

DECLARATION OF NATHANIEL E FRANK-WHITE

1. I am a Records Request Processor at the Internet Archive. I make this declaration of my own personal knowledge.

2. The Internet Archive is a website that provides access to a digital library of Internet sites and other cultural artifacts in digital form. Like a paper library, we provide free access to researchers, historians, scholars, and the general public. The Internet Archive has partnered with and receives support from various institutions, including the Library of Congress.

3. The Internet Archive has created a service known as the Wayback Machine. The Wayback Machine makes it possible to browse more than 450 billion pages stored in the Internet Archive's web archive. Visitors to the Wayback Machine can search archives by URL (i.e., a website address). If archived records for a URL are available, the visitor will be presented with a display of available dates. The visitor may select one of those dates, and begin browsing an archived version of the Web. Links on archived files in the Wayback Machine point to other archived files (whether HTML pages or other file types), if any are found for the URL indicated by a given link. For instance, the Wayback Machine is designed such that when a visitor clicks on a hyperlink on an archived page that points to another URL, the visitor will be served the archived file found for the hyperlink's URL with the closest available date to the initial file containing the hyperlink.

4. The archived data made viewable and browseable by the Wayback Machine is obtained by use of web archiving software that automatically stores copies of files available via the Internet, each file preserved as it existed at a particular point in time.

5. The Internet Archive assigns a URL on its site to the archived files in the format http://web.archive.org/web/[Year in yyyy][Month in mm][Day in dd][Time code in hh:mm:ss]/[Archived URL] aka an "extended URL". Thus, the extended URL http://web.archive.org/web/19970126045828/http://www.archive.org/ would be the URL for the record of the Internet Archive home page HTML file (http://www.archive.org/) archived on January 26, 1997 at 4:58 a.m. and 28 seconds (1997/01/26 at 04:58:28). The date indicated by an extended URL applies to a preserved instance of a file for a given URL, but not necessarily to any other files linked therein. Thus, in the case of a page constituted by a primary HTML file and other separate files (e.g., files with images, audio, multimedia, design elements, or other embedded content) linked within that primary HTML file, the primary HTML file and the other files will each have their own respective extended URLs and may not have been archived on the same dates.

6. Attached hereto as Exhibit A are true and accurate copies of screenshots of the Internet Archive's records of the archived files for the URLs and the dates specified in the attached coversheet of each printout.

INTERNET ARCHIVE
archive.org

7. Attached hereto as Exhibit B are true and accurate copies of the Internet Archive's records of the archived files for the URLs and the dates specified in the attached coversheet of each file.

8. I declare under penalty of perjury that the foregoing is true and correct.

DATE: May 27, 2022

Nathaniel E Frank-White

Nathaniel E Frank-White

EXHIBIT A

https://web.archive.org/web/20101122194800/http://www.toshiba.com/ind/index.jsp

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Drives



EQP Global



News

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- TOSHIBA'S SCiB™ BATTERY SELECTED FOR SHIMANO'S ELECTRIC BICYCLE PARTS
- Toshiba to Build Drive Motors for Electrified Vehicles in the U.S.
- Toshiba's SCiB™ rechargeable battery selected for "Ev-neo," Honda's new commercial-use electric motorcycle
- Honda Plans to Begin Sales of Commercial Use Electric Scooter, EV-neo, in December 2010
- TOSHIBA ADJUSTABLE SPEED DRIVES AND MOTORS COMPLIANT WITH AMERICAN RECOVERY AND REINVESTMENT ACT
- TOSHIBA ESTABLISHES NORTH AMERICAN SALES & SUPPORT FOR SCiB™ BATTERY
- TOSHIBA DEVELOPS EQP GLOBAL MOTOR AND LAUNCHES EQP GLOBAL WEBSITE

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For the following captures I clicked the tabs labeled Specifications, Manuals, Brochures, Drawings, Setup software, and Support, and captured each one separately.

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  - Motors
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  - Drives
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    - P9 Low Voltage Pumping Control
    - G7 LV Severe Duty Industrial
    - GX7 LV Severe Duty Specialty
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    - W7 LV Variable Torque Water/Wastewater
    - T300MVi MV Standard Duty All Purpose
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  - Power Apparatus & Components
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Take a closer look

GX7 Low Voltage
Severe Duty Specialty

ARRA COMPLIANT

Toshiba's GX7 Series PWM adjustable speed drive is a severe duty drive built to handle all conventional applications in the industry, ranging from the simplest to the most complex. The GX7 Series offers flux-vector technology with or without encoder feedback. This drive maintains astoundingly tight control over both torque and speed with the industry's most user-friendly operator interface. The GX7 is designed to handle the most extreme conditions, continuing the G-Series tradition of delivering a robust performance platform.

Specifications | Manuals | Brochures | Drawings | Setup Software | Support

GX7 Standard Specifications

Voltage Class	600 VAC			
Maximum HP	500 HP	600 HP	700 HP	800 HP
Drive Rating (A)	481 A	601 A	698 A	770 A
Dimensions	95"H x 32"W x 30.5"D			
Power Requirements				
Output Frequency	0 to 299 Hz			
Control Power	DC Bus Control Power			
Tolerance	Voltage: ±10%; Frequency: ±2%			
Control Specifications				
Control Method	Sine Wave PWM System; Flux Field Current Vector Control			
V/Hz Control	Constant Torque, Variable Torque, Open-Loop Vector, Auto or Manual Torque Boost, 5-Point V/Hz Custom Curves			
Overload Rating	130% for 120 Seconds; 110% Continuous			
Frequency Setting	Rotary Encoder Integrated into EOI, 0 to 10 V, ±10 V, 4 to 20 mA, Binary Input, Motorized Potentiometer Input			
Frequency Precision	Analog Input: ±0.2% of Maximum Output Frequency; Digital Input: ±0.01% of Maximum Output Frequency			
Frequency Resolution	Panel Operation: 0.01 Hz; Analog Input 10 to 12-Bit A to D Converter: 0.1 Hz			
Acceleration / Deceleration	0.1 to 6000 Seconds			
Speed Regulation	Up to 0.1%; 60:1 Speed Range			
Torque Setting	±250% of the Rated Torque			
Set Point Control (PID)	Proportional Gain, Integral Gain, Feedback Settings Upper/Lower Deviation Limits, Feedback Source Delay Filter, Feedback Settings Differential Gain			
Analog Inputs	Four Programmable: (1) 4 to 20 mA, (1) 0 to 10 V, (1) -10 to +10 V, (1) 1 to 10kΩ Potentiometer Connection			
Analog Outputs	Two Programmable to 31 Functions			
Discrete Inputs	Eight Programmable to 67 Functions; Expandable to N-Value			
Output Contacts	Three Output Terminals, Programmable to 52 Functions; Form C Contacts Rated 250 V AC, Two Amps Inductive			
Signal Isolation	Available Three-Channel Signal Isolation for AM/FM Outputs and II Terminal Input, Rated at 750 V			
Power Terminals	Input (L1, L2, L3) Output (T1, T2, T3) DCL (PO, PA), DBR (PA, PB), DCBUS (PA, PC)			
Control Board Communication Ports	RS232/485 and TTL Ports Standard			
Data Transmission	Profibus, DeviceNet, Modbus RTU, Modbus+, Metasys, Ethernet (Some Devices are External)			
Main Protective Functions	Current Limit, Overcurrent, Overvoltage, Undervoltage, Load-Side Short Circuit, Load-Side Ground Fault, Armature Short; Overtorque, ASD Overload, Motor Overload, Heatsink Overheat, Open Output Phase, Loss of Feedback, CPU Error, Communications Error			
Soft Stall	Automatic Load Reduction Control During Overload			
Retry	Can Automatically Clear Fault Upon Trip; Programmable to 10 Tries with up to 10 Seconds Between Tries			
Restart	Restart into a Rotating Motor			
Interface				

HALLIBURTON EXHIBIT 1006
Halliburton Energy Services, Inc. v. U.S. Well Services, LLC, IPR2023-00557, Page 7

LCD/EOI (Liquid Crystal Display/Electronic Operator Interface)	Backlit LCD Display; Ability to Display Multiple Parameters on One Screen; Keypad may be Operated from External Power Source; Software is Flash Upgradeable; Includes Multi-Function Rotary Encoder
LED Indicators	Run (Red)/Stop (Green), Remote/Local (Green), DC Bus Charge Indication (Red)
Keys	Local/Remote, Monitor/Program, Run, Enter, ESC, Stop/Reset, Up, Down
Monitoring	Main Display Shows Two Monitored Items Continuously, or Scrolls Up to 40 Items
Selectable Display Units	User-Selectable and Configurable along with Scaling Factor Multiplier; Voltage Display Selectable: Volts or %;
	Current Display Selectable: Amps or %.
EOI Communication Ports	RS232/485 and TTL Ports Standard
Remote-Mount Display	Remote Mountable Up to 1000 Feet
Construction	
Enclosure	NEMA 1, IP20, Gasketed and Filtered
Panel Construction	Free-Standing, Front-Maintenance Type, Top or Bottom Access for Motor and Power Cables
Cooling	Forced-Air Cooled Top-Mounted Fans may be Removed During Shipment or Installation
Color	ANSI-61 Gray
Ambient Conditions	
Ambient Temperature	-10 to 40°C (-14 to 104°F)
Humidity	Max. 95% (Non-Condensing)
Altitude	1000 Meters (3300 Feet) Above Sea Level or Less
Installation	Indoor, No Direct Sunlight, Protect from Corrosive Gases and/or Explosive Gases
Standards	
Electrical Compliance	NEC, ANSI

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Take a closer look

GX7 Low Voltage
Severe Duty Specialty

ARRA COMPLIANT

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Specifications | Manuals | Brochures | Drawings | Setup Software | Support

- ASD PRO Software Operation Manual
- Toshiba Zigbee Wireless System Installation and Operation Manual
- GX7 Addendum Manual
- G7 Operation Manual

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- GX7 Brochure
- ASD All Products Brochure
- Motor Drive PAC Highlights Brochure
- TIC All Products Brochure

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Specifications | Manuals | Brochures | Drawings | Setup Software | Support

- GX7 600V 500-800KVA Drawings
- GX7/HX7 690V 370-750KW Drawings
- GX7/HX7 690V 670-1120KW Drawings
- GX7 600V 900-1200KVA Drawings

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Power Terminals	Input (L1, L2, L3) Output (T1, T2, T3) DCL (PO, PA), DBR (PA, PB), DCBUS (PA, PC)			
Control Board Communication Ports	RS232/485 and TTL Ports Standard			
Data Transmission	Profibus, DeviceNet, Modbus RTU, Modbus+, Metasys, Ethernet (Some Devices are External)			
Main Protective Functions	Current Limit, Overcurrent, Overvoltage, Undervoltage, Load-Side Short Circuit, Load-Side Ground Fault, Armature Short; Overtorque, ASD Overload, Motor Overload, Heatsink Overheat, Open Output Phase, Loss of Feedback, CPU Error, Communications Error			
Soft Stall	Automatic Load Reduction Control During Overload			
Retry	Can Automatically Clear Fault Upon Trip; Programmable to 10 Tries with up to 10 Seconds Between Tries			
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Interface				
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LED Indicators	Run (Red)/Stop (Green), Remote/Local (Green), DC Bus Charge Indication (Red)			
Keys	Local/Remote, Monitor/Program, Run, Enter, ESC, Stop/Reset, Up, Down			
Monitoring	Main Display Shows Two Monitored Items Continuously, or Scrolls Up to 40 Items			
Selectable Display Units	User-Selectable and Configurable along with Scaling Factor Multiplier; Voltage Display Selectable: Volts or %;			
	Current Display Selectable: Amps or %.			
EOI Communication Ports	RS232/485 and TTL Ports Standard			

