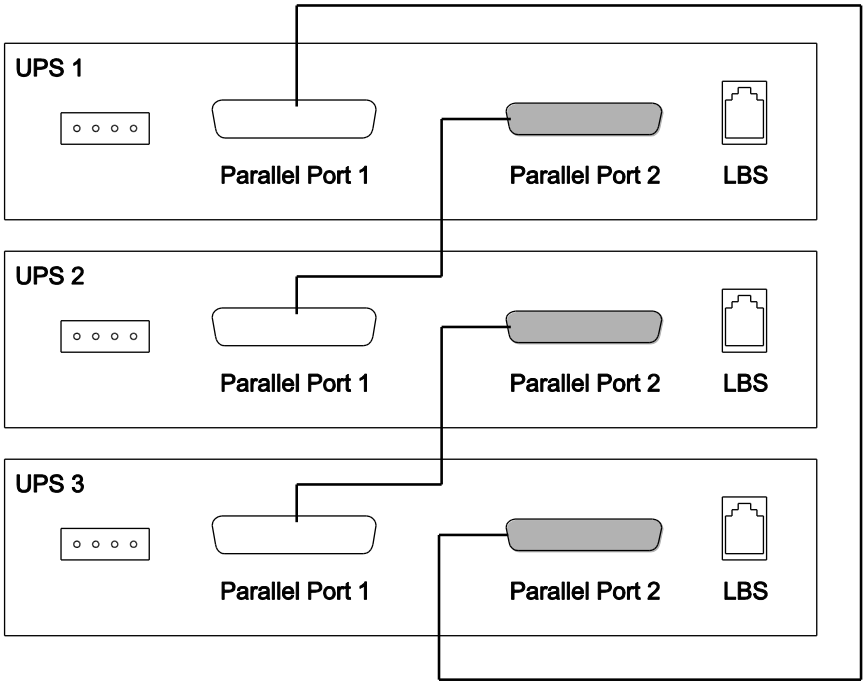


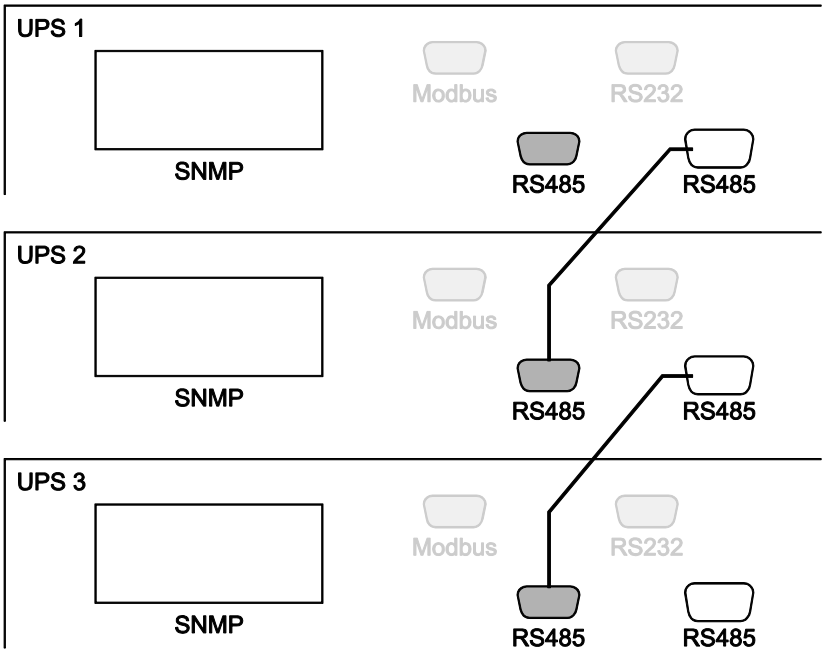
Figure 8 Units connected in parallel

3. Below the black start switch on each UPS, remove the plate that covers the parallel connectors.
4. Connect the CAN bus, labelled **Parallel Port 1** and **Parallel Port 2**, in a ring arrangement using the supplied cables as shown below. Make sure you wire all CAN bus connectors and secure them in place using their captive screw locks.



5. Replace the protective cover to protect the CAN bus cables against accidental removal.
6. Optional connection. You can control and monitor all units using the RS232 port on one UPS. To do this, connect the RS485 socket of one unit to RS485 socket of the next unit and so on until all units are connected in a daisy-chain as shown below.

> **Note:** Do not connect the units in a loop.



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7. If required, wire the LBS (load bus synchronisation) connection as described on page **Error! Bookmark not defined.**.
8. If required, wire a remote emergency power off (EPO) switch as described on page **Error! Bookmark not defined.**.

Operation

Working modes

The UPS has the following modes of operation:

- On-line mode
- Battery mode
- Auto-restart mode
- Bypass mode
- ECO mode
- Frequency converter mode

Each operating mode is described below.

On-Line mode

This is the default mode of operation in which the load is supplied via the inverter when the a.c. input and load are within their normal ranges. The battery is trickle charged in this mode.

During fault conditions the UPS automatically switches to either bypass mode or battery mode without interruption of power to the load.

Battery mode

In battery mode the load is supplied from the battery via the inverter, the UPS beeps every 3 s, and the rectifier and charger are turned off. The UPS switches to battery mode when there is no a.c. input or the a.c. input is outside its normal range. On the front panel the Mains LED if off and the Battery LED is on.

When the battery reaches a pre-set low limit, the system gives a low battery voltage alarm signal, the LCD provides a low battery alarm, and the UPS beeps every second. Eventually the UPS shuts down to prevent damage to the batteries.

When the a.c. mains is restored the inverter starts automatically and the UPS reverts to on-line mode. If you turn off the UPS in battery mode it restarts in bypass mode and you must press the INVERTER ON button to start the inverter.

Auto-restart mode

Following an extended a.c. mains failure the battery will become exhausted. When the battery reaches the end of discharge (EOD) voltage the inverter shuts down and no more power is supplied to the load.

By default the UPS remains shut down after EOD. However it can be programmed to automatically restart after a time delay. This is normally done by the commissioning engineer.

Bypass mode

In bypass mode the load is supplied directly from the a.c. mains input and the battery is charged. The UPS switches to bypass mode when any of the following conditions occur:

- An output overload – the unit beeps twice every second, indicating that the load must be reduced to within its normal range as soon as possible. Once the overload is removed the inverter re-starts after a 5 minute delay. If the UPS is overloaded too many times in any one hour it will eventually remain in bypass mode.
- The UPS is too hot – the UPS reverts to on-line mode as soon as the unit temperature returns to normal.
- The UPS fails – a serious fault has occurred within the UPS that must be repaired.
- The UPS inverter is turned off.

In bypass mode the Inverter LED is off and the Bypass LED is on.

