EQ5 SERIES
Quick Start Guide
for Constant Torque Applications

TECO ⊛ Westinghouse

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EQ5 Drive Quick Start Guide for Constant Torque Applications

Contents

EQ5 Drive Quick Start Guide for Constant Torque Applications

Introduction

This Quick Start Guide is a supplement to other documentation supplied with this equipment and will help the user in properly wiring the EQ5 and motor. This Quick Start guide is for use with installing and setting up the EQ5 drive for Industrial Applications (Constant torque, such as Conveyor belts, Extruders, Punch Press, etc…)

⚠️ ***Warning / Danger: Improper wiring can and will cause bodily harm as well as damage to the equipment***

When installing the system be sure to follow good wiring practices and all applicable codes. Ensure that the mounting of the various components are secure and that the environment, such as extreme dampness, poor ventilation etc. will not cause system degradation.

Please read this quick start guide in combination with the EQ5 Operations Manual (Document No. TWMC-EQ5OM provided with the EQ5 thoroughly before attempting any installation.

EQ5 Drive Quick Start Guide for Constant Torque Applications

1. EQ5 Model Identification and Mounting

It is essential to verify the EQ5 drive nameplate and make sure that the EQ5 drive has the correct rating so it can be used with your motor. Please check the EQ5 nameplate information as shown in the example below.

Model No.	EQ5-2020-N1	
Serial No.	89A735A0001	

Input		Output Variable Torque	Output Constant Torque
Volts	200-230	20 HP	15
Amps	70	200-230 Volts	200-230
Freq(Hz)	50/60	0.1-120 Freq Range(Hz)	0.1-120
Phase(s)	3	55 Amps	46
		110% Overload(1min)	150%
		SCCR	100kA

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Made in Japan

- Check that the input voltage range meets the ***input power*** requirements.

- Ensure that the ***Constant Torque FLA and Output Voltage*** rating on the EQ5 drive label meets the motor requirements (nameplate).

1.2 Mounting

Mounting of the EQ5 drive is extremely important for accessibility as well as for the environment. Various EQ5 drive models are available and the mounting dimensions (footprint) may be different. Because the mounting procedure is fairly extensive, it is beyond the scope of this document, the user is referred to the EQ5 Operations Manual (Document No. TWMC-EQ5OM) received with the EQ5, ***Chapter 2 Installation and Electrical Connections***. Match the model that you received and follow the procedure described in the manual to ensure a safe and functional installation. In cases where the system has more than one EQ5 drive, refer to the proper clearances required for adequate ventilation. *Please pay particular attention to:*

- The clearances to be maintained around the enclosure for adequate ventilation.

- The environmental specifications such as avoiding excessive dampness, extreme temperatures, chemical exposure, corrosive areas etc. to avoid damage to the equipment and to maintain safety.
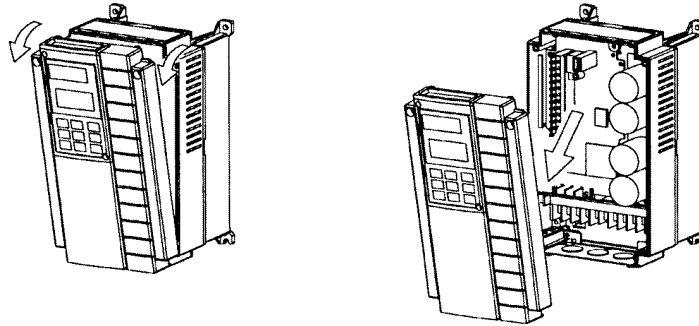
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Fig. 2 Removing the Surface Cover (for inverters rated 30HP/CT, 40HP/VT or less)

For drives rated at 40HP/CT, 50HP/VT or more, first remove the six mounting screws, then remove the cover (see Fig. 3).
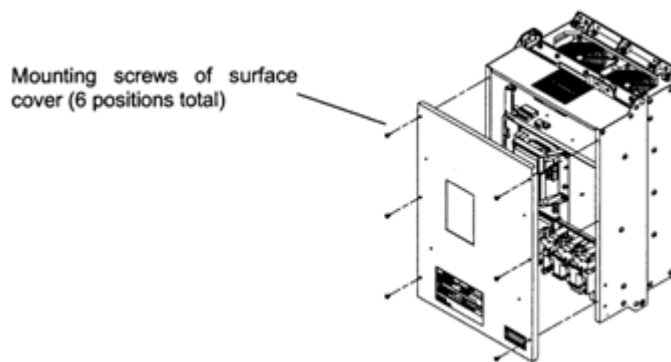
Mounting screws of surface cover (6 positions total)

Fig. 3 Removing the Surface Cover (for inverters rated 40HP/CT, 50HP/VT or more)

Removing the digital operator

After removing the cover, loosen the mounting screws of the digital operator and remove as shown in Fig.4.
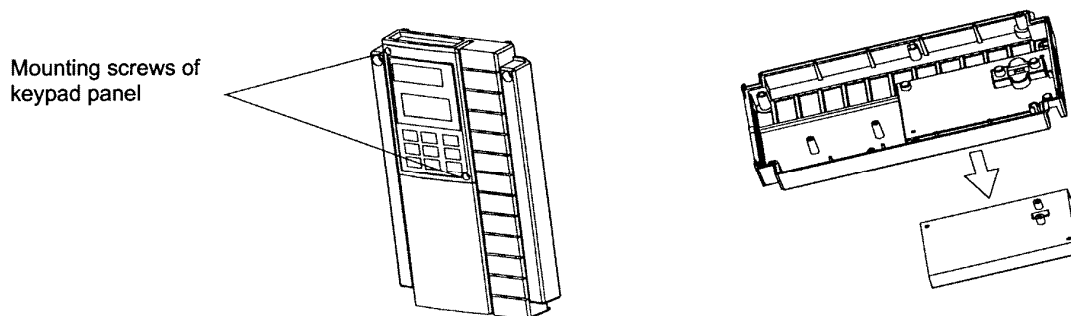
Mounting screws of keypad panel

Fig. 4 Removing the Digital Operator (30HP/CT, 40HP/VT or less)

