

TOSHIBA 4400
15/20/25/30/50/80/100kVA – Base Unit
GUIDE SPECIFICATION
THREE PHASE UNINTERRUPTIBLE POWER SUPPLY

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1 SCOPE

1.1 System

This specification describes a continuous duty, three-phase, On Line, Double Conversion, Voltage and Frequency Independent (VFI) uninterruptible power supply system, hereafter referred to as the UPS.

2 SYSTEM DESCRIPTION

2.1 Applicable Standards:

The UPS shall be designed in accordance with and be compliant with the following sections of the current revisions of the following standards:

UL 1778 (CUL)
National Electrical Code (NFPA-70)
CE
IBC
CBC
ANSI C62.41 (IEEE 587) – Standard for Surge Withstandability
NEMA PET-1993
OSHA
ASME
ISO 9001, 14001:2004
RoHS Compliant
AARA - American Recovery and Reinvestment Act of 2009
BAA - Buy American Act (FAR 52.225-5(a)(4))
OSHPD - State of California Office of Statewide Health Planning and Development (seismic option)
IBC code ICC-ES AC156 and the California Building Code (CBC) SECTION 1708A (seismic option)

2.2 Components:

The UPS shall consist of the following components:

- AC to DC Converter
- DC to DC Converter / Charger
- DC to AC Pulse-Width Modulated (PWM) Inverter
- Static Switch Bypass
- Microprocessor Controlled Logic and Control Circuitry
- LCD Touchscreen Display
- Dry Contact Status Terminals
- Dry Contact DB9 Port
- Cooling Fans
- Input Circuit Breaker
- Output EMI / RFI Filters

- (Optional) External Input / Output Transformers
- (Optional) External Battery Cabinet(s)
- (Optional) External Maintenance Bypass Cabinet
- (Optional) External Communications

2.3 System Operation:

The UPS shall operate as a fully automatic, On Line, Double Conversion, Voltage and Frequency Independent (VFI) system in the following modes:

2.3.1 Normal

NORMAL - Incoming AC power is converted into DC power using an AC to DC IGBT converter circuit. The DC power is then stored in a capacitor bank and used to charge the battery bank while at the same time providing clean, DC power to the inverter circuitry. The DC to AC IGBT inverter converts DC power to a constant, regulated AC power which feeds the load.

2.3.2 Loss of Main Power

Upon failure of commercial AC power, the UPS shall derive power from the internal/external battery bank and continue feeding the load with clean, regulated AC power. There is no interruption to the critical load upon failure or restoration of commercial AC power.

2.3.3 Return of Main Power and Recharge

Upon restoration of the commercial AC source, the AC-DC converter powers the inverter while simultaneously recharging the battery bank. The UPS shall have the following recharge process:

- A constant level of current is used to recharge the batteries (the process shall utilize a current-limit function to prevent overcharging batteries, thus extending the life of the batteries).
- As the batteries reach the normal charge level, a constant-voltage control shall begin which causes the battery recharge current to gradually decrease.
- Under normal operation, the UPS battery bank "floats" at the 2.25-2.27 volts per cell DC level to stay fully charged and ready for the next discharge.

2.3.4 Transfer to Bypass AC source

If the UPS becomes overloaded, or an internal fault is detected, the UPS controls shall automatically transfer the critical load from the inverter output to the fully rated static bypass AC source without interruption. When the overload or internal warning condition is removed, after a preset "hold" period the UPS will automatically re-transfer the critical load from the bypass to the inverter output without interruption of power to the critical load.

2.3.5 Maintenance Bypass System (MBS)

An optional manual make-before-break maintenance bypass system may be provided to electrically isolate the UPS for maintenance or test without affecting load operation. The MBS shall include interlock and keys which protect from improper opening or closing of MBS breakers. The MBS may also incorporate a Solenoid Key Release Unit (SKRU) which shall utilize status signals from the UPS to prevent an interruptible or unsafe transfer between Inverter Operation and Maintenance Bypass Operation.

