T1000 Series Single Phase Uninterruptible Power Systems
Product Specifications – Rev 1.0 May 2015
6000VA (5400W)

1.0 Scope

This specification document describes the Toshiba T1000 Series. The T1000 is continuous duty, single-phase, on-line, solid-state uninterruptible power supply system hereafter referred to as the UPS. The UPS will supply a clean regulated AC power output sine wave which is unaffected by the quality of the AC input. The input and output voltages are single phase.

2.0 General Operation

Under normal operating conditions, the UPS' rectifier converts alternating current AC power to direct current (DC) power, which is required for the system's inverter and battery charger. The charger supplies regulated DC power to keep the batteries constantly charged. The inverter uses pulse width modulation (PWM) that fully utilizes the characteristics of insulated-gate bipolar transistors (IGBT) to convert DC power to regulated AC power. Therefore there is a constant supply of power. The batteries will instantaneously supply the inverter DC power when an AC power line failure occurs.

2.1 Performance Standards:

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

- UL 1778 (CUL)
- CE
- FCC Class A

3.0 General

3.1 Materials

All materials used are of new manufacture using the latest technology and have not been in prior service except for specified factory testing. IGBT's are used exclusively in the rectifier, inverter and converter/chopper sections.

3.2 Components:

All functioning components are solid state.
The UPS consist of the following components:

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

3.3 Assembly

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The UPS is delivered fully assembled and fully functional.

4.0 System Theory, Modes of Operations and Main Components Functions

4.1 Theory

AC input from the utility system is converted into DC power. The stepped up DC power is then converted to AC power by the inverter. The output voltage waveform of the inverter will be a pulse voltage waveform modulated by the PWM control. The PWM-Modulated voltage waveform is transformed into a sine voltage waveform by the inductive component of the inverter inductor and by the capacitive component of the capacitor filter. The chopper, inverter, and charger use IGBT's that have a high switching speed.

4.2 Modes of Operation

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

A. NORMAL - Incoming AC power is boosted using a power factor correction (PFC) 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. BATTERY - Upon failure of commercial AC power, the UPS derives power from the battery bank and continues 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 recharge process is:

a) The internal battery charger supplies a constant level of current 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 approximately 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 surge suppression. "Return from Bypass mode" is an automatic function, which does not interrupt the critical load. Transfer to Bypass may also be performed as a manual operation via the UPS front panel.

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4.3 Main Components Functions

4.3.1 Converter / Charger / DC Chopper

DESCRIPTION – The converter consists of a PFC network using IGBTs and diodes to boost the input and rectify to regulated DC power to supply the inverter.

1) TRANSIENT SUPPRESSER - The incoming AC utility connects first to a 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 attenuate conducted emissions and boost RF immunity.

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 auto sensing, continuous, without battery operation.
b) Capacity: Battery recharges to within 90% of nominal from a fully discharged state in 4 hours.

3) DC CHOPPER – The PFC converter includes a DC/DC boost function to interface the battery to the UPS, boosting the battery voltage to a DC level that supplies the inverter.

4.3.2 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.

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 (with fans operating) at 1 meter from the front panel.

4.3.3 Static Bypass Switch

1) TRANSFER - The static bypass switch consists of thyristor switches to permit manual switching from bypass to UPS and UPS to bypass without power interruption. The UPS instantaneously transfers to bypass should an inverter component fail during normal operation. Auto-retransfer to UPS after an overload condition is completed within one second after the bus has returned to nominal.

2) REMOTE RUN/STOP - A set of normally open dry contacts are provided to remotely transfer the UPS on-line and off-line.

4.3.4 Microcontroller Control System

1) DESCRIPTION - The UPS system is provided with a microcontroller-based internal control

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system to perform start-up, transfers, monitoring, control, and battery recharging. The microcontroller provides information to the user (via a 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 LED) - Lights when normal AC input power is being supplied to the unit.
b) WARNING (Amber LED) – Lamp is OFF when the UPS is normal.
c) ON-LINE FAULT (Green/Red LED) – GREEN when voltage is within specifications, and RED when voltage is out of specifications or other faults have occurred.

3) SYSTEM METERING - The UPS is provided with a 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 display.

5) Battery Test Function
The UPS is provided with a selectable "Battery Test" function 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.

5.0 System Parameters

5.1 UPS Input

Input Voltage	: 208/240VAC Single Phase
Input Voltage Requirement	: 2 Wires + Ground
Input Voltage Variation	: +10% to -30% {Typical load 70%
Rated Frequency	: 50/60 Hz
Frequency Range	: 45 - 65 Hz
Power Factor	: > 0.95 lagging
Input Capacity	: 100% of UPS Output Capacity
Input Current Limit	: 125% of nominal capacity
Input Current THD	: < 5% Total Harmonic Distortion (THD)

5.2 UPS Output

Rated Voltage	: 208/240/120 VAC Single Phase
Rated Current	: 25.0 A (Based on 240 V)
Output Voltage Requirements	: 1 Phase, 2 Wires + Ground
Output Capacity	: 6 kVA, 5.4 kW
Rated Load Power Factor	: 0.9 lagging
Efficiency	: Typical: >90%, Minimum: >87% (AC/DC/AC)
Voltage Regulation	: +/- 3% nominal (balanced load)

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Rated Frequency	: 50/60 Hz (Auto sensing or manually selectable)
Frequency Regulation	: +/- 0.25 Hz
Frequency Sync. Range	: +/- 3.0 Hz
Voltage Transients	: +/- 8% (100% step load change)
	: +/- 3% (loss or return of input power)
Transient Voltage Recovery	: 30ms maximum to within 2% of nominal, R load
Overload Cap. (on inverter)	: 125% for 1 min.
	: 150% for 10 sec.
Overload Cap. (on Bypass)	: 1000% for 1 cycle
Crest Factor	: 3.0 at full load
Harmonic Voltage Distortion	: 3% THD @ 100% linear load
	: 5% THD @ 100% Non-linear load