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Remote-Mount Display	Remote Mountable Up to 1000 Feet
Construction	
Enclosure	NEMA 1, IP20, Gasketed and Filtered
Panel Construction	Free-Standing, Front-Maintenance Type, Top or Bottom Access for Motor and Power Cables
Cooling	Forced-Air Cooled Top-Mounted Fans may be Removed During Shipment or Installation
Color	ANSI-61 Gray
Ambient Conditions	
Ambient Temperature	-10 to 40°C (-14 to 104°F)
Humidity	Max. 95% (Non-Condensing)
Altitude	1000 Meters (3300 Feet) Above Sea Level or Less
Installation	Indoor, No Direct Sunlight, Protect from Corrosive Gases and/or Explosive Gases
Standards	
Electrical Compliance	NEC, ANSI

EXHIBIT B

https://web.archive.org/web/20101123110801/http://www.toshiba.com/ind/data/tag_files/GX7_Brochure_3862.pdf

TOSHIBA
Leading Innovation

ADJUSTABLE SPEED DRIVES



GX7 Series

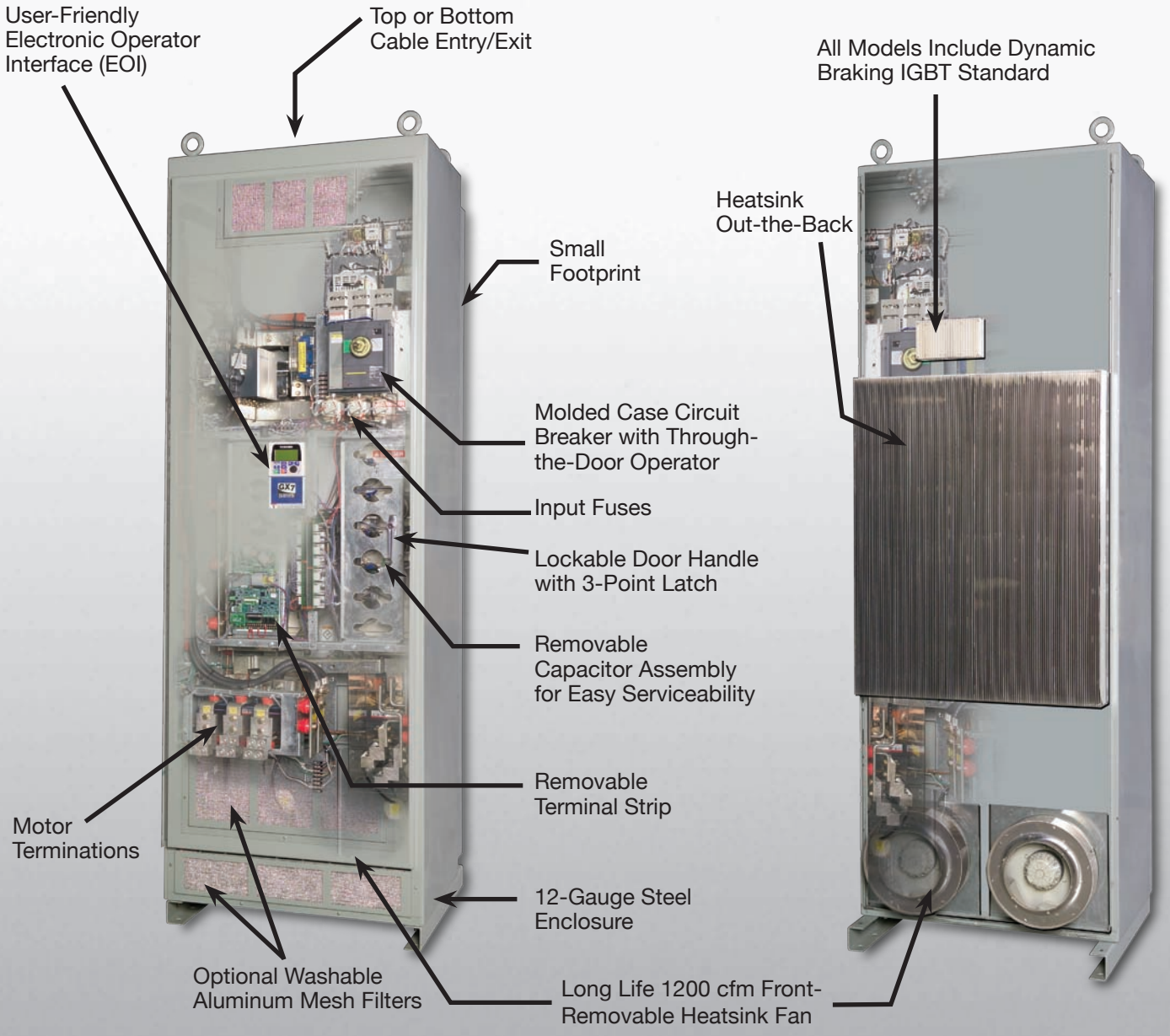
Reliability *in motion*®

ARRA COMPLIANT
AMERICAN REINVESTMENT RECOVERY ACT

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Toshiba GX7

Toshiba's GX7 Series PWM adjustable speed drive is a severe duty drive built to handle all conventional applications in the industry, ranging from the simplest to the most complex. The GX7 Series offers flux-vector technology with or without encoder feedback. This drive maintains astoundingly tight control over both torque and speed with the industry's most user-friendly operator interface. The GX7 is designed to handle the most extreme conditions, continuing the G-Series tradition of delivering a robust performance platform.



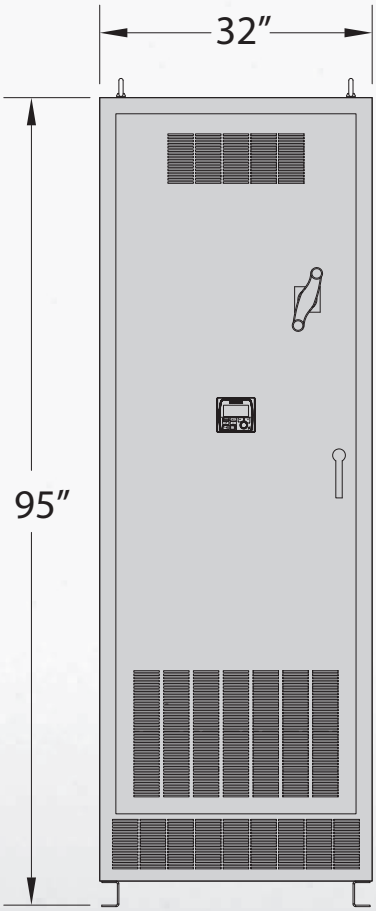
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Industrial Solutions

Small Footprint

Today, the high cost of real estate and space constraints in existing facilities make size an important factor in drive selection. Toshiba responds with the GX7. The GX7 provides proper cooling of internal electronic components to ensure optimum performance and durability even in a small footprint enclosure.

- 500 to 800 HP; Only 32 Inches Wide
- 95 Inches High and 30.5 Inches Deep
- Saves Real Estate on New Designs
- Easy Replacement for Dated Drives in Existing Facilities



Industrially Hardened

The GX7 Series has the highest overload capability available for a 600 V, 500 HP and above drive. Rated at 110% continuous current, 130% up to 120 seconds, the GX7 can withstand load conditions that would cause other drives to fail.

The GX7 is ready for continuous, trouble-free operation in the most demanding manufacturing environments. In addition, it is designed for an operating environment of -10 to 40°C at elevations of -1000 to 1000 meters.



Variety of Communication Options

In the fast-paced manufacturing world, coordinated systems require drive-to-drive or drive-to-control system communication. Toshiba's GX7 comes standard with RS232/485 and TTL communication ports. In addition to the standard communications features, Toshiba offers a number of popular industrial communication protocol options including: Modbus RTU, Modbus Plus, Ethernet IP, Profibus DP, DeviceNet and Johnson Controls Metasys N2.

Proven Technology

Advanced Electronic Operator Interface

The GX7's Electronic Operator Interface (EOI) features a multi-line, graphics-capable, plain English, back-lit LCD. The EOI is so intuitive that the manual is usually unneeded to make setting adjustments. The GX7 has menu-driven programming as well as direct access to the parameters. A high reliability rotary encoder makes programming easy. Startup Wizard helps facilitate initial programming.

Configurables

- Easy to Remote-Mount the Display (up to 1000 Feet)
- Real-Time Clock Option (Stores up to 100 Past Faults with Date and Time Stamp)
- Graphics-Capable LCD to Aid in Diagnostics
- Flash-Upgradeable EOI Software
- Help from Toshiba Customizing Application-Specific Wizards



Standard Keypad Design for Low Voltage and Medium Voltage Drives

Monitor Software

The free monitor software allows the user to monitor and control critical operational parameters using serial communication. The software contains real-time graphing, a very useful tool for data analysis which allows files and tables to be created with the software from the obtained data.

Process Control

The built-in Proportional/Integral/Derivative (PID) control loop provides regulation of many processes without the need for external devices. Deviation limits, online switching, and delay filtering functions are included to enhance the flexibility and reliability of PID process control.

Meets or Exceeds Your Specifications

GX7 Specifications

Standard Specifications				
Item				
Voltage Class	600 VAC			
Maximum HP	500 HP	600 HP	700 HP	800 HP
Drive Rating (A)	481 A	601 A	698 A	770 A
Dimensions	95”H x 32”W x 30.5”D			
Power Requirements				
Output Frequency	0 to 299 Hz			
Control Power	DC Bus Control Power			
Tolerance	Voltage: ±10%; Frequency: ±2%			
Control Specifications				
Control Method	Sine Wave PWM System; Flux Field Current Vector Control			
V/Hz Control	Constant Torque, Variable Torque, Open-Loop Vector, Auto or Manual Torque Boost, 5-Point V/Hz Custom Curves			
Overload Rating	130% for 120 Seconds; 110% Continuous			
Frequency Setting	Rotary Encoder Integrated into EOI, 0 to 10 V, ±10 V, 4 to 20 mA, Binary Input, Motorized Potentiometer Input			
Frequency Precision	Analog Input: ±0.2% of Maximum Output Frequency; Digital Input: ±0.01% of Maximum Output Frequency			
Frequency Resolution	Panel Operation: 0.01 Hz; Analog Input 10 to 12-Bit A to D Converter: 0.1 Hz			
Acceleration / Deceleration	0.1 to 6000 Seconds			
Speed Regulation	Up to 0.1%; 60:1 Speed Range			
Torque Setting	±250% of the Rated Torque			
Set Point Control (PID)	Proportional Gain, Integral Gain, Feedback Settings Upper/Lower Deviation Limits, Feedback Source Delay Filter, Feedback Settings Differential Gain			
Analog Inputs	Four Programmable: (1) 4 to 20 mA, (1) 0 to 10 V, (1) -10 to +10 V, (1) 1 to 10kΩ Potentiometer Connection			
Analog Outputs	Two Programmable to 31 Functions			
Discrete Inputs	Eight Programmable to 67 Functions; Expandable to N-Value			
Output Contacts	Three Output Terminals, Programmable to 52 Functions; Form C Contacts Rated 250 V AC, Two Amps Inductive			
Signal Isolation	Available Three-Channel Signal Isolation for AM/FM Outputs and II Terminal Input, Rated at 750 V			
Power Terminals	Input (L1, L2, L3) Output (T1, T2, T3) DCL (PO, PA), DBR (PA, PB), DCBUS (PA, PC)			
Control Board Communication Ports	RS232/485 and TTL Ports Standard			
Data Transmission	Profibus, DeviceNet, Modbus RTU, Modbus+, Metasys, Ethernet (Some Devices are External)			
Main Protective Functions	Current Limit, Overcurrent, Overvoltage, Undervoltage, Load-Side Short Circuit, Load-Side Ground Fault, Armature Short; Overtorque, ASD Overload, Motor Overload, Heatsink Overheat, Open Output Phase, Loss of Feedback, CPU Error, Communications Error			
Soft Stall	Automatic Load Reduction Control During Overload			
Retry	Can Automatically Clear Fault Upon Trip; Programmable to 10 Tries with up to 10 Seconds Between Tries			
Restart	Restart into a Rotating Motor			
Interface				
LCD/EOI (Liquid Crystal Display/Electronic Operator Interface)	Backlit LCD Display; Ability to Display Multiple Parameters on One Screen; Keypad may be Operated from External Power Source; Software is Flash Upgradeable; Includes Multi-Function Rotary Encoder			
LED Indicators	Run (Red)/Stop (Green), Remote/Local (Green), DC Bus Charge Indication (Red)			
Keys	Local/Remote, Monitor/Program, Run, Enter, ESC, Stop/Reset, Up, Down			
Monitoring	Main Display Shows Two Monitored Items Continuously, or Scrolls Up to 40 Items			
Selectable Display Units	User-Selectable and Configurable along with Scaling Factor Multiplier; Voltage Display Selectable: Volts or %; Current Display Selectable: Amps or %.			
EOI Communication Ports	RS232/485 and TTL Ports Standard			
Remote-Mount Display	Remote Mountable Up to 1000 Feet			
Construction				
Enclosure	NEMA 1, IP20, Gasketed and Filtered			
Panel Construction	Free-Standing, Front-Maintenance Type, Top or Bottom Access for Motor and Power Cables			
Cooling	Forced-Air Cooled Top-Mounted Fans may be Removed During Shipment or Installation			
Color	ANSI-61 Gray			
Ambient Conditions				
Ambient Temperature	-10 to 40°C (-14 to 104°F)			
Humidity	Max. 95% (Non-Condensing)			
Altitude	1000 Meters (3300 Feet) Above Sea Level or Less			
Installation	Indoor, No Direct Sunlight, Protect from Corrosive Gases and/or Explosive Gases			
Standards				
Electrical Compliance	NEC, ANSI			

