

PART 1 - GENERAL

1.0 Scope

This specification shall cover Toshiba VF-nC1 AC Variable Frequency Drives, 6 pulse for 100V single-phase 0.1 to 0.75kW, 200V single-phase 0.2 to 2.2kW and 200V three-phase 0.1 to 2.2kW.

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
- H. ISO 14001

1.2 Submittal

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

PART 2 – VF-nC1 VARIABLE FREQUENCY DRIVE

2.0 General

- A. This specification covers AC adjustable frequency drives for Industrial and OEM 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 VF-nC1 VFD shall have 3 basic design criteria:
Input Filtering Section shall include a built-in RF/EMI filter for the single-phase 200-240V units.
- 1) **Rectifier Section** that shall include diode bridge rectifier to convert AC to DC.
 - 2) **DC Filtering Section** that shall include capacitors to eliminate “ripple” affect on the DC bus to produce smooth DC bus voltage.
 - 3) **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. Single-phase 100-115VAC 50/60Hz
 - II. Single-phase 200-240VAC 50/60Hz
 - III. Three-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 and 150% for 1 minute.
- D. The drive should have a common design for all horsepower models.

2.3 Control Features

- A. The drive shall be capable of setting both upper and lower limit frequencies.
- B. The ASD shall have a PWM carrier frequency adjustment range of 2 to 16kHz. The minimum acceptable full speed carrier frequency (60 Hz) with no derating shall be 4 kHz.
- C. The drive shall be capable of PI set point control.
- D. One touch setup for motor operated potentiometer and three wire control.
- E. 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.
- F. The drive shall have an adjustable retry function after a fault. The auto retry function shall selectable up to 10 retry attempts.
- G. The drive shall have two programmable: 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 3600 seconds) with choice of linear, S, or C 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% - 150%) 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 Z_{in} :42k Ω)
 - 3) 0 to 5 Vdc (Z_{in} :42k Ω)
 - 4) 0/4 to 20mA (Z_{in} :250 Ω),
 - 5) 15 Preset speeds
 - 6) Motorized speed pot.
 - 7) Built in potentiometer
 - 8) Digital operator interface
- B. The drive shall have 1 programmable analog output programmable to 5 choices.
- C. The drive shall have 3 programmable outputs programmable to 30 choices (one form A, one form C relay, and one open collector).
- D. The drive shall have 6 programmable digital inputs programmable to 52 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 200,000 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) Inverter overload pre-alarm
 - 2) Motor overload pre-alarm
 - 3) Inverter overheat pre-alarm
 - 4) Over current pre-alarm
 - 5) Executing retry
- 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 digital display shall be capable of monitoring the following 17 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) PI Feedback Value
- 15) Drive Overload Ratio
- 16) DBR Overload Ratio
- 17) Output Power

B. The drive's 133 parameters shall be adjustable from the 6 key touchpad.

- C. The drive shall be controlled through Palm-Pilot software.
- D. The drive shall have an optional Nema 4 keypad capable of being extended 15 feet from the drive.
- E. The drive shall contain a reset of all parameters to factory default settings.
- F. The drive shall have an elapsed time meter and will save the past four faults in memory.

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) Devicenet
- 5) Profibus DP

2.9 Drive Environmental Conditions

- A. Environment - Indoors NEMA 1
- B. Ambient temperature - -10° to 50°C 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.

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 service, whichever comes first.