TOSHIBA
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Q9 ASD Quick Start Guide

Document Number: 59490-002

Date: October, 2009

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Introduction

Congratulations on the purchase of the new **Q9 True Torque Control² Adjustable Speed Drive**!

The **Q9 True Torque Control² Adjustable Speed Drive** (ASD) is a solid-state AC drive that features **True Torque Control²**. Toshiba'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 Q9 ASD uses digitally-controlled pulse width modulation. The programmable functions may be accessed via the easy-to-use menu or via the **Direct Access Numbers**. These features, combined with Toshiba's high-performance software, delivers unparalleled motor control and reliability.

The Q9 ASD is a very powerful tool, yet surprisingly simple to operate. The user-friendly **Electronic Operator Interface** (EOI) of the Q9 ASD has an easy-to-read LCD Screen. The **EOI** provides easy access to the many monitoring and programming features of the Q9 ASD.

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 Q9 ASD, a working familiarity with this guide will be required. This guide has been prepared for the ASD installer, user, and maintenance personnel. This guide may also be used as a reference guide or for training. With this in mind, use this guide to develop a system familiarity before attempting to install or operate the device.

For a more in-depth description of the many features of the Q9 ASD see the ***Q9 ASD Installation and Operation Manual***. The ***Q9 ASD Installation and Operation Manual*** may be downloaded from www.toshiba.com/ind or a printed copy may be acquired from your Toshiba Sales Representative.

Important Notice

The instructions contained in this guide 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 Sales Representative.

The contents of this guide 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 may void all warranties and may void the UL 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.

About This Guide

This guide was written by the Toshiba Technical Publications Group. This group is tasked with providing technical documentation for the **Q9 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. E-mail your comments, questions, or concerns about this publication to **Technical-Publications-Dept@tic.toshiba.com**.

Guide's Purpose and Scope

This guide provides information on how to safely install, operate, maintain, and dispose of your **Q9Adjustable Speed Drive**. The information provided in this guide is applicable to the **Q9 Adjustable Speed Drive** only.

This guide 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 guide. Read the guide completely before installing, operating, performing maintenance, or disposing of this equipment.

This guide 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 guide 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 guide.

Printed in the U.S.A.

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 Support Center is open from 8 a.m. to 5 p.m. (CST), Monday through Friday. The Center's toll free number is US (800) 231-1412/Fax (713) 937-9349 — Canada (800) 527-1204. For after-hours support follow the directions in the outgoing message when calling.

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 web site at www.tic.toshiba.com/ind.

TOSHIBA INTERNATIONAL CORPORATION

Q9 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:_____

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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 guide.

Safety Alert Symbol

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

Signal Words

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

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

DANGER

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

WARNING

The word **CAUTION** preceded by the safety alert symbol indicates that a potentially hazardous situation exists that, 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 that, if not avoided, may result in equipment and property damage.

CAUTION

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 loss of life.

Electrical Hazard Symbol

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

Explosion Hazard Symbol

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

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 guide.

Warning labels that are attached to the equipment will include the exclamation mark within a triangle. **DO NOT** remove or cover any of these 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 loss of life if safe procedures or methods are not followed as outlined in this guide.

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 guide.
- Be familiar with the construction and function of the ASD, the equipment being driven, and the hazards involved.
- Be 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.

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 may have been 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 the ASD if it is damaged or if it is missing any component(s).
- Ensure that the rated capacity and the model number specified on the nameplate conform to the order specifications.
- Modification of this equipment is dangerous and is to be performed by factory trained personnel. When modifications are required contact your Toshiba Sales Representative.
- Inspections may be required after moving equipment.
- Contact your Toshiba Sales Representative to report discrepancies or for assistance if required.

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 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 Q9 ASD is -13° to 149° F (-25° to 65° 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 Q9 ASD is intended for permanent installations only.
- Installation should conform to the **2008 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 2008 NEC Article 110-13).
- **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, metal particles, explosive/ corrosive mists or gases, or sources of electrical noise are present.
- The installation location shall not be exposed to direct sunlight.
- **DO NOT** obstruct the ventilation openings. Allow proper clearance spaces for installation. Refer to the section titled Mounting the ASD on pg. 11 for further information on ventilation requirements.
- The ambient operating temperature range of the Q9 ASD is 14° to 104° F (-10° to 40° C).

Mounting Requirements

- Only Qualified Personnel should install this equipment.
- Install the unit in a secure and upright position in a well-ventilated area.
- As a minimum, the installation of the equipment should conform to the **2008 National Electrical Code — Article 110** (NEC), 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 ASD installer/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.
- A separate ground cable should be run inside of the conduit with the input power, output power, and control circuits.
- **DO NOT** connect **CC** to earth ground.
- Use **IICC** terminal as the return for the **VI/II** (V/I) input.
- Always ground the ASD 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 **2008 NEC** and any applicable local codes.

— The Metal Of Conduit Is Not An Acceptable Ground —

Grounding Capacitor Switch

The ASD is equipped with leak reduction capacitors which are used to reduce the EMI leakage via the 3-phase power-input circuit and for compliance with the **Electromagnetic Compatibility Directive** (EMC).

The effective value of the capacitor may be increased, reduced, or removed entirely via the **Selector Switch**, **Switching Bar**, or the **Switching Screw** — the type used is typeform-specific.

The **Grounding Capacitor Switch** allows the user to quickly change the value of the leakage-reduction capacitance of the 3-phase input circuit without the use of any tools.

See the section titled Power Connection Requirements on pg. 13 for more on the Grounding Capacitor.

See figures 4, 5, 6, and 7 on pg. 15 for an electrical depiction of the leakage-reduction functionality of the Grounding Capacitor and the methods used to set the capacitance value.

Power Connections

⚠ DANGER ⚠

Contact With Energized Wiring Will Cause Severe Injury Or Loss Of Life.

- Turn off, lockout, and tag out 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/tag out procedures, connect 3-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 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 (i.e., place U1, V1, W1, and a ground wire in one conduit and U2, V2, W2 and a ground wire 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 2008 NEC Article 310 adjustment factors).
- 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** 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.
- External dynamic braking resistors must be thermally protected. See the ***Q9 Adjustable Speed Drive Installation and Operation Manual*** for further information on the requirements of the Dynamic Braking setup and use.
- It is the responsibility of the ASD installer/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 ASD 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 parameters **F250** and **F304**.

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

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 upon observing certain precautions and performing proper system integration.
- 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).
- 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 **Only**.
- 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 personnel. 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. 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.

System Setup Requirements

- When using the ASD as an integral part of a larger system, it is the responsibility of the ASD installer/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 system damage or injury to personnel (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.
- 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 must be posted to this effect at the equipment installation location.
- **DO NOT** install power factor improvement capacitors or surge absorbers 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.

CAUTION

- The **Dynamic Braking** function is not used with the Q9 ASD.
- **DO NOT** attempt to configure or connect the DBR function to the Q9 ASD.
- Attempts to configure or adapt the ASD to use the Dynamic Braking function may result in system damage or injury to personnel.
- If a secondary magnetic contactor (MC) or an ASD output disconnect 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, or W).
- When using an ASD output disconnect the ASD and the motor must be stopped before the disconnect is either opened or closed. Closing the output disconnect while the 3-phase output of the ASD is active may result in equipment damage or injury to personnel.

Operational and Maintenance Precautions

⚠ WARNING

- Turn off, lockout, and tag out the main power, the control power, and instrumentation connections before inspecting or servicing the ASD, connecting or disconnecting the power wiring to the equipment, or opening the door of the enclosure.
- 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** (Shown for smaller ASD in Figure 2 on pg. 12; is located on the front panel of larger ASDs). 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 or open 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.

Installation and Connections

The Q9 ASD 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 R/L1, S/L2, and T/L3 terminals). The control terminals of the ASD may be used by connecting the input terminals of the **Terminal Board** to the proper sensors or signal input sources (see the section titled I/O and Control on pg. 17 and Figure 9 on pg. 20).

System performance may be further enhanced by assigning application-specific functions to the output terminals of the **Terminal Board** and connecting the terminals to the proper indicators or actuators (LEDs, relays, contactors, etc.).

Note: *The optional ASD interface boards may be used to expand the I/O functionality of the ASD.*

Installation Notes

⚠ CAUTION

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 (U/T1, V/T2, and W/T3).

DO NOT apply commercial power to the ASD output terminals **U/T1**, **V/T2**, and **W/T3**.

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.*

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 over-voltage and under-voltage stall protection level parameters 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 higher than the rated output of the ASD.

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

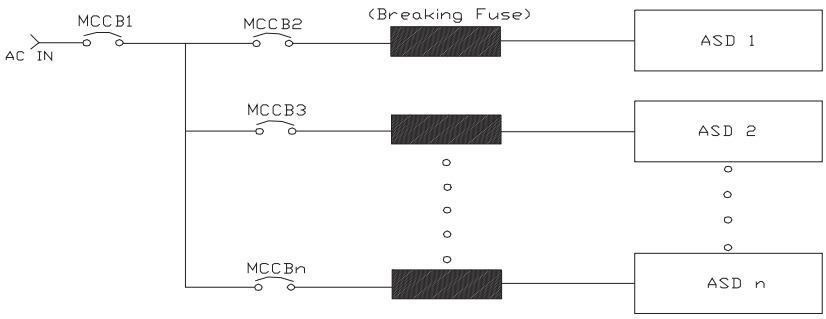
Disconnect the ASD from the motor before megging or applying a bypass voltage to the motor.

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.

Not all ASDs 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 1, 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 1. Typical Circuit Breaker Configuration.



Mounting the ASD

CAUTION

— The following thermal specifications apply to the 230- and the 460-volt ASDs ONLY —

Install the unit securely in a well ventilated area that is out of direct sunlight.

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.

The ambient operating temperature rating of the Q9 ASD is 14° to 104° F (-10° to 40° C).

When installing adjacent ASDs horizontally Toshiba recommends at least 5 cm of space between adjacent units. However, horizontally mounted ASDs may be installed side-by-side with no space in between the adjacent units — side-by-side installations require that the top cover be removed from each ASD.

For 150 HP ASDs and above, a minimum of 50 cm of space is required above and below adjacent units and any obstruction. This space is the recommended minimum space requirement for the ASD and ensures that adequate ventilation is provided for each unit. More space will provide a better environment for cooling (see the section titled Enclosure Dimensions on pg. 46 for additional information on mounting space requirements).

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

Connecting the ASD

⚠ DANGER ⚠

Refer to the section titled Installation Precautions on pg. 4 and the section titled Lead Length Specifications on pg. 16 before connecting the ASD and the motor to electrical power.

Power Connections

⚠ DANGER ⚠

Contact With 3-Phase Input/Output Terminals May Cause Electrical Shock Resulting In Injury Or Loss Of Life.

See Figure 20 on pg. 22 for a system I/O connectivity schematic.

An inductor (DCL) may be connected across the **PO** and **PA/+** terminals to provide additional filtering. When not used, a jumper must be connected across these terminals.

PA/+ and **PB** are used for the DBR connection if using a braking resistor.

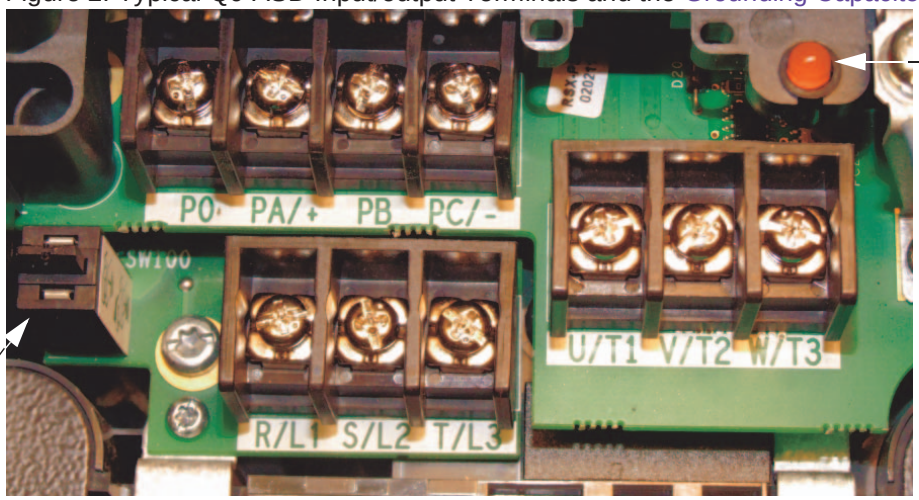
PC/- is the negative terminal of the DC bus.

R/L1, **S/L2**, and **T/L3** are the 3-phase input supply terminals for the ASD.

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

The location of the **Charge LED** for the smaller typeform ASD is provided in Figure 2. The **Charge LED** is located on the front door of the enclosure of the larger ASDs.

Figure 2. Typical Q9 ASD Input/output Terminals and the Grounding Capacitor Switch.



Grounding Capacitor Switch — Pull for **Small** capacitance/push for **Large** capacitance.

