VVDED399094US
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Raleigh, NC, USA

Instruction Bulletin

ALTIVAR® 58 Type FVC Drive Controllers

Keypad Display Programming Guide
VW3A58101U

Telemecanique

SQUARE D

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand this bulletin in its entirety before installing or operating ALTIVAR 58 Type FVC drive controllers. Installation, adjustment, repair, and maintenance of the drive controllers must be performed by qualified personnel.
- Disconnect all power including external control power that may be present before servicing the drive controller. WAIT THREE MINUTES for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 87 to verify that the DC voltage is less than 45 V. The drive controller LEDs are not accurate indicators of the absence of DC bus voltage.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Install and close all covers before applying power or starting and stopping the drive controller.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing the drive controller:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive controller disconnect.
- Lock the disconnect in the open position.

Electrical shock will result in death or serious injury.

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CHAPTER 1—OVERVIEW

INTRODUCTION

The ALTIVAR 58 (ATV58) Type FVC family of adjustable frequency AC drive controllers is used to control three-phase asynchronous motors. ATV58 Type FVC controllers range from 1 to 75 hp (0.75 to 55 kW) constant torque, 380–500 V, three-phase input.

This manual covers the programming and operation of ATV58 Type FVC drive controllers using the keypad display, part number VW3A58101U. This manual also documents the additional functionality obtained by installing the following option cards:

- Analog I/O extension card (part number VW3A58201U)
- digital I/O extension card (part number VW3A58202U)

This manual does not cover the other available I/O and communication option cards. (See Appendix B for a complete list of options and accessories.) For information on programming the additional parameters that these cards provide, refer to the manuals that come with the cards.

Certain modes, menus, and operations can be modified if the drive controller is equipped with other options. Consult the documentation pertaining to each of these options.

For installation, wiring, start-up, and maintenance, consult the drive controller instruction bulletin, VVDED399093US, and the instruction bulletin provided with the I/O extension card if applicable.

NOTE: When referring to parameter codes, this manual uses a seven-segment digit font that emulates the way the codes appear in the keypad display, including the spacing between characters.

KEYPAD DISPLAY

The keypad display allows:

- Display of the drive controller part number, electrical values, parameters, and faults
- Adjustment and configuration of the drive controller
- Local command
- Storage of four controller configurations that can be read or downloaded to multiple drive controllers

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KEYPAD MOUNTING

Mounting the Keypad on the Drive Controller

Mount the keypad display as shown in Figure 1.

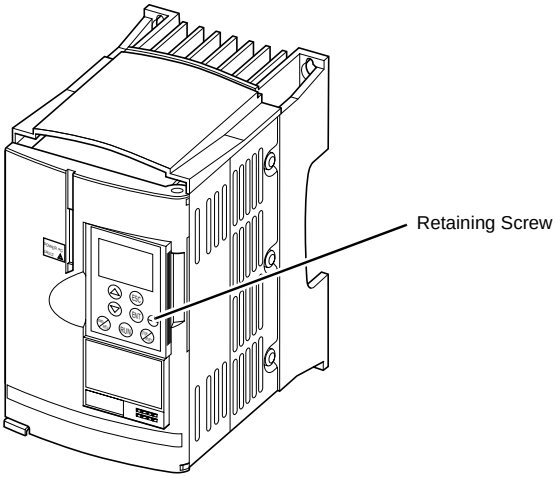

Figure 1: Drive Controller with the Keypad Mounted

You can mount or remove the keypad while power is applied to the drive controller. However, if you remove the keypad while drive controller command from the keypad is active, the drive controller trips on the serial link fault. See SLF in Table 27, beginning on page 91.

Remote Mounting the Keypad

To remote mount the keypad, use the keypad remote mounting kit, part number VW3A58103. This kit has an IP65 rating and contains:

- A three meter (9.8 ft) cable with connectors
- Parts for mounting the keypad on the cover of an enclosure
- An instruction sheet

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SETTING THE 50/60 HZ SWITCH

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand this bulletin in its entirety before installing or operating ALTIVAR 58 Type FVC drive controllers. Installation, adjustment, repair, and maintenance of these drive controllers must be performed by qualified personnel.
- Disconnect all power before servicing the drive controller. WAIT THREE MINUTES until the DC bus capacitors discharge, then measure DC bus capacitor voltage between J2-5 (+) and J2-6 (–) for drive controllers ATV58FHD28N4 and D79N4, or between J2-5 (PA) and J18-7 for drive controllers ATV58FHU18N4 to D23N4, to verify that the DC voltage is less than 45 V. Refer to the bus voltage measurement procedure on page 87.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury.

Figure 2 on page 4 shows the location of the 50/60 Hz switch on the drive controller. *Before powering up the drive controller and using the keypad display, you must* ***set the 50/60 Hz switch*** *to correspond with the frequency of the incoming AC power.*

1. Unlock and open the cover to access the 50/60 Hz switch on the control board. If an option card is present, the switch is accessible through the card.
2. Set the switch to the position corresponding to the frequency of the incoming AC power.
3. Close all covers.

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The nominal motor voltage (UnS) in the *3—Drive* menu is initially configured by the switch position:

For the 50 Hz position:
400 V, 50 Hz

For the 60 Hz position (factory setting):
460 V, 60 Hz

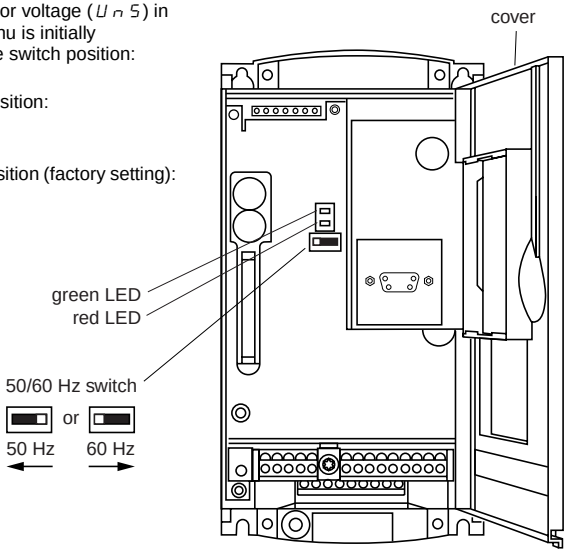

Figure 2: Location of 50/60 Hz Switch

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FUNCTION OF KEYS AND MEANING OF DISPLAYS

Figure 3 shows the front of the keypad display. The keys and displays are explained below.

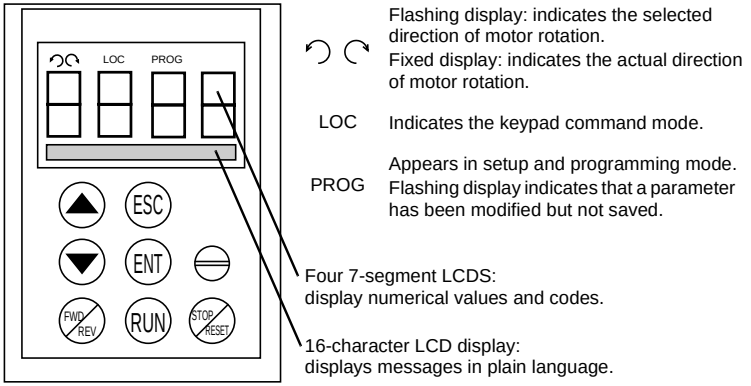

Figure 3: Front View of the Keypad

Press to move within the menus or among the parameters, and to scroll a numeric value up or down.

Press to return to the previous menu, or abandon an adjustment in progress and return to the original value.

Press to select a menu, or to validate and save a choice or an adjustment parameter.

If command by the keypad is selected:

Press to change the direction of motor rotation.

Press to start the motor.

Press to stop the motor or reset a fault. The Stop key can also stop the drive controller in terminal command mode if so configured (see page 45).

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CONFIGURATION RECOMMENDATIONS

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

Parameter changes affect drive controller operation. Most parameter changes require pressing ENT. Some parameter changes, such as reference frequency, take effect as soon as you press the up or down arrow keys. Read and understand this manual before using the keypad display.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Prior to configuration, prepare your program settings using the form in Appendix A on page 95.

Internal checks facilitate the programming of the ATV58 Type FVC drive controller. To help you understand and become comfortable with the keypad, we recommend that you access the menus and program the controller in the following order. All steps are not obligatory in all cases.

1. Set the 50/60 Hz switch.
2. Select the language.
3. Select the macro-configuration.
4. Select two or three-wire control in the *4—Control* menu.
5. Configure the parameters in the *3—Drive* menu.
6. Assign the inputs and outputs in the *5—I/O* menu.
7. Configure the parameters in the *4—Control* menu.
8. Configure the switching frequency type in the *3—Drive* menu.
9. Configure the fault management parameters in the *6—Fault* menu.
10. Set the Communication or Application configurations, if using one of these options.
11. Select the speed loop type (IP or PI) in the *3—Drive* menu.
12. Configure the settings in the *2—Adjust* menu.

NOTE: You must ensure that the programmed functions are compatible with the control scheme used.

*If the Freewheel Stop/Run Permissive function is assigned to a logic input, the drive controller does **not** start the motor unless that logic input is connected to +24 V.*

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MINIMUM START-UP

You can use this procedure as a minimum start-up:

- In simple applications where the drive controller factory settings are sufficient in open loop mode
- On installation when it is necessary to operate the motor before fully completing the start-up sequence

Minimum Start-up Procedure

1. Make sure that the 50/60 Hz switch is in the correct position, corresponding to the frequency of the incoming AC power, as shown in Figure 2 on page 4.
2. Ensure that the macro-configuration factory setting is suitable for the application. (Refer to Table 1 on page 19.) If not, change it using the *Macro-Config* menu.
3. Verify that the control scheme is compatible with the macro-configuration, ensuring that the necessary safety precautions have been taken.
4. In the *3—Drive* menu:
   a. Modify the factory settings as necessary to ensure that they are compatible with the motor nameplate values. Refer to Table 8 on page 35.
   b. Verify that the control mode (LFr) is set to open loop.
   c. Run the Auto-tuning function.
5. If necessary, adjust the parameters in the *2—Adjust* menu (ramps, motor thermal protection, etc.). See Table 4 on page 23.

*If the Freewheel Stop/Run Permissive function is assigned to a logic input, the drive controller does **not** start the motor unless the logic input is connected to +24 V.*

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PERFORMANCE OPTIMIZATION

Control modes

The ATV58 Type FVC controller has two control modes:

- *Open loop mode (SVC)*, with no speed feedback from the encoder. Speed correction is still possible in this control mode, using tachogenerator feedback (option card VW3A58201U).
- *Closed loop mode,* with flux vector control (FVC) using speed feedback by an incremental encoder. In this mode, you can achieve high-performance speed and torque accuracy at very low speed.

You can select the required control mode by configuring parameter CLr or assigning a logic input. The change of mode takes effect only after the motor stops, with the drive controller run command removed.

Encoder Test and FVC Setup Procedure (Closed Loop)

Perform the following procedure in **open loop** (SVC) mode. Follow Steps 1, 2, and 3 from page 7, then continue here.

1. In the *3—Drive* menu:
   a. Configure the motor nameplate parameters.
   b. Perform an auto-tune to adapt the drive controller to the motor. Auto-tune performed in one control mode remains valid in the other; there is no need to repeat the procedure if you change the mode between open loop and closed loop.
   c. Configure the number of encoder pulses (PGI) and select the Encoder Test function (EnC = Yes) to test the entire feedback sequence.
2. Exit the *3—Drive* menu and go to the *1—Display* menu.
3. Start the motor and keep it running for at least three seconds at a stabilized speed over 10 Hz. Ensure that the motor is running correctly. If fault SPF is displayed, ensure that:
   — The mechanical and electrical components of the encoder are operating correctly.
   — The motor is connected, switched on, and rotating in the correct direction (if necessary, reverse two motor phases or the wires to A and A– on the encoder).
   — The number of pulses is configured correctly.
4. Return to the *3—Drive* menu; parameter EnC should automatically be set to Done.
5. Configure the FVC control mode (CLr = closed loop).

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Manual Optimization of the FVC Parameters

Manual adjustment is recommended if the auto-tuning procedure cannot be performed, or if it does not perform as expected. The essential parameters in FVC (closed loop) mode are no-load current and nominal motor slip. You can use the *1—Display* menu to view current, voltage, frequency, etc. on the keypad display without the need for measuring devices.

No-Load Current

This parameter is adjusted by Mot.CosPhi, COS, in the *3—Drive* menu.

Run the motor at no-load with the output frequency equal to the nominal frequency divided by 2, and then adjust COS until the motor voltage equals the nominal voltage divided by 2 (view parameter UOP in the *1—Display* menu).

Example: With a 460 V 60 Hz motor, adjust COS to obtain 230 V at 30 Hz. If UOP is less than 230 V, reduce COS. If UOP is greater than 230 V, increase COS.

Nominal Motor Slip

This parameter is adjusted by Nominal Speed, nSP, in the *3—Drive* menu and Slip Comp., SLP, in the *2—Adjust* menu.

1. Set the nominal speed to the value shown on the motor nameplate.
2. Run the motor at approximately nominal torque, with the output frequency equal to the nominal frequency divided by 2.
3. Adjust SLP to obtain the lowest motor current (view parameter LCr in the *1—Display* menu).

Loop Adjustment

The *3—Drive* menu offers a choice between two types of speed loops: IP loop (adjusts gain and stability) or PI loop (adjusts proportional gain and integral gain).

1. With the ramps set to the minimum, apply a speed reference of 5–10 Hz.
2. Start and stop the motor, observing the change in speed, response time, stability, and overspeed.
3. Follow the steps below to obtain optimum performance.

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IP Loop Adjustment

1. Gradually increase FLG (gain) to improve the loop response time (passband). Reduce FLG in the event of instability.
2. Gradually increase StA (stability) to avoid any overspeed.

PI Loop Adjustment

1. Set SIG (integral gain) to 0.
2. Gradually increase SPG (proportional gain) as far as possible before oscillation begins and note the value obtained (this is SPGmax).
3. Adjust SPG to 0.7 x SPGmax.
4. Gradually increase SIG (to reduce the speed error) as far as possible before oscillation begins.

Motor Fluxing

The Motor Fluxing function (FLU in the *2—Adjust* menu) is used to achieve and maintain nominal flux in the motor when no forward or reverse movement is requested. The presence of flux before the motor is started ensures maximum performance in the starting dynamics. This function is available in both the open loop (SVC) and closed loop (FVC) control modes.

With FLU = FCT, Continuous Flux

When the motor is stopped:

Flux builds continuously in the motor and zero speed is maintained.

With a run command:

Flux has already built in the motor and it begins to rotate immediately.

CAUTION
MOTOR OVERHEATING When parameter FLU is set to FCT (Continuous Flux), voltage and current are applied to the motor even when the motor is stopped and the run command is removed. Ensure that the motor can withstand the heat generated under this condition. **Failure to follow this instruction can result in equipment damage.**

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With FLU = FNC, Non-continuous Flux

With a run command and the motor stopped:

Flux builds in the motor before rotation begins. The speed starts to increase as soon as the flux reaches its nominal level.

With a run command and the motor already turning (freewheeling):

Flux builds in the motor until it reaches its nominal level. From this point, the drive controller increases or decreases speed to match the setpoint.

At the end of a stop cycle:

At the end of the deceleration ramp, zero speed is maintained for the period tdC if automatic DC injection (AdC) is enabled in the *3—Drive* menu. At the end of tdC the motor is no longer controlled and the flux disappears automatically.

If a logic input is assigned to the motor fluxing function:

When this input is activated, the flux functions in the same way as with FLU = FCT, continuous flux.

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ACCESS LEVELS

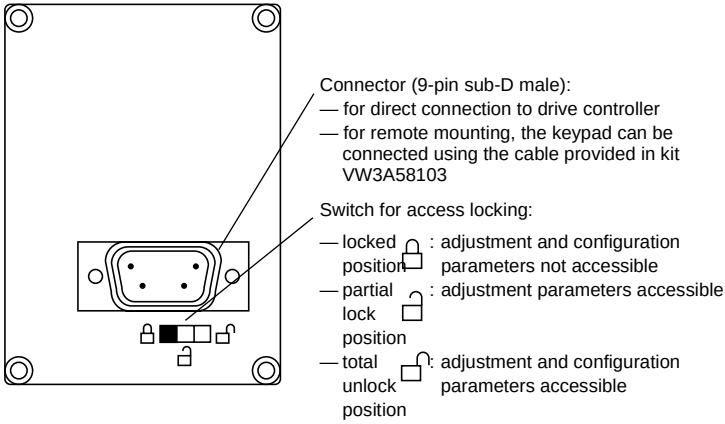

Figure 4: Rear View of Keypad

The access locking switch on the back of the keypad display allows three levels of access to the menus based on switch position. You can also limit access to the menus by requiring an access code (see the *7—Files* menu on page 79).

Locked Position Display Mode Only: Use this level when the motor is running to prevent modifications to drive controller programming. The following functions are accessible:

- Selecting a language in the *Language* menu.
- Displaying the macro-configuration or the pre-programmed values for the selected application in the *Macro-Config* menu.
- Displaying the voltage and power rating of the drive controller in the *Identification* menu.
- Displaying the electrical values, the operational status, or fault readout in the *1—Display* menu.

Partial Lock Position Display and Adjustment Modes Only: Use this level during start-up for access to basic set up parameters. The following functions are accessible:

- Those listed above
- Adjusting parameters in the *2—Adjust* menu that are accessible when the motor is running.

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Total Unlock Position 🔓 **All modes:** Use this level during start-up for access to advanced set-up parameters. The following functions are accessible:

- Those listed in both access levels above.
- Selecting a different macro-configuration in the *Macro-Config* menu.
- Adjusting the performance of the drive system in the *3—Drive* menu.
- Configuring the drive controller to be commanded from either the terminal strip, the keypad, or the integrated serial link using the *4—Control* menu.
- Changing the assignments of the inputs and outputs in the *5—I/O* menu.
- Configuring motor protection, drive controller protection, and response after a fault has occurred in the *6—Fault* menu.
- Saving the drive controller configurations, recalling them from memory, returning to factory settings, and protecting your configuration in the *7—Files* menu.
- Adjusting the communication parameters in the *Communication* menu if a communication card is installed.
- You can access the *Application* menu if a customer application card is installed.

Access To Menus

The position of the access locking switch determines which menus are accessible. Each menu contains parameters to be adjusted or configured. Figure 5 shows the menus as they appear on the display when the access locking switch is in the **Total Unlock Position** 🔓**.**

NOTE: If an access code (password) has already been programmed, certain menus may not be modifiable or may not be visible. In this case refer to “Access Code” on page 81 to learn how to enter the access code.

