TOSHIBA

6F3H1048

Uninterruptible Power System (UPS)

G8000U Series

Operation Manual

REQUIREMENT

1. Read through this operation manual carefully before operating the UPS.
2. Place this manual close to the UPS to be able to refer to whenever necessary.
3. This manual should be distributed to the proper personnel who will operate and/or maintain the UPS.

July 2003

Notices

1. This instruction shall not be partially/entirely copied without authorization by Toshiba Corporation.
2. Please inform Toshiba Corporation or authorized representatives in case of inconsistencies, omissions or questions.

1. Introduction

This Uninterruptible Power System (abbreviated as "UPS" hereafter), G8000 series is designed to supply power with stable voltage amplitude and frequency to the load, even while the commercial utility line has interruptions, brownouts, blackouts or voltage/frequency deviation.

This instruction is designed to ensure the safe and correct operation of the G8000 UPS. Please read through all of the chapters before operation. Above all, read the “General safety instructions”, “Important safety instructions”, "Safety Precautions" and "Operation" chapters as these must be carefully read. Please make sure you have a thorough understanding of the information in these 4 chapters.

Personnel who will install, operate and maintain this UPS should carefully read this manual before installation and operation.

Keep this manual close to the UPS so that you can refer whenever necessary.

Also, please read through the installation manual (6G3H0529). That manual describes the important instructions during the UPS installation. Both manuals should be kept together.

2. GENERAL SAFETY INSTRUCTIONS

Each *Warning* in this manual appears in one of four ways:

1) *Danger*- The danger symbol is a lightning bolt mark enclosed in a triangle which precedes the word "DANGER". The danger symbol is used to indicate imminently hazardous situations, locations, and conditions which, if not avoided, WILL result in death, serious injury, and/or severe property damage.

DANGER

2) *Warning*- The warning symbol is an exclamation mark enclosed in a triangle which precedes the word "WARNING". The warning symbol is used to indicate potentially hazardous situations and conditions which, if not avoided, COULD result in serious injury or death. Severe property damage COULD also occur.

WARNING

3) *Caution*- The caution symbol is an exclamation mark enclosed in a triangle which precedes the word "CAUTION". The caution symbol is used to indicate potentially hazardous situations and conditions which, if not avoided, COULD result in injury. Equipment damage COULD also occur.

CAUTION

4) *Attention*- The attention warning symbol is an exclamation mark enclosed in a triangle which precedes the word "ATTENTION". The attention symbol is used to indicate situations and conditions that COULD cause operator injury and/or equipment damage.

ATTENTION

Other warning symbols may appear along with the *Danger* and *Caution* symbols. The additional symbols are used to specify special hazards. These warnings describe particular areas where special care and/or procedures are required in order to prevent serious injury and possible death:

1) *Electrical warnings*- The electrical warning symbol is a lighting bolt mark enclosed in a triangle. The Electrical warning symbol is used to indicate high voltage locations and conditions that COULD cause serious injury or death if the proper precautions are not observed:

2) *Explosion warnings*- The explosion warning symbol is an explosion mark enclosed in a triangle. The Explosion warning symbol is used to indicate locations and conditions where molten, exploding parts that COULD cause serious injury or death if the proper precautions are not observed:

3. IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This instruction contains important instructions for G8000U Series 150, 225 and 300kVA that should be followed during the installation, operation, and maintenance of the UPS systems. Please refer to the battery manufacturer's instructions for details on operating and maintaining the batteries for each system.

UPS System's input and output are NOT equipped with an over-current protection device, nor an output disconnection at the AC output. Therefore, a circuit breaker should be provided by the user between the UPS output and the critical load input. The minimum device ratings should be as follows:

Model	Rated Output	Breaker Rating	Model	Rated Output	Breaker Rating
150kVA	480V/277Vac	480V-225A	225kVA	480V/277Vac	480V-350A
300kVA	480V/277Vac	480V-500A			

Circuit breakers should be provided by the user between AC input (or Bypass input) and power sources. The minimum device ratings should be as follows:

Model	Rated Input	Breaker Rating	Model	Rated Input	Breaker Rating
150kVA	480V/277Vac	480V-225A	225kVA	480V/277Vac	480V-350A
300kVA	480V/277Vac	480V-500A			

The maximum ambient temperatures in which the UPS should be operated is 40°C (104°F), and 32°C (90°F) maximum if the battery system is subject to the same ambient temperature.

The nominal battery voltage for these models is 360Vdc. The nominal battery float voltage is 405Vdc. Only a certified service representative with battery experience should perform service on batteries. Keep unauthorized people away from batteries.
Please refer to the battery manufacturer's instruction when battery maintenance and/or replacement are scheduled.

CAUTION

Misuse of this equipment could result in personal injury and/or equipment damage.
In no event will Toshiba Corporation be responsible or liable for either indirect or consequential damage or injury that may come from the use of this equipment.

4. Safety Precautions

Application

This UPS shall NOT be applied to support equipment (*) that could affect human lives.

Special considerations are required when applying this UPS to the equipment (**) that affect human safety and/or maintain public services.

Be sure to contact/inform Toshiba if it is such a case. The application without special consideration may cause serious accidents.

(*)
- Medical operation room equipment
- Life support equipment (artificial dialysis, incubators, etc.)
- Toxic gas or smoke eliminators
- Equipment that must be provided under fire laws, construction standard or other ordinances
- Equipment equivalent to the above

(**)
- Equipment to supervise or control airways, railways, roads, sea-lanes or other transportation.
- Equipment in nuclear power plants.
- Equipment to control communications.
- Equipment equivalent/similar to the above mentioned.

Disclaimer

In no event will Toshiba Corporation be responsible or liable for either indirect or consequential damage or injury that may come from the use of this equipment.

Any modifications without authorization by Toshiba could result in personal injuries, death or destruction of the UPS.

Warning Labels Check

Make sure all the warning labels are accordingly placed in the appropriate locations (see page 10~12).

If a label is missing or illegible, contact Toshiba or authorized representatives.

WARNING

If the UPS produces smoke or smells strange, turn off AC input breaker and battery breaker immediately.

Continued running may result in fire. Contact Toshiba or authorized representatives.

Contact the Toshiba or authorized representatives in case of malfunction or fault.

This UPS should be repaired only by authorized Toshiba service personnel. Service by untrained personnel may extend the fault further and/or may result in electric shock or personal injury.

Do NOT modify the UPS, relocate after initial installation, or replace parts by untrained personnel.

Electrical shock, injury or UPS faults may happen if non-certified technicians attempt to modify or relocate the UPS.

Please contact Toshiba if you need UPS modifications or plan to move the UPS.

PROHIBITED

Do NOT open the front cover.

There are energy-high current areas and parts within the UPS.

- Electric shock, burns or other personal injuries may occur if the front cover is opened by untrained personnel.

PROHIBITED

WARNING

Do NOT remove the rear/side panels.

The parts inside carry energy-high current. That may result in electric shock, burns, personal injuries or UPS faults by removing these panels.

PROHIBITED

CAUTION

Operators should be certified* personnel.

Operation of the UPS by uncertified or untrained personnel may result in electric shock, personal injury or UPS fault.

* In accordance with the customers' requirements.

Make sure the air vents on the front and top of the UPS are not blocked.

Blocking the vents will cause the temperature inside the UPS to rise and may result in fire or UPS faults.

Please understand what the warning labels state, and follow the warnings or procedures indicated on these labels.

Operating the equipment without thorough understanding of these labels may result in electric shock, burns or personal injuries.

. See Page 10~12 for warning label location.

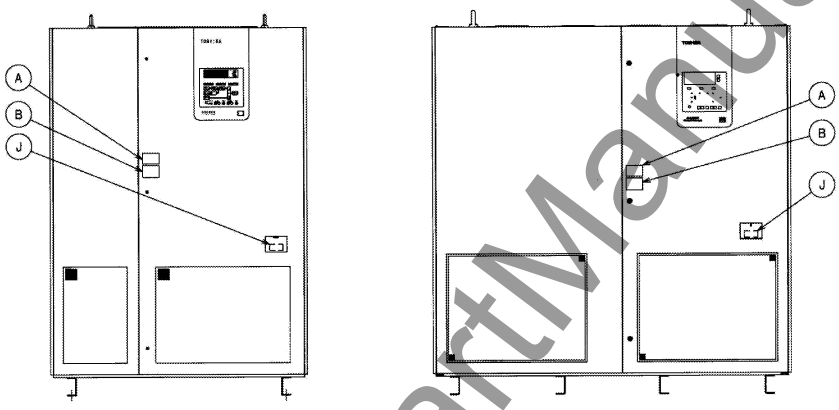
Checking warning labels

(1) Warning label locations on the UPS are shown in Figures below. Please make sure these warning labels are adhered in specified locations.

(2) Please read all warning labels and understand what they mean.

(3) Make sure warning labels are always legible. Do NOT allow them to be removed or covered up.

Locations of the Warning Labels



150, 225kVA 300kVA

Ⓐ

⚠ DANGER

CONTAINS PARTS NOT SERVICEABLE BY THE USER

- Do not remove cover
- No user serviceable parts inside.
- Refer servicing to qualified service personnel.
- Intended for installation in a controlled environment.

Ⓑ

⚠ DANGER

RISK OF ELECTRIC SHOCK

- This UPS receive power from more than one source-disconnection of all sources is required to de-energize this unit before servicing.
- Dangerous electric charge may be stored in capacitors and associated circuitry.
- Wait at least five (5) minutes for power to dissipate then check voltage before servicing.

Ⓙ

⚠ CAUTION

8A

(control power source switch)

Do not turn off while operating.

⚠ The exclamation mark within a triangle is intended to tell the user or the service personnel that cautionary markings are located with “CAUTION,” “WARNING,” or “DANGER”.

Figure 4.1 UPS exterior showing warning label locations

5. Installation Precautions

Please have the certified/qualified electrician to install the UPS per local, state and National Electrical Code.

UPS faults or improper operation may occur if not installed properly per Codes and the installation manual.

MANDATORY

The UPS is to be installed in a controlled environment.

High temperature/humidity may shorten the life of components within the UPS.

MANDATORY

Do NOT install the UPS close to a water source.

It may cause electrical shock, UPS fault or other accidents.

PROHIBITED

Please ask Toshiba or authorized representatives when the UPS and/or components are to be disposed.

It may be illegal to dispose of certain components without conforming to environmental regulation for industrial/commercial waste.

MANDATORY

Connect ground wire to the earth ground terminal only.

Missing ground wire may cause electrical shock. Connecting to more than one ground may cause ground loop.

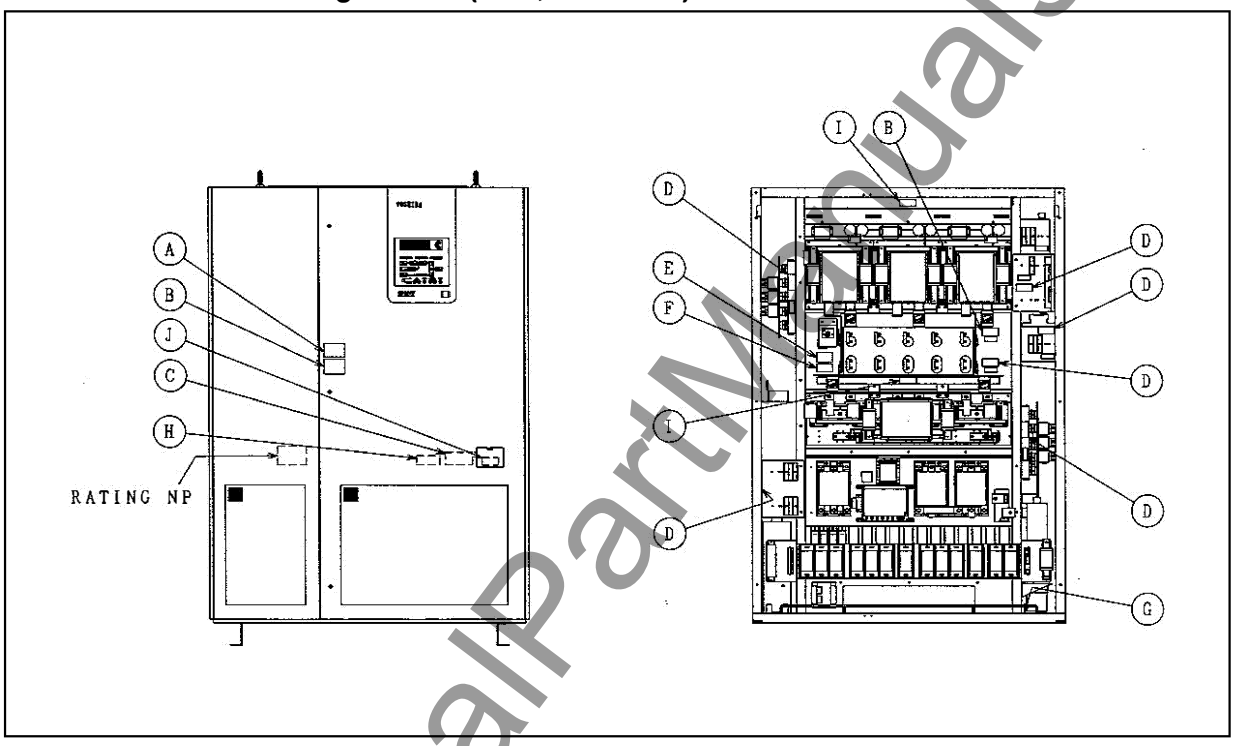
Refer to the installation manual for ground wiring details.

MANDATORY

Check warning labels;

(1) Warning label locations on the UPS are shown in Figures below. Please make sure these warning labels are adhered in specified spots.
(2) Please read all warning labels and understand what they mean.
(3) Make sure warning labels are always legible. Do NOT allow them be removed or covered up.