Power Connection Requirements

Connect the 3-phase input power to the input terminals of the Q9 ASD at **R/L1**, **S/L2**, and **T/L3** (see Figure 3 for the typical electrical connection scheme). Connect the output of the ASD to the motor from the ASD terminals **U/T1**, **V/T2**, and **W/T3**. The input and output conductors and terminal lugs used shall be in accordance with the requirements listed in the section titled Current/Voltage Specifications on pg. 53.

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 2008 NEC Article 310 adjustment factors).

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

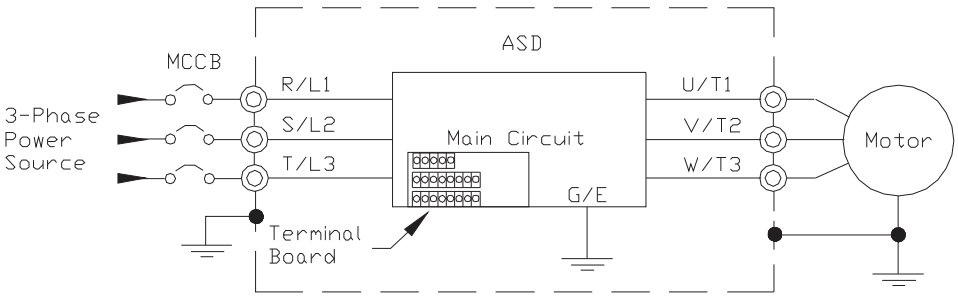
Install a molded case circuit breaker (MCCB) or fuse between the 3-phase power source and the ASD in accordance with the fault current setting of the ASD and **2008 NEC Article 430**.

The ASD is designed and tested to comply with UL Standard 508C. Modifications to the ASD system or failure to comply with the short circuit protection requirements outlined in this guide may disqualify the UL rating. See Table 9 on pg. 57 for typeform-specific short circuit protection recommendations.

As a minimum, the installation of the ASD shall conform to **2008 NEC Article 110**, the **Occupational Safety and Health Administration** requirements, and to any other local and regional industry codes and standards.

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 3. Q9 ASD/Motor Typical Connection Diagram.



System Grounding

Proper grounding helps to prevent electrical shock and to reduce electrical noise. The Q9 ASD is designed to be grounded in accordance with **Article 250** of the **2008 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**.

— 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.

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.

- **DO NOT** install the input power and output power wires in the same duct or in parallel with each other, and do not bind them together.
- **DO NOT** install the input/output power wires 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.

Grounding Capacitor

The **Grounding Capacitor** plays a role in minimizing the effects of leakage current through the ASD system and through ground paths to other systems. Leakage current may cause the improper operation of earth-leakage current breakers, leakage-current relays, ground relays, fire alarms, and other sensors — and it may cause superimposed noise on CRT screens.

The Grounding Capacitor Switch allows the user to quickly change the value of the leakage-reduction capacitance of the 3-phase input circuit. See figures 4, 5, 6, and 7 on pg. 15 for an electrical depiction of the leakage-reduction functionality and the methods used to change the capacitance value. The method used is typeform-specific.

If using a 460-volt 5 HP ASD or a 460-volt ASD that is in the range of 7.5 HP to 25 HP, and the **U/T1**, **V/T2**, and **W/T3** connections to the motor are 100 meters or more in length, the ASD **Carrier Frequency** must be set to 4 kHz or less when activating or deactivating the Grounding Capacitor Switch. ASD overheating may occur if the **Carrier Frequency** is set above 4 kHz when activating or deactivating the Grounding Capacitor Switch.

See pg. 5 for more information on the Grounding Capacitor Switch and pg. 12 for the location.

Figure 4. The **Grounding Capacitor Switch** is used on typeforms — **200-volt** 0.5 HP to 10 HP and the 25 and 30 HP/**400-volt** 1.0 HP to 250 HP.
The value may be set to **Maximum** (default setting) or to **Zero** by pushing or pulling the switch actuator, respectively.

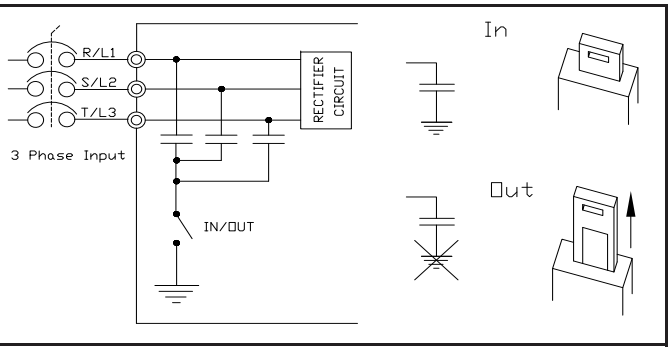


Figure 5. The **Grounding Capacitor Switch** is used on typeforms — **200-volt** 15 HP to 20 HP and the 40 HP to 60 HP/ **400-volt** 30 HP to 100 HP.
The value may be set to **Large** (default setting) or **Small** by pushing or pulling the switch actuator, respectively.

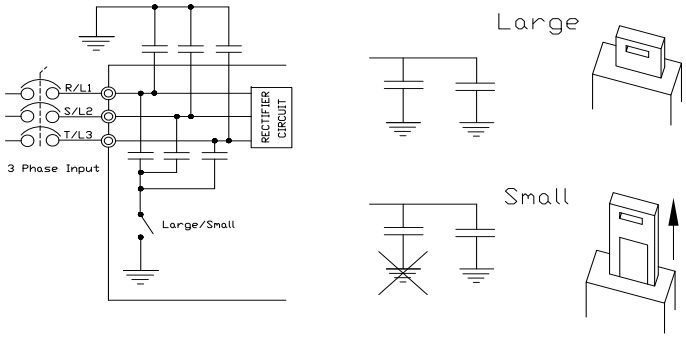


Figure 6. The **Grounding Capacitor Bar** is used on typeforms — **200-volt** 75 HP and the 100 HP/**400-volt** 125 HP and the 150 HP.
The value may be set to **Large** or **Small** (default setting) by connecting or disconnecting the switching bar, respectively.

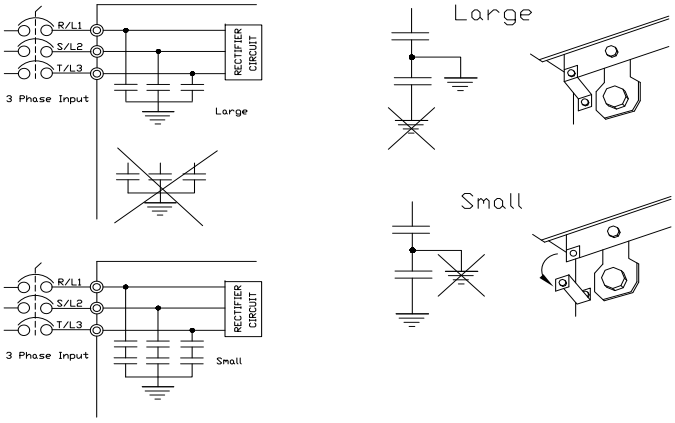
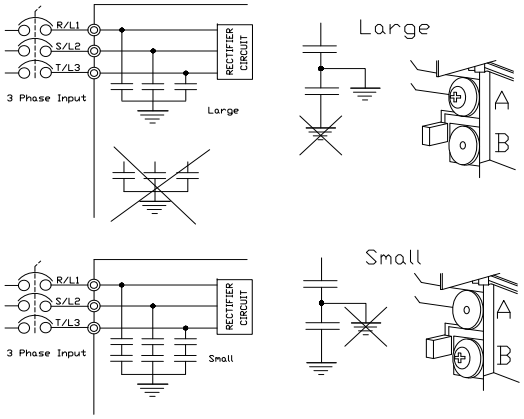


Figure 7. The **Grounding Capacitor Screw** is used on typeforms — **400-volt** 175 HP and above.
The value may be set to **Large** or **Small** (default setting) by placing the screw in the **A** position or by placing the screw in the **B** position, respectively.



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 1 may require filters to be added to the output of the ASD. Table 1 lists the suggested maximum lead lengths for the listed motor voltages.

Table 1. Lead Length Specifications.

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

Note: *Contact the Toshiba Customer Support Center 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.

When operating in the ***Vector Control*** *mode the carrier frequency should be set to 2.2 kHz or above.*

I/O and Control

The Q9 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 **Terminal Board** supports discrete and analog I/O functions and is shown in Figure 9 on pg. 20. Table 2 lists the names, descriptions, and default settings (of programmable terminals) of the input and output terminals of the **Terminal Board**.

Note: *To use the input lines of the **Terminal Board** to provide **Run** commands the **Command Mode** setting must be set to **Terminal Block**.*

Figure 20 on pg. 22 shows the typical connection diagram for the Q9 ASD system.

Table 2. Terminal Board Terminal Names and Functions.

Terminal Name	Input/Output	Function (Default Setting If Programmable) (see Terminal Descriptions on pg. 18)	Circuit Config.
ST	Discrete Input Connect to CC to activate (Sink mode).	**Standby** — Activation required for normal ASD operation. Multifunctional programmable discrete input.	Figure 10 on pg. 21.
RES		**Reset** — Activation resets ASD when Faulted — ignored when not Faulted. Multifunctional programmable discrete input.	
F		**Forward** — Multifunctional programmable discrete input.	
R		**Reverse** — Multifunctional programmable discrete input.	
S1		**Fire Speed** — Multifunctional programmable discrete input.	
S2		**Preset Speed 2** — Multifunctional programmable discrete input.	
S3		**Damper Feedback** — Multifunctional programmable discrete input.	
S4		**Emergency Off** — Multifunctional programmable discrete input.	
O1A/B (OUT1)	Switched Output	**Low-Speed** — Multifunctional programmable discrete output.	Figure 16 on pg. 21.
O2A/B (OUT2)		**Reach Frequency** — Multifunctional programmable discrete output.	
FLA		Fault relay (N.O.).	Figure 19 on pg. 21.
FLB		Fault relay (N.C.).	
FLC		Fault relay (common).	
RR	Analog Input	**Frequency Mode 1** — Multifunction programmable analog input. (0.0 to 10 volt input — 0 Hz to Maximum Frequency).	Figure 11 on pg. 21.
RX		**Unassigned** — Multifunctional programmable analog input (-10 to +10 VDC input — Unassigned).	Figure 12 on pg. 21.
V/I (Select **V** or **I** via SW301)		**Unassigned** — **V** — Multifunctional programmable isolated analog voltage input (0 to 10 VDC input).	Figure 13 on pg. 21.
		Frequency Mode 2 — I (default setting) —Multifunctional programmable isolated analog current input (4 [0] to 20 mADC input — 0 Hz to Maximum Frequency).	
AM	Analog Output	**Output Current —** Current output that is proportional to the output current of the ASD or to the magnitude of the function assigned to this terminal.	Figure 18 on pg. 21
FM		**Output Frequency —** Current or Voltage output that is proportional to the output frequency of the ASD or to the magnitude of the function assigned to this terminal. Select **Current** or **Voltage** at F681.	
SU+	DC Input	Externally-supplied 24 VDC backup control power (1.1 A max.).	
P24	DC Output	24 VDC (200 mA max.) output.	Figure 14 on pg. 21.
PP		10.0 VDC (10 mA max.) voltage source for the external potentiometer.	Figure 15 on pg. 21.
FP	Pulsed Output	**Output Frequency —** Multifunctional programmable output pulse train of a frequency based on the output frequency.	Figure 17 on pg. 21.
IICC		Return for the **V/I** input terminal.	**Do Not** connect to **Earth Gnd** or to each other.
CC		Return for the **AM**, **FM**, **SU+**, and the discrete input terminals.	
CCA		Return for the **RR**, **RX**, **P24**, and the **PP** terminals.	

Terminal Descriptions

Note: *The programmable terminal assignments may be accessed and changed from their default settings as mapped on pg. 31 or via the* ***Direct Access*** *method: Program ⇒ Direct Access ⇒* ***Applicable Parameter Number****. See the section titled Program Mode Menu Navigation on pg. 31 for the applicable* ***Direct Access*** *parameter numbers.*

For further information on terminal assignments and default setting changes, see the sections titled Input Terminals on pg. 33 and Default Setting Changes on pg. 44.

Note: *See the section titled Cable/Terminal Specifications on pg. 55 for the Q9 ASD conductor and terminal electrical specifications.*

Note: *Programmable terminals will not retain their settings indefinitely in the event of a power loss. Connect an external +24 VDC supply to the* ***SU+*** *terminal to retain the programmable settings in the event of Control Power loss (see Figure 20 on pg. 22).*

ST — The default setting for this terminal is the **Standby** mode controller. As the default setting, this terminal must be activated for normal system operation. The **ST** terminal is activated by connecting **CC** to this terminal (Sink mode). When deactivated **OFF** is displayed on the **Frequency Command** screen.This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F113).

