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ALTIVAR™ 16

PC Connection Option

VW3-A16104

for ALTIVAR™ 16 Drive Controllers

User's Manual

Telemecanique

SQUARE D

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1—OPTION INSTALLATION AND OPERATION

INTRODUCTION

The VW3-A16104 PC Connection option is used for configuring ALTIVAR™ 16 drive controllers with a personal computer. This option allows access to all parameters as well as reassignment of the inputs and outputs on the option cards. For installation and use of the option cards and the other options available for the ALTIVAR 16, refer to the appropriate instruction bulletins.

The VW3-A16104 PC Connection option kit contains:

- PC connection option box
- 9-pin to 9-pin cable
- 9-pin to 25-pin adaptor
- DOS-compatible Setup Software

Hardware installation instructions follow. For an overview of software features see page 4 through page 6. For software installation procedures, see page 8.

INSTALLATION OF OPTION

To mount the PC Connection option on the drive controller (refer to Fig. 1):

1. Remove programming cover plate from front of drive. Do not remove any other covers.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

Do not remove any other cover besides programming cover plate when installing the option.

Failure to observe this precaution will cause death, personal injury or electric shock.

2. Plug PC Connection option box provided with kit into front of drive controller. Use screwdriver to secure option box. Connect cable provided in kit to option box.
3. Connect other end of cable to COM terminal on computer. If the COM terminal is 25-pin, use the 9-pin to 25-pin adaptor.

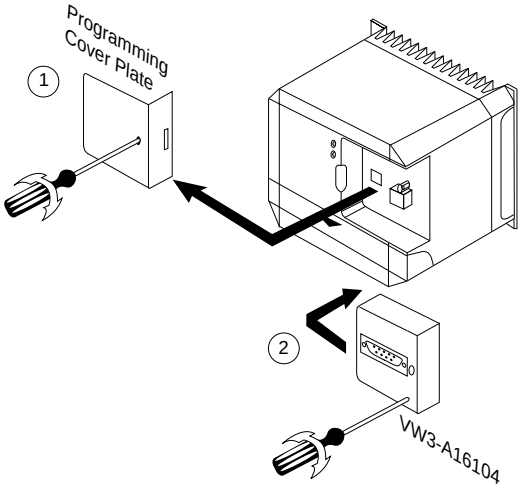


Figure 1: Mounting Option VW3-A16104

SOFTWARE FEATURES

The Setup Software provides access to all configuration and adjustment functions as well as the ability to reassign the inputs and outputs on the option cards. In addition, it allows you to:

- Prepare a job in the design office without connecting the drive controller to the computer.
- Save configurations and adjustments on hard disk or floppy disk and download them into the drive controller.
- Provide a printout of configurations and adjustments.

This section provides a general overview of software features and key / mouse operation. For software installation instructions, see “INSTALLATION OF SOFTWARE” on page 8. For a detailed discussion of the Menus and their contents, see “Type ATV / Option” on page 14.

Hardware Requirements

The software runs on any computer operating on DOS version 3.1 or higher with a minimum of 256K bytes of RAM, a COM serial communication port, and a 3 1 / 2" disk drive.

Screen Layout

The Setup Software has six main menus which always appear in the upper band of the computer screen:

- File
- Mode
- Configuration
- Command / Display
- System
- Help

Each main menu has several sub-menus allowing access to file management functions and drive parameters. Figure 2 shows the six main menus with the Configuration menu open.

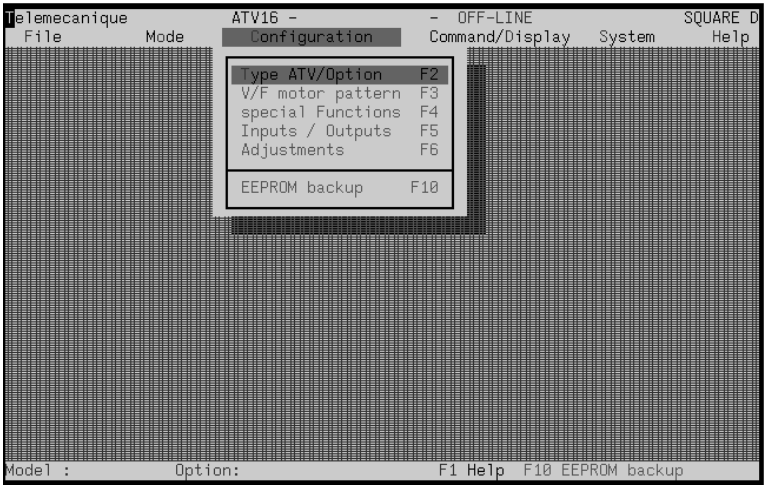


Figure 2: Main Menus

Mouse Operation

You can select menus and sub-menus and enter parameter values with your computer keypad or, if the DOS mouse driver is installed, with a mouse. If using a mouse, follow these instructions.

- To open a Help window, click on the Help menu or click on Help at the bottom of the screen. To exit, click on the box at the top left corner.
- To open a main menu, click on the menu name. Figure 2 shows the Configuration Menu open.
- To open a sub-menu, highlight the sub-menu name by clicking on it, then click again. The sub-menu will then open. Figure 3 illustrates as an example the V/f Motor Pattern sub-menu available from the Configuration main menu.
- Within a sub-menu, parameter values are specified in various ways. When a parameter has an arrow beside its value (see Switching frequency in Figure 3), click on the arrow. This will open up a window with the complete range of choices. When a parameter has only a value associated with its name (see Nominal motor frequency in Fig. 3), click on the displayed value, type in the desired value, then press <Enter>. Within a partitioned sub-menu (see Fig. 4 for an example), use the <Tab> key to move from one box to another and then use the up and down arrows (↑↓) to scroll through the parameters within a box.
- When selecting between Yes and No or OK and Abort, click on the desired choice.

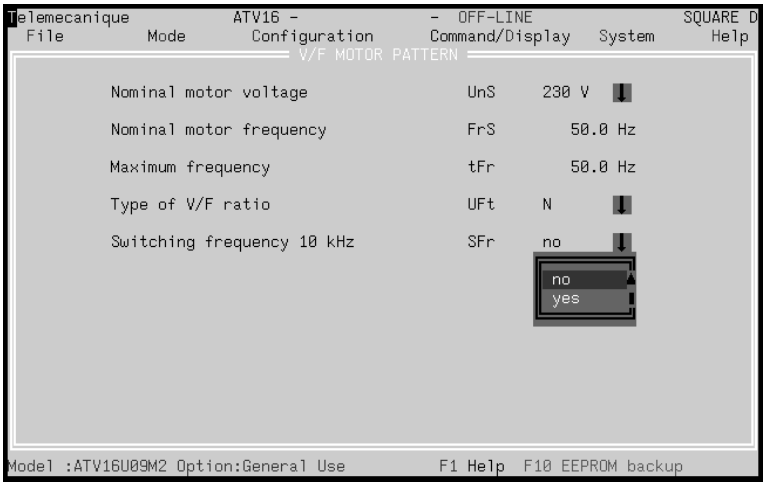


Figure 3: V/f Motor Pattern Sub-menu

Key Operation

If you are not using a mouse, you can select menus and enter parameter values with your computer keypad. Follow these instructions for key operation:

- Press <F1> to open a Help window. To exit a Help window, press <Esc>.
- To open a main menu, simultaneously press <Alt> and the highlighted letter in the menu name.
- To open a sub-menu, use the up and down arrows (↑↓) to place the cursor on the sub-menu required, then press <Enter>. Alternately, type the letter that appears highlighted in the sub-menu name. To open a Configuration sub-menu, press the function key associated with the sub-menu name (see Fig. 2).
- To cancel an operation or to exit a sub-menu, press <Esc>.
- Within a sub-menu, use the up and down arrow keys (↑↓) to scroll to the desired parameter. If the parameter has an arrow beside the value (see Switching frequency in Fig. 3), press <Enter>. This will open up a window with the complete range of the parameter's values. When a parameter has only a value associated with its name (see Nominal motor frequency in Fig. 3), press <Enter>, type in the desired value, and press <Enter> again. Within a partitioned sub-menu (see Fig. 4 for an example), use the <Tab> key to move from one box to another and then use the up and down arrows (↑↓) to scroll through the parameters within a box.
- When selecting between a choice such as Yes and No or OK and Abort, use the <Tab> key to highlight your selection and then press <Enter>.

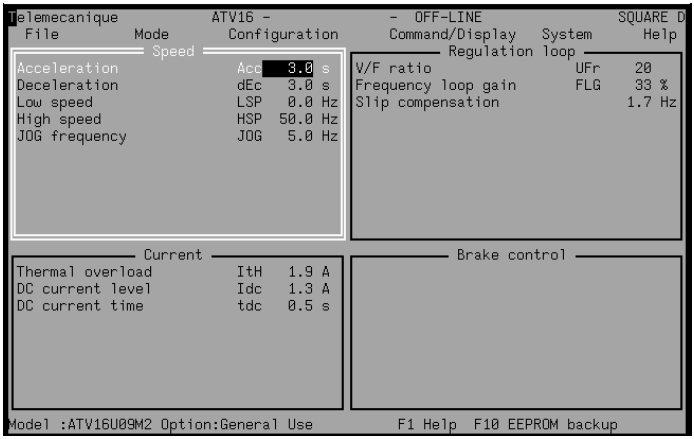


Figure 4: Adjustments Sub-menu

INSTALLATION OF SOFTWARE

To install the Setup Software:

1. Turn on the computer.
2. Insert the floppy disk in drive A.
3. Type “C:” and press <Enter>.
4. Copy all files from the floppy disk to the hard disk by typing “Copy A: *.* C:” and press <Enter>.
5. To protect the floppy disk, installation and use of the Setup Software on a hard disk is recommended.