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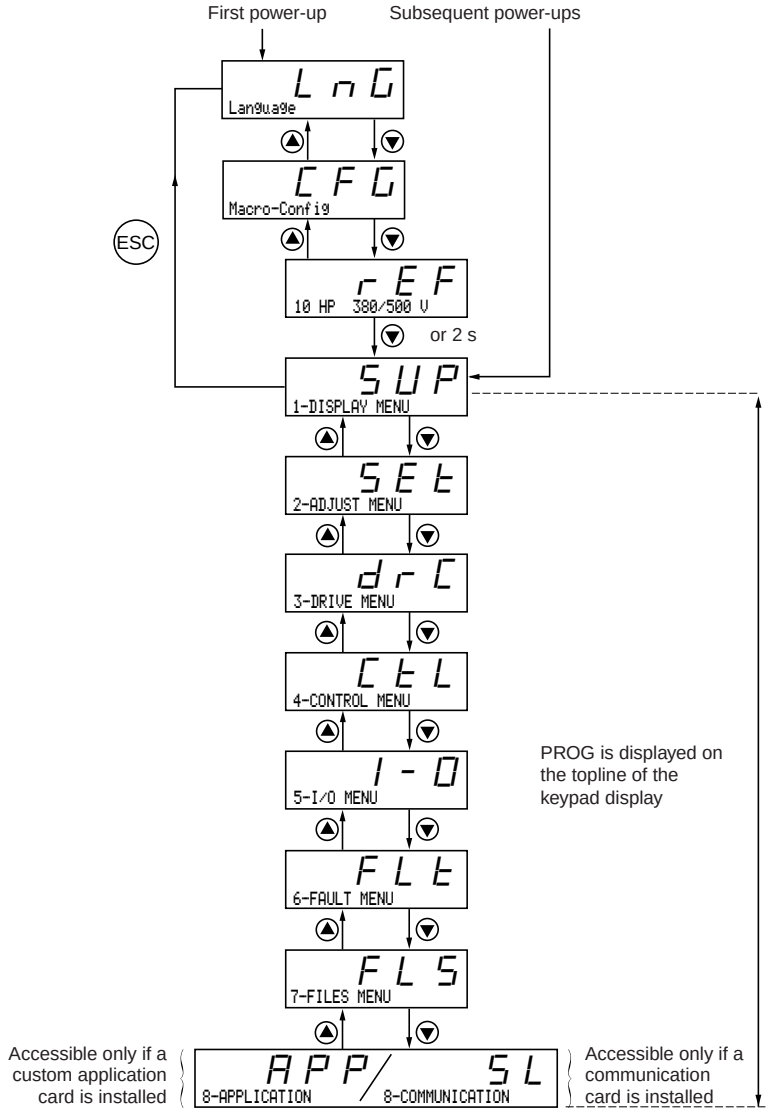

Figure 5: Menus

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Principles of Programming

The principle of programming is always the same, regardless of the access locking switch. Figures 6 and 7 show examples of programming steps.

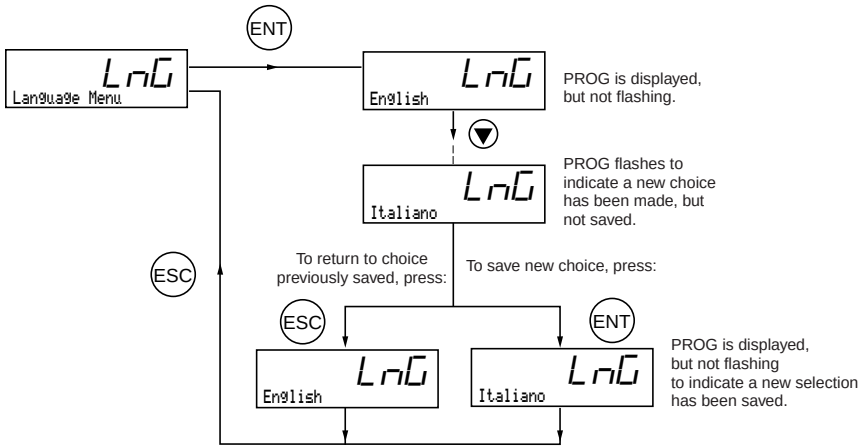

Figure 6: Language Selection Programming Example

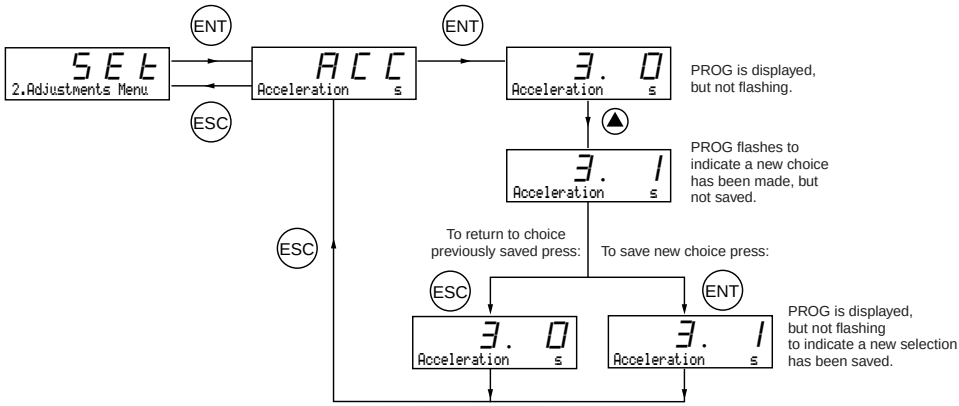

Figure 7: Acceleration Time Programming Example

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CHAPTER 2—MENUS

This chapter explains menus and parameter functions.

LANGUAGE

The Language menu (see Figure 6 on page 15) is accessible regardless of the access locking switch setting. The available languages are English (factory setting), French, German, Spanish, or Italian. The language is modifiable with the motor stopped or running.

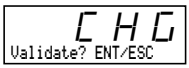
MACRO-CONFIGURATION

Selecting a macro-configuration automatically configures the drive controller for an application. The macro-configuration menu can always be displayed, but can only be modified when the access locking switch is in the position and the motor is stopped. Two application types are available:

- Material Handling (HdG)
- General Use (GEn)

Modifying the Macro-Configuration

Modifying the macro-configuration requires two confirmations since it automatically changes the function assignments. When a change to the macro-configuration is requested the following screen is displayed:



Press ENT to proceed with change
Press ESC to return to the previous configuration

Figure 8: Macro-Configuration Validation

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

Factory default settings will be substituted for present settings when the macro-configuration is changed and confirmed.

Factory default settings may not be compatible with the application. After changing the macro-configuration, verify that the new settings are compatible with application requirements.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

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Macro-Configuration and I/O Functions

The macro-configuration automatically assigns the inputs and outputs to functions suitable for the application, making the parameters related to these functions available. The factory-set macro-configuration is Material Handling. Table 1 shows the drive controller I/O assignments as a function of the macro-configuration selected when the drive controller is set for two-wire control. For the logic input assignments when the drive controller is set for three-wire control, refer to Table 10 on page 41.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

If both LI1 and LI2 are selected (high state) and LI1 reverts to a zero state, the drive controller will reverse direction. The logic inputs must be programmed appropriately for the application to prevent the motor from rotating in an unintended direction.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Customizing the Macro-Configuration

With the access locking switch in the 🔓 position, you can customize the drive controller configuration by changing the assignment of the inputs and outputs in the *5—I/O* menu. When an I/O assignment is modified, the macro-configuration screen displays the following:

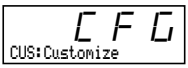

Figure 9: Customized Macro-Configuration

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Table 1: Drive Controller I/O Assignments

	HdG: Material Handling (Factory default)	GEn: General Use
Logic Input LI1[1]	Forward	Forward
Logic Input LI2	Reverse	Reverse
Logic Input LI3	2 Preset speeds	Jog
Logic Input LI4	4 Preset speeds	Freewheel stop [2]
Analog Input AI1[1]	Reference summing	Reference summing
Analog Input AI2	Reference summing	Reference summing
Relay R1[1]	Drive fault relay	Drive fault relay
Relay R2	Not assigned	Not assigned
Analog Output AO1	Motor frequency	Motor frequency

[1] LI1, AI1, and R1 assignments are not visible in the I/O menu. LI1 and R1 are not reassignable. AI1 is reassignable if the PID function is enabled.

[2] If the Freewheel Stop/ Run Permissive function is configured, the drive controller does not start the motor unless the logic input is connected to +24 V.

Table 2: I/O Extension Card Factory Presets

	HdG: Material Handling	GEn: General Use
Logic Input LI5	8 preset speeds	Fault reset
Logic Input LI6	Fault reset	Current limit [1] or Torque limit 2 [2]
Analog Input AI3 [1] or Logic Inputs A, A–, B, B– [3]	Reference summing [1]	Reference summing [1]
	Speed feedback	Speed feedback
Logic Output LO	Current level attained	Output contactor command
Analog Output AO	Motor current	Motor current

[1] With analog I/O extension card (VW3A58201U).

[2] With digital I/O extension card (VW3A58202U).

NOTE: You must ensure that the programmed functions are compatible with the control scheme used.

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DRIVE CONTROLLER IDENTIFICATION SCREEN

This screen shows the power rating and the voltage rating of the drive controller. The power rating is displayed:

- In horsepower if the 50/60 Hz selector switch on the drive controller is set to 60 Hz
- In kilowatts if the selector switch is set to 50 Hz

Refer to Figure 10 for the access path.

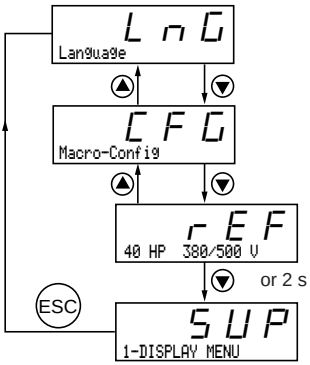

Figure 10: Drive Controller Identification Screen

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1—DISPLAY MENU

Display parameters can be viewed in any access level. You can scroll through these parameters with the motor running.

Menu 1

Table 3: 1—Display Menu Parameters

Parameter	Code	Function	Units
Drv. state Use this parameter to monitor drive status.	 rdy run ACC dEC CLI dCb nSt Obr FLUX	Drive controller status: indicates the state of the drive controller and fault codes. — Drive controller ready — Motor at steady state speed — Motor speeding up (accelerating) — Motor slowing down (decelerating) — Drive in current limit — Drive applying DC injection braking to motor — Drive in freewheel stop mode — Braking in decel. ramp adaptation mode — Drive supplying current for motor fluxing	—
Freq. Ref. - Hz	FrH	Reference frequency—command	Hz
Output Freq. - Hz	rFr	Output frequency applied to the motor—actual	Hz
Motor SPeed - RPM	SPd	Motor speed estimated by the drive controller. Based on nominal motor speed (nSP) entry. See Table 8 on page 35.	RPM
Motor Current - A	LCr	Motor current	A
Machine Spd.	USP	Machine speed estimated by the drive controller. USP is proportional to rFr scaled by the coefficient, USC, which is adjustable in the *2—Adjust* menu.	—
Output Power - %	OPr	Output power estimated by the drive controller. 100% corresponds to nominal power.	%
Mains Voltage V	ULn	Display of incoming line voltage	V
Motor Thermal - %	tHr	Thermal state: 100% corresponds to the nominal motor thermal state. Above 118%, the drive trips on OLF (motor overload fault).	%
Drive Thermal - %	tHd	Thermal state of the drive controller: 100% corresponds to the nominal drive controller thermal state. Above 118%, the drive trips on OHF (drive overheating fault). It resets when the thermal state goes below 70%.	%
Last Fault	LFt	Display of the last fault	—
Freq. Ref	LFr	Local frequency reference: This adjustment parameter appears in place of the FrH parameter when keypad command is activated using the LCC parameter (see page 45) in the *4—Control* menu.	Hz
Motor Voltage	UOP	Display of voltage applied to the motor	V

Note: If USP is greater than 9999, the display value is USP/1000.

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2—ADJUST MENU

The *2—Adjust* menu is accessible when the access locking switch is set to either  or  . You can modify the adjustment parameters while the drive controller is commanding the motor to run; however, it is recommended that you make all adjustments with the motor stopped.

> **⚠ WARNING**
>
> **UNINTENDED EQUIPMENT ACTION**
>
> Changes made to adjustment parameters while the motor is running may cause unintended equipment action. When changing adjustment parameters, ensure that the motor is stopped.
>
> **Failure to follow this instruction can result in death, serious injury, or equipment damage.**

There are two types of adjustment parameters: parameters that are always accessible (fixed adjustment parameters), and parameters that may be accessible depending on:

- The macro-configuration selected.
- The presence of an I/O extension card.
- I/O re-assignments for certain functions.
- The control mode (LFr) selection.

A common set of adjustment parameters, shown in Table 4 on page 23, is accessible in any macro-configuration.

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Menu 2

Table 4: Menu 2—Common Adjustment Parameters

Parameter	Code	Description	Adjustment Range	Factory Setting
Freq. Ref. - Hz	LFr	Appears when drive controller command from the keypad has been activated using the LCC parameter (see page 45) in the *4—Control* menu.	LSP to HSP	
Ramp Incr.	Inr	Increment of time adjustment for ACC, dEC, AC2, and dE2 ramp settings.	0.1 or 0.01 s	0.1 s
IR Compens. - %	UFr	Drive controller output voltage compensation. This parameter modifies the internal default values or the values determined through Auto-tuning.	0 to 150%	100%
Slip Comp. - %	SLP	Adjust for fine-tuning of speed regulation. 100% value is determined by the entry of nSP (Nom. Mot SPeed)	0 to 150%	100%
Jump Freq. - Hz	JPF	Frequency avoidance in steady-state over a frequency range of ±2.5 Hz around programmed JPF.	0 to HSP	0 Hz
Acceleration -s Deceleration -s	ACC dEC	Acceleration ramp time: Time for motor to go from 0 to FrS (Nom. Mot. Freq.). Deceleration ramp time: Time for motor to go from FrS to 0.	If Inr = 0.1 s, then the range is 0.1 to 999.9 s. If Inr = 0.01 s, then the range is 0.01 to 99.9 s.	3 s 3 s
Low SPeed - Hz	LSP	Low speed (minimum speed without external reference).	0 to HSP	0 Hz
High SPeed - Hz	HSP	High speed (maximum speed with full external reference applied). Ensure that this adjustment is suitable for the motor and the application.	LSP to tFr	50/60 Hz depending on switch setting
Gain - %	FLG	Frequency loop gain for IP-type loop (SSL = IP structure in the *3—Drive* menu). Used to adapt the response of the machine speed according to the dynamics. For high resistive torque, high inertia, or fast cycle machines, increase the gain gradually.	0 to 100	20 %

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Menu 2

Table 4: Menu 2—Common Adjustment Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Stability - %	StA	For IP-type loop (SSL = IP structure in the *3—Drive* menu). Used to adapt the return to steady state after a speed transient, according to the dynamics of the machine. Gradually increase the stability to avoid any overspeed.	0 to 100	20%
SPeed Prop.g -%	SPG	Speed loop proportional gain for PI-type loop (SSL = PI structure in the *3—Drive* menu)	0 to 1000	40%
SPeed int.g. -%	SIG	Speed loop integral gain for PI-type loop (SSL = PI structure in the *3—Drive* menu)	0 to 1000	40%
+/-SPeed lim -%	SrP	Limits the range of operation of +Speed/–Speed commands around the reference as a percentage. This parameter appears if two inputs are assigned to the +Speed/–Speed functions, and if parameter Str = SRE in the *4—Control* menu	0 to 50 %	10%
ThermCurrent -A	ItH	Current used for motor thermal overload protection. Adjust ItH to the nominal current that appears on the motor nameplate.	0.25 to 1.36 I_n [1]	Varies according to drive controller size.

⚠ CAUTION

MOTOR OVERHEATING

This drive controller does not provide direct thermal protection for the motor. Use of a thermal sensor in the motor may be required for protection at all speeds or loading conditions. Consult the motor manufacturer for the thermal capability of the motor when operated over the desired speed range.

Failure to follow this instruction can result in injury or equipment damage.

[1] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

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Menu 2

Table 4: Menu 2—Common Adjustment Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
NOTE: Additional parameters appear in this menu at this point if certain macro-configurations are selected. See Tables 5 and 6 on page 30.				
Machine Coef	USC	Scaling factor for adjusting speed display (USP) to correspond to process limits (ft/min, etc.) using the output frequency value (rFr). Value: USP = rFr x USC	0.01 to 100.00	1
LSP Time - s	tLS	Low speed dwell time. If the external speed reference falls below the level required to operate above the Low Speed (LSP) setting, the motor operates at low speed for the time set by this parameter. If the speed reference remains below the Low Speed threshold for this period, the motor stops even if the run command is maintained. If the speed reference is raised above the Low Speed threshold, the motor re-starts and ramps to the new reference if a valid run command is still present. If tLS = 0, no timing takes place; that is, the function is not active.	0.0 to 999.9 s, independent of the setting of Ramp Incr. (Inr)	0
Motor Flux	FLU	Selects motor fluxing mode. Used to achieve and maintain nominal flux in the motor even when no valid run command was issued. Allows for fastest starting times possible when a run command is given.	FNC (No Continuous Flux) or FCT (Continuous Flux)	FNC
PID ref. off.	rE0	Used to adjust the process range. See “Calculating PID Reference Gain and Offset” on page 27 for details.	–999 to 999	0
PID Ref.Gain	PrG	Used to adjust the sensor range to match the process range. See “Calculating PID Reference Gain and Offset” on page 27 for details.	–999 to 999	999
PID Speed r.	PSr	PID speed input ratio. Used to adjust the influence of this input on the regulator—for example, to define the relationship between a linear speed and an angular speed.	0 to 100	0
PID Filter - s	PSP	Used to adjust the filter time constant on the PID feedback.	0.0 to 10.0	0 s

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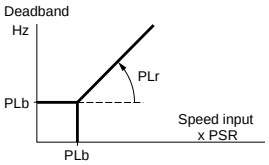
Menu 2

Table 4: Menu 2—Common Adjustment Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Min.feed.PID -%	PAL	Below this feedback value, the output assigned to PID feedback alarm changes to 1. 100% = max. feedback 0% = min. feedback	0 to 100%	0%
Max.feed.PID -%	PAH	Above this feedback value, the output assigned to PID feedback alarm changes to 1. 100% = max. feedback 0% = min. feedback	0 to 100%	0%
PID error - %	PEr	Error value above which the output assigned to PID error changes to 1. 100% = max. feedback minus min. feedback 0% = 0	0 to 100%	100%
PID Preset 2 -%	P i2	2nd preset PID setpoint, when a logic input is assigned to the function, 4 preset PID setpoints. 100% = process max. 0% = process min.	0 to 100%	30%
PID Preset 3 -%	P i3	3rd preset PID setpoint, when a logic input is assigned to the function, 4 preset PID setpoints. 100% = process max. 0% = process min.	0 to 100%	60%
PID Limit r. -%	PLr	Limiting of the output from the PID regulator as a percentage of the output signal from the speed input multiplier.  	0 to 100%	20%
PID base lim-Hz	PLb	Base limit for the output from the PID regulator.	0.0 Hz to HSP	HSP

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Calculating PID Reference Gain and Offset

To calculate the process range (PID ref. off., rEO), use the following formula:

$$rEO = \frac{\text{ProcessMin} - \text{MinFeedback}}{\text{MaxFeedback} - \text{MinFeedback}} \times 999 \text{ (in customer units)}$$

To adjust the sensor range to match the process range (PID Ref.Gain, PrG), use the following formula:

$$PrG = \frac{\text{ProcessMax} - \text{ProcessMin}}{\text{MaxFeedback} - \text{MinFeedback}} \times 999 \text{ (in customer units)}$$

- Process max. and process min. correspond to the customer's adjustment range in customer units, as shown in Figure 11 on page 28.
  Example: set between 5 bar and 12 bar.
  - — *Process max.* is the process value to be set when the signal is at its maximum (10 V, 20 mA) on the analog input selected for the PID setpoint (for example: 12 bar for 10 V on 0–10 V input).
  - — *Process min.* is the process value to be set when the signal is at its minimum (0 V, 0 mA, 4 mA) on the analog input selected for the PID setpoint (for example: 5 bar for 0 V on 0–10 V input).
- *Min. feedback* and *max. feedback* correspond to the sensor feedback range in customer units, as shown in Figure 12 on page 28.
  - — *Min. feedback* is the value measured for the minimum signal on the analog input (0 V, 0 mA, 4 mA) selected for the PID feedback (for example: 0 bar measured at 4 mA on 4–20 mA input).
  - — *Max. feedback* is the value measured for the maximum signal on the analog input (10 V, 20 mA) selected for the PID feedback (for example, 15 bar measured at 20 mA on 4–20 mA input).