3 SYSTEM PARAMETERS

3.1 UPS Input:

- 1) Rating
 - 15kVA : 15 kVA (13.5 kW)
 - 20kVA : 20 kVA (18 kW)
 - 25kVA : 25 kVA (22.5 kW)
 - 30kVA : 30 kVA (27 kW)
 - 50kVA : 50 kVA (45 kW)
 - 80kVA : 80 kVA (72 kW)
 - 100kVA : 100kVA (90 kW)
- 2) Voltage Variation
 - 15-80kVA : +10% to -15% with utilizing batteries*
 - 100kVA : +10% to -10% with utilizing batteries*
- 3) Rated Frequency : 50/60 Hz
- 4) Frequency Range : 45 - 65 Hz without utilizing batteries
- 5) Power Factor : > 0.98 lagging
- 6) Input Capacity : 110% of UPS Output Capacity
- 7) Walk-In Function : From 20% to 100% over 5 seconds (Adjustable)
- 8) Input Current Limit : 125% of nominal capacity
- 9) Inrush Current : < 600% under synchronous condition
- 10) Input Current THD : < 3% Total Harmonic Distortion (THD)
- 11) Surge Withstandability : Meets ANSI C62.41 (IEEE 587)
- 12) Input Phase Rotation (Protection/Detection) : Standard front-panel alarm panel shall Notify user that unit has been supplied with incorrect phase rotation on input to allow for correct installation. The UPS shall be fully protected to prevent damage from this event.

*Unit can operate at -30% Input Voltage at reduced load and in controlled temperature

3.2 UPS Output:

- 1) Rating
 - 15kVA : 15 kVA (13.5 kW)
 - 20kVA : 20 kVA (18 kW)
 - 25kVA : 25 kVA (22.5 kW)
 - 30kVA : 30 kVA (27 kW)
 - 50kVA : 50 kVA (45 kW)
 - 80kVA : 80 kVA (72 kW)
 - 100kVA : 100kVA (90 kW)
- 2) Rated Load Power Factor : 0.9 lagging
- 3) Voltage Regulation : +/- 2% nominal (balanced load)
- 4) Voltage Adjust. Range : +/- 5% manually (by front panel user interface)

- 5) Phase Displacement : +/- 2 deg. (balanced load)
: +/- 4 deg. (100% unbalanced load)
- 6) Rated Frequency : 50/60 Hz
- 7) Frequency Regulation : +/- 0.01% free running
- 8) Frequency Synch. Range : +/- 0.5/1.0/1.5 Hz (+/- 1.0 Hz Standard)
(User selectable)
- 9) Frequency Slew Rate : 1.0 Hz/second to 3.0 Hz/second
- 10) Voltage Transients : +/- 5% (100% step load change)
: +/- 3% (loss or return of input power)
: +/- 8% (bypass to inverter)
- 11) Transient Voltage Recovery : 50ms maximum to within 2% of nominal
- 12) Overload Cap. (on inverter)
15-80kVA : 109% Continuous, 125% for 90 sec., 150% for 30 sec.
100kVA : 104% Continuous, 125% for 90 sec., 150% for 30 sec.
- 13) Overload Cap. (on bypass) : 1000% for 10ms, 125% for 10 min.
- 14) Crest Factor
15-80kVA : 2.5 – 3.0 within the kW range.
100kVA : 2.0 within the kW range.
- 15) Harmonic Voltage Distortion : 1.5% THD maximum, 1% maximum for any single harmonic (linear load)
- 16) Inrush Current Protection : Automatic transfer to bypass, then auto-return to inverter (retransfer may be inhibited via display)
- 17) Output Overcurrent Monitoring : Hall-Effect Current Transformer
Output Overcurrent Protection : Semiconductor fast acting fusing

3.3 (OPTIONAL) External Battery Cabinets:

- 1) Battery Type: Sealed, Valve Regulated Lead Acid cells
- 2) Backup Time with 1 matching battery cabinet (Estimated):

UPS Capacity	Estimated Backup Time at Full Load (0.9PF)
15kVA	34 min.
20kVA	24 min.
25kVA	18 min.
30kVA	147 min.
50kVA	15 min.
80kVA	8.5 min.
100kVA	5 min.