For drives rated at 40HP/CT, 50HP/VT or above, loosen the mounting screws of the digital operator and remove using the finger holds on the digital operator case (see Fig. 5).
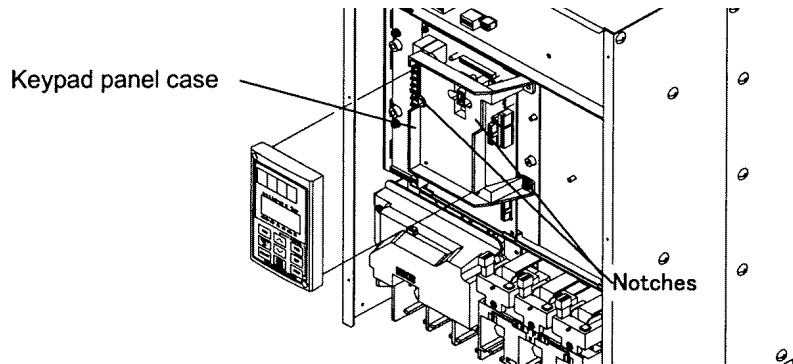

Fig. 5 Removing the Digital Operator (40HP/CT, 50HP/VT and above)

2. Input Power and Motor Connection

Fig.6 below shows the electrical connections for the input power and motor terminals for various EQ5 models. Verify the input power and motor terminals of the model you are installing. *WITH POWER OFF,* make the appropriate connections.

Make sure to follow good wiring practices and all applicable codes. Ensure that the equipment is grounded properly as shown.

 DANGER, *LETHAL VOLTAGES ARE PRESENT- Before applying power to the EQ5 Drive, ensure that the terminal cover is fastened and all wiring connections are secure. After the power has been turned OFF, wait at least five minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.*
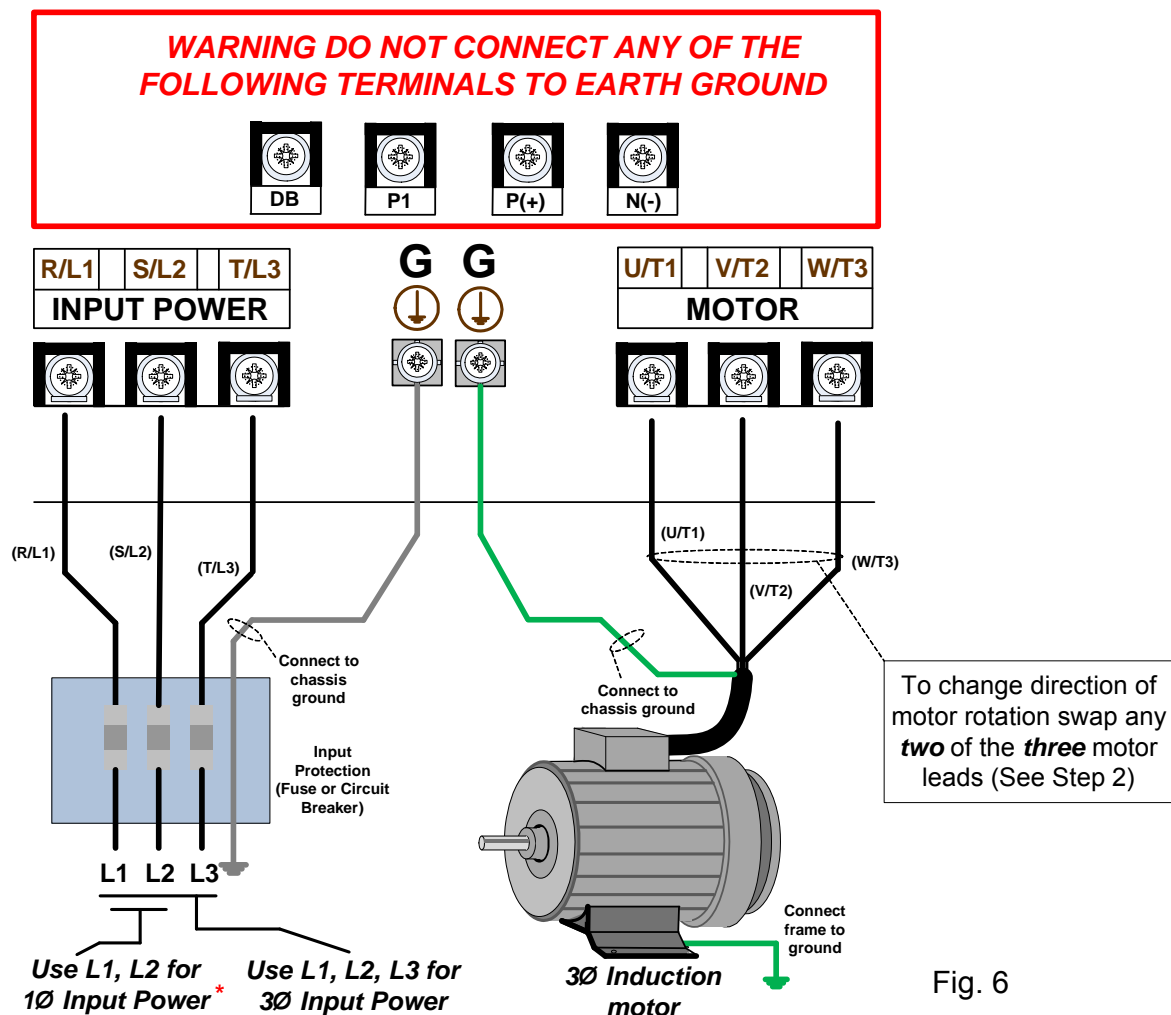

Fig. 6

 * Make sure the drive is properly sized for single phase input. (consult factory)

3. Check Motor Rotation and Direction

This test is to be performed solely from the EQ5 keypad. Apply power to the EQ5 drive after all the electrical connections have been made and protective covers have been re-attached. At this point, DO NOT RUN THE MOTOR, the keypad should display as shown below in *Fig. 3* and the speed reference *0.00* should be blinking.

Next use the [⋀] and [⋁] keys to set a speed reference of 5.00 Hz, then

press the [FWD] button.

The motor should now be operating at low speed running in forward (clockwise) direction.

Next press [STOP] on the keypad to stop the motor.

If the motor direction is incorrect, power down the EQ5 drive.

After the power has been turned OFF, wait at least five minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

Using Safety precaution, and referring to *Fig.6,* swap any **two** of the **three** output leads to the motor (U/T1, V/T2 and W/T3). After the wiring change, repeat *Step 3* and recheck motor direction.