ECO mode

If specified, your UPS may be set to operate in ECO mode instead of on-line mode. In ECO mode the load is supplied via the bypass circuit and not the inverter, allowing the UPS to work at higher efficiency. The battery is trickle charged in this mode. If the a.c. input is lost or goes beyond its normal range the UPS automatically switches to battery mode, however, the transfer speed is slower than on-line mode and may not be suitable for all applications.

Frequency converter mode

The UPS can be programmed to work as a frequency converter to provide either a 50 or 60 HZ a.c. output voltage. In this mode static bypass operation is disabled and the UPS may operate in battery mode.

Before switch on

Before turning on the unit for the first time or after any wiring or battery changes:

1. Read the section above on working modes.
2. Check all the wiring.
3. Check that the rated load does not exceed the rated output of the UPS.
4. If the UPS is supplied by a generator, check that the generator is correctly rated and wired (see **Error! Reference source not found.** on page 11).
5. Apply the wheel locks and screw down the feet to prevent the UPS from moving.

Switching on the UPS

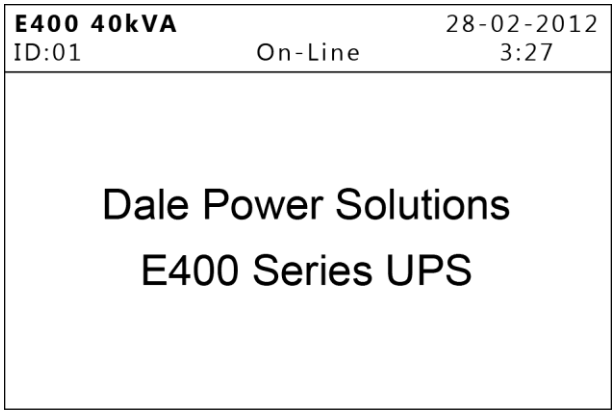
Note: It is important to switch on your UPS as described below as damage may occur when supplying certain load types.

Caution: When using the UPS for the first time, charge the batteries for at least 8 hours as they may have lost charge during the time between production and installation.

To switch on the UPS:

1. Ensure all UPS breakers are switched off.
2. Switch on the battery breaker.
3. Switch on the distribution breaker (including a split supply breaker if this is in use).
4. Switch on the UPS bypass and output breakers. The Bypass and Output LEDs are illuminated. You should immediately hear the fans start up

   The LCD should begin to work. The model number and working mode is initially displayed on the front panel LCD. After a few seconds this changes to system information.



5. Switch on the UPS main breaker.

   After a few seconds the Mains and Inverter LEDs are illuminated and the Bypass LED goes out (see **Error! Reference source not found.** on page **Error! Bookmark not defined.**).

   Note: If switching on into a transformer load, ensure the UPS is initially working in bypass mode before switching to on-line mode.

6. If possible apply the load gradually.

Caution: If the UPS input power is provided by a generator it is important to apply the load gradually.

In this state your unit is working correctly and delivering power to the load. There is no need to alter any settings.

Commissioning test procedure

Perform this test once the unit is operating normally.

1. Switch off the mains to simulate a utility failure. The rectifier should turn off and the battery should feed the inverter without interruption. The battery, inverter and output indictors should be on.
2. Switch on the mains to simulate utility recovery, the rectifier should restart automatically after 10 s and supply the load.

Switching off the UPS

Caution: All power to the load will be removed when you follow this procedure.

To switch off the UPS:

1. Switch off the battery breaker according to the manufacturer's instructions.
2. Switch off the mains and bypass breakers. If the UPS has a dual mains supply, switch off both supplies and lock them out.

Transferring the load to an EMBS

Transferring to an emergency backup supply (EMBS) is only possible if an external maintenance bypass breaker has been wired into the system.

To transfer to an EMBS while maintaining the load:

1. Switch off the UPS inverter to put the unit into static bypass.
2. Switch on the external maintenance bypass breaker.
3. Switch off the UPS and battery as described above. The UPS is now off.
4. Perform the required maintenance work on the UPS.
5. After the maintenance work is complete, switch on the UPS as described above.
6. Switch off the external maintenance bypass breaker. The inverter should start automatically.

Front panel controls and indicators

The front panel controls and indicators are shown in **Error! Reference source not found.**. Using the buttons, LEDs and the menu structure displayed on the LCD panel you can:

- Check the status of the UPS
- Check and make changes to the settings

> **Note:** Your UPS is setup to your requirements by the distributor prior to delivery. There is normally no reason to change any of the settings.

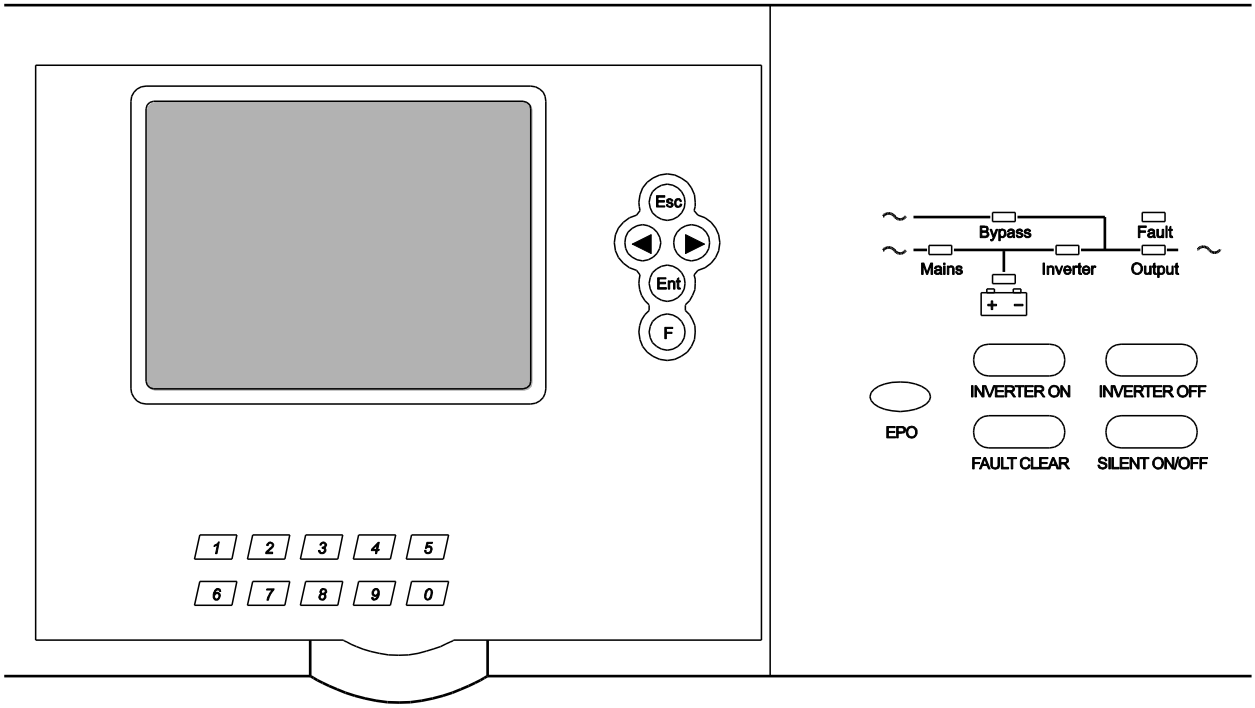


Figure 9 Front panel controls and indicators

The LCD panel is hinged along its top edge and can be pulled out at the bottom to create different viewing angles if required. It is also possible to connect a second LCD for remote monitoring and control. Contact your distributor for details.