Locations of the Warning Labels (150, 225 kVA)



Locations of the Warning Labels (300 kVA)

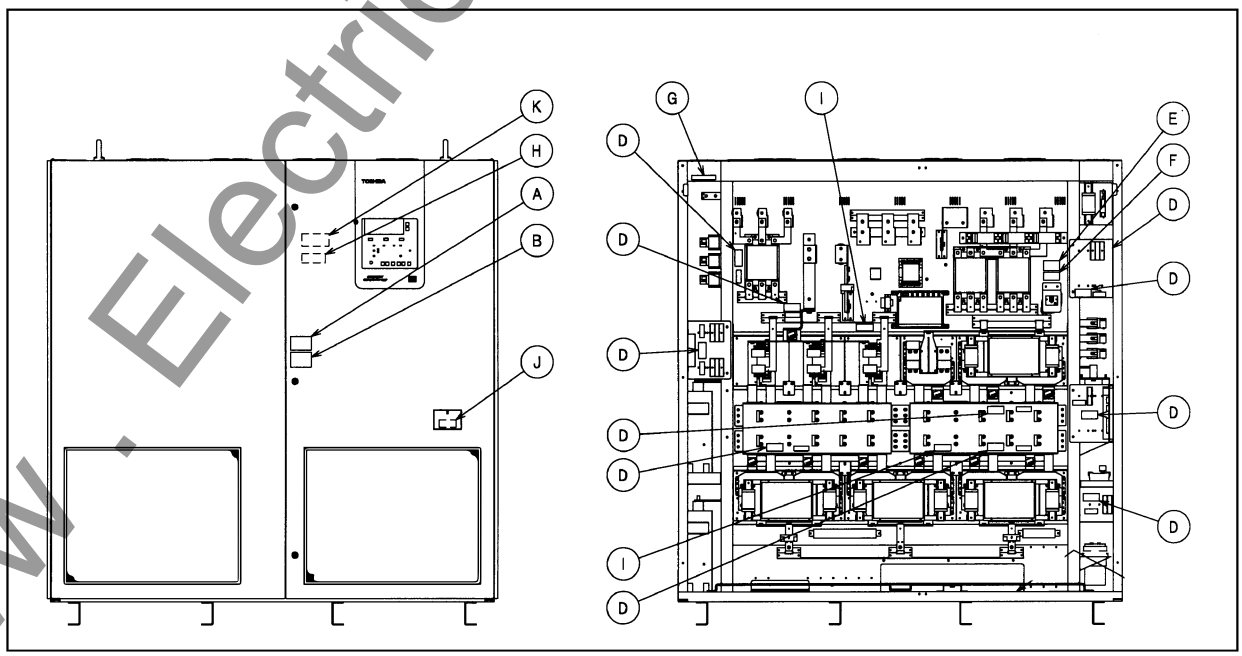


Figure 5.1 UPS exterior/interior showing warning labels

The meaning of symbols in these cautionary markings is following.

1) 

The exclamation mark within a triangle is intended to tell the user or the service personnel that cautionary markings are located with “CAUTION,” “WARNING,” or “DANGER”.

2) 

The lightning flash with arrowhead within a triangle is intended to tell the user or the service personnel that parts inside the product are a risk of electric shock to personnel.

3) 

The ground symbol in a blue circle is intended to tell the user or the service personnel the location of the equipment-grounding conductor.

Ⓐ

⚠ DANGER

CONTAINS PARTS NOT SERVICEABLE BY THE USER

- Do not remove cover
- No user serviceable parts inside.
- Refer servicing to qualified service personnel.
- Intended for installation in a controlled environment.

Ⓑ

RISK OF ELECTRIC SHOCK

- This UPS receive power from more than one source-disconnection of all sources is required to de-energize this unit before servicing.
- Dangerous electric charge may be stored in capacitors and associated circuitry.
- Wait at least five (5) minutes for power to dissipate then check voltage before servicing.

Ⓒ (For 150/225kVA)

USE COPPER CONDUCTORS ONLY
REFER TO INSTRUCTION MANUAL REGARDING TIGHTENING TORQUE OF TERMINAL BLOCKS.

1	2	3	4	5	6	7	8	9	10	11	12	13
U	V	W	U	V	W	N	U	V	W	N	-	+

480V AC INPUT | 480V BYPASS INPUT | 480V AC OUTPUT | 400V BATTERY

Ⓓ

⚠ WARNING

CRITICAL FUSE SIZING

- Incorrect fuse replacement size may result in fire or inadequate equipment protection.
- Replace only with same type and rating of fuse.

Ⓔ

⚠ DANGER

RISK OF ELECTRIC SHOCK

- Capacitors stay charged after power has been shut off.
- Accidental contact with live parts can cause personal injury and death.
- Turn off and lock out all power sources.
- Wait at least five (5) minutes for power to dissipate then check voltage before servicing

Ⓕ

⚠ DANGER

RISK OF ELECTRIC SHOCK OR ELECTRIC ENERGY-HIGH CURRENT LEVELS

- Dangerous electric charge may be stored in capacitor and associated circuitry.
- Test before touching.

Ⓖ

⏚	Grounding Electrode Terminal

Ⓗ

⚠ CAUTION

The output ac circuit is considered as a separately-derived source. If local codes require grounding of this circuit, use terminal (identify terminal) for bonding this circuit to the enclosure. Ground the enclosure to a suitable grounding electrode in accordance with local code requirements.

Ⓘ

⚠ CAUTION

RISK OF ELECTRIC SHOCK
Heat Sink (IGBT) is not grounded.
Test before touching.

Ⓙ

⚠ CAUTION

8A
(control power source switch)
Do not turn off while operating.

Ⓚ (For 300kVA)

USE COPPER CONDUCTORS ONLY
REFER TO INSTRUCTION MANUAL REGARDING TIGHTENING TORQUE OF TERMINAL BLOCKS.

1	2	3	4	5	6	7	8	9	10	11	12
U	V	W	-	+	U	V	W	N	U	V	W

480V AC INPUT 400V BATTERY 480V BYPASS INPUT 480V AC OUTPUT

* The label G is attached at the ground wire connection point.
** The label E is mounted in the vicinity of the main circuit transformers and reactors that can be seen from the back of the UPS.

Figure 5.2 Warning Labels

6. Handling Precautions

Perform daily inspections and planned periodic maintenance.

In order to extend the service life and optimal performance, the UPS must be installed in a suitable environment, and should have adequate daily/periodic inspections.

The periodic inspection is significantly effective to prevent the UPS from faults or accidents. It is recommended to have preventive maintenance by Toshiba service technicians.
For service information, contact Toshiba.

Conditioned environment in the room the UPS and the battery are installed is required.

Turning off the air conditioner will cause high temperatures and may result in an UPS fault.

High temperatures shorten the life of components within the UPS and battery systems.

Please operate the UPS using the procedures described in Chapter 10 "Operation", while referring to the instruction/information on graphic panel LCD.

Operation procedures other than specified may result in an UPS fault.

* The startup and stop procedures described in this manual are only for the UPS.
For system operation procedure with maintenance bypass and/or distribution cabinet, please refer to the system operating procedures.

Do NOT turn off the control power source switch (8A) during operation.

This may result in UPS faults.

PROHIBITED

Do NOT put pieces of metal, flammable objects or fingers into the air vents or mechanical gaps of the UPS.

It may cause fire, explosions, or may give an electrical shock.

PROHIBITED

Do NOT operate the UPS in wet locations.

Operation in wet location may cause electrical shock, UPS fault or other accidents.

PROHIBITED

Keep the reset button pressed for 5 seconds to reset the UPS.

The UPS may not be reset if the duration is too short.

MANDATORY

7. Contents

8. Outline and Layout

⚠ **WARNING**	**Do NOT open the front and/or rear panel.** The parts inside carry energy-high current. Touching them may result in electric shock, burns or UPS fault.

⚠ **CAUTION**	**Make sure the air vents on the front and top of the UPS are not covered.** Covering the vents will cause the temperature inside the UPS to rise and may result in fire and/or UPS faults.

Figure 8.1 shows the outline dimensions of the 150kVA & 225kVA UPS.

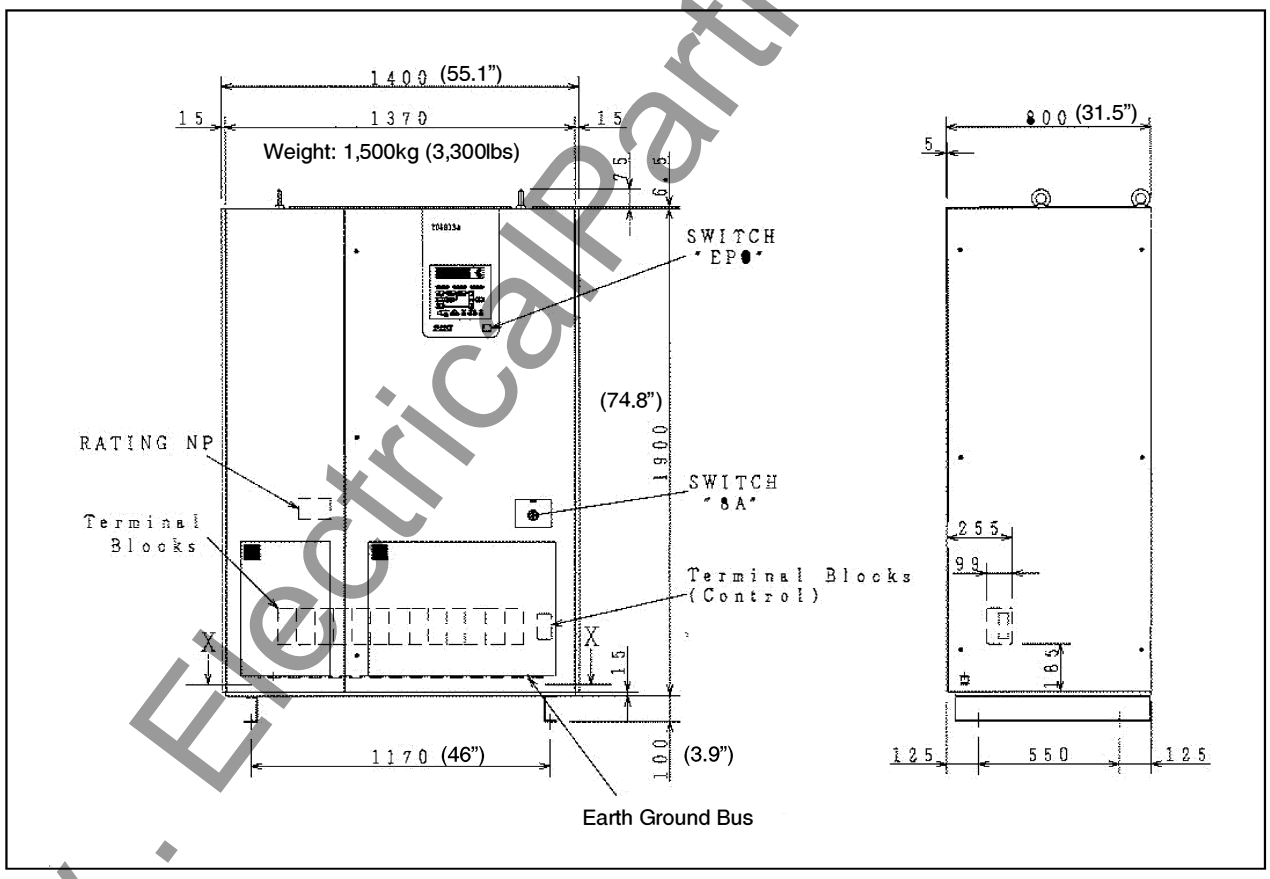


Figure 8.1 150 & 225kVA UPS Exterior dimensions (front & right side)

Figure 8.2 shows the outline dimensions of the 300kVA UPS.

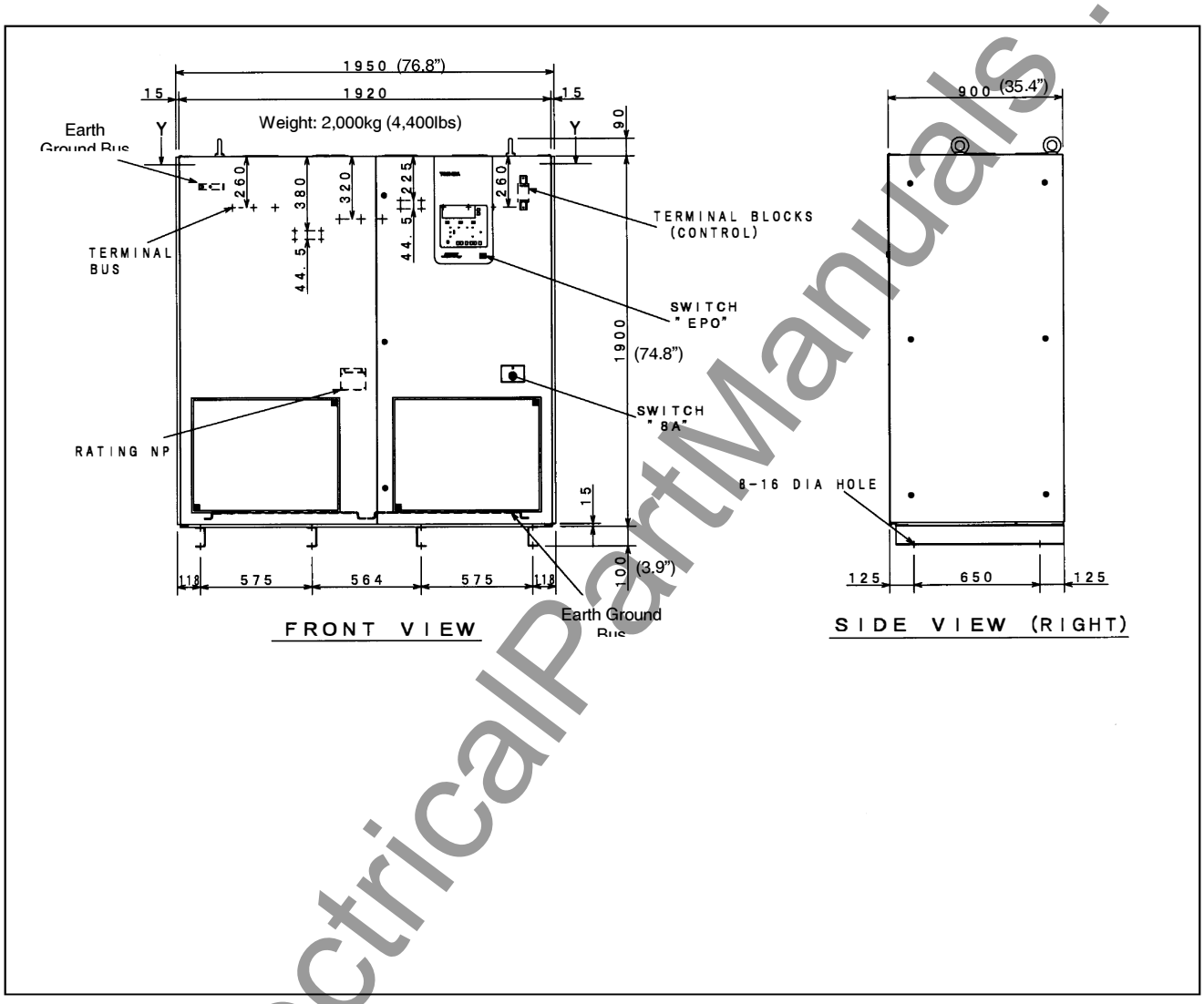
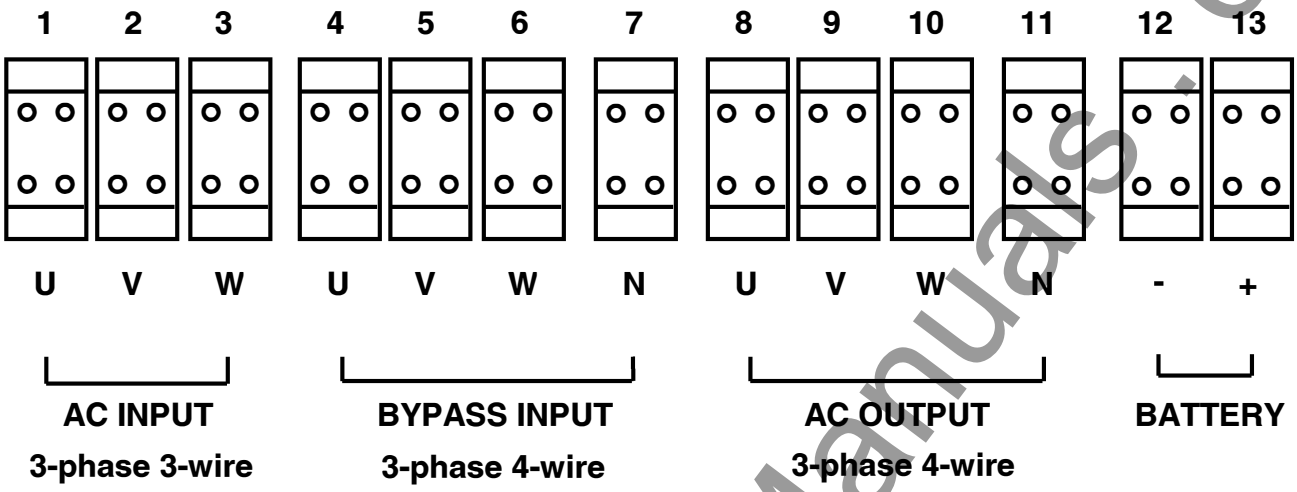


Figure 8.2 300kVA UPS Exterior dimensions (front & right side)

8.1 UPS Connections

Terminal Blocks 150, 225kVA



The terminals shown are located at the bottom inside of the 150/225kVA UPS. External cable size is recommended in the Table 8.1/8.2.