TECO Westinghouse Motor Company   EQ5 Quick Start Guide   8

4. Speed Reference Configuration

The EQ5 offers users several choices to set the speed reference from different sources. The most commonly used methods are described in the next sections.

Frequency reference command is selected with parameter F01.

| F01 | Frequency Command 1 |

 This function selects the method by which to set the output frequency.

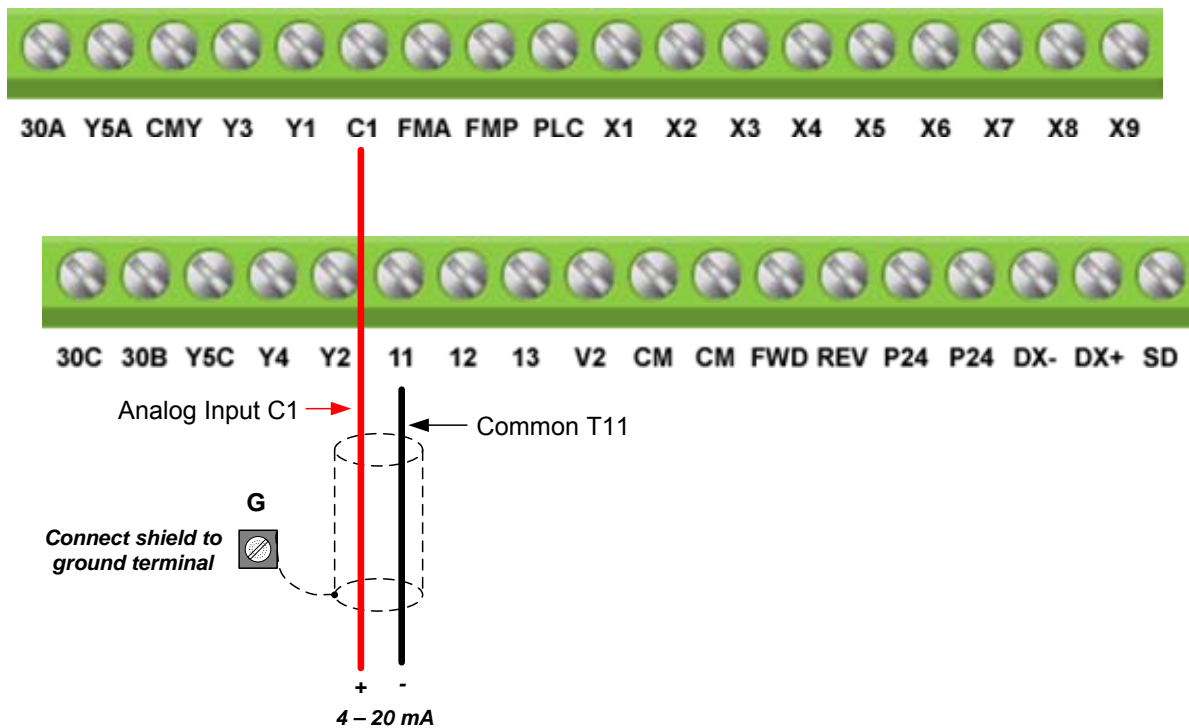| F | 0 | 1 | F | R | E | Q | | C | M | D | 1 | |

Setting Range: 0 to 11

4.1 Reference from Keypad (Default Setting, F01 = 0)

Speed reference from digital operator (Keypad) is the default setting. Use the ⌄ and ⌃ keys to change the speed reference.

4.2 Reference from External Analog Signal (0-10V / 4-20mA) (F01 = 1)

Analog Reference: 0 – 10 V

30C 30B Y5C Y4 Y2 11 12 13 V2 CM CM FWD REV P24 P24 DX- DX+ SD

Common T11 →   ← Analog Input T12

G

Connect shield to ground terminal

-   +
0 – 10 V

30A Y5A CMY Y3 Y1 C1 FMA FMP PLC X1 X2 X3 X4 X5 X6 X7 X8 X9

30C 30B Y5C Y4 Y2 11 12 13 V2 CM CM FWD REV P24 P24 DX- DX+ SD

Analog Input C1 →   ← Common T11

G

Connect shield to ground terminal

+   -
4 – 20 mA
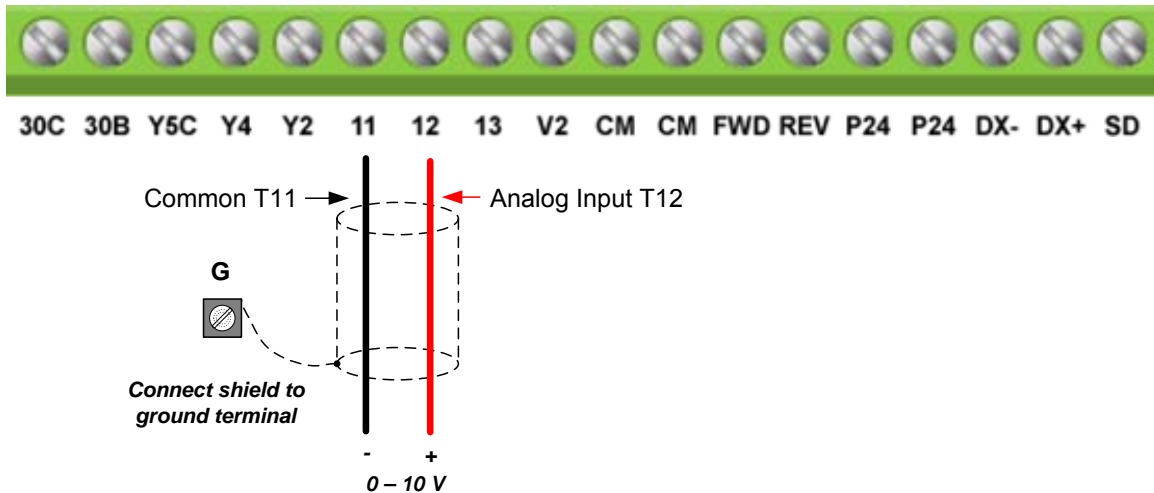
Potentiometer (Speed Pot):