Caution: To ensure no one accidentally catches a tilted panel it is advisable to return it to its vertical position when not in use.

The following table describes the operation of the LED indicators:

LED	Colour	Description
Output	Green	On when the load is being supplied
Inverter	Green	On when the UPS is supplying power. Flashes when the inverter is overloaded or it is faulty
Battery	Green	On when power is supplied from the battery. Flashes if the battery is low, disconnected, reversed polarity, not charging or if the voltage is abnormally high
Mains	Green	On when mains is present and within limits. Flashes if the mains is outside its normal range
Bypass	Green	On when power is supplied via the bypass. Flashes when the bypass is not available, out of

		limits, overcurrent or the switch or wiring are faulty

Buttons	Definition
Ent	Press to confirm an operation or enter a lower menu level
Esc	Press to cancel an operation or return to the previous menu level
◄	Press to select another menu item or change a parameter
►	Press to select another menu item or change a parameter
F	Press to view event and alarm logs
0 to 9	Press to enter a digit from 0 to 9 when making changes to settings
EPO	Emergency Power Off. Press to disconnect power from the load. The rectifier, inverter, static bypass and battery operation are disabled
Inverter ON	Press to enable inverter operation
Inverter OFF	Press to inhibit inverter operation
Fault Clear	Press to reset UPS functions once the fault is cleared
Silence ON/OFF	Press to toggle the buzzer on and off. After a fault the buzzer is re-enabled

Fault	Red	On when there is any type of fault

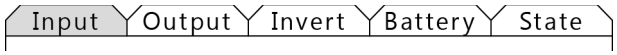
The following table describes the button functions:

Navigating the system menu

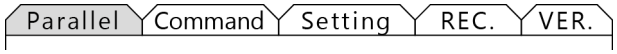
The system menu consists of a series of pages you access via a set of tabs and the front panel keys.

To display a menu page:

1. Press ◄ or ► to display the tabs. The Input tab is highlighted and the input information is displayed on the screen below the tab (as shown in the following sections).



2. Press ◄ or ► repeatedly to scroll along the tabs. Eventually the following set of additional tabs is displayed:



Note: The values shown below are examples only. The values in your system are likely to be different.

Input information

Input | Output | Invert | Battery | State

Mains	A(AB)	B(BC)	C(CA)
Line Voltage (V)	415.2	416.7	416.0
Phase Voltage (V)	239.5	240.4	241.6
Phase Current (A)	0.9	1.3	1.0
Power Factor	0.00	0.00	0.00
Frequency	49.9		
Bypass			
Line Voltage (V)	416.6	417.8	417.6
Phase Voltage (V)	240.5	240.7	241.0
Frequency	49.0		

Output information

Input | Output | Invert | Battery | State

	A(AB)	B(BC)	C(CA)
Line Voltage (V)	398.1	400.4	399.1
Phase Voltage (V)	229.2	230.7	231.6
Phase Current (A)	0.0	0.0	0.0
Frequency	50.0		
Apparent Power (kVA)	0.0	0.0	0.0
Active Power (kW)	0.0	0.0	0.0
Load Percent (%)	0.0	0.0	0.0
Load Peak Rate	0.0	0.0	0.0

Inverter information

Input | Output | Invert | Battery | State

	A(AB)	B(BC)	C(CA)
Line Voltage (V)	398.3	398.3	398.3
Phase Voltage (V)	230.0	230.1	230.0
Phase Current (A)	0.0	0.0	0.0
Frequence (Hz)	49.9		

Positive BUS Voltage (V)	390.0
Negative BUS Voltage (V)	390.0

Battery information

Input | Output | Invert | Battery | State

Positive Battery Voltage	(V)	0.0
Negative Battery Voltage	(V)	0.0
Positive Battery Current	(A)	0.0
Negative Battery Current	(A)	0.0
Battery State		No Battery
Support (min)		0
Capability (%)		0
Lasting (min)		0
Battery Temperature (°C)		0

State information

Input | Output | Invert | Battery | State

Input Switch	ON
Output Switch	ON
ByPass Switch	ON
Manu-ByPass Switch	OFF
OutSide-ByPass Switch	OFF
OutSide-Output Switch	ON
Switch to ByPass times	1
Inside Temperature (°C)	26
Lightning Strike times	0
Dynomotor	disconnect

Parallel information

Parallel | Command | Setting | REC. | VER.

	A	B	C
Apparent Power (kVA)	0.0	0.0	0.0
Active Power (kVA)	0.0	0.0	0.0
Parallel Link Number	1		
Inverter Output Number	1		
LBS Active	no ACT		
Inverter Output	Master		

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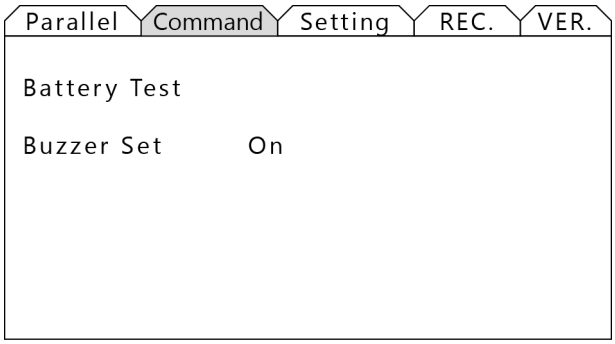
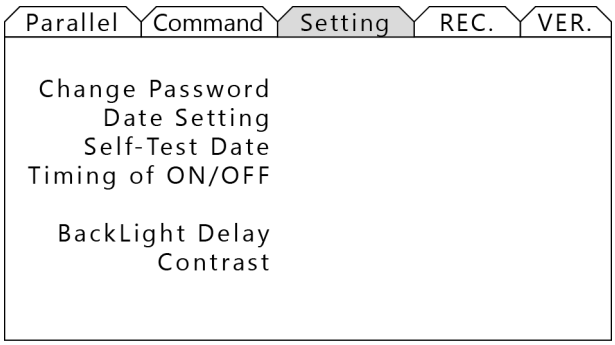
info@dalepowersolutions.com | www.dalepowersolutions.com | +44 (0) 1723 583511