Table 8.1 Recommended Cable Size and Tightening Torque for 150kVA UPS

The tightening torque must be greater than 90 percent of the recommended torque.

Cable Size and Tightening Torque for 150kVA UPS (Only copper wires allowed)		
Block Number	Cable Size	Tightening Torque
1	AWG 3/0 or larger	275 in-lbs
2	AWG 3/0 or larger	275 in-lbs
3	AWG 3/0 or larger	275 in-lbs
4	AWG 3/0 or larger	275 in-lbs
5	AWG 3/0 or larger	275 in-lbs
6	AWG 3/0 or larger	275 in-lbs
7	AWG 3/0 or larger	275 in-lbs
8	AWG 3/0 or larger	275 in-lbs
9	AWG 3/0 or larger	275 in-lbs
10	AWG 3/0 or larger	275 in-lbs
11	AWG 3/0 or larger	275 in-lbs
12	Two AWG 3/0 or larger	275 in-lbs
13	Two AWG 3/0 or larger	275 in-lbs

NOTE: Maximum cable size is 350MCM

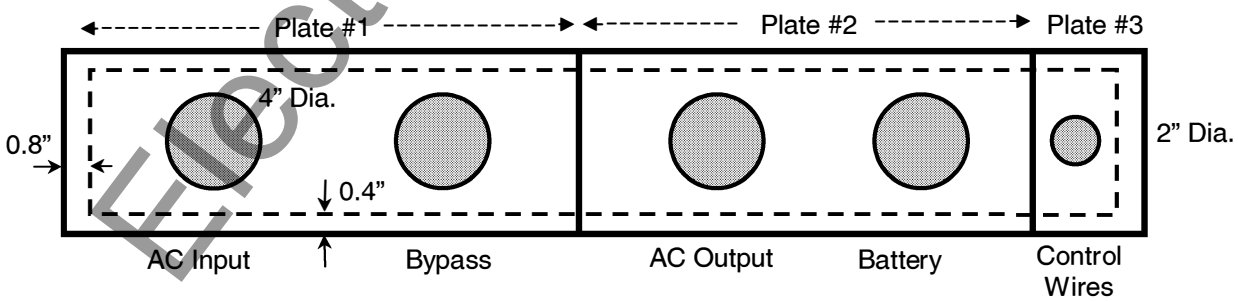
Table 8.2 Recommended Cable Size and Tightening Torque for 225kVA UPS

The tightening torque must be greater than 90 percent of the recommended torque.

Cable Size and Tightening Torque for 225kVA UPS (Only copper wires allowed)		
Block Number	Cable Size	Tightening Torque
1	300MCM or larger	500 in-lbs
2	300MCM or larger	500 in-lbs
3	300MCM or larger	500 in-lbs
4	300MCM or larger	500 in-lbs
5	300MCM or larger	500 in-lbs
6	300MCM or larger	500 in-lbs
7	300MCM or larger	500 in-lbs
8	300MCM or larger	500 in-lbs
9	300MCM or larger	500 in-lbs
10	300MCM or larger	500 in-lbs
11	300MCM or larger	500 in-lbs
12	Two 300MCM or larger	500 in-lbs
13	Two 300MCM or larger	500 in-lbs

NOTE: Maximum cable size is 500MCM

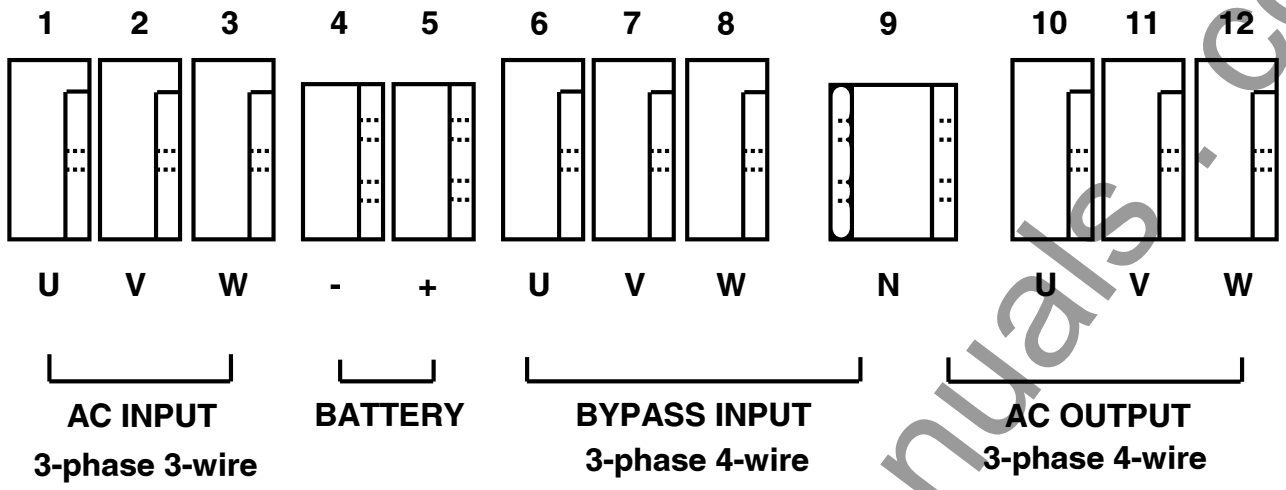
3 cable knockout plates are provided at bottom of the 150/225kVA UPS. Holes are recommended in Figure 8.3. The 5 holes must be punched by the installing electrical contractor.



3 solid rectangles show the cable knockout plates' outline. The dashed rectangle shows the UPS opening under the plates.

Figure 8.3 Cable knockout plates at the bottom (150 & 225kVA)

Terminal Bus 300kVA



The terminal buses shown are located at the top inside of the 300kVA UPS. Dashed line in each terminal stands for side view of screw holes to tighten lugs.

External cable size is recommended in the Table 8.3. This table shows only the torque to tighten a terminal bus & a corresponding lug. Torque to tighten the cable end in a compression lug shall be specified by the lug vendor recommended in Table 8.4.

Table 8.3 Recommended Cable Size and Tightening Torque for 300kVA UPS

The tightening torque must be greater than 90 percent of the recommended torque.

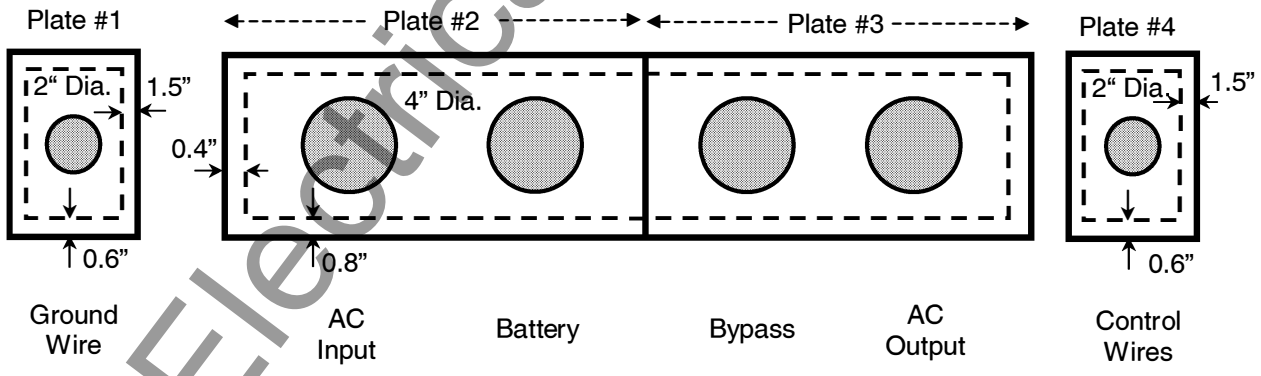
Cable Size and Tightening Torque at 300kVA UPS Terminals		
Bus Number	Cable Size (Only copper wires allowed)	Torque to tighten the terminal bus
1	Two 3/0 AWG or larger	215-386 in-lbs
2	Two 3/0 AWG or larger	215-386 in-lbs
3	Two 3/0 AWG or larger	215-386 in-lbs
4	Three 350MCM or larger	215-386 in-lbs
5	Three 350MCM or larger	215-386 in-lbs
6	Two 3/0 AWG or larger	215-386 in-lbs
7	Two 3/0 AWG or larger	215-386 in-lbs
8	Two 3/0 AWG or larger	215-386 in-lbs
9	Six 350MCM or larger	215-386 in-lbs
10	Two 3/0 AWG or larger	215-386 in-lbs
11	Two 3/0 AWG or larger	215-386 in-lbs
12	Two 3/0 AWG or larger	215-386 in-lbs

NOTE: Maximum cable size is 600MCM

Table 8.4 Recommended Lugs

At Terminal Bus #	Recommendation	
	Vendor	Catalog #
1	ILSCO	TA-600 AU-600
2		
3		
4	ILSCO	TA-600 T3A2-600N
5		
6	ILSCO	TA-600 AU-600
7		
8		
9		TA-600, T3A2-600N
10		TA-600 AU-600
11		
12		

4 cable knockout plates are provided at the top of the 300kVA UPS. Holes are recommended in Figure 8.4. The 6 holes must be punched by the installing electrical contractor.



4 solid rectangles show the cable knockout plates' outline. The 3 dashed rectangles show the UPS opening under the plates.

Figure 8.4 Cable knockout plates at the top (300kVA)

9. Operating interface

⚠ **WARNING**	**If the UPS produces smoke or smells strange, immediately turn off circuit breakers of AC and DC input.** Continued use may result in fire. Contact Toshiba or Authorized representatives.

9.1 Operating Switches

Figure 9.1 and Table 9.1 show the location and functions of the operating switches to operate the UPS circuit shown in Figures 9.2.

NOTES	**Do NOT turn off the control power source switch (8A) during UPS operation.** This may result in UPS faults.

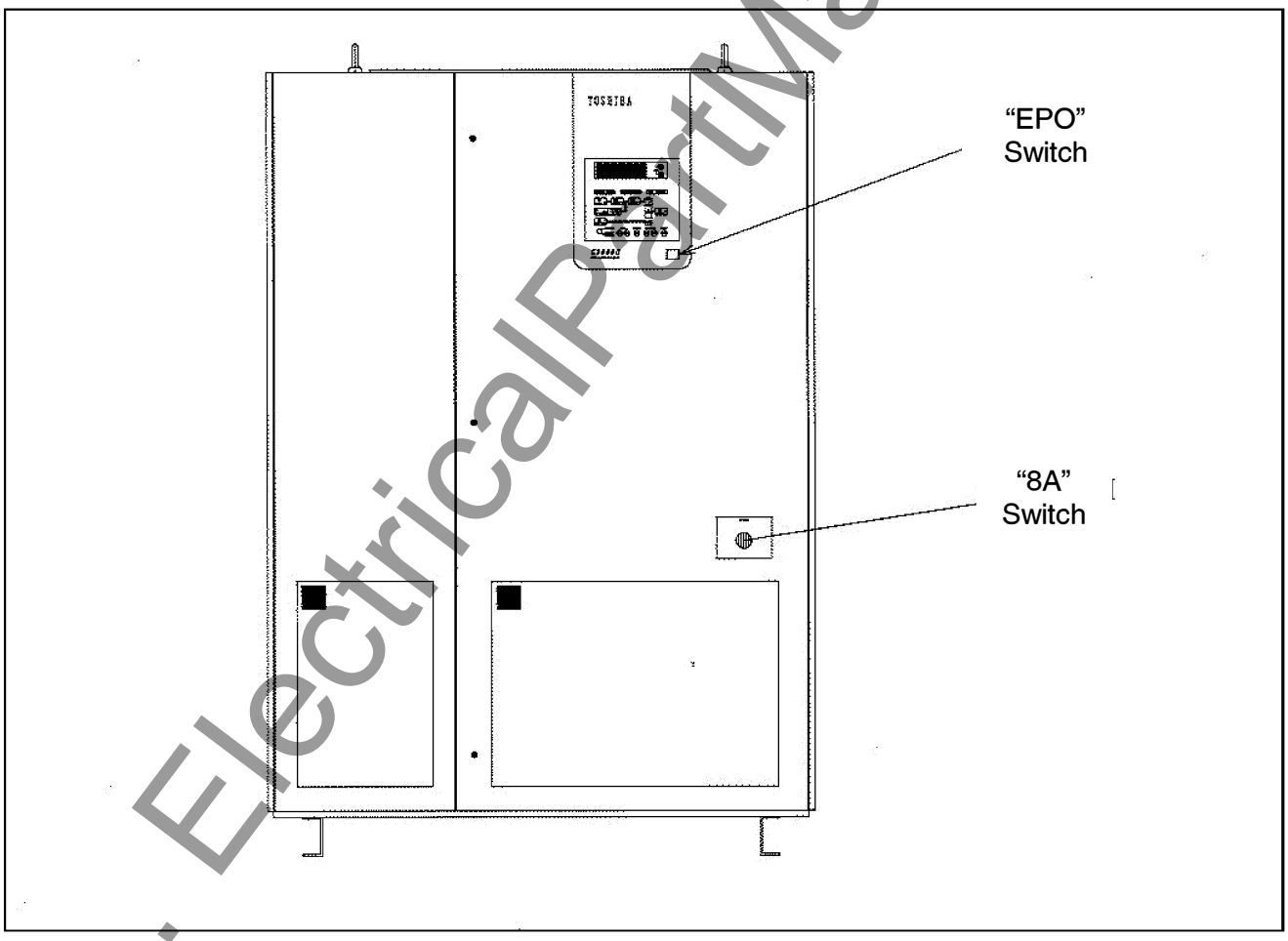


Figure 9.1 Operating Switches

Table 9.1 Control Functions

No.	Device	Name / Function	Normal Position During Operation	Remarks
	"8A" Switch	Control power source switch When AC input is normal, this switch energizes the control circuit.	ON	
	"EPO" Switch	Emergency power off switch Whenever this switch is pressed, UPS will stop operation, and all the breakers will be tripped/opened.	OFF	