Connect shield to ground terminal

**Potentiometer
1 ~ 5K Ohm**
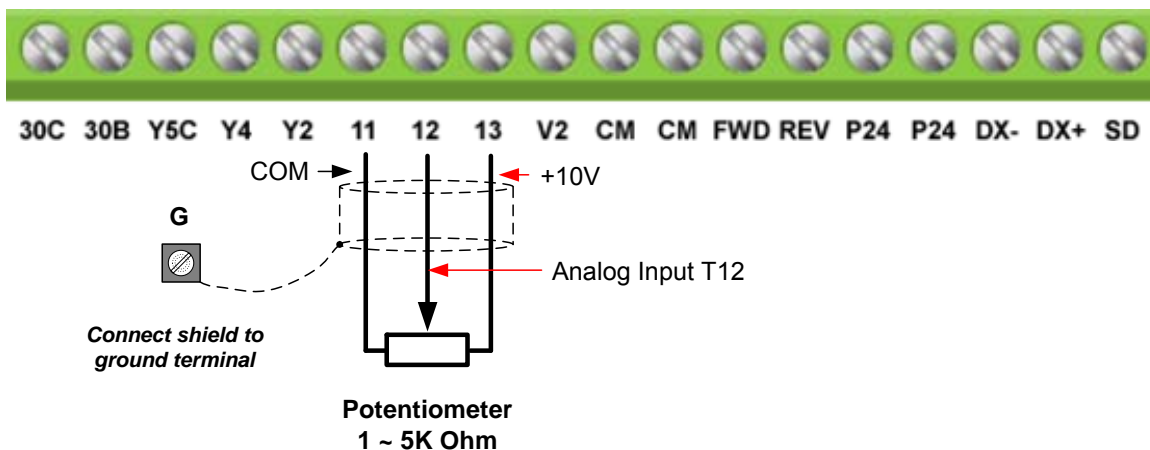
4.3 Reference from Serial Communication RS485 (H30 = 2 or 3)

RS485 PLC / Computer Connection
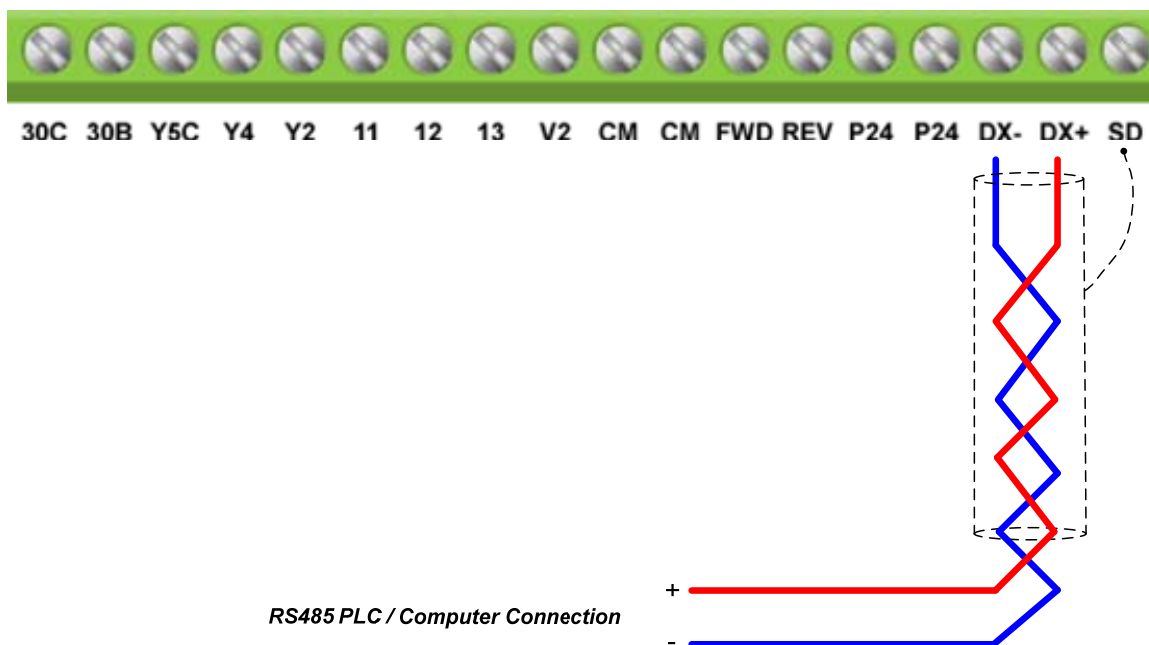
To set the speed reference for the EQ5 via serial communication parameter H30 has be set to either a "1" for frequency command via serial communication only or to "3" for Run/Stop (Operation Command) and Frequency Reference (Frequency Command).

Default Communication Setting is: Address "1", 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

| H30 | Serial link (Function Select) |

The serial comm. link function uses RS485 Modbus RTU protocol and allows for:

1) Monitoring (data monitoring, function data check).
2) Frequency setting.
3) Operation command (FWD, REV, and other commands for digital input)
4) Write function data.

| H | 3 | 0 | L | I | N | K | | F | U | N | C | |

Setting range: 0 to 3

Set value	Frequency command	Operation command
0	Disabled	Disabled
1	**Enabled**	Disabled
2	Disabled	Enabled
3	**Enabled**	Enabled

Frequency Reference Command Register

EQ5 Frequency Reference Register: 1797 (Decimal)

Bit 0 – Bit 15: 0.00 ~ 120.00 Hz

Examples:

Frequency Reference Command: 10.00 Hz (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 05 03 E8 98 01

To set the frequency reference to 10.00, a value of '1000' (03E8h) has to be send to the EQ5

Frequency Reference Command: 30.00 Hz (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 05 0B B8 9F FD

To set the frequency reference to 30.00, a value of '3000' (0BB8h) has to be send to the EQ5

Frequency Reference Command: 60.00 Hz (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 05 17 70 96 AB

To set the frequency reference to 60.00, a value of '6000' (1770h) has to be send to the EQ5

Note: The last 2 bytes of the command strings consist of a CRC16 checksum, please refer to the EQ5 Operations Manual (Document No. TWMC-EQ5OM), *chapter 8* for additional information.

5. Run / Stop Configuration

The EQ5 offers users several choices to run and stop the drive from different sources. The most commonly used methods are described in the next sections.

Run/Stop Method is selected with parameter F02.

| F02 | Operation Method |

This function sets the operation command input method.

| F | 0 | 2 | O | P | R | | M | E | T | H | O | D |

5.1 Run/Stop from Keypad (Default Setting, F02 = 0)

Run from digital operator (Keypad) is the default setting.