Command information

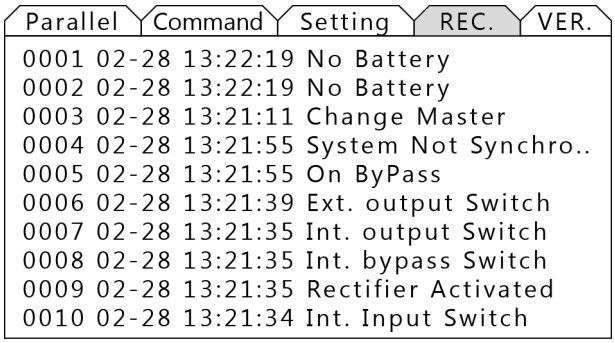


Setting information

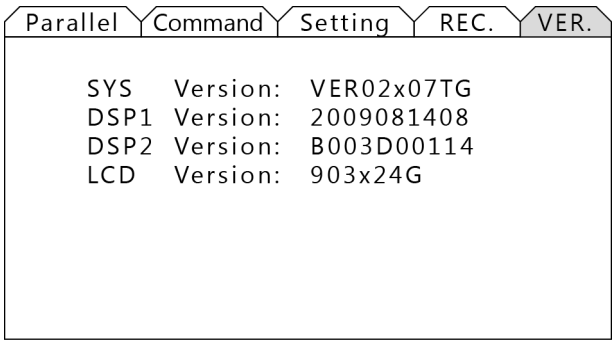


Recorded events list

This page shows up to 120 of the most recently recorded events (normal operation and fault information).



Version information

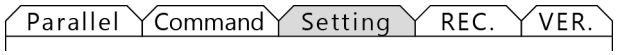


Change settings

At the time of installation your installer will alter the settings to meet your order requirements, however if you need to make a change, use the following procedure.

To change a system setting:

1. Press ◄ or ► to highlight the **Setting** tab.



2. Press **Ent**. The first item on the **Setting** page is highlighted (this is usually **Language**).
3. Either press **Ent** to change the language settings, or press ◄ or ► to highlight another parameter and then press **Ent**.
4. Depending on the parameter either press ◄ or ►, or use the number keys to change the setting.
5. Press **Ent** to save the new setting (or press **Esc** to cancel the change).

The changeable parameters and their values are shown in the following table:

Setting Parameter	Description
Language	Change the display language
Password	Set if required. _ _ _ _ _ _ (range 0 to 9, 6 digits)
Data setting	YYYY-MM-DD hh:mm
Self-Test Date	Disable (default) Monthly Day of month: _ _ Time: _ _ : _ _ Duration: _ _ (range 1 to 99 minutes) Weekly Day: Mon, Tues, Wed, Thurs, Fri, Sat, Sun Time: _ _ : _ _ Duration: _ _ (range 1 to 99 minutes)

Setting Parameter	Description
Timing of ON/OFF	Disable (default) Everyday Turn ON time _ _ : _ _ Turn OFF time _ _ : _ _ (hh:mm) Weekly Turn ON day: Mon, Tues, Wed, Thurs, Fri, Sat, Sun Turn ON time _ _ : _ _ Turn ON day: Mon, Tues, Wed, Thurs, Fri, Sat, Sun Turn ON time _ _ : _ _
Backlight Delay	Adjust how long the backlight stays on for in minutes
Contrast	Adjust the display contrast
Work Mode	Single (default, stand-alone UPS in on-line mode) ECO (single UPS only, UPS in off-line high efficiency mode) Master (sets UPS as master in a master/slave system) Slave (sets UPS as a slave in a master/slave system) Parallel
LBS Setting	Load bus synchronisation in an A + B system. Disable (default), Master, Slave
System Voltage Level	220 V 230 V 240 V (default)
System Frequency Level	50 Hz (default) 60 Hz
Auto Turn-on	Allows the UPS to auto-restart when mains is re-applied after a 100% battery discharge following a mains failure. Enable (default) Disable
Bypass frequency range	1% 2% 3% 4% 5% (default)
Bypass Volt Upper Limit	5% 10% 15% (default)
Bypass Volt Lower Limit	-20% -30% -45% (default)
Invert-Volt fine	Allows you to fine adjust the inverter output 0% 0.5% 1% 1.5% 2% 2.5% 3% 3.5% 4% 4.5% 5%
Parallel ID	Set the UPS identity in a parallel configuration 1 (default) 2 3 4
Parallel Amount	Set the number of units in a parallel configuration 1 (default) 2 3 4
Parallel Redundancy	Set the number of paralleled redundant units in an N + x system 0 (default) 1 2 3
Switch Bypass time	3 4 5 6 (default) 7 8 9 10
M/S Alternate Cyc (month)	Set the master/slave alternate times on months 1 2 3 4 5 6
Power Walk In (s)	Set the input current ramp up time 5 (default) 10 15 20
Single Battery Voltage (V)	Set the voltage of the battery blocks 2 4 6 12 (default)

Setting Parameter	Description
Battery Number	Set the number of batteries on a string 2x16 2x17 2x18 2x19 2x20
Battery Group	Set the number of battery strings in a group 1 2 3 4 5 6 7 8
Single Battery Capability	Battery capacity: _ _ _ _ Ah (range 7 to 2000)
Boost upper limit Volt.	Set the upper limit voltage in boost mode 2.27 V/cell (default, range 2.20 to 2.40)
Float base Volt.	Set the float mode voltage 2.27 V/cell (default, range 2.20 to 2.29)
Battery Protect Volt.	Set the end of discharge voltage 1.65 V/cell (default, range 1.20 to 1.90)
Boost Charge	Boost charges the batteries at the end of a recharge Enable (default) Disable (use for VRLA batteries)
Shutdown Pre Alarm Time	Set the number of minutes before a predicted shutdown that an alarm is given. The prediction is based on the battery capacity and load. Time (1 to 99): _ _ (minutes)
Max charge current	Set to 10% of the battery Ah capacity rating in amperes. _ _ A (E420 and E430, 1 to 15 A; E440, E460 and E480, 1 to 30 A in 1 A steps)

LCD display messages

Display messages appear on the bottom line of the LCD display.

Display	Meaning
CurState: Init	Initialisation
No-Out	No output
Bypass	UPS in bypass mode
Mains	Rectifier working
Battery	Battery invert
Testing	Battery test in progress
Starting	Starting
CurState: ECO	UPS running in ECO power saving mode
CurState: EPO	Emergency Power OFF mode
CurState: M-Byp	UPS in maintenance bypass mode
CurState: Fault	UPS fault
Battery Charging	Battery float charging
Battery Boost	Battery boost charging
Invter ON/ Invter OFF	Inverter working or not
Inver Master	Master of multi UPS system
SWMB ON/ SWMB OFF	Maintenance switch close or open

Maintenance

Fan

At normal room ambient temperature the fans will operate continuously for 20,000 to 40,000 hours. Increased ambient temperatures will shorten this lifetime.

Periodically ensure that air is blowing out of the rear of the unit.