RES — The default setting for this terminal is **Reset**. The **RES** terminal is activated by connecting **CC** to this terminal (Sink mode). A momentary connection to **CC** resets the ASD and any fault indications from the display. **Reset** is effective when faulted only. This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F114).

F — The default setting for this terminal is the **Forward** run command. The **F** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F111).

R — The default setting for this terminal is the **Reverse** run command. The **R** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F112).

S1 — The default setting for this terminal is the **Preset Speed 1**. The **S1** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F115).

S2 — The default setting for this terminal is the **Preset Speed 2**. The **S2** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F116).

S3 — The default setting for this terminal is the **Preset Speed 3**. The **S3** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F117).

S4 — The default setting for this terminal is the **Emergency Off**. The **S4** terminal is activated by connecting **CC** to this terminal (Sink mode). This input terminal may be programmed to any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** (see F118).

RR — The default function assigned to this terminal is the **Frequency Mode 1** setting. The **RR** terminal accepts a 0 – 10 VDC input signal that is used to control the function assigned to this terminal. This input terminal may be programmed to control the speed or torque of the motor via an amplitude setting or regulate by setting a limit. The gain and bias of this terminal may be adjusted for application-specific suitability (see F210 – F215). See Figure 20 on pg. 22 for an electrical depiction of the **RR** terminal. This terminal references **CCA**.

RX — The default function assigned to this terminal is the **Torque Command** setting. The **RX** terminal accepts a ±10 VDC input signal that is used to carry out the function assigned to this terminal. This input terminal may be programmed to control the speed or torque of the motor via an amplitude setting or regulate by setting a limit. The gain and bias of this terminal may be adjusted for application-specific suitability. This terminal references **CCA**.

V/I — The V/I terminal has the dual function of being able to receive an input voltage or current. The function as a voltage input to receive a 0 – 10 VDC input signal. The function as a current input is to receive a 0 – 20 mA input signal. Using either input type, the function is to control the 0.0 – Maximum Frequency output or the 0.0 to 250% torque output of the ASD. This is an isolated input terminal. This terminal may be programmed to control the speed or torque of the motor and cannot process both input types simultaneously. SW301 must be set to V or I to receive a voltage or current, respectively (see Figure 9 on pg. 20). Terminal scaling is accomplished via **F201** – **F20**. The gain and bias of this terminal may be adjusted for application-specific suitability (see F470 and F471).

SU+ — Externally supplied +24 VDC ±10% at 1.1 A (minimum) backup control power. This terminal references **CC**.

P24 — +24 VDC at 200 mA power supply for customer use. This terminal references **CCA**.

PP — The function of output **PP** is to provide a 10 VDC/10 mADC 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. This terminal references **CCA**.

O1A/B (OUT1A/B) — The default function assigned to this terminal is **Output Low-Speed**. This output may be programmed to provide an indication (open or closed) that any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** has occurred or is active. This function may be used to signal external equipment (e.g., activate the brake) (see F130). The **OUT1** terminal is rated at 2 A/ 120 VAC and 2 A/30 VDC.

O2A/B (OUT2A/B) — The default function assigned to this terminal is **ACC/DEC Complete**. This output may be programmed to provide an indication (open or closed) that any one of the functions listed in the ***Q9 ASD Installation and Operation Manual*** has occurred or is active. This function may be used to signal external equipment (e.g., activate the brake) (see F131). The **OUT2** terminal is rated at 2A/120 VAC and 2A/30 VDC.

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 increases 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 one of the functions listed in the ***Q9 ASD Installation and Operation Manual***.

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 the ***Q9 ASD Installation and Operation Manual***.

FM — This output terminal produces an output current or voltage 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 the ***Q9 ASD Installation and Operation Manual***. The Voltage/Current output selection is performed at **F681**.

FLA — One of two normally-closed contacts that, under user-defined conditions, connect to **FLC**.

FLB — One of two normally-open contacts that, under user-defined conditions, connect to **FLC**.

FLC — **FLC** is the common leg of a single-pole double-throw form C relay. The **FL** relay is the **Fault Relay** by default, but may be programmed to any one of the conditions listed in the ***Q9 ASD Installation and Operation Manual***. For further information on this terminal see **F132** and Figure 8.

Note: *The **FLA**, **FLB**, and **FLC** contacts are rated at 2A/120 VAC and 2A/30 VDC.*

Figure 8. FLA, FLB, and FLC Switching Contacts Are Shown in the De-Energized State.

Note: *The relay is shown in the normal operating condition. During a faulted condition the relay connection is **FLC**-to-**FLA**.*

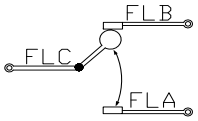
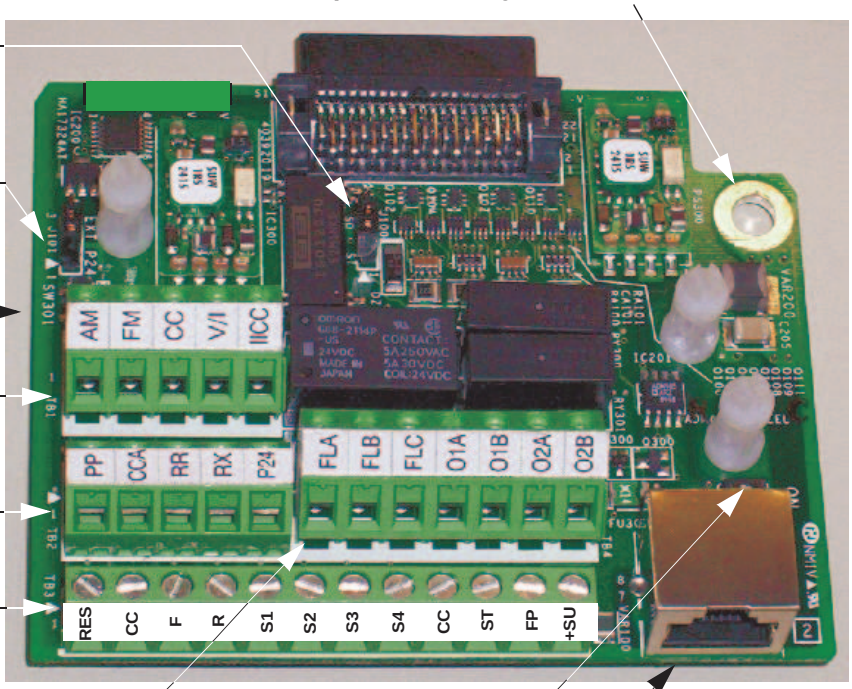


Figure 9. Terminal Board.

CAUTION **Ensure that the ground screw is securely in place to prevent arcing, intermittent operation, or system failure.**



J100
1 to 2 = Sink
2 to 3 = Source

J101
(24V)
1 to 2 = System Supplied
2 to 3 = Ext. Supplied

SW301
V/I Switch

TB1

TB2

TB3

TB4

SW200
Half/Full Duplex Switch

S4
RS485 4-Wire Communication

See Figure 20 on pg. 22 for more information on the Terminal Board connections.

See the section titled Terminal Descriptions on pg. 18 for terminal descriptions.

See the section titled Cable/Terminal Specifications on pg. 55 for information on the proper cable/terminal sizes and torque specifications when making **Terminal Board** connections.

I/O Circuit Configurations

Figure 10. Discrete Input.

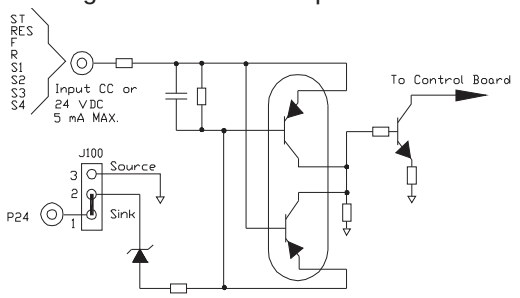


Figure 11. RR Input.

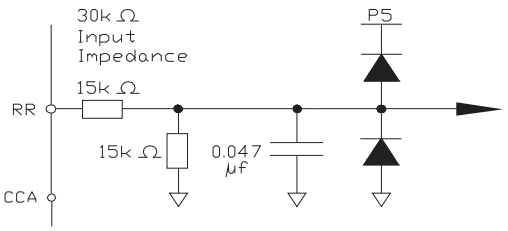


Figure 12. RX Input.

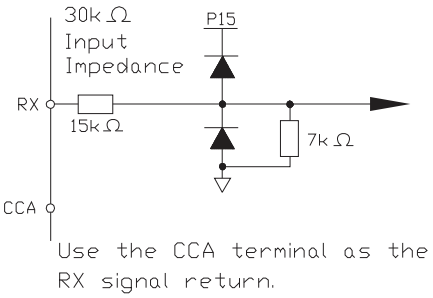


Figure 13. V/I Isolated Input.

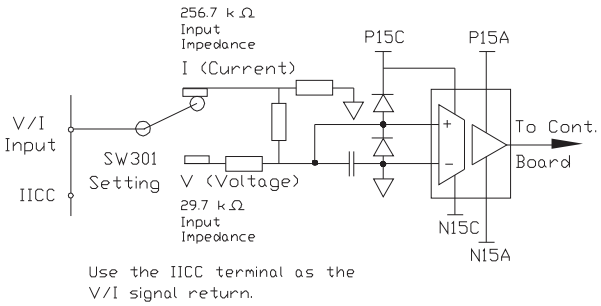


Figure 14. P24 Output.

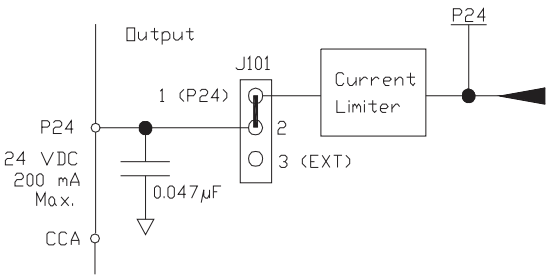


Figure 15. PP Output.

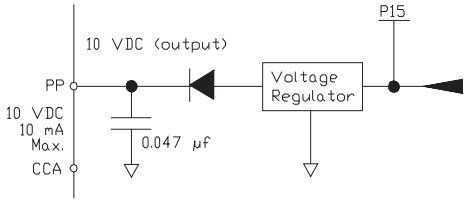


Figure 16. OUT1/OUT2 Output.

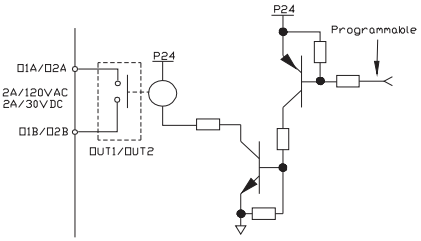


Figure 17. FP Output.

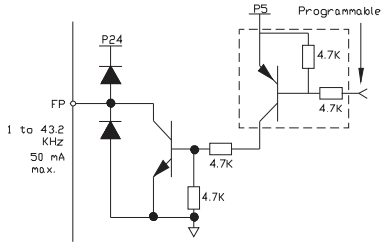


Figure 18. AM/FM Output.