RUNNING THE SOFTWARE

To run the Setup Software:

1. ATV16 is the executable program used to start the software.
   — To start the software, type “ATV16” from drive C and subdirectory which contains it.
2. A presentation screen appears briefly, showing the name of the program.
3. The first time you run the software, a menu will appear after the presentation screen with four language choices: German, English, Spanish and French (see Fig. 5).
   — Select the language desired and click on OK or press <Enter>.

Each time you start the software, it will run in the selected language. If you want to change the language selection, restart the software by typing “ATV16/L”. The software will start and present the language choice menu for a new selection.

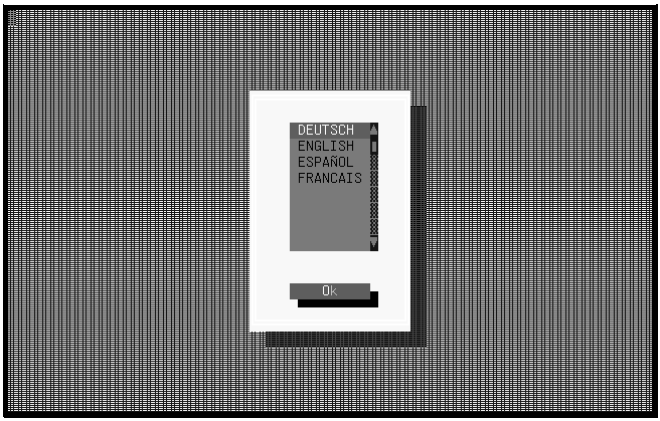


Figure 5: Language Choice Menu

4. A copyright screen appears after the Language Choice Menu (Fig. 6).
   — Read the warning and click on OK or press <Enter>.

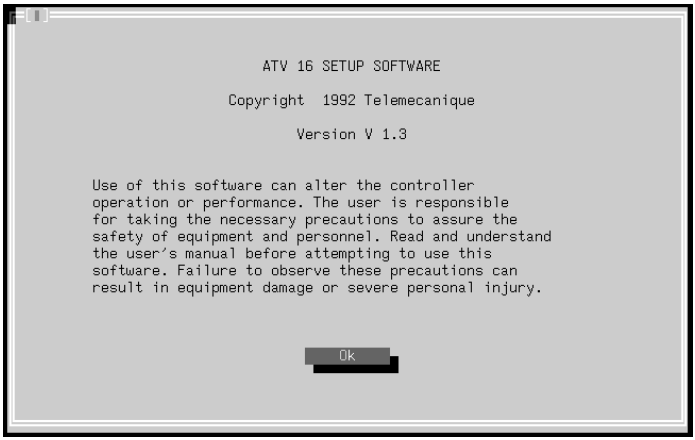


Figure 6: Copyright Screen

5. The next screen to appear will show the on-line status of your computer. If your PC is connected to the drive controller, the screen will show on-line status, type of drive controller, description of drive controller, version of software and type of option card if one is installed. If your PC is not connected to the drive controller, a warning will appear instead indicating a serial link problem. The Off-Line Warning screen is shown in Figure 7.
   — In either case, click on Yes or press <Enter>.

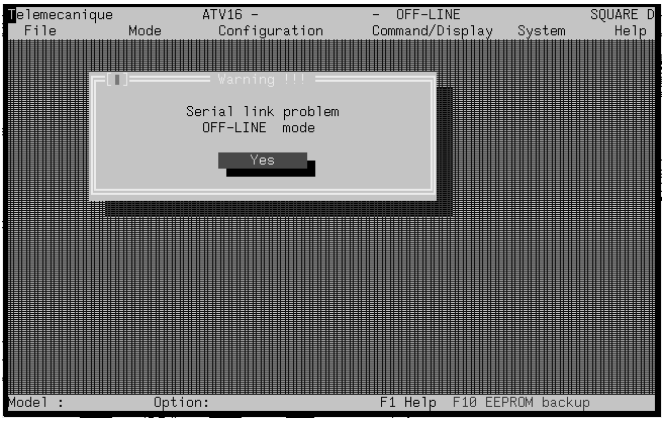


Figure 7: Off-Line Warning Screen

6. The main menus will appear next (Fig. 8).
   — If mode is set to Off-line (see page 13), before you can use the Setup Software to set or change drive parameters, you must first set the values on the Type ATV / Option sub-menu. See page 14 for a description of this screen.

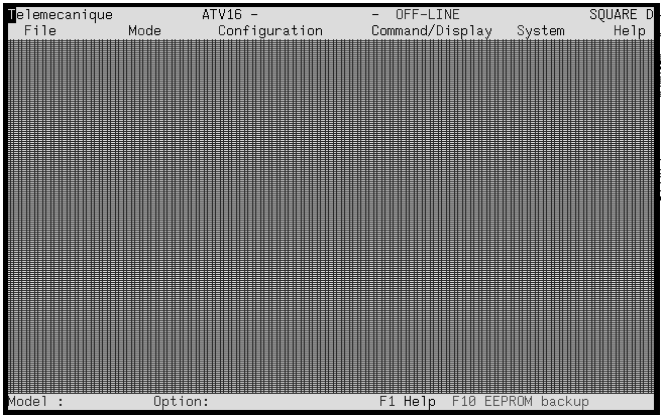


Figure 8: Main Menus

MENUS

There are six main menus in the Setup Software: File, Mode, Configuration, Command / Display, System and Help. These always appear in the upper band of the computer screen (see Fig. 9). Each main menu is divided into various sub-menus. These are discussed in the following sections. For instructions on how to call up the various sub-menus and how to enter parameter values, see “SOFTWARE FEATURES” on page 4.

File Menu

The **File** menu (Fig. 9) allows you to create, modify, save and print drive controller configurations. It also allows you to exit the software and return to the operating system.

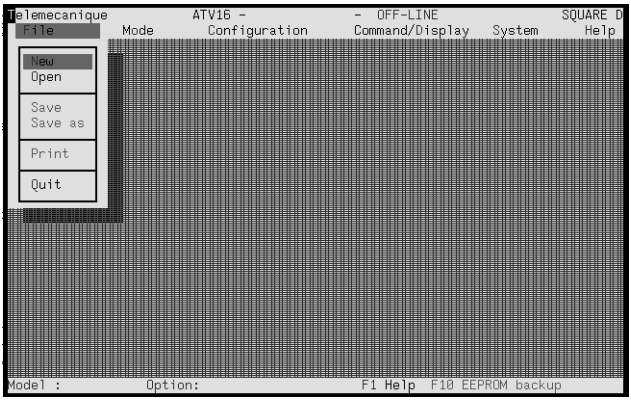


Figure 9: File Menu

New

New allows you to create a new drive controller configuration. When you select New, a warning will appear allowing you to save the current configuration first.

Open

Selecting **Open** calls up the Read Configuration screen (Fig. 10). Type the name of the desired file into the window and click on OK or press <Enter>. The specified file will open.

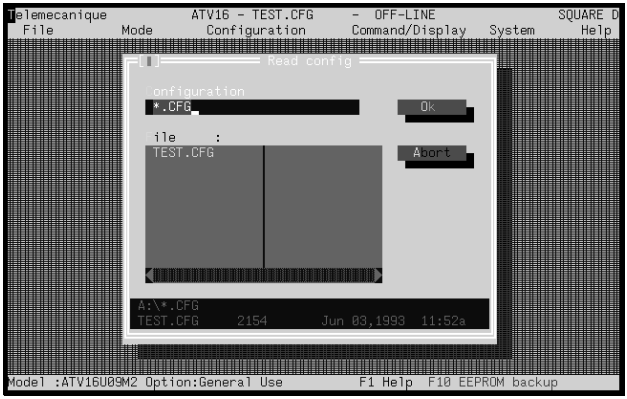


Figure 10: Read Configuration Screen

Save

Save allows you to save an open file. If a file is not open, Save cannot be selected. In this case, choose **Save As**.

Save As

Use **Save As** to save a new configuration or to save an open file under a new name. Selecting Save As causes a screen to appear. Type the new file name into the screen and click on OK or press <Enter>. The software automatically assigns a .CFG extension to the file name.

Print

Print allows you to print a configuration file.

Quit

Quit allows you to exit the Setup Software and return to the operating system.

Mode Menu

Use the **Mode** menu to enable and disable the serial link from the computer to the drive controller. If the computer is correctly connected to the drive controller serial link, the Setup Software defaults to On-Line mode when it is started. If the computer is not connected to the drive controller, the Setup Software defaults to Off-Line mode.

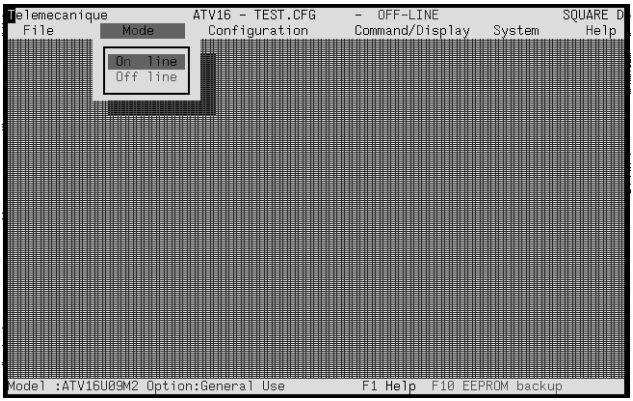


Figure 11: Mode Menu

On-Line

When **On-Line** is selected, any changes made to the parameter settings immediately affect drive controller operation. However, changes made to the drive controller settings are not saved in the drive controller EEPROM. To save in EEPROM, see “EEPROM Backup” on page 17.

Off-Line

When **Off-Line** is selected, changes made to the parameter settings do not immediately affect the drive controller. In Off-Line mode, you can make parameter changes and save them to a file to be loaded into the drive controller at a later time.

