

**SPECIFICATION for**  
**SINGLE PHASE UNINTERRUPTIBLE POWER SYSTEM**

1600XP  
3.6-22 kVA - Internal Battery



## 1.0 SCOPE

### 1.1 System

This specification describes the Toshiba 1600XP Series of continuous duty, single-phase, on-line, solid-state uninterruptible power supply system hereafter referred to as the UPS.

## 2.0 SYSTEM DESCRIPTION

### 2.1 Applicable Standards:

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

- ANSI C62.41 (IEEE 587) – Standard for Surge Withstand ability
- UL 1778 (CUL)
- CE
- FCC Class A
- National Electrical Code (NFPA-70)
- NEMA PE-1
- OSHA
- ASME
- ISO 9001, 14001
- RoHs

### 2.2 Components:

The UPS consist of the following components:

- A. Converter
- B. Chopper / Charger
- C. Pulse-Width Modulated (PWM) Inverter
- D. Static Switch Bypass
- E. Microprocessor Controlled Logic and Touchpad Control Panel
- F. Input Circuit Breaker
- G. Battery System
- H. Output Isolation Transformer

### 2.3 System Operation:

The UPS operates as an on-line, fully automatic system in the following modes:

A. **NORMAL** - Incoming AC power is boosted using a chopper circuit, and converted into DC power. The DC power is then used to charge the battery bank while at the same time providing clean, DC power to the inverter circuitry. The inverter converts DC power to a clean regulated AC power which feeds the load.

B. **EMERGENCY** - Upon failure of commercial AC power, the UPS derives power from the 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.

C. RECHARGE - Upon restoration of the commercial AC source, the rectifier/chopper powers the inverter while simultaneously recharging the battery bank. The UPS has the following recharge process:

- a) A constant level of current is used to recharge the batteries (the process utilizes a current-limit function to prevent overcharging batteries, thus extending the life of the batteries)
- b) As the batteries reach the normal charge level, a constant-voltage control begins which causes the battery recharge current to gradually decrease
- c) 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.

D. BYPASS MODE - Upon detection of an internal fault or output overload, the UPS automatically switches from inverter power to an internal bypass via the static switch. Transfer is within 4 milliseconds, causing no interruption to the critical load. While in bypass, the UPS protects against spikes and common/normal mode noise by utilizing line filters and an output isolation transformer. "Return from Bypass mode" is an automatic function, without interruption to the critical load. Transfer to Bypass may also be performed as a manual operation via the UPS front panel.

E. POWER CONDITIONING MODE - Should the batteries be removed from the UPS, the UPS continues to function and still provide protection against spikes, common/normal mode noise, load steps and frequency shifts (without battery back-up capability).

**3.0 SYSTEM PARAMETERS**

A. UPS Input:

- Input Voltage : 208/240VAC Single Phase
  - Input Voltage Requirement : 2 Wire + Ground
  - Voltage Variation : +10% to -30% \*
  - Rated Frequency : 50/60 Hz
  - Frequency Range : 45 - 65 Hz
  - Power Factor : > 0.95 lagging
  - Input Capacity : 110% of UPS Output Capacity
  - Input Current Limit : 125% of nominal capacity
  - Input Current THD : < 5% Total Harmonic Distortion (THD)
- \* For continuous operation at -30%, derate the maximum operating temperature to 90 °F (32 °C.)

B. UPS Output

- Rated Voltage : 120/208/240 VAC Single Phase
- Output Voltage Requirements : 1 Phase, 3 Wire + Ground
- Output Capacity :
 

<u>kVA</u>	<u>kW</u>
3.6 kVA	3.1 kW
6 kVA	5.1 kW
8 kVA	6.8 kW
10 kVA	8.5 kW
14 kVA	11.9 kW
18 kVA	15.3 kW
22 kVA	18.7 kW

Rated Load Power Factor	: 0.85 lagging
Efficiency	: Typical: 85%, Minimum: 83% (AC/AC)
Voltage Regulation	: +/- 3% nominal (balanced load)
Rated Frequency	: 50/60 Hz (Autosensing or manually selectable)
Frequency Regulation	: +/- 0.5, 1.0, or 1.5 Hz
Frequency Synch. Range	: +/- 1.0 Hz
Voltage Transients	: +/- 8% (100% step load change)
	: +/- 3% (loss or return of input power)
Transient Voltage Recovery	: 50ms maximum to within 2% of nominal
Overload Cap. (on inverter)	: 125% for 30 sec.,
	: 150% for 10 sec.
Overload Cap. (on Bypass)	: 1000% for 1 cycle
Crest Factor	: 3.0
Harmonic Voltage Distortion	: 3% THD @ 100% linear load
	: 6% THD @ 100% Non-linear

C. Batteries

- 1) Internal Battery Type: Sealed, Valve Regulated Lead Acid cells
- 2) Protection Time:

Internal Battery Backup provides the listed backup time at the following loads for each UPS:

UPS Capacity	Run-time at Full Load*	
	0.7 PF	.085 PF
3.6 kVA	8 min.	7 min.
6 kVA	8 min.	7 min.
8 kVA	7 min.	7 min.
10 kVA	7 min.	5 min.
14 kVA	7 min.	7 min.
18 kVA	7 min.	5 min.
22 kVA	5 min.	3 min.

\*Times are accurate provided normal Preventative Maintenance procedures are followed.