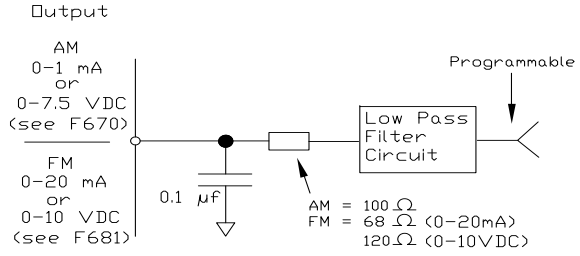
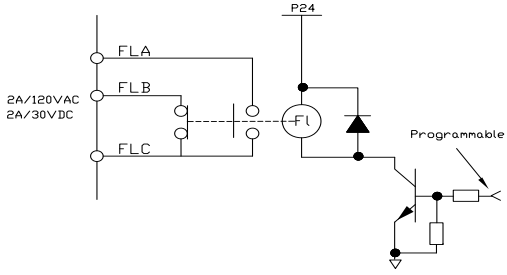


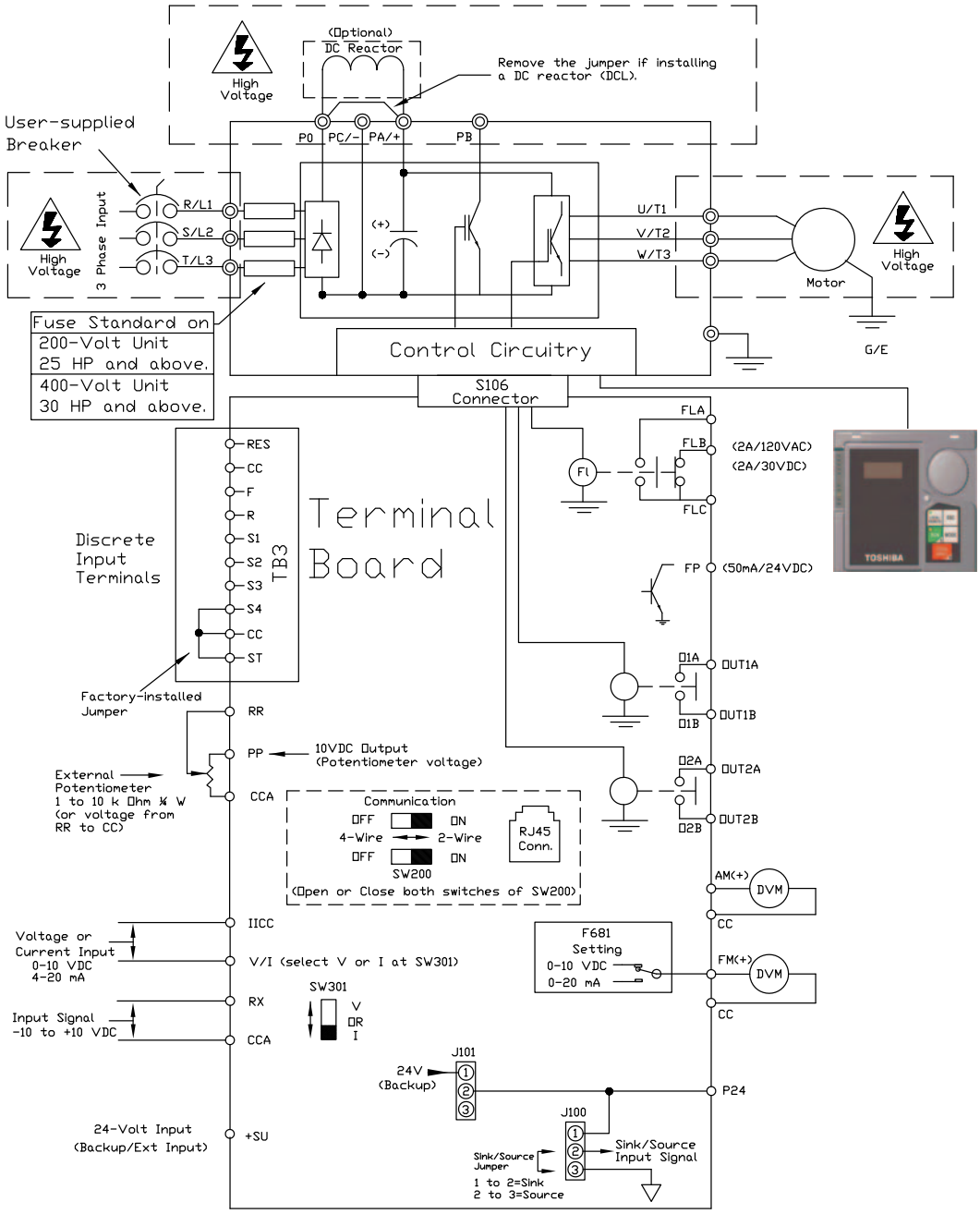
Figure 19. Fault Relay (shown not faulted).



Typical Connection Diagram

Figure 20. The Q9 ASD Typical Connection Diagram.

Note: *When connecting multiple wires to any of the ASD terminals, do not connect a solid wire and a stranded wire to the same terminal.*



Note: *The **AM**, **FM**, and the **+SU** analog terminals are referenced to **CC**.*

*The **RR**, **RX**, **P24**, and the **PP** analog terminals are referenced to **CCA**.*

*The isolated **V/I** analog terminal references **IICC**.*

Startup and Test

Before turning on the ASD ensure that:

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

Electronic Operator Interface

The ASD **Electronic Operator Interface** (EOI) is comprised of an LCD Screen, two LEDs, a rotary encoder, and five keys. These items are described and their locations are provided in Figure 21. on pg. 25.

EOI Operation

The **EOI** is the primary input/output device for the user. The **EOI** may be used to monitor system functions, input data into the system, perform diagnostics, and view performance data (e.g., motor frequency, bus voltage, torque, etc.).

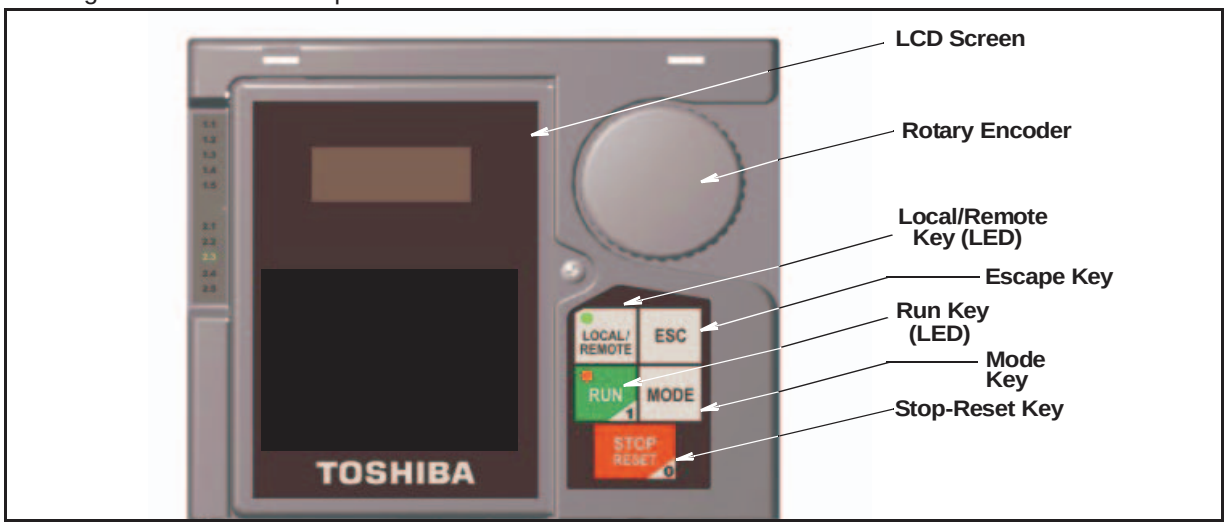
The software used with the ASD is menu driven; thus, making it a select and click environment. The operating parameters of a motor may be selected and viewed or changed using the **EOI** (or via communications).

EOI Remote Mounting

The **EOI** may be mounted remotely using the optional **ASD-MTG-KIT9**. The kit contains all of the hardware required to mount the **EOI** of the 9-Series ASD remotely.

System operation and **EOI** operation while using the remotely-mounted **EOI** are the same as with the ASD-mounted configuration.

Figure 21. Electronic Operator Interface Features.



EOI Features

LCD Screen — Displays configuration information, performance data (e.g., output frequency, bus voltage, torque, etc.), and diagnostic information.

Rotary Encoder — Used to access the Q9 ASD menu selections, change the value of a displayed parameter, and performs the **Enter** key function. Turn the **Rotary Encoder** either clockwise or counterclockwise to perform the **Up** or **Down** functions of the displayed menu selection. Press the **Rotary Encoder** to perform the **Enter** (select) function.

Local/Remote Key — Toggles the system to and from the **Local** and **Remote** modes. The LED is on when the system is in the **Local Command** mode. The **Local** mode allows the **Command** and **Frequency** control functions to be carried out via the **EOI**.

The **Remote** mode enables the **Command** and **Frequency** control functions to be carried out via the **Terminal Board**, **RS485**, **Communication Card**, or **Pulse Input**. The selection may be made via Program ⇒ Utility Group ⇒ Command Mode and Frequency Mode 1, respectively.

ESC Key — Returns the system to the previously viewed menu item. Subsequent **Escape** key activation scrolls through the **Root Menu** until reaching the **Frequency Command** screen (see Figure 22 on pg. 27). Further **ESC** key entries are ignored.

Run Key — Issues the **Run** command while in the **Local** mode. The **Run** key LED illuminates green while stopped. Illuminates red while running or while exciting the motor.

Mode Key — Provides a means to access the five root menus. Pressing the **Mode Key** key repeatedly loops the system through the five root menus (see Figure 22 on pg. 27). While looping through the root menus, the **Program** menu will display the default **Program** root menu screen item or the **Program** sub-menu item being accessed prior to pressing the **Mode** key.

Stop-Reset Key — This key has three functions.

1. Issues the **Off** command (decelerates to **Stop** at the programmed rate; **F721**) if pressed once while in the **Local** mode.
2. Initiates an **Emergency Off Fault** if pressed twice quickly from the **Local** or **Remote** modes. The **Emergency Off** function terminates the ASD output and will apply the stopping method selected at **F603**.
3. Resets active **Faults** and/or active **Alarms** if pressed twice quickly. The source of the **Fault** or **Alarm** must be determined and corrected before normal ASD operation can resume.

LCD Screen

The **LCD Screen** is the primary user input/output information center. Parameter settings may be viewed, or selected and changed using the LCD Screen module of the **EOI**. To view or change a parameter setting using the LCD Screen, press the **Mode** key until the **Program** menu is displayed. Turn the **Rotary Encoder** until the desired **Primary Menu** item of the **Program** menu is displayed. Press the **Rotary Encoder** to select the item from the **Primary Menu** (repeat the press-to-select for submenu items).

See the section titled Default Setting Changes on pg. 44 for more information on changing parameter setting.

Repeated **ESC** key entries at any time takes the menu back one level each time the **ESC** key is pressed until the **Frequency Command** screen is reached. Further **ESC** key entire are ignored.

LCD Screen Installation Note

When installing the LCD Screen module of the **EOI**, ensure that the left side of the display is inserted first with the top and bottom catches (see Phillips screws at underside of screen) securely in place. This ensures the proper alignment and electrical connection of the NX connector of the **LCD Screen** module PCB. Gently hold the screen in place while securing the Phillips mounting screw.

If improperly seated, the periphery of the **LCD Screen** module will not be flush with the front panel surface and the unit will not function properly.

System Configuration and Menu Options

Root Menu Items

The **Mode** key accesses the five primary modes of the ASD: the **Frequency Command** mode, the **Setup** mode, the **PID Setup** mode, the **Program** mode, and the **Monitor** mode. From either mode, press the **Mode** key to loop through to the other four modes (see Figure 22). Press the **ESC** key from any mode to return to the previous mode until reaching the **Frequency Command** mode.

The **Alarm** or **Fault** screen will be displayed in the event of an active **Alarm** or **Fault**. **Alarm** text will be displayed on the **Frequency Command** screen when active. See the ***Q9 ASD Installation and Operation Manual*** for more information on Alarms and Trips.

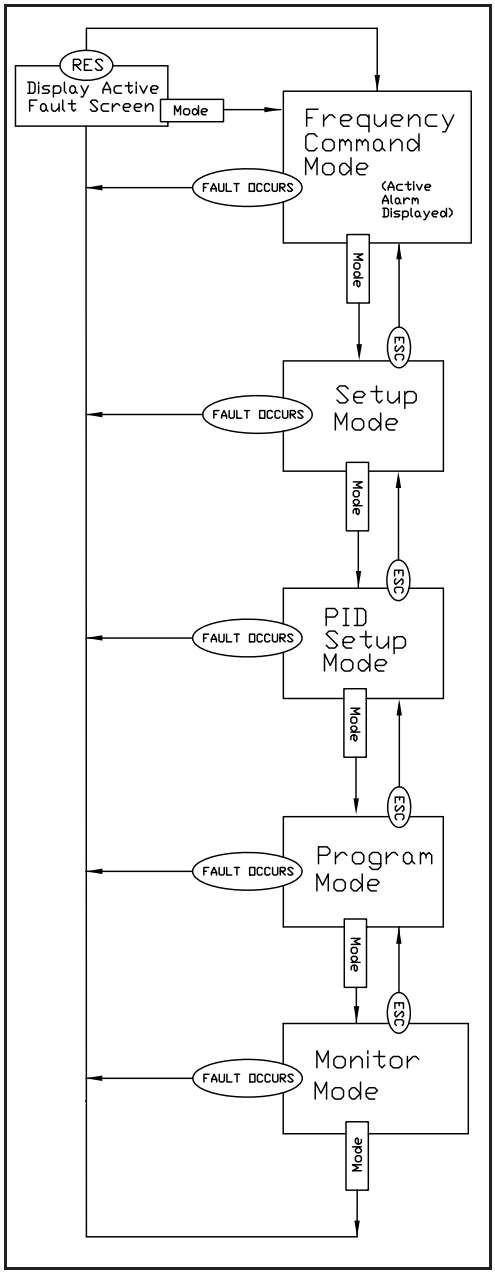


Figure 22. ASD Root Menu Navigation.

Frequency Command Mode

Frequency Setting

While operating in the **Local** mode (Local LED is illuminated), the running frequency of the motor may be set from the **Frequency Command** screen. Using the **Rotary Encoder**, enter the **Frequency Command** value, connect **ST** to **CC**, provide a **Run** command (F and/or R) and then press the **Run** key. The motor will run at the **Frequency Command** speed and may be changed while running. See Operation (Local) on pg. 44 for more information on the **Frequency Command** mode.