- 3) DC Battery Voltage Range :

UPS Capacity	15-100 kVA
Nominal Voltage	288 VDC
Alarms Voltage(V low)	252 VDC
Shutdown Voltage (V min)	230 VDC

- 4) Ripple Voltage: <0.5% RMS maximum
- 5) DC-AC Efficiency : ≥92%

- 6) Recharge Current
 15-30kVA :6A Standard, 20A Max
 50-80kVA :10A Standard, 20A Max
 100kVA :16A Standard, 20A Max

3.4 Environment

- 1) AC-AC Efficiency @ % of rated load

Capacity	25%	50%	75%	100%
15kVA	88.8%	90.9%	91.0%	91.0%
20kVA	88.8%	90.9%	91.0%	91.0%
25kVA	88.8%	90.9%	91.0%	91.0%
30kVA	88.8%	90.9%	91.0%	91.0%
50kVA	88.8%	90.9%	91.0%	91.0%
80kVA	88.8%	90.9%	91.0%	91.0%
100kVA	88.8%	90.9%	91.0%	91.0%

- 2) Thermal Load at Rated Output

Capacity	No Load (BTU/hr.)	25% (BTU/hr.)	50% (BTU/hr.)	75% (BTU/hr.)	100% (BTU/hr.)
15kVA	1024	1457	2308	3417	4556
20kVA	1365	1942	3078	4556	6074
25kVA	1706	2428	3847	5695	7593
30kVA	2047	2914	4617	6834	9111
50kVA	3412	4856	7695	11,389	15,186
80kVA	5459	7746	12,297	18,223	24,297
100kVA	6824	9683	15,371	22,779	30,372

- 3) Temperature

Operating : 32°F – 104°F (0 °C – 40 °C)
 Storage : 14°F – 122°F (-10 °C – 50 °C)

NOTE: Prolonged operation or storage of the optional matching backup battery cabinet batteries at temperatures in excess of 77°F (25 °C) will degrade battery performance and operational life.

- 4) Relative Humidity : 30 – 95% (non-condensing)
 5) Audible Noise : <65 dB (A-weight @ 1 meter)
 6) Altitude (w/o derating) : 3300-ft. (1,000 m)
 7) Color : O'Brien Black (Textured)

4 FUNCTIONAL DESCRIPTION

4.1 Converter / Charger

4.1.1 DESCRIPTION

The converter/charger shall consist of a solid-state three phase rectifier, DC to DC converter, output filter, and transient suppresser network to regulate and maintain DC power to the inverter.

4.1.2 TRANSIENT SUPPRESSER

The incoming AC utility shall first be connected to a molded case circuit breaker as a means of disconnecting power to the UPS. Power shall flow through a surge absorber to prevent large transients from passing through to the load or damaging the batteries. Power shall then flow through a line filter to prevent sags or surges from passing to the load.

4.1.3 AC CONVERTER/CHARGER

The AC Converter shall serve to change incoming AC power to DC, which shall be supplied to the DC Converter. From this point, DC power is used to recharge the battery bank while simultaneously providing power to the inverter.

- Input Frequency Range: 45-65 Hz, continuous, without battery operation
- Capacity: Battery recharge shall be to within 90% of nominal from a fully discharged state in 10 times the discharge time.