NOTE: The reference value and the feedback value should always be positive, even if a bipolar analog input is used. Example: AI1 or AI3 (–10 V, +10 V). Negative values are not considered.

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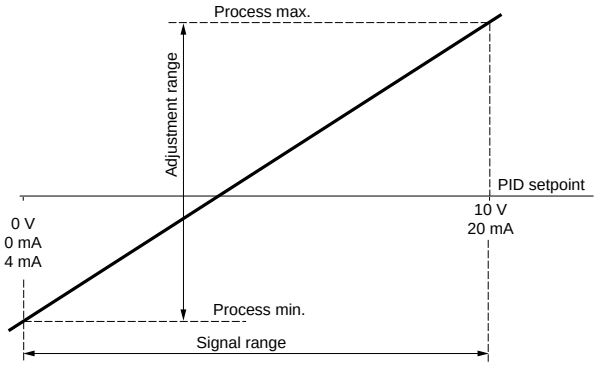

Figure 11: Adjustment Range

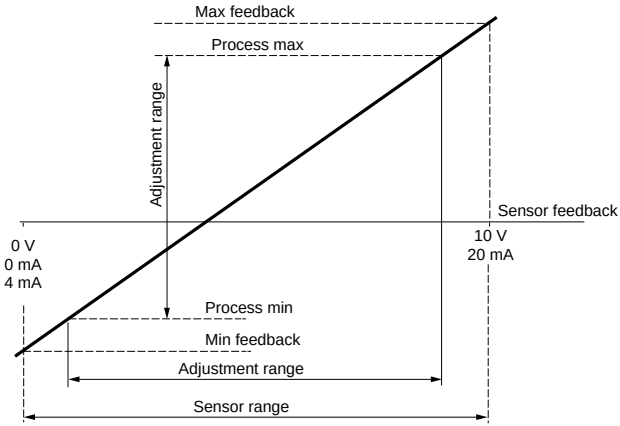

Figure 12: Sensor Feedback Range

NOTE: The adjustment range (process min. and process max.) should be included within the sensor range (min. feedback and max. feedback).

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Sample Gain and Offset Calculation:

To set the volume of a tank to between 100 m^3 and 10 m^3:

1. The sensor supplies a current signal 0 mA -> 5 m^3 / 20 mA -> 200 m^3
   Select input AI2: min. signal = 0 mA, max. signal = 20 mA

   Find the process value corresponding to the min. and max. input signal to define min. feedback and max. feedback:

Signal set by input AI2	Corresponding process value
Min. signal 0 mA Max. signal 20 mA	5 m^3 = Min. feedback 200 m^3 = Max. feedback

2. Select the desired input AI1: min. signal = 0 V, max. signal = 10 V.

Signal set by input AI1	Corresponding process value
Min. signal 0 V Max. signal 10 V	10 m^3 = Min. process reference 100 m^3 = Max. process reference

3. Scaling

$$RefGain = \left(\frac{100-10}{200-5}\right) \times 999 = (0.4615) \times 999 = 461$$

$$Offset = \left(\frac{10-5}{200-5}\right) \times 999 = (0.0256) \times 999 = 26$$

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Additional Adjustment Parameters for Material Handling

Menu 2

Table 5 lists the additional parameters accessible when the macro-configuration is set to Material Handling.

Table 5: Menu 2—Additional Adjustment Parameters with Material Handling Macro-Configuration

Parameter	Code	Description	Adjustment Range	Factory Setting
Preset SP.2- Hz	SP2	Second preset speed [1]	LSP to HSP	10 Hz
Preset SP.3- Hz	SP3	Third preset speed [1]	LSP to HSP	15 Hz
Preset SP.4- Hz ★	SP4	Fourth preset speed	LSP to HSP	20 Hz
Preset SP.5- Hz ★	SP5	Fifth preset speed	LSP to HSP	25 Hz
Preset SP.6- Hz ★	SP6	Sixth preset speed	LSP to HSP	30 Hz
Preset SP.7- Hz ★	SP7	Seventh preset speed	LSP to HSP	35 Hz

[1] FVC default.

★ Parameters appear if an I/O extension card is installed.

Additional Adjustment Parameters for General Use

Menu 2

Table 6 lists the additional parameters accessible when the macro-configuration is set to General Use.

Table 6: Menu 2—Additional Adjustment Parameters with General Use Macro-Configuration

Parameter	Code	Description	Adjustment Range	Factory Setting
Jog Freq. -Hz	JOG	Frequency when operating in Jog [1]	0 to 10 Hz	10 Hz
Jog Delay - s	JGt	Delay between two consecutive jog operations [1]	0 to 2 s	0.5 s

[1] FVC default.

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Additional Adjustment Parameters After I/O Re-assignment

Table 7 lists the additional parameters that may be accessible after the drive controller I/O are re-assigned or specific control parameters are selected.

Menu 2

Table 7: Menu 2—Additional Adjustment Parameters After I/O Re-assignment

Parameter	Code	Description	Adjustment Range	Factory Setting
Freq. Detect-Hz	Ftd	Above this motor frequency threshold, the logic output goes to high state (1).	LSP to HSP	50/60 Hz [1]
Curr.Lev.Att- A	Ctd	Above this current threshold, the logic output or relay goes to high state (1).	0.25 to 1.36 I_n [3]	1.36 I_n [3]
ThermLevAtt - %	ttd	Above this motor thermal state threshold, the logic output or relay goes to high state (1).	0 to 118%	100%
Torque lim2 -%	tL2	Second torque limit, activated by a logic input.	0% to 200% [2]	200%
Accelerate 2- s Decelerate 2- s	AC2 dE2	Alternate acceleration/deceleration ramp time selections. Selection methods include: logic input assigned to RP2: Switch Ramp2; frequency threshold (SwitchRamp2, Frt in the *3—Drive* menu); a logic input assigned to –Speed with Save Ref. (Str) parameter set to SRE.	If Inr = 0.1 s, then the range is 0.1 to 999.9 s. If Inr = 0.01 s, then the range is 0.01 to 99.9 s.	5 s
Beg ACC Rnd. - %	tA1	Start of CUS-type acceleration ramp rounded as percentage of total ramp time (parameter rPt = CUS in the *3—Drive* menu).	0 to 100	10%
End ACC Rnd. - %	tA2	End of CUS-type acceleration ramp.	0 to (100–tA1)	10%
Beg DEC Rnd. - %	tA3	Start of CUS-type deceleration ramp rounded as a percent of total ramp time.	0 to 100	10%
End DEC Rnd. - %	tA4	End of CUS-type deceleration ramp.	0 to (100–tA3)	10%
DC Inj. Curr. -A	IdC	DC injection braking current level. Accessible if a logic input is assigned to DC injection braking. After 30 s, IdC is automatically set to 0.5 ItH if previously set to a higher value.	0.10 to 1.36 I_n [3]	0.7 ItH

[1] Depending on the position of the 50/60 Hz switch.

[2] 100% corresponds to the nominal torque of a motor with horsepower size equal to that of the drive controller at its constant torque rating.

[3] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

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Menu 2

Table 7: Menu 2—Additional Adjustment Parameters After I/O Re-assignment (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
DC Inj. Time - s	tdC	If CtrL = open loop: sets DC injection braking time on stopping. If CtrL = closed loop: sets zero speed holding time on stopping. If tdC is set to CONT, DC injection is continuously applied to the motor on stopping. If CtrL = open loop, the injection current becomes equal to the value of SdC after 30 seconds.	0 to 30 s or CONT	0.5 s
dc I at rest - A	SdC	The DC injection braking current level applied after 30 seconds when tdC is set to CONT and CtrL = open loop.	0.1 to 1.36 I_n [3]	Depends on drive controller rating
TachFBCoeff (Available only with I/O extension card installed)	dtS	Tachometer scaling factor associated with the tachometer feedback function: $dtS = \frac{9}{\text{tachometer voltage at HSP}}$	1 to 2	1
Preset SP.2 - Hz	SP2	Second preset speed	LSP to HSP	10 Hz
Preset SP.3 - Hz	SP3	Third preset speed	LSP to HSP	15 Hz
Preset SP.4 - Hz	SP4	Fourth preset speed	LSP to HSP	20 Hz
Preset SP.5 - Hz	SP5	Fifth preset speed	LSP to HSP	25 Hz
Preset SP.6 - Hz	SP6	Sixth preset speed	LSP to HSP	30 Hz
Preset SP.7 - Hz	SP7	Seventh preset speed	LSP to HSP	35 Hz
Jog Freq. - Hz	JOG	Frequency when operating in jog	0 to 10 Hz	10 Hz
Jog Delay - s	JGt	Delay time between two consecutive jog operations	0 to 2 s	0.5 s
BrReleaseI -A	Ibr	Brake release current	0 to 1.36 I_n [3]	0 A
BrReleasTime -s	brt	Brake release time	0 to 5 s	0 s
BrEngageLev -Hz	bEn	Brake engage frequency	0 to LSP	0 Hz
BrEngageTime -s	bEt	Brake engage time	0 to 5 s	0 s
Brake impul.	bIP	When set to Yes, provides impulse of forward or motoring torque on brake release regardless of direction command given. If set to No, torque is produced in the requested direction of rotation.	Yes or No	No

[1] Depending on the position of the 50/60 Hz switch.

[2] 100% corresponds to the nominal torque of a motor with horsepower size equal to that of the drive controller at its constant torque rating.

[3] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

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Menu 2

Table 7: Menu 2—Additional Adjustment Parameters After I/O Re-assignment (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
PI Prop. Gain	rPG	Proportional gain for PID regulator	0.01 to 100	1
PI Int. Gain-1/s	r IG	Integral gain for PID regulator	0.01 to 100/s	1/s
PID der. g.	rdG	Derivative gain of the PID regulator	0.00 to 100.0	0.00
PI Inversion	PIC	Inverts the PI feedback signal No: Normal Yes: Inverted	Yes or No	No

[1] Depending on the position of the 50/60 Hz switch.

[2] 100% corresponds to the nominal torque of a motor with horsepower size equal to that of the drive controller at its constant torque rating.

[3] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

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3—DRIVE MENU

Menu Overview

This menu is accessible when the access locking switch is in the  position. The parameters can only be modified when the motor is stopped and the run commands removed.

To obtain optimal performance:

- Enter the motor nameplate values into the *3—Drive* menu
- Initiate an auto-tune (on a standard asynchronous motor). See page 35 for more information concerning the auto-tune function (tUn).

Table 8 on page 35 shows the parameters accessed in the *3—Drive* menu**.**

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Menu 3

Table 8: 3—Drive Menu Parameters

Parameter	Code	Description	Adjustment Range	Factory Setting
Nom.Mot.Volt- V	UnS	Nominal motor voltage given on the motor nameplate label	200 to 500 V	400/460 V [1]
Nom.Mot.Freq -Hz	FrS	Nominal motor frequency given on the motor nameplate label	40 to tFr	50/60 Hz [1]
NomMotCurr.- A	nCr	Nominal motor current given on the motor nameplate label	0.25 to 1.36 I_n [2]	0.9 I_n [2]
Nom.MotSpeed -RPM	nSP	Nominal motor speed given on the motor nameplate label	0 to 9999 RPM	Depends on drive rating
Mot.CosPhi	COS	Motor power factor given on the motor nameplate. This defines the power factor at controller full-load amperage.	0.5 to 1	Depends on drive rating
Control mode	Ctr	Selects the control mode: open loop (SVC) or closed loop (FVC).	Open loop or Closed loop	Open loop
Enc Pulse No	PG I	Number of encoder pulses per revolution (control card inputs).	100 to 5000	1024
Auto Tuning	tUn	Used to auto-tune motor control when this parameter is set to Yes. Once auto-tuning is complete, the parameter automatically returns to Done, or No if a fault occurs.	Yes or No	No

⚠ CAUTION

UNINTENDED EQUIPMENT OPERATION

Auto-tuning is only performed if no command has been activated. If a freewheel stop or fast stop function is assigned to a logic output, this input must be set to 1 (active at 0). Also, all motor parameters (UnS, FrS, nCr, nSP, COS) must be correctly configured before performing auto-tuning. During auto-tuning, the motor is under nominal current.

Auto-tuning may last for one minute. **Do not interrupt**; wait for the display to change to Done or No.

Failure to follow this instruction can result in injury or equipment damage.

[1] Depending on the position of the 50/60 Hz switch.

[2] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

[3] Refer to the drive controller instruction bulletin, VVDED399093US, for duty cycle ratings of the drive controllers.

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Menu 3

Table 8: 3—Drive Menu Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Encoder chk	EnC	Check the encoder feedback. Done is displayed if the check has already been performed.	Yes or No	No
Max.Freq. - Hz	tFr	Maximum output frequency. The maximum value is a function of the switching frequency (SFr, see page 38).	40 to 450 Hz	60/72 Hz [1]

⚠ CAUTION

MACHINERY OVERSPEED

Some motors and/or loads may not be suited for operation above nameplate motor speed and frequency. Consult the motor manufacturer before operating the motor above the rated speed.

Failure to follow this instruction can result in injury or equipment damage.

DecRampAdapt	brA	Activation allows the deceleration ramp time to be automatically increased, avoiding an overbraking fault (ObF) if the ramp time was set too short for the system inertia reflected to the motor shaft. This function may be incompatible with ramp positioning and with dynamic braking. If relay R2 is assigned to Brake Logic, brA can only be set to No.	Yes or No *Note: The factory setting depends on the macro-configuration used:* No *for Material Handling,* Yes *for General Use.*	No
SwitchRamp2- Hz	Frt	Frequency for ramp switching. When the output frequency is greater than Frt, the ramp times are AC2 and dE2. This parameter is not available if a logic input is already assigned to ramp switching.	0 to HSP	0 Hz

[1] Depending on the position of the 50/60 Hz switch.

[2] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

[3] Refer to the drive controller instruction bulletin, VVDED399093US, for duty cycle ratings of the drive controllers.

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Menu 3

Table 8: 3—Drive Menu Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Ramp Type	rPt	Defines the shape of the acceleration and deceleration ramps. See Figure 13 on page 39 for examples.	LIN (linear) S (S-shaped) U (U-shaped) CUS (Custom)	LIN
DecRamp Coeff (available only if fast stop is enabled)	dCF	Coefficient for reducing the deceleration ramp time when a logic input has been assigned to the Fast Stop function. For example: If dEC=20 s, setting dCF to 2 results in a 10 s deceleration ramp setting.	1 to 10	4
Trq.Limit1 -%	tLI	Torque limit allows limitation of the maximum motor torque	0 to 200%	200%
Int.I Lim -A	CLI	Current limit is used to limit the maximum motor current	0 to 1.36 In [2]	1.36 In [2]
Auto DC Inj.	AdC	Allows deactivation of automatic DC injection at stop	Yes or No	Yes
Sw. Freq. Type	SFt	Allows selection of the type of switching frequency. **LF** allows adjustment between 0.5 and 4 kHz using the SFr parameter. **HF1** and **HF2** allow adjustment between 4 and 16 kHz: **HF1** is for applications with a low duty cycle, without derating the drive controller. If the drive controller thermal state goes above 95%, the switching frequency automatically goes to 2 or 4 kHz (depending on rating). When the thermal state returns to 70%, the switching frequency returns to the set value. **HF2** is for machines with a high duty cycle with derating of the drive controller by one power rating. The drive parameters (current limit, thermal current, etc.) are automatically scaled.	LF HF1 HF2 [3]	LF

[1] Depending on the position of the 50/60 Hz switch.

[2] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

[3] Refer to the drive controller instruction bulletin, VVDED399093US, for duty cycle ratings of the drive controllers.

NOTE: Modifying SFt causes the following parameters to revert to factory settings:
3—Drive menu: nCr, CLI, SFr, nrd
2—Adjust menu: tHI, IdC, Ibr, Ctd

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Menu 3

Table 8: 3—Drive Menu Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Sw Freq -kHz	SFr	Selection of switching frequency. The range depends on the SFt parameter. The maximum operational frequency (tFr) is limited depending on the switching frequency, as shown in Table 9 on page 40.	LF: 0.5, 1, 2, or 4 kHz HF1 or HF2: 4, 8, 12, or 16 kHz [3]	LF: 4 kHz HF1 or HF2: (depending on controller rating)
Noise Reduct	nrd	This function randomly modulates the switching frequency in order to reduce audible motor noise.	Yes or No	Yes if SFt = LF No if SFt = HF1 or HF2
PG Type ★	PGt	Type of sensor used when an encoder feedback I/O card is installed. INC: incremental encoder (A, A–, B, B– are wired). DET: Detector (only A is wired).	INC or DET	DET
Num. Pulses ★	PLS	The number of pulses per sensor revolution	1 to 1024	1
Speed Reg.	SSL	Used to select the type of speed loop (IP = IP structure, PI = PI structure; see Figure 14 on page 40 for examples).	IP or PI	IP

★ *Parameter appears only if an I/O extension card is installed.*

[1] Depending on the position of the 50/60 Hz switch.

[2] I_n = drive controller constant torque output current rating shown in the drive controller instruction bulletin, VVDED399093US, and on the drive controller nameplate.

[3] Refer to the drive controller instruction bulletin, VVDED399093US, for duty cycle ratings of the drive controllers.

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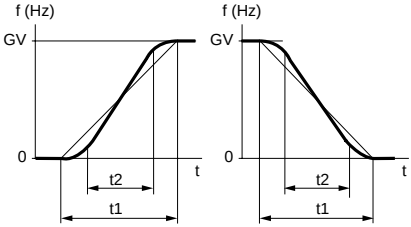
Acceleration and Deceleration Ramp Shapes

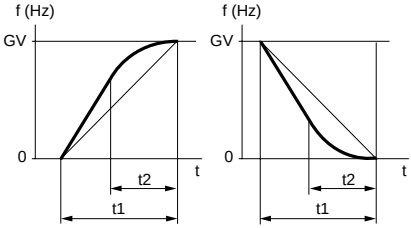
S-Shaped Ramps

The curve coefficient is fixed, with t1 = set ramp time and t2 = 0.6 x t1.



U-Shaped Ramps

The curve coefficient is fixed, with t1 = set ramp time and t2 = 0.5 x t1.



Customized Ramps

- tA1 can be set between 0 and 100 % of ACC or AC2.
- tA2 can be set between 0 and (100 % – tA1) of ACC or AC2.
- tA3 can be set between 0 and 100 % of dEC or dE2.
- tA4 can be set between 0 and (100 % – tA3) of dEC or dE2.

These parameters can be set in the *2—Adjust* menu.

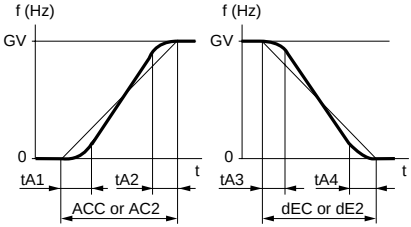


Figure 13: Acceleration and Deceleration Ramp Shapes

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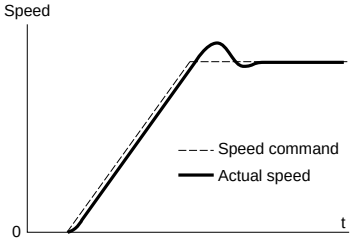
Speed Loops

PI Loop

- Response time is very short.
- It is possible to exceed the reference level.