Setup Mode

The **Setup** mode is comprised of the commonly used configuration items listed below. See the ***Q9 ASD Installation and Operation Manual*** for further information on these items.

The quick-access items are listed below:

Acceleration Time 1.

Deceleration Time 1.

Upper-Limit Frequency.

Lower-Limit Frequency.

VI/II (V/I) Reference 1.

VI/II (V/I) Frequency 1.

VI/II (V/I) Reference 2.

VI/II (V/I) Frequency 2.

Type Reset.

V/f Pattern.

Electronic Thermal Protection 1.

PID Setup Mode

The **PID Setup** (Proportional-Integral-Derivative) mode is comprised of parameter settings that are specific to the PID operating mode. PID is a closed-loop control technique that seeks error minimization by reacting to three values: One that is proportional to the error, one that is representative of the error, and one that is representative of the rate of change of the error.

The quick-access items are listed below:

Command Mode.

Frequency Mode 1.

VI/II (V/I) Reference 1.

VI/II (V/I) Frequency 1.

VI/II (V/I) Reference 2.

VI/II (V/I) Frequency 2.

PID-Control Switching.

PID Feedback Selection.

PID Feedback Delay Filter.

PID Feedback Proportional (P) Gain.

PID Feedback Integral (I) Gain.

PID Deviation Upper-Limit.

PID Deviation Lower-Limit.

PID Feedback Differential (D) Gain.

Process Upper-Limit.

Process Lower-Limit.

PID Control Wait Time.

PID Output Upper-Limit.

PID Output Lower-Limit.

Process Increasing Rate.

Process Decreasing Rate.

Upper-Limit Frequency.

Lower-Limit Frequency.

Low Output Disable Time.

Acceleration Time 1.

Deceleration Time 1.

Frequency Command Panel (Same as Command Entered Via Frequency Command Screen).

PID Feedback (Read-Only — Displays Active Feedback Value in Hz).

Monitor Mode

The **Monitor** mode allows the user to monitor motor performance variables, control settings, and configuration data during motor operation. There are 30 items that may be monitored from this mode. The items are listed and described below.

Press the **Rotary Encoder** to access the listing of monitored parameters. Turn the **Rotary Encoder** to access subsequent monitored parameters.

Note: *The **Monitor** mode is a read-only mode. The settings cannot be changed from the **Monitor** mode. For information on how to change the values, see the section titled* *Default Setting Changes on pg. 44**.*

Note: *The F701 setting will determine if the Current and Voltage values displayed appear as **A** (Amps) or **V** (Voltage), or if the value is shown as a **%** (percentage) of the ASD rating.*

Frequency at Trip — Displays the running frequency or the at-trip frequency if tripped.

Frequency Reference — Displays the **Frequency Setpoint** (commanded frequency).

Output Current — Displays the **Output Current** as a percentage of the rated capacity of the ASD.

DC (Bus) Voltage — Displays the **Bus Voltage** as a percentage of the rated capacity of the ASD.

Output Voltage — Displays the **Output Voltage** as a percentage of the rated capacity of the ASD.

(Discrete) Input Terminals — Displays any activated discrete input terminals of the **Terminal Board**.

(Discrete) Output Terminals — Displays any activated discrete output terminals of the **Terminal Board**.

Run Time — Displays the **Cumulative Run Time** in hours. Select **Clear Run Timer** at F007 to reset this reading.

Compensation Frequency — Displays the **Output Frequency** after the application of the slip compensation correction value (Post Compensation Frequency).

PID Feedback — Provides a status of the **PID Real Time Feedback** in Hz.

Motor OL Ratio — Displays the real-time **Motor Overload** value as a percentage of the rated capacity of the motor.

ASD OL Ratio — Displays the real-time **ASD Overload** as a percentage of the rated capacity of the ASD.

Motor Load — Displays the real-time **Motor Load** as a percentage of the rated capacity of the motor.

ASD Load — Displays the **ASD Load** as a percentage of the rated capacity of the ASD.

Input Power — Displays the **Input Power** in Kilowatts (kW).

Output Power — Displays the **Output Power** in Kilowatts (kW).

Input kWH — Displays the **Input Power** in kWH.

Output kWH — Displays the **Output Power** in kWH.

Direction — Displays the **Direction** command (Forward/Reverse).

RR — Displays the **RR** input value as a percentage of the full range of the **RR** value (potentiometer input).

VI/II (V/I) — Displays the **V/I** input setting as a percentage of the full range of the **V/I** value.

Note: *The isolated **VI/II (V/I)** input terminal may receive **Current** or **Voltage** to control the output speed or the output torque. The input signal type must be selected at **SW301** on the **Terminal Board**.*

*The **V** input setting of **SW301** is used for the 0 – 10 VDC analog input signal and the **I** input setting of **SW301** is used for the 0 – 20 mA analog input signal. Either may be used as a frequency or torque control source. Throughout this guide they will be selection-specific and may be listed as **VI/II (V/I)**.*

See parameter F201 for more information on the setup of this input.

RX — Displays the **RX** input setting as a percentage of the full range of the **RX** value (-10 to +10 VDC input).

RX2 — Displays the **RX2** input setting as a percentage of the full range of the **RX2** value.

Note: *The RX2 terminal function is available on the **Expansion IO Card Option 1** option board (P/N ETB003Z) only.*

FM Output — Displays the magnitude of the function assigned to this terminal relative to the full-scale reading of the **FM** terminal. This terminal may be configured at F005 for application-specific suitability.

AM Output — Displays the magnitude of the function assigned to this terminal relative to the full-scale reading of the **AM** terminal. This terminal may be configured at F670 for application-specific suitability.

Fault — Displays the active fault or **No Error** if there are no errors.

Past Trip 1 — This function records and displays the last trip incurred. Subsequent trips will replace **Past Trip 1**. As trip records are replaced they are shifted to the next level of the **Past Trip** locations until being deleted (i.e., **Past Trip 1** is moved to **Past Trip 2** and then to **Past Trip 3** until being shifted out of **Past Trip 4**). Once shifted out of **Past Trip 4** the record is deleted. If no trips have occurred since the last reset, **No Error** is displayed for each trip record.

Past Trip 2 — Past trip information or **None**.

Past Trip 3 — Past trip information or **None**.

Past Trip 4 — Past trip information or **None**.

Note: *An improper ASD setup may cause some trips — reset the ASD to the **Factory Default** settings before pursuing a systemic malfunction (Program ⇒ Utility Group ⇒ Type Reset ⇒ **Factory Settings**).*

Direction — Displays the **Direction** command (forward/reverse).

Discrete Input Terminals — Displays the status (activated = reverse video) of the discrete input terminals of the **Terminal Board**.

Discrete Output Terminals — Displays the status (activated = reverse video) of the discrete output lines of the **Terminal Board**.

Program Mode Menu Navigation

The following table lists the menu items of the **Program** mode and maps the flow of the menu selections. The **Parameter Numbers** for the listed functions are provided where applicable.

The functions listed may be viewed, or selected and changed as mapped below or via the **Direct Access** method: Program ⇒ Direct Access ⇒ ***Applicable Parameter Number***.

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
OUTPUT FREQUENCY (Turn the Rotary Encoder to Change Frequency Setting)			N/A
SETUP		Acceleration Time 1	F009
		Decel Time 1	F010
		Upper-Limit Frequency	F012
		Lower-Limit Frequency	F013
		VI/II (V/I) Reference 1	F201
		VI/II (V/I) Frequency 1	F202
		VI/II (V/I) Reference 2	F203
		VI/II (V/I) Frequency 2	F204
		Type Reset	F007
		V/f Pattern	F015
		Electronic Thermal Protection 1	F600
PID SETUP		Command Mode	F003
		Frequency Mode 1	F004
		VI/II (V/I) Reference 1	F201
		VI/II (V/I) Frequency 1	F202
		VI/II (V/I) Reference 2	F203
		VI/II (V/I) Frequency 2	F204
		PID Switching	F359
		Input Feedback Select	F360
		PID Feedback Delay Filter	F361
		PID Feedback Proportional Gain	F362

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PID SETUP		PID Feedback Integral Gain	F363
		PID Upper Deviation Limit	F364
		PID Lower Deviation Limit	F365
		PID Feedback Differential Gain	F366
		Process Upper-Limit	F367
		Process Lower-Limit	F368
		PID Control Wait Time	F369
		PID Output Upper-Limit	F370
		PID Output Lower-Limit	F371
		Process Increasing Rate	F372
		Process Decreasing Rate	F373
		Upper-Limit Frequency	F012
		Lower-Limit Frequency	F013
		Low Output Disable Time	F256
		Acceleration Time 1	F009
		Decel Time 1	F010
		Frequency Command Panel	N/A
		PID Feedback	
PROGRAM	Search		N/A
	Direct Access		
	Fundamental 1	Maximum Output Frequency	F011
		Base Frequency 1	F014
		Voltage Compensation	F307
		Base Voltage 1	F409
		Disable Forward/Reverse Run	F311
		Upper-Limit Frequency	F012
		Lower-Limit Frequency	F013
		V/f Pattern	F015

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Fundamental 1	Torque Boost 1	F016
		Acceleration Time 1	F009
		Decel Time 1	F010
		Accel/Decel Pattern 1	F502
	Fundamental 2	Base Frequency 2	F170
		Base Voltage 2	F171
		Torque Boost 2	F172
		Electronic Thermal Protection 2	F173
		Acceleration Time 2	F500
		Deceleration Time 2	F501
		Accel/Decel Pattern 2	F503
		Accel/Decel Switching Frequency 1	F505
	Panel Control	Panel Direction	F008
		Panel Stopping Pattern	F721
		Panel Accel/Decel Selection	F504
		Switch-On-The-Fly	F295
		Lock CMOD/FMOD	F736
	Input Terminals	F Terminal	F111
		R Terminal	F112
		ST Terminal	F113
		RES Terminal	F114
		S1 Terminal	F115
		S2 Terminal	F116
		S3 Terminal	F117
		S4 Terminal	F118
		LI1 Terminal	F119
		LI2 Terminal	F120
		LI3 Terminal	F121
		LI4 Terminal	F122

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Input Terminals	LI5 Terminal	F123
		LI6 Terminal	F124
		LI7 Terminal	F125
		LI8 Terminal	F126
		On Terminal	F110
		Direction Priority	F105
		Input Priority	F106
	Output Terminals	OUT1 Terminal	F130
		OUT2 Terminal	F131
		FL Terminal	F132
		OUT3 Terminal	F133
		OUT4 Terminal	F134
		OUT5 Terminal	F135
		OUT6 Terminal	F136
		OUT7 Terminal	F137
		R2 Terminal	F138
		Low-Signal Frequency	F100
		Reach Frequency	F101
		Reach Detection	F102
		FP Terminal Assignment	F676
		FP Terminal Scaling	F677
	Special Controls	Startup Frequency	F240
		End Frequency	F243
		Run Frequency	F241
		Run Frequency Hysteresis	F242
		Jump Frequency 1	F270
		Jump Frequency 1 Bandwidth	F271
		Jump Frequency 2	F272
		Jump Frequency 2 Bandwidth	F273

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Special Controls	Jump Frequency 3	F274
		Jump 3 Frequency Bandwidth	F275
		PWM Carrier Frequency	F300
		LCD Contrast	F790
		VI/II (V/I) Input-Loss Response	F644
		VI/II (V/I) Input-Loss Detection Level	F633
		Preset Speed 14	F293
		Forced Fire-Speed	F650
		Preset Speed 15	F294
		Power Switching	F354
		Power Switching Frequency	F355
		ASD Switching Wait Time	F356
		Commercial Power Wait Time	F357
		Commercial Power Hold Time	F358
		DC Injection Braking Start Frequency	F250
		DC Injection Braking Current	F251
		DC Injection Braking Time	F252
		DC Injection On During Direction Change	F253
		Shaft Stationary	F254
		kWH Memory Selection	F748
		kWH Units Selection	F749
	Preset Speeds	Preset Speed 1	F018
		Preset Speed 2	F019
		Preset Speed 3	F020
		Preset Speed 4	F021
		Preset Speed 5	F022
		Preset Speed 6	F023
		Preset Speed 7	F024
		Preset Speed 8	F287

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Preset Speeds	Preset Speed 9	F288
		Preset Speed 10	F289
		Preset Speed 11	F290
		Preset Speed 12	F291
		Preset Speed 13	F292
		Preset Speed 14	F293
		Preset Speed 15	F294
	Protection	Dynamic Braking (Not Used)	F304
		Dynamic Braking Resistance (Not Used)	F308
		Dynamic Braking Capacity (Not Used)	F309
		Over-Current Stall Level	F601
		Over-Voltage Stall Enable	F305
		Over-Voltage Stall Level	F626
		Emergency Off Mode Selection	F603
		Emergency Off DC Injection Time	F604
		Number of Retries	F303
		Speed Search Selection	F301
		Ridethrough Mode	F302
		Ridethrough Time	F310
		Under-Voltage Trip	F627
		Overload Reduction Starting Frequency	F606
		Soft Stall Selection	F017
		Trip Save	F602
		Cooling Fan Control	F620
		Run-Time Alarm Setting	F621
		Output Phase Loss	F605
		Low-Current Trip	F610
		Low-Current Setting	F611