Use the Forward key (FWD) to run the drive in forward direction and the Reverse key (REV) to run the drive in reverse direction. (Note: to disable reverse direction set parameter H08 to 1)
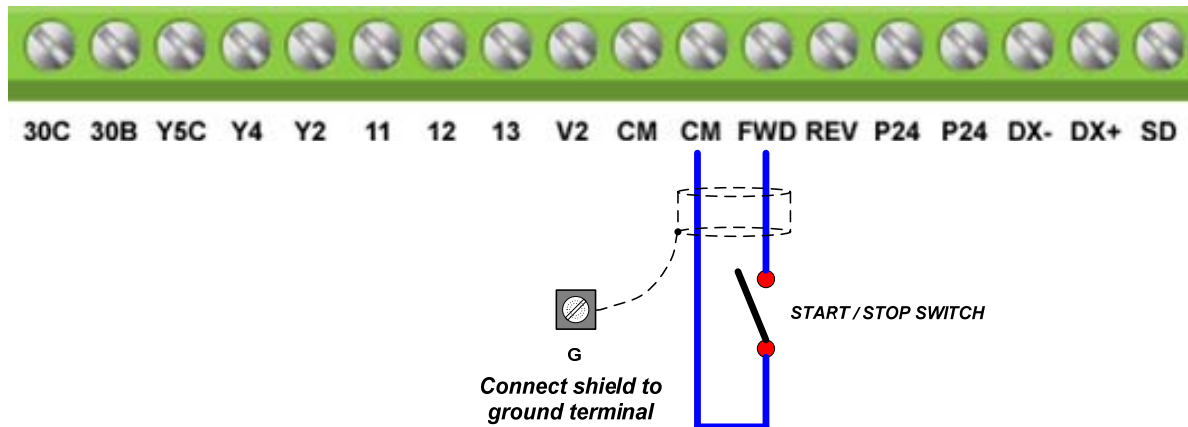
Use the Stop key (FWD) to stop the drive. (Note: Stop method can be set with parameter H07, default is *ramp to stop)*
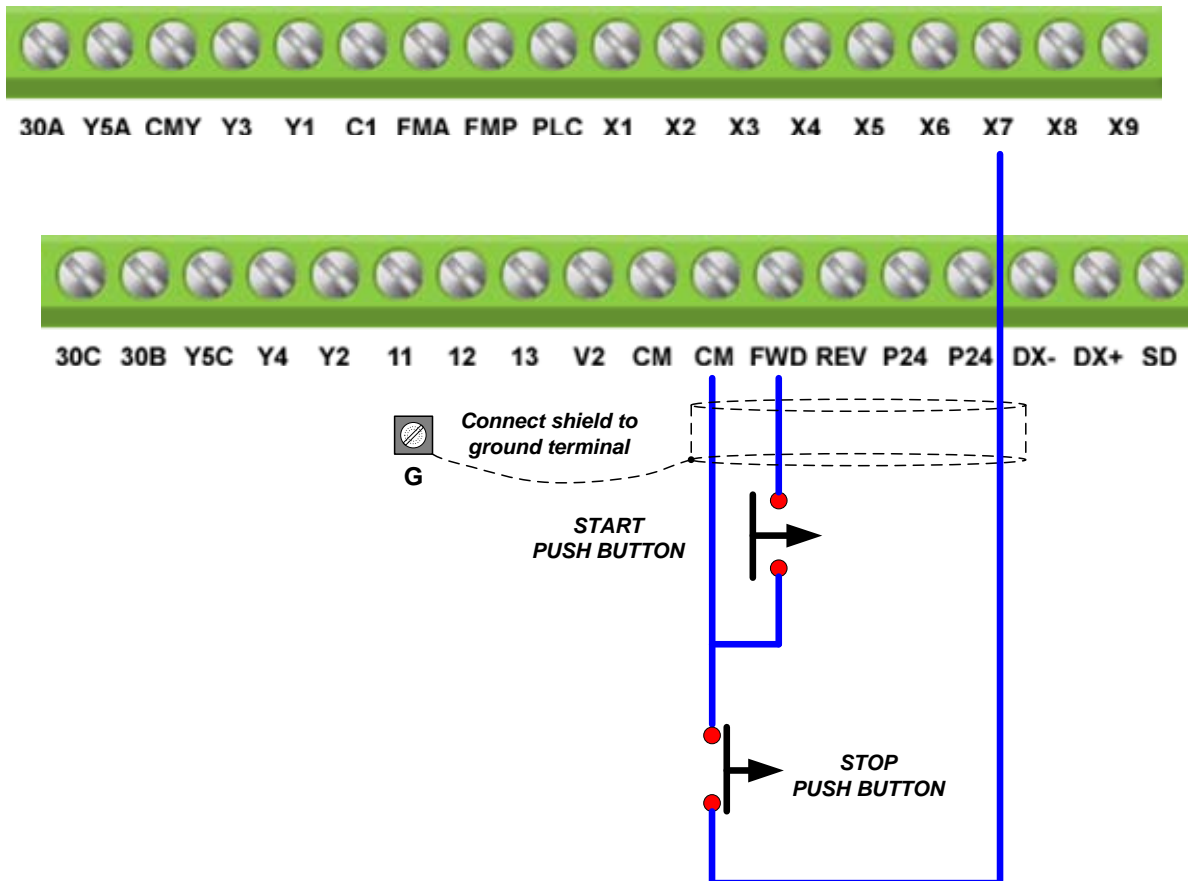
5.2 Run/Stop from External Switch / Contact or Pushbutton (F02 = 1)