Battery

We recommend the use of sealed lead acid, maintenance free batteries. Battery life depends on the ambient temperature and the number of discharge/charge cycles. Battery life is shortened with high ambient temperature and deep discharges.

To maximise the life of your batteries, maintain them as follows:

- Maintain the ambient temperature in the range 15 to 25°C
- Avoid discharge currents of less than 10% of full load current.
- Do not operate the UPS in battery mode continuously for more than the specified autonomy (hold-up time).
- Charge the battery for at least 12 hours every 3 months if it has not been used. If the ambient temperature is higher than 25°C, charge the battery every 2 months.
- Maintain external batteries at least once a year.

If the backup time has significantly reduced, or a battery fault is displayed on the LCD screen contact your distributor to find out if the batteries need replacing.

WARNING

DON'T SHORT CIRCUIT THE BATTERY AS IT CAN CAUSE A FIRE.

DON’T OPEN THE BATTERY AS THE ELECTROLYTE INSIDE IS HARMFUL TO SKIN AND EYES.

Battery change

Caution: We strongly recommend you switch off the whole UPS when you need to change an external battery group.

Visual check

Ensure there is adequate ventilation to maintain the UPS at the correct temperature.

UPS status check

Check the following:

- Ensure there are no faults or alarms indicated.
- If the UPS is working in bypass mode, investigate the cause.
- If the UPS is working in battery mode, make sure it is normal, if not, investigate.

Function check

Perform the following function checking every 6 months:

1. Press the INVERTER OFF button to ensure the buzzer, indicators and LCD are operating normally.

2. Press the INVERTER ON button. Check the indicators, LCD and UPS inverter, and ensure they are working normally.
3. When the UPS is working in on-line mode, perform a battery test.

Troubleshooting

Before contacting your distributor, try to solve your problem using the information in the following table. If you need to contact your distributor make sure you have the model number and serial number of your UPS.

Black Start procedure

Use this procedure to start the UPS from the battery only when the mains supply is absent, or to check the system as part of the commissioning process.

To start the UPS using the black start switch:

1. Unlock and open the front door.
2. Turn on the battery breaker. The battery will supply the auxiliary power board.
3. Press the **Black Start** button. After about 30 seconds the UPS will be ready to supply load current.
4. Turn on the output breaker.

Events

No	Display message	Description
1	Initializing	The DSP and MCU is initialising
2	Standby	
3	Non-output	The UPS is not providing power to the output
4	On bypass	The inverter is off and the load is being supplied via the bypass switch
5	On line	The load is being supplied via the inverter
6	Discharging battery	The load is being supplied from the battery
7	EPO activated	The emergency power off switch has been activated
8	Automatic self-test	The pre-programmed battery test has started
9	Inverter is soft starting	
10	System fault detected	
11	Int. maintain bypass switch closed	The internal bypass breaker has been closed manually
12	Int. input switch opened	The internal input breaker has been opened manually
13	Int. input switch closed	The internal input breaker has been closed manually
14	Rectifier deactivated	The rectifier has been deactivated
15	Rectifier activated	The rectifier has been activated
16	Rectifier over current	Input voltage in the range 208 V to 305 V, UPS is de-rated
17	Battery charge deactivated	The charger has been deactivated
18	Positive battery boost charging	The positive batteries are in constant-voltage or constant-current boost charge mode
19	Positive battery float charging	The positive batteries are being float charged
20	Negative battery boost charging	The negative batteries are in constant-voltage or constant-current boost charge mode

No	Display message	Description
21	Negative battery float charging	The negative batteries are being float charged
22	Int. bypass switch closed	The internal bypass breaker has been closed manually
23	Int. bypass switch opened	The internal bypass breaker has been opened manually
24	Int. output switch closed	The internal output breaker has been closed manually
25	Int. output switch opened	The internal output breaker has been opened manually
26	Ext. bypass switch closed	The external bypass breaker (parallel system) has been closed manually
27	Ext. bypass switch opened	The external bypass breaker (parallel system) has been opened manually
28	Ext. output switch closed	The external output breaker (parallel system) has been closed manually
29	Ext. output switch opened	The external output breaker (parallel system) has been opened manually
30	Coming to internal transfer	Allow transfer to bypass or inverter with 3/4 cycle break. Use of this command will drop the load
31	Coming to overload due to inverter off	When the inverter off manually, the load will be exceeded the power capacity
32	Coming to interval transfer due to inverter off	When the inverter off manually, The load exceeded the power capacity
33	Inverter invalid due to over load	The load exceeds the UPS output capability
34	Change master	Inverter master
35	Transfer times-out	Latched load transfer to bypass as a result of repeated transfers within one current hour. Automatic reset is attempted in the next hour
36	UPS in shutdown due to overload	
37	UPS in bypass due to overload	
38	Parallel in bypass	The parallel system has switched to bypass
39	LBS activated	
40	Thunder protect	The lightning protector has been activated
41	ECO activated	The inverter is on but the load is being supplied via the bypass switch

Alarm information

No	Display message	Description
1	Rectifier fault	Rectifier, inverter and charger shutdown
2	Rectifier over temperature	Charger and inverter shutdown
3	Inverter over temperature	Inverter shutdown
4	Auxiliary power 1 fault	Control power 1 has failed
5	Auxiliary power 2 fault	Control power 2 has failed
6	Fan fault	One or more fans has failed. Rectifier, inverter and charger shutdown
7	Fan power fault	One or more fan power supplies is not working. The UPS will continue to work but the FPSU must be replaced.
8	DC bus over voltage	Rectifier, inverter and battery converter shutdown
9	DC bus below voltage	Rectifier, inverter and battery converter shutdown

No	Display message	Description
10	DC bus unbalance	The difference between the positive and negative DC buses exceeds 30 V
11	Mains site wiring fault	Wrong input phase rotation
12	Soft start fault	Rectifier can't start because the DC bus voltage is too low
13	Input neutral line missing	UPS switched to battery mode
14	Battery reverse	Battery polarity incorrect
15	No battery	Battery is disconnected
16	Positive battery charger fault	Charger shutdown
17	Negative battery charger fault	Charger shutdown
18	Battery under voltage	Charger is deactivated
19	Battery over voltage	Charger is deactivated
20	Battery under voltage pre-warning	The UPS is in battery mode and the battery voltage is low. **Note:** Runtime is limited.
21	Mains freq. abnormal	Rectifier shutdown
22	Mains volt. abnormal	Rectifier shutdown
23	Inverter fault	The inverter has shutdown because its output voltage is out of range (rated voltage +12.5% and –25%), and the UPS has transferred to bypass. Power off the UPS to clear this fault.
24	Inverter IGBT bridge direct conduct protection	Inverter shutdown
25	Inverter thyristor short fault	There is a short circuit inverter SCR
26	Inverter thyristor broken fault	There is an open circuit inverter SCR
27	Bypass thyristor short fault	There is a short circuit bypass SCR
28	Bypass thyristor broken fault	There is an open circuit bypass SCR
29	CAN comm. fault	CAN communication fault
30	Parallel system load sharing fault	Load sharing unbalance has exceeded 30%
31	Bypass site wiring fault	Wrong bypass phase rotation
32	System not synchronized to bypass	System cannot synchronize to bypass. Mode may not be available
33	Bypass unable to trace	
34	Bypass not available	The frequency or voltage is out of range for bypass
35	IGBT over current	
36	Fuse blown	One or more inverter fuses has blown
37	Parallel cable connection error	A parallel cable is not correctly connected in a parallel system
38	Parallel relay fault	Occurs when a parallel circuit relay cannot be turned on correctly. The UPS shuts down. Power off the UPS to clear this fault
39	LBS not sync.	Two paralleled system are not synchronised
40	Initialisation fault	
41	Inverter on invalid	The inverter on button has been activated
42	Overload	The load exceeds the UPS capacity
43	Parallel overload	
44	DC component over limitation	The DC component exceeds the specified value