Configuration Menu

Use the **Configuration** menu (Fig. 12) to display and modify parameters on the drive controller. The drive controller parameters and their settings are explained in detail in Chapter 2.

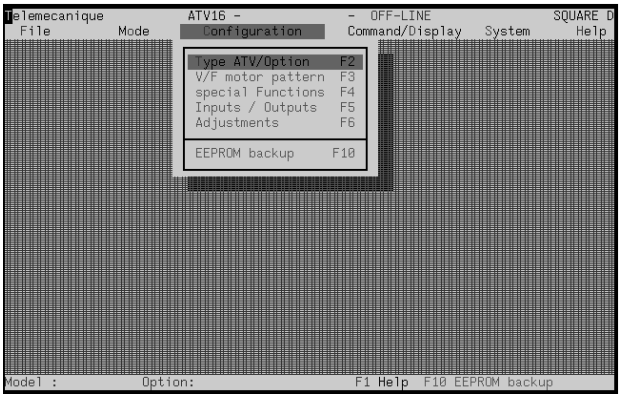


Figure 12: Configuration Menu

Type ATV/Option

If mode is set to **On-Line**, the **Type ATV/Option** sub-menu (see Fig. 13) displays the following:

- Catalog number of the drive controller
- Drive controller software version
- Type of option card installed
- Type of communication option installed
- Settings of the switches on the drive controller

If mode is set to **Off-Line**, you can configure the software for the correct drive controller by setting the following from the Type ATV / Option sub-menu:

- Drive catalog number
- Type of option card
- Type of communication option
- Settings of the 50 / 60 Hz and 0-20 / 4-20 mA jumpers

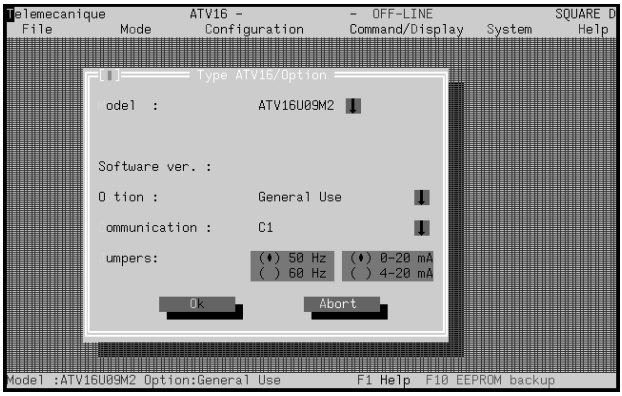


Figure 13: Type ATV/Option Sub-menu

V/f Motor Pattern

Use the **V/f Motor Pattern** sub-menu (Fig. 14) to set:

- Nominal motor voltage
- Nominal motor frequency
- Maximum frequency
- Type of Volts / frequency ratio
- Switching frequency of the drive controller

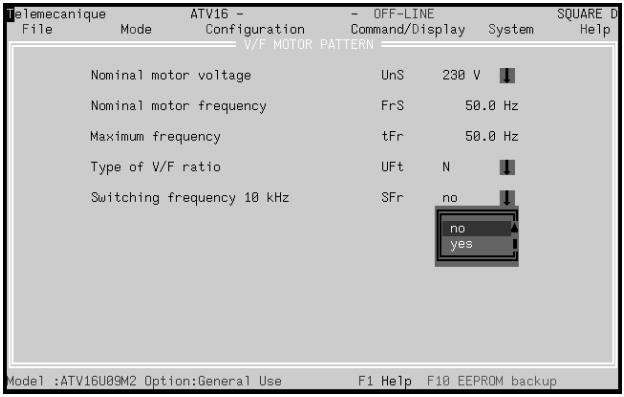


Figure 14: V/F Motor Pattern Sub-menu

Special Functions

The **Special Functions** sub-menu (Fig. 15) is used to set the special configuration functions. These are:

- Deceleration ramp adaptation
- Slip compensation
- Automatic DC injection braking
- Automatic restart
- Catching a spinning load
- Controlled stop on loss of input power
- Type of acceleration and deceleration ramps

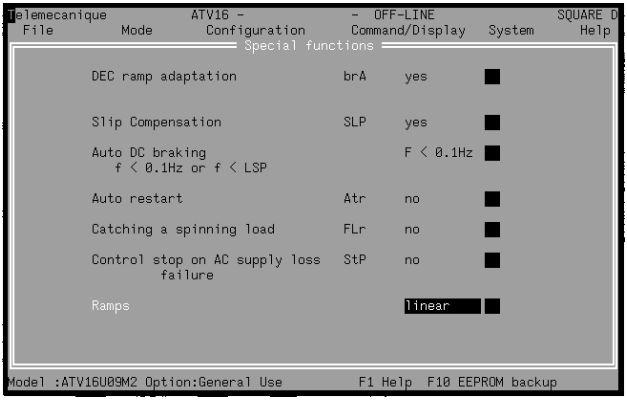


Figure 15: Special Functions Sub-menu

Inputs/Outputs

Use the **Inputs/Outputs** sub-menu (Fig. 16) to configure option card inputs and outputs. You can access this sub-menu only if an option card is installed in the drive controller.

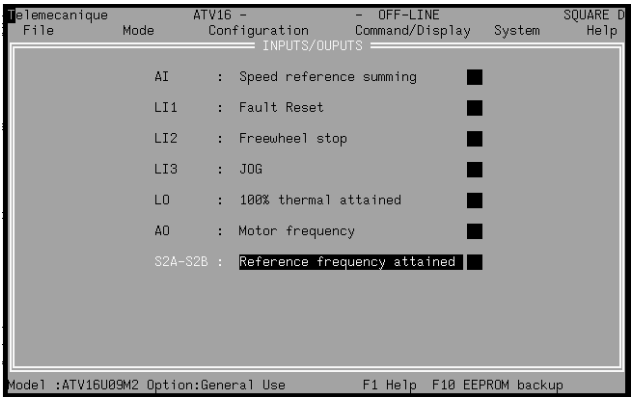


Figure 16: Inputs/Outputs Sub-menu

Adjustments

The **Adjustments** sub-menu (Fig. 17) allows you to adjust the following parameters:

- Acceleration ramp
- Deceleration ramp
- Low speed
- High speed
- Volts / frequency ratio
- Frequency loop gain
- Thermal overload
- DC current level
- DC current time

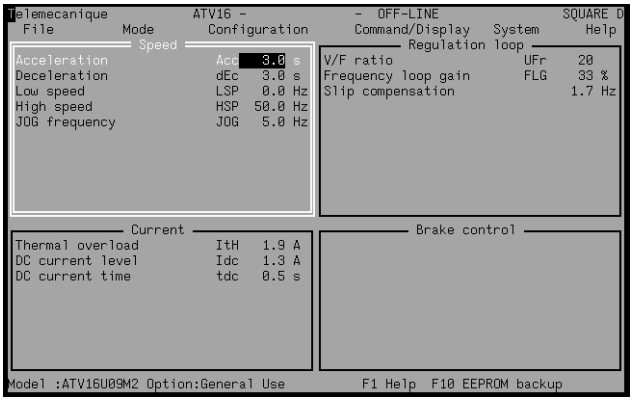


Figure 17: Adjustments Sub-menu

EEPROM Backup

Choosing **EEPROM Backup** allows you to save the configuration in the drive controller. If the Setup Software is running off-line, this choice is not accessible.

Command/Display Menu

Use the **Command/Display** menu (Fig. 18) to monitor and set drive controller run commands, to display past faults, and to view the status of option card inputs / outputs.

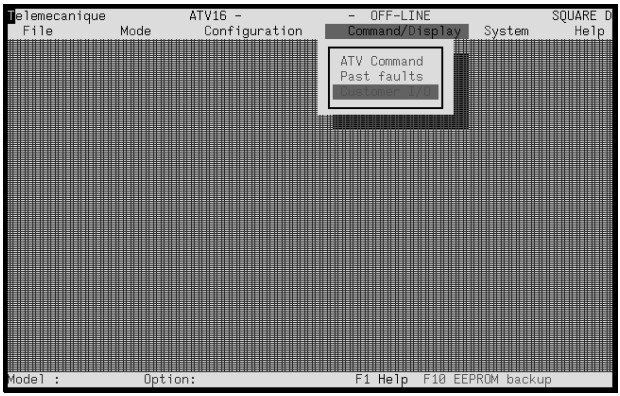


Figure 18: Command/Display Menu

ATV Command

The **ATV Command** sub-menu (Fig. 19) has four sections:

- **Command** allows you to control the drive over the serial link.
- **Adjustments** allows you to set parameters. These parameters also appear in the Adjustments sub-menu under Configuration.
- **Display** shows motor current, output frequency, rotational frequency, AC supply voltage, and, if an option card is installed, the status of the inputs and outputs.
- **Speed Controller Status** displays the status of the serial link and the drive controller.

Each section of the ATV Command sub-menu is discussed in detail below.

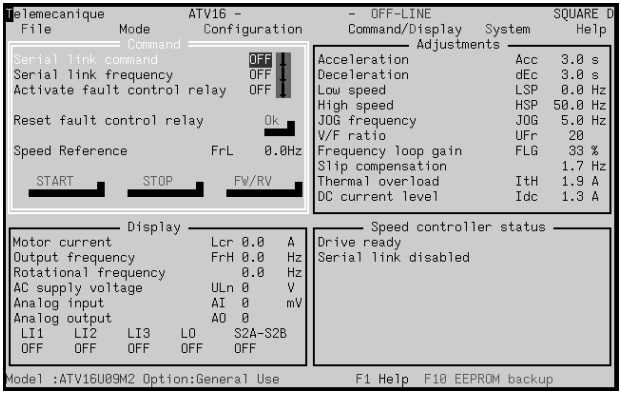


Figure 19: ATV Command Sub-menu

⚠ CAUTION

LOSS OF CONTROL.

