

PART 1 - GENERAL

1.0 Scope

This specification shall cover Toshiba S11 AC Variable Frequency Drives, 6 pulse for 3-phase 200-240VAC, 380-500VAC and single phase 200V to 240VAC.

1.1 References

- A. National Electric Manufacturers Association (NEMA)
- B. Underwriters Laboratories, Inc. (UL) and CSA
- C. National Electric Code (NEC)
- D. CE Low voltage directive EN50178 Electrical equipment for use in power installations
- E. EMC directive 89/336/EEC (See also EN50081-2 and EN50082-2)
- F. IEEE 519. Compliance of IEEE 519 can be determined after Toshiba performs a harmonics analysis. The analysis will be done after we receive a completed harmonics questionnaire.
- G. ISO 9001

1.2 Submittal

Submittals shall include Toshiba standard operation manual. Schematics can be obtained from factory upon request.

PART 2 – S11 VARIABLE FREQUENCY DRIVE

2.0 General

- A. This specification covers AC adjustable frequency drives for Industrial and HVAC applications.
- B. The manufacturer shall not have less than fifteen years of experience in the manufacture of VFD's.
- C. The manufacturer shall manufacture both AC drives and motors at the same facility.

2.1 Design Criteria

- A. The drive should be a PWM (Pulse Width Modulated) transistorized inverter using IGBT's (Insulated Gate Bipolar Transistors) and must be fully digital.
- B. The drive shall utilize Insulated Gate Bipolar Transistor (IGBT's) in its power section.

- C. The S11 VFD shall have 3 basic design criteria:
- 1) **Input Filtering Section** that shall include a built in RF/EMI filter.
 - 2) **Rectifier Section** that shall include diode bridge rectifier to convert AC to DC.
 - 3) **DC Filtering Section** that shall include capacitors to eliminate “ripple” affect on the DC bus to produce smooth DC bus voltage.
 - 4) **Switching Section** that shall included Insulated Gate Bipolar Transistors (IGBT) to provided Pulse Width Modulation.

2.2 Ratings and overload capability of the VFD

- A. The drive main input power shall be:
- I. Three phase 200-240VAC 50/60Hz
 - II. Three phase 380-500VAC 50/60Hz
 - III. Single phase 200-240VAC 50/60Hz
- B. The drive shall have a tolerance for voltage +10%, -15% and frequency $\pm 5\%$.
- C. The drive overload current shall be 100% continuous , 150% for 1 minute, 200% for 0.5 seconds.
- D. The drive should have a common design for all horsepower models:
230V – 0.5 through 20HP Three phase input, 0.5 through 3HP Single phase input
460V – 5 through 20HP Three phase input.
600V – 2 through 20HP Three phase input.

2.3 Control Features

- A. The drive shall have True Torque Control with Automatic energy-saving control.
- B. The drive shall have two (2) frequency priority selection features.
- C. The drive shall be capable of setting both upper and lower limit frequencies.
- D. The ASD shall have a PWM carrier frequency adjustment range of 0.5 to 16.0 kHz. The default value is 12.0 kHz. The maximum acceptable full speed carrier frequency (60 Hz) with no derating shall be 4 kHz.
- E. The drive shall be capable of PID set point control.
- F. One touch setup for motor operated potentiometer and three wire control.
- G. The drive shall be able to start and stop from a two-wire control (dry contacts), three wire momentary contact closure, keypad, and serial interface.
- H. The drive shall have an adjustable retry function after a fault. The auto retry function shall selectable up to 10 retry attempts.
- I. The drive shall have two programmable functions of the following: acceleration and deceleration rates, acceleration and deceleration patterns, electronic thermal protection settings, base frequencies, voltage boosts, and stall protection selections which can be chosen while running to run motor A or motor B.

2.4 Operational Functions

- A. The drive shall contain two separate acceleration/deceleration times (0.1 to 3200 seconds) with choice of linear and two S-curves.
- B. The drive shall contain fifteen programmable preset speeds, which can be activated from the terminal inputs or host computer.
- C. The drive shall restart into a rotating motor operating in either the forward or reverse direction and match that frequency.
- D. The drive shall have adjustable soft stall (10% - 199%) which reduces frequency and voltage of the inverter to sustain a run in an overload situation.
- E. The drive shall have adjustable UL listed electronic overload protection (10% - 100%).