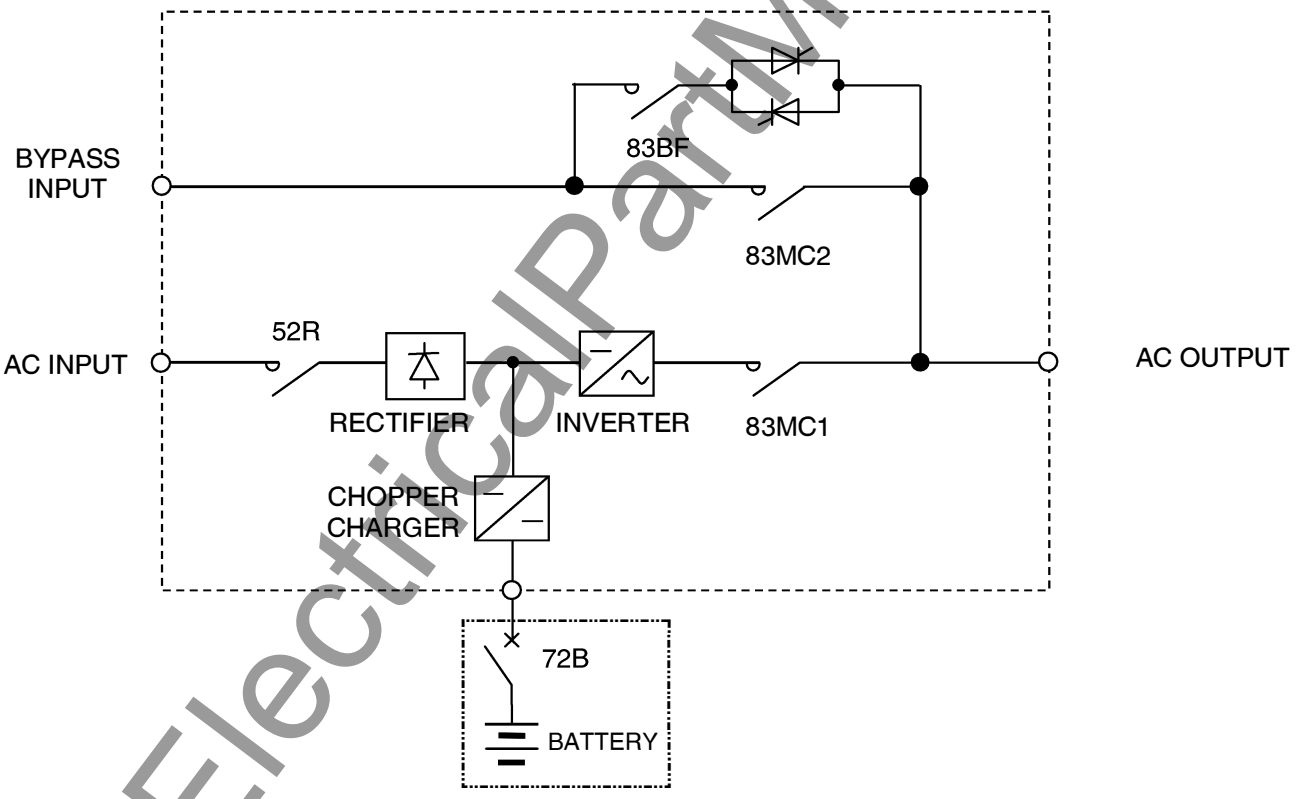


Figure 9.2 UPS Circuit Configuration

9.2 Key-Switch and Buttons

The key-switch and operating buttons on the graphic panel are shown in Figure 9.2.1. See section 9.2.1 "Key-switch" and section 9.2.2 "Operating buttons" for each function.

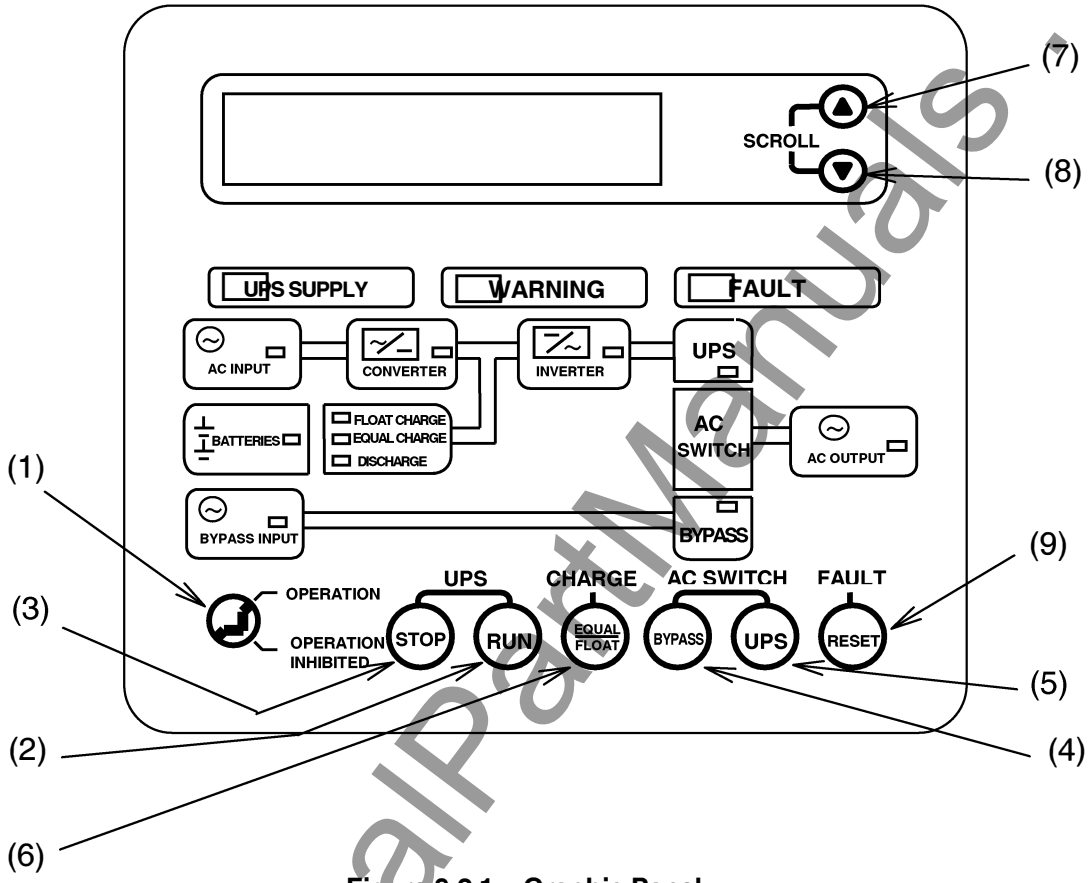


Figure 9.2.1 Graphic Panel

9.2.1 Key-switch

Table 9.2 shows the function of the key-switch on the graphic panel.

Table 9.2 Key-switch function

No.	Name	Function	Remarks
(1)	OPERATION LOCK	This key-switch enables operation buttons pressed when it is in "OPERATION" mode. When the key-switch is at "OPERATION INHIBITED" mode, the operation is disabled, and buttons (2) ~ (6) and (9) shown in Table 9.3 are not operative. They have no effect upon the UPS operation. LCD scroll buttons (7) and (8) still work regardless of the key-switch position.	The key-switch at the "OPERATION INHIBITED" can eliminate misoperation procedures.

9.2.2 Operating Buttons

Table 9.3 shows the functions of the operating buttons on the graphic panel.

NOTES	**Keep an operating button pressed for 0.5 seconds at least, when changing UPS modes.** **Keep the reset button pressed for 5 seconds to reset the UPS.** The UPS may not respond if this duration is too short.

Table 9.3 Button function

No.	Name	Function	Remarks
(2)	RUN	To start up the UPS.	The UPS starts up when this button is pressed. (Key-Switch in OPERATION mode)
(3)	STOP	To stop the UPS.	The UPS stops when this button is pressed. (Key-Switch in OPERATION mode)
(4)	UPS	To transfer to normal operation from bypass operation	The UPS transfers to normal operation, if this button is pressed while bypass operation. (Key-Switch in OPERATION mode)
(5)	BYPASS	To transfer to bypass operation from normal operation	The UPS transfers to bypass operation, if this button is pressed while normal operation. (Key-Switch in OPERATION mode)
(6)	FLOAT / EQUAL	To flip the recharge mode between float charge and equalize charge.	The UPS flips recharge voltage between float charge & equalize charge. Equalize charge voltage can be programmed as protection charge, with battery overheat contact on, if desired. (Key-Switch in OPERATION mode)
(7)	SCROLL UP	To scroll the LCD screens.	See Section 12.2.4 "LCD Scroll with faults or warnings" and Section 10.2.4 "LCD Scroll" for details.
(8)	SCROLL DOWN		
(9)	RESET	To reset the UPS faults and warnings shown on the LCD.	

9.3 External Connections

The terminal layout of external connection TB1 is shown in Table 9.3.1.

Table 9.3.1 External Connection

No.	I/O	Signal Name	Operation
1	Output	Low Battery	Close at Low Battery
2	Output	Backup Operation	Close while Backup Operation
3	Output	Fault	Close by Faults
4	Output	Inverter Supply	Close during Normal Operation
5	Output	Warning	Close by Warnings
6	Input	P24	
7	Input	Remote Run	Close to run UPS
8	Input	P24	
9	Input	Remote Stop	Close to stop UPS
10	Output	Bypass Supply	Close during Bypass Operation
11	Output	Output Signal Ground	(Ground for pin #1~5 & #10)
12	Input	P24	Battery's
13	Input	Battery Overheat	Overheat B-contact
14	Output		Bypass Breaker
15	Output	52C Trip Signal	Shunt Trip Signal by EPO
16	Output		Battery Breaker shunt trip
17	Output	72B Trip Signal	by EPO or Battery shutdown
18	Output		Battery breaker's
19	Output	72B Aux. Contact	Auxiliary A-conatct

The UPS, the battery cabinet and the bypass breaker should be wired as shown in Figure 9.3.1.

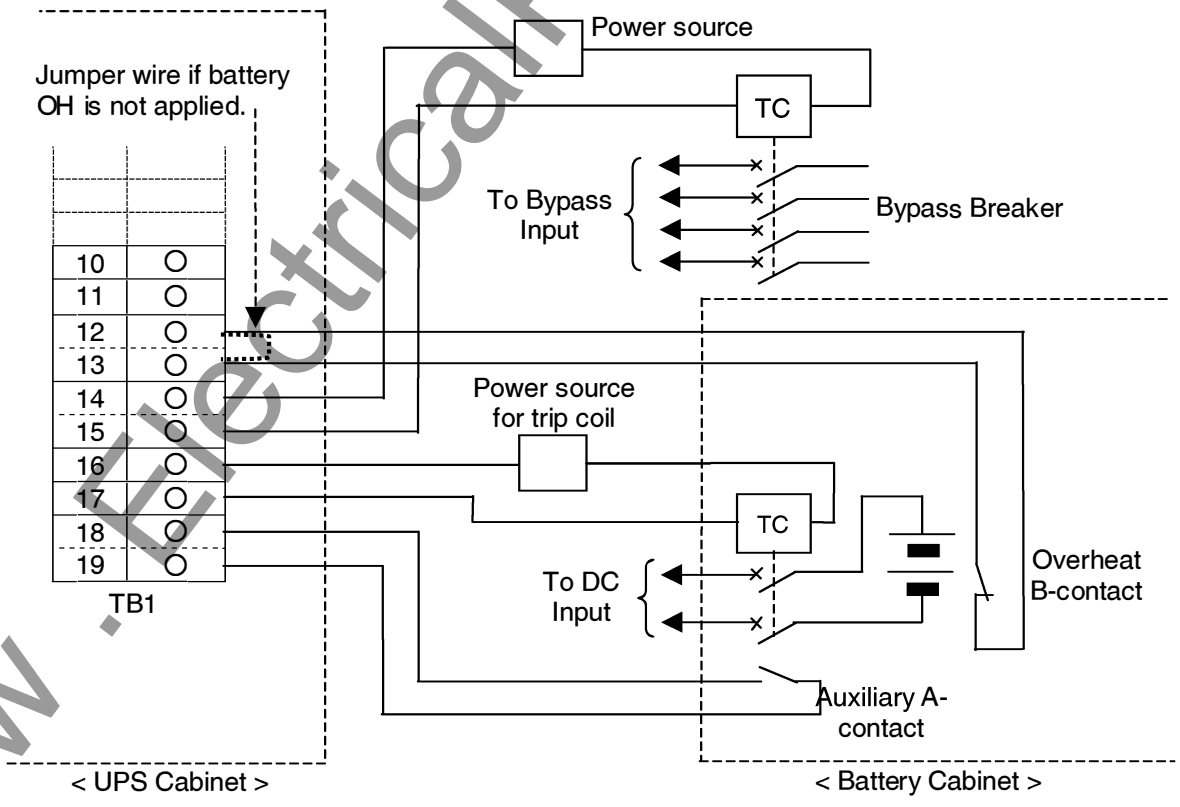


Figure 9.3.1 Connection among UPS, battery cabinet & bypass breaker

10. Graphical Interface

10.1 LED Indication

Figure 10.1.1 and Table 10.1 show the graphic panel detail.