When using the Setup Software with the serial link enabled, some input signals present on the terminal connections of the drive controller main control board are ignored.

Before enabling the serial link with the Setup Software, verify that independent or redundant control paths are present for all critical command signals on the drive controller main control board inputs.

Failure to observe this precaution can result in personal injury or equipment damage.

Command: When the Setup Software is started, the following commands come up in the OFF state:

- **Serial link command:** If OFF, the drive controller is started and stopped with a FW/RV command and speed reference. If ON, the drive controller is run from the computer over the serial link. The Start, Stop and FW/RV commands come from the settings on the ATV Command sub-menu, and the Forward and Reverse terminals on the control board are ignored. When Serial link command is set to ON, a warning appears indicating that the commands to the software automatically affect drive controller operation. To set the Serial link command to ON, tab to OK or click on OK. Whenever the serial communication link between the drive controller and the PC is lost, the Serial link command will revert to OFF.
- **Serial link frequency:** If OFF, the speed reference comes from AIV, AIC or AI. If ON, the speed reference comes from the setting of Speed reference (see below) in the ATV Command sub-menu, and the AIV and AIC

terminals on the control board are ignored. Whenever the serial communication link between the drive controller and the PC is lost, the Serial link frequency will revert to OFF.

NOTE: If either or both Serial link command or Serial link frequency are set to On, the Serial link is enabled. This is indicated in the display section. No other screen can be accessed when the serial link is enabled and the motor is running. To access other screens, stop the motor and set both to Off.

- **Activate fault control relay:** This allows simulation of a fault for testing the mains control sequence. When set to ON, the relay opens and the drive controller faults. When set to OFF, the relay closes and the drive can be reset.
- **Reset fault control relay:** To reset the drive controller, tab to Reset fault control relay and press <Enter>, or click on OK. Resettable faults are: Overvoltage, Overload, Overbraking, Speed feedback faults, and Serial link fault.
- **Speed reference (FrL):** This parameter sets the speed reference when the drive controller is running from the serial link. Serial link frequency must be set to ON.
- **START:** To start the drive controller when running from the serial link, press <Enter> when Start is highlighted, press "S" at any time, or click on Start. Serial link command must be set to ON.
- **STOP:** To stop the drive controller when running from the serial link, press <Enter> when Stop is highlighted, press "T" at any time, or click on Stop. Serial link command must be set to ON.
- **FW/RV:** To change direction of motor rotation when running from the serial link, press <Enter> when FW/RV is highlighted, press "F" at any time, or click on FW/RV. Serial link command must be set to ON.

Adjustments: The same parameters which appear in the Adjustments sub-menu (see page 17) also appear here and can be adjusted while the drive controller is running.

Display: The values of the following parameters are displayed:

- Motor current in Amps
- Output frequency in Hz
- Rotational frequency in Hz
- Mains voltage in Volts
- Input/Output status if an option card is present

Speed Controller Status: This section displays drive controller ready status and whether the serial link is enabled or disabled. If either Serial link command or Serial link frequency (or both) are set to ON, "Serial link enabled" appears and the drive controller is controlled by the computer over the serial link. If both are set to OFF, "Serial link disabled" appears and the drive controller is run externally.

Running from the Computer: To run the drive controller from the computer, set Mode to On-line and set Serial link command to ON. If the Speed reference is to come from the computer, set Serial link frequency to ON, then set the desired speed reference. To Start the drive controller, press “S”, click on START or arrow to START and press <Enter>. To Stop the drive controller, press “T”, click on STOP or arrow to STOP and press <Enter>. To change motor direction of rotation, press “F”, click on FW / RV, or arrow to FW / RV and press <Enter>.

Past Faults

The Past Faults sub-menu (Fig. 20) displays the last eight drive controller faults.

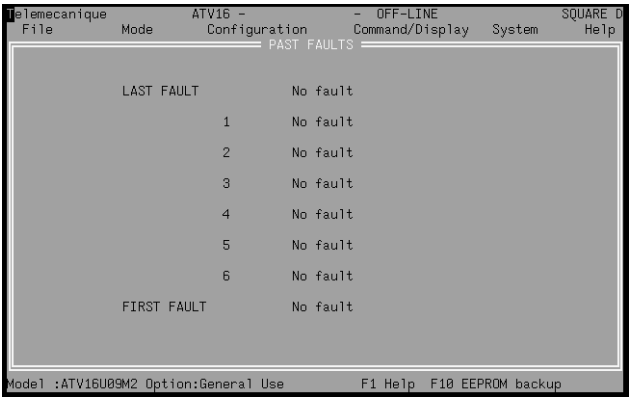


Figure 20: Past Faults Sub-menu

Customer I/O

The Customer I / O sub-menu (Fig. 21) displays the state of the option card inputs / outputs.

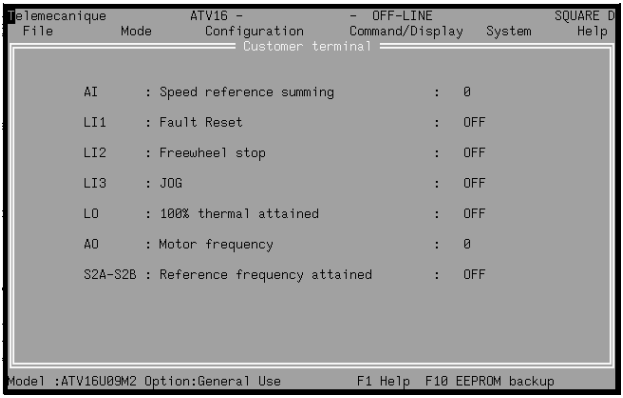


Figure 21: Customer I/O Sub-menu

System Menu

Use the **System** menu (Fig. 22) to configure the computer running the Setup Software.

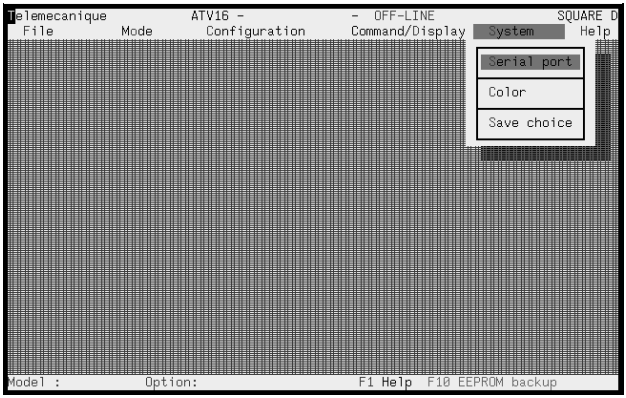


Figure 22: System Menu

Serial Port

The **Serial Port** sub-menu (Fig. 23) allows you to choose which COM port is connected to the drive controller. The parameter is factory set to COM1.

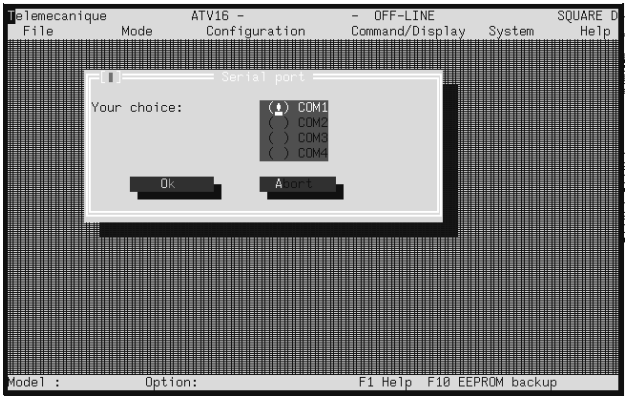


Figure 23: Serial Port Sub-menu

Color

The **Color** sub-menu (Fig. 24) allows you to specify the type of computer screen used. Factory set to Auto, the setting can be changed to Monochrome, LCD or Color.

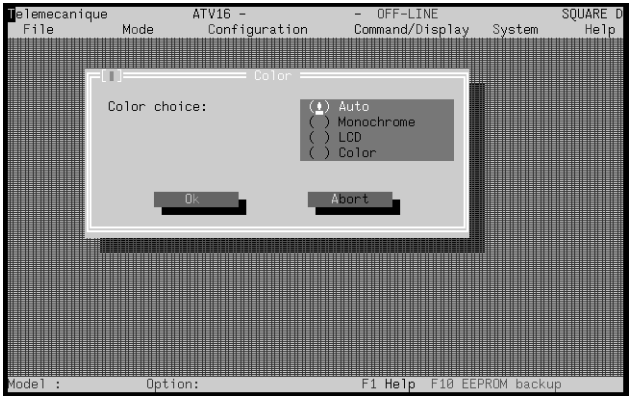


Figure 24: Color Sub-menu

Save Choice

Selecting **Save Choice** saves the system configuration.

Help Menu

The **Help** menu (Fig. 25) allows access to Help windows which explain the Setup Software features.

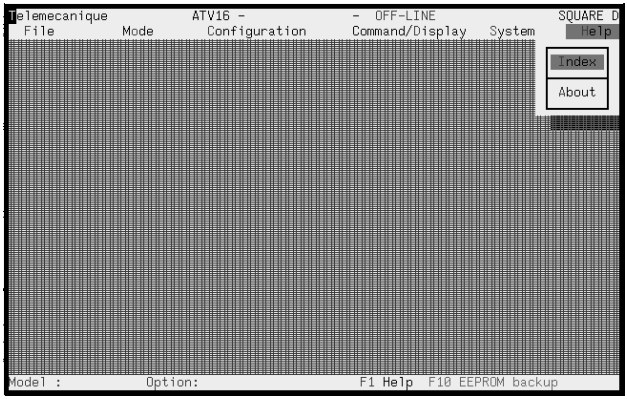


Figure 25: Help Menu

Index

The **Index** screen (Fig. 26) provides an index to the Help screens.