IP Loop

- Response time is longer than for the PI loop.
- It is not possible to exceed the reference level.

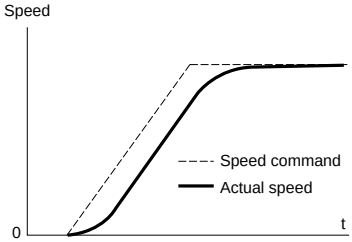


Figure 14: Speed Loops

Switching Frequency

The maximum operational frequency (ŁFr) is limited depending on the switching frequency, as shown in Table 9.

Table 9: Maximum Operational Frequency Based on Switching Frequency

Switching Frequency SFr (kHZ)	0.5	1	2	4	8	12	16
Maximum Operational Frequency ŁFr (Hz)	62	125	250	450	450	450	450

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4—CONTROL MENU

This menu is accessible when the access locking switch is in the position. The parameters can only be modified when the motor is stopped and the run commands are removed.

Menu 4

Table 10: 4—Control Menu: Keypad or Two/Three-Wire Control

Parameter	Code	Description	Adjustment Range	Factory Setting
TermStripCon.	tCC	Configuration of the terminal strip command: two- or three-wire control.	2W or 3W	2W

NOTE: Modification of this parameter requires two confirmations since it causes a reassignment of the logic inputs.

When two-wire control is selected, the LI assignments are those shown in Table 1 on page 18. Table 11 below shows the LI assignments when three-wire control is selected. Figure 15 gives an example of three-wire control.

In three-wire control, LI1 and LI2 cannot be reassigned. *Selecting three-wire control inhibits the automatic restart function.*

Table 11: LI Assignments for Three-Wire Control

I/O	Material Handling	General Use	I/O	Material Handling	General Use
LI1	STOP	STOP	LI4	2 Preset speeds	Jog
LI2	Run forward	Run forward	LI5★	4 Preset speeds	Freewheel stop
LI3	Run reverse	Run reverse	LI6★	8 Preset speeds	Fault reset

★ These I/O can be accessed only if an I/O extension card is installed.

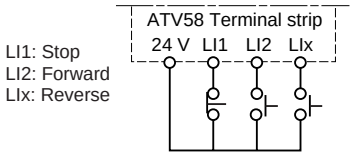

Figure 15: Three-Wire Control

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Menu 4

Table 12: 4—Control Menu: Two-Wire Control Type

Parameter	Code	Description	Adjustment Range	Factory Setting
Type 2 Wire	tCt	This parameter appears when two-wire control is selected and defines the type of two-wire control. See “Two-Wire Control Types” below for definitions.	LEL,TRN, or PFW	LEL
RV inhibit	rIn	When configured for Yes, this function inhibits reverse operation even when reverse operation is requested by a summing or PI regulator function or by the keypad display FWD/REV key. This parameter is not available if a logic input is configured for reverse. Likewise, a logic input cannot be configured for reverse if this parameter is set to Yes.	Yes or No	No
deadb./Pedst	bSP	This function can be used to manage low speed operation of a process. See Figure 17 on page 43. • BNS = Pedestal • BLS = Deadband	No BLS BNS	No

Two-Wire Control Types

- LEL: If the forward or reverse input is high when the drive controller is powered up, the drive controller will start the motor. If both inputs are high on power up, the controller will run forward.
- TrN: The drive controller must see a transition from low to high of the forward or reverse input before it will start the motor. Therefore, if the forward or reverse input is high when the drive controller is powered up, the input must be cycled before the drive controller will start the motor.
- PFW: Forward input has priority over reverse input with this control. If forward is activated while the controller is running in reverse, the controller will run forward.

Figure 16 on page 43 gives an example of two-wire control.

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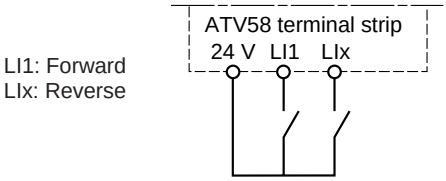

Figure 16: Two-Wire Control

Figure 17 shows lows speed operation when **deadb./Pedst** (b S P) is set to No, BNS (pedestal), or BLS (deadband).

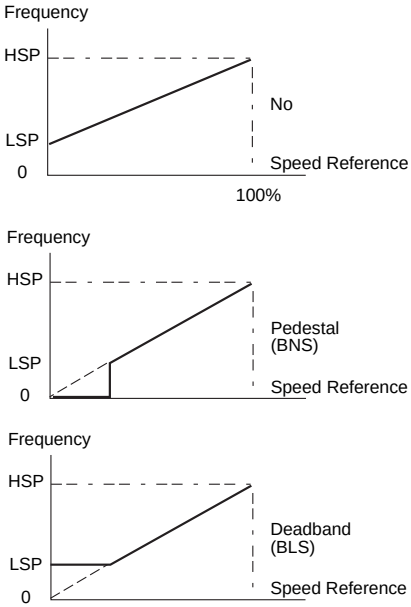

Figure 17: Managing Low Speed Operation

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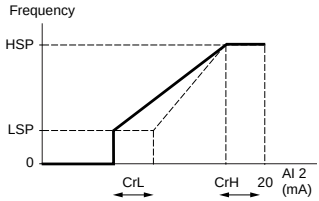
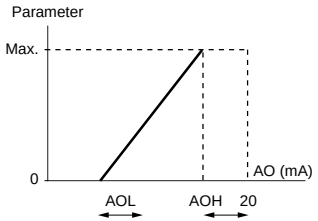
Menu 4

Note: If CRL is set higher than CRH, reverse sense operation results (i.e., 20 mA equals low speed and 4 mA equals high speed).

Table 13: 4—Control Menu: Other Parameters

Parameter	Code	Description	Adjustment Range	Factory Setting
AI2 min. Ref.-mA AI2 Max. Ref-mA	CrL CrH	• CrL: Minimum value of the signal on analog input AI2 • CrH: Maximum value of the signal on analog input AI2 These two parameters define the intended useful range of the signal at AI2 (e.g., 0–20 mA, 4–20 mA, 20–4 mA, etc.) 	CrL: 0–20 mA CrH: 4–20 mA	CrL: 4 mA CrH: 20 mA
AO min. Val-mA ★ AO Max. Val-mA ★	AOL AOH	AOL: Minimum value of the signal on analog output AO AOH: Maximum value of the signal on analog output AO These two parameters define the intended useful range for AO and AO1 (e.g., 0–20 mA, 4–20 mA, 20–4 mA, etc.) 		
Save Ref (Available only if logic inputs are assigned to +Speed/–Speed.)	Str	This function allows saving the reference, either when the run command is removed (RAM) or when mains power is removed (EEP). When the motor is next started, the reference speed will be the last saved reference. In order for speed reference to be saved in EEP mode, the run command must not be present when re-applying power.	No RAM EEP SRE	No

★ These parameters are available only with an I/O extension card installed.

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Menu 4

Table 13: 4—Control Menu: Other Parameters (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
KeypadCom.	LCC	Allows command of the drive controller via the keypad. The Stop/Reset, Run and Fwd/Rev keys are active. The reference speed is given by the LFr parameter (see page 23). *Only the freewheel stop, fast stop, and stop by DC injection commands remain active at the terminal strip.* If the link between the drive controller and keypad is lost, the drive controller trips on the SLF fault (serial link fault).	Yes or No	No
Stop Priorit.	PSt	This function gives priority to the Stop key on the keypad no matter what the command source (terminal strip, keypad or serial link). To change the PSt parameter to No: 1. Display No. 2. Press ENT. 3. The drive controller displays “See manual”. 4. Press the up arrow key, then the down arrow key, then ENT, then ESC. *When set to No, the **Stop key** on the keypad is **inactive.*** To return to Yes, display Yes then press enter.	Yes or No	Yes

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Disabling the Stop key on the keypad will prevent the drive controller from stopping when the Stop key is pressed. An external stop command must be installed to stop the motor.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

DriveAddress	Add	Drive controller address controlled through the RS485 port by a MODBUS device (i.e., without the keypad display).	0 to 31	0

★ These parameters are available only with an I/O extension card installed.

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5—I/O MENU

This menu allows you to assign functions to the inputs and outputs. It is accessible when the access locking switch is in the position. The I/O assignments are modifiable only when the motor is stopped and the run commands removed.

The inputs and outputs displayed in the *5—I/O* menu vary depending on selections made in the *4—Control* menu, and whether an I/O extension card is installed. The default settings depend on the macro-configuration selected (see Table 1 on page 19 for factory settings).

Table 14 shows which functions can be assigned to the analog input (AI) and which can be assigned to a logic input (LI). Additional inputs are available and can be assigned when an I/O extension card is installed. *LI1 and R1 cannot be reassigned. AI1, LI1, and R1 are not displayed in the I/O menu.*

Menu 5

NOTE: When reassigning inputs from +Speed and –Speed, reassign –Speed first.

When reassigning inputs from preset speeds, reassign in the following order: PS8, PS4, PS2.

Table 14: Assigning Configurable Inputs

Code and Parameter	Description	With an I/O Extension Card			
			LI5–LI6	AI3	A, A–, B, B–[1]
		Without an I/O Extension Card			
		AI2	LI2–LI4		
NO: Not assigned	Not assigned	X	X	X	X
RV: Reverse	Run reverse		X		
RP2: Switch ramp2	Ramp switching		X		
JOG	Jog		X		
+SP: + SPeed	+Speed		X		
-SP: - SPeed	–Speed		X		
PS2: 2 Preset SP	2 preset speeds		X		
PS4: 4 Preset SP	4 preset speeds		X		
PS8: 8 Preset SP	8 preset speeds		X		
NST: Freewhl Stop	Freewheel stop/Run permissive		X		
DCI: DC inject	DC injection braking		X		
FST: Fast stop	Fast stop		X		
CHP: Multi.Motor	Open loop/closed loop switching when CtrL = closed loop		X		
TL2: Torque Lim2	Second torque limit		X		
FLO: Forced Local	Force to local (terminal strip or keypad)		X		

[1] Logic input. Assign encoder input A, A–, B, B– using menu Assign AI3.

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Menu 5

Table 14: Assigning Configurable Inputs (Continued)

Code and Parameter	Description	With an I/O Extension Card			
			LI5–LI6	AI3	A, A–, B, B– [1]
		Without an I/O Extension Card			
		AI2	LI2–LI4		
RST: Fault Reset	Fault reset		X		
RFC: Auto/manu	Reference switching		X		
ATN: Auto-tune	Auto-tuning		X		
FR2: SPeed Ref2	Speed reference 2	X			
SAI: Summed Ref.	Reference summing	X		X	
PIF: PI regulator	PI regulator feedback	X		X	
SFB: Tacho feedbk	Tachogenerator			X	
PTC: Therm. Sensor	PTC probes			X	
ATL: Torque Lim.	Analog torque limit			X	
RGI: PG feedbk	Encoder or sensor feedback				X
SPM: Ref.memory	Reference saved		X		
FLU: Motor fluxing	Motor fluxing		X		
PAU: PID Auto/Man	PID Auto/Manu if one AI is assigned to PIF		X		
PIS: PIDint.reset	PID integral shunting if one AI is assigned to PIF		X		
PR2: PID 2 Preset	Two preset PID setpoints if one AI is assigned to PIF		X		
PR4: PID 4 Preset	Four preset PID setpoints if one AI is assigned to PIF		X		
DAI: Subtract ref	Subtracting reference	X		X	
PIM: PID Man.ref.	Manual PID speed reference if one AI is assigned to PIF			X	
FPI: PID SPd inP.	PID speed reference if one AI is assigned to PIF			X	

[1] Logic input. Assign encoder input A, A–, B, B– using menu Assign AI3.

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Table 15 shows which functions can be assigned to relay output R2, logic output LO, and analog output AO.

Menu 5

Table 15: Assigning Configurable Outputs

Code and Parameter	Description	With I/O Extension Card		
			LO	AO
		Without I/O Extension Card		
		R2		AO1
NO: Not assigned	Not assigned	X	X	X
RUN: DriveRunning	Drive controller running	X	X	
OCC: OutPut Cont.	Output contactor command	X	X	
FTA: Freq Attain.	Frequency threshold attained	X	X	
FLA: HSP Attained	High speed attained	X	X	
CTA: I Attained	Current level attained	X	X	
SRA: FRH Attained	Reference speed attained	X	X	
TSA: Mtr Therm Lvl	Motor thermal level attained	X	X	
BLC: Brk Logic	Brake logic	X		
OCR: Motor current	Motor current			X
OFR: Motor Frequency	Motor speed			X
ORP: OutPut RamP	Ramp output			X
TRQ: Motor torque	Motor torque			X
STQ: Signed Torq.	Signed motor torque			X
PEE: PID error	PID error if one AI is assigned to PIF	X	X	
PFA: PID Feed alm	PID feedback alarm if one AI is assigned to PIF	X	X	
ORS: Signed ramP	Signed ramp output			X
OPS: PID ref.	PID setpoint output if one AI is assigned to PIF			X
OPF: PID Feedback	PID feedback output if one AI is assigned to PIF			X
OPE: PID error	PID error output if one AI is assigned to PIF			X
OPI: PID Integral	PID integral output if one AI is assigned to PIF			X

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Additional Parameters After I/O Assignment

After the I/O are assigned, additional parameters related to the functions automatically appear in the menus, and the macro-configuration is CUS: Customized. Tables 16 and 17 list these additional parameters.

Menu 2

Table 16: Additional Parameters Appearing in the *2—Adjust* Menu After I/O Reassignment

I/O	Assignment		Additional Parameters
LI	RP2	Ramp switching	AC2 dE2
LI	JOG	Jog	JOG JGt
LI	PS4	4 preset speeds	SP2 SP3
LI	PS8	8 preset speeds	SP4 SP5 SP6 SP7
LI	DCI	DC injection braking	IdC
LI	TL2	Second torque limit	tL2
LI	PR4	Four preset PID setpoints	P I2 P I3
AI	PIF	PI regulator feedback	rPG, r IG, P IC, rdG, rEd, PrG, PSr, PSP, PLr, PLb
AI	SFB	Tachogenerator	dtS
R2	BLC	Brake logic	Ibr, brt, bEn, bEt, b IP
R2/LO	FTA	Frequency threshold attained	Ftd
R2/LO	CTA	Current threshold attained	Ctd
R2/LO	TSA	Thermal threshold attained	ttd
R2/LO	PEE	PID error	PEr
R2/LO	PFA	PID feedback alarm	PAL, PAH

Table 17: Other Additional Parameters After I/O Reassignment

I/O	Assignment		Additional Parameters
LI	-SP	–Speed	Str in the *4—Control* menu
LI	FST	Fast stop	dCF in the *3—Drive* menu
LI	CHP	Motor switching	PCC in the *3—Drive* menu
LI	RST	Fault reset	rSt in the *6—Fault* menu
AI	SFB	Tachogenerator	Sdd in the *6—Fault* menu
A+, A–, B+, B–	SAI	Summing reference	PGt, PLS in the *3—Drive* menu
A+, A–, B+, B–	RGI	Encoder feedback	PGt, PLS in the *3—Drive* menu

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Function Compatibility

Table 18 shows the incompatibilities between functions, which limit the application functions that can be assigned. The functions not listed in the table are compatible with all other functions.

NOTE: You must de-select any incompatible functions before programming the desired function. For example, if preset speeds is programmed, you must clear it before selecting the +/–Speed parameter.

Table 18: Function Compatibility

	DC injection braking	Summing inputs	PID regulator	+/–Speed	Reference switching	Freewheel stop	Fast stop	Jog operation	Preset speeds	Speed regulation with tachogenerator	Torque limitation via AI3	Torque limitation via LI	Reference saved	Closed loop FVC	Open/closed loop switching
DC injection braking	×					↑								●	
Summing inputs		×			●										
PID regulator			×	●	●			●	●	●			●		●
+/–Speed			●	×	●			↑	●				●		
Reference switching		●	●	●	×				●						
Freewheel stop	←					×	←							←	
Fast stop						↑	×								
Jog operation			●	←				×	←				●		
Preset speeds			●	●	●			↑	×				●		
Speed regulation with tachogenerator			●							×				●	
Torque limitation via AI3											×	●			
Torque limitation via LI											●	×			
Reference saved			●	●				●	●				×		●
Closed loop FVC	●					↑				●				×	
Open/closed loop switching			●										●		×

Legend: ● Incompatible functions ❒ Compatible functions × No significance

Priority functions (functions that cannot be active simultaneously):
← ↑ The arrow points to the function that has priority.

- Stop functions have priority over run commands.
- Speed references via logic command have priority over analog setpoints.

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Using the Logic Inputs

Run Forward and Run Reverse

The logic input used for run reverse can be reassigned if the application has only one rotation direction.

Two-Wire Control

In two-wire control, Run (forward or reverse) and Stop are commanded by the same logic input. When the logic input is closed (set to state 1), run is commanded; when it is opened (set to state 0), stop is commanded. See tCt on page 42 for more information.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

If both LI1 and LI2 are selected (set to state 1) and LI1 reverts to state 0, the drive controller will reverse direction. The logic inputs must be programmed appropriately for the application to prevent the motor from rotating in an unintended direction.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Three-Wire Control

In three-wire control, Run (forward or reverse) and Stop are commanded by two different logic inputs. LI1 is always assigned to Stop, which is obtained by opening LI1 (setting it to state 0). A pulse on the run input is saved until the stop input is opened.

Whenever the drive is powered up or reset, the motor will run only after pulsing the Forward or Reverse inputs.

Ramp Switching

This function allows switching between the first (ACC and dEC) and second (AC2 and dE2) ramps. There are two ways to activate the function:

- Assigning a logic input to RP2: Switch RampZ and closing the assigned input (setting it to state 1)
- Detection of a frequency threshold. This must be configured with the Frt parameter.

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If a logic input is assigned to the function, only the assigned input can initiate ramp switching.

Jog

A logic input can be assigned to the Jog function to define a motor speed from 0 to 10 Hz. A run command (forward or reverse) is also required.

If the Jog contact is closed (set to state 1) and then a run command is given, the acceleration ramp is 0.1 s. The deceleration ramp will be 0.1 s when the run command is removed.

If a run command is given and then the Jog contact is closed (set to state 1):

- The acceleration ramp is 0.1 s if the motor speed is less than the programmed Jog speed.
- The deceleration ramp is followed if the motor speed is higher than the programmed Jog speed.

When the Jog contact is opened (set to state 0), the ACC and dEC ramp settings are used to adjust the motor speed.

The following Jog parameters are modifiable in the *2—Adjust* menu:

- Jog frequency (JOG)
- Delay between jog cycles (JGt)

+Speed/–Speed

Listed below are the two types of operation for +Speed/–Speed. In both, the maximum speed is set by the reference speeds at the analog inputs. (For example, if 60 Hz is the desired maximum speed, a jumper can be installed from +10 Vdc to AI1.)

- Using pushbuttons. Two logic inputs are required in addition to the run direction inputs. The +Speed input increases the speed and the –Speed input decreases the speed. If logic inputs are assigned to +Speed/–Speed, the Str parameter appears in the *4—Control* menu, allowing the reference speed to be saved (see page 44).

  NOTE: When three-wire control is selected, –Speed is automatically assigned to the next input after the one assigned to +Speed.

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- Using selector switches. Only one logic input, assigned to +Speed, is required. When using selector switches, there is one position for each rotation direction.