2.5 Input / Output Capabilities

- A. The drive shall accept the following frequency commands signals:
 - 1) 3k Ω potentiometer (1k Ω to 10K Ω potentiometer connection also possible)
 - 2) 0 to 10 Vdc (Input Impedance: VIA/VIB=30k Ω)
 - 3) 4 to 20mA (Input Impedance:250 Ω)
 - 4) 15 Preset speeds
 - 5) Motorized speed pot.
 - 6) Built in potentiometer
 - 7) Digital operator interface
- B. The drive shall have 1 programmable analog output programmable to 18 choices.
- C. The drive shall have 3 programmable outputs programmable to 58 choices (one form A, one form C relay, and one open collector).
- D. The drive shall have 8 programmable digital inputs programmable to 65 choices.

2.6 Protective Features

- A. The drive shall contain three critical frequency jump points with individual bandwidth.
- B. The drive shall be UL rated for no less that 5,000 AIC without the use of input fuses.
- C. The drive shall have external fault input.
- D. The drive shall be capable of re-setting faults remotely and locally.
- E. The drive shall alarm in the following operating conditions:
 - 1) Stall Prevention
 - 2) Over voltage
 - 3) Overload
 - 4) Under-Voltage
 - 5) Executing retry

6) Upper / Lower Limit setting error

G. The drive shall identify and display the following 27 faults:

- 1) Over current during acceleration trip
- 2) Over current during deceleration trip
- 3) Over current during normal run trip
- 4) Load end overcurrent at startup
- 5) Main circuit over current at startup
- 6) Output phase failure
- 7) Input phase failure
- 8) Overvoltage during acceleration trip
- 9) Overvoltage during deceleration trip
- 10) Overvoltage during normal (constant speed) run trip
- 11) Inverter overloaded trip
- 12) Motor overloaded trip
- 13) External thermal trip
- 14) Dynamic braking resistor overload trip
- 15) Inverter overheat trip
- 16) Emergency off trip message.
- 17) EEPROM failure during write cycle
- 18) RAM error
- 19) ROM error
- 20) CPU error
- 21) Communication interruption error
- 22) Low operating current trip
- 23) Main circuit under voltage trip
- 24) Over torque trip
- 25) Ground fault trip
- 26) Inverter type form mismatch error
- 27) Auto tuning error

2.7 Operating Panel and Monitor Functions

- A. The drive shall have a 4-digit 7-segment LED.
- B. Inverter Status shall be indicating by LED lights on panel for run, monitor, program, % indication, Hz, frequency setting potentiometer, up/down and run lamp.
- C. The charge lamp shall indicate that the main circuit capacitors are electrically charged.
- D. The drive digital display shall be capable of monitoring the following functions:
 - 1) Post Compensation Output Frequency
 - 2) Direction of Rotation
 - 3) Frequency Command Setting
 - 4) Output Current
 - 5) Input Voltage

- 6) Output Voltage
- 7) Input terminal status
- 8) Output terminal status
- 9) CPU version
- 10) Memory version
- 11) Four most recent faults
- 12) Cumulative run timer
- 13) Torque Current
- 14) PID Feedback Value
- 15) Drive Overload Ratio
- 16) DBR Overload Ratio
- 17) Input Power
- 18) Output Power

- E. The drive's parameters shall be adjustable from the 6 key touchpad.
- F. The drive shall have an optional remote mount LCD NEMA 4 keypad capable of being extended 15 feet from the drive.
- G. The drive shall contain a reset of all parameters to factory default settings.

2.8 Optional features

- A. Pneumatic interface (3-15psi) transducers are available upon request.
- B. Isolated input and output transducers are available upon request.
- C. All drives regardless of size/voltage should have isolated bypass capability as an available option.

Communication options to include:

- 1) RS485
- 2) RS232
- 3) Modbus RTU
- 4) Modbus+
- 5) Devicenet
- 6) Profibus DP
- 7) Ethernet
- 8) Metasys

2.9 Drive Environmental Conditions

- A. Environment shall be IP20 or NEMA 1 with conduit adapter kit.
- B. Ambient temperature, -10° to 50°C or 14° to 122°F No direct sunlight
- C. Altitude, 3,300 feet maximum without derating.
- D. Relative humidity, 93% maximum (no condensation allowed).
- E. Vibration, 0.6G maximum.

- F. IP 55 Enclosure are available on the following ratings:
 - I. 240V, single phase, 1hp to 3hp
 - II. 240V, three phase, 0.5hp to 5hp
 - III. 460V, three phase, 2hp to 5hp
- G. All IP 55 rated drives shall have a built in circuit breaker.

Part 3 – Start-up, Training and Warranty

- A. Start-up and training service is available as an additional option
- B. The drive manufacturer shall guarantee the operation of the drive against failure due to defects for 18 months after shipment or 12 months of installation, whichever comes first.