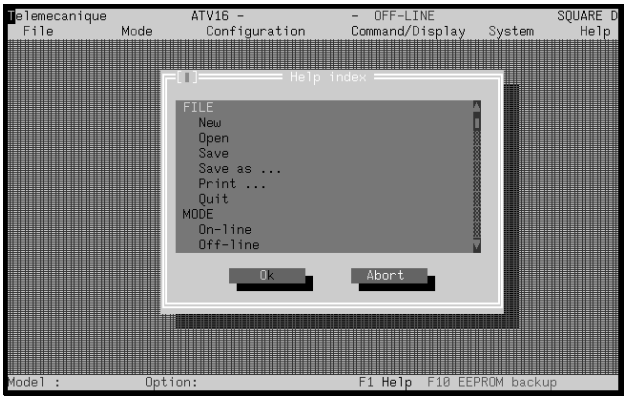


Figure 26: Index Screen

About

T**he About** screen (Fig. 27) shows the Setup Software version number.

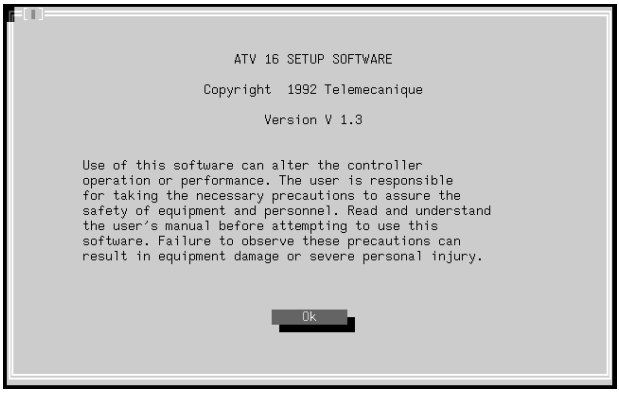


Figure 27: About Screen

CHAPTER 2—PARAMETERS

INTRODUCTION

This chapter provides detailed information about the ALTIVAR 16 drive controller parameters accessible with the PC Connection option. It consists of six sections:

- Basic drive controller parameters
- Parameters available with option VW3-A16201 (General Use / Material Handling Card) installed in drive controller and set for General Use
- Parameters available with option VW3-A16201 (General Use / Material Handling Card) installed in drive controller and set for Material Handling
- Parameters available with option VW3-A16202 (Variable Torque Card) installed in drive controller
- Parameters available with option VW3-A16203 (High Speed Motor Card) installed in drive controller
- Parameters available with option VW3-A16204 (General Use / 3-Wire Control Card) installed in drive controller

BASIC DRIVE CONTROLLER PARAMETERS

This section provides information about the basic drive controller parameters.

V/f Motor Pattern Parameters

V/f Motor Pattern parameters are associated with the volts/frequency ratio supplied to the motor. They are accessible through the V/f Motor Pattern screen under the Configuration menu in the Setup Software (see page 15).

Table 1: Basic Drive Controller V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 200 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 200 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	N, P, L	N	Type of volts/frequency ratio: N: Standard applications at constant torque not requiring high voltage boost. P: Quadratic torque applications (pumps, fans). L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.
Switching frequency 10 kHz **SFr**	no, yes	no	Normal setting is 5 kHz. Can be increased to 10 kHz for less audible motor noise. When switching frequency is increased to 10 kHz, drive controller must be derated by 20%. Option VW3-A16202 (Variable Torque Option Card) is factory set for 10 kHz and does not require derating of the drive.

[1] Factory setting is dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 2: Basic Drive Controller Special Functions

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no, yes	yes	If set to yes, the deceleration ramp time is automatically adjusted to compensate for load inertia and to avoid an Overbraking fault (**ObF**).
Slip compensation **SLP**	no, yes	yes	If set to yes, drive controller maintains a constant speed to the motor for a given reference as the load changes, automatically correcting the frequency. Factory setting is that of a standard asynchronous 4-pole squirrel cage motor of equivalent power. Slip Compensation should be disabled in the following cases: machines with high inertia, synchronous motors, and variable torque applications.
Automatic DC injection braking	no, f < 0.1 Hz, f < **LSP**	f < 0.1 Hz	If not set to no, DC current will automatically be injected when f < 0.1 Hz or when f < **LSP**, depending on setting.
Automatic restart **Atr**	no, yes	no	Enables drive controller to automatically restart after an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault. For **OSF** and **OBF** faults, drive controller remains disabled for 1 minute after fault appears, causing fault relay of drive controller to engage, then restarts automatically if fault has disappeared. If cause of fault is present at end of 1 minute, drive controller must be reset manually. Drive controller will attempt 5 automatic restarts (one every minute) before it must be manually reset. For **OLF** fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

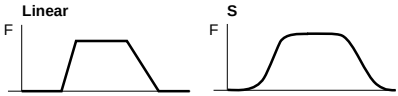
⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury or equipment damage.

Table 2: Basic Drive Controller Special Functions (Continued)

Parameter	Range	Factory Setting	Description
Catching a spinning load **FLr**	no, yes	no	When set to yes, allows smooth restarting of motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, motor accelerates back up to speed without starting at zero.
Controlled stop on loss of AC supply **StP**	no, yes	no	When set to yes, at loss of input power, deceleration follows a self-adjusting ramp which is a function of the regenerated energy. When set to no, motor coasts to a stop.
Ramps	Linear, S ramp	Linear	Determines type of acceleration and deceleration ramps. See diagrams below. Linear ramp used when acceleration and deceleration ramp times are greater than 1-2 seconds. S ramp used on applications with shorter ramp times. 

OPTION VW3-A16201 GENERAL USE

This section provides information about the parameters for the basic drive controller with option VW3-A16201 (General Use / Material Handling) installed and set for general use.

V/f Motor Pattern Parameters

V / f Motor Pattern parameters are associated with the volts / frequency ratio supplied to the motor. They are accessible through the V / f Motor Pattern screen under the Configuration menu (see page 15).

Table 3: VW3-A16201 Option Card—General Use
V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 200 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 200 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	N, L	N	Type of volts/frequency ratio: N: Standard applications at constant torque not requiring high voltage boost. L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.
Switching frequency 10 kHz **SFr**	no, yes	no	Normal setting 5 kHz. Can be increased to 10 kHz for less audible motor noise. When switching frequency is increased to 10 kHz, drive controller must be derated by 20%.

[1] Factory settings are dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 4: VW3-A16201 Option Card—General Use Special Functions

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no, yes	yes	If set to yes, deceleration ramp time is automatically adjusted to compensate for load inertia to avoid an Overbraking fault (**ObF**).
Slip compensation **SLP**	no, yes	yes	If set to yes, drive controller maintains a constant speed to the motor for a given reference as the load changes, automatically correcting the frequency. Factory setting is that of a standard asynchronous 4-pole squirrel cage motor of equivalent power. Slip Compensation should be disabled for machines with high inertia, synchronous motors, and variable torque applications.
Automatic DC injection braking	no, f < 0.1 Hz, f < **LSP**	f < 0.1 Hz	If not set to no, DC current will automatically be injected when f < 0.1 Hz or when f < **LSP**, depending on setting.
Automatic restart **Atr**	no, yes	no	Enables drive controller to automatically restart following an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault. For **OSF** and **OBF** faults, drive controller remains disabled for 1 minute after fault appears, causing fault relay of drive controller to engage, then restarts automatically if fault has disappeared. If cause of fault is present at end of 1 minute, drive controller must be reset manually. Drive controller will attempt 5 automatic restarts (one every minute) before it must be manually reset. For **OLF** fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

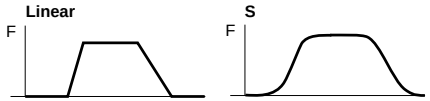
⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury or equipment damage.

Table 4: VW3-A16201 Option Card—General Use Special Functions (Continued)

Parameter	Range	Factory Setting	Description
Catching a spinning load **FLr**	no, yes	no	When set to yes, allows smooth restarting of motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, motor accelerates back up to speed without starting at zero.
Controlled stop on loss of AC supply **StP**	no, yes	no	When set to yes, at loss of input power, deceleration follows a self-adjusting ramp, which is a function of the regenerated energy. When set to no, the motor coasts to a stop.
Ramps	Linear, S ramp	Linear	Determines type of acceleration and deceleration ramps. See diagrams below. Linear ramp used when acceleration and deceleration ramp times are greater than 1-2 seconds. S ramp used on applications with shorter ramp times. 
Adjustable current limitation	0.5 to 1.5 In	1.5 In	Maximum output of drive controller is limited to the amount set by this parameter when a logic input is assigned to this function and is high (state 1).

Inputs/Outputs

When an option card is installed in an ALTIVAR 16 drive controller, the factory settings of the inputs / outputs can be reassigned if switch 2 on the option card is set to ON. This section lists and describes the inputs / outputs for option card VW3-A16201 set for General Use. The inputs / outputs can be reassigned through the Inputs / Outputs screen under the Configuration menu (see page 14). The settings can be displayed on the Customer I / O screen under the Command / Display menu (see page 18).