4.1.4 DC CONVERTER

The DC Converter circuit shall consist of inductors, capacitors, diodes and IGBT's (Insulated Gate Bipolar Transistors). The DC Converter shall have the function of providing start-up protection (by checking phase rotation of incoming utility power), boosting the DC to the inverter (during low AC input voltage conditions), providing power factor enhancement, and reducing reflected harmonics to incoming utility power.

4.2 Pulse Width Modulated (PWM) Inverter

4.2.1 DESCRIPTION

The PWM (Pulse Width Modulated) inverter shall incorporate an advanced IGBT design, an output isolation transformer, and output overcurrent protection for clean, regulated output power to the critical load.

4.2.2 INVERTER

The inverter network shall consist of a high speed IGBT switching network designed to supply non-linear loads with a clean and steady voltage waveform. The inverter switching speed shall be fast enough to limit audible noise to 65 dBA at 1 meter. The inverter shall be capable of providing power to a 100% unbalanced load continuously.

4.2.3 INPUT ISOLATION TRANSFORMER

The inverter network shall incorporate a shielded isolation transformer to provide complete isolation of the load from utility AC, as well as providing attenuation for high frequency noise common mode). Additionally, the transformer shall have a set of windings to condition the internal static bypass line.

4.2.4 OVERCURRENT PROTECTION

The output circuitry shall be equipped with a Hall Effect Current Transformer to detect and protect the inverter from excessively high currents.

4.3 Static Bypass Switch

4.3.1 TRANSFER

The static bypass switch shall consist of thyristor switches in conjunction with an output contactor to permit manual switching from bypass to UPS and UPS to bypass without power interruption. The UPS shall instantaneously transfer to bypass should a component fail during normal operation (provided the UPS and bypass are in synchronization). Auto-retransfer to UPS after an overload condition shall be completed within one second after the bus has dropped to 100% of nominal.

4.3.2 REMOTE RUN/STOP

A set of normally open dry contacts shall be provided to remotely transfer the UPS on-line and off-line. When the UPS is in this mode of operation, the UPS front control panel shall be disabled to provide a secured configuration.

4.4 Microprocessor Control System

4.4.1 DESCRIPTION

The UPS system shall be provided with a highly reliable microprocessor internal control system to perform start-up, transfers, monitoring, and battery recharging. The microprocessor shall provide important information to the user (via a liquid crystal display) with such as system status, fault messages and input and output parameters.

4.4.2 LED INDICATORS

The following LED indicators shall be provided on the UPS front panel displays, which mimic power flow through the UPS:

- AC INPUT (Green Lamp) - Lights when normal AC input power is being supplied to the unit.
- INVERTER (Green Lamp) - Lights when the UPS unit's inverter is normal.
- BATTERY (Green Lamp) - Lights when the batteries are discharging: flickers when the battery voltage is below minimum.
- BYPASS (Green Lamp) - Lights when in circuit-bypass mode.
- FAULT (Red Lamp) - Lights when a fault has been detected. See "System Diagnostics" for specific fault.

4.4.3 SYSTEM METERING

The UPS shall be provided with a single read-out display which displays, upon request, the following information:

- AC INPUT VOLTAGE (Line to Line)
- AC INPUT CURRENT
- AC OUTPUT VOLTAGE (Line to Line, Line to Neutral)
- AC OUTPUT CURRENT
- BATTERY VOLTAGE
- BATTERY CHARGING CURRENT
- INPUT FREQUENCY

- OUTPUT FREQUENCY
- INPUT/ OUTPUT kW
- POWER FACTOR

4.4.4 SYSTEM DIAGNOSTICS

The following diagnostic information shall be provided to troubleshoot the UPS should a fault occur. These items shall be included along with time/date stamps and maintained in a re-accessible log.