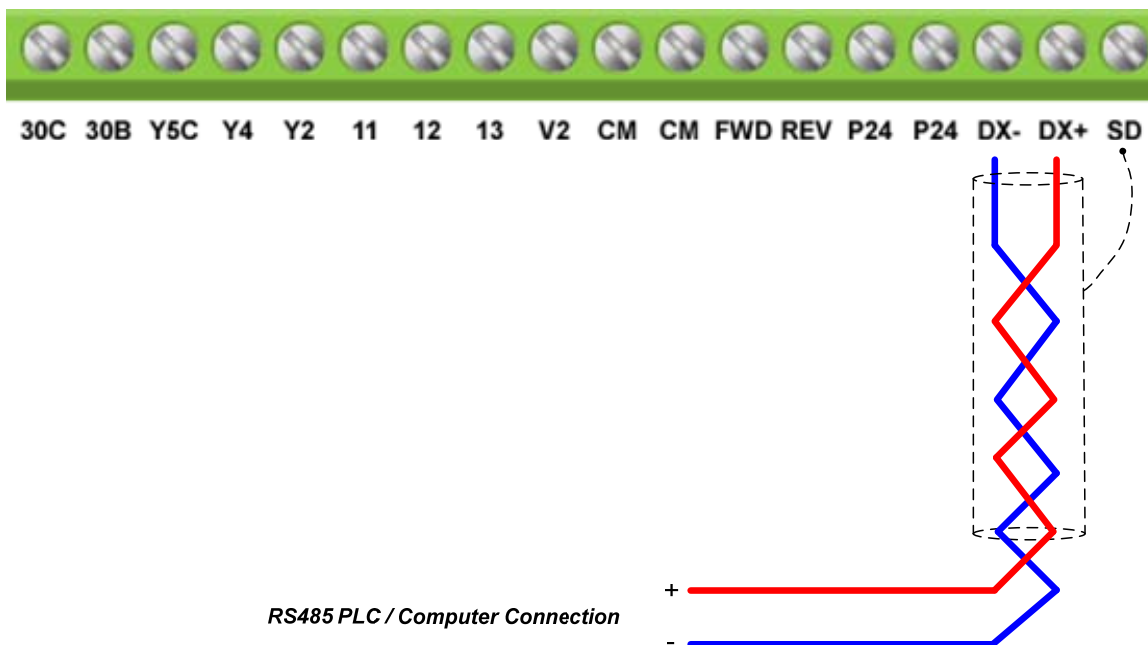Use an external contact or switch to Run and Stop drive.

Permanent Switch / Contact

Momentary Contacts (Push Buttons)

Note: Stop method can be set with parameter H07, default is *ramp to stop*.

5.3 Run/Stop from Serial Communication RS485 (H30 = 2 or 3)

RS485 PLC / Computer Connection

To Run/Stop (Operation Command) the EQ5 via serial communication parameter H30 has be set to either a "2" for Run/Stop via serial communication only or to "3" for Run/Stop (Operation Command) and Frequency Reference (Frequency Command).

Default Communication Setting is: Address "1", 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

[H30] [Serial link (Function Select)]

The serial comm. link function uses RS485 Modbus RTU protocol and allows for:
 1) Monitoring (data monitoring, function data check).
 2) Frequency setting.
 3) Operation command (FWD, REV, and other commands for digital input)
 4) Write function data.

`H 3 0 L I N K   F U N C`

Setting range: 0 to 3

Set value	Frequency command	Operation command
0	Disabled	Disabled
1	Enabled	Disabled
2	Disabled	**Enabled**
3	Enabled	**Enabled**

Command Register

EQ5 Command Register: 1798 (Decimal)

Bit 0: Run Forward
Bit 1: Run Reverse
Bit 2 ~ Bit 15: Refer to *EQ5 AC Drive Operations Manual (chapter 8)*

Examples:

Run Forward Command (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 06 00 01 A9 7F

Run Reverse Command (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 06 00 02 E9 7E

Stop Command (EQ5 Address: 01)

Command String (hexadecimal): 01 06 07 06 00 00 68 BF

Note: The last 2 bytes of the command strings consist of a CRC16 checksum, please refer to the EQ5 Operations Manual (Document No. TWMC-EQ5OM), *chapter 8* for additional information.

6. Digital Operator Panel

The Digital Operator has various functions for inputting, controlling, and displaying operations such as frequency setting, run/stop command, confirming and changing function data, confirming status, and copying. Please review and become familiar with each function before attempting to operate the drive. The Digital Operator can be removed or inserted during inverter operation, however, if it is removed during a keypad operation (e.g., run/stop, frequency setting), the inverter will stop and initiate an alarm.

6.1 Overview and Navigation

Appearance of Digital Operator

LED Monitor:
4-digit 7-segment display used to display data such as setting frequency, output frequency and alarm code.

Auxiliary Information Indication for LED Monitor:
Indicates selected units or multiple of the monitored data shown on the LED monitor and is displayed on the top line of the LCD monitor. The ■ symbol indicates selected units or multiple number. The symbol ▲ indicates there is an upper screen not currently displayed.

LCD Monitor:
Used to display various items of information as operation status and function data. An operation guide message, which can be scrolled, is displayed at the bottom of the LCD monitor. This LCD monitor has a backlight feature which turns on when the control power is applied or any keypad key is pressed. It stays on approximately 5 minutes after the last key stroke.

Indication on LCD Monitor:
Displays one of the following operation status:
  FWD: Forward operation
  REV: Reverse operation
  STOP: Stop
Displays the selected operation mode:
  REM: Terminal block
  LOC: Keypad panel
  COMM: Communication terminal
  JOG: Jogging mode
The symbol ▼ indicates there is a lower screen not currently displayed.

Run LED :
  Indicates that an operation command was input by Pressing the FWD FWD or REV REV key.

Control Keys
 (valid during digital operator operation):

Used for inverter run and stop
  FWD Forward operation command
 REV Reverse operation command
  STOP Stop command

Operation Keys:
  Used for switching screens, data change, frequency setting, etc.

Functions of Operation Keys

Operation Key	Main Function
PRG	Used to switch the current screen display to the menu screen or switch to the initial display screen in the operation/trip mode.
FUNC DATA	Used to switch the LED monitor or to determine the entered frequency, function code, or data.
∧ ∨	Used to change data, move the cursor up or down, or scroll the display screen.
SHIFT >>	Used to move the cursor horizontally when changing data. When this key is pressed with the up or down key, the cursor moves to the next parameter function block.
RESET	Used to cancel the current input data and switch the display screen. If an alarm occurs, this key is used to reset the trip status (valid only when the alarm mode initial screen is displayed).
STOP + ∧	Used to switch normal operation mode to jogging operation mode or vice versa. The selected mode is displayed on the LCD screen.
STOP + RESET	Switches the operating mode from digital operator to terminal block operation (Local / Remote), and vice versa. When these keys are operated, function F01 data is automatically set to 3 if set at 0, or automatically set to 0 if set from 1 thru 4. The selected mode is displayed on the LCD screen.