Table 5: VW3-A16201 Option Card—General Use Inputs/Outputs

Terminal	Assignable Functions
AI	Speed feedback * Speed reference summing
LI1	Start/Stop * Fault reset Freewheel stop Switch to ramp 2 Reduce I limit Jog
LI2	Preset speed 3 Fault reset * Freewheel stop Switch to ramp 2 Reduce I limit Jog
LI3	Preset speed 4 Fault reset Freewheel stop Switch to ramp 2 Reduce I limit * Jog
LO	* 100% thermal state attained Reference frequency attained I limit attained Low speed attained High speed attained 1.1 Ith (motor thermal overload) attained
AO	* Motor frequency Motor current
S2A-S2B	100% thermal state attained * Reference frequency attained

* Factory setting

Enabling the serial link (setting either serial link command or serial link frequency to ON in the ATV / Command screen) allows the drive controller to operate independently from the inputs on the option card. Table 6 shows which control input terminal functions of the drive controller are valid regardless of serial link setting and which are disabled when operated in this mode.

Table 6: VW3-A16201 Option Card—General Use
Serial Link Drive Control Hierarchy

Valid Inputs	Disabled When Serial Link Command is Set to ON	Disabled When Serial Link Frequency is Set to ON
Fault reset	Start/stop	Preset speed
Freewheel stop		Jog
Switch to ramp 2		
Reduce I limit		

Table 7: VW3-A16201 Option Card—General Use
Description of Inputs/Outputs

Function	Description
Analog Input AI	± 10 V signal. Note when using AI, the connection between AI and COM must be removed.
Speed feedback	When using a tachogenerator, the signal is connected to AI and the AI input is set for Speed Feedback. This improves speed regulation to 0.1%. The output voltage signal of the tachogenerator must be scaled to limit the voltage to 10 V at AI. Scaling is accomplished by using an external voltage divider circuit. For more information on using a tachogenerator, refer to “Speed Feedback” on page 96.
Speed reference summing	The +/- 10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low Speed (**LSP**), 10 V = High Speed (**HSP**).
Logic Inputs LI1, LI2, LI3	The three logic inputs allow the control of specific functions from an external source. The full range of values is shown on the Inputs/Outputs screen (see page 16). Note: Preset Speeds requires two inputs.
Start/Stop	Drive controller changes state when logic input assigned to this function goes high (state 1). When the drive controller is ready (motor not running) and the logic input goes high, the drive controller starts. It is stopped when logic input goes high again. Speed reference and direction command must be present.
Fault reset	When the logic input goes high (state 1), the drive controller is reset if the cause of the fault has disappeared. The following faults can be reset: Overvoltage (**OSF**), Overload (**OLF**), Overbraking (**ObF**, **ObF.**), Speed Feedback (**SPF**, **SPF.**) and Serial Link fault (**SLF**). The drive controller is automatically reset after Phase Failure (**PHF**), Undervoltage (**USF**) and Option Card fault (**OPt**) if the cause of the fault has been corrected.
Freewheel stop	When logic input is high (state 1) and drive controller is commanded to stop, drive controller decelerates with no power applied to motor. Deceleration time depends on motor speed, machine inertia and resistant torque.
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 (**Ac2**) and Deceleration Ramp 2 (**dE2**), set on the Adjustments screen (see page 17). The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.

Table 7: VW3-A16201 Option Card—General Use Description of Inputs/Outputs (Continued)

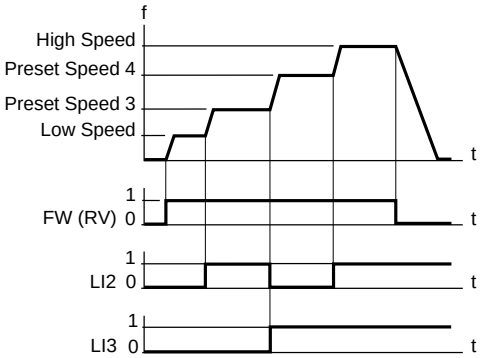
Function	Description
Reduce current limit	Allows reduction of current limit. When the logic input is high (state 1), the maximum output current of the drive controller is reduced to the amount set by the adjustable current limitation parameter on the Special Functions screen (see page 16). This reduces the maximum torque available to the motor. The reduction of current does not change other parameters such as DC Injection or Slip Compensation.
Jog	When the input set for Jog is high (state 1) and a direction command (FW/RV) is present, the drive controller will jog at the frequency set by the Jog parameter on the Adjustments screen (see page 17). Factory set for 5 Hz, this parameter is adjustable between 0 and 10 Hz. When jogging, the acceleration and deceleration ramp rates are 0.1 s. The minimum time between jog pulses is 0.5 s.
Preset speeds	**LI1** **LI2** **Reference** 0 0 Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card) 1 0 Preset speed 3, factory set at 5 Hz 0 1 Preset speed 4, factory set at 25 Hz 1 1 High speed setting  Preset Speed 1 is Low Speed (**LSP**) or the value of the reference signal. Drive controller runs at Preset Speed 1 when logic inputs assigned to Preset Speeds are both low (state 0). Preset Speed 2 is High Speed (**HSP**). Drive controller runs at Preset Speed 2 when logic inputs assigned to Preset Speeds are both high (state 1).
Preset speed 3	The drive controller will run at Preset Speed 3 when the logic input assigned to Preset Speed 3 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 3 is factory set at 5 Hz, and can be adjusted by changing the Preset Speed 3 parameter on the Adjustments screen under the Configuration menu (see page 17).
Preset speed 4	The drive controller will run at Preset Speed 4 when the logic input assigned to Preset Speed 4 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 4 is factory set at 25 Hz, and can be adjusted by changing the Preset Speed 4 parameter on the Adjustments screen under the Configuration menu (see page 17).

Table 7: VW3-A16201 Option Card—General Use Description of Inputs/Outputs (Continued)

Function	Description
Logic Output LO	PLC compatible collector output. Full range of settings is available from the Inputs/Outputs screen (see page 16).
100% thermal state attained	Signals when 100% thermal state is attained. Can be used for a pre-alarm or alarm.
Reference frequency attained	Signals when reference frequency is attained.
I limit attained	Signals when drive controller is at current limit.
Low speed attained	Signals when drive controller has attained Low Speed (**LSP**).
High speed attained	Signals when drive controller has attained High Speed (**HSP**).
1.1 Ith attained	Signals when 1.1 Ith motor overload protection threshold is attained. Used for a pre-alarm or alarm.
Analog Output AO	0-20 mA signal. Full range of settings is available from the Inputs/Outputs screen (see page 16).
Motor frequency	Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (**HSP**).
Motor current	Analog output of motor current. 0 mA = 0A, 20 mA = 1.82 times the permanent output current of the drive controller.
Relay Output S2A-S2B	Relay output. Full range of settings is available from the Inputs/Outputs screen (see page 16).
100% thermal state attained	Relay closes when 100% thermal state is attained. Can be used for a pre-alarm or alarm.
Reference frequency attained	Relay closes when reference frequency is attained.

Adjustments

Availability of Adjustment parameters is a function of the configuration of the drive controller and the option board, if present. The adjustment parameters are accessible through the Adjustments screen under the Configuration menu (page 17).

Table 8: VW3-A16201 Option Card—General Use Adjustments

Parameter	Range	Factory Setting	Description
Speed			
Acceleration **Acc**	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor frequency from zero speed.
Deceleration **dEc**	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor frequency to zero speed.
Low speed **LSP**	0 to **HSP**	0 Hz	Low speed setting.
High speed **HSP**	**LSP** to **tFr**	50 Hz if **FrS**=50 60 Hz if **FrS**=60	High speed setting. This is the frequency which is equal to 10 V on AIV or AI, or 20 mA on AIC.
Jog frequency **JOG**	0.1 to 10 Hz	5 Hz	Frequency at which the drive controller will jog when the input, set for Jog, is high (state 1) and a direction command (FW/RV) is present.
Acceleration ramp 2 **Ac2**	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is set to Switch to Ramp 2.
Deceleration ramp 2 **dE2**	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input is set to Switch to Ramp 2.
Preset speed 3 **3SP**	**LSP** to **HSP**	5.0 Hz	Used when input is set to Preset Speed 3.
Preset speed 4 **4SP**	**LSP** to **HSP**	25 Hz	Used when input is set to Preset Speed 4.
Regulation loop			
V/f ratio **UFr**	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at low speed.
Frequency loop gain **FLG**	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

⚠ CAUTION

MOTOR MAY STALL.

Inhibiting this function can cause motor to stall if required torque is too high.

Failure to observe this precaution can result in equipment damage.

Table 8: VW3-A16201 Option Card—General Use Adjustments (Continued)

Parameter	Range	Factory Setting	Description
Current			
Thermal Overload **Ith**	0.45 In to 1.05 In	0.9 In	Motor thermal overload protection. Adjust to the current value shown on the motor nameplate. To suppress motor thermal protection, increase value to the maximum and provide external protection.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe these precautions can result in equipment damage.

⚠ 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 and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

Failure to observe this precaution can result in personal injury or equipment damage.

DC current level **Idc**	0.1 to 1.5 Ith	0.7 Ith	Amount of DC injected at the end of the deceleration ramp.
DC current time **tdc**	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the deceleration ramp.
Current limit level	0.5 to1.5 In	1.5 In	Reduction of current limit when input assigned to Reduce Current Limit is high (state 1).

OPTION VW3-A16201 MATERIAL HANDLING

This section provides information about the parameters for the basic drive controller with option VW3-A16201 (General Use / Material Handling) installed and set for material handling.

V/f Motor Pattern Parameters

V / f Motor Pattern parameters are associated with the volts / frequency ratio supplied to the motor. They are accessible through the V / f Motor Pattern screen under the Configuration menu (see page 15).

Table 9: VW3-A16201 Option Card—Material Handling V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 200 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 200 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	N, L	L	Type of volts/frequency ratio: N: Standard applications at constant torque not requiring high voltage boost. L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.
Switching frequency 10 kHz **SFr**	no	no	The switching frequency is 5 kHz.