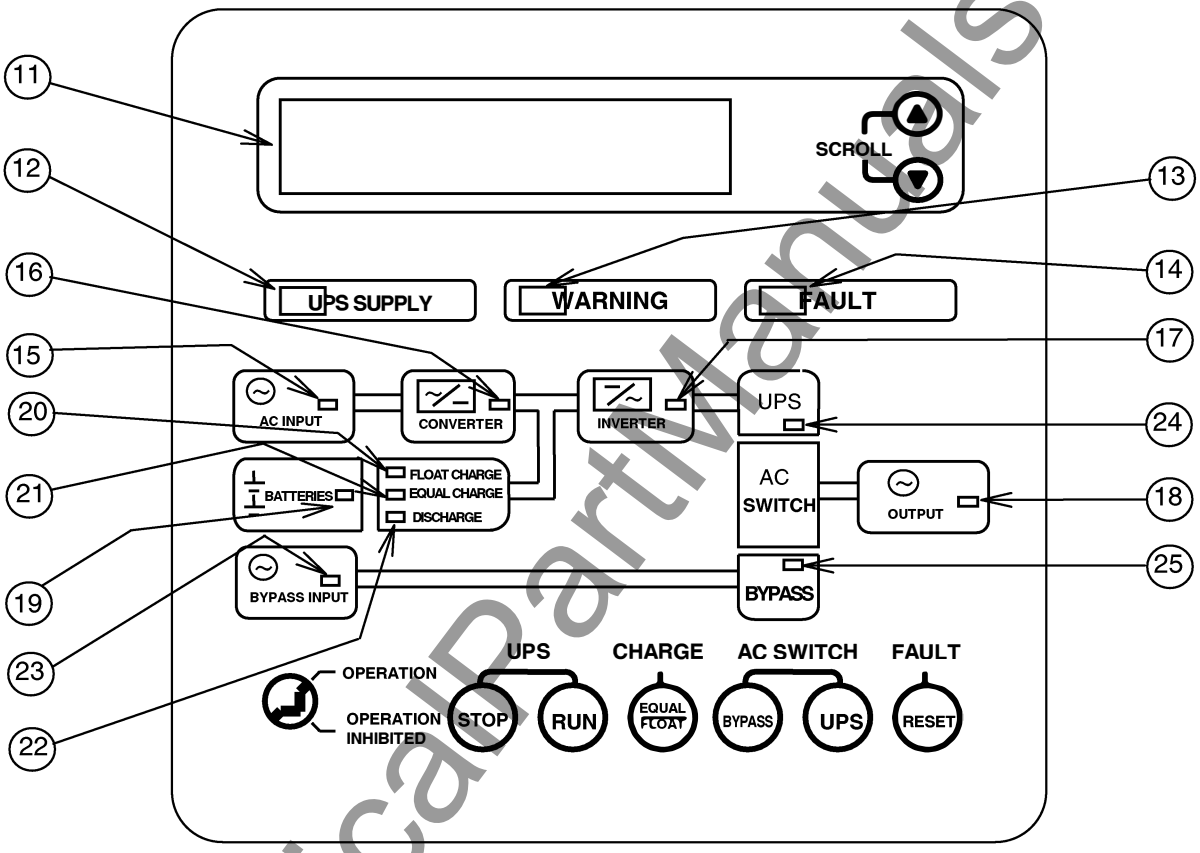


Figure 10.1.1 Graphic Panel

Table 10.1 LCD/LED Legend

No.	Name	Function
(11)	LCD	LCD indicates operation procedure, measured data and warnings/faults. Detailed in section 10.2 "LCD Display."
(12)	UPS SUPPLY LED	Turned on while the inverter is on. Flashes during start-up or stop procedure.
(13)	WARNING LED	Normally off. Turned on with warnings, flashes with AC input abnormality.
(14)	FAULT LED	Normally off. Turned on with faults.
(15)	AC INPUT LED	Normally on with regular AC input. Flashes with AC input under-voltage (85%).
(16)	RECTIFIER LED	Turned on after DC caps are charged up through the rectifier.
(17)	INVERTER LED	Flashes during start-up or stop procedure. Turned on after the inverter starts up, and during available.
(18)	AC OUTPUT LED	Turned on with AC output fed by either the bypass or inverter sources.
(19)	BATTERY LED	Turned on with battery connected. (Aux-contact on)
(20)	FLOAT CHARGE LED	Turned on during float charge.
(21)	EQUALIZE CHARGE LED	Turned on during equalize charge or protection charge with battery OH contact open.
(22)	DISCHARGE LED	Turned on during battery discharge.
(23)	BYPASS INPUT LED	Normally on with regular bypass input. Flashes with bypass under-voltage (85%).
(24)	UPS LED	Turned on during UPS Supply.
(25)	BYPASS LED	Turned on during Bypass Supply.

10.2 LCD Indication

LCD screens consist of the following terms.

(1) Normal Display ..... Initial display, operation guidance, and measured data

(2) Fault Display ..... Displays detailed data when a fault occurs.

(3) Warning Display ..... Displays detailed data when a warning occurs.

The operator can scroll among these terms with scroll buttons pressed.

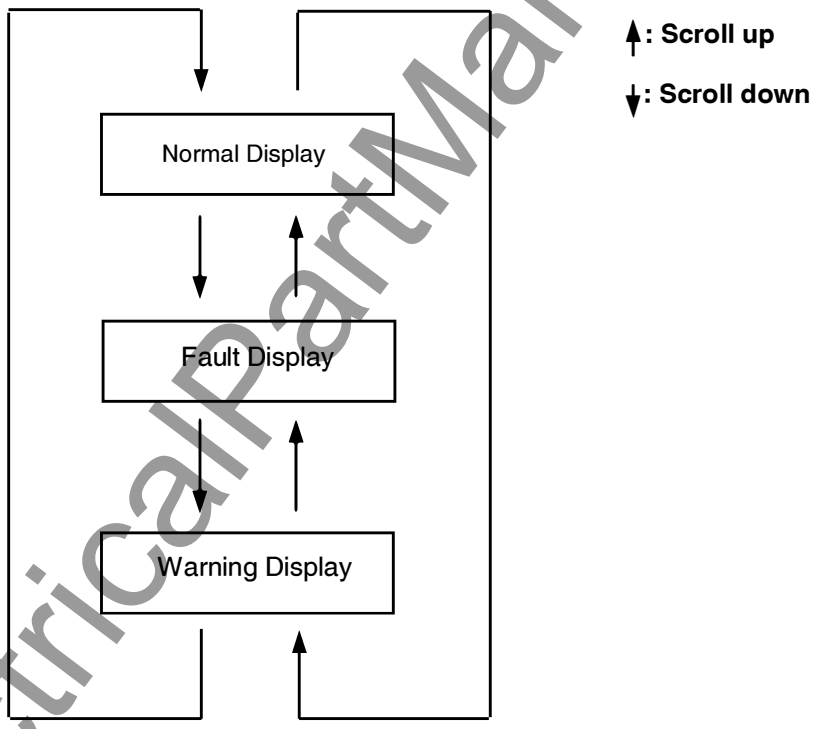


Figure 10.2.1 LCD indication terms

10.2.1 Normal Display

The Normal Display screen indicates the UPS operational status and provides 15 screens: an operation guidance screen, an operation mode screen and 13 screens of measured data. Table 10.2 shows these screens page by page.

Table 10.2 Normal Display

No.	LCD Screen	Description
1	Operation Guidance (Example 1) **BYPASS** **PRESS 'RUN' SWITCH**	Shows the UPS status at the top and guidance message or measured data underneath. (Example 1) Shows a guidance message at start up.
	(Example 2) **UPS SUPPLY** **AC-VO 480[V]** **AC-I O 50[%]** Voltage (example) Current ratio (example)	(Example 2) Shows the output voltage & current after start up.
2	Operation Mode (Example) **OPERATION MODE** **NORMAL OPERATION MODE** **SYNC.**	Shows the UPS Operation mode.
3	Measurement screen #1 Output voltage **O/P VOLTAGE** **VOLT. 480[V]** **FREQ. 60.0[Hz]**	Shows the output voltage between lines.
4	Measurement screen #2 Output current (RMS) **O/P CURRENT (r.m.s)** **U 50[%]** **V 50[%]** **W 50[%]**	Shows the output current RMS (%) for each phase.
5	Measurement screen #3 Output current (peak) **O/P CURRENT (PEAK)** **U 50[%]** **V 50[%]** **W 50[%]**	Shows the output current peak (%) for each phase. $\frac{\text{Peak value of output current}}{\text{RMS value for rated current} \times 1.41} \times 100\ [\%]$

Table 10.2 Normal Display (continued)

6	Measurement screen #4 AC input **AC INPUT** **AC I/P-V 480[V]** **FREQ. 60.0[Hz]**	Shows the voltage and frequency of the AC input.
7	Measurement screen #5 Bypass input **BYPASS INPUT** **BYP I/P-V 480[V]** **FREQ. 60.0[Hz]**	Shows the voltage and frequency of the Bypass input.
8	Measurement screen #6 Battery **BATTERY** **BACK-UP RATING 10[MIN]** **DISCHARGING 15[MIN]**	Shows the rated battery backup time with rated load and cumulative discharged time.
9	Measurement screen #7 DC circuit **DC INPUT** **DC-V 632[V]** **BATT-V 400[V]** **BATT-I 0[A]**	Shows the DC bus voltage, battery voltage and battery current. Negative battery current stands for recharge current and positive stands for discharge.
10	Measurement screen #8 Counter values **MODE COUNT** **UPS 35[M]** **BATTERY 56[MIN]** **32[TIM]**	Shows the cumulative UPS operation time, the cumulative battery backup time and the number of battery backup operations.
11	Measurement screen #9 Clock **CLOCK** **TIME: 03-24-02 12:58**	Shows the present time. (24-hour clock)

10.2.2 Fault Display

The Fault Display screen indicates the fault records until they are reset.

Table 10.3 Fault Display Screen

LCD Screen	Description
Indication of no fault **FAULTS & WARNINGS** **NO FAULT** **NO WARNING**	This screen is displayed if there is no fault recorded, or after the reset button is pressed.
Indication if faults recorded **FAULTS & WARNINGS** **1 FUSE BLOWN** **09-09-02 08:05:30** **↓ ANOTHER ITEM**	A fault record is shown with time stamp if recorded. An arrow shows up with another record which can be scrolled by pressing the △ ▽ buttons.

* The fault records will remain in the memory until the reset button is pressed for at least 5 seconds, even after the actual cause of the fault has been resolved. Note that the fault records are not deleted when the UPS is turned off.

10.2.3 Warning Display

The Warning Display screen indicates the warning records until they are reset.

Table 10.4 Warning Display Screen

LCD Screen	Description
Indication of no warning **FAULTS & WARNINGS** **NO ALARM** **NO WARNING**	This screen is displayed if there is no warning recorded, or after the reset button is pressed.
Indication if warnings recorded **FAULTS & WARNINGS** **1 UPS OVER LOAD** **09-09-02 08:05:30** **↓ ANOTHER ITEM**	A warning record is shown with time stamp if recorded. An arrow shows up with another record which can be scrolled by pressing the △ ▽ buttons.

10.2.4 LCD Scroll

All the screens can be scrolled with △ and ▽ buttons on the graphic panel. See figure 9.2.1 for the location of the △ and ▽ scroll buttons.

Symbol	Name	Description
▲	SCROLL UP	Moves back to the previous screen (see Figure 9.2.1)
▼	SCROLL DOWN	Moves forward to the next screen (see Figure 9.2.1)

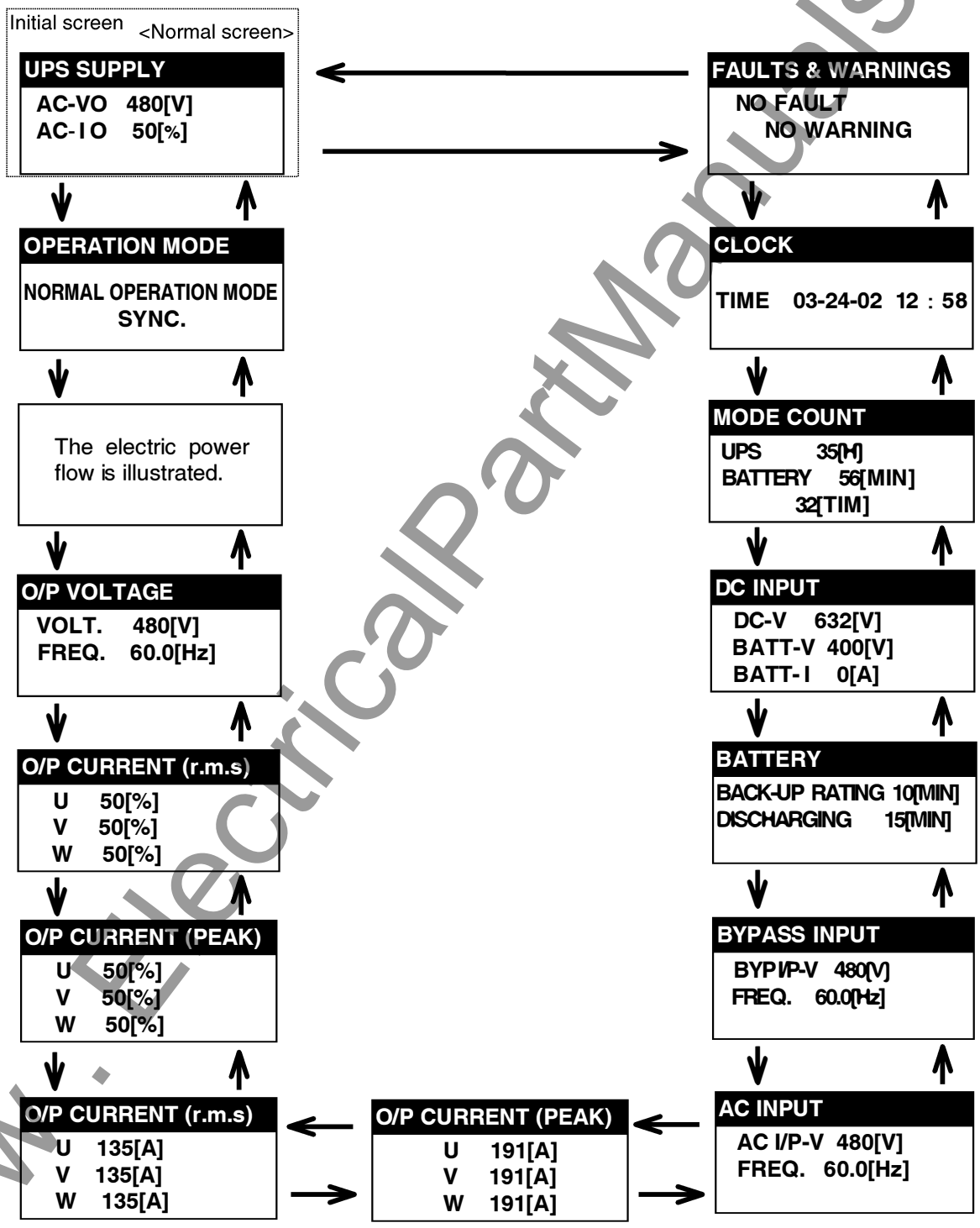


Figure 10.2 LCD Scroll Circulation

11. Operation

This section describes the basic procedures to operate the UPS.

⚠ CAUTION	**Operators should be qualified/trained personnel.** Operation of the UPS by unqualified or untrained personnel may result in electric shock, personal injury or fault.
	Make sure you understand the meaning of the warning labels on the equipment, and follow the precautions indicated. Operating the equipment without understanding of these labels may result in electric shock or burns. See Page 7 for the location of these warning labels.

NOTES	**Operate the UPS in the specified condition.** Operating the UPS in other conditions may result in fault.
	During operation, do not turn off the air conditioner for the UPS room and the battery room. This will cause the temperature to rise and will result in UPS or battery fault.
	When you start or stop the UPS, follow the instruction on the LCD and perform the proper procedures.

11.1 Operation Types

The operation summary is shown below.

No.	Operation	Description	Page No.
1	Startup	Starting up and operating the UPS.	36
2	Switch Power Supply	Switching power supply source between UPS and Bypass.	38
3	Stop	Stop the inverter and chopper/charger.	39
4	Complete shutdown	Turn off the control power supply. Shutting down the UPS completely.	40
5	Float / Equalize charge	Changing the battery recharge mode between float charge & equalize charge.	41
6	Protection charge	Automatic recharge mode transition from protection charge to float charge.	43

11.2 Pre-operational check

Be sure to check the following items before operating the UPS:

(1) Make sure all covers/panels are in place and properly screwed.