No	Display message	Description
45	Bypass over current	An over current alarm is given
46	Ext. fire alarm	External fire detector has been activated
47	Ext. smog alarm	External smog detector has been activated

Frequently asked questions

No	Problem	Causes	Solution
1	No LCD display	Display cable not plugged in correctly	Unplug the cable from the rear of the LCD panel and then plug it in again
2	Blue screen LCD	LCD interference	
3	Red LED on module	Module not plugged in correctly	Pull out the module and then push back in
4	UPS won't start	Input breaker is open	Close the input breaker
		AC input is out of specification	Check that the voltage and frequency are within limits
5	No output from UPS	Output breaker is open	Close the output breaker
		UPS disabled at the LCD control panel	Enable the UPS using the LCD control panel
6	Inverter not working	Inverter not started	Press Inverter ON for 2 seconds
7	UPS works on bypass only	Mains breaker is open	Close the mains breaker
		UPS working in ECO mode	Set the UPS to work in on-line mode
		Switch Bypass times out (If the UPS has repeatedly switched to bypass due to over current/temp more than the 'bypass switch times')	Increase the time or restart the UPS
8	Can't 'black start' the UPS	Battery breaker is open	Close the battery breaker
		A battery fuse is open	Change the fuse
		Battery low	Recharge the battery

Appendix 1 Signals options

RS232 serial port

E400 series units are fitted with a standard RS232 serial port, which can be used to:

- Monitor the UPS power status
- Monitor the UPS alarm information
- Monitor the UPS running parameters
- Perform a battery test

To enable RS232 control:

1. Connect the UPS to your computer using the supplied RS232 cable.
2. Load the supplied software onto your computer.

Connections between computer and UPS RS232

Computer		UPS
RDX 2	←	TX 3
TDX 3	→	RX 2
GND 5		GND 5

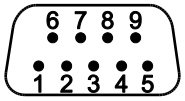


Figure 9 RS232 serial port pin-outs looking at the socket on the UPS

RS232 communications data format

Parameter	Value
Baud rate	2400 bps
Byte length	8bit
End bit	1bit
Parity check	Null

Contact closure for external batteries

E400 series units are fitted with a Wieland Electric socket (plug part number 25.340.3453.0) for contact closure signals to drive an external main breaker and an external maintenance breaker. The connector is located behind a protective cover just below the black start switch (see Figure 3 on page 14). The signal connections are as follows:

Pin number	Function
1	+5V
2	Output to main breaker
3	+5V
4	Output to maintenance breaker

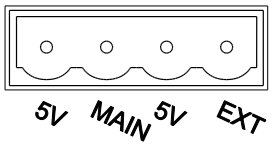


Figure 10 Contact closure socket

SNMP card (with environmental monitor

If your unit is fitted with the optional SNMP card (located in the Intelligent Slot on the front panel), connect it to your computer with a network cable. You can also connect a modem and environment controls as shown in Figure 11.

For instructions on how to operate the SNMP card, refer to the documentation on the supplied CD.

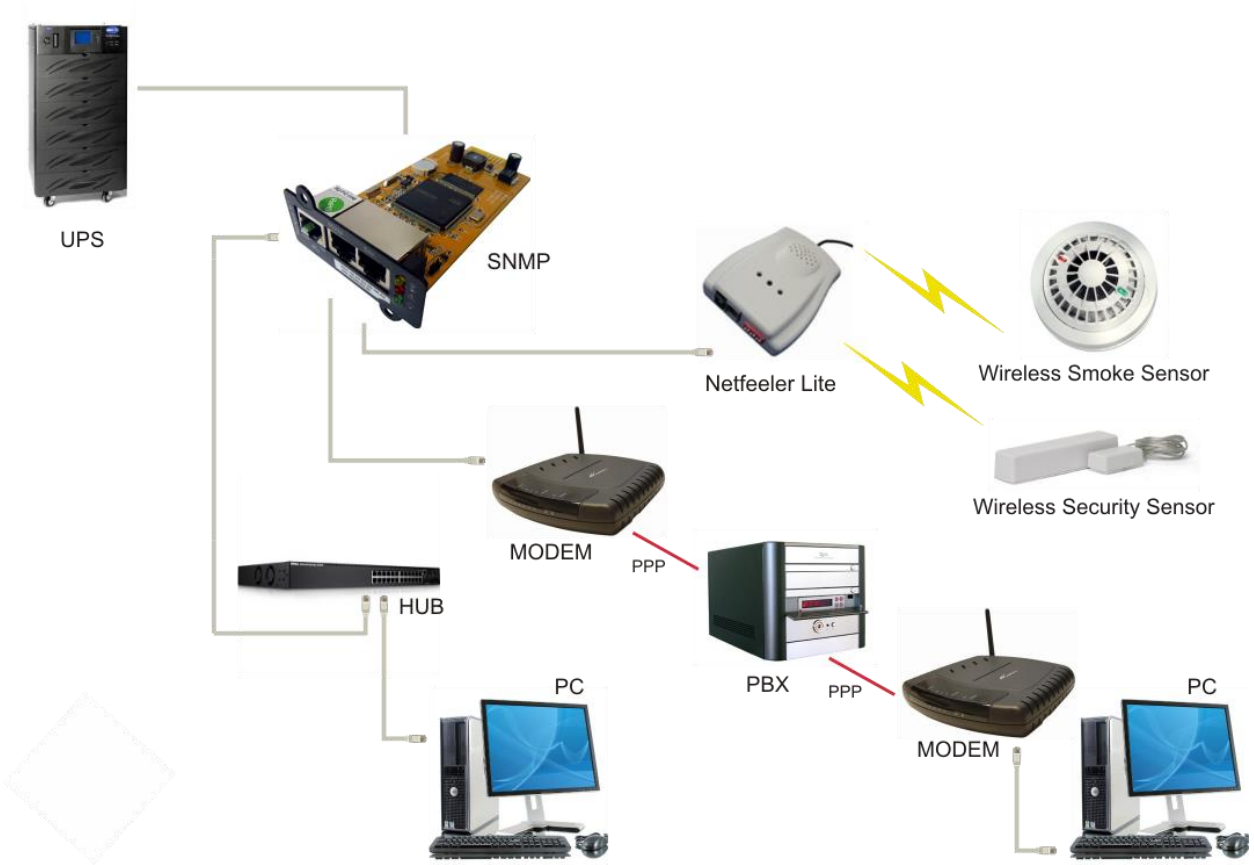


Figure 11 A topology using network, modem and environmental functions

The SNMP card supports the MEGAtec protocol, allowing you to remotely monitor and manage your UPS system.