[1] Factory settings are dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 10: VW3-A16201 Option Card—Material Handling Special Functions

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no	no	The deceleration ramp is not automatically adjusted to compensate for load inertia.
Slip compensation **SLP**	no, yes	yes	If set to yes, drive controller maintains a constant speed to the motor for a given reference as the load changes, automatically correcting the frequency. Factory setting is that of a standard asynchronous 4-pole squirrel cage motor of equivalent power. This value may need to be adjusted. Slip Compensation should be disabled in the following cases: machines with high inertia, synchronous motors, and variable torque applications.
Automatic DC injection braking	no, f < brake engage frequency threshold	no	If set to f<SrF (brake engage frequency for brake control), DC will automatically be injected at that point. If set to no, DC will not be injected.
Automatic restart **Atr**	no	no	When set to no, drive controller will not automatically restart following an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault.

⚠ WARNING

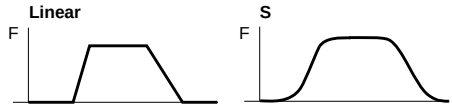
UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury or equipment damage.

Catching a spinning load **FLr**	no	no	When set to no, after a brief input line undervoltage, the motor accelerates back up to speed, starting at zero.

Table 10: VW3-A16201 Option Card—Material Handling Special Functions (Continued)

Parameter	Range	Factory Setting	Description
Controlled stop on loss of AC supply **StP**	no, yes	no	When set to yes, at loss of input power, deceleration follows a self-adjusting ramp, which is a function of the regenerated energy. When set to no, motor coasts to a stop.
Ramps	Linear, S ramp	S ramp	Determines type of acceleration and deceleration ramps (linear or S). See diagrams below. Linear ramp used when acceleration and deceleration ramp times are greater than 1-2 seconds. S ramp used on applications with shorter ramp times. 
+Speed/-Speed with Store Setspeed	no, RAM, EEPROM	no	When inputs are set to +Speed/-Speed, this function gives the option for the last speed to be stored when power is removed, or the FW/RV signal is taken away. When power or FW/RV signal is restored, drive controller returns to the last speed.

Inputs/Outputs

When an option card is installed in an ALTIVAR 16 drive controller, the factory settings of the inputs / outputs can be reassigned if switch 2 on the option card is set to ON. This section lists and describes the inputs / outputs for option VW3-A16201 set for material handling. The inputs / outputs can be reassigned through the Inputs / Outputs screen under the Configuration menu (see page 16). They can be displayed on the Customer I / O screen under the Command / Display menu (see page 21).

Table 11: VW3-A16201 Option Card—Material Handling Inputs/Outputs

Terminal	Assignable Functions
AI	Speed feedback Speed feedback + deviation detection * Speed reference summing
LI1	Start/stop Fast stop * Fault reset +Speed Switch to ramp 2 Motor power change
LI2	* Preset speed 3 Fast stop Fault reset -Speed Switch to ramp 2 Motor power change
LI3	* Preset speed 4 Fast stop Fault reset Switch to ramp 2 Motor power change
LO	* I limit attained Low speed attained 1.1 Ith (motor thermal overload) attained
AO	* Motor frequency Motor current
S2A-S2B	* Brake control

* Factory setting

Enabling the serial link (setting either serial link command or serial link frequency to ON in the ATV / Command screen) allows the drive controller to operate independently from the inputs on the option card. Table 12 shows which control input terminal functions of the drive controller are valid regardless of serial link setting and which are disabled when operated in this mode.

Table 12: VW3-A16201 Option Card—Material Handling Serial Link Drive Control Hierarchy

Valid Inputs	Disabled When Serial Link Command is Set to ON	Disabled When Serial Link Frequency is Set to ON
Fast stop	Start/stop	Preset speed
Fault reset		
Switch to ramp 2		
Motor power change		
+Speed/-Speed		

Table 13: VW3-A16201 Option Card—Material Handling Description of Inputs/Outputs

Function	Description
Analog Input AI	± 10 V signal. Note when using AI, the connection between AI and COM must be removed.
Speed feedback	When using a tachogenerator, the signal is connected to AI and the AI input is set for Speed Feedback. This improves the speed regulation to 0.1%. The output voltage signal of the tachogenerator must be scaled in order to limit the voltage to 10 V at AI. Scaling is accomplished by using an external voltage divider circuit. For more information on using a tachogenerator, see “Speed Feedback” on page 96.
Speed feedback + deviation detection	This functions the same as Speed Feedback, however the Speed feedback faults Overspeed (**SPF**) and No tachofeedback (**SPF.**) can be detected. **SPF** is caused by the incorrect adjustment of tachogenerator feedback or machine overload. **SPF.** is caused by the loss of the tachogenerator signal. See chapter 3 for faults and corrective actions. For more information on using a tachogenerator, see “Speed Feedback” on page 96.
Speed reference summing	The +/- 10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Note that although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low Speed (**LSP**), 10 V = High Speed (**HSP**).
Logic Inputs LI1, LI2, LI3	The three logic inputs allow the control of specific functions from an external source. The full range of values is shown on the Inputs/Outputs screen under the Configuration menu (see page 16). Preset Speeds and +Speed/-Speed require two inputs.
Start/Stop	The drive controller changes state when the logic input assigned to this function goes high (state 1). When the drive controller is ready (motor not running) and the logic input goes high, the drive controller starts.The drive controller is stopped when the logic input goes high again. A speed reference and direction command must be present.
Fast stop	When the input set for Fast stop is high (state 1) and the drive controller is commanded to stop, the drive controller will follow the minimum deceleration ramp possible while avoiding an Overbraking (**ObF**) fault. Actual deceleration ramp time is a function of the load.
Fault reset	When the logic input goes high (state 1), the drive controller is reset if the cause of the fault has disappeared. The following faults can be reset: Overvoltage (**OSF**), Overload (**OLF**), Overbraking (**ObF**, **ObF.**), Speed Feedback (**SPF**, **SPF.**) and Serial Link fault (**SLF**). The drive controller is automatically reset after Phase Failure (**PHF**), Undervoltage (**USF**) and Option Card fault (**OPt**) if the cause of the fault has been corrected.
+Speed/- Speed	Increase or decrease of the speed by using two logic inputs, similar to a motorized potentiometer.
+Speed	When input is high (state 1), frequency increases according to acceleration ramp. The maximum frequency is limited by the reference frequency. When the input goes low (state 0), the speed is maintained.
-Speed	When input is high (state 1), frequency decreases according to deceleration ramp. The minimum frequency is limited by the setting of Low Speed (**LSP**). When the input goes low (state 0), the speed is maintained.

Table 13: VW3-A16201 Option Card—Material Handling
Description of Inputs/Outputs (Continued)

Function	Description
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 (**Ac2**) and Deceleration Ramp 2 (**dE2**), set on the Adjustments screen under the Configuration menu (see page 17). The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.
Motor Power Change	Use of one drive controller on either of two motors with different ratings. Switching between motors is performed by an appropriate drive output sequence. The switching must be made with the drive disabled. This function allows optimization of both motors. The following parameters are automatically changed by the ratio set by the Motor power ratio parameter on the Adjustments screen (see page 17). • Volts/frequency ratio (**UFr**) • Slip compensation • DC injection braking • Brake release current threshold (**Ibr**) • ItH (**motor thermal overload protection is inhibited; provide external thermal protection**)

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe this precaution can result in equipment damage.

Table 13: VW3-A16201 Option Card—Material Handling
Description of Inputs/Outputs (Continued)

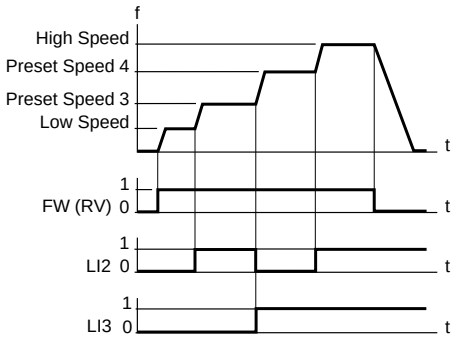
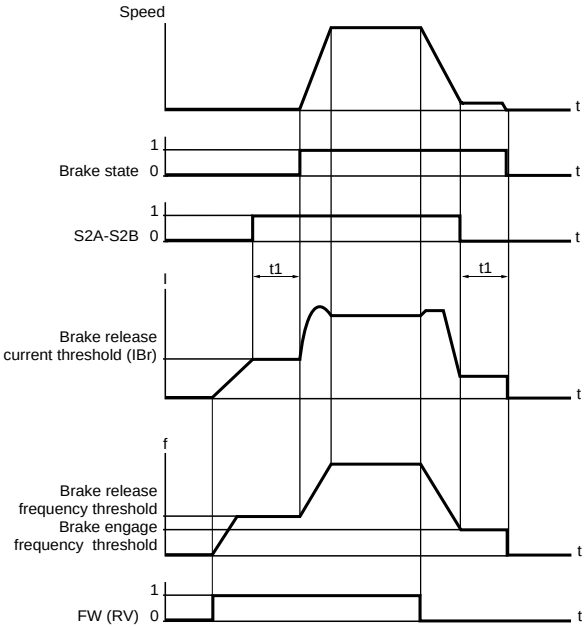
Function	Description
Preset speeds	**LI1** **LI2** **Reference** 0 0 Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card). 1 0 Preset speed 3, factory set at 5 Hz 0 1 Preset speed 4, factory set at 25 Hz 1 1 High speed setting  Preset Speed 1 is Low Speed (**LSP**) or the value of the reference signal. Drive controller runs at Preset Speed 1 when logic inputs assigned to Preset Speeds are both low (state 0). Preset Speed 2 is High Speed (**HSP**). Drive controller runs at Preset Speed 2 when logic inputs assigned to Preset Speeds are both high (state 1). For Preset Speed input states and timing diagram, see figure above.
Preset speed 3	The drive controller will run at Preset Speed 3 when the logic input assigned to Preset Speed 3 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 3 is factory set at 5 Hz, and can be adjusted by changing the Preset Speed 3 parameter on the Adjustments screen under the Configuration menu (see page 17).
Preset speed 4	The drive controller will run at Preset Speed 4 when the logic input assigned to Preset Speed 4 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 4 is factory set at 25 Hz, and can be adjusted by changing the Preset Speed 4 parameter on the Adjustments screen under the Configuration menu (see page 17).
Logic Output LO	PLC compatible open collector output. The range of assignments is shown on the Inputs/Outputs screen under the Configuration menu (page 16).
I limit attained	Signals when drive controller is at current limit.
Low speed attained	Signals when drive controller has attained Low Speed (**LSP**).
1.1 Ith attained	Signals when 1.1Ith motor overload protection threshold is attained. Can be used for pre-alarm or alarm.