(2) Make sure the temperature control in the UPS/Battery room is within specified limits.

(3) Before starting the UPS, check the power source for the UPS to make sure AC input power is on.

(4) Make sure battery breaker's auxiliary A-contact is connected to the terminal block TB1 as described in Figure 9.3.2.

11.3 Procedures

11.3.1 Startup

Table 11.1 shows the procedure to start up the UPS.

LED legend ▭ : Off ■ : On ☼ : Flash

Table 11.1 Startup Procedures

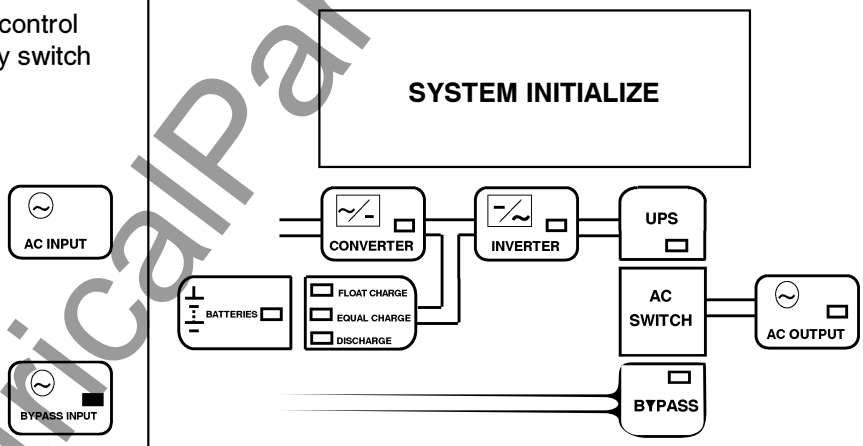
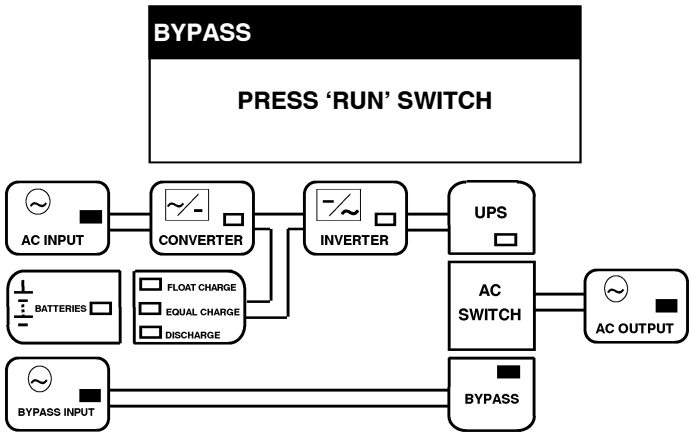
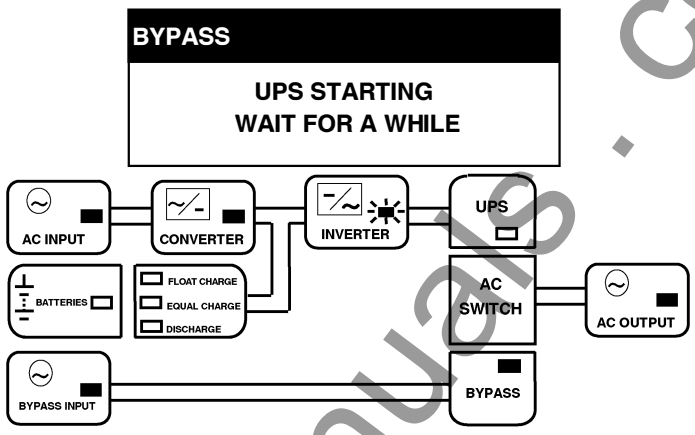
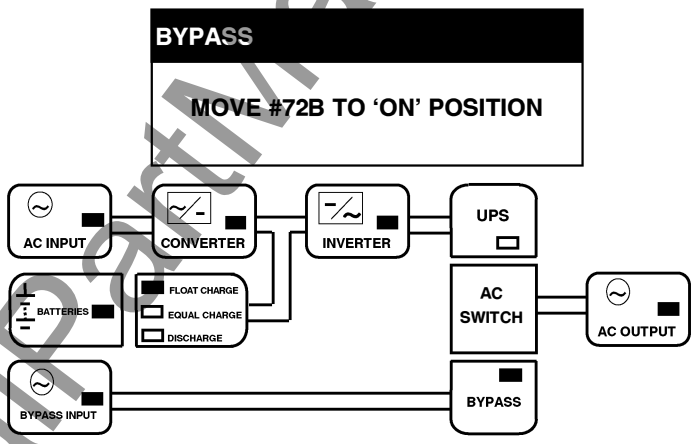
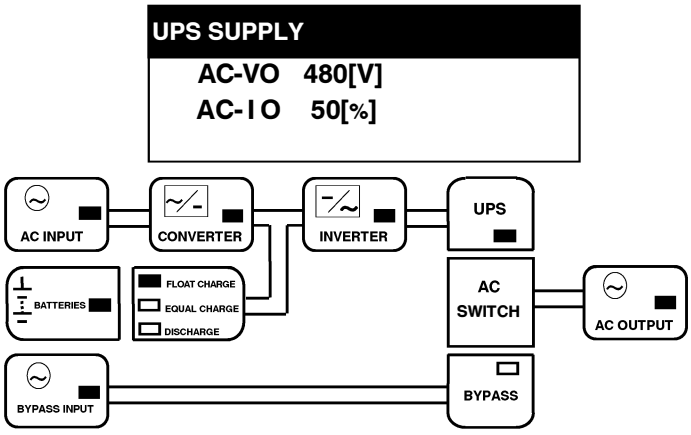
Step	Procedure	LCD/LED Status
☼ 1	Turn on the control power supply switch (8A).	
2	Wait for a few seconds.	

Table 11.1 Startup Procedures (Cont'd)

3	Press the "RUN" button [(2) in Figure 9.2.1 on page 25] for 0.5 sec.	 CONVERTER LED is on & INVERTER LED flashes.
4	Turn on the DC input breaker	 BATTERIES LED is on.
5	Press the "UPS" button [(5) in Figure 9.2.1 on page 25] for 0.5 sec.* - This completes the UPS startup procedure.	 BYPASS LED is off & UPS LED is on.

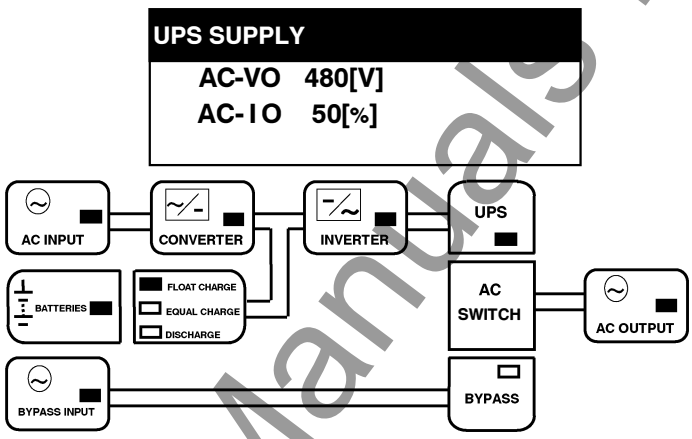
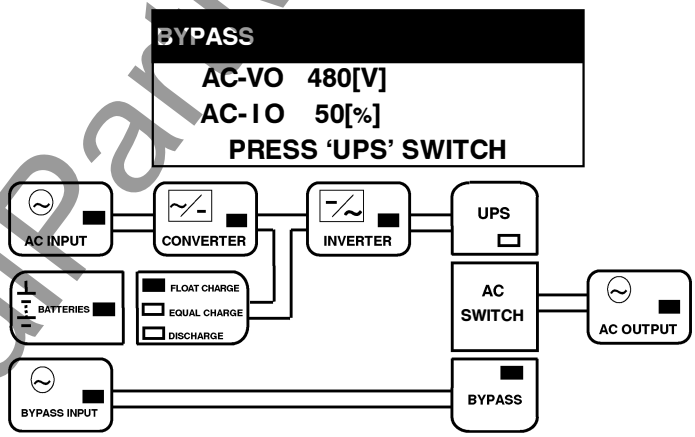
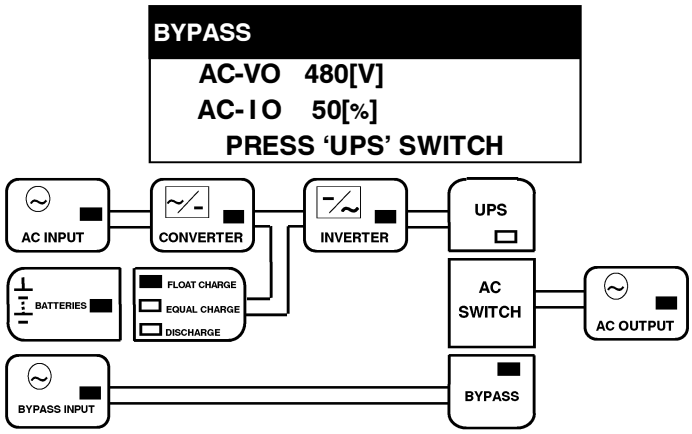
* Notes:

- If the AC switch dose not function, contact Toshiba or authorized representatives.
- If the bypass power source is out of specification, this operation will be inhibited. In order to switch manually, press the "UPS" button for 5 seconds or more.

11.3.2 Switch Power Supply (UPS→Bypass)

Table 11.2 shows the procedure to transfer between the UPS supply and the bypass.

Table 11.2 UPS Power Supply → Bypass Power Supply

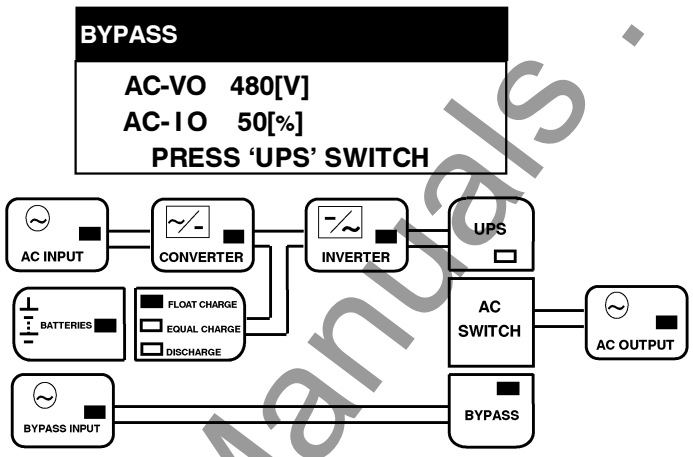
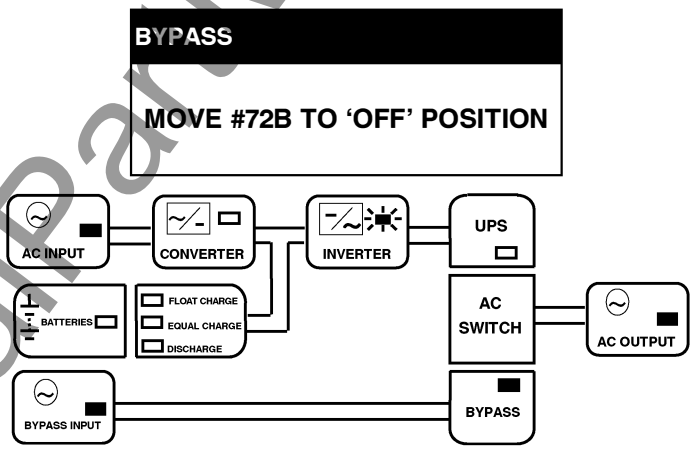
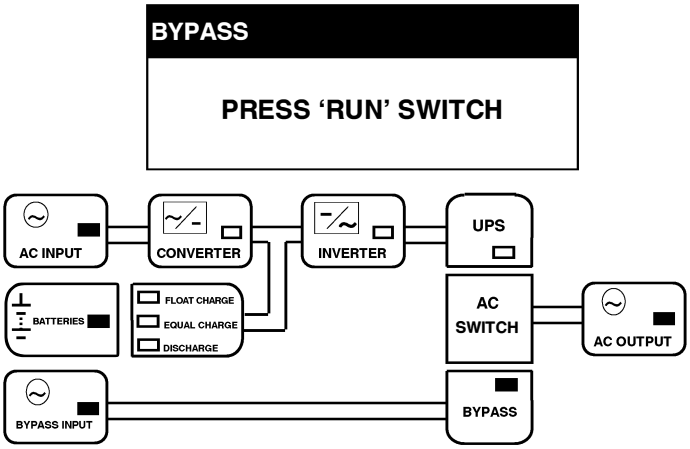
Step	Procedure	LCD/LED Status
1	Check AC INPUT LED & BYPASS LED are on to make sure power is being delivered to the UPS.	
2	Press the "BYPASS" button [(4) in Figure 9.2.1 on page 25] for 0.5 sec.	 UPS LED is off & BYPASS LED is on.
3	Please wait - Procedure completed.	

* To change from Bypass to UPS supply, follow the procedure step #5 in Table 11.1. If the AC switch does not function, contact Toshiba or authorized representatives.

11.3.3 Stop

Table 11.3 shows the procedure to stop the UPS.

Table 11.3 Stop

Step	Procedure	LCD/LED Status
1	Transfer to Bypass supply as described in Table 11.2.	 UPS LED is off & BYPASS LED is on.
2	Turn off the DC input breaker, and, Press the "STOP" button [(3) in Figure 9.2.1 on page 25] for 0.5 sec at least.	 BATTERIES LED is off & INVERTER LED flashes then off. FLOAT CHARGE LED & CONVERTER LED are off.
3	Please wait. - Procedure completed.	

11.3.4 Complete Shutdown

This section shows the procedure to turn off the control power and shut down the UPS completely.

Table 11.4 Complete Shutdown

Step	Procedure	LCD/LED Status
1-3	Same as steps 1-3 in Section 11.3.3 "Stop."	
4	Scroll the LCD screen to see the DC INPUT and make sure DC bus voltage is 0V. (see 10.2.4 "LCD Scroll" on page 36)	**DC INPUT** **DC-V 0[V]** **BATT-V 0[V]** **BATT-I 0[A]**
5	Turn off the control power supply switch (8A) *	Nothing is displayed on the LCD and all LEDs are off.
6	Turn off all breakers at AC output, Bypass Input & AC Output.	(Shutdown is completed and UPS is isolated.)