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TOSHIBA INTERNATIONAL CORPORATION



North American Headquarters and Manufacturing Facility (Houston, TX)



TOSHIBA — Quality by Design

Toshiba's culture and history is strongly rooted in quality. Our designs are technologically innovative, and our products are manufactured from start to end using only the highest quality domestic and foreign parts.

Product Warranty

Toshiba offers a comprehensive warranty program on its full line of industrial products. Consult your salesperson or the factory for specific information.

Need to Know More?

Be sure to visit our website located at www.toshiba.com/ind for the latest information on Toshiba products and services.

Customer Support Services

Toshiba offers 24 hour service nationwide. For assistance of any type, call: 1-800-231-1412.

ADJUSTABLE SPEED DRIVES MOTORS CONTROLS UPS INSTRUMENTATION PLC

TOSHIBA

Available Through:

TOSHIBA INTERNATIONAL CORPORATION

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TOSHIBA

G7 Adjustable Speed Drive Operation Manual

Document Number: 51546-009

Date: March, 2005

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Introduction

Congratulations on the purchase of the new **G7 True Torque Control² Adjustable Speed Drive** (ASD). The **G7 True Torque Control² Adjustable Speed Drive** is a solid-state AC drive that features **True Torque Control²**. TIC's **Vector Control Algorithm** enables the motor to develop high starting torque and provide compensation for motor slip, which results in smooth, quick starts and highly efficient operation. The G7 uses digitally-controlled pulse width modulation. The programmable functions may be accessed via the easy-to-use menu or via the **Direct Access Numbers** (see page 59). This feature, combined with Toshiba's high-performance software, delivers unparalleled motor control and reliability.

The G7 is a very powerful tool, yet surprisingly simple to operate. The user-friendly **Electronic Operator Interface** (EOI) of the G7 has an easy-to-read 240 x 64 pixel graphical LCD screen. The **EOI** provides easy access to the many monitoring and programming features of the G7.

The motor control software is menu-driven, which allows for easy access to the motor control parameters and quick changes when required.

To maximize the abilities of your new G7, a working familiarity with this manual will be required. This manual has been prepared for the **G7 ASD** installer, user, and maintenance personnel. This manual may also be used as a reference guide or for training. With this in mind, use this manual to develop a system familiarity before attempting to install or operate the device.

Important Notice

The instructions contained in this manual are not intended to cover all details or variations in equipment types, nor may it provide for every possible contingency concerning the installation, operation, or maintenance of this equipment. Should additional information be required contact your Toshiba representative.

The contents of this manual shall not become a part of or modify any prior or existing agreement, commitment, or relationship. The sales contract contains the entire obligation of Toshiba International Corporation. The warranty contained in the contract between the parties is the sole warranty of Toshiba International Corporation and any statements contained herein do not create new warranties or modify the existing warranty.

Any electrical or mechanical modifications to this equipment without prior written consent of Toshiba International Corporation will void all warranties and may void the UL/CUL listing or other safety certifications. Unauthorized modifications may also result in a safety hazard or equipment damage.

Misuse of this equipment could result in injury and equipment damage. In no event will Toshiba Corporation be responsible or liable for direct, indirect, special, or consequential damage or injury that may result from the misuse of this equipment.

Contacting Toshiba's Customer Support Center

Toshiba's Customer Support Center can be contacted to obtain help in resolving any **Adjustable Speed Drive** system problem that you may experience or to provide application information.

The center is open from 8 a.m. to 5 p.m. (CST), Monday through Friday. The Support Center's toll free number is US (800) 231-1412/Fax (713) 466-8773 — Canada (800) 527-1204.

You may also contact Toshiba by writing to:

Toshiba International Corporation

13131 West Little York Road

Houston, Texas 77041-9990

Attn: ASD Product Manager.

For further information on Toshiba's products and services, please visit our website at **www.tic.toshiba.com** (right click and select Open Weblink in Browser).

TOSHIBA INTERNATIONAL CORPORATION

G7 Adjustable Speed Drive

Please complete the Warranty Card supplied with the ASD and return it to Toshiba by prepaid mail. This will activate the 12 month warranty from the date of installation; but, shall not exceed 18 months from the shipping date.

Complete the following information and retain for your records.

Model Number: _____

Serial Number:_____

Project Number (if applicable):_____

Date of Installation:_____

Inspected By:_____

Name of Application:_____

About This Manual

This manual was written by the Toshiba Technical Publications Group. This group is tasked with providing technical documentation for the **G7 Adjustable Speed Drive**. Every effort has been made to provide accurate and concise information to you, our customer.

At Toshiba we're continuously searching for better ways to meet the constantly changing needs of our customers. Email your comments, questions, or concerns about this publication to **Technical-Publications-Dept@TIC.TOSHIBA.COM**.

Manual's Purpose and Scope

This manual provides information on how to safely install, operate, maintain, and dispose of your **G7 True Torque Control^2 Adjustable Speed Drive**. The information provided in this manual is applicable to the **G7 True Torque Control^2 Adjustable Speed Drive** only.

This operation manual provides information on the various features and functions of this powerful cost-saving device, including

- Installation,
- System operation,
- Configuration and menu options, and
- Mechanical and electrical specifications.

Included is a section on general safety instructions that describe the warning labels and symbols that are used throughout the manual. Read the manual completely before installing, operating, performing maintenance, or disposing of this equipment.

This manual and the accompanying drawings should be considered a permanent part of the equipment and should be readily available for reference and review. Dimensions shown in the manual are in metric and/or the English equivalent.

Because of our commitment to continuous improvement, Toshiba International Corporation reserves the right, without prior notice, to update information, make product changes, or to discontinue any product or service identified in this publication.

Toshiba International Corporation (TIC) shall not be liable for direct, indirect, special, or consequential damages resulting from the use of the information contained within this manual.

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General Safety Information

DO NOT attempt to install, operate, maintain or dispose of this equipment until you have read and understood all of the product safety information and directions that are contained in this manual.

Safety Alert Symbol

The **Safety Alert Symbol** indicates that a potential personal injury hazard exists. The symbol is comprised of an equilateral triangle enclosing an exclamation mark.



Signal Words

Listed below are the signal words that are used throughout this manual followed by their descriptions and associated symbols. When the words **DANGER**, **WARNING** and **CAUTION** are used in this manual they will be followed by important safety information that must be carefully adhered to.

The word **DANGER** preceded by the safety alert symbol indicates that an imminently hazardous situation exists that, if not avoided, will result in death or serious injury to personnel.



DANGER

The word **WARNING** preceded by the safety alert symbol indicates that a potentially hazardous situation exists that, if not avoided, could result in death or serious injury to personnel.



WARNING

The word **CAUTION** preceded by the safety alert symbol indicates that a potentially hazardous situation exists which, if not avoided, may result in minor or moderate injury.



CAUTION

The word **CAUTION** without the safety alert symbol indicates a potentially hazardous situation exists which, if not avoided, may result in equipment and property damage.

CAUTION

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Special Symbols

To identify special hazards, other symbols may appear in conjunction with the **DANGER**, **WARNING** and **CAUTION** signal words. These symbols indicate areas that require special and/or strict adherence to the procedures to prevent serious injury to personnel or death.

Electrical Hazard Symbol

A symbol which indicates a hazard of injury from electrical shock or burn. It is comprised of an equilateral triangle enclosing a lightning bolt.



Explosion Hazard Symbol

A symbol which indicates a hazard of injury from exploding parts. It is comprised of an equilateral triangle enclosing an explosion image.



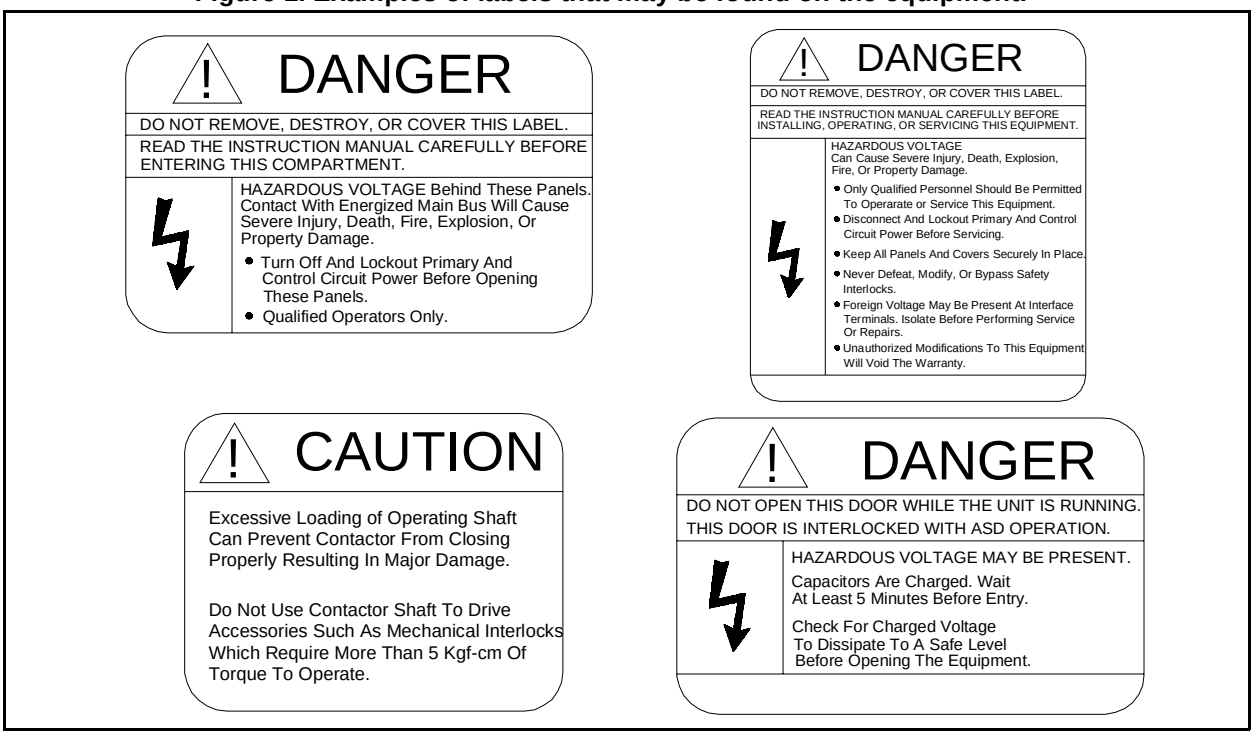
Equipment Warning Labels

DO NOT attempt to install, operate, perform maintenance, or dispose of this equipment until you have read and understood all of the product labels and user directions that are contained in this manual.