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Protection	Low-Current Time	F612
		Low-Current Detect Hysteresis Width	F609
		Abnormal Speed Time	F622
		Overspeed Frequency	F623
		Speed Drop Frequency	F624
		Short Circuit Test	F613
		Over-Torque Trip	F615
		Over-Torque Level (Positive Torque)	F616
		Over-Torque Level (Negative Torque)	F617
		Over-Torque Detection Time	F618
		Over-Torque Detection Hysteresis	F619
		Input Phase Loss	F608
		Adding Input Selection	F660
		Multiplying Input Selection	F661
		PM Current Level	F640
		PM Current Time	F641
	Feedback Settings	PID Switching	F359
		Input Feedback Selection	F360
		Delay Filter	F361
		Proportional Gain	F362
		Integral Gain	F363
		Upper Deviation Limit	F364
		Lower Deviation Limit	F365
		Differential Gain	F366
		Process Upper-Limit	F367
		Process Lower-Limit	F368
		PID Wait Time	F369
		PID Output Upper-Limit	F370
		PID Output Lower-Limit	F371

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Feedback Settings	Process Increasing Rate	F372
		Process Decreasing Rate	F373
	Communication Settings	ASD Number	F802
		2-Wire Baud Rate	F800
		4-Wire Baud Rate	F820
		Parity (RS485 2- and 4-Wire)	F801
		Time Out Time (RS485 2- and 4-Wire)	F803
		Time-Out Action (RS485 2- and 4-Wire)	F804
		Send Wait Time (2-Wire)	F805
		Send Wait Time (4-Wire)	F825
		ASD-to-ASD Comm. (RS485 2-Wire)	F806
		ASD-to-ASD Comm. (RS485 4-Wire)	F826
		Communication Reference Selection	F810
		Communication Reference 1	F811
		Communication Frequency 1	F812
		Communication Reference 2	F813
		Communication Frequency 2	F814
		Network Reset	F899
	AM/FM	FM Assignment	F005
		FM Adjustment	F006
		FM Output Gradient Characteristic	F682
		FM Bias Adjustment	F683
		FM Voltage/Current Output Switching	F681
		AM Assignment	F670
		AM Adjustment	F671
		AM Output Gradient Characteristic	F685
		AM Bias Adjustment	F686
	Utility Group	Type Reset	F007
		Command Mode	F003

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Utility Group	Frequency Mode 1	F004
		PWM Carrier Frequency	F300
		Panel Frequency Lockout	F730
		CPU Version	N/A
		CPU Revision	
		MC Version	
		MC Revision	
		Control EEPROM Version	
		ASD Typeform	
		Frequency Multiplier	F702
		User Unit Type	F703
		Units for Voltage/Current	F701
		User Units Selection	F092
	Motor Settings	Base Frequency 1	F014
		Base Voltage 1	F409
		Torque Boost 1	F016
		Electronic Thermal Protection 1	F600
		Base Frequency 2	F170
		Base Voltage 2	F171
		Torque Boost 2	F172
		Electronic Thermal Protection 2	F173
		Autotune Control	F400
		Motor Slip Gain	F401
		Autotuning Control 2	F402
		Motor Rated Capacity	F405
		Motor Rated Current	F406
		Motor Rated RPM	F407
		Motor Constant 1	F410

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Motor Settings	Motor Constant 2	F411
		Motor Constant 3	F412
		Motor Constant 4	F413
	Frequency Settings	Reference Priority Selection	F200
		Frequency Mode 2	F207
		Mode 1/Mode 2 Switching Frequency	F208
		VI/II (V/I) Reference 1	F201
		VI/II (V/I) Frequency 1	F202
		VI/II (V/I) Reference 2	F203
		VI/II (V/I) Frequency 2	F204
		VI/II (V/I) Torque Reference 1	F205
		VI/II (V/I) Torque Reference 2	F206
		RR Reference 1	F210
		RR Frequency 1	F211
		RR Reference 2	F212
		RR Frequency 2	F213
		RR Torque Reference 1	F214
		RR Torque Reference 2	F215
		RX Reference 1	F216
		RX Frequency 1	F217
		RX Reference 2	F218
		RX Frequency 2	F219
		RX Torque Reference 1	F220
		RX Torque Reference 2	F221
		RX2 Reference 1	F222
		RX2 Frequency 1	F223
		RX2 Reference 2	F224
		RX2 Frequency 2	F225
		BIN Reference 1	F228

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	Frequency Settings	BIN Frequency 1	F229
		BIN Reference 2	F230
		BIN Frequency 2	F231
		PG Reference 1	F234
		PG Frequency 1	F235
		PG Reference 2	F236
		PG Frequency 2	F237
		Jog Run Frequency	F260
		Jog Stop Control	F261
	My Function Unit 1	My Function Selection	F977
		Input Function Target 1	F900
		Input Function Command 1	F901
		Input Function Target 2	F902
		Input Function Command 2	F903
		Input Function Target 3	F904
		Output Function Assigned	F905
	My Function Unit 2	Input Function Target 1	F906
		Input Function Command 1	F907
		Input Function Target 2	F908
		Input Function Command 2	F909
		Input Function Target 3	F910
		Output Function Assigned	F911
	My Function Unit 3	Input Function Target 1	F912
		Input Function Command 1	F913
		Input Function Target 2	F914
		Input Function Command 2	F915
		Input Function Target 3	F916
		Output Function Assigned	F917
	My Function Unit 4	Input Function Target 1	F935

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	My Function Unit 4	Input Function Command 1	F936
		Input Function Target 2	F937
		Input Function Command 2	F938
		Input Function Target 3	F939
		Output Function Assigned	F940
	My Function Unit 5	Input Function Target 1	F941
		Input Function Command 1	F942
		Input Function Target 2	F943
		Input Function Command 2	F944
		Input Function Target 3	F945
		Output Function Assigned	F946
	My Function Unit 6	Input Function Target 1	F947
		Input Function Command 1	F948
		Input Function Target 2	F949
		Input Function Command 2	F950
		Input Function Target 3	F951
		Output Function Assigned	F952
	My Function Unit 7	Input Function Target 1	F953
		Input Function Command 1	F954
		Input Function Target 2	F955
		Input Function Command 2	F956
		Input Function Target 3	F957
		Output Function Assigned	F958
	My Function Data	My Function Percent Data 1	F918
		My Function Percent Data 2	F919
		My Function Percent Data 3	F920
		My Function Percent Data 4	F921
		My Function Percent Data 5	F922

Program Mode Menu Navigation			
Primary Menu	**Sub Menu**	**Parameter Name**	**Parameter Number**
PROGRAM	My Function Data	My Function Frequency Data 1	F923
		My Function Frequency Data 2	F924
		My Function Frequency Data 3	F925
		My Function Frequency Data 4	F926
		My Function Frequency Data 5	F927
		My Function Time Data 1	F928
		My Function Time Data 2	F929
		My Function Time Data 3	F930
		My Function Time Data 4	F931
		My Function Time Data 5	F932
		My Function Count Data 1	F933
		My Function Count Data 2	F934
	My Function Analog	Input Target 11	F959
		Assigned Object 11	F961
		Input Target 21	F962
		Assigned Object 21	F964
	My Function Monitor	Output Function 11	F965
		Output Command 11	F966
		Output Function 21	F967
		Output Command 21	F968
		Output Function 31	F969
		Output Command 31	F970
		Output Function 41	F971
		Output Command 41	F972
MONITOR	Read-Only (See Monitor Mode on pg. 29).		N/A

System Operation

Operation (Local)

To run the motor perform the following steps:

1. Press the **Mode** key until the **Frequency Command** screen is displayed.
2. Press the **Local/Remote** key to enter the **Local** mode (Local LED is illuminated).
3. Use the **Rotary Encoder** to set the desired running speed.

Frequency Command Screen.

Note: *Ensure that there are no personnel around or near the motor or the motor-driven equipment.*

4. Press the **Run** key (green **Run** LED illuminates red) and the motor runs at the **Frequency Command** value set at step 3.

Note: *The speed of the motor may be changed while the motor is running by using the Rotary Encoder to change the **Frequency Command** value.*

5. Press the **Stop-Reset** key to stop the motor.

Default Setting Changes

To change a parameter setting from the keypad, go to the **Program** menu by pressing the **Mode** key until **Program** is displayed.

From the **Program** menu turn the **Rotary Encoder** until the desired parameter group is displayed. Press the **Rotary Encoder** to access the sub-menu items — repeat as required until reaching the parameter to be changed.

Once a parameter setting is displayed, press the **Rotary Encoder** to enter the **Edit** mode (parameter title flashes). Turn the **Rotary Encoder** to change the parameter setting.

While still in the **Edit** mode, press **ESC** or the **Mode** key to exit the menu without saving the change, or press the **Rotary Encoder** to accept and save the changed setting.

Note: *Some parameters use the unsaved changed value until the ASD is Reset or powered off (e.g., Frequency Command, Accel/Decel, etc.).*

Turn the **Rotary Encoder** to repeatedly loop through the complete listing of sub-menu items for a given **Program Menu** group.

For a complete listing of the **Program** menu items see the section titled Program Mode Menu Navigation on pg. 31. The menu items are mapped for convenience.

From any menu, press the **Mode** key to return to the root menu. Repeated **Mode** key entries loop the system through the root menus as shown in Figure 22 on pg. 27.

Search (For Default Setting Changes)

A listing of all parameters that have been changed from the factory default settings may be viewed sequentially by accessing the **Search** screen (Program ⇒ **Search**).

The **Search** feature allows the user to view (and/or change) the parameters that are different from the factory default settings. From the **Search** screen, press the **Rotary Encoder** to start the **Search** function. Once started, the system automatically scrolls through all of the system parameters and halts once reaching a changed parameter.

After stopping at a changed parameter, the **Rotary Encoder** may be clicked either clockwise or counter-clockwise once to continue scrolling either forward or reverse, respectively. With each **Up** or **Down** click from a stop, the system scrolls and stops at the next parameter that has been changed.

Press the **Rotary Encoder** once while the system is halted at a changed parameter to enter the **Edit** mode (parameter title flashes). Turn the **Rotary Encoder** to change the setting.

While still in the **Edit** mode, press the **Mode** key to exit the **Search** function without saving the change, press the **ESC** key to return to the **Search** mode, or press the **Rotary Encoder** to accept and save the new setting.

Note: *Some parameters use the unsaved changed value until the ASD is reset or powered off (e.g., Frequency Command, Accel/Decel, etc.).*

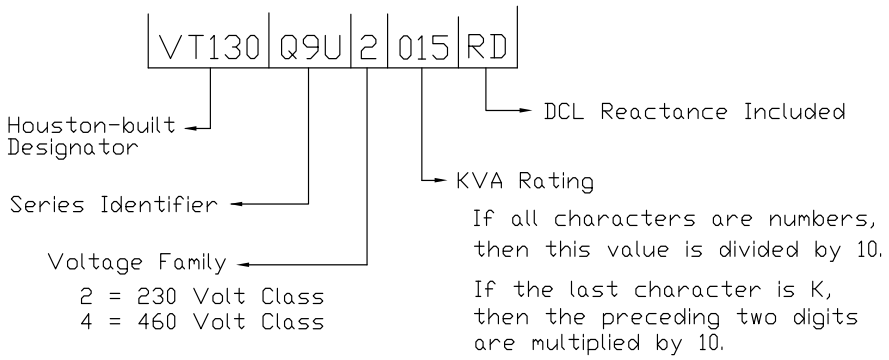
Pressing the **Mode** key when done searching or when halted at a changed parameter returns the system to the primary menu loop.

Enclosure Dimensions

The part numbering convention and the enclosure dimensions for the available models (typeforms) are listed below.

Use the part numbering convention to identify the ASD typeform and for placing orders.

Q9 Part Numbering Convention.



Note: *The Type 1 enclosed versions of these drives meet or exceed the specification* ***UL 50-1995****, the* ***Standard for Heating and Cooling Equipment****, and complies with the applicable requirements for installation in a compartment handling conditioned air.*

Note: *All Toshiba ASD enclosures carry an IP20 rating.*

Enclosure Dimensions

Table 3. 230-Volt Q9 ASD Systems.