3) DC Voltage Range:

UPS Capacity	3.6 kVA	6 kVA	8 -22 kVA
Nominal DC Bus Voltage	144 VDC	216 VDC	288 VDC
Voltage Range	114-164 VDC	170-245.7 VDC	227-327 VDC
Shutdown Voltage	114 VDC	170 VDC	227 VDC

D. Environmental

Heat Generation:	: <u>UNIT</u>	<u>BTU/hr.</u>
	3.6kVA	2139
	6 kVA	3564
	8 kVA	4095
	10 kVA	5118
	14 kVA	6610
	18 kVA	8499
	22 kVA	10,387

Operating Temperature:	
60 Hz	: 32 to 104° F (0 to 40° C)

50 Hz		: 32 to 91° F (0 to 33° C)
Storage Temperature:	UPS	: -4 to 104° F (-20 to 40° C)
Relative Humidity		: 30-90% (non-condensing)
Audible Noise		: <50 dBA @ 1 meter
Altitude		: < 6,600-ft. maximum (< 2,000 m)

## 4.0 FUNCTIONAL DESCRIPTION

### A. Converter / Charger / DC Chopper

DESCRIPTION - The converter/charger consists of a solid-state three phase rectifier, DC to DC converter (chopper), output filter, and transient suppresser network to regulate and maintain DC power to the inverter.

1) TRANSIENT SUPPRESSER - The incoming AC utility connects first to a molded case circuit breaker as a means of disconnecting power to the UPS. Power flows through a surge absorber to prevent large transients from passing through to the load or damaging the batteries. Power flows through a line filter to prevent sags or surges from passing to the load.

2) CONVERTER/CHARGER - The converter serves to change incoming AC power to DC, which is supplied to the DC chopper. From this point, DC power is used to recharge the battery bank while simultaneously providing power to the inverter.

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

3) DC CHOPPER - The chopper circuit consists of inductors, capacitors, diodes and IGBT's (Insulated Gate Bipolar Transistors). The chopper provides 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.

### B. Pulse Width Modulated (PWM) Inverter

DESCRIPTION - The PWM (Pulse Width Modulated) inverter incorporates an advanced IGBT design, and output over current protection for clean, regulated output power to the critical load.

1) INVERTER - The inverter network consists of a high speed IGBT switching network designed to supply non-linear loads with a clean and steady voltage waveform. The inverter switching speed is fast enough to limit audible noise to 50 dBA at 3 feet (measured on 'A' scale).

2) OVERCURRENT PROTECTION - The output circuitry is equipped with a Hall Effect Current Transformer to detect and protect the inverter from excessively high currents.

### C. Static Bypass Switch

1) TRANSFER - The static bypass switch consists 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 instantaneously transfers 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 is completed within one second after the bus has dropped to 100% of nominal.

2) REMOTE RUN/STOP - A set of normally open dry contacts are 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 is disabled to provide a secured configuration.

**D. Microprocessor Control System**

1) DESCRIPTION - The UPS system is provided with a microprocessor internal control system to perform start-up, transfers, monitoring, and battery recharging. The microprocessor provides information to the user (via a touchscreen liquid crystal display with searchable menu tree) such as system status, fault messages and input and output parameters.

2) LED INDICATORS - The following LED indicators are provided on the UPS front panel displays, which mimic power flow through the UPS:

- a) AC INPUT (Green Lamp) - Lights when normal AC input power is being supplied to the unit.
- b) WARNING (Amber Lamp) – Lamp is OFF when the UPS is normal.
- c) ON-LINE FAULT (Green/Red Lamp) – GREEN when voltage is within specifications, and RED when voltage is out of specifications

3) SYSTEM METERING - The UPS is provided with a touchscreen display which can display current system operation, monitor current operating mode, performance settings, or fault/incident records.

4) SYSTEM DIAGNOSTICS - Should a fault occur during operation, diagnostic information is displayed in the lower left corner of the touchscreen:

**5.0 MECHANICAL DESIGN**

**A. UPS Enclosure:**

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

<u>UPS Size</u>	<u>Dimensions</u>	<u>Weight</u>
3.6 kVA	22.1 in. H x 10.0 in. W x 34.0 in. D	250 lbs.
6 kVA	27.5 in. H x 10.0 in. W x 34.0 in. D	288 lbs
8 kVA	28.4 in. H x 13.0 in. W x 34.9 in. D	476 lbs
10 kVA	28.4 in. H x 13.0 in. W x 34.9 in. D	476 lbs
14 kVA	39.0 in. H x 17.5 in. W x 36.1 in. D	784 lbs
18 kVA	39.0 in. H x 17.5 in. W x 36.1 in. D	784 lbs
22 kVA	39.0 in. H x 17.5 in. W x 36.1 in. D	784 lbs

**B. Cable Entry:**

The UPS is provided with cable entry at the bottom rear of the UPS enclosure.

C. Ventilation and Maintenance Requirements:

The UPS requires the following minimum space for ventilation and maintenance: 28” (front), 18” (top), 6” (rear), and 0” (side).

## 6.0 STANDARD FEATURES

A. Emergency Power Off (EPO)

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

B. RS232-C Communication Interface for factory use.

C. DB9 Dry Contact interface

The following normally open dry contacts are provided through a DB9 male connector located on the rear of the UPS:

- 1) UPS On
- 2) Bypass Active
- 3) Input Power Loss
- 4) Battery Voltage Low
- 5) Fault Signal Detection
- 6) Battery Depleted

D. Battery Test Function

The UPS is provided with a “Battery Test” pushbutton 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.

## 7.0 SERVICE AND WARRANTY

Warranty:

The UPS system is provided with a comprehensive three-year warranty. The warranty shall cover parts, labor, travel and freight for the UPS within the contiguous 48 states. The battery system has a full two year warranty with 3 year’s pro-rata total of 5 year battery warranty. Typical on-site response time is 4 hours (24 hours maximum). The warranty period shall expire three years for UPS and two years for the battery system from date of shipment from manufacturer’s facility.