Shown below are examples of safety labels that may be found attached to the equipment. **DO NOT** remove or cover any of the labels. If the labels are damaged or if additional labels are required, contact your Toshiba sales representative for additional labels.

Labels attached to the equipment are there to provide useful information or to indicate an imminently hazardous situation that may result in serious injury, severe property and equipment damage, or death if the instructions are not followed.

Figure 1. Examples of labels that may be found on the equipment.



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Qualified Personnel

Installation, operation, and maintenance shall be performed by **Qualified Personnel Only**. A **Qualified Person** is one that has the skills and knowledge relating to the construction, installation, operation, and maintenance of the electrical equipment and has received safety training on the hazards involved (Refer to the latest edition of NFPA 70E for additional safety requirements).

Qualified Personnel shall:

- Have carefully read the entire operation manual.
- Be familiar with the construction and function of the ASD, the equipment being driven, and the hazards involved.
- Able to recognize and properly address hazards associated with the application of motor-driven equipment.
- Be trained and authorized to safely energize, de-energize, ground, lockout/tagout circuits and equipment, and clear faults in accordance with established safety practices.
- Be trained in the proper care and use of protective equipment such as safety shoes, rubber gloves, hard hats, safety glasses, face shields, flash clothing, etc., in accordance with established safety practices.
- Be trained in rendering first aid.

For further information on workplace safety visit www.osha.gov.

Equipment Inspection

- Upon receipt of the equipment inspect the packaging and equipment for shipping damage.
- Carefully unpack the equipment and check for parts that were damaged during shipping, missing parts, or concealed damage. If any discrepancies are discovered, it should be noted with the carrier prior to accepting the shipment, if possible. File a claim with the carrier if necessary and immediately notify your Toshiba sales representative.
- **DO NOT** install or energize equipment that has been damaged. Damaged equipment may fail during operation resulting in equipment damage or personal injury.
- Check to see that the rated capacity and the model number specified on the nameplate conform to the order specifications.
- Modification of this equipment is dangerous and must not be performed except by factory trained representatives. When modifications are required contact your Toshiba sales representative.
- Inspections may be required before and after moving installed equipment.
- Keep the equipment in an upright position.
- Contact your Toshiba sales representative to report discrepancies or for assistance if required.

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Handling and Storage

- Use proper lifting techniques when moving the ASD; including properly sizing up the load, getting assistance, and using a forklift if required.
- Store in a well-ventilated covered location and preferably in the original carton if the equipment will not be used upon receipt.
- Store in a cool, clean, and dry location. Avoid storage locations with extreme temperatures, rapid temperature changes, high humidity, moisture, dust, corrosive gases, or metal particles.
- The storage temperature range of the **G7 ASD** is 14° to 104° F (-10 to 40° C).
- Do not store the unit in places that are exposed to outside weather conditions (i.e., wind, rain, snow, etc.).
- Store in an upright position.

Disposal

Never dispose of electrical components via incineration. Contact your state environmental agency for details on disposal of electrical components and packaging in your area.

Installation Precautions

Location and Ambient Requirements

- The Toshiba ASD is intended for permanent installations only.
- Installation should conform to the **2002 National Electrical Code — Article 110** (NEC) (*Requirements For Electrical Installations*), all regulations of the **Occupational Safety and Health Administration**, and any other applicable national, regional, or industry codes and standards.
- Select a mounting location that is easily accessible, has adequate personnel working space, and adequate illumination for adjustment, inspection, and maintenance of the equipment (refer to 2002 NEC Article 110-13).
- A noncombustible insulating floor or mat should be provided in the area immediately surrounding the electrical system.
- **Do Not** mount the ASD in a location that would produce catastrophic results if it were to fall from its mounting location (equipment damage or injury).
- **Do Not** mount the ASD in a location that would allow it to be exposed to flammable chemicals or gases, water, solvents, or other fluids.
- Avoid installation in areas where vibration, heat, humidity, dust, fibers, steel particles, explosive/ corrosive mists or gases, or sources of electrical noise are present.
- The installation location shall not be exposed to direct sunlight.
- Allow proper clearance spaces for installation. Do not obstruct the ventilation openings. Refer to the section titled Installation and Connections on pg. 17 for further information on ventilation requirements.
- The ambient operating temperature range of the **G7 ASD** is 14° to 104° F (-10 to 40° C).
- See the section titled Installation and Connections on pg. 17 for additional information on installing the drive.

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Mounting Requirements

- Only **Qualified Personnel** should install this equipment.
- Install the unit in a secure and upright position in a well-ventilated area.
- A noncombustible insulating floor or mat should be provided in the area immediately surrounding the electrical system at the place where maintenance operations are to be performed.
- As a minimum, the installation of the equipment should conform to the NEC Article 110 Requirements For Electrical Installations, OSHA, as well as any other applicable national, regional, or industry codes and standards.
- Installation practices should conform to the latest revision of NFPA 70E Electrical Safety Requirements for Employee Workplaces.
- It is the responsibility of the person installing the ASD or the electrical maintenance personnel to ensure that the unit is installed into an enclosure that will protect personnel against electric shock.

Conductor Routing and Grounding

⚠ WARNING ⚠

- Use separate metal conduits for routing the input power, output power, and control circuits and each shall have its own ground cable.
- A separate ground cable should be run inside the conduit with the input power, output power, and and control circuits.
- **DO NOT** connect control terminal strip return marked CC to earth ground.
- Always ground the unit to prevent electrical shock and to help reduce electrical noise.
- It is the responsibility of the person installing the ASD or the electrical maintenance personnel to provide proper grounding and branch circuit protection in accordance with the **2002 NEC** and any applicable local codes.

The Metal Of Conduit Is Not An Acceptable Ground.

Power Connections

⚠ DANGER ⚠

Contact With Energized Wiring Will Cause Severe Injury Or Death.

- Turn off, lockout, and tagout all power sources before proceeding to connect the power wiring to the equipment.
- After ensuring that all power sources are turned off and isolated in accordance with established lockout/tagout procedures, connect three-phase power source wiring of the correct voltage to the correct input terminals and connect the output terminals to a motor of the correct voltage and type for the application (refer to NEC Article 300 – Wiring Methods and Article 310 – Conductors For General Wiring). Size the branch circuit conductors in accordance with NEC Table 310.16.
- If multiple conductors that are smaller than the recommended sizes are used in parallel for the input or output power, each branch of the parallel set shall have its own conduit and not share its conduit with other parallel sets (i.e., place U1, V1, and W1 in one conduit and U2, V2, and W2 in another) (refer to NEC Article 300.20 and Article 310.4). National and local electrical codes should be

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referenced if three or more power conductors are run in the same conduit (refer to 2002 NEC Article 310 adjustment factors on page 70-142).

- Ensure that the 3-phase input power is **Not** connected to the output of the ASD. This will damage the ASD and may cause injury to personnel.
- Do not install the ASD if it is damaged or if it is missing any component(s).
- **Do Not** connect resistors across terminals PA – PC or PO – PC. This may cause a fire.
- Ensure the correct phase sequence and the desired direction of motor rotation in the **Bypass** mode (if applicable).
- Turn the power on only after attaching and/or securing the front cover.

Protection

- Ensure that primary protection exists for the input wiring to the equipment. This protection must be able to interrupt the available fault current from the power line. The equipment may or may not be equipped with an input disconnect (option).
- All cable entry openings must be sealed to reduce the risk of entry by vermin and to allow for maximum cooling efficiency.
- Follow all warnings and precautions and do not exceed equipment ratings.
- If using multiple motors provide separate overload protection for each motor and use V/f control.
- External dynamic braking resistors must be thermally protected.
- It is the responsibility of the person installing the ASD or the electrical maintenance personnel to setup the **Emergency Off** braking system of the ASD. The function of the **Emergency Off** braking function is to remove output power from the drive in the event of an emergency. A supplemental braking system may also be engaged in the event of an emergency. For further information on braking systems, see DC Injection Braking Start Frequency on pg. 105 and Dynamic Braking Enable on pg. 112.

Note: *A supplemental emergency stopping system should be used with the ASD. Emergency stopping should not be a task of the ASD alone.*

- Follow all warnings and precautions and do not exceed equipment ratings.

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System Integration Precautions

The following precautions are provided as general guidelines for the setup of the ASD within the system.

- The Toshiba ASD is a general-purpose product. It is a system component only and the system design should take this into consideration. Please contact your Toshiba sales representative for application-specific information or for training support.
- The Toshiba ASD is part of a larger system and the safe operation of the ASD will depend on observing certain precautions and performing proper system integration.
- A detailed system analysis and job safety analysis should be performed by the systems designer and/or systems integrator before the installation of the ASD component. Contact your Toshiba sales representative for options availability and for application-specific system integration information if required.

Personnel Protection

- Installation, operation, and maintenance shall be performed by **Qualified Personnel <u>Only</u>**.
- A thorough understanding of the ASD will be required before the installation, operation, or maintenance of the ASD.

⚠ WARNING ⚡

- Rotating machinery and live conductors can be hazardous and shall not come into contact with humans. Personnel should be protected from all rotating machinery and electrical hazards at all times.
- Insulators, machine guards, and electrical safeguards may fail or be defeated by the purposeful or inadvertent actions of workers. Insulators, machine guards, and electrical safeguards are to be inspected (and tested where possible) at installation and periodically after installation for potential hazardous conditions.
- Do not allow personnel near rotating machinery. Warning signs to this effect shall be posted at or near the machinery.
- Do not allow personnel near electrical conductors. Human contact with electrical conductors can be fatal. Warning signs to this effect shall be posted at or near the hazard.
- Personal protection equipment shall be provided and used to protect employees from any hazards inherent to system operation.
- Follow all warnings and precautions and do not exceed equipment ratings.

System Setup Requirements

- When using the ASD as an integral part of a larger system, it is the responsibility of the ASD installer or maintenance personnel to ensure that there is a fail-safe in place, i.e., an arrangement designed to switch the system to a safe condition if there is a fault or failure.
- System safety features should be employed and designed into the integrated system in a manner such that system operation, even in the event of system failure, will not cause harm or result in personnel injury or system damage (i.e., E-Off, Auto-Restart settings, System Interlocks, etc.).
- The programming setup and system configuration of the ASD may allow it to start the motor unexpectedly. A familiarity with the Auto-restart settings are a requirement to use this product.

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- Improperly designed or improperly installed system interlocks may render the motor unable to start or stop on command.
- The failure of external or ancillary components may cause intermittent system operation, i.e., the system may start the motor without warning.
- There may be thermal or physical properties, or ancillary devices integrated into the overall system that may allow for the ASD to start the motor without warning. Signs at the equipment installation must be posted to this effect.
- If a secondary magnetic contactor (MC) is used between the ASD and the load, it should be interlocked to halt the ASD before the secondary contact opens. If the output contactor is used for bypass operation, it must be interlocked such that commercial power is never applied to the ASD output terminals (U, V, W).
- Power factor improvement capacitors or surge absorbers must not be installed on the output of the ASD.
- Use of the built-in system protective features is highly recommended (i.e., E-Off, Overload Protection, etc.).
- The operating controls and system status indicators should be clearly readable and positioned where the operator can see them without obstruction.
- Additional warnings and notifications shall be posted at the equipment installation location as deemed required by **Qualified Personnel**.
- Follow all warnings and precautions and do not exceed equipment ratings.