NetAgent II-3 Ports supports the Modem Dial-in (PPP) function to enable remote control via the Internet when your network is unavailable.

In addition to the features of a standard NetAgent Mini, NetAgent II has the option to add NetFeelerLite to detect temperature, humidity, smoke and security sensors, thus making NetAgent II a versatile management tool. NetAgent II also supports multiple languages and is setup for web-based auto-detection of language.

Relay card (monitoring and control)

E400 series units are fitted with a relay card (located in the Intelligent Slot, see Figure 3 on page 14) you have access to monitoring and control functionality via a set of dry contacts and a single opto-coupled input.

Connections:

Pin no.	Description	Contact status	Additional fault information
1	Mains out of limits	closed (on)	
2	Battery low	open (off)	
3	Battery low	closed (on)	
4	Bypass output	closed (on)	
5	Internal failure	closed (on)	• Rectifier fault • inverter fault and shutdown • over temperature and shutdown • short circuit and shutdown
6	Inverter output	closed (on)	
7	System alarm	closed (on)	• Rectifier fault • inverter fault and shutdown • over temperature and shutdown • short circuit and shutdown
8	Relay common GND		
9	Remote shutdown	+V (see opto specification below)	+5 V to +12 Vd.c. input
10	Remote shutdown	0 V (not the same as relay common)	
1	Mains out of limits	closed (on)	
2	Battery low	open (off)	
3	Battery low	closed (on)	
4	Bypass output	closed (on)	
5	Internal failure	closed (on)	• Rectifier fault • inverter fault and shutdown • over temperature and shutdown • short circuit and shutdown
6	Inverter output	closed (on)	
7	System alarm	closed (on)	• Rectifier fault • inverter fault and shutdown • over temperature and shutdown • short circuit and shutdown

Relay contact specifications:

Parameter	Value
Maximum switched voltage	277 Va.c. or 30 Vd.c.
Typical switched voltage	5 to 12 Vd.c.
Maximum switched current	NO: 10 A NC: 3 A
Maximum switched power	NO: 1400 VA, 150 W NC: 850 VA, 90 W

Opto-coupler input specifications (used for remote shutdown):

Parameter	Value
Reverse voltage (V_R)	5 Vd.c.
Forward input voltage	30 Vd.c. max., 5 to 12 Vd.c. typical
Forward current	25 mA max., 16 mA typical
Pulse forward current (I_{FP})	1 A (100 µs pulse, 100 pps)

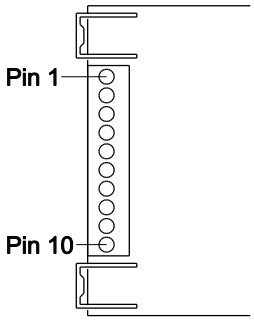


Figure 12 Relay card connector (viewed from connector side)

To connect to the relay card:

1. Unlock and open the front door.
2. On the front panel, unscrew the card and slide it out completely or sufficiently to access the terminal block.
3. Using the information in the tables above, wire your signal cables to the terminal block (Figure 13).
4. Refit the card and secure it in place with the cover plate.

Dry contact relay signals

To wire to the sockets you will need:

- Wieland Electric plugs, part number 25.340.0753.0

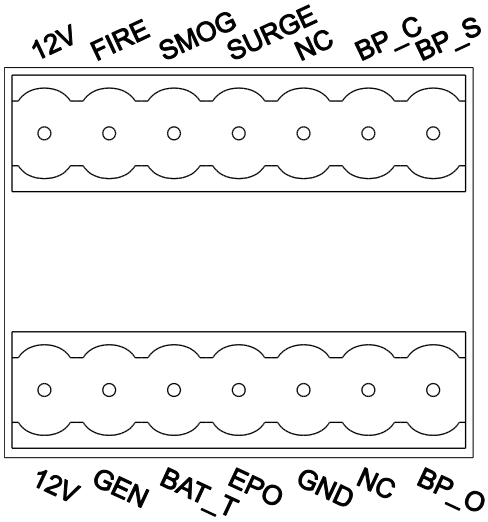


Figure 13 Dry contact relay sockets

Connections:

Signal name	Description
12V	Provides a +12 V 100 mA isolated supply on each connector row
FIRE	Fire alarm input signal
SMOG	Smog alarm input signal
SURGE	Surge alarm output signal
NC	No connection
BP_C	Anti-backfeed relay common
BP_S	Anti-backfeed relay normally open To prevent the input being energised by backfeeding in the event of an internal failure, connect this signal to an external circuit breaker trip
GEN	Generator signal input
BAT_T	Over temperature switch on battery. Feed +12 V via the switch when the battery temperature is exceeded
EPO	Emergency power off connect to +12V for complete power off (pulse contact)
GND	Common return (0 V) for the +12 V supply and relays. This is not connected to the chassis
BP_O	Anti-backfeed relay normally closed To prevent the input being energised by backfeeding in the event of an internal failure, connect this signal to an external circuit breaker trip

Battery temperature sensor

A battery temperature sensor is available as an option for E400 series units. When connected the sensor monitors and displays battery cabinet temperature, and it controls the UPS to compensate the battery charging voltage. The sensor is connected to the MODBUS connector on the UPS (see Figure 3 on page 14).

For further details ask you distributor for the sensor user manual.

Appendix 2 Parallel operation

The following signals are available on each UPS for parallel operation:

- Parallel port connectors. These must be connected as described in **Error! Reference source not found.** on page **Error! Bookmark not defined.**.
- LBS (Load Bus Synchronisation) signals. These may be used to synchronise two paralleled systems as described below.
- Remote emergency power off (EPO) as described below.

LBS (Load Bus Synchronisation)

It is possible to synchronise the outputs of two separate paralleled systems, where each system can consist of up to 4 paralleled units. It is only necessary to connect UPS number 1 of each system.

To do this, connect the LBS connector of system A to the LBS connector of system B (Figure 14). The LBS connectors are RJ11 sockets on the front panel.