  NOTE: This type of operation is not compatible with three-wire control.

  The Save Reference (SAVE) parameter can be used to save the last speed reference when the run command is removed or when the power is removed.

Figures 18 and 19 illustrate wiring and timing for the +Speed/–Speed function.

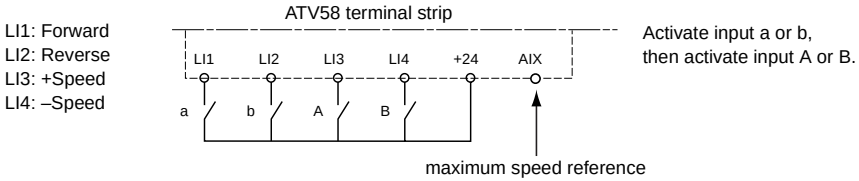
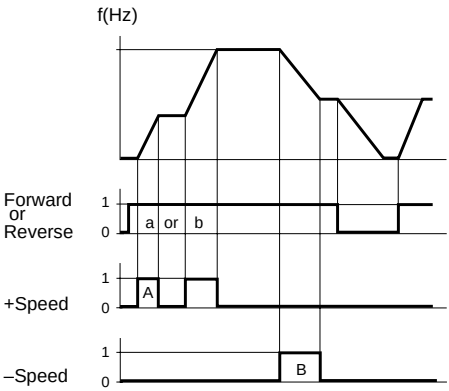


Figure 18: +Speed/–Speed Wiring Diagram



NOTE: To reassign the logic inputs to a function other than +Speed/–Speed, you must clear –Speed first.

Figure 19: +Speed/–Speed Timing Diagram

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Figures 20 and 21 show a wiring example and timing diagram for +Speed using selector switches. This function requires a maximum speed reference input.

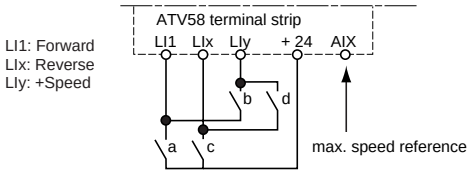

Figure 20: Wiring Example for +Speed (Selector Switches)

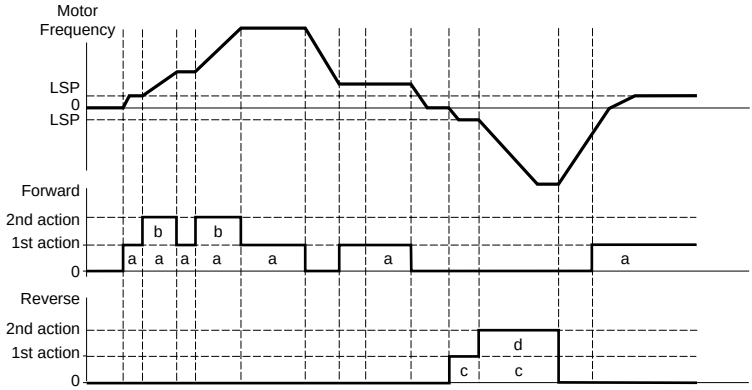

Figure 21: +Speed Timing Diagram (Selector Switches)

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Using Single-Action Pushbuttons for +Speed/–Speed with Reference Saving

This section describes the use of the SAVE save reference parameter in the *4—Control* menu.

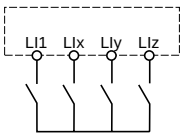
When using single-action pushbuttons for +Speed/–Speed, two logic inputs are required in addition to the operating direction(s).

- The input assigned to the +Speed command increases the speed.
- The input assigned to the –Speed command decreases the speed.

Keep in mind the following points:

- The minimum rotation speed is limited to LSP.
- If SAVE = No, RAM, or EEP, the analog references fix the maximum rotation speed (for example, by connection of AI1 to +10 V). If the reference decreases and drops below the rotation speed, the rotation speed follows the reference. The valid acceleration parameter (ACC/dEC or AC2/dC2) gives the rate of increase.
- If SAVE = SRE, HSP fixes the maximum rotation speed. When the run command is issued, the drive controller changes to the setpoint reference following the ACC/dEC ramps. Pressing +Speed/–Speed varies the speed around this setpoint following the AC2/dE2 ramps.
- –Speed has priority over +Speed.
- Parameter SrP in the *2—Adjust* menu limits +Speed/–Speed adjustment around the setpoint by a percentage of the setpoint.
- If the reference changes, the ratio between the reference and the setpoint resulting from the +Speed/–Speed correction is maintained.

Figure 22 shows wiring examples for +Speed/–Speed with single-action pushbuttons.



LI1: Forward
LIx: Reverse
LIy: +Speed
LIz: –Speed

Figure 22: Wiring Examples

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Figure 23 gives an example of timing when using +Speed/–Speed with single-action pushbuttons and $5Er$ = No.

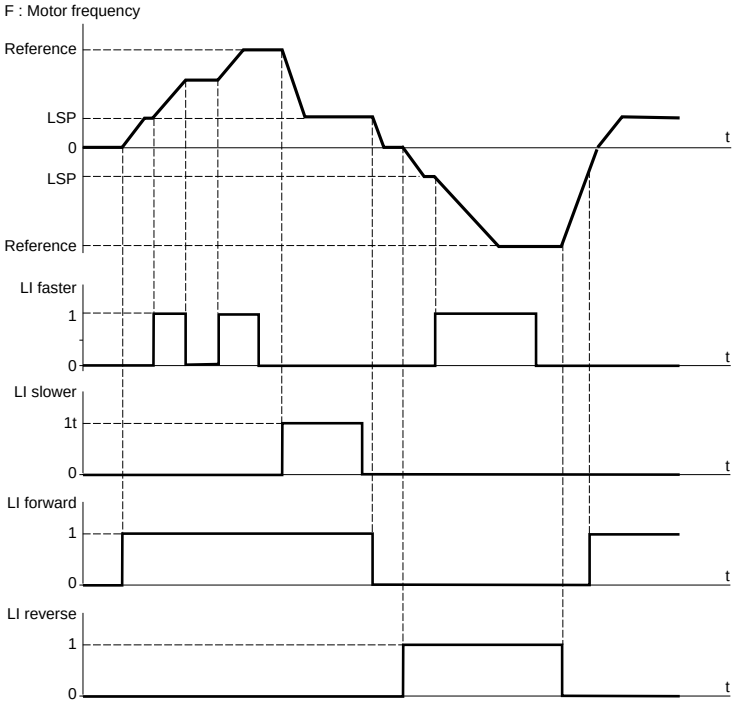

Figure 23: Timing Diagram ($5Er$ = No)

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Figure 24 gives an example of timing when using +Speed/–Speed with single action pushbuttons and reference saving by $5Er$ = RAM or $5Er$ = EEP. Note that in both cases, when pressing the +Speed or –Speed pushbuttons, the speed reference is saved when the pushbutton is released.

- $5Er$ = RAM (saved in RAM): After a stop **without** the drive controller being powered down, when a run command appears the frequency increases to the saved value if the +Speed/–Speed commands are not active. +Speed/–Speed still have priority.
- $5Er$ = EEP (saved in EEPROM): After a stop **with or without** the drive controller being powered down, when a run command appears the frequency increases to the saved value if the +Speed/–Speed commands are not active. +Speed/–Speed still have priority.

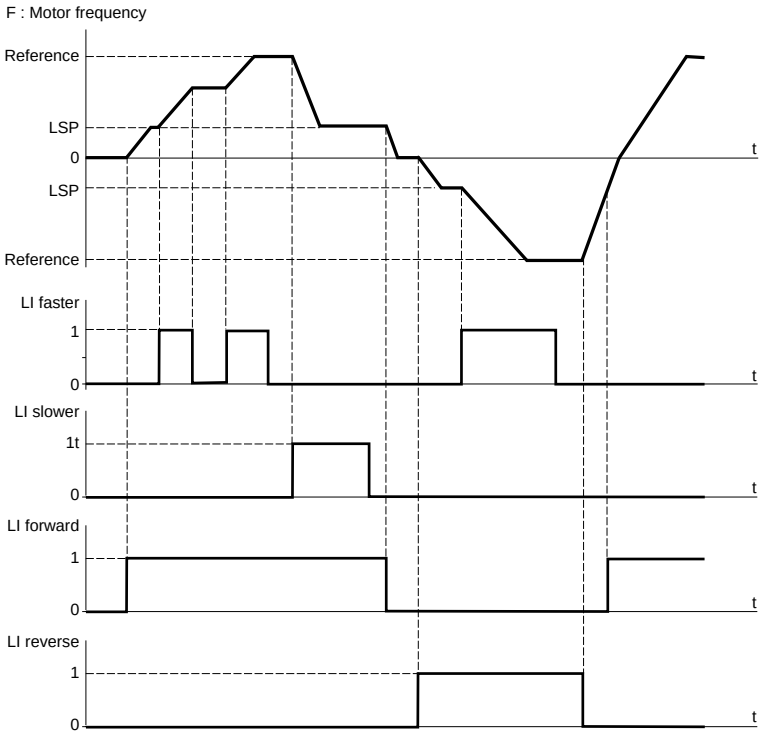

Figure 24: Timing Diagram ($5Er$ = RAM or EEP)

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Figure 25 gives an example of timing when using +Speed/–Speed with single-action pushbuttons and no reference saving (5tr = SRE). Adjustments around the setpoint using +Speed and –Speed are made following the AC2 and dE2 ramps.

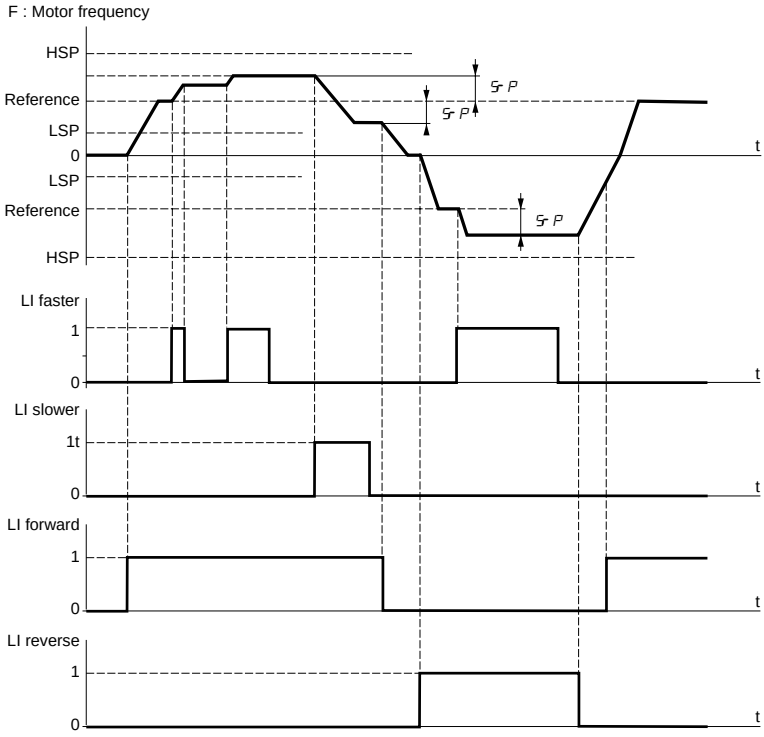

Figure 25: Timing Diagram (5tr = SRE)

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Preset Speeds

Table 19 shows how the logic inputs are configured for preset speeds and the input states that activate them. Two, four, or eight speeds can be preset, requiring one, two, or three logic inputs, respectively.

Table 19: Preset Speed Logic

2 Preset Speeds		4 Preset Speeds			8 Preset Speeds			
Assign LIx to PS2.		Assign LIx to PS2, then LIy to PS4.			Assign LIx to PS2, then LIy to PS4, then LIz to PS8.			
LIx	**Speed reference**	**LIy**	**LIx**	**Speed reference**	**LIz**	**LIy**	**LIx**	**Speed reference**
0	LSP + AI reference	0	0	LSP + AI reference	0	0	0	LSP + AI reference
1	HSP	0	1	SP2	0	0	1	SP2
		1	0	SP3	0	1	0	SP3
		1	1	HSP	0	1	1	SP4
					1	0	0	SP5
					1	0	1	SP6
					1	1	0	SP7
					1	1	1	HSP

NOTE: To reassign the logic inputs to a function other than preset speeds, clear PS8 (LIz), then PS4 (LIy), then PS2 (LIx).

Reference Switching (Auto/Manual)

This function enables switching between two references (at AI1 and AI2) by a logic input command. This function automatically assigns AI2 to Speed Reference 2.

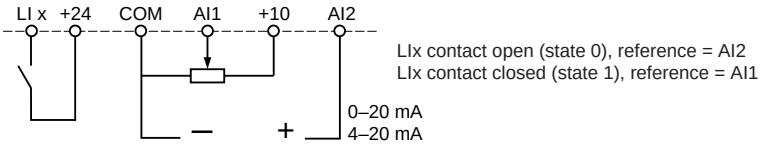

Figure 26: Reference Switching Wiring Diagram

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Freewheel Stop (Coast to Stop)/Run Permissive

A logic input can be assigned to the Freewheel Stop/Run Permissive (NST) function. The drive controller does not run until the logic input is closed (set to state 1). Opening the logic input assigned to the function (setting it to state 0) causes the drive controller to stop applying power to the motor and the motor to coast to a stop. When the logic input is open, nSt is displayed in the Drive state screen on the keypad display to indicate that a freewheel stop has been requested. The drive controller will not run until the logic input is closed. This can be used with the Forced Local function for drive controllers on communication networks.

DC Injection Braking

DC injection braking can be activated at the end of each stop cycle (AdC=Yes), or it can be obtained by closing the logic input assigned to the DC Injection Braking function (setting it to state 1).

Fast Stop

⚠ WARNING

EXTENDED STOPPING TIME

Deceleration time during fast stop may be automatically extended depending on the braking ability of the drive controller. A dynamic brake or mechanical stopping/holding brake may be required for consistent stopping times independent of motor load conditions. Fast stop does not function during loss of power or drive controller fault.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Fast stop is a controlled deceleration stop with the deceleration ramp time reduced by a programmable coefficient (see dCF on page 37). Fast stop is obtained by opening the logic input assigned to the function (setting it to state 0).

Open Loop/Closed Loop Switching

This function is used to switch between open loop and closed loop control mode. It is available only if parameter Ctr is set to closed loop (FVC) in the *3—Drive* menu. All adjustments and performance optimization must be conducted in closed loop mode (see “Performance Optimization” on page 8).

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To switch the control mode, stop the drive controller and remove the run commands. Then change the state of logic input CHP.

Second Torque Limit

Second torque limit reduces the maximum motor torque when the logic input is closed (state 1). The tL2 parameter in the *2—Adjust* menu must be modified from the default value for this function to take effect.

Fault Reset

Fault reset clears the fault message and resets the drive controller if the cause of the fault has disappeared. Two types of reset are possible: partial or total. This is determined by the rSt parameter in the Fault menu. For a partial reset (rSt = RSP), the following faults are reset and cleared from the display:

- mains overvoltage
- DC bus overvoltage
- output phase loss
- ramp not followed
- communication fault
- motor overload
- loss of 4–20 mA
- external fault
- motor overheating
- serial link fault
- drive controller overheating
- overspeed

For a total reset (rSt = RSG), all faults except SCF (motor short circuit) are ignored (permitting continuous operation of the controller) as long as the logic input assigned to Fault Reset remains active (state 1).

CAUTION

MOTOR OVERHEATING

Repeated reset of the thermal state after a thermal overload can result in thermal stress to the motor.

When faults occur, promptly inspect the motor and driven equipment for problems (locked shaft, mechanical overload, etc.) before restarting. Also check the power supplied to the motor for abnormal conditions (phase loss, phase imbalance, etc.).

Failure to follow this instruction can result in equipment damage.

Force to Local

This function permits the transfer of control from serial link command to local command (using the keypad or terminal strip, depending on the setting of the LCC parameter in the *4—Control* menu). Assigning this parameter selects local command when the logic input is closed (state 1).

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Auto-tuning

When the assigned logic input changes to state 1, an auto-tune is performed in the same way as setting parameter tUn to Yes in the *3—Drive* menu. Auto-tuning is performed only if no other command has been activated.

If a Freewheel Stop or Fast Stop function is assigned to a logic input, this input must be closed (set to state 1) for the auto-tune to occur.

Reference Saving

This parameter saves the speed reference value of the analog input using a logic input as a trigger. Observe the following points:

- This function is used to control the speed of several drive controllers alternately via a single analog setpoint and a logic input for each controller.
- It is also used to confirm a line reference (serial link) on several drive controllers via a logic input. This allows movements to be synchronized by getting rid of variations when the reference is sent.
- The setpoint is acquired 100 ms after the logic input is detected at state 1. The reference remains at this point until the logic input transitions again from 0 to 1 and remains at 1 for more that 100 ms.

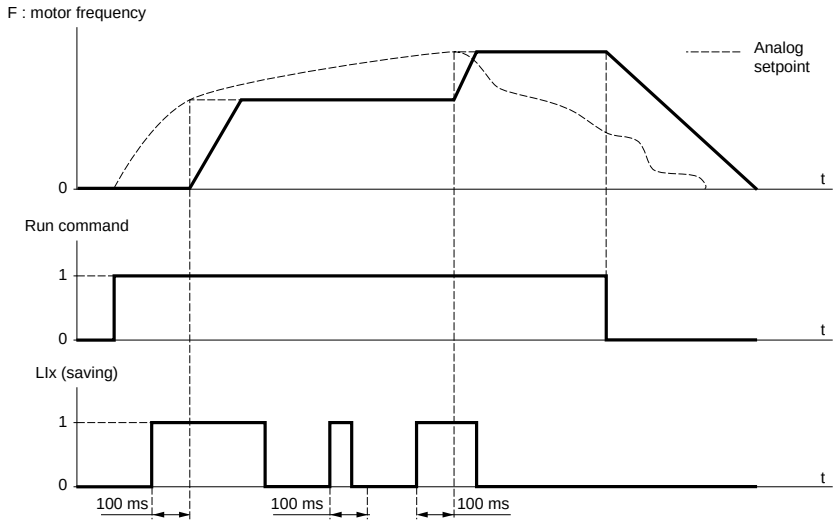

Figure 27: Reference Saving

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Motor Fluxing

Motor fluxing can improve acceleration response time by establishing magnetic flux in the motor before it receives a run command. There are three motor fluxing options:

- Continuous mode (FCT): Flux is established and maintained in the motor as long as power is applied to the drive controller.
- Motor fluxing by logic input: A logic input is assigned to the motor fluxing function. When the assigned logic input is active (state 1), flux builds in the motor.

> **CAUTION**
>
> **MOTOR OVERHEATING**
>
> When parameter FLU is set to FCT (continuous flux), voltage and current are applied to the motor even when the motor is stopped and the run command is removed. Ensure that the motor can withstand the heat generated under this condition.
>
> **Failure to follow this instruction can result in equipment damage.**

- Normal operation: If the logic input is inactive (state 0) when a run command is given, or if no logic input has been assigned to the function (FLU = FNC), flux builds in the motor when it starts up. This is the factory setting.

The flux current is equal to 1.5 x nCr (configured nominal motor current) until full flux is established; it is then adjusted to the motor no-load current.

Motor fluxing can be selected in open or closed loop operation.

Auto/Man PID, PID Integral Shunting, and Preset PID Setpoints

Refer to “PI Regulator” on page 64.