Operational and Maintenance Precautions

⚠ WARNING

- Turn off, lockout, and tagout the main power, the control power, and instrumentation connections before inspecting or servicing the drive, or opening the door of the enclosure.
- Turn off, lockout, and tagout the main power, the control power, and instrumentation connections before proceeding to disconnect or connect the power wiring to the equipment.
- The capacitors of the ASD maintain a residual charge for a period of time after turning the ASD off. The required time for each ASD typeform is indicated with a cabinet label and a **Charge LED**. Wait for at least the minimum time indicated on the enclosure-mounted label and ensure that the **Charge LED** has gone out before opening the door of the ASD once the ASD power has been turned off.
- Turn the power on only after attaching (or closing) the front cover and **Do Not** remove the front cover of the ASD when the power is on.
- **Do Not** attempt to disassemble, modify, or repair the ASD. Call your Toshiba sales representative for repair information.
- Do not place any objects inside of the ASD.
- If the ASD should emit smoke or an unusual odor or sound, turn the power off immediately.
- The heat sink and other components may become extremely hot to the touch. Allow the unit to cool before coming in contact with these items.
- Remove power from the ASD during extended periods of non-use.
- The system should be inspected periodically for damaged or improperly functioning parts, cleanliness, and to ensure that the connectors are tightened securely.

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- Ensure that the **Run** functions (**F**, **R**, **Preset Speed**, etc.) of the ASD are off before performing a **Reset**. The post-reset settings may allow the ASD to start unexpectedly.
- **Retry** or **Reset** settings may allow the motor to start unexpectedly. Warnings to this effect should be clearly posted near the ASD and motor.
- In the event of a power failure, the motor may restart after power is restored.
- Follow all warnings and precautions and do not exceed equipment ratings.

DO NOT install, operate, perform maintenance, or dispose of this equipment until you have read and understood all of the product warnings and user directions. Failure to do so may result in equipment damage, operator injury, or loss of life.

Service Life Information

Part Name	Service Life	Remarks
Large Capacity Electrolytic Capacitor	5 Years	When not used for long periods, charge semi-annually.
Cooling Fan	26,000 Hours	
CN Connectors	100 Connects/Disconnects	
On-board Relays	500,000 Actuations	

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CE Compliance Requirements

In addition to the local and regional safety requirements, this section describes additional criteria that must be met to qualify for **European Conformity** (CE) certification. All relevant apparatus placed on the European market is required to comply to the European Community directive on electromagnetic compatibility (EMC). The following instructions provide a means of compliance for the 7-series of ASDs. A Technical Construction File (TFC) indicates the rationale used to declare compliance and is on file at Toshiba International Corporation, Houston, Texas U.S.A.

EMC Installation Guidelines

All systems placed on the European market are required to comply with the European Community directive regarding electromagnet compatibility (EMC). Toshiba ensures that all systems deployed in the European market have been screened and are in 100% compliance with the following standards:

- Radiated Interference: EN 55011 Group 1 Class A
- Mains Interference: EN 55011 Group 1 Class A
- Radiated Susceptibility: IEC 801-3 1984
- Conducted RFI Susceptibility: prEN55101-4 (prIEC801-6) Doc 90/30270
- Electrostatic Discharge: IEC801-2 1991
- Electrical Fast Transient: IEC 801-4 1988
- Surge: IEC1000-4-5 1995 2 KV line-to-line, 4 KV line-to-earth
- Voltage Interruption: IEC 1000-4-11

General EMC Guidelines for Consideration

- Input filters of the appropriate rating shall be used.
- Proper grounding is a requirement.
- Grounds shall be kept to the minimum length to accomplish the connection.
- Grounds shall have low RF impedance.
- A central ground shall employed in a complex system.
- Paint or corrosion can hamper good grounding; remove as required.
- Keep control and power cabling separated. Minimize exposed (unscreened) cable.
- Use 3600 screened connections where possible.

CE Compliant Installation Guidelines

ASDs should be installed in accordance with the following guidelines.

1. **Filtering** — An input filter shall be used with the ASD. A Schaffner FN258 series input filter of the appropriate rating shall be mounted next to the ASD.
2. **Mechanical** — The ASD and the associated equipment shall be mounted on a flat metallic backplane. A minimum space of 5 cm (2 inches) shall be between the ASD and the filter to allow for ventilation. The filter output cable is to be connected from the bottom of the filter to the ASD power input and is to be the minimum length required for a connection. See Table 1 on page 11 for filter selection assistance.

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Units received as an Open Chassis shall not be placed into operation until being placed into an approved enclosure that will protect personnel against electrical shock.

Opening and closing of enclosures or barriers should be possible only with the use of a key or a tool.

3. **Cabling** — The power, filter, and motor cables shall be of the appropriate current rating. The cables shall be connected in accordance with the guidelines of the manufacturer and the applicable local and national agencies. A 4-core screened cable (such as RS 379-384) is to be used for the power and earth connections to minimize RF emissions. Control cabling must be screened using P/N RS 367-347 or a similar component.

4. **Grounding** — The mains (input) ground shall be connected at the ground terminal provided on the filter. The filter and motor shall be grounded at the ground terminals provided in the ASD.

5. **Screening** — The mains (input) screen is to be connected to the metallic back-plane at the filter; remove any finish coating as required. The screen over the filter output cables, the motor cable screen, and the control wire screens must be connected to the ASD case using glands or conduit connectors. The motor cable screen shall be connected to the motor case. When using a braking resistor, the cabling between the resistor and ASD shall also be screened. This screen shall connect to both the ASD enclosure and the resistor enclosure.

6. Where residual-current-operated protective device (RCD) is used for protection in case of direct or indirect contact, only RCD of type B is allowed on the supply side of this Electronic Equipment (EE). Otherwise, another protective measure shall be applied, such as separation of the EE from the environment by double or feinforced insulation, or isolation of the EE and the supply system by a transformer.

See the G7 Filter Selection below for the recommended input filters for a given typeform.

Table 1.

G7 Filter Selection Table

230V			
VT130G7U2010B	FN258-7	VT130G7U4110B	FN258-30
		VT130G7U4160B	
VT130G7U2015B	FN258-16	VT130G7U4220B	FN258-42
VT130G7U2025B		VT130G7U4270B	FN258-55
VT130G7U2035B		VT130G7U4330B	
VT130G7U2055B	FN258-30	VT130G7U4400B	FN258-75
VT130G7U2080B		VT130G7U4500B	FN258-100
VT130G7U2110B	FN258-42	VT130G7U4600B	
VT130G7U2160B	FN258-75	VT130G7U4750B	FN258-130
VT130G7U2220B	FN258-100	VT130G7U410KB	FN258-180
VT130G7U2270B		VT130G7U412KB	FS5236-300
VT130G7U2330B	FN258-130	VT130G7U415KB	

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G7 Filter Selection Table

460V	
VT130G7U4015B	FN258-7
VT130G7U4025B	
VT130G7U4035B	
VT130G7U4055B	FN258-16
VT130G7U4080B	
VT130G7U4110B	FN258-30
VT130G7U4160B	
VT130G7U4220B	FN258-42
VT130G7U4270B	FN258-55
VT130G7U4330B	
VT130G7U4400B	FN258-75
VT130G7U4500B	FN258-100
VT130G7U4600B	
VT130G7U4750B	FN258-130
VT130G7U410KB	FN258-180
VT130G7U412KB	FS5236-300
VT130G7U415KB	
VT130G7U420KB	FS5236-500
VT130G7U425KB	
VT130G7U430KB	
VT130G7U4015B	FN258-7
VT130G7U4025B	
VT130G7U4035B	
VT130G7U4055B	FN258-16
VT130G7U4080B	
VT130G7U420KB	FS5236-500
VT130G7U425KB	
VT130G7U430KB	
600V	
VT130G7U6015B	FN258-7
VT130G7U6025B	
VT130G7U6035B	
VT130G7U6055B	FN258-16
VT130G7U6080B	
VT130G7U6110B	
VT130G7U6160B	FN258-30
VT130G7U6220B	FN258-42
VT130G7U6270B	
VT130G7U6330B	FN258-55
VT130G7U6400B	
VT130G7U6500B	FN258-75
VT130G7U6600B	FN258-100
VT130G7U6750B	
VT130G7U610KB	FN258-130
VT130G7U612KB	FS5236-180
VT130G7U615KB	
VT130G7U620KB	FS5236-300
VT130G7U625KB	FS5236-500
VT130G7U630KB	

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Motor Characteristics

Listed below are some variable speed AC motor control concepts with which the user of the **G7 Adjustable Speed Drive** should become familiar.

Motor Autotuning

Motor production methods may cause minor differences in the motor operation. The negative effects of these differences may be minimized by using the **Autotune** feature of the **G7 ASD**. **Autotuning** is a function of the G7 that measures several parameters of the connected motor and places these readings in a stored table. The software uses the information in the table to help optimize the response of the ASD to application-specific load and operational requirements. The **Autotuning** function may be enabled for automatic tuning, configured manually at **F400**, or disabled.

The measured parameters include the rotor resistance, the stator resistance, the required excitation inductance, rotational inertia values, and leakage inductance values.

The **G7 ASD** is also equipped with a factory-loaded table of motor parameters that fit several different types of motors. To use this function, disable **Autotune** and select a motor type at **F413**.

Pulse Width Modulation Operation

The **G7 ASD** uses a sinusoidal **Pulse Width Modulation** (PWM) control system. The output current waveform generated by the ASD approaches that of a perfect sine wave; however, the output waveform is slightly distorted. For this reason, the motor may produce more heat, noise, and vibration when operated by an ASD, rather than directly from commercial power.

Low Speed Operation

Operating a general-purpose motor at lower speeds may cause a decrease in the cooling ability of the motor. Reducing the torque requirement of the motor at lower speeds will decrease the generated heat at lower speeds.

When the motor is to be operated at low speed (less than 50% of full speed) and at the rated torque continuously, a Toshiba VF motor (designed for use in conjunction with an ASD) is recommended. When the ASD is used with a VF motor, the **VF Motor** overload protection setting must be enabled (see Program ⇒ Protection Parameters ⇒ Overload ⇒ **V/f Motor Enable/Disable**).

Overload Protection Adjustment

The **G7 ASD** software monitors the output current of the system and determines when an overload condition occurs. The overload current level is a percentage of the rating of the motor. This function protects the motor from overload.

The default setting for the overload detection circuit is set to the maximum rated current of the ASD at the factory. This setting will have to be adjusted to match the rating of the motor with which the ASD is to be used. To change the overload reference level, see **Electronic Thermal Protection #1 on pg. 154**.

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Operation Above 60 Hz

A motor produces more noise and vibration when it is operated at frequencies above 60 Hz. Also, when operating a motor above 60 Hz, the rated limit of the motor or its bearings may be exceeded; this may void the motor warranty.

Contact the motor manufacturer for additional information before operating the motor above 60 Hz.

Power Factor Correction

DO NOT connect a power factor correction capacitor or surge absorber to the output of the ASD.

If the ASD is used with a motor that is equipped with a capacitor for power factor correction, remove the capacitor from the motor.

Connecting either of these devices to the output of the ASD may cause the ASD to malfunction and trip, or the output device may cause an over-current condition resulting in damage to the device or the ASD.

Light Load Conditions

When a motor is operated under a continuous light load (i.e., at a load of less than 50% of its rated capacity) or it drives a load which produces a very small amount of inertia, it may become unstable and produce abnormal vibration or trips because of an over-current condition. In such a case, the carrier frequency may be lowered to compensate for this undesirable condition (see Program ⇒ Special Control Parameters ⇒ **Carrier Frequency**).

Note: *For proper operation, the carrier frequency must be 2.2 kHz or above except when operating in the **Constant Torque**, **Variable Torque**, or the **5-Point Setting** modes.*

Motor/Load Combinations

When the ASD is used in combination with one of the following motors or loads, it may result in unstable operation.

- A motor with a rated capacity that exceeds the motor capacity recommended for the ASD.
- An explosion-proof motor.