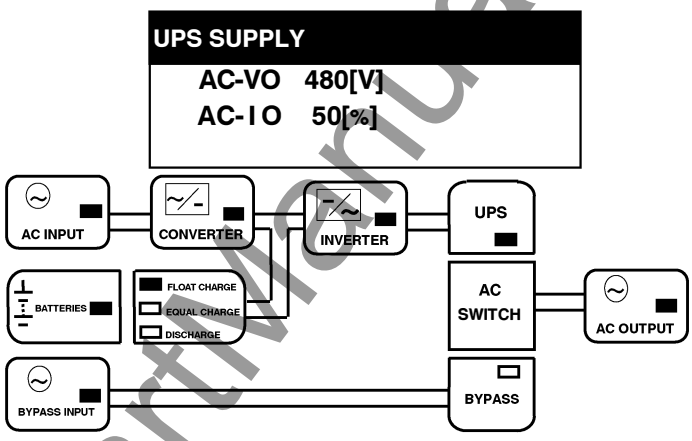
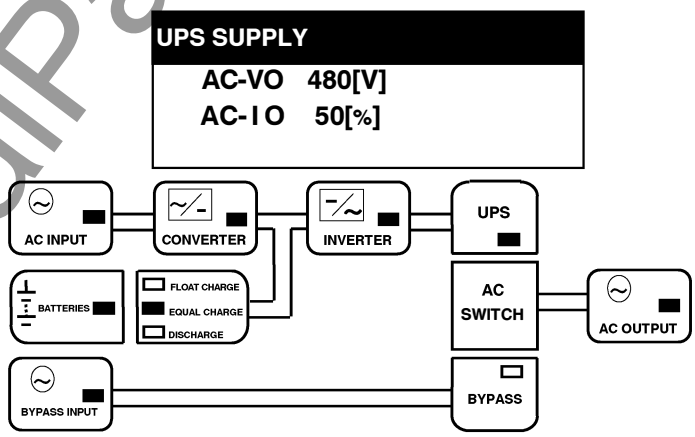
* This operation is different from the displayed instruction on the screen. Be sure to perform the procedure specified here.

11.3.5 Changing Between Float Charge and Equalize Charge

This section shows the procedure to change the recharge mode between float charge and equalize charge.

(1) Table 11.5 shows the procedure to change from float charge to equalize charge.

Table 11.5 Change From Float Charge to Equalize Charge

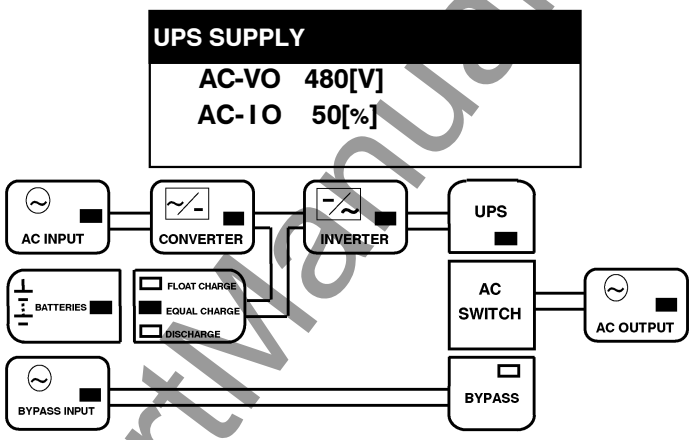
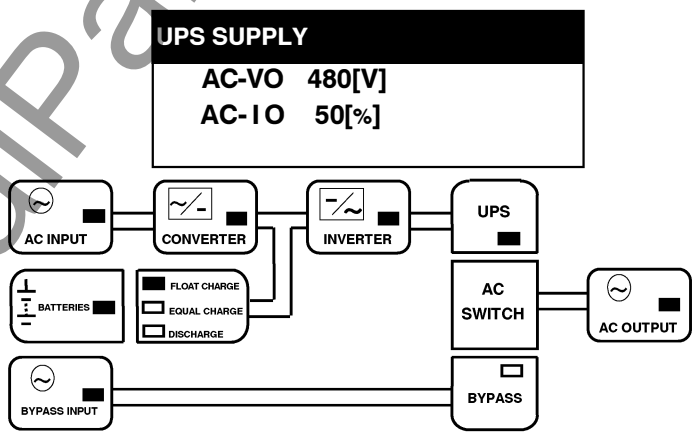
Step	Procedure	LCD/LED Status
1	Make sure that the FLOAT CHARGE LED is On.	
2	Press FLOAT/EQUAL button [(6) in Figure 9.2.1 on page 25] for 0.5 sec. - Change completed.	 EQUAL CHARGE LED is On, FLOAT CHARGE LED is Off.

* In equalize charge mode, the battery is charged for a programmed period at a specified voltage (depending on the battery spec) rather than the float charge, in order to prevent voltage deviations among battery cells. This should be done once every six months if possible.
The G8000 UPS has an automatic function to perform the equalize recharge after battery backup operation.

(2) Table 11.6 shows the *manual* procedure to change from equalize charge to float charge.

After recharging mode is changed to equalize, the mode will automatically be changed back to float charge after a programmed duration has elapsed. So, manual mode change is not usually required.

Table 11.6 Changing From Equalize Charge to Float Charge

Step	Procedure	LCD/LED Status
1	Make sure EQUAL CHARGE LED is On.	
2	Press FLOAT/EQUAL button [(6) in Figure 9.2.1 on page 25] for 0.5 sec. - Change completed.	 FLOAT CHARGE LED is On, EQUAL CHARGE LED is Off.

11.3.6 Changing to Float Charge from Protection Charge (If applicable)

Table 11.7 shows the manual procedure to change from protection charge to float charge. This operation applies to batteries which needs protection charge when over temperature.

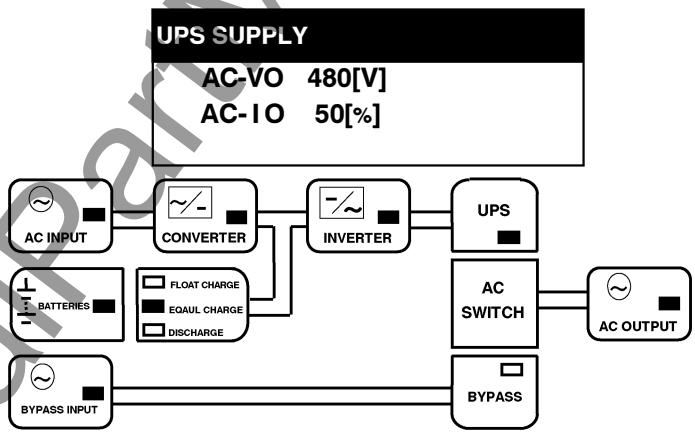
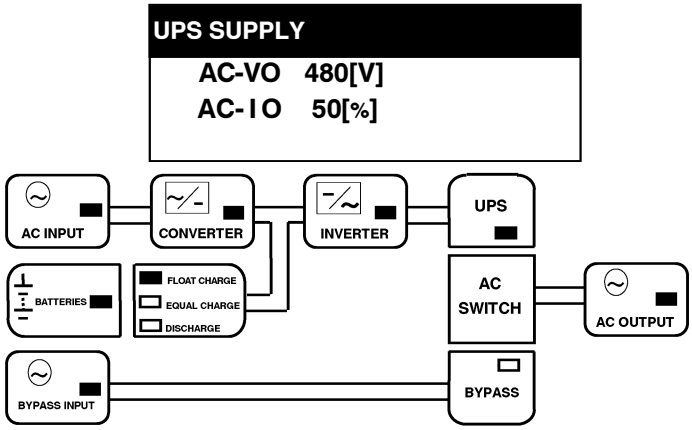
(1) The battery is normally being charged at float charge mode.

(2) To prevent the battery thermal runaway, this mode will automatically be changed to protection charge when a "BATT FAULT1" (Battery over temperature) warning occurs.

(3) In protection charge mode, the battery is automatically charged at a voltage about 5% lower than float charge

(4) If the "BATT FAULT1" warning message goes away and a programmed duration is elapsed (about 24 hours), this mode will automatically be changed back to float charge. So, it is not usually required to change the recharge mode *manually* back to the float charge.

Table 11.7 Changing from Protection Charge to Float Charge

Step	Procedure	LCD/LED Status
1	Make sure the PROTECTION LED is On.	
2	Make sure that the "BATT FAULT1" warning goes away.	
3	Press "FLOAT/EQAUL" button [(6) in Figure 9.2.1 on page 25] for 0.5 sec. * - Change completed.	 FLOAT CHARGE is On, EQUAL CAHRGE* LED is Off.

12. Troubleshooting

When an error occurs in the UPS, error data is displayed on the LCD screen and the waveform is saved. This section will describe the types of errors, the error messages displayed on the LCD screen, the process of saving waveforms and the procedures to correct the errors.

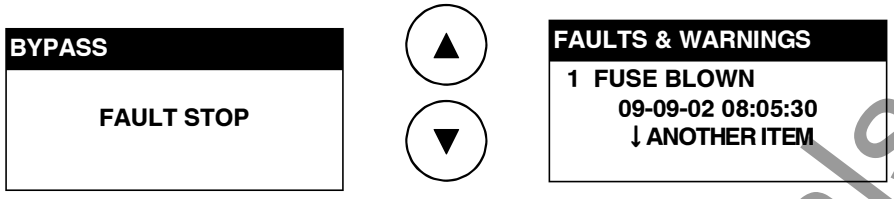
12.1 Types of Errors

The following types of errors may occur in the UPS:

No.	Name	Description
1	Fault (Trip)	The UPS has been tripped and has stopped operating. The UPS is on Bypass.
2	Warning-1 (Input power failure)	Power is supplied from the battery. When the warning is corrected, power will automatically be supplied from the AC input.
3	Warning-2 (Stop and restart)	The UPS transfers to Bypass supply and the UPS stops operating. When the warning is corrected, the UPS will automatically be restarted and revert to UPS supply.
4	Warning (Operation control)	An error or a phenomena related to an error occurred. Since this problem does not directly affect operation, the system switches to synchronized mode.
	(guidance)	An error or indication of an error has occurred, but operation was not affected.

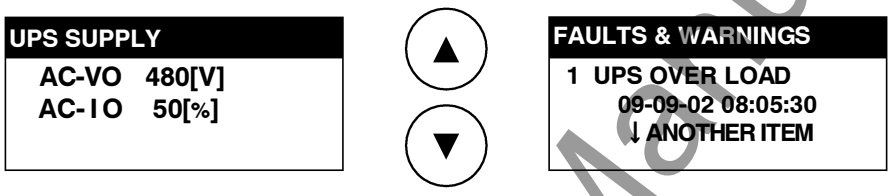
12.2 LCD Fault Displays

When a fault occurs, a screen is shown as in Figure 12.1.
When a warning occurs, a screen is shown as in Figure 12.2.



Select the desired fault data with the scroll buttons.
Detailed fault data will be displayed.

Figure 12.1 Fault Display



Select the desired warning data with the scroll buttons.
Detailed warning data will be displayed.

Figure 12.2 Warning Display

12.2.1 Fault Data Screen

This screen appears when a trip error is detected. Up to 10 screens of fault data can be displayed.

Figure 12.3 and Table 12.1 show a sample screen and describe the data shown in the screen.

Figure 12.3 Sample Fault Data Screen

Table 12.1 Fault Data Screen Descriptions

No.	Name	Description
(1)	No.	The number of the message in the order that it was detected (1 - 10). (Up to 10 screens of fault data can be displayed.)
(2)	Fault Message	Shows the nature of the fault. For details, see Section 11.2.3 "Fault Messages".
(3)	Time	The date and time (in 24-hour format) the fault was detected.
(4)	Scroll indicator	Indicates whether there is a fault screen before or after this screen. ↑ indicates there is a previous fault screen. ↓ indicates there is a next fault screen. ↑↓ indicates there are previous and next fault screens.

12.2.2 Warning Data Screen

These screens appear when a warning has occurred. Up to 10 screens can be displayed. Figure 12.4 and Table 12.2 show an example of the screen and describe the data shown in the screen.

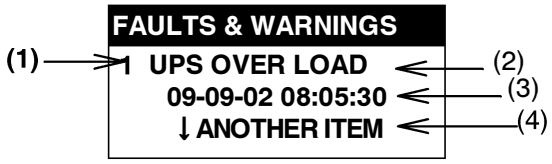


Figure 12.4 Warning Screen Example

Table 12.2 Warning Data Screen Descriptions

No.	Name	Description
(1)	No.	The number of the message in the detection order (1 - 10). (Up to 10 screens of warning data can be displayed.)
(2)	Warning Message	Shows the nature of the warning. For details, see Section 11.2.3 "Fault Messages".
(3)	Time	The date and time (in 24-hour format) the warning was detected.
(4)	Scroll indicator	Indicates whether there is a warning screen before or after this screen. • ↑ indicates there is a warning screen above this screen. • ↓ indicates there is a warning screen below this screen. • ↑↓ indicates there are warning screens both above and below this screen.

12.2.3 Fault Messages

Figures 12.6 show the locations for fault detection. Tables 12.4 through 12.8 list the fault messages described in Section 12.2.1 "Fault Data Screen". The content and display text for the fault and warning messages are in Tables 12.4 through 12.8. UPS's can be shipped with different protective configurations from the standard shown in figure 12.6, if specified by the customer. See the protective configuration indicated on the single line diagram for each UPS.

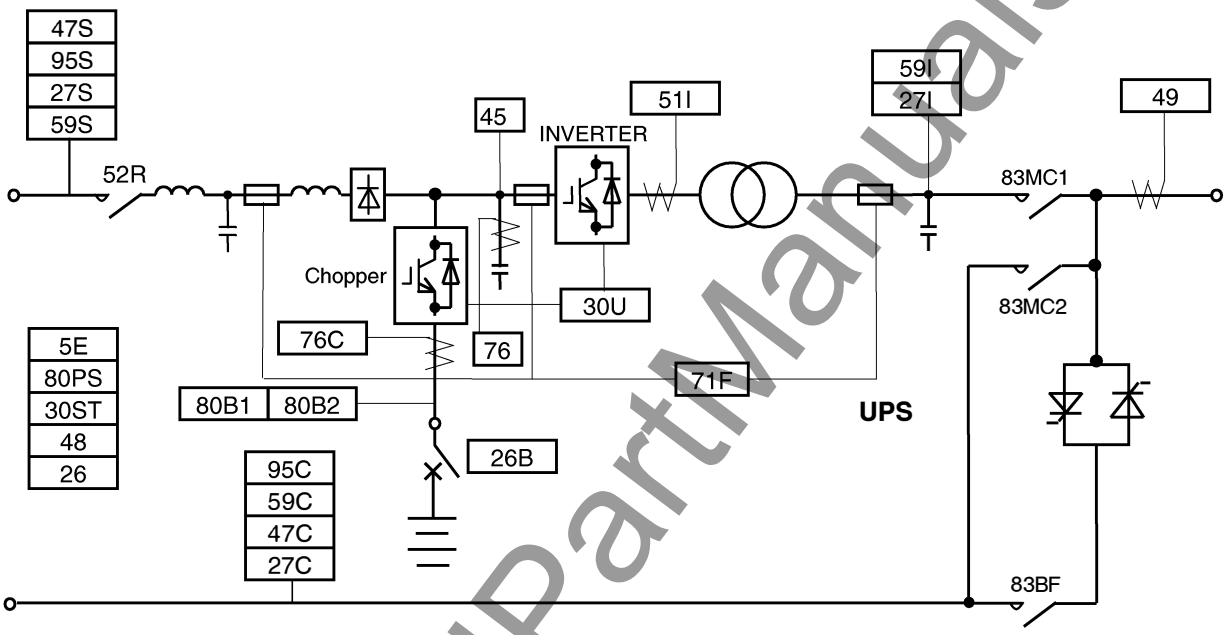


Figure 12.6 Protective Detector Locations

Table 12.4 Fault (Trip)

#	Item	LCD Message Indication	Description
1	71F	FUSE BLOWN	AC or DC Main circuit fuse blown.
2	30ST	(No indication)	An error occurred in the main control microprocessor (CPU).
3	80PS	CONT. PS. ERR	The control power supply voltage failed.
4	80B2	BATT. UV	Battery voltage is below cutoff voltage.
5	48	STARTUP ERR	Startup was not completed in a time frame.
6	76	DC OC	Over-current in DC circuit.
7	26	OVER HEAT	Temp High in the cabinet.
8	5E	EMG.STOP	An emergency stop was activated by the external contact

Table 12.5 Warning – 1 (Converter stop/Input power error)

#	Item	LCD Message Indication	Description
1	27S	AC I/P UV	AC input voltage is low.
2	59S	AC I/P OV	AC input voltage is high.
3	95S	I/P FREQ. ERR	AC input frequency error.
4	47S	AC PHASE ERR	AC Input phase rotation error.