Frame	ASD HP Rating	Model No. VT130Q9U	Enclosure Figure Number	A Width (in/mm)	B Height (in/mm)	C Depth (in/mm)	Mounting Hole Dimensions (in/mm)						
							D	E	F	G	H	R1	R2
2	1	2015	Figure 23	5.1/130	10.0/254	6.0/152	8.7/220	4.5/114	N/A			0.098/2.5	0.217/5.5
	2	2025											
3	3	2035		6.1/155	11.1/281	6.5/164	9.8/249	5.4/138					
	5	2055											
4	7.5	2080		6.9/175	12.6/320		11.1/283	6.2/158					0.236/6.0
5A	10	2110		8.3/210		7.6/194		7.5/190				0.118/3.0	0.276/7.0
5B	15	2160		9.1/230	16.7/425	7.5/191	15.2/386	8.3/210					
	20	2220											
6	25	2270	Figure 24	9.4/240	16.5/420	8.3/212	15.9/403	8.1/206					0.295/7.5
	30	2330											
7B	40	2400		12.6/320	21.7/550	9.5/242	20.7/525	11.0/280				0.177/4.5	0.394/10
	50	2500											
	60	2600											
9	75	2750	Figure 26	12.2/310	26.7/680	14.6/370	25.6/650	9.8/250				0.224/5.7	0.472/12
	100	210K											
10	125	212K		13.8/350	30.8/782		29.8/758	11.7/298					
9	75	2750RD		12.2/310	36.2/920		25.6/650	9.8/250	5.9/150	3.0/75	9.5/240		
	100	210KRD											
10	125	212KRD		13.8/350	40.2/1022		29.8/758	11.7/298		2.8/72			

RD suffix = DCL included.

Table 4. 460-Volt Q9 ASD Systems.

Frame	ASD HP Rating	Model Number VT130Q9U	Enclosure Figure Number	A Width (in/mm)	B Height (in/mm)	C Depth (in/mm)	Mounting Hole Dimensions (in/mm)						
							D	E	F	G	H	R1	R2
2	1	4015	Figure 23	5.1/130	10.0/254	6.0/152	8.7/220	4.5/114	N/A			0.098/2.5	0.217/5.5
	2	4025											
	3	4035											
3	5	4055		6.1/155	11.1/281	6.5/164	9.8/249	5.4/138					
	7.5	4080											
4	10	4110		6.9/175	12.6/320		11.1/283	6.2/158					0.236/6.0
5A	15	4160		8.3/210		7.6/194		7.5/190					0.276/7.0
	20	4220											
5B	25	4270	Figure 24	9.1/230	16.7/425	7.5/191	15.2/386	8.3/210				0.118/3.0	
	30	4330											
6	40	4400		9.4/240	16.5/420	8.3/212	15.9/403	8.1/206					0.295/7.5
7A	50	4500	Figure 25		21.7/550	9.5/242	20.8/529						
	60	4600											
8	75	4750		12.6/320	24.8/630	11.4/290	23.8/605	11.0/280				0.177/4.5	0.394/10
	100	410K											
	125	412K											
9	150	*415K	Figure 26	12.2/310	26.8/680	14.6/370	25.6/650	9.8/250				0.224/5.7	0.472/12
10	200	*420K		13.8/350	30.8/782		29.8/758	11.7/298					
11	250	*425K		13.0/334	37.4/950		36.2/920	11.2/285					
12	300	*430K		16.9/430				13.8/350					
	350	*435K											
13	400	*440K		23.0/585				21.3/540					
9	150	415KRD		12.2/310	26.8/680		25.6/650	9.8/250	5.9/150	3.0/75	9.5/240		
10	200	420KRD		13.8/350	30.8/782		29.8/758	11.7/298		2.8/72			
11	250	425KRD		13.0/334	37.4/950		36.2/920	11.2/285		3.0/75			
12	300	430KRD		16.9/430				13.8/350					
	350	435KRD											
13	400	440KRD		23.0/585				21.3/540					

* = Reactance NOT included; but, required (ACL or DCL).

RD suffix = DCL included.

Figure 23. See Table 3 and 4 for Actual Dimensions.

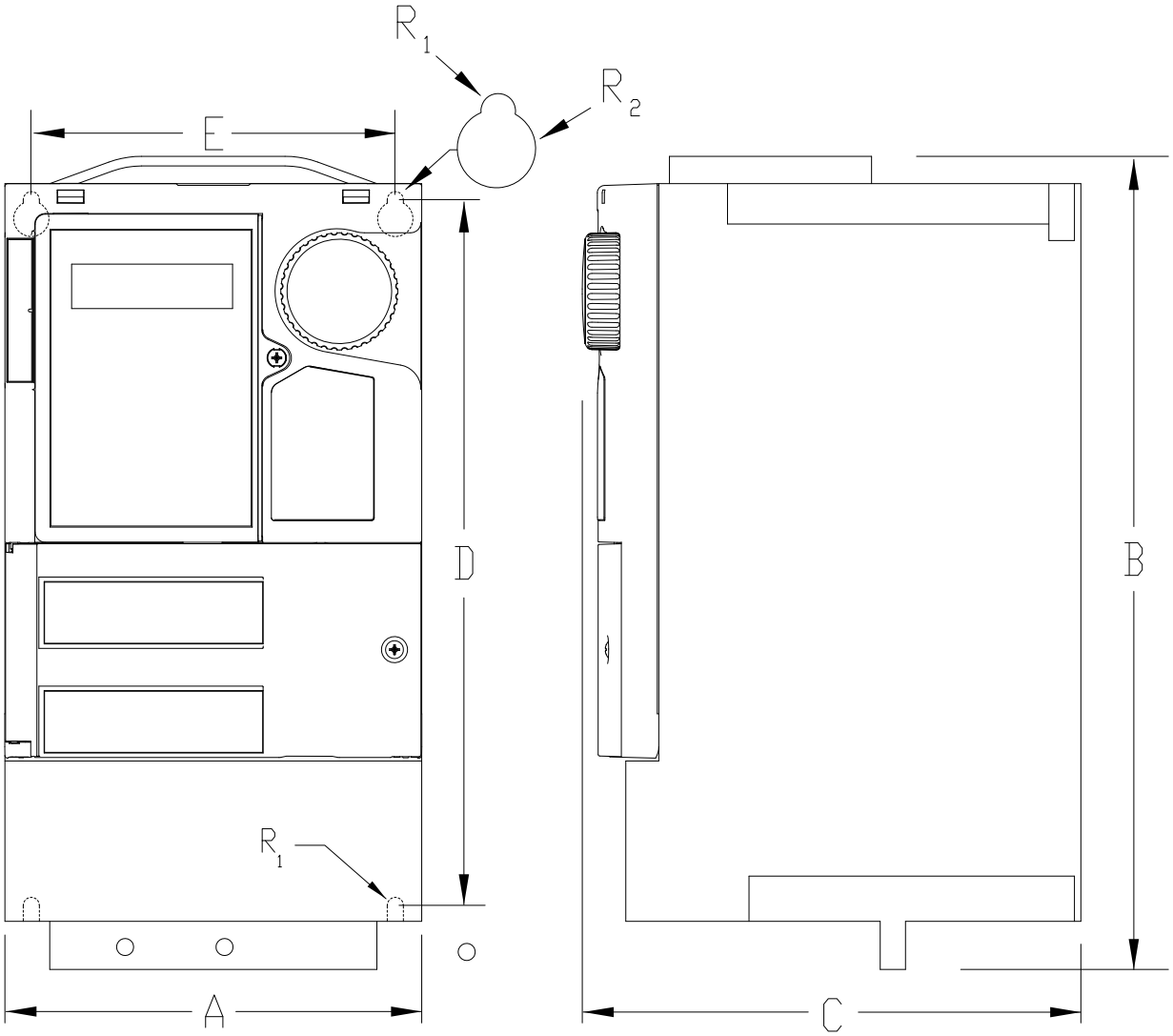


Figure 24. See Table 3 and 4 for Actual Dimensions.

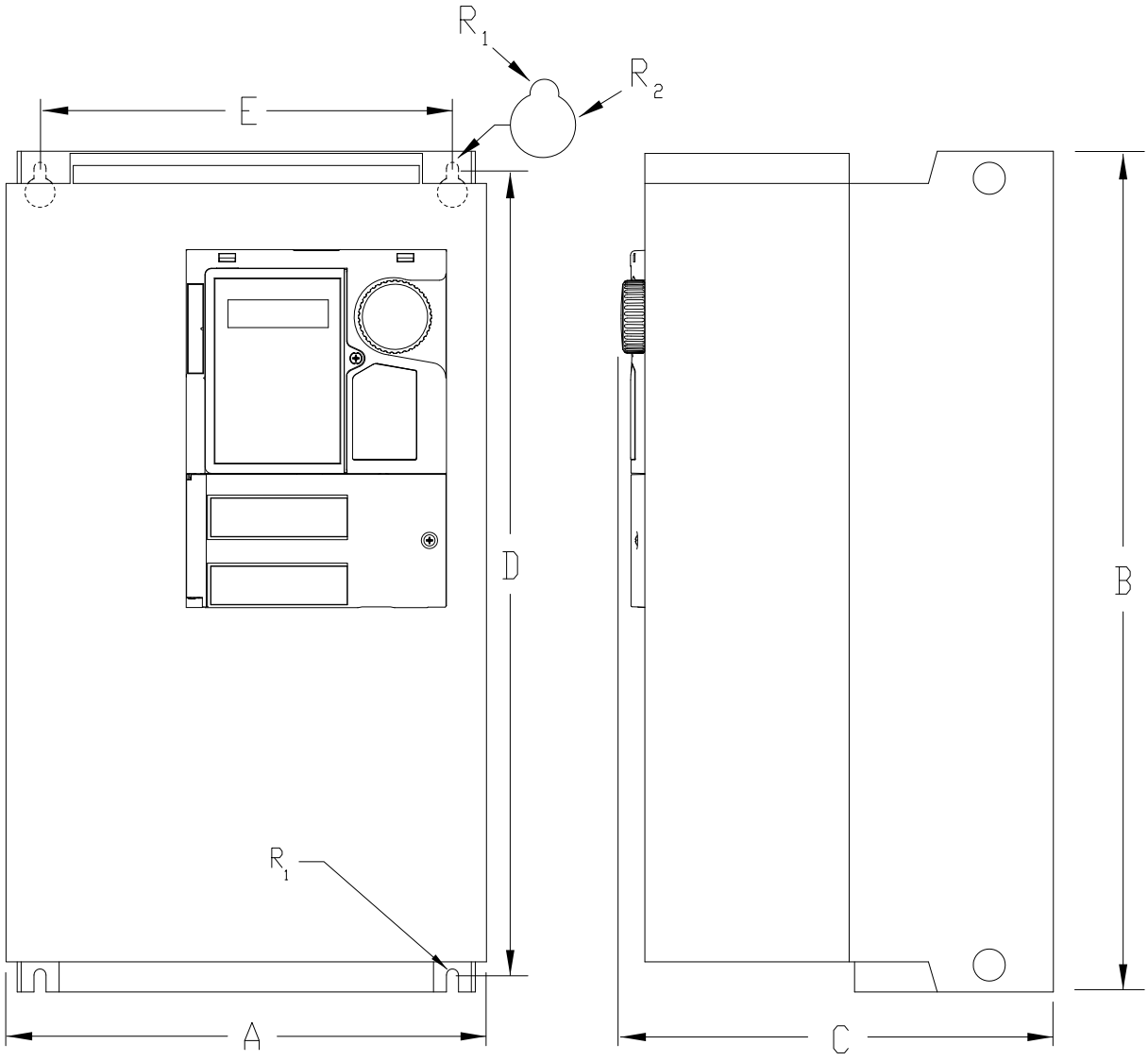


Figure 25. See Table 4 for Actual Dimensions.