When using the ASD with an explosion-proof motor or other special motor types, lower the carrier frequency to stabilize the operation. **DO NOT** set the carrier frequency below 2.2 kHz if operating the system in the vector control mode.

Note: *For proper operation, the carrier frequency must be 2.2 kHz or above except when operating in the **Constant Torque**, **Variable Torque**, or the **5-Point Setting** modes.*

- If the motor that is coupled to a load that has a large backlash or a reciprocating load, use one of the following procedures to stabilize its operation.
  - Adjust the **S-pattern** acceleration/deceleration setting,
  - If in the **Vector** control mode, adjust the response time, or
  - Switch to the **Constant Torque** control mode.

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Load-produced Negative Torque

When the ASD is used with a load that produces negative torque (an overhauling load), the over-voltage or over-current protective functions of the ASD may cause nuisance tripping.

To minimize the undesirable effects of negative torque the dynamic braking system may be used. The dynamic braking system converts the regenerated energy into heat that is dissipated using a braking resistor. The braking resistor must be suitably matched to the load. Dynamic braking is also effective in reducing the DC bus voltage during a momentary over-voltage condition.

⚠ CAUTION

If under extreme conditions the dynamic braking system or a component of this system were to fail, the dynamic braking resistor may experience an extended over-current condition. The DBR circuit was designed to dissipate excessive amounts of heat and if the extended over-current condition were allowed to exceed the circuit parameters, this condition could result in a fire hazard.

To combat this condition, the 3-phase input may be connected using contactors that are configured to open in the event of an extended DBR over-current condition or an internal circuit failure. Using a thermal sensor and/or overload protection as the 3-phase input contactor drive signal, the contactors will open and remove the 3-phase input power in the event of an extended DBR over-current or system over-voltage condition.

Motor Braking

The motor may continue to rotate and coast to a stop after being shut off due to the inertia of the load. If an immediate stop is required, a braking system should be used. The two most common types of motor braking systems used with the **G7 ASD** are **DC Injection Braking** and **Dynamic Braking**.

For further information on braking systems, see **DC Injection Braking on pg. 105** and **Dynamic Braking Enable on pg. 112**.

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ASD Characteristics

Over-current Protection

Each **G7 ASD** model was designed for a specified operating power range. The ASD will incur a trip if the design specifications are exceeded.

However, the ASD may be operated at 110% of the specified output-current range continuously or at 150% for a limited amount of time as indicated in the section titled Current/Voltage Specifications on pg. 193. Also, the Overcurrent Stall Level may be adjusted to help with nuisance over-current trips (see **F601**).

When using the ASD for an application that controls a motor which is rated significantly less than the maximum current rating of the ASD, the over-current limit (Thermal Overload Protection) setting will have to be changed to match the application. For further information on this parameter, see Electronic Thermal Protection #1 on pg. 154.

ASD Capacity

The **G7 ASD** must not be used with a motor that has a significantly larger capacity, even if the motor is operated under a small load. An ASD being used in this way will be susceptible to a high-output peak current which may result in nuisance tripping.

Do not apply a level of input voltage to an ASD that is beyond that which the ASD is rated. The input voltage may be stepped down when required with the use of a step-down transformer or some other type of voltage-reduction system.

Using Vector Control

Using **Vector Control** enables the system to produce very high torque over the entire operating range even at extremely low speeds. **Vector Control** may be used with or without feedback. However, using feedback increases the speed accuracy for applications requiring precise speed control. Enabling the **Automatic Energy Savings** further increases the efficiency of the **G7 ASD** while maintaining its robust performance.

Vector Control is not capable of operating multiple motors connected in parallel.

See **F015 on pg. 64** for further information on using **Vector Control**.

Local/Remote Operation

While running in the **Local** mode at a non-zero speed, if the RJ45 connector is removed from the **EOI** and then reinserted, the ASD remains in the **Local** mode even though the **Local** LED is off (press **Run** to illuminate the **Local** LED). The ASD output remains at the frequency of the **Frequency Command** field at the time of the disconnect so long as the connector is disconnected.

Once reinserted, the reference frequency that was loaded into the EEPROM (not RAM) before the disconnect will be the frequency to which the ASD output will return.

To prevent this condition, before disconnecting the RJ45 connector ensure that the ASD is off.

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Installation and Connections

The **G7 True Torque Control^2 Adjustable Speed Drive** may be set up initially by performing a few simple configuration settings. To operate properly, the ASD must be securely mounted and connected to a power source (3-phase AC input at the **L1/R**, **L2/S**, and **L3/T** terminals). The control terminals of the ASD may be used by connecting the terminals of the **Control Terminal Strip** to the proper sensors or signal input sources (see the section titled I/O and Control on pg. 22).

Note: *The optional **ASD-Multicom** boards may be used to expand the I/O functionality of the ASD. See the section titled G7 Optional Devices on pg. 200 for further information on the available options.*

The output terminals of the ASD (**T1/U**, **T2/V**, and **T3/W**) must be connected to the motor that is to be controlled (see Figure 18 on pg. 30).

As a minimum, the installation of the ASD shall conform to **Article 110** of the **2002 NEC**, the **Occupational Safety and Health Administration** requirements, and to any other local and regional industry codes and standards.

Upon initial system powerup, the **Startup Wizard** starts automatically. The **Startup Wizard** assists the user with the initial configuration of the **G7 True Torque Control^2 Adjustable Speed Drive**. See the section titled Initial Setup on pg. 38 for additional information on the **Startup Wizard**.

Installation Notes

When a brake-equipped motor is connected to the ASD, it is possible that the brake may not release at startup because of insufficient voltage. To avoid this, **Do Not** connect the brake or the brake contactor to the output of the ASD.

If an output contactor is used for bypass operation, it must be interlocked such that commercial power is never applied to the output terminals of the ASD (**T1/U**, **T2/V**, or **T3/W**).

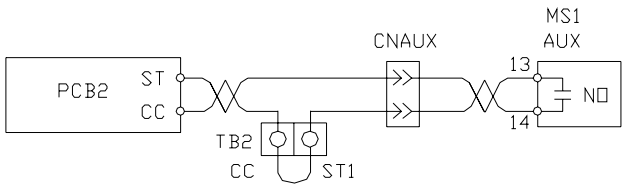
If a secondary magnetic contactor (MC) is used between the output of the ASD and the motor, it should be interlocked such that the **ST – CC** connection is disconnected before the output contactor is opened.

Do Not open and then close a secondary magnetic contactor between the ASD and the motor unless the ASD is off and the motor is not rotating.

Note: *Re-application of power via a secondary contact while the ASD is on or while the motor is still turning may cause ASD damage.*

On some devices the **ST**-to-**CC** connection is further enhanced by the operation of the **MS1 AUX** relay circuit. The **MS1 AUX** relay circuit is normally open and closes the **ST**-to-**CC** connection (via **ST1**) only after normal system power is available. The **MS1 AUX** relay circuit prohibits the **ST**-to-**CC** connection in the event that the **MS1** contactor fails to close during start up or if **MS1** opens while the ASD is running. For the 230 volt ASD this feature is available on the 30 HP system, on the 460 volt ASD this feature is available on the 75 HP and above systems, and on the 600 volt ASD it is available on the 60 HP and above systems.

Figure 2. ST activation using the MS1 AUX circuit configuration.



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The ASD input voltage should remain within 10% of the specified input voltage range. Input voltages approaching the upper or lower limit settings may require that the overvoltage and undervoltage stall protection level parameters, **F626** and **F629**, be adjusted. Voltages outside of the permissible tolerance should be avoided.

The frequency of the input power should be ±2 Hz of the specified input frequency.

Do not use an ASD with a motor that has a power rating that is higher than the rated output of the ASD.

The ASD is designed to operate NEMA B motors. Consult with your sales representative before using the ASD for special applications such as with an explosion-proof motor or applications with a piston load.

Do Not apply commercial power to the output terminals **T1/U**, **T2/V**, or **T3/W**.

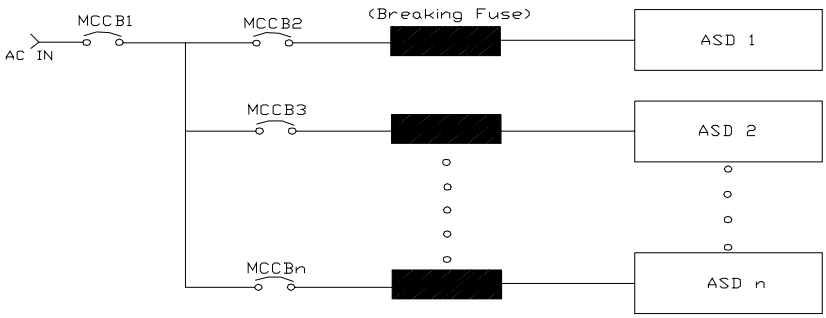
Disconnect the ASD from the motor before megging or applying a bypass voltage to the motor.

Interface problems may occur when an ASD is used in conjunction with some types of process controllers. Signal isolation may be required to prevent controller and/or ASD malfunction (contact your Toshiba sales representative or the process controller manufacturer for additional information about compatibility and signal isolation).

Use caution when setting the output frequency. Over speeding a motor decreases its ability to deliver torque and may result in damage to the motor and/or the driven equipment.

All **G7 ASD**s are equipped with internal DC bus fuses. However, not all **G7 ASD**s are equipped with internal primary power input fuses (HP dependent). When connecting two or more drives that have no internal fuse to the same power line as shown in Figure 3, it will be necessary to select a circuit-breaking configuration that will ensure that if a short circuit occurs in ASD 1, only MCCB2 trips, not MCCB1. If it is not feasible to use this configuration, insert a fuse between MCCB2 and ASD 1.

Figure 3. Circuit breaker configuration.



Mounting the ASD

CAUTION

Install the unit securely in a well ventilated area that is out of direct sunlight using the mounting holes on the rear of the ASD.

The ambient temperature rating for the **G7 ASD** is from 14 to 104° F (-10 to 40° C). The process of converting AC to DC, and then back to AC produces heat. During normal ASD operation, up to 5% of the input energy to the ASD may be dissipated as heat. If installing the ASD in a cabinet, ensure that there is adequate ventilation.

Do Not operate the ASD with the enclosure door open.

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When installing multiple ASDs, ensure that there is a clearance space of at least 8 inches (20 cm) from the top and the bottom of adjacent units. There should be at least 2 inches (5 cm) on either side of adjacent units. For the models below 50 HP the top and bottom clearance specifications may be reduced to 4 inches (10 cm). This space ensures that adequate ventilation is provided (see the section titled Enclosure Dimensions and Conduit Plate Information on pg. 182 for additional information on mounting space requirements).

Note: *Ensure that the ventilation openings are not obstructed.*

ASDs produce high-frequency noise — steps must be taken during installation to avoid the negative effects of noise. Listed below are some examples of measures that will help to combat noise problems.

- Separate the input and output power conductors of the main circuit. Do not install the input and output wires in the same duct or in parallel with each other, and do not bind them together.
- Do not install the input or output power conductors of the main circuit and the wires of the control circuit in the same duct or in parallel with each other, and do not bind them together.
- Use shielded wires or twisted wires for the control circuits.
- Ensure that the grounding terminals (G/E) of the ASD are securely connected to ground.
- Connect a surge suppressor to every electromagnetic contactor and every relay installed near the ASD.
- Install noise filters as required.

Connecting the ASD

DANGER

Refer to the section titled Installation Precautions on pg. 4 and the section titled Lead Length Specifications on pg. 21 before attempting to connect the ASD and the motor to electrical power.

System Grounding

Proper grounding helps to prevent electrical shock and to reduce electrical noise. The ASD is designed to be grounded in accordance with **Article 250** of the **2002 NEC** or **Section 10/Part One** of the **Canadian Electrical Code** (CEC).