Table 12.6 Warning - 2 (Stop and restart)

#	Item	LCD Message Indication	Description
1	27I	AC O/P UV	AC output voltage is low.
2	59I	AC O/P OV	AC output voltage is high.
3	49	AC O/P OL	Output overload
4	51I	INV. OC	Inverter over-current.
5	76C	BATT. OC	Over-current in Battery section.
6	45	DC OV	Over-voltage in DC circuit.
7	30U	UNIT FAULT	IGBT Stack Failure.

Table 12.7 Warning (Operation control)

#	Item	LCD Message Indication	Description
1	27C	BYPASS UV	Bypass voltage is low.
2	59C	BYPASS OV	Bypass voltage is high.
3	95C	BYPASS ASY.	Bypass frequency error.
4	47C	BYPASS ERR.	Bypass phase rotation error.

Table 12.8 Warning (Guidance)

#	Item	LCD Message Indication	Description
1	26B	BATT. OVER HEAT	Battery temperature is too high.
2	80B1	BATT. UV (ALM)	Battery voltage is near cutoff voltage.

12.2.4 LCD Scroll with faults or warnings

Memory Card Option	**When the UPS has stopped due to a fault, be sure to remove the memory card before resetting the LCD Fault Error screen on the panel.** Resetting (restarting) the UPS without removing the memory card will delete the data needed to determine the cause of the fault.
NOTES	**When removing the memory card, do NOT touch the other sections of the UPS.** Touching the other sections of the UPS may result in electric shock.

This section describes how to scroll through the LCD screens when a fault has occurred (when Fault Data screens exist).

Figure 12.8 shows the locations of the buttons to scroll the LCD screens. See Table 12.9 and Figure 12.9 for detail of the scroll buttons and how they are used for screen scrolling.

Note that pressing the "RESET" button (9) will delete the waveform data stored on the memory card as well as the Fault and Warning Data Screens. Be sure to remove the memory card before pressing the "RESET" button.

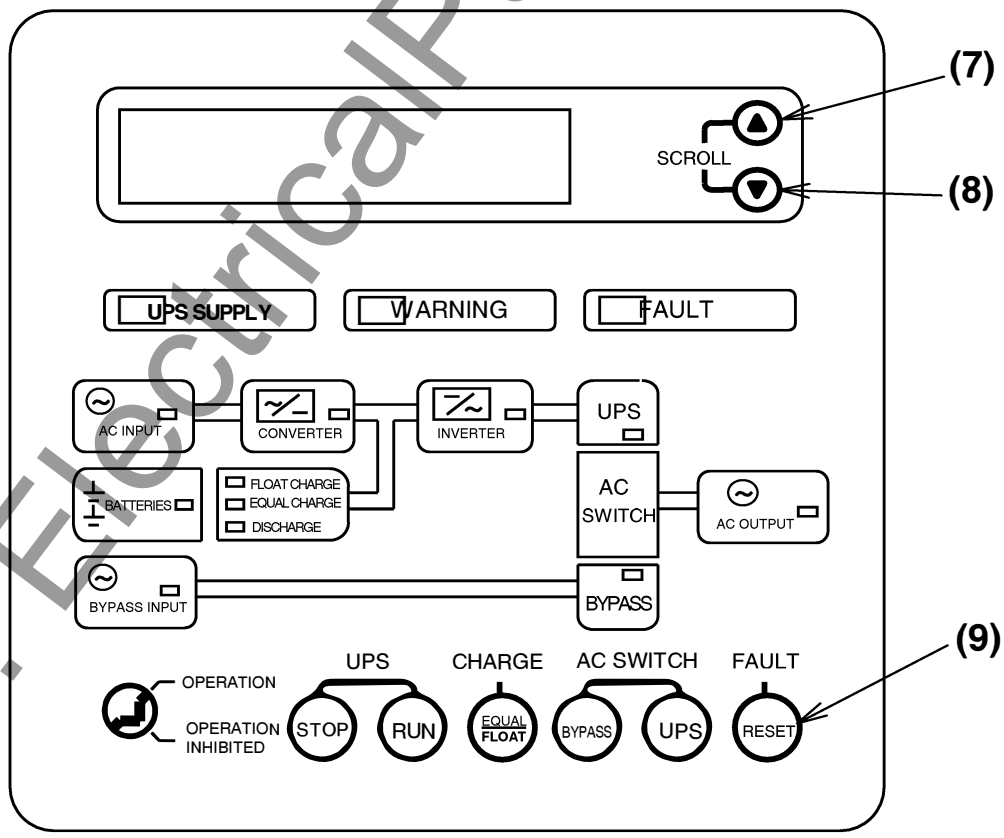
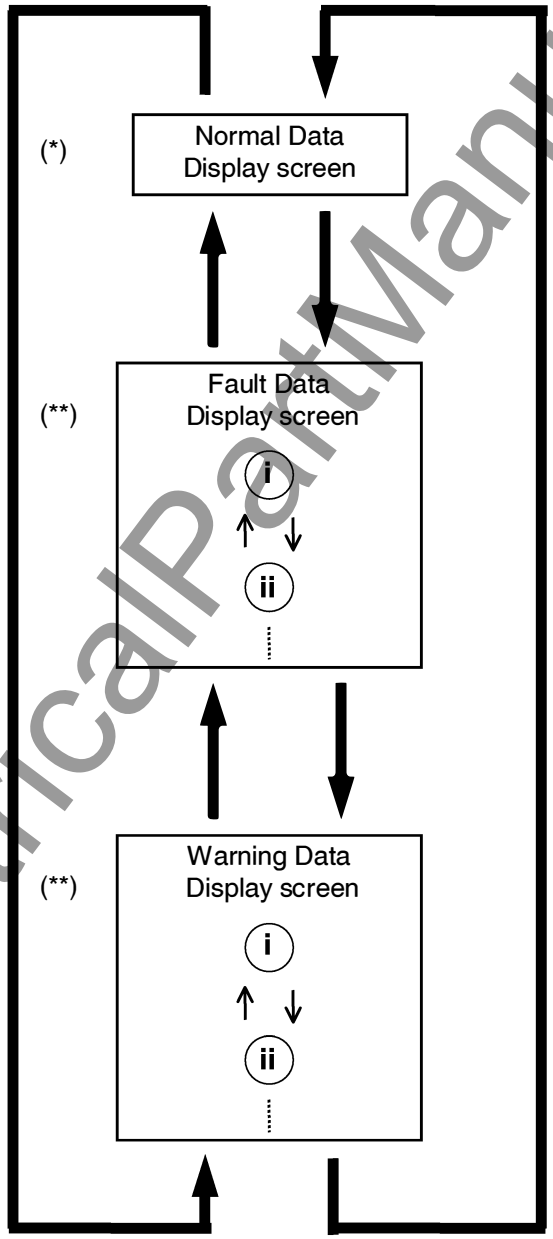


Figure 12.8 Position of Scroll buttons in Fault Data Screens

Table 12.9 Scroll Buttons

No.	Name	Description
(7)	SCROLL UP	Scrolls to the previous screen (see Figure 12.9)
(8)	SCROLL DOWN	Scrolls to the next screen (see Figure 12.9)
(9)	RESET	Deletes the stored waveform and fault and warning data in the memory card. (Optional PC memory card)



Remarks

* See section 10.2.1 “Normal Display" for the screen contents.

** ⓘ ⓘⓘ, etc. represent the order in which the faults occurred.

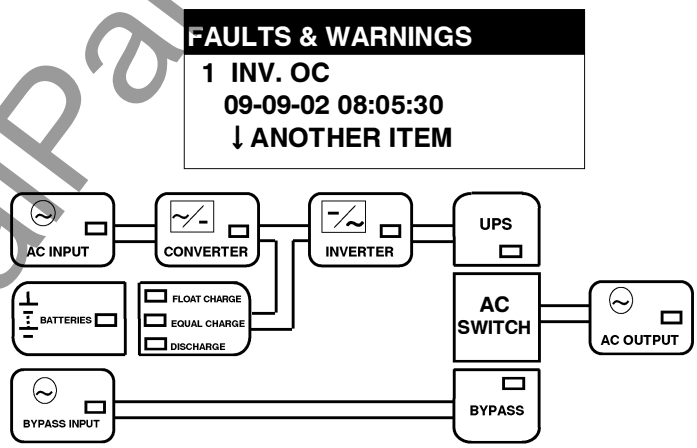
Figure 12.9 Changing screens with scroll buttons

12.3 Restoring UPS Operation

⚠ **WARNING**	**Contact Toshiba in the event of malfunction or fault.** This UPS should be repaired only by authorized Toshiba service personnel. Servicing by untrained personnel may extend the fault or result in electric shock or personal injury. **Do NOT attempt to modify or relocate the UPS.** Electric shock, personal injury or fault may result if personnel other than trained Toshiba technician attempt to modify or relocate the UPS. Be sure to contact Toshiba if you need modifications or if you need to relocate the UPS. **Do not open the front and/or rear panels.** The parts inside carry energy-high current. Touching them may result in electric shock, burns or fault.

This section describes the procedure to restore UPS operation. Table 11.11 shows an example in which the UPS is restored after a trip fault occurred on inverter over current with the message "INV. OC"

Table 12.11 Restoring UPS Operation (Example)

Step	Procedure	LCD/LED Status
1	Check the LCD screen. Also check other fault data screens with scroll buttons (7) and (8) on the graphic panel.	
2	Remove the memory card in the panel and insert a new memory card. *	(Optional)
3	Contact Toshiba.	Follow the directions given by the service personnel.

In the case of other faults as well, restore the UPS by doing the following:

(1) Check the nature of the fault on the LCD screen.

(2) Contact Toshiba.

(3) Follow the directions given by Toshiba service personnel.

Note: * Before removing the memory card, always verify the memory card LED shown is Off.

13. UPS Specifications

13.1 General Specification

Terms	Specification	Remarks
Conforming Standard	UL1778-2001	cUL, IEC, JIS
Ambient Temperature	0C~40C (32F~104F)	
Relative Humidity	30% ~ 95%	Non-condensing
Altitude	< 2,000m (< 6,560 ft)	
Insulation Resistance	3MΩ	With 500V-Megger
Insulation withstanding voltage	AC 2kV – 1min. AC 1.5kV – 1min. AC 500V – 1min.	Main Circuit External Interface Electronic Circuit
Audible Noise	65dB(150/225kVA), 70dB(300kVA)	1m (39") away from front

13.2 Mechanical Specification

Rated Capacity		150kVA	225kVA	300kVA
Cabinet Protection Conformity		IEC298 IP20 (*)		
Exterior Paint		2.8Y7.7/0.3		
Panel Thickness:	Front	1.6mm (1/16”)		
	Back/Side/Top	1.2mm (3/64”)		
	Bottom	3.2mm (1/8”)		
Input / Output cabling entrance		Bottom		Top
Ground / Control wiring entrance		Bottom		Top
Clearances:	in Front	1,100mm (43” 7/16)		
	in Back & Side	0mm (0”)		
	on Top	400mm (15” 3/4)		
Outline Dimension:	(Width)	1,400mm (55” 1/8)		1950mm (76” 3/4)
	(Depth)	800mm (31” 1/2)		900mm (35” 7/16)
	(Height)	2,000mm (78” 3/4)		2,000mm (78” 3/4)
Weight		1,200kg (2,640lbs)	1,500kg (3,300lbs)	2,000kg (4,400lbs)
Floor loading per footprint		1,071 kg/m^2 (219 lbs/ft^2)	1,339 kg/m^2 (274 lbs/ft^2)	1,139 kg/m^2 (233 lbs/ft^2)
Heat Rejection		9 kW (30,840 BTU/h)	11.5 kW (39,230 BTU/h)	18 kW (61,680 BTU/h)

(*) IP20 refers to foreign objects entrance and prevents objects of 12mm-diameter(15/32”) or larger.

13.3 Electrical Specification

Rated Capacity	150kVA (120kW)	225kVA (180kW)	300kVA (240kW)
AC Input			
Input Voltage	480V (+10% ~ -30%), 3-Phase 3-Wire		
Input Frequency	60Hz ± 5%		
Input Power Factor	0.95 ~ 1.00 Lagging (at 100% Load)		
Current Harmonic Distortion	3% Maximum (at 100% Load)		
Input Capacity Required	154kVA	232kVA	309kVA
Circuit Breaker Rating at 480V input	225A Trip	350A Trip	500A Trip
DC Input			
Voltage Window	288 ~ 414 V		
Recharge Voltage Regulation	±0.5%		
AC Output			
Output Voltage	480/277V ± 0.5%, 3-Phase 4-Wire		
Output Power Factor	0.8 Lagging		
Voltage Distortion	2.5% with 100% Linear Load / 4% with Non-Linear Load		
Transient Voltage Regulation	< ±2%		
Transient Settling Time	< 2 Cycles		
Crest Factor	< 3.0		
Output Frequency	60Hz ± 0.01% (at Free-running Mode)		
Synchronous window to the utility line	59Hz ~ 61Hz		
Frequency Slew Rate	1Hz/Sec		
Over Load Rating	100%-Continuous / 125%-10min. / 150%-1min.		

Appendix

Word Definitions

(1) Whole UPS concern

a. UPS: Uninterruptible Power System

(2) Circuit breakers

a. MCCB: Molded Case Circuit Breaker
b. ACB: Air Circuit Breaker

(3) Graphical interface

a. Graphic display panel: It contains push buttons, an LCD and LED's to show the operating procedure and/or the UPS status.
b. LCD: Liquid Crystal Display. This shows the operational procedures and the status of the UPS.
c. LED: Light Emitting Diode. Individual lamps located on the graphic panel indicate the status of the UPS.
d. Scroll buttons: The △ and ▽ buttons are used to scroll forward/backward LCD screens. It scrolls back to the 1st screen after circulating all the screen pages.

(4) Control system

a. Synchronized mode: The UPS output tracks the phase & frequency of the Bypass.