- UPS Ok
- Memory Error
- Wrong Phase Rotation of AC Input
- Internal AC Circuit Fault
- Internal DC Circuit Fault
- Heatsink Overheat
- DC unbalanced
- DC Circuit Over/Under voltage
- DC Circuit Overcurrent
- DC Converter Input Overcurrent
- Inverter Overcurrent
- Inverter Over/Under voltage
- Inverter Overload
- UPS Overload (including Bypass)
- Inverter Output Current Limit
- Low Battery Voltage
- I/O not Synchronized
- Auto-transfer Mode
- Fuse Open
- Battery Discharging Mode
- UPS Output Disabled

5 MECHANICAL DESIGN

5.1 UPS Enclosure

The UPS shall be in a freestanding, NEMA1 enclosure equipped with casters and leveling feet. The overall dimensions and weights shall be as follows:

<u>UPS Size</u>	<u>Dimensions</u>	<u>Weight</u>
15 kVA	20.12"W x 37.4"D x 65.06"H	720 lb.
20 kVA	20.12"W x 37.4"D x 65.06"H	720 lb.
25 kVA	20.12"W x 37.4"D x 65.06"H	720 lb.
30 kVA	20.12"W x 37.4"D x 65.06"H	720 lb.
50 kVA	32.1"W x 37.2"D x 73.8"H	1350 lb.
80 kVA	32.1"W x 37.2"D x 73.6"H	1500 lb.
100 kVA	32.1"W x 37.2"D x 73.6"H	1650 lb.

5.2 (OPTIONAL) External Matching Battery Enclosure

The matching battery cabinet shall consist of a freestanding, matching NEMA1 enclosure equipped with either casters and leveling feet, or C-Channel base. No proprietary software shall be required to reset battery timers or replace batteries. The maximum overall dimensions and weights shall be as follows:

<u>UPS Size</u>	<u>Dimensions</u>	<u>Weight</u>
15-30 kVA	20.12"W x 37.4"D x 65.06"H	1460 lb.
50 kVA	32.1"W x 37.2"D x 73.6"H	2460 lb.
80 kVA	32.1"W x 37.2"D x 73.6"H	2460 lb.
100 kVA	32.1"W x 37.2"D x 73.6"H	2460 lb.

5.3 Cable Entry

Cable entry to the UPS shall be:

- Bottom entry
- Left and Right Side entry
- Top entry

5.4 Ventilation and Maintenance Requirements

The UPS shall require the following minimum space for ventilation and maintenance: 36" (front), 16" (top), 0" (rear and sides).

6 STANDARD FEATRUES

6.1 Emergency Power Off (EPO)

Emergency Power Off (EPO) terminals which trip open the UPS and battery circuit breakers.

6.2 RS-232 Communications Interface

Serial data link will enable the UPS to interface with a computer to provide power status and diagnostic information.

6.3 DB9 Dry Contact Interface

The following normally open dry contacts shall be provided through a DB9 male connector located inside the front door:

- 1) Bypass Active
- 2) Battery Voltage Low
- 3) UPS On-Line
- 4) Battery Charging
- 5) Battery Discharging (Input Power Loss)
- 6) Fault Signal Detected

6.4 Battery Fault Test Function

The UPS shall be provided with a "Battery Test" command to periodically check the condition of the batteries. Upon detection of a battery problem, the UPS shall notify the user of this condition allowing the user to perform a detailed check of the battery string.

7 (OPTIONAL) COMMUNICATIONS

7.1 RemotEye® Network Adapter

The UPS shall provide either an internal or external support for an internet web/SNMP adapter RemotEye for the optional capability of remote or internet system monitoring.

7.1.1 SNMP Ability

RemotEye shall provide a SNMP interface for the UPS. The SNMP interface shall provide for easy integration of UPS management into an existing SNMP Network Management System. At any given time, SNMP queries shall be able to poll the RemotEye 4 agent for the current status of its connected UPS.

7.1.2 HTTP Familiarity

The RemotEye shall provide a HTTP interface for the UPS to allow easy access of the UPS information from any machine with a web browser. At any time, a network workstation or management station shall be able to open a RemotEye website. RemotEye website shall enable the UPS system information to be configured and monitored remotely. RemotEye shall provide access to 3 java applets for monitoring, event logging, and trend analysis.