The grounding conductor shall be sized in accordance with **Article 250-122** of the **NEC** or **Part One-Table 6** of the **CEC**.

Note: *The metal of conduit is not an acceptable ground.*

The input, output, and control lines of the system shall be run in separate metal conduits and each shall have its own ground conductor.

Power Connections

DANGER

L1/R, **L2/S**, and **L3/T** are the 3-phase input supply terminals for the ASD. The ASD may be operated from a single-phase supply. When operating using a single-phase supply, use the **L1** and **L3** terminals.

T1/U, **T2/V**, and **T3/W** are the output terminals of the ASD that connect to the motor.

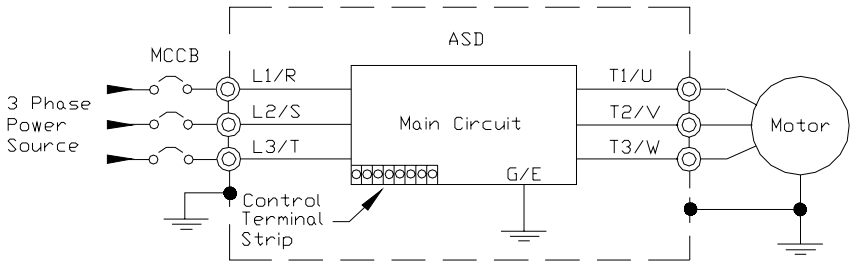
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An inductor may be connected across terminals **PA** and **PO** to provide additional filtering. When not used, a jumper is connected across these terminals (see Figure 18 on pg. 30).

Connect the input and output power lines of the ASD as shown in Figure 4.

Note: *In the event that the motor rotates in the wrong direction when powered up, reverse any two of the three ASD output power leads connected to the motor.*

Figure 4. ASD/Motor connection diagram.



Connect the 3-phase input power to the input terminals of the ASD at **L1/R**, **L2/S**, and **L3/T**. Connect the output of the ASD to the motor from terminals **T1/U**, **T2/V**, and **T3/W**. The input and output conductors and terminal lugs used shall be in accordance with the requirements listed in the section titled Cable/Terminal Specifications on pg. 195.

If multiple conductors are used in parallel for the input or output power and it is necessary to use separate conduits, each parallel set shall have its own conduit and not share its conduit with other parallel sets (i.e., place U1, V1, and W1 in one conduit and U2, V2, and W2 in another) (refer to NEC Article 300.20 and Article 310.4). National and local electrical codes should be referenced if three or more power conductors are run in the same conduit (refer to 2002 NEC Article 310 adjustment factors).

Note: *National and local codes should be referenced when running more than three conductors in the same conduit.*

Install a molded case circuit breaker (MCCB) or fuse between the 3-phase power source and the ASD in accordance with the fault current setting of the ASD and **2002 NEC Article 430**.

CAUTION

For 600 volt ASDs, the 15 HP or less ASDs (P/N VT130G7U6015B – 6160B) require a class-J fuse rated at 600 Volts/30 A.

A phase-shifting transformer (or other means) must be supplied by the user when configured for 12-pulse operation.

External fuses are required on the ASDs listed below when configured for 12-pulse operation.

VT130G7U2600B(DR)
VT130G7U2750B(DR)
VT130G7U412KB(DR)
VT130G7U415KB(DR)
VT130G7U610KB(DR)
VT130G7U612KB(DR)
VT130G7U615KB(DR)

Use either the Ferraz Shawmut Semiconductor fuse (P/N A70QS200) and fuse block P234C, or the Toshiba ASD-FUSEKIT-12P. The Toshiba kit includes the required fuses and the mounting hardware for the fuses.

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Lead Length Specifications

Adhere to the NEC and any local codes during the installation of ASD/Motor systems. Excessive lead lengths may adversely effect the performance of the motor. Special cables are not required. Lead lengths from the ASD to the motor in excess of those listed in Table 2 may require filters to be added to the output of the ASD. Table 2 lists the suggested maximum lead lengths for the listed motor voltages.

Table 2.

Model	PWM Carrier Frequency	NEMA MG-1-1998 Section IV Part 31 Compliant Motors[2]
230 Volt	All	1000 feet
460 Volt	< 5 kHz	600 feet
	≥ 5 kHz	300 feet
600 Volt	< 5 kHz	200 feet
	≥ 5 kHz	100 feet

Note: *Contact Toshiba for application assistance when using lead lengths in excess of those listed.*

Exceeding the peak voltage rating or the allowable thermal rise time of the motor insulation will reduce the life expectancy of the motor.

For proper operation, the carrier frequency must be 2.2 kHz or above except when operating in the ***Constant Torque****,* ***Variable Torque****, or the* ***5-Point Setting*** *modes.*

Startup and Test

Perform the following checks before turning on the unit:

- **L1/R**, **L2/S**, and **L3/T** are connected to the 3-phase input power.
- **T1/U**, **T2/V**, and **T3/W** are connected to the motor.
- The 3-phase input voltage is within the specified tolerance.
- There are no shorts and all grounds are secured.

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I/O and Control

The ASD can be controlled by several input types and combinations thereof, as well as operate within a wide range of output frequency and voltage levels. This section discusses the ASD control methods and supported I/O functions.

The **Control Terminal Strip** PCB (P/N 48570) supports discrete and analog I/O functions and is shown in Figure 6 on pg. 25. Table 3 lists the names, the default settings, and the descriptions of the input and output terminals of the **Control Terminal Strip PCB**.

Note: *To use the input control lines of the **Control Terminal Strip** the **Command Mode** setting must be set to **Use Control Terminal Strip** (Program ⇒ Fundamental Parameters ⇒ Standard Mode Selection ⇒ Command Mode ⇒ **Use Control Terminal Strip**).*

Figure 18 on pg. 30 shows the basic connection diagram for the G7 system.

Table 3. Control Terminal Strip default assignment terminal names and functions.

Default Term. Setting	Input/Output	Default Function (also see Terminal Descriptions on pg. 23)	Circuit Config.
ST	Discrete Input	**Standby** (jumper to **CC** to operate the unit) — Multifunctional programmable discrete input (see Installation Notes on pg. 17 for further information on this terminal).	Figure 8 on pg. 29.
RES	Discrete Input	**Reset** — Multifunctional programmable discrete input.	
F	Discrete Input	**Forward** — Multifunctional programmable discrete input.	
R	Discrete Input	**Reverse** — Multifunctional programmable discrete input.	
S1	Discrete Input	**Preset Speed 1** — Multifunctional programmable discrete input.	
S2	Discrete Input	**Preset Speed 2** — Multifunctional programmable discrete input.	
S3	Discrete Input	**Preset Speed 3** — Multifunctional programmable discrete input.	
S4	Discrete Input	**Emergency Off** — Multifunctional programmable discrete input.	
RR	Analog Input	**RR** — Multifunction programmable analog input (0.0 to 10 volt input — 0 to 80 Hz output). **Reference CC**.	Figure 9 on pg. 29.
RX	Analog Input	**RX** — Multifunctional programmable analog input (-10 to +10 VDC input — -80 to +80 Hz output). **Reference CC**.	Figure 10 on pg. 29.
II	Analog Input	**II** — Multifunctional programmable analog input (4 [0] to 20 mADC input — 0 to 80 Hz output) (see Figure 6 on pg. 25 for the location of the **II** terminal). **Reference CC**.	Figure 11 on pg. 29.
VI	Analog Input	**VI** — Multifunctional programmable analog input (0 to 10 VDC input — 0 to 80 Hz output). **Reference CC**.	
P24	DC Output	24 VDC @ 50 mA output.	Figure 12 on pg. 29.
PP	DC Output	**PP** — 10.0 VDC voltage source for the external potentiometer.	Figure 13 on pg. 29.
OUT1	Discrete Output	**Low Frequency** — Multifunctional programmable discrete output.	Figure 14 on pg. 29.
OUT2	Discrete Output	**Reach Frequency** — Multifunctional programmable discrete output.	
FP	Output	**Frequency Pulse** — an output pulse train that has a frequency which is based on the output frequency of the ASD.	Figure 15 on pg. 29.
AM	Output	Produces an output current that is proportional to the magnitude of the function assigned to this terminal (see Table 7 on page 61).	Figure 16 on pg. 29
FM	Output		
FLC	Output	Fault relay (common).	Figure 17 on pg. 29.
FLB	Output	Fault relay (N.C.).	
FLA	Output	Fault relay (N.O.).	
CC	—	Control common (**Do Not** connect to **Earth Gnd**).	
Discrete Input Terminals ⇒ Connect to **CC** to activate. **Analog Input Terminals** reference **CC**.			

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Terminal Descriptions

Note: *The programmable terminal assignments may be accessed and changed from their default settings as mapped on pg. 47 or via the* ***Direct Access*** *method: Program ⇒ Direct Access ⇒* ***applicable parameter number****. See the section titled Program Mode on pg. 47 for the applicable* ***Direct Access*** *parameter numbers.*

For further information on terminal assignments and default setting changes, see the section titled Output Terminal Functions on pg. 49 and CHANGED FROM DEFAULT on pg. 47.

ST — The default setting for this terminal is **ST**. The function of this input as **ST** is a **Standby** mode controller (system is in **Standby** when on). As the default setting, this terminal must be connected to **CC** for normal operation. If not connected to **CC**, **Off** is displayed on the LCD screen. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F113**).

RES — The default setting for this terminal is **RES**. The function of this input as **RES** is a system **Reset**. A momentary connection to **CC** resets the ASD and any fault indications from the display. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F114**). **Reset** is effective when faulted only.

F — The default setting for this terminal is **F**. The function of this input as **F** is **Forward Run.** A connection to **CC** runs the motor in the **Forward** direction when it is on. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F111**).

R — The default setting for this terminal is **R**. The function of this input as **R** is **Reverse Run.** A connection to **CC** runs the motor in the **Reverse** direction when it is on. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F112**).

S1 — The default setting for this terminal is **S1**. The function of this input as **S1** is to run the motor at **Preset Speed #1** (see Preset Speed #1 on pg. 66) when it is on. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F115**).

S2 — The default setting for this terminal is **S2**. The function of this input as **S2** is to run the motor at **Preset Speed #2** (see Preset Speed #2 on pg. 66) when it is on. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F116**).

S3 — The default setting for this terminal is **S3**. The function of this input as **S3** is to run the motor at **Preset Speed #3** (see Preset Speed #3 on pg. 67) when it is on. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F117**).

S4 — The default setting for this terminal is **Emergency Off** (normally closed). The function of this input as **Emergency Off** is to remove power from the output of the ASD and may apply a supplemental braking system using the method selected at **F603**. This input terminal may be programmed to any 1 of the 68 possible functions that are listed in Table 8 on page 76 (see **F118**).

RR — The default function assigned to this terminal is to carry out the **Frequency Mode #1** setting. The **RR** terminal accepts a 0 – 10 VDC input signal that controls the function assigned to this terminal. This input terminal may be programmed to control the speed or torque of the motor. It may also be used to regulate (limit) the speed or torque of the motor. The gain and bias of this terminal may be adjusted for application-specific suitability (see **F210** – **F213**).

RX — The **RX** terminal accepts a ±10 VDC input signal that controls the function assigned to this terminal. This input terminal may be programmed to control the speed, torque, or direction of the motor. It may also be used to regulate (limit) the speed or torque of the motor. The gain and bias of this terminal may be adjusted for application-specific suitability (see **F216** – **F219**).

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II — The function of the **II** input is to receive a 4 – 20 mA input signal that controls a 0 – 80 Hz output. This input terminal may be programmed to control the speed or torque of the motor and may not be used when using the **VI** input. Also, the gain and bias of this terminal may be adjusted (see **F201** – **F204**).

VI — The function of the **VI** input terminal is to receive a 0 – 10 VDC input signal that controls a 0 – 80 Hz output. This input terminal may be programmed to control the speed or torque of the motor and may not be used when using the **II** input. Also, the gain and bias of this terminal may be adjusted (see **F201** – **F204**).