Table 13: VW3-A16201 Option Card—Material Handling
Description of Inputs/Outputs (Continued)

Function	Description
Analog Output AO	0-20 mA signal. The range of assignments is shown on the Inputs/Outputs screen under the Configuration menu (page 16).
Motor frequency	Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (**HSP**).
Motor current	Analog output of motor current. 0 mA= 0 A, 20 mA = 1.82 times the permanent output current of the drive controller.

Table 13: VW3-A16201 Option Card—Material Handling
Description of Inputs/Outputs (Continued)

Function	Description
Relay Output S2A-S2B	Relay output.
Brake control	For use with a mechanical brake. Brake control: The S2A-S2B relay on the VW3-A16201 option card is set for brake control. The release and engaging of the mechanical brake follows the graph below. When the brake release frequency threshold and the brake release current threshold (**Ibr**) are reached, the S2A-S2B relay closes. During a time delay of t1, the acceleration ramp is inhibited. This ensures that the motor develops the necessary torque before the actual release of the brake. For the brake to engage, when the deceleration ramp reaches the brake engage frequency threshold, the S2A-S2B relay opens. The brake engages after a time delay of t1.  **Adjustments:** Brake release frequency threshold Brake release current threshold (**Ibr**) Brake release time delay Brake engage frequency threshold

Adjustments

Availability of Adjustment parameters is a function of the configuration of the drive controller and the option board, if present. The adjustment parameters are accessible through the Adjustments screen under the Configuration menu (page 17).

Table 14: VW3-A16201 Option Card—Material Handling Adjustments

Parameter	Range	Factory Setting	Description
Speed			
Acceleration **Acc**	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor frequency from zero speed.
Deceleration **dEc**	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor frequency to zero speed.
Low speed **LSP**	0 to **HSP**	0 Hz	Low speed setting.
High speed **HSP**	**LSP** to **tFr**	50 Hz if **FrS**=50 60 Hz if **FrS**=60	High speed setting. This is the frequency which is equal to 10 V on AIV or AI, or 20 mA on AIC.
Acceleration ramp 2 **Ac2**	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is set to Switch to Ramp 2.
Deceleration ramp 2 **dE2**	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input is set to Switch to Ramp 2.
Preset speed 3 **3SP**	**LSP** to **HSP**	5.0 Hz	Used when input is set to Preset Speed 3.
Preset speed 4 **4SP**	**LSP** to **HSP**	25 Hz	Used when input is set to Preset Speed 4.
Regulation loop			
V/f ratio **UFr**	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at low speed.
Frequency loop gain **FLG**	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

⚠ CAUTION

MOTOR MAY STALL.

Inhibiting this function can cause motor to stall if required torque is too high.

Failure to observe this precaution can result in equipment damage.

Table 14: VW3-A16201 Option Card—Material Handling Adjustments (Continued)

Parameter	Range	Factory Setting	Description
Slip compensation	0 to 5 Hz	Varies with drive controller rating	Maintains a constant speed to the motor for a given reference as the load changes, automatically correcting the frequency.
Integral gain	1 to 100	1.0	Allows use of a tachogenerator to improve the speed regulation. This parameter appears when AI is set to Speed Feedback or Feedback+Deviation Detection. Refer to "Speed Feedback" on page 96 for more information.
Current			
Thermal overload **Ith**	0.45 In to 1.05 In	0.9 In	Motor thermal overload protection. Adjust to the current value shown on the motor nameplate. To suppress motor thermal protection, increase the value to the maximum and provide external protection.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe this precaution can result in equipment damage.

⚠ 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 and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

Failure to observe this precaution can result in personal injury or equipment damage.

Table 14: VW3-A16201 Option Card—Material Handling Adjustments (Continued)

Parameter	Range	Factory Setting	Description
DC current level **Idc**	0.1 to 1.5 Ith	0.7 Ith	Amount of DC injected at the end of the deceleration ramp.
DC current time **tdc**	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the deceleration ramp.
Motor power ratio	1/1 to 1/5	1/1	Ratio of motor power to drive controller power used when logic input is set for Motor power change.
Brake control			
Brake release current **Ibr**	0.0 to 1.05 In	0	Current threshold which, along with brake release frequency threshold, initiates the closing of S2A-S2B. Value in Amps, varies with drive controller rating.
Brake release frequency	0.0 to **LSP**	LSP	Frequency threshold which, along with brake release current threshold, initiates the closing of S2A-S2B.
Brake engage frequency	0.0 to **LSP**	LSP	Frequency threshold which initiates the opening of S2A-S2B.
Brake release time delay	0 to 5 s	0 s	Time delay for brake release. Based on amount of time for the motor to develop the necessary torque before the actual release of the brake.

OPTION VW3-A16202 VARIABLE TORQUE

This section provides information about the parameters for the basic drive controller with option VW3-A16202 (Variable Torque Card) installed.

V/f Motor Pattern Parameters

V / f Motor Pattern parameters are associated with the volts / frequency ratio supplied to the motor. They are accessible through the V / f Motor Pattern screen under the Configuration menu in the Setup Software (see page 15).

Table 15: VW3-A16202 Option Card—Variable Torque V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 200 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 200 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	P	P	Type of volts/frequency ratio: P: Volts/frequency ratio adjusted for quadratic torque applications such as fans or centrifugal pumps.
Switching frequency 10 kHz **SFr**	no, yes	yes	Carrier frequency of the output pulses. Set to 10 kHz for reduced audible motor noise. Can be changed to 5 kHz. With the variable torque option card installed and switching frequency set at 10 kHz, the drive controller does not require derating.

[1] Factory settings are dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 16: VW3-A16202 Option Card—Variable Torque Special Functions

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no, yes	yes	When set to Yes, the deceleration ramp time is automatically adjusted to compensate for load inertia and to avoid Overbraking fault (**ObF**).
Slip compensation **SLP**	no	no	Slip Compensation disabled.
Automatic DC injection braking	no	no	No DC injection at the end of the deceleration ramp.
Automatic restart **Atr**	no, yes	yes	Enables drive controller to automatically restart following an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault. For **OSF** and **OBF** faults, drive controller remains disabled for 1 minute after fault appears, causing fault relay of drive controller to engage, then restarts automatically if fault has disappeared. If cause of fault is present at end of 1 minute, drive controller must be reset manually. Drive controller will attempt 5 automatic restarts (one every minute) before it must be manually reset. For **OLF** fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

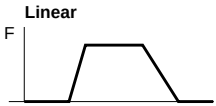
⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe this precaution can result in death, severe personal injury, or equipment damage.

Table 16: VW3-A16202 Option Card—Variable Torque Special Functions (Continued)

Parameter	Range	Factory Setting	Description
Catching a spinning load **FLr**	no, yes	yes	When set to yes, this function allows smooth restarting of the motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, the motor accelerates back up to speed without starting at zero.
Controlled stop on loss of AC supply **StP**	no, yes	no	When set to yes, at loss of input power, deceleration follows a self-adjusting ramp, which is a function of the regenerated energy. When set to no, motor coasts to a stop.
Ramps	Linear	Linear	Type of acceleration and deceleration ramps. 

Inputs/Outputs

When an option card is installed in an ALTIVAR 16 drive controller, the factory settings of the inputs / outputs can be reassigned if switch 2 on the option card is set to ON. This section lists and describes the inputs / outputs for option VW3-A16202. The inputs / outputs can be reassigned through the Inputs / Outputs screen under the Configuration menu (see page 16). They can be displayed on the Customer I / O screen under the Command / Display menu (see page 21).

Table 17: VW3-A16202 Option Card—Variable Torque Inputs/Outputs

Terminal	Assignable Functions
AI	Speed reference summing PI feedback * Manual reference
LI1	* Freewheel stop Switch to ramp 2
LI2	* Automatic/manual reference switching Switch to ramp 2
LI3	* DC injection braking Switch to ramp 2
LO	* Reference frequency attained
AO	* Motor frequency
S2A-S2B	* High speed attained

***** Factory setting

Enabling the serial link (setting either serial link command or serial link frequency to ON in the ATV / Command screen) allows the drive controller to operate independently from the inputs on the option card. Table 18 shows which control input terminal functions of the drive controller are valid regardless of serial link setting and which are disabled when operated in this mode.

Table 18: VW3-A16202 Option Card—Variable Torque Serial Link Drive Control Hierarchy

Valid Inputs	Disabled When Serial Link Command Set to ON	Disabled When Serial Link Frequency Set to ON
Freewheel stop Switch to ramp 2 DC injection braking		Automatic/manual reference switching

Table 19: VW3-A16202 Option Card—Variable Torque Description of Inputs/Outputs

Function	Description
Analog Input AI	± 10 V signal. Note when using AI, the connection between AI and COM must be removed.
Speed reference summing	The +/- 10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Note that although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low speed (**LSP**), 10 V = High speed (**HSP**).
PI feedback