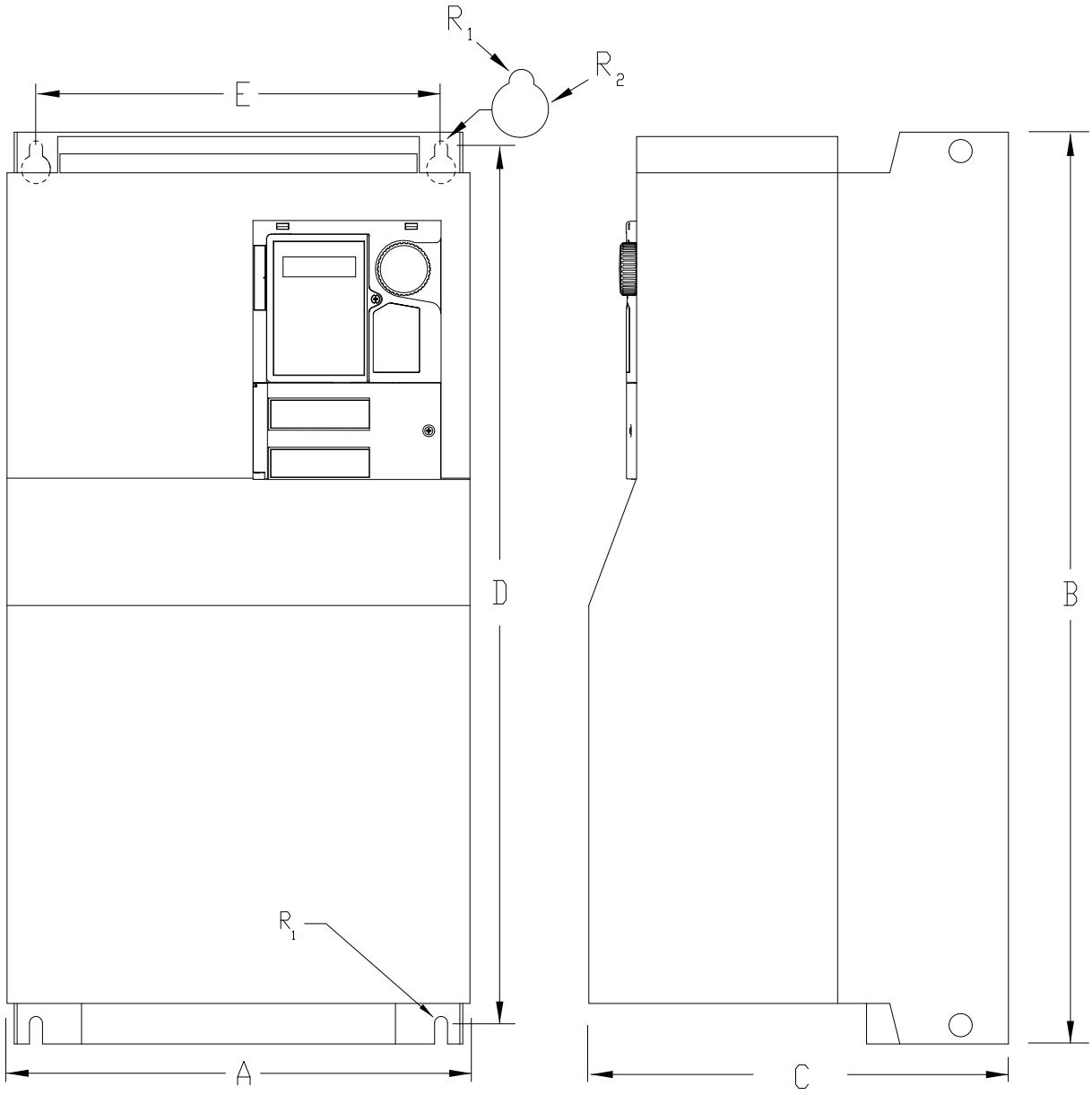
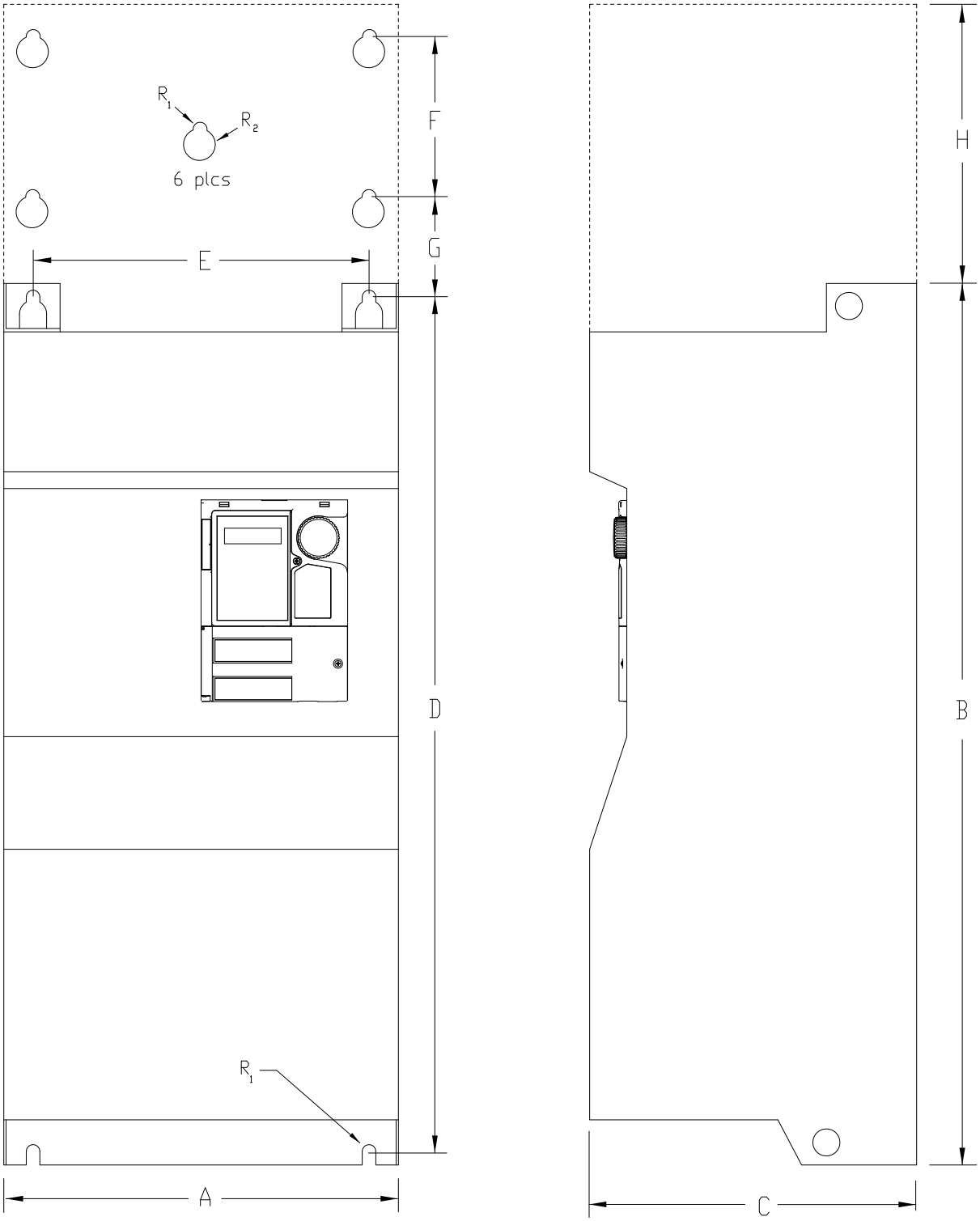


Figure 26. See Table 3 and 4 for Actual Dimensions.



Current/Voltage Specifications

Table 5. 230-Volt UL Type-1/IP-20 Chassis Standard Ratings Table.

Model Number VT130Q9U	100% Output Current Continuous	Overload Current 110% for 60 Seconds	Input Voltage 3-Ph 50/60 ±2 Hz	Output Voltage 3-Ph Variable Frequency	Typical Motor HP
2010	3.7 A	4.1 A	200–240 VAC (±10%)	Input Voltage Level (Max.)	0.75
2015	4.8 A	5.3 A			1.0
2025	7.8 A	8.6 A			2.0
2035	11.0 A	12.1 A			3.0
2055	17.5A	19.3 A			5.0
2080	25.3 A	27.8 A			7.5
2110	32.2 A	35.4 A			10
2160	48.3 A	53.1 A			15
2220	62.1 A	68.3 A			20
2270	78.2 A	86.0 A			25
2330	92.0 A	101 A			30
2400	120 A	132 A			40
2500	150 A	165 A			50
2600	177 A	195 A			60

Table 6. 460-Volt UL Type-1/IP-20 Chassis Standard Ratings Table.

Model Number VT130Q9U	100% Output Current Continuous	Overload Current 110% for 60 Seconds	Input Voltage 3-Ph 50/60 ±2 Hz	Output Voltage 3-Ph Variable Frequency	Typical Motor HP
4015	2.1 A	2.3 A	380 – 480 VAC (±10%)	Input Voltage Level (Max.)	1.0
4025	3.4 A	3.7 A			2.0
4035	4.8 A	5.3 A			3.0
4055	7.6 A	8.4 A			5.0
4080	11.0 A	12.1 A			7.5
4110	14.0 A	15.4 A			10
4160	21.0 A	23.1 A			15
4220	27.0 A	29.7 A			20
4270	34.0 A	37.4 A			25
4330	40.0 A	44.0 A			30
4400	52.0 A	57.2 A			40
4500	65.0 A	71.5 A			50
4600	77.0 A	84.7 A			60
4750	96.0 A	106 A			75
410K	124 A	136 A			100
412K	156 A	172 A			125
415K	180 A	198 A			150
420K	240 A	264 A			200
425K	302 A	332 A			250
430K	361 A	397 A			300
435K	414 A	455 A			350
440K	477 A	525 A			400

Cable/Terminal Specifications

Installation should conform to the 2008 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.

Note: *The following ratings are guidelines and shall not be the sole determining factor of the lug or wire size used with the ASD. Application-specific applicables, wire insulation type, conductor material, and local and regional regulations are but a few of the considerations when selecting the actual lug and wire type to be used with the ASD.*

Note: *Cable/Terminal specifications are based on the rated current of the Q9 ASD and **DO NOT** include the 10% Service Factor.*

Note: *Use only 75° C copper wire/cable for motor and power connections.*

Table 7. 230-Volt Q9 ASD Cable/Terminal/Torque Specifications.

Model Number VT130Q9U	Wire/Cable Size		Lug Size Range		Terminal Board Wire Size	Torque	
	AWG or kcmil						
	Input/Output Power		Wire-Size/Lug-Capacity for Input/Output Power		In-Lbs./N·m		
	Recommended	Maximum	3Ø-Input	3Ø-Output	TB1 – 4 Terminals	3Ø-Input	3Ø-Output
2010	14	10	14 to 10		20 (3-core shield) Torque to 5.3/0.6	12.4/1.4	
2015	14	10					
2025	14	10					
2035	14	10					
2055	10	10					
2080	8	8	12 to 8			26.6/3	
2110	8	8	10 to 4				
2160	6	3	8 to 2			47.8/5.4	
2220	4	3					
2270	3	3	4 to 1/0			212/24	
2330	2	2					
2400	1/0	4/0	2 to 300			360/41	
2500	2/0	4/0					
2600	4/0	4/0					

Table 8. 460-Volt Q9 ASD Cable/Terminal/Torque Specifications.

Model Number VT130Q9U	Wire/Cable Size		Lug Size Range		Terminal Board Wire Size	Torque	
	AWG or kcmil						
	Input/Output Power		Wire-Size/Lug-Capacity for Input/Output Power		In-Lbs./N·m		
	Recommended	Maximum	3Ø-Input	3Ø-Output	TB1 – 4 Terminals	3Ø-Input	3Ø-Output
4015	14	10	14 to 10		20 (3-core shield) Torque to 5.3/0.6	12.4/1.4	
4025	14	10					
4035	14	10					
4055	14	10					
4080	14	10					
4110	12	8	12 to 8			26.6/3	
4160	8	4	10 to 4				
4220	8	4					
4270	6	3	8 to 2			47.8/5.4	
4330	6	3					
4400	6	2	4 to 1/0			212/24	
4500	4	2					
4600	3	2					
4750	1	4/0	2 to 300			360/41	
410K	1/0	4/0					
412K	3/0	4/0					
415K	*1	*4/0	6 to 250			212/24	
420K	*2/0	*250					
425K	*4/0	*250					
430K	*300	*350	4 to 350			360/41	
435K	*350	*350					
440K	**250	**350					

Note: *(*) Indicates that the item is one of a set of two (listed type) parallel cables.*

Note: *(**) Indicates that the item is one of a set of three (listed type) parallel cables.*

Short Circuit Protection Recommendations

Table 9. 230/240 and 400/480-Volt ASD Recommended Circuit Breaker Selection.

Model Number VT130Q9U	HP	Continuous Output Current (Amps)	Circuit Breaker Part Number
2010	0.75	3.7	Contact Toshiba Customer Service
2015	1.0	4.8	Contact Toshiba Customer Service
2025	2.0	7.8	Contact Toshiba Customer Service
2035	3.0	11.0	HLL36025
2055	5.0	17.5	HLL36025
2080	7.5	25.3	HLL36040
2110	10	32.2	HLL36050
2160	15	48.3	HLL36070
2220	20	62.1	HLL36090
2270	25	78.2	HLL36100
2330	30	92.0	HLL36100
2400	40	120	HLL36125
2500	50	150	HLL36150
2600	60	177	JLL36200
4015	1.0	2.1	Contact Toshiba Customer Service
4025	2.0	3.4	Contact Toshiba Customer Service
4035	3.0	4.8	Contact Toshiba Customer Service
4055	5.0	7.6	HLL36025
4080	7.5	11	HLL36040
4110	10	14	HLL36050
4160	15	21	HLL36070
4220	20	27	HLL36090
4270	25	34	HLL36100
4330	30	40	HLL36100
4400	40	52	HLL36125
4500	50	65	HLL36150
4600	60	77	JLL36200
4750	75	96	JLL36225
410K	100	124	JLL36250
412K	125	156	LIL36300
415K	150	180	LIL36300
420K	200	240	LIL36400
425K	250	302	LIL36400
430K	300	361	Contact Toshiba Customer Service
435K	350	414	Contact Toshiba Customer Service
440K	400	477	Contact Toshiba Customer Service

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