P24 — +24 VDC @ 50 mA power supply for customer use.

PP — The function of output **PP** is to provide a 10 VDC output that may be divided using a potentiometer. The tapped voltage is applied to the **RR** input to provide manual control of the **RR** programmed function.

OUT1 — The default setting for this output terminal is the **Output Low Speed** indicator. This output terminal may be programmed to provide an indication that 1 of 60 possible events has taken place. This function may be used to signal external equipment or to activate the brake (see **F130**). The **OUT1** contact is rated at 2A/250 VAC.

OUT2 — The default setting for this output terminal is the **ACC/DEC Complete** indicator. This output terminal may be programmed to provide an indication that 1 of 60 possible events has taken place. This function may be used to signal external equipment or to activate the brake (see **F131**). The **OUT2** contact is rated at 2A/250 VAC.

FP — The default function of this output terminal is to output a series of pulses at a rate that is a function of the output frequency of the ASD. As the output frequency of the ASD goes up so does the **FP** output pulse rate. This terminal may be programmed to provide output pulses at a rate that is a function of the output frequency or the magnitude of any 1 of the 31 the functions listed in Table 7 on pg. 61 (see **F676**).

AM — This output terminal produces an output current that is proportional to the output frequency of the ASD or of the magnitude of the function assigned to this terminal. The available assignments for this output terminal are listed in Table 7 on page 61. For further information on this terminal see F670 on pg. 163.

FM — This output terminal produces an output current that is proportional to the output frequency of the ASD or of the magnitude of the function assigned to this terminal. The available assignments for this output terminal are listed in Table 7 on page 61. For further information on this terminal see F005 on pg. 60.

FLC — **FLC** is the middle leg of a single-pole double-throw (relay) switch. This **FLC** contact of the relay is switched between **FLB** and **FLA**. This contact may be programmed to switch between **FLB** and **FLA** as a function of any 1 of the 60 conditions listed in Table 9 on page 81 (see **F132** and Figure 5 on pg. 24).

FLB — One of two contacts that, under user-defined conditions, connect to **FLC** (see Figure 5 on pg. 24).

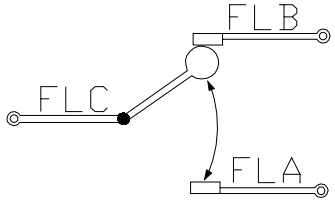
FLA — One of two contacts that, under user-defined conditions, connect to **FLC** (see Figure 5 on pg. 24).

Note: *The **FLA** and **FLC** contacts are rated at 2A/250 VAC. The **FLB** contact is rated at 1A/ 250 VAC.*

CC — Control common (**Do Not** connect to **Earth Gnd**).

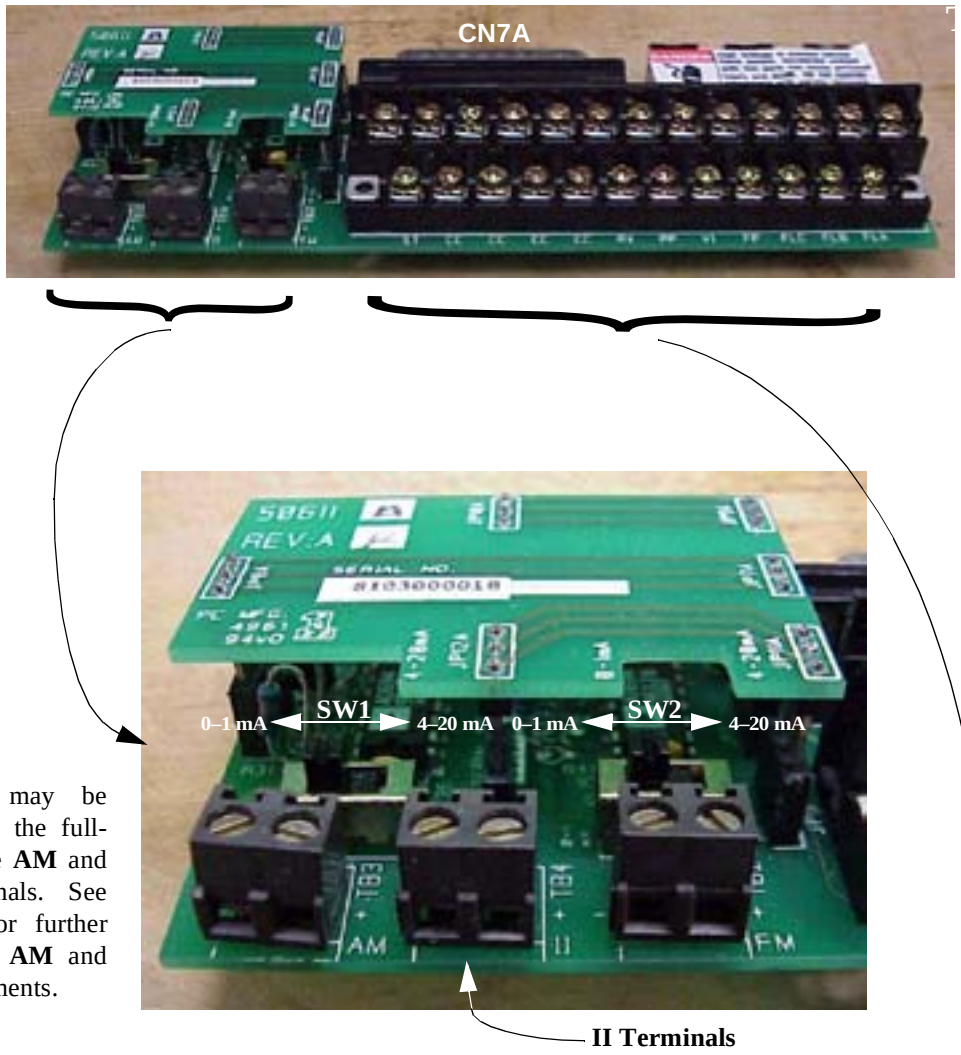
Figure 5. FLA, FLB, and FLC switching contacts shown in the de-energized state.

Note: *The relay is shown in the **Faulted** or de-energized condition. During normal system operation the relay connection is **FLC**-to-**FLA**.*



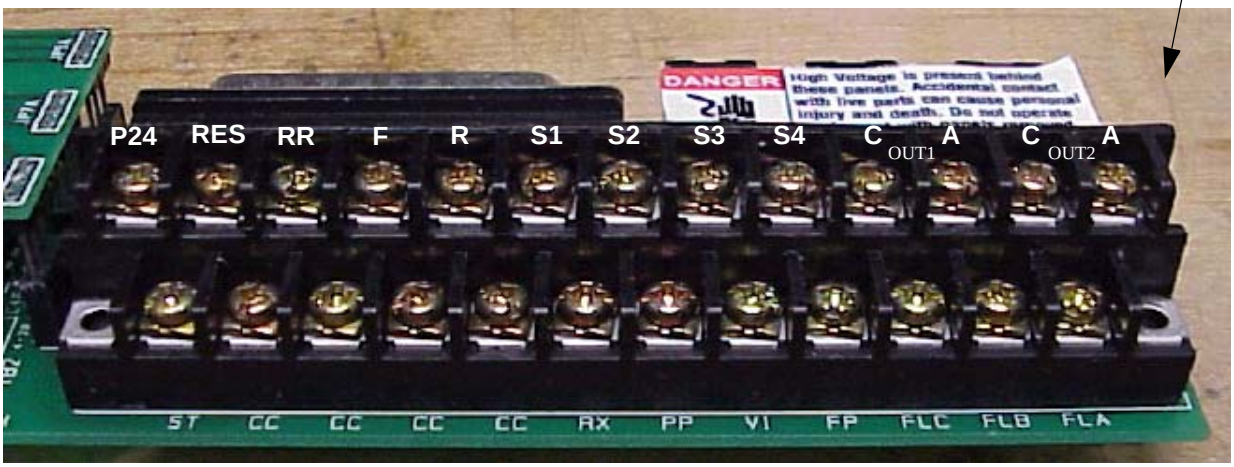
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Figure 6. Control Terminal Strip PCB.



SW1 and **SW2** may be switched to change the full-scale reading of the **AM** and **FM** output terminals. See **F670** and **F005** for further information on the **AM** and **FM** terminal adjustments.

The input and output terminals of the **Control Terminal Strip**. For further information on these terminals see pg. 22.



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G7 ASD Control

The Control PCB (P/N 56000) serves as the primary control source for the G7 ASD and receives input from the Control Terminal Strip PCB (see Figure 6 on pg. 25), an Option Card, RS232/RS485 Communications, or the EOI.

The Control PCB has been enhanced to support two new functions: Multiple Protocol Communications and the ability to communicate in either half- or full-duplex modes.

Using the optional multiple-protocol communications interface; the ASD-NANOCOM, the Control PCB may be configured for the type of communications protocol being received and respond appropriately to the sending device. The ASD-NANOCOM connects to the J4 and J5 connectors (see Figure 7). A jumper PCB (P/N 55365) is required at the J4 connector if not using the ASD-NANOCOM.

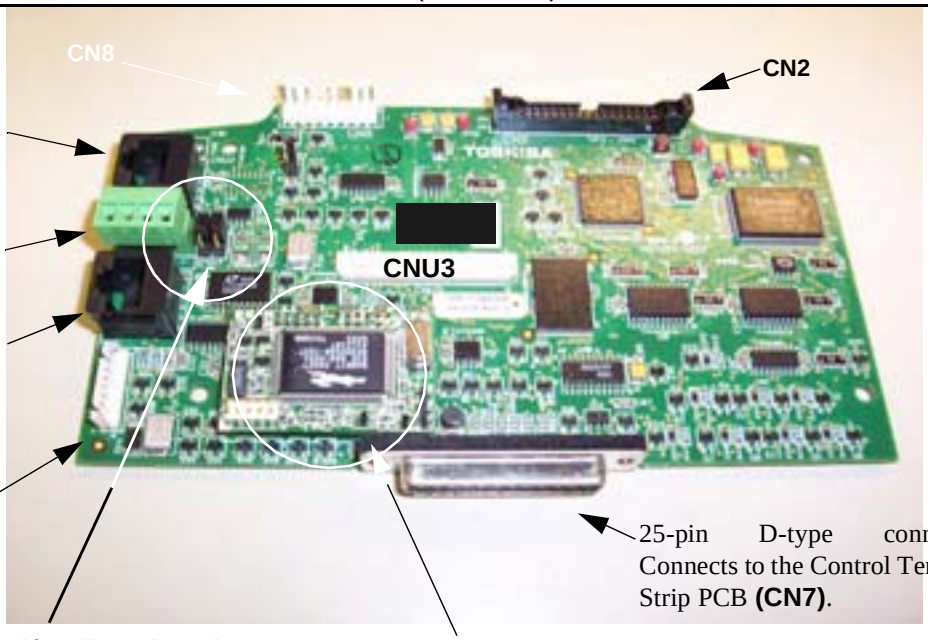
The ASD-NANOCOM must be setup to support the desired communications protocol via Program ⇒ Communication Setting Parameters ⇒ **Communication Settings**. Consult the ASD-NANOCOM User's Manual (P/N 10572-1.000-000) for a complete listing of the setup requirements.

Half or Full duplex communications is available when using RS232/RS485 communications. The jumpers at the JP1 and the JP2 connectors may be moved from one position to the other to facilitate either half- or full-duplex operation. If no jumpers are used the system will operate in the full duplex mode.

For more information on the G7 ASD communication requirements, please visit WWW.TIC.TOSHIBA.COM to acquire a copy of the 7-Series Communications User Manual and WWW.ICCDESIGNS.COM to acquire a copy of the ASD-NANOCOM User Manual.

Contact your Toshiba representative if more information is required on the ASD-NANOCOM.

Figure 7. Control Board of the **G7 ASD** (P/N 56000).



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