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Encoder Inputs Using I/O Extension Card VW3A58202U

Speed Regulation

To improve speed regulation in applications with frequent load variations, use these inputs to connect an encoder. To program the encoder speed feedback, configure AI3 in the *5—I/O* menu for RGI: Encoder Feedback. Then configure the encoder type (PGE) and number of pulses (PLS) in the *3—Drive* menu.

The A, A–, B, and B– inputs on the I/O option card are for use in both the forward and reverse directions. Using the A input with an inductive sensor or photoelectric detector provides simplified but less accurate regulation in one rotation direction only.

Summing Speed Reference

The feedback from the encoder inputs is summed with AI1.

Using the Analog Inputs

The AI1 input is set for speed reference unless the PI regulator function is enabled. In this case, AI1 is used for the PI set point reference. The possible assignments of AI2 and AI3 are Speed Reference Summing and PI Regulator.

Speed Reference Summing

The frequency references at AI2 can be summed with those at AI1 and/or AI3.

PI Regulator

Used to regulate a process with a reference and a feedback given by a sensor. A speed input gives an initial (or predictive) setpoint for start-up. In PID mode the ramps are all linear, even if they are configured differently.

See Figure 28 on page 65 for a diagram of the PID principle. See Table 20 on page 66 for a summary of the components of the PI regulator function.

NOTE: PID regulator mode is active if AI is assigned to PID feedback.

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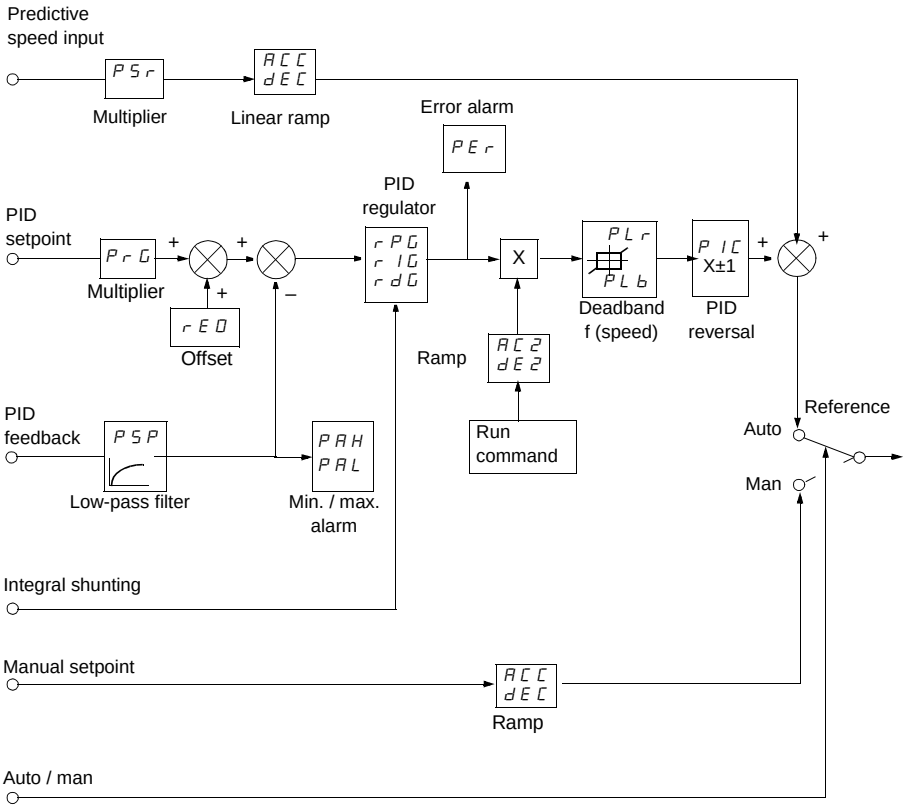

Figure 28: Diagram of PID Principle

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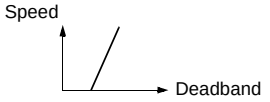
Table 20: Summary of PI Regulator Function

<table>
<tr><td>Speed input</td><td>Line setpoint (serial link) or analog input AI3.</td></tr>
<tr><td>PID setpoint</td><td>Line setpoint (serial link), or 2 or 4 setpoints preset via logic input, or analog input AI1 (± AI2 ± AI3).</td></tr>
<tr><td>PID feedback</td><td>Analog input AI2 or analog input AI3.</td></tr>
<tr><td>Manual setpoint</td><td>(Speed regulation mode.) Analog input AI3.</td></tr>
<tr><td>Integral shunting</td><td>Logic input LI. Integral shunted if LIx is equal to 1.</td></tr>
<tr><td>Auto/man</td><td>Logic input LI for switching operation to speed regulation (manual) if LIx = 1, or PID regulation (auto) if LIx = 0.

In automatic mode the following actions are possible:
• Adapt the setpoint input to the process feedback: GAIN (PrG) and OFFSET (rE0).
• Correct PID inversion.
• Adjust the proportional, integral and derivative gain (rPG, rIG and rdG).
• Use the “alarm” on logic output if a threshold is exceeded (Max. feedback, Min. feedback and PID error).
• Assign an analog output for the PID setpoint, PID feedback and PID error.
• Limit the action of the PID according to the speed, with an adjustable base and ratio:
 

• Apply a ramp to establish the action of the PID (AC2) on start-up and a ramp (dE2) on stopping.

The motor speed is limited to a value between LSP and HSP, and is displayed as a percentage.</td></tr>
<tr><td>Preset setpoints</td><td>2 or 4 preset setpoints require the use of 1 or 2 logic inputs respectively

<table>
<tr><td colspan="2">2 preset setpoints</td><td colspan="3">4 preset setpoints</td></tr>
<tr><td colspan="2">Assign: LIx to Pr2</td><td colspan="3">Assign: LIx to Pr2, then LIy to Pr4</td></tr>
<tr><td>LIx</td><td>Reference</td><td>LIy</td><td>LIx</td><td>Reference</td></tr>
<tr><td>0</td><td>Analog reference</td><td>0</td><td>0</td><td>Analog reference</td></tr>
<tr><td>1</td><td>Process max.</td><td>0</td><td>1</td><td>PI2 (adjustable)</td></tr>
<tr><td></td><td></td><td>1</td><td>0</td><td>PI3 (adjustable)</td></tr>
<tr><td></td><td></td><td>1</td><td>1</td><td>Process max.</td></tr>
</table></td></tr>
</table>

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Assignment of AI2 and AI3

Summing speed reference: The frequency setpoints given by AI2 and AI3 can be summed with AI1.

Speed regulation with tachogenerator (Assignment on AI3 only with I/O extension card VW3A58201U):

An external divider bridge is required to adapt the voltage of the tachogenerator. The maximum voltage must be between 5 and 9 V. A precise setting is then obtained by setting the dtS parameter available in the *2—Adjust* menu.

PTC probe processing (only with an I/O extension card using the analog input): Connect the PTC probes in the motor windings to analog input AI3 for direct thermal protection of the motor.

Total resistance of the probe circuit at 20 °C = 750 Ω.

Torque limit: (Assignment on AI3 only with I/O extension card VW3A58201U):

The signal applied at AI3 operates in a linear fashion on the internal torque limit (parameter tLI in the *3—Drive* menu):

— If AI3 = 0 V, limit = tLI x 0 = 0
— If AI3 = 10 V, limit = tLI.

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Using the Control Card Encoder Inputs (Closed Loop FVC)

Use the encoder inputs on the control card (inputs A, A–, B, B–) for fine speed adjustments (irrespective of the state of the load) and for control optimization. Set the flux vector control mode, CLr in the *3—Drive* menu, to closed loop. Note the following points:

- Consistency between the drive controller output frequency and the speed feedback from the encoder is monitored in the drive controller fault management system.
- If there is no encoder signal (closed loop mode) or in the event of inconsistency, the drive controller experiences a speed feedback fault condition and displays fault code SPF.
- During operation, if the difference between the motor frequency and the speed feedback is greater than 5 Hz, the drive controller experiences a speed feedback fault condition and displays fault code SPF.
- If the speed feedback is greater than 1.2 x tFr (maximum frequency setting), the drive controller experiences an overspeed fault condition and displays fault code SOF.

⚠ CAUTION

MISIDENTIFICATION OF INPUT TERMINALS

The encoder input terminals on the I/O extension card are identified in the same way as the encoder input terminals on the control card (A, A–, B, B–). Suitable precautions should be taken to avoid any possible confusion, and the terminals should be checked before setup.

Failure to follow this instruction can result in injury or equipment damage.

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Using the Controller Relay and Logic Outputs

The relay R2 on the drive controller or the logic output (LO) on an option card can be configured as follows:

Output Contactor Command (OCC)—The Output Contactor Command function allows the drive controller to operate a contactor between the controller and the motor. The controller closes the contactor when a run command is given. When there is no longer any current in the motor, the controller opens the contactor. When using an output contactor, set output phase loss (OPL) to No.

NOTE: If braking by DC injection is configured, do not exceed the contactor rating; otherwise, the contactor will not open until the end of braking.

Drive Running (RUN)—The logic output is active (state 1) if the motor is being fed by the drive controller (current present) or if a run command is active, even with a zero speed reference.

Frequency Threshold Attained (FTA)—The logic output is active (state 1) if the motor frequency is greater than or equal to the frequency threshold set by the FTd parameter in the *2—Adjust* menu**.**

Frequency Reference Attained (SRA)—The logic output is active (state 1) if the motor frequency is equal to the speed reference value.

High Speed Attained (FLA)—The logic output is active (state 1) if the motor frequency is equal to the high speed value (HSP).

Current Threshold Attained (CTA)—The logic output is active (state 1) if the motor current is greater than or equal to the current threshold set by the CTd parameter in the *2—Adjust* menu.

Thermal State Attained (TSA)—The logic output is active (state 1) if the motor thermal state meets or exceeds the thermal state set by ttd parameter in the *2—Adjust* menu.

PID Error (PEE)—This is assignable to R2 or LO. The logic output is active (state 1) if the PID regulator output error exceeds the threshold set by parameter PEr .

PID Feedback Alarm (PFA)—This is assignable to R2 or LO. The logic output is active (state 1) if the PID feedback moves outside the range set by parameters PAH and PAL .

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Brake Logic Command (BLC)—This parameter allows the drive controller to manage a mechanical brake. It is assignable to R2. Figures 29 and 30 on pages 71 and 72 show timing diagrams for brake logic. Figure 29 shows the braking sequence in open loop mode and Figure 30 in closed loop mode.

Below are the recommended settings for brake control in a vertical lifting application. (In horizontal applications, set IbR to 0 and bIP to No.)

- Brake pulse (bIP): Yes. Ensure that when the drive controller is set to Run Forward, the direction of rotation corresponds to the direction for lifting the load.
- Brake release current (IbR): Adjust the brake release current to the nominal current indicated on the motor. The brake release current can be adjusted up to the drive controller's maximum value.
- Acceleration time: For lifting applications, set the acceleration ramps to more than 0.5 seconds. The drive controller must never enter into the current limit state. The same recommendation applies for deceleration. *NOTE: Use a braking resistor in lifting applications. Ensure that the settings and configurations selected cannot cause a drop or a loss of control of the lifted load.*
- Brake release delay (brt): The time required for the mechanical brake to open. Adjust according to the type of brake.
- Brake engage frequency (bEn): Available in open loop mode (CLr = open loop in the *3—Drive* menu). Preset to twice the nominal slip, then adjust for the smoothest brake performance.
- Brake engage delay (bEt): This is the time required for the mechanical brake to close. Adjust according to the closing time for the type of brake used.

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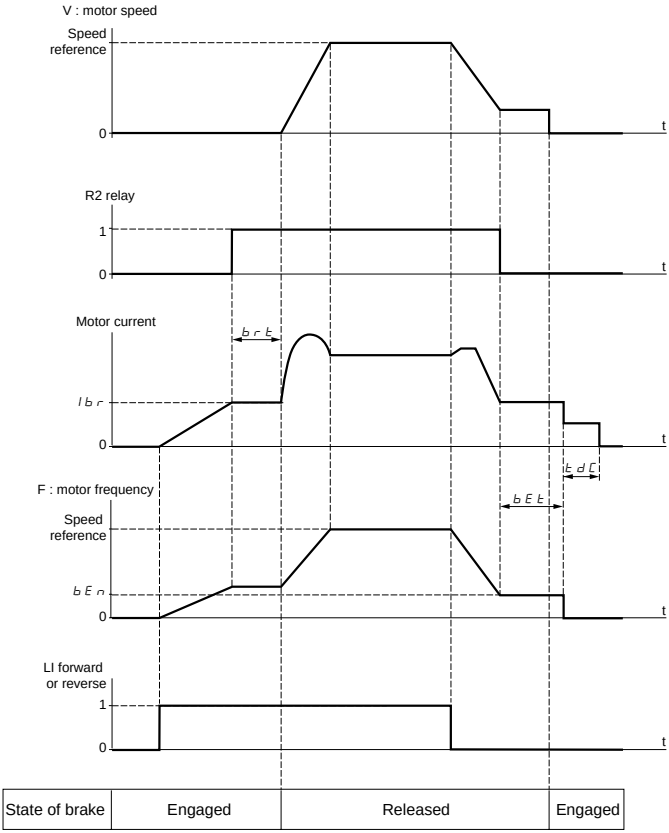

Figure 29: Braking Sequence in Open Loop Mode

Settings which can be accessed in the *2—Adjust* menu when in the open loop mode are as follows:

- Brake release delay time (brt).
- Brake release current (Ibr).
- Brake engage frequency (bEn).
- Brake engage delay time (bEt).
- DC injection braking time on stopping (tdC).
- Brake pulse (b IP). When set to Yes, it always gives a motor torque in the forward direction before the brake is released, which should correspond to the up direction for vertical lifting. When set to No, the torque direction corresponds to the requested operating direction. Use No for horizontal movement.

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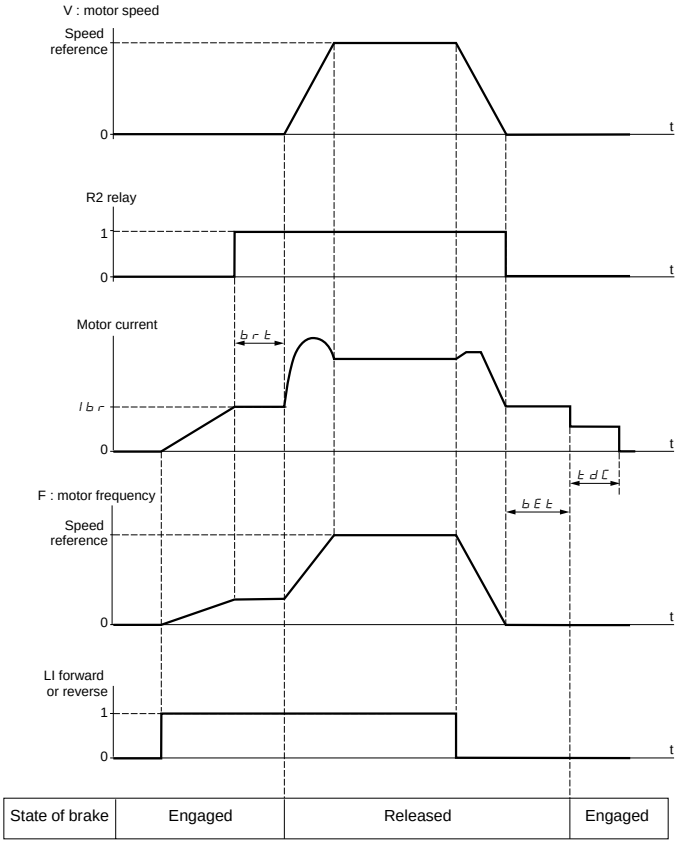

Figure 30: Braking Sequence in Closed Loop Mode

The following settings are accessible in the *2—Adjust* menu when in the closed loop mode:

- Brake release delay (brt).
- Brake release current (Ibr).
- Brake engage delay (bEt).
- Brake pulse (b IP). When set to Yes, it always gives a motor torque in the forward direction before the brake is released, which should correspond to the up direction for vertical lifting. When set to No, the torque direction corresponds to the requested operating direction. Use No for horizontal movement.
- Zero speed maintain-time in stop mode (tdC).

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Using the Analog Output(s) on the Basic Controller and I/O Extension Cards

The analog outputs on the basic controller and on the analog and digital I/O extension cards are current outputs. The minimum and maximum values are configurable, each with a range of 0–20 mA.

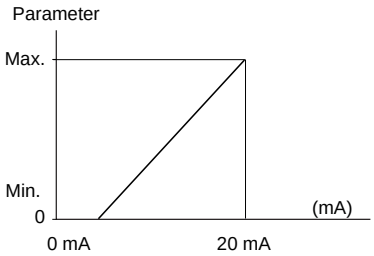

Figure 31: Analog Output Minimum and Maximum Values

Motor Current (Code OCR)—When configured for motor current, the analog output provides a signal proportional to motor current.

- The minimum configured value corresponds to zero current.
- The maximum configured value of the analog output corresponds to 200% of the drive controller's constant torque output current rating.

Output Frequency (Code OFR)—When configured for output frequency, the analog output provides a signal proportional to the motor frequency estimated by the drive controller.

- The minimum configured value corresponds to zero.
- The maximum configured value of the analog output corresponds to the maximum frequency setting (*tFr*), not the high speed setting (*HSP*).

Ramp Output (Code ORP)—When configured for ramp output, the analog output provides a signal proportional to the drive controller's internal frequency ramp.

- The minimum configured value corresponds to zero.
- The maximum configured value of the analog output corresponds to the maximum frequency setting (*tFr*), not the high speed setting (*HSP*).

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Motor Torque (Code TRQ)—When configured for motor torque, the analog output provides a signal proportional to motor torque as an absolute value.

- The minimum configured value corresponds to zero.
- The maximum configured value of the analog output corresponds to 200% of the nominal motor torque.

Signed Motor Torque (Code STQ)—When configured for signed motor torque, the analog output provides a signal proportional to motor torque and an indication of braking torque or motoring torque.

- The minimum configured value corresponds to 200% braking torque.
- The maximum value of the analog output corresponds to 200% of the nominal torque.
- Zero torque corresponds to (minimum value + maximum value) ÷ 2.

Signed Ramp (Code ORS)—When configured for signal ramp, the analog output provides a signal proportional to the drive controller's internal frequency ramp. This output is scaled to indicate rotation direction.

- AOL corresponds to the maximum frequency (parameter tFr) in the reverse direction.
- AOH corresponds to the maximum frequency (parameter tFr) in the forward direction.
- Zero frequency corresponds to (AOH+AOL) ÷ 2.

PID Setpoint (Code OPS)—The image of the PID regulator setpoint.

- AOL corresponds to the minimum setpoint.
- AOH corresponds to the maximum setpoint.

PID Feedback (Code OPF)—The image of the PID regulator feedback.

- AOL corresponds to the minimum feedback.
- AOH corresponds to the maximum feedback.

PID Error (Code OPE)—The image of the PID regulator error as a percentage of the sensor range (maximum feedback minus minimum feedback).

- AOL corresponds to –5%.
- AOH corresponds to +5 %.
- Zero corresponds to (AOH+AOL) ÷ 2.

PID Integral (Code OPI)—The image of the PID regulator error integral.

- AOL corresponds to LSP.
- AOH corresponds to HSP.

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6—FAULT MENU

This menu is only accessible when the access locking switch is in the position. Modifications can only be made when the motor is stopped and run commands are removed.