Efficiency Vs. Load	
Load (%)	Efficiency (%)
100% Load	89.0%
75% Load	88.2%
50% Load	85.6%
25% Load	78.5%

5.3 Environmental

Heat Rejection	: @ 100% full load 2755 BTU/hr
Operating Temperature:	
60 Hz	: 32 to 104° F (0 to 40° C)
50 Hz	: 32 to 104° F (0 to 40° C)
UPS Storage Temperature	: -4 to 104° F (-20 to 40° C)
Relative Humidity	: 30-90% (non-condensing)
Audible Noise	: <50 dBA @ 1 meter
Altitude	: < 11,500-ft. maximum (< 3,500 m)

6.0 UPS Batteries

6.1 Battery Voltage Range

Battery Voltage Range	
Nominal Battery Voltage	216 VDC
Voltage Range	170-245.7 VDC
Shutdown Voltage	170 VDC (minimum)

6.2 Protection Time: Internal Battery Backup provides the listed backup time at the following load:

Run-time at Full Load*	
0.9 PF	0.96 PF
5 min.	4 min.

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

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6.3 Internal Battery Type:

Sealed, Valve Regulated Lead Acid cells (VRLA)
Batteries are hot-swappable (with no option panel installed)

7.0 System Status and Control Indicators

7.1 Front Panel

The UPS has a front LCD screen panel that shows all of its parameters while allowing control of the UPS.

Operation Panel Features:

1) AC Input Voltage green LED Indicator
2) Warning Amber LED Indicator
3) On-Line (inverter)/Fault green/red LED Indicator
4) Liquid Crystal Display (LCD)
5) UPS Control STOP (Bypass) and RUN (On-Line) from push button.

The UPS front screen panel is TAB menu driven. The screen has a dedicated footer that displays any alarms and faults which makes it easier for the operator just to glance over the display without having to touch the display.

8.0 Dimensions, Weights and Mechanical (Based on Standard Models Only)

8.1 UPS Enclosure:

The UPS is in a freestanding, NEMA1 enclosure equipped with optional casters and leveling feet for tower model, or with stationary ears for rackmount model. The overall dimensions and weights are as follows (note: the weights and dimensions are based without packaging material):

Rackmount	UPS	Battery	Transformer
Weight	63 lbs.	147 lbs.	76 lbs
Depth	24.38 in.	24.38 in.	24.38 in.
Width	16.73 in	16.73 in	16.73 in
Height	5.22 in.	5.22 in.	5.22 in.

Tower	UPS	Battery	Transformer
Weight	63 lbs.	147 lbs.	76 lbs
Depth	24.38 in.	24.38 in.	24.38 in.
Width	16.73 in	16.73 in	16.73 in
Height	5.22 in.	5.22 in.	5.22 in.

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8.2 Cable Entry:

The UPS is provided with cable access at the back of the UPS enclosure.

8.3 Ventilation and Maintenance Requirements:

The UPS requires the following minimum space for ventilation and maintenance for rackmount and tower: 32" (front), 0" (top), 12" (rear), and 0" (side).

9.0 External Communications

9.1 EPO Control

The UPS comes equipped with terminals for receiving an emergency power-off (EPO) command via its contacts located (close contacts for EPO) on its terminal block.

9.2 DB9 Dry Contacts

This is a standard feature that is offered on all the T1000 models. This feature has a limited amount of status that can be monitored remotely, but it stills offers the most vital alarms and faults signals. The dry contacts offer the following alarms/faults:

1) Fault Signal
2) Normal Input Power Supply
3) Bypass Operation
4) Battery Voltage Drop (Low Battery)
5) UPS Operation (Closed while on normal operation)
6) Power Failure

9.3 USB Communication Interface for factory and end user use.

This is a standard feature that is offered on all the T1000 models. This feature is used for factory to configure UPS settings. It also offers end users the ability to monitor the T1000 via the T1000 USB computer software.

10.0 Reliability

Mean Time Between Failures (MTBF) of 80,000 hours at 25C.

11.0 Conformance

The UPS Complies with UL 1778 (CUL), CE, and FCC Class A.

12.0 Warranty

The UPS system is provided with a comprehensive three-year warranty and the battery system has a full two year warranty. It covers parts and labor. The warranty period shall expire three years for UPS and two years for the battery system from date of shipment from manufacturer's facility.

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13.0 Options

13.1 Remote Monitoring

The UPS has a communication slot that allows field installation of an optional RemotEye 4 card. The RemotEye 4 card allows the UPS to communicate with the Local Area Network via Ethernet Modbus TCP & RTU, BACnet IP & MSTP, SNMP, and HTTP/HTTPS (web).

13.2 Environmental Monitoring Device (EMD)

The EMD is an environmental monitoring device that provides remote monitoring of temperature, humidity and other environmental conditions via standard web browser or network management systems. The EMD provides automated events notification when temperature, humidity or user defined dry contacts is out of configured tolerance.

13.3 Matching Battery Cabinets

The T1000 can be combined with an External Matching Battery Cabinet for additional Battery runtime. The matching battery cabinet comes with replaceable DC fuses and an Anderson Style Connector cable for easy setup. Up to two matching battery cabinets can be combined with the T1000. Here are the battery runtimes when combined with one or two battery cabinets:

14.0 T1000 Series is designed and manufactured in the USA.