7.1.3 Shutdown Capability

The RemotEye application software shall allow RemotEye to remotely notify and shutdown selected network servers.

Network Adapter/External Hardware
AMD 188ES-20MHz
512kB SRAM: 512kB Flash
Two asynchronous serial ports
10 BaseT RJ-45 connector
Toshiba UPS communication protocol
SNMP over UDP/IP : HTTP over TCP/IP:ARP, RARP, TFTP and ICMP
MIB_II : Toshiba v1.2_MIB :JEM MIB : RFC 1628
Traffic LED for network : Status LED for status : Power LED for Power
2 digit (default setting is Switches 1 and 2 off)
Temperature Range: 0 – 40 °C
Relative Humidity: 10 – 80 %
Power Requirements: 12 VDC ungrounded
2.0 Watts Maximum
Dimensions: 5.28”(134mm) x 3.40”(86mm) x 1.10”(27mm) (LxWxH)
Weight: 0.38lbs(170g)
Certifications: IEC 62040-2, UL, CUL, CE, ANSI C62.41 (IEEE 587 cat B)

7.2 (OPTIONAL) Remote Status Alarm Panel (RSAP)

The manufacturer shall optionally provide a RSAP that shall provide a wall-mounted LED mimic display for UPS status events of:

- Input ON
- Bypass ON
- Inverter ON
- Low Battery, AC Fail
- New alarm annunciation
- Battery backup for the RSAP monitor.

8 (OPTIONAL) MAINTENANCE BYPASS PANEL

The manufacturer can optionally provide a MBS (Maintenance Bypass Panel) for the UPS.

8.1 Site Installation

The MBS can be available in a three-breaker wall mount or floor mount configuration.

8.2 Electrical Configuration

The MBS can be available in two, three, or four breaker configurations.

8.3 Mechanical Interlock

The MBS can have the option for either a two-kirk-key mechanical interlock system, or a SKRU (Solenoid Key Release Unit) interlock system.

8.4 External Maintenance Bypass:

- A manually operated maintenance bypass panel can be provided to bypass the power feeding the critical load from inverter to a static switch panel without causing any power interruption.
- Bypass input breaker can supply input power to the UPS module static bypass input. If the system design calls for separate UPS and bypass inputs, a bypass input breaker can be installed on each input.
- UPS maintenance bypass breaker can allow power flow to the load when the UPS is bypassed. This can be a normally open circuit breaker.
- The UPS module output can feed the UPS output isolation breaker.
- Optionally, the two input bypass breaker can be used to feed both the UPS converter input and the UPS bypass input.

9 (OPTIONAL) POWER DISTRIBUTION UNITS (OPTION)

The UPS manufacturer can provide optional PDUs (Power Distribution Units) for stepping the UPS output voltage down to service load voltages. The PDUs can be provided in either front-access cabinet or Rack-mount style.

10 WARRANTY

10.1 UPS Warranty

The UPS shall come with a 36-month warranty on all mechanical, electrical, electronic components. Parts, labor, and travel are included during warranty period. Optional extended warranties shall be available.

10.2 UPS Battery Warranty

The back-up batteries shall come with a three-year full warranty. Parts, labor, and travel are included during warranty period. Optional extended warranties shall be available.

10.3 Warranty Support Availability

Warranty and technical support shall be available 24/7/365.

11 (OPTIONAL) EXTENDED SERVICES (OPTION)

The UPS manufacturer can offer:

- Startup Service
- Maintenance Contracts (Silver, Gold, Platinum)
- Preventive Maintenance Contracts
- Spare-parts kits (A, B, and C level)
- Extended warranty coverage for up to an additional 5 years
- Enhanced warranty contract (24/7 + Holiday coverage)
- Load bank testing
- Factory witness testing
- Site monitor and power audits