Menu 6

Table 21: 6—Fault Menu

Parameter	Code	Description	Adjustment Range	Factory Setting
Auto Restart	AtR	In **two-wire control** mode, this function allows the drive controller to automatically restart if the cause of the fault is corrected and a run command is maintained. An automatic restart is possible after the following faults: • Input overvoltage • DC bus overvoltage • External fault • Serial link fault • Loss of 4–20 mA follower • Motor overload (after the thermal state has decreased below 100%) • Drive controller overheating (when the thermal state has decreased below 70%) • Motor overheating (when the thermal sensor resistance is less than 1500 ohms) • Communication fault *An automatic restart is not possible in three-wire control mode.*	Yes or No	No

NOTE: When automatic restart is active, the fault relay remains energized. When the fault is corrected, the drive controller attempts to restart the motor after a delay of 30 s. If the fault condition remains after six restart attempts, the fault relay de-energizes and the drive controller can only be reset by cycling the power.

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

Automatic restart can only be used for machines or installations that present no danger in the event of automatic restarting, either for personnel or equipment.

Equipment operation must conform with national and local safety regulations.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

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Menu 6

NOTE: Reset Type is accessible if the Reset Fault function is assigned to a logic input.

Table 21: 6—Fault Menu (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Reset Type	rSt	• Faults reset by a partial reset (rSt = RSP) are: • OSF overvoltage • ObF overbraking • OtF motor overheating • LFF loss of 4–20 mA • OLF motor overload • rnF ramp not followed • OFF motor phase loss • OHF drive overheating • SLF loss of RS485 • EPF external fault Faults reset by a total reset (rSt = RSG) are all faults except motor short circuit fault. Total reset overrides all other faults. To configure rSt to RSG: 1. Display RSG 2. Press the ENT key. 3. The drive displays “See manual”. 4. Press the up arrow key, then the down arrow key, then ENT twice.	RSP (partial reset) RSG (total reset)	RSP

CAUTION

MOTOR OVERHEATING

Repeated reset of the thermal state after a thermal overload can result in thermal stress to the motor.

When faults occur, promptly inspect the motor and driven equipment for problems (locked shaft, mechanical overload, etc.) before restarting. Also check the power supplied to the motor for abnormal conditions (phase loss, phase imbalance, etc.).

Failure to follow this instruction can result in equipment damage.

OutPhaseLoss	OPL	Allows activation of output phase loss fault detection. *The parameter should be set to* No *if there is a contactor between the drive controller and the motor.*	Yes or No	Yes
InPut Phase Loss	IPL	Allows activation of input phase loss fault detection.	Yes or No	Yes

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Menu 6

Table 21: 6—Fault Menu (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
ThermalProType	tHt	This function defines the type of thermal protection carried out by the drive controller. • No: No motor thermal protection. • ACL: Self-cooled motor. Thermal protection is a function of output frequency. The lower the output frequency, the lower the thermal trip threshold. • FCL: Force-cooled motor. Thermal protection is independent of output frequency.	No, ACL, FCL	ACL
LossFollower	LFL	Allows activation of a loss of 4–20 mA follower fault. This fault can only be configured if the minimum and maximum reference parameters for AI2 (CrL and CrH) are greater than 3 mA. If CrL > CrH, LFL is automatically set to Yes.	Yes or No	No
Catch On Fly	FLr	Allows a smooth restart after a: • Brief loss of input power • Fault reset or automatic restart • Freewheel stop or DC injection braking with a logic input • Momentary interruption of the drive controller output If relay R2 is assigned to the brake logic function, FLr is always set to No.	Yes or No	No

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

Automatic catch on the fly can only be used for machines or installations that present no danger in the event of automatic restarting, either for personnel or equipment.

Equipment operation must conform with national and local safety regulations.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

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Menu 6

Table 21: 6—Fault Menu (Continued)

Parameter	Code	Description	Adjustment Range	Factory Setting
Cont. Stop	StP	Controlled stop upon loss of input phase. This function is only operational if the IPL parameter (Input Phase Loss) is set to No. If IPL is set to Yes, leave StP set to No. • No: loss of input phase causes drive to trip • NMS: Maintaining DC bus: the DC bus is kept energized by regenerating the kinetic energy from the machine inertia, until the USF (Undervoltage) fault appears. • FRP: Following a ramp: deceleration following the programmed ramp, either dEC or dE2 until the motor stops or the USF (Undervoltage) fault appears.	No, NMS, FRP	No
RampNotFoll	Sdd	This function can be accessed if feedback via tachogenerator or pulse generator is programmed. When enabled, it is used to trip the drive controller if a speed error is detected (difference between the stator frequency and the measured motor shaft speed).	Yes or No	No

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7—FILES MENU

The *7—Files* menu is accessible when the access locking switch is set to the position. Changes can only be made when the motor is stopped and run commands removed.

The keypad display can store four drive controller configuration files.

Menu 7

Table 22: 7—Files Menu

Parameter	Code	Description	Adjustment Range	Factory Setting
File 1 State File 2 State File 3 State File 4 State	F 1S F 2S F 3S F 4S	Displays the state of the corresponding file. FRE: File free EnG: A configuration has already been saved in this file	FRE ENG	FRE FRE FRE FRE
OPerat. TyPe	F 0t	Allows selection of the following file operations: • No: no operation requested (default value each time the keypad display is connected to the drive controller). • STR: save the configuration in a keypad file. • REC: transfer a keypad file to the drive controller. • INI: return the drive controller to the factory settings.	No STR REC INI	No

NOTE: The stored program is substituted for present settings when a file is transferred to the drive controller.

NOTE: Factory default settings are substituted for present settings when INI is selected and confirmed by pressing ENT twice when prompted.

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

The factory default settings or the settings in a transferred file may not be compatible with the application. After changing the controller program, verify that the settings are compatible with the application requirements. Set all unused I/O functions to Not Assigned.

If the stop key is disabled in a stored file, this will be transferred if the file is downloaded. An external stop command must be installed to stop the motor.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Password	C 0d	See “Access Code” on page 81.

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Re-initializing the Drive Controller

Figure 32 shows the process of storing and recalling files to re-initialize the drive controller. Follow the path indicated by the bold lines.

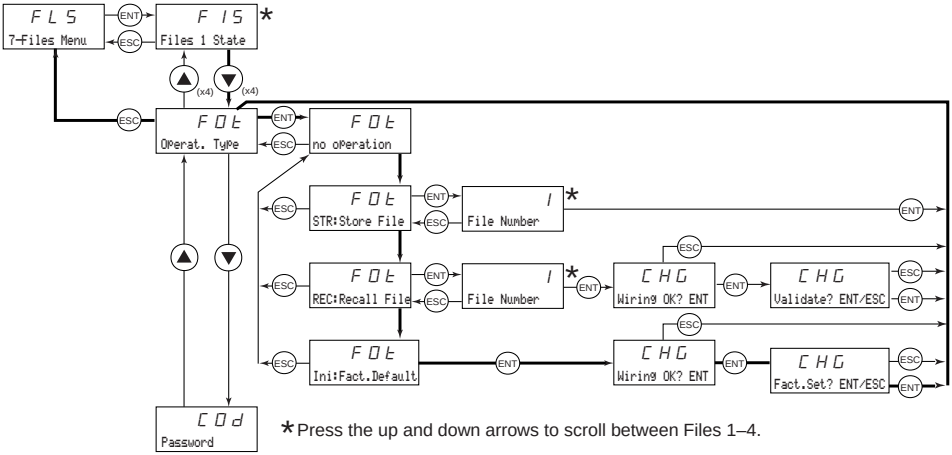


Figure 32: Re-initializing the Drive Controller

File Operation

To store or recall a file:

- Select STR to store a file or REC to recall a file.
- Select File number to specify the file.
- If Operation = STR: the display automatically returns to the Operation parameter, set to No.
- If Operation = REC, a second confirmation must be made:

  The display indicates:

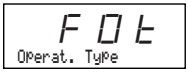
  Press ENT to confirm.

  The display then indicates:

  Press ENT to confirm.

  The display automatically returns to:

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Access Code

You can use this parameter to protect the drive controller configuration with a user-assigned access code (password).

Table 23: Access Code

Parameter	Code	Description	Factory setting
Config. Code	COd	Configuration code used as an access code.	0000

NOTE: Use this parameter with caution. It can prohibit access to parameters. Carefully note and save any modification of this parameter value.

The access code is expressed with four digits. The left-most three act as a user-assigned password and do not affect the access level. The fourth digit can range from 0 to 9 and determines which menus can be accessed for display or modification. Table 24 explains the access levels.

NOTE: The access code can limit the menu access allowed by the locking switch setting.

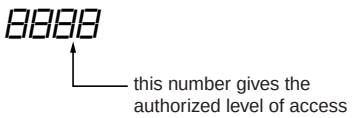

Figure 33: Access Code Display

Table 24: Significance of Access Code Last Digit

Menus Affected:	***Access is locked*** **if the last digit of code is:**	***Display is allowed*** **if the last digit of code is:**	***Modification is allowed*** **if the last digit of code is:**
2	0[1] or 9	1	2
2–8 and macro-configuration	0[1] or 9	3	4
8	0[1] or 9	5	6
2–8	0[1] or 9	7	8

[1] If using the factory setting (0000), access to the menus is limited only by the position of the keypad locking switch.

For example, if the access code is 2337, display of menus 2–8 is allowed, but modification is not.

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To access the menus protected by the access code, you must first enter the correct code in the *7—Files* menu. (This menu and the *1—Display menu* are always accessible, provided that the locking switch on the back of the keypad is set to the total unlock position, .)

If you enter an incorrect code, it is refused and the following message is displayed:

Figure 34: Incorrect Code Display

To clear the message, press ENT or ESC on the keypad. The value displayed by the Code parameter becomes 0000, but the level of accessibility remains unchanged. You can then try again to enter the correct code.

After entering a correct access code, you can display and change the configuration of the drive controller. Cycle the power to re-enable the protected condition.

To change an access code:

1. Select the existing code in the *7—Files* menu, then press ENT.
2. Use the ▲ and ▼ keys to change the number, then press ENT. The following message is displayed:

Figure 35: Change Access Code Display

3. Press ENT to enter the access code or ESC to abort the change.

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COMMUNICATION MENU

The Communication menu is displayed only if a communication card is installed. It is accessible when the access locking switch on the back of the keypad is set to the position. Configuration can be performed only while the motor is stopped and the run commands removed.

For information on the communication option card, refer to the instructions shipped with the card.

For information concerning communication using the RS485 port available at the keypad display mounting location, refer to VVDED397057US. For information on the drive controller, refer to the ALTIVAR 58 installation guide, bulletin no. VVDED399093US.

APPLICATION MENU

The *Application* menu is only displayed if a custom application card is installed. It is accessible when the access locking switch on the back of the keypad is set to the position. Configuration can be performed only while the motor is stopped and the run commands removed.

For more information concerning the custom application card, refer to the instructions shipped with the card.

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CHAPTER 3—DIAGNOSTICS AND TROUBLESHOOTING

KEYPAD DISPLAY AND INDICATING LEDS

When a fault condition is detected, the keypad display shows a fault code and a plain language message (as described in Table 27 on page 91) as long as power is maintained. In addition, the LEDs on the front of the drive controller indicate several states:

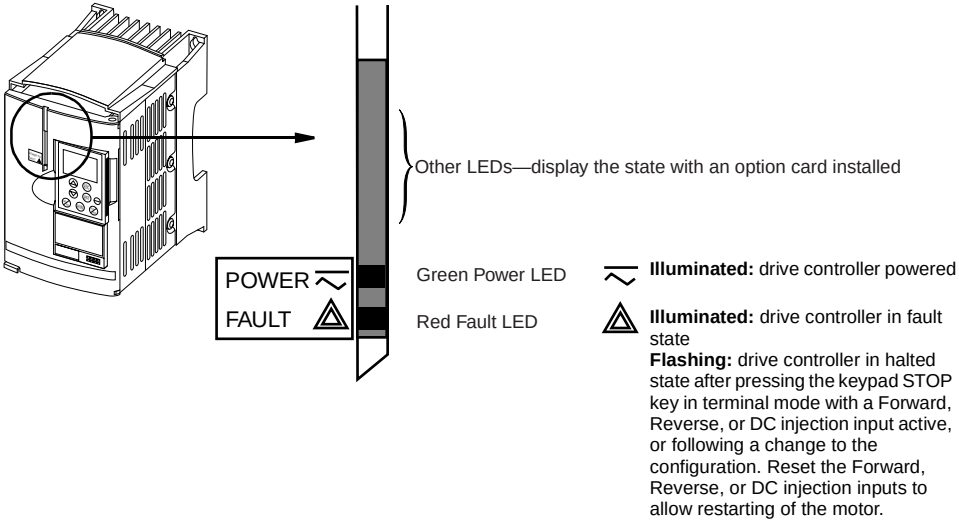

Figure 36: Location and Description of LEDs

FAULT STORAGE

If power is maintained, the first fault detected is saved and displayed on the keypad. The drive controller trips, the red fault LED illuminates, and the fault relay de-energizes. To reset the fault:

1. Remove power from the drive controller.
2. Before restoring power, identify and correct the cause of the fault.
3. Restore power. This will reset the fault if it has been corrected.

In certain cases, if automatic restart is enabled, the drive controller can automatically restart after the cause of the fault is corrected. See page 75.

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USING FAULT CODES AND MESSAGES TO SOLVE PROBLEMS

The fault messages displayed on the keypad can be used to troubleshoot problems. There are three types of faults:

- Protective faults: These faults are displayed when the drive controller detects conditions that, if left uncorrected, may result in damage to the drive controller and/or motor. The drive controller shuts down to prevent this from occurring.
- Drive faults: These faults are displayed when a problem is detected in the drive controller.
- Process faults: These faults are displayed when a process feedback or communication signal used by the drive controller is interrupted momentarily or completely.

Table 25: Fault Messages

Protective Faults	Drive Faults	Process Faults
• Input phase loss • Undervoltage • Overvoltage • Drive overheating • Motor overload • Overbraking • Motor phase loss • Overcurrent • Motor short circuit • Motor overheating • Thermal sensor fault • Overspeed • Ramp not followed	• Precharge fault • EEPROM fault • Internal fault • Internal communication fault • Power rating error • Option error • Option removed • EEPROM checks	• Loss of 4-20 mA signal • Loss of RS485 • External fault • Speed feedback fault • Communication network fault • Configuration fault

MAINTENANCE

Read the safety statements on page 87 before proceeding with any maintenance or troubleshooting procedures.

The following steps should be done at regular intervals:

- Check the condition and tightness of the connections.
- Make sure that the ventilation is effective and the temperature around the drive controller remains within specified levels.
- Remove dust and debris from the drive controller, if necessary.

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PRECAUTIONS

Table 27 on page 91 lists faults, associated codes, the probable causes of the faults, and the associated corrective action. Before taking corrective action, follow the procedures outlined on pages 87-90.

⚠ DANGER

HAZARDOUS VOLTAGE

Read and understand these procedures before servicing ALTIVAR 58 drive controllers. Installation, adjustment, and maintenance of these drive controllers must be performed by qualified personnel.

Electrical shock will result in death or serious injury.

The following procedures are intended for use by qualified electrical maintenance personnel and should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service, or maintain the equipment discussed.

PROCEDURE 1: BUS VOLTAGE MEASUREMENT

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the bus voltage measurement procedure before performing procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Electrical shock will result in death or serious injury.

The DC bus voltage level is determined by monitoring the (+) and (–) measurement points. Their location varies by drive controller model number as listed in Table 26 on page 88 and shown in Figure 37 on page 89. The drive controller model number is listed on its nameplate.

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Table 26: DC Bus Measurement Points for Different ATV58 Models

Model Number of Drive Controller ATV58FH•	+ Measurement Point		– Measurement Point	
	Terminal Block or Connector	Terminal Designation	Terminal Block or Connector	Terminal Designation
D28N4• to D79N4•	J2	+	J2	–
U18N4• to D23N4•	J2	PA	J18	7

To measure the DC bus capacitor voltage:

1. Disconnect all power from the drive controller including external control power that may be present on the control board and the option board terminals.
2. Wait three minutes for the DC bus capacitors to discharge.
3. Read the model number of the drive controller from the nameplate and identify the corresponding (+) and (–) measurement points from Table 26 above and Figure 37 on page 89.
4. Open the door or cover of the drive controller.
5. Set the voltmeter to the 1000 Vdc scale. Measure the voltage between the (+) and (–) measurement points identified in Step 3. Verify that the DC bus voltage has discharged below 45 V before servicing the drive controller.
6. If the DC bus capacitors will not discharge below 45 V, contact your local Square D representative. **Do not operate the drive controller.**
7. Replace all covers and doors after servicing the drive controller.

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The J18 connector is in the upper left hand corner of the main control board behind the flexible shield. Use a thin probe to access the connector pin.

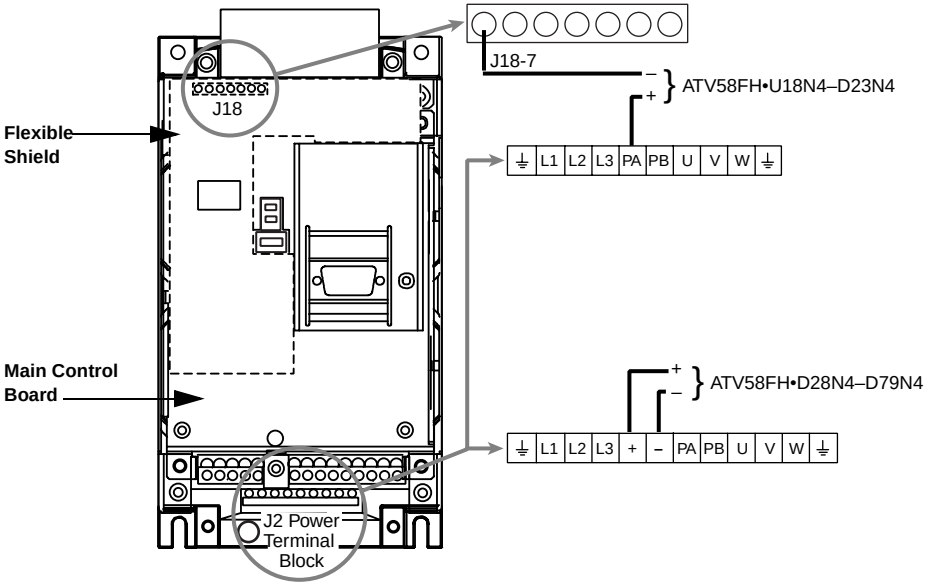

Figure 37: DC Bus Measurement Terminals

PROCEDURE 2: CHECKING THE SUPPLY VOLTAGE

Measure the input line voltage to determine whether the voltage is within the drive controller tolerance.

1. Perform the bus voltage measurement procedure on page 87.
2. Attach meter leads to L1 and L2. Set the voltmeter to the 600 Vac scale.
3. Reapply power and check for the correct line voltage, shown on the drive controller nameplate rating.
4. Remove power and repeat the procedure for L2 and L3, and L1 and L3.
5. When all phases have been measured, remove power. Remove leads and replace all covers and doors.

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PROCEDURE 3: CHECKING THE PERIPHERAL EQUIPMENT

The following equipment may need to be checked. Follow the manufacturers' procedures when checking this equipment.

1. A protective device, such as a circuit breaker, may have tripped or a fuse may have blown.
2. A switching device, such as a contactor, may not be closing at the correct time.
3. Conductors may require repair or replacement.
4. Cable connections to the motor or high resistance connections to ground may need to be checked. Follow NEMA standard procedure WC-53.
5. Motor insulation may need to be checked. Follow NEMA standard procedure MG-1. Do not apply high voltage to terminals U, V, or W (see page 89). Do not connect the high potential dielectric test equipment or insulation resistance tester to the drive controller since the test voltages used may damage the drive controller. Always disconnect the motor conductors from the drive controller while performing such tests.