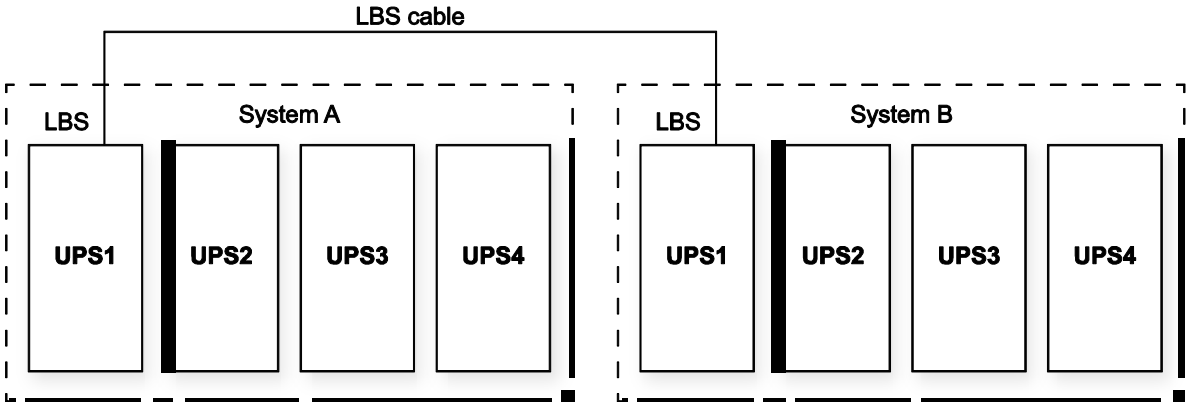


Figure 14 Synchronisation of two paralleled systems

Remote emergency power off (EPO)

In a parallel system the EPO switch on the front panel of any unit will turn off the whole system. It is also possible to add a remote EPO switch in addition to the front panel switch.

Wire the switch as shown in Figure 15. Only one 12V connection is required and it can be made to any unit in the system.

Switch type: normally open

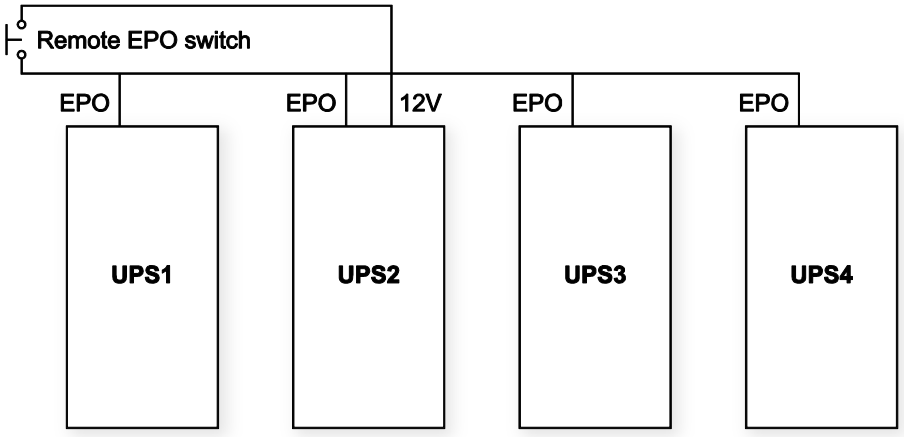


Figure 15 An N+1 parallel system with remote EPO switch

Appendix 3 Specifications

Electrical

Model	E420	E430	E440	E460	E480
Capacity	20 kVA	30 kVA	40 kVA	60 kVA	80 kVA

Input					
Input current (maximum)	40 A	63 A	80 A	125 A	160 A
Power factor	<0.99				
Input type	3 phase 4 wire (L1, L2, L3, N and E)				
Rated voltage	380 / 400 / 415 V a.c.				
Voltage range	P_o≤ 69%: 208 ± 5 V a.c. to 478 ± 5 V a.c. P_o> 69%: 304 ± 5 V a.c. to 478 ± 5 V a.c.				
Frequency range	40± 0.5 Hz to 70± 0.5 Hz				
THDI	Input THDV:≤1%, linear load: ≤3% Input THDV:≤1%, non-linear load:≤7%				

Battery					
Number of 12 V batteries	32, 34, 36, 38 or 40 in series				
Battery type	VRLA				
Discharge current (A) @ 320 V d.c.	E420 54	E430 81	E440 106	E460 160	E480 213
Charge current (A)	15		30		

Output	
Output current (A) @380 V (full load) @400 V @415 V	32, 34, 36, 38 or 40 in series
Output type	3 phase 4 wire (L1, L2, L3, N and E)
Power factor	0.8
Waveform	Sine wave
Crest factor	<3:1
Frequency	50Hz/60Hz+ 0.5 Hz (battery mode)
Output precision	1.0%
Voltage distortion (THD)	<2% with 100% linear load <4.5% with 100% non-linear load
DC component	<500 mV d.c.
Voltage precision	Output balanceable: + 1.0% Output non-balanceable: + 3.0%
Overload	110%, 1 h 125%, 10min 150%, 1min Bypass mode: 125% to 170%, 10 min
Bypass and ECO voltage range	Adjustable via the LCD panel using ‘bypass volt upper limit’ and ‘bypass volt lower limit’
Efficiency in line mode	<90%
Efficiency in battery mode	20/30 kVA, >93%: 40/60/80 kVA, >94%
Efficiency in ECO mode	<97%
Dynamic respond	5.0%, 20ms

Switch time	
Between normal mode and battery mode	0ms
Between inverter and bypass	0ms Unlock: <15ms (50Hz), <13.33ms (60Hz)

Parallel operation	
Parallel equal current	1+1<8%, N+1<10%

Safety and EMC	
Safety	3C/EN60950/EN50091-1
Isolation resistance	>2MΩ (500Vd.c.)
Isolation voltage	2,820Vd.c., <3.5mA1min
EMC	Conduction: IEC 62040-2
	Radiation: IEC 62040-2 C3
	Harmonic: IEC 62040-2

Reliability	
MTBF	Inverter: 50,000 hrs Single module: 250,000 hrs 1+1 expandable modules: 400,000 hrs
MTTR	<30min

Mechanical

	E420, E430 and E440	E460 and E480
Height (mm)	1200	1800
Width (mm)	600	600
Depth (mm)	730	730
Net weight (gross weight)	E420: 186 kg (226 kg) E430: 192 kg (232 kg) E440: 201 kg (248 kg) E460: 297 kg (354 kg) E480: 312 kg (369 kg)	
Audible noise	<56 dB (1m)	
Colour	Black	
Display	LCD and LED	
Ingress protection	IP20	
Vibration	ISTA (International Safe Transmission Association) 1B	
Transport	ISTA 1B	

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Appendix 4 Optional equipment

The following items are available as options for the UPS:

- SNMP card
- Battery temperature compensation (special order)
- Paralleling cables
- RS485 cable (serial data cable to connect between paralleled units)
- LBS cable