6.2 Programming Parameters

On the program menu screen, select **1. DATA SET.** The parameter select screen appears. Select the desired parameter and set value as follows.
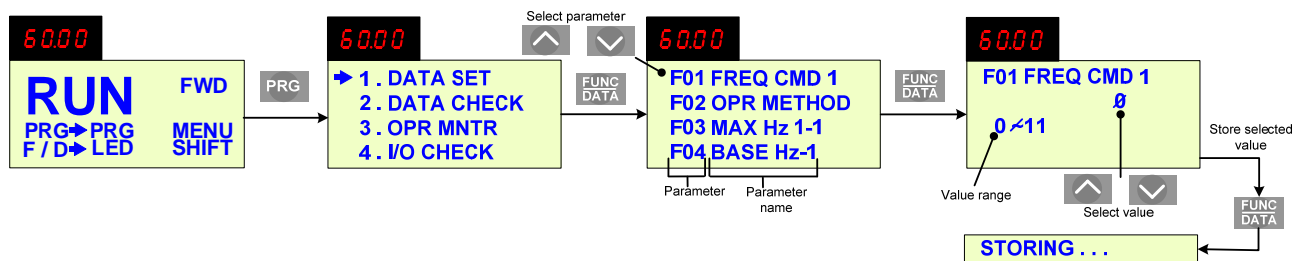

The parameter designations (function codes) consist of alphanumeric characters with unique alphabetical letters assigned to each parameter group (see table on the next page).

Parameter Designations and Corresponding Groups

Parameter	Group name	Remarks
F00 - F42	Fundamental Functions	
E01 - E47	Extension Terminal Functions	
C01 - C33	Control Functions of Frequency	
P01 - P09	Motor Parameters	
H03 - H39	High Performance Functions	
A01 - A18	Alternative Motor Parameters	
U01 - U61	User Functions	
o01 - o55	Optional Functions	Can be selected only with an option connected.

6.3 Monitoring Signals and Status

Select **3. OPR MNTR** on the program menu screen to display the current inverter operating status.
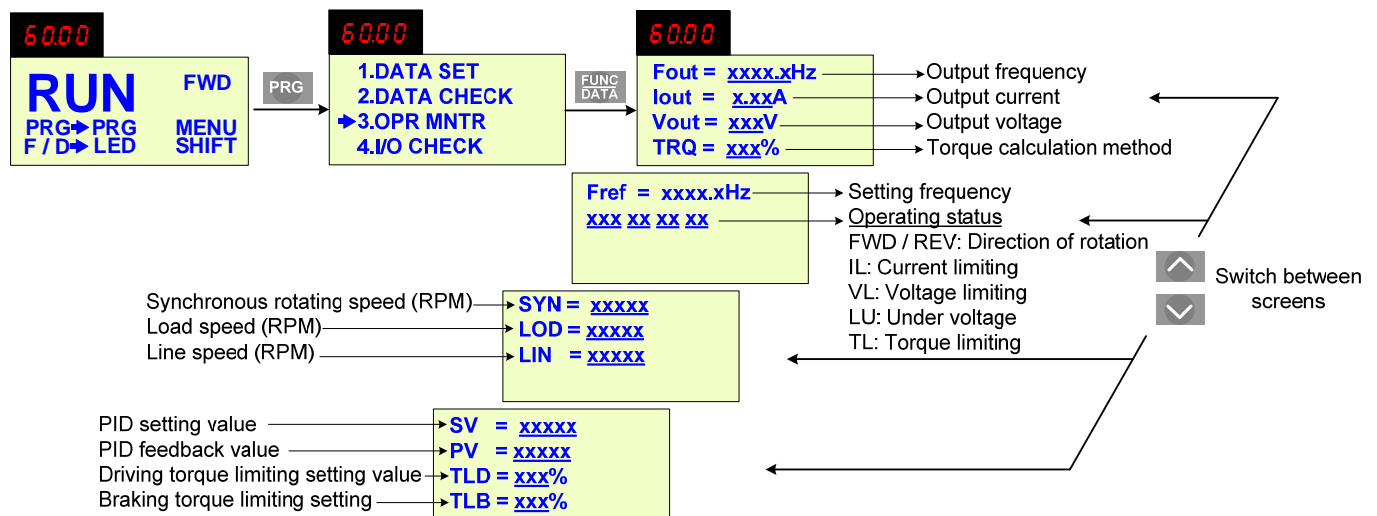
7. Motor and Application Specific Settings

It is essential that before running the motor, the motor nameplate data matches the motor data in the EQ5.

7.1 Set Motor Name Plate Data (P02, P03, F11)

P02	Motor 1 (Capacity)

The nominal motor capacity is set at the factory. Please verify that the motor name plate data matches the motor capacity shown in parameter P1. The setting should only be changed when driving a motor with a different capacity.

P	0	2	M	1	-	C	A	P			

Setting values for models with nominal motor capacities of 30 HP or less: 0.01 to 60 HP

Setting values for models with nominal motor capacities of 40 HP or more: 0.01 to 800 HP

The motor rated current is set at the factory based on the drive size. Please verify that the motor FLA on the motor nameplate matches the motor rated current shown in parameter P3.

P03	Motor 1 (Rated Current)

This function sets the rated current value of motor 1.

P	0	3	M	1	-	I	r				

Setting range: 0.00 to 2,000A

F11	Electric Thermal O/L Relay (level)

This function sets the operation current level for the electronic thermal O/L relay. Verify that the motor FLA on the motor nameplate matches the overload level shown in parameter F11

F	1	1	0	L		L	E	V	E	L	1	

Setting range is 20 to 135% of the rated current of the inverter.

7.2   Acceleration and Deceleration Time (F07 / F08)

Acceleration and *Deceleration* times directly control the system dynamic response. In general, the longer the acceleration and deceleration time, the slower the system response, and the shorter time, the faster the response. An excessive amount of time can result in sluggish system performance while too short of a time may result in system instability.