CAUTION

CIRCUIT NOT ISOLATED

Any circuit requiring high potential dielectric tests must be disconnected from the drive controller prior to performing the test. Do not perform high potential dielectric tests on circuits while the circuits are connected to the drive controller.

Failure to follow this instruction can result in equipment damage.

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FAULT CODES AND MESSAGES

Table 27: Fault Codes and Messages

Fault	Probable Causes	Corrective Actions
PHF INPUT PHASE LOSS	1. Input phase loss. 2. Power fuses blown. 3. Input line failure (t>1s).	1. Check input line voltage (Procedure 2 on page 89). 2. Check fuses and circuit breaker (Procedure 3 on page 90). 3. Reset.
USF UNDERVOLTAGE	1. Supply too low. 2. Temporary voltage drop (t≥200 ms).	1. Check input line voltage (Procedure 2 on page 89).
OSF OVERVOLTAGE	1. Supply too high. See Table 28.	1. Check input line voltage (Procedure 2 on page 89). 2. Reset the drive controller.
OHF DRIVE OVERHEATING	1. Heatsink temperature too high.	1. Check motor load, fan, and ambient temperature around the drive controller. Wait for the drive controller to cool down before resetting.
OLF MOTOR OVERLOAD	1. If thermal trip setting is ≥118% of normal thermal state, thermal trip is due to prolonged overload or output phase failure. 2. Motor power rating too low for application.	1. Check setting of Thermal Current (ItH, see page 24) and compare with motor I_n (FLA). Check load and compare with operating speed. Check braking conditions (possibility of single-phase operation). Wait approximately 7 minutes before resetting. 2. Verify that motor and drive controller selection are correct for application.
ObF OVERBRAKING	1. Overvoltage or overcurrent due to excessive braking or an overhauling load. See Table 28.	1. Increase deceleration time. Add dynamic braking option if necessary.
OPF MOTOR PHASE LOSS	1. Loss of a phase on the output of the drive controller. 2. Drive oversized for motor.	1. Check the wiring to the motor (Procedure 3 on page 90). 2. Disable OPL and provide external overload protection.
LFF LOSS OF 4-20 mA	1. Loss of 4-20 mA follower signal on AI2 input. See Table 29	1. Verify signal connections. 2. Check signal.
OCF OVERCURRENT	1. Ramp too short. 2. Inertia too high, or load too large 3. Mechanical blockage.	1. Check the parameter adjustments. 2. Check the sizing of the drive controller, motor and load. 3. Remove all power. With the drive controller disconnected, check for mechanical blockage.

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Table 27: Fault Codes and Messages (Continued)

Fault	Probable Causes	Corrective Actions
SCF MOT SHORT CKT	1. Short circuit or grounding on drive controller output.	1. Remove all power. With drive controller disconnected, check connecting cables and motor insulation. 2. Check the drive controller transistors.
CrF PRECHARGE FAULT	1. Capacitor charge relay closure command fault. 2. Failed precharge resistor.	1. Perform the bus voltage measurement procedure (Procedure 1 on page 87). Check the connections in the drive controller.
SLF LOSS OF RS485	1. Bad connection between the drive controller and the keypad display.	1. Check the connection between the drive controller and the programming keypad display.
OtF MOTOR OVERHEATING	1. Motor temperature too high.	1. Check the motor ventilation, ambient temperature, and the motor load. 2. Check the type of thermal sensors used.
tSF THERMAL SENSOR FAULT	1. Bad connection between the motor thermal sensors and the drive controller.	1. Check the connection between the thermal sensors and the drive controller. 2. Check the thermal sensors.
EEF EEPROM FAULT	1. Memory error.	1. Remove power from drive controller and reset.
InF INTERNAL FAULT	1. Internal fault. 2. Internal connection fault.	1. Perform the bus voltage measurement procedure (Procedure 1 on page 87), then check the internal connections.
EPF EXTERNAL FAULT	1. Fault caused by an external source such as a PLC.	1. Verify the external source which caused the fault and reset.
SPF SPEED FEEDBACK FAULT	1. Loss of speed feedback.	1. Check the wiring of the sensor.
AnF RAMP NOT FOLLOWED	1. Ramp not followed. 2. Speed opposite from reference.	1. Check the adjustment and wiring of the speed feedback. 2. Check the adjustments against the load. 3. Check the sizing of the motor and drive controller. Dynamic braking may be necessary.
SOF OVERSPEED	1. Instability. 2. Overhauling load.	1. Check parameter adjustments. 2. Add dynamic braking. 3. Verify the sizing of the motor, drive controller, and load.
CnF COMM. NETWORK FAULT	1. Fault on the communication network.	1. Check the connection of the communication network to the drive controller. 2. Check the time-out.

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Table 27: Fault Codes and Messages (Continued)

Fault	Probable Causes	Corrective Actions
ILF INTERNAL COMM. FAULT	1. Communication fault between the control board and the option card.	1. Perform the bus voltage measurement procedure (Procedure 1 on page 87). Check the connection between the option card and the control board.
CFF PWR RATE ERR-ENT OPTION ERR.-ENT OPT. REMOVED-ENT EEP CKS.-ENT	Error probably caused by changing a card. - Change of the power rating on the power board - Change of the type of option card or installation of an option card if one had not been installed before and the macro-configuration was CUS - Option card removed - Saved configuration cannot be read Pressing Ent causes the message: “Fact.Setting? ENT/ESC” to appear.	1. Check the configuration of the power board and other boards. 2. Reset by cycling power. 3. Save the configuration in a file on the keypad. 4. Press ENT to return to factory settings.
CFI CONFIG FAULT	1. The configuration sent to the drive controller via the serial link cannot be read.	1. Verify the configuration sent. 2. Send a configuration which can be read.
InI	Incompatible drive	

Table 28: Overvoltage/Overbraking Trip and Reset Points

	Overvoltage Trip Point	Overbraking Trip Point	Reset Point
ATV58FH••••N4	800 V	840 V	785 V

Table 29: Trip and Reset Points when Loss of 4–20 mA

	Trip Point	Reset Point
ATV58FH••••N4	AI2 < 2 mA	AI2 > 2.5 mA

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APPENDIX A—DRIVE CONTROLLER CONFIGURATION

Use these pages to note the configuration and adjustments of the ALTIVAR 58 Type FVC drive controller.

DRIVE CONTROLLER IDENTIFICATION

Drive catalog number: ATV58.....

Customer identification number: .....

Option card: No Yes Catalog number: .....

Access code: No Yes: .....

Configuration is in file number ..... of the programming terminal.

Macro-configuration: .....

For customized configuration (CUS), record assignments of inputs/outputs in Tables 30 to 35.

For a menu overview, see page 99.

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FACTORY SETTINGS

The following tables list the factory setting for each parameter. Record the new customer setting in the Customer Setting column. If no change has been made to the factory setting, the record “no change” in the Customer Setting column.

Table 30: 2—Adjust Menu Parameters

Code	Fact. Setting	Cust. Setting	Code	Fact. Setting	Cust. Setting
Inr	0.1 s	s	ItH	According to controller rating	A
ACC	3 s	s	IdC	According to controller rating	A
dEC	3 s	s	tdC	0.5 s	s
AC2	5 s	s	SdC	According to controller rating	A
dE2	5 s	s	UFr	100%	%
tA1	10	%	SLP	100%	%
tA2	10	%	SP2	10 Hz	Hz
tA3	10	%	SP3	15 Hz	Hz
tA4	10	%	SP4	20 Hz	Hz
LSP	0 Hz	Hz	SP5	25 Hz	Hz
HSP	50/60 Hz	Hz	SP6	30 Hz	Hz
FLG	20	%	SP7	35 Hz	Hz
StA	20	%	JOG	10 Hz	Hz
SPG	40	%	JGt	0.5 s	s
SIG	40	%	Ibr	0 A	A
brt	0 s	s	tLS	0 (no time limit)	s
bEn	0 Hz	Hz	SrP	10%	%
bEt	0 s	s	rE0	0	
bIP	No		PrG	999	
dtS	1		PSr	0	
rPG	1		PSP	0 s	s
rIG	1/s	/s	PAL	0%	%
rdG	0.00		PAH	0%	%
PIC	No		PEr	100%	%
Ftd	50/60 Hz	Hz	PI2	30%	%
Ctd	1.36 I_n	A	PI3	60%	%
ttd	100%	%	PLr	20%	%
tL2	200%	%	PLb	HSP	Hz
JPF	0 Hz	Hz	FLU	FNC	
USC	1				

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Table 31: 3—Drive Menu Parameters

Code	Fact. Setting	Cust. Setting	Code	Fact. Setting	Cust. Setting
UnS	depends on catalog number	V	FrE	0 Hz	Hz
FrS	50 / 60 Hz	Hz	dCF	4	
nCr	0.9 In	A	tLI	200%	%
nSP	depends on catalog number	rpm	CLI	1.3 6 In	
COS	depends on catalog number		AdC	No	
Ctr	open loop		SFt	LF	
PGI	1024		SFr	depends on catalog number	kHz
tUn	No		nrd	Yes	
tFr	60 / 72 Hz	Hz	PGt	DET	
EnC	No		PLS	1	
rPt	LIN		SSL	IP	
brA	No				

Table 32: 4—Control Menu Parameters

Code	Fact. Setting	Cust. Setting	Code	Fact. Setting	Cust. Setting
tCC	2 W		AOL	0 mA	mA
tCt	LEL		AOH	20 mA	mA
r In	No		Str	No	
bSP	No		LCC	No	
CrL	4 mA	mA	PSt	Yes	
CrH	20 mA	mA	Add	0	

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Table 33: 5—I/O Menu Parameters

Code	Fact. Setting	Cust. Setting	Code	Fact. Setting	Cust. Setting
AI1	Factory settings depend on the macro configuration. See page 17.		LI5	Factory settings depend on the macro configuration. See page 17.	
AI2			LI6		
AI3			r1		Fault
LI1			r2		
LI2			LO		
LI3			AO		
LI4					

Table 34: 6—Fault Menu Parameters

Code	Fact. Setting	Cust. Setting	Code	Fact. Setting	Cust. Setting
Atr	No		LFL	No	
r5t	RSP		FLr	No	
OPL	Yes		StP	No	
IPL	Yes		Sdd	No	
tHt	ACL				

Use the table below to note what drive controller configuration is stored in a file in the keypad display.

Table 35: 7—Files Menu Parameters

Code	Fact. Setting	Customer Notes (For example, “File stored for HVAC Drive #11”)
F1S	Free	
F2S	Free	
F3S	Free	
F4S	Free	

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MENU OVERVIEW

Language menu

Name	Code
English	LnG
Français	LnG
Deutsch	LnG
Español	LnG
Italiano	LnG

Macro-Config menu

Name	Code
Hdg: Handling	CFG
GEn: General Use	CFG

1—Display menu

Name	Code
Drive State	---
Freq. Ref.	LFr
Freq. Ref.	FrH
Output Freq.	rFr
Motor Speed	SPd
MotorCurrent	LCr
Machine Spd	USP
Output Power	OPr
MainsVoltage	ULn
MotorThermal	tHr
DriveThermal	tHd
Last Fault	LFt
Motor volt.	UOP

2—Adjust menu

Name	Code
Freq. Ref. - Hz	LFr
Ramp Incr. - s	Inr
Acceleration - s	ACC
Deceleration - s	dEC
Accelerate2 - s	AC2
Decelerate2 - s	dE2
Beg ACC Rnd. - %	tA1
End ACC Rnd. - %	tA2
Beg DEC Rnd. - %	tA3
End DEC Rnd. - %	tA4
Low Speed - Hz	LSP
High Speed - Hz	HSP
Gain - %	FLG
Stability - %	StA
Speed Prop.g - %	SPG
Speed int.g. - %	SIG

2—Adjust menu (continued)

Name	Code
ThermCurrent - A	ItH
DC Inj. Curr.- A	IdC
DC Inj. Time - s	tdC
dc I at rest - A	SdC
IR Compens. - %	UFr
Slip Comp. - %	SLP
Preset SP.2 - Hz	SP2
Preset SP.3 - Hz	SP3
Preset SP.4 - Hz	SP4
Preset SP.5 - Hz	SP5
Preset SP.6 - Hz	SP6
Preset SP.7 - Hz	SP7
Jog Freq. - Hz	JOG
Jog Delay - s	JGt
BrRelease I - A	Ibr
BrReleasTime - s	brt
BrEngage Lev- Hz	bEn
BrEngageTime- Hz	bEt
Brake impul.	bIP
Tacho Coeff.	dtS
PI Prop.Gain	rPG
PI Int.Gain	rIG
PID der.g.	rdG
PI Inversion	PIC
Freq.Lev.Att- Hz	Ftd
Curr.Lev.Att - A	Ctd
ThermLev.Att - %	ttd
Trq. Limit 2 - %	tL2
Jump Freq. - Hz	JPF
Machine Coef	USC
LSP Time - s	tLS
+/-SPeedLim. - %	SrP
PID ref.off.	rEO
Ref. Gain PI	PrG
PID SPeed r.	PSr
PID Filter - s	PSP
Min.feed.PID - %	PAL
Max.feed.PID - %	PAH
PID error - %	PEr
PID Preset 2 - %	PI2
PID Preset 3 - %	PI3
PID Limit r. - %	PLr
PID base lim.- Hz	PLb
Motor fluxing	FLU

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3—Drive menu

Name	Code
Nom.Mot.Volt - V	UnS
Nom.Mot.Freq - Hz	FrS
Nom.Mot.Curr - A	nCr
Nom.MotSpeed - RPM	nSP
Mot. Cos Phi	COS
Control mode	Ctr
Enc Pulse No	PGI
Auto Tuning	tUn
Encoder chk	EnC
Max. Freq. - Hz	tFr
DecRampAdapt	brA
SwitchRamp2 - Hz	Frt
Ramp Type	rPt
DECRAmpCoeff	dCF
Trq.Limit. 1 _ %	tLI
Int. I Lim - A	CLI
Auto DC Inj.	AdC
Sw Freq. Type	SFt
Sw Freq - kHz	SFr
Noise Reduct	nrd
PG Type	PGt
Num. Pulses	PLS
Speed Reg.	SSL

4—Control menu

Name	Code
TermStripCon	tCC
Type 2 Wire	tCt
RV inhibit	rIn
deadb./Pedst	bSP
AI2 min Ref. - mA	CrL
AI2 Max Ref. - mA	CrH
Min Val AO - mA	AOL
Max Val AO - mA	AOH
Save Ref.	Str
KeyPad Comm.	LCC
Stop Priorit	PSt
DriveAddress	Add

5—I/O menu

Name	Code
LI2 Assign. LI3 Assign. LI4 Assign. LI5 Assign. LI6 Assign.	LI2 LI3 LI4 LI5 LI6
NO :Not assigned RV :Reverse RP2:Switch RampZ JOG +SP:+ Speed -SP:- Speed PS2:2 Preset SP PS4:4 Preset SP PS8:8 Preset SP NST:Freewhl Stop DCI:DC inject. FST:Fast stop CHP:Multi. Motor TL2:Trq.Limit 2 FLO:Forced Local RST:Fault Reset RFC:Auto/Man ATN:Auto-tune SPM:Ref.memory FLI:Motor fluxing PAU:PID Auto/Man PIS:PIDint.reset PR2:PID 2 Preset PR4:PID 4 Preset	
R2 Assign. L0 Assign.	r2 LO
NO :Not assigned RUN:DriveRunning OCC:OutputCont. FTA:Freq Attain. FLA:HSP Attained CTA:I Attained SRA:FRH Attained TSA:MtrThermLvl BLC:Brk Logic PEE:PID error PFA:PID Feed alm	

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5—I/O menu (continued)

Name	Code
AI2 Assign. AI3 Assign.	AI2 AI3
NO :Not assigned FR2:SPeed Ref2 SAI:Summed Ref. PIF:PID Regulator DAI:Subtract ref PIM:PID Man.ref. FPI:PID SPd inP. SFB:Tacho feedbk PTC:Therm.Sensor ATL:Torque Limit	
AO Assign. AO1 Assign.	AO AO1
OCR:Motor Curr. OFR:Motor Freq ORP:OutPut ramP TRQ:Motor torque STQ:Signed Torq. ORS:Signed ramP OPS:PID ref. OPF:PID Feedback OPE:PID Error OPI:PID Integral	

6—Fault menu

Name	Code
Auto Restart	AtR
Reset TyPe	rSt
OutPhaseLoss	OPL
InPhaseLoss	IPL
ThermProTyPe	tHt
LossFollower	LFL
Catch On Fly	FLr
Cont. StoP	StP
RampNotFoll	Sdd

7—Files menu

Name	Code
File 1 State	F1S
File 2 State	F2S
File 3 State	F3S
File 4 State	F4S
OPerat.TyPe	FOt
Password	COd

8—Communication menu

Refer to the documentation provided with the communication card.

8—Application menu

Refer to the documentation provided with the application card.

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APPENDIX B—OPTIONS AND ACCESSORIES

The following table shows the accessories available for ALTIVAR 58 Type FVC drive controllers.

Catalog No.	Description
VW3A58101U	Keypad Display
VW3A58103	Remote Mounting Kit for Keypad Display
VW3A8104	Test & Commissioning Software
VW3A58201U	Analog I/O Option Card
VW3A58202U	Digital I/O Option Card
VW3A58302U	MODBUS® Plus Communication Card
VW3A58303U	MODBUS/UNITELWAY™ Communication Card
VW3A58304EU	Interbus S Communication Card. Requires external power supply.
VW3A58306U	RS485 Cable w/ MODBUS Mapping Guide
VW3A58307U	Profibus DP Communication Card
VW3A58311U	FIPIO® Communication Card
VW3A58822	Fan Kit for ATV58FHU18N4 to U41N4
VW3A58823	Fan Kit for ATV58FHU54N4 to U90N4
VW3A58824	Fan Kit for ATV58FHD12N4 to D23N4
VW3A58825	Fan Kit for ATV58FHD28N4 to D46N4
VW3A58826	Fan Kit for ATV58FHD54N4 to D79N4
VW3A58832	EMC Kit for ATV58FHU18N4 to U41N4
VW3A58833	EMC Kit for ATV58FHU54N4 to U90N4
VW3A58834	EMC Kit for ATV58FHD12N4 to D23N4
VW3A58843	Conduit Box Kit for ATV58FHU18N4 to U41N4
VW3A58844	Conduit Box Kit for ATV58FHU54N4 to U90N4
VW3A58845	Conduit Box Kit for ATV58FHD12N4 to D23N4
VW3A58846	Conduit Box for ATV58FHD28N4 to D46N4
VW3A58847	Conduit Box for ATV58FHD54N4 to D79N4
VW3A66711	DB Resistor Kit for ATV58FHU18N4 to U72N4
VW3A66712	DB Resistor Kit for ATV58FHU90N4, D12N4
VW3A66713	DB Resistor Kit for ATV58FHD16N4, D23N4
VW3A66714	DB Resistor Kit for ATV58FHD28N4 to D46N4
VW3A66715	DB Resistor Kit for ATV58FHD54N4
VW3A66716	DB Resistor Kit for ATV58FHD64N4, D79N4

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Symbols

Numerics

A

B

C

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D

E–F

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G–H

I

J–K

L

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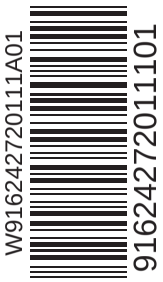

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