The default values suggested normally result in good system performance for the majority of Fan and Pump applications. If the values need to be adjusted, caution should be exercised, and the changes should be in small increments to avoid system instability.
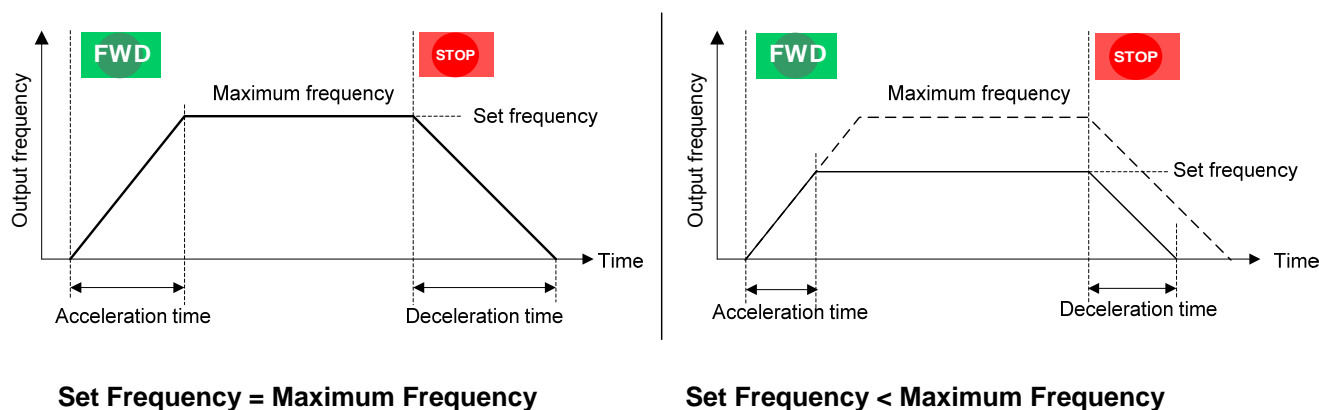
F07	Acceleration Time 1
F08	Deceleration Time 1

These parameters set the acceleration and deceleration times of the output frequency from 0 to maximum frequency and from maximum frequency to 0.

F	0	7	A	C	C		T	I	M	E	1	
F	0	8	D	E	C		T	I	M	E	1	

Setting range: 0.01 to 3600 Sec.

Acceleration and deceleration times are represented by the three most significant (high order) digits. Set acceleration and deceleration times with respect to maximum frequency.   The relationship between the set frequency value and acceleration/deceleration times is as follows:

Set Frequency = Maximum Frequency   **Set Frequency < Maximum Frequency**

Note: If the set acceleration and deceleration times are set too low, the torque limiting function or stall prevention function can become activated if the load torque and or inertia are relatively high. This will prolong the acceleration and or deceleration times and not allow the set times to be followed. In this case the acceleration and or the deceleration times should be adjusted.

7.3   Torque Boost (F09, Default 0.1)

IMPORTANT:

THIS PARAMETER REQUIRES TO BE CHANGED FOR CONSTANT TORQUE APPLICATIONS.

This parameter sets the relationship between output frequency and output voltage. Constant torque applications have the same torque requirements at low speed as well as at high speed.

Initial Setup

For medium duty applications set parameter F09 to an initial value of 1.0.

For heavy duty applications set parameter F09 to an initial value of 2.0.
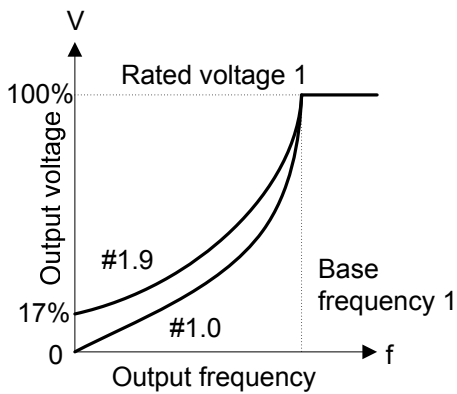
F09	Torque Boost

This parameter sets the torque boost for motor 1.

F	0	9	T	R	Q		B	O	O	S	T	1

Setting range: 0.0 to 20.0

| Setting range	Characteristics selected
0.0	Automatic torque boost characteristic where the torque boost value of a constant torque load (a linear change) is automatically adjusted. The motor tuning (P04 / A13) should be set to "2" for this function to be valid.
0.1 to 0.9	Square law reduction torque for fan and pump loads.
1.0 to 1.9	**Proportional torque for middle duty loads between square law reduction torque and constant torque (linear change).**
2.0 to 20.0	**Constant torque (linear change).**

Medium Duty Applications
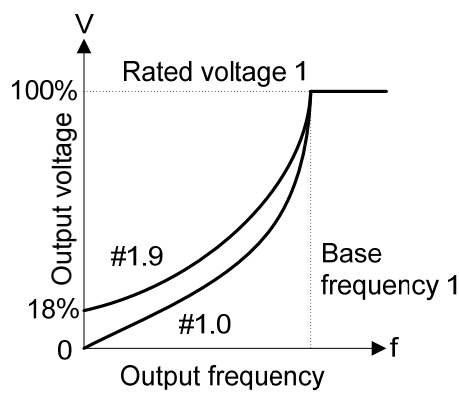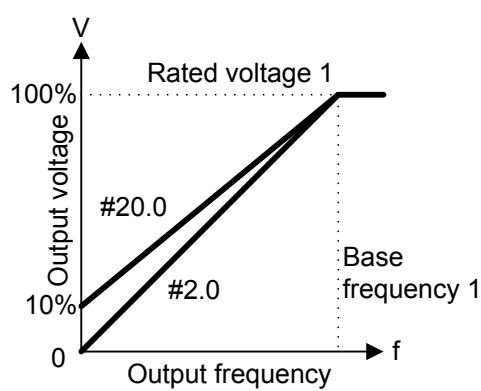

EQ5 30HP or Less

EQ5 40HP and above

Heavy Duty Applications
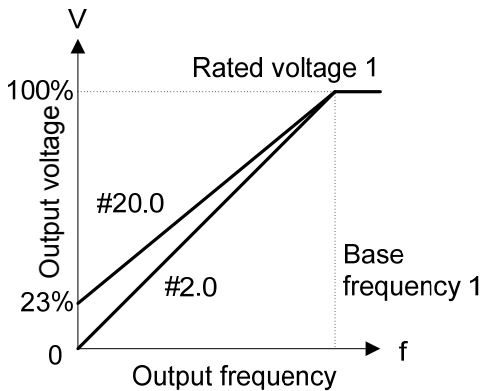
EQ5 30HP or Less

EQ5 40HP and above

⚠️ ***Warning: A larger than required torque boost value creates over-excitation at low speeds, continued operation may cause the motor to overheat. Check the characteristics of the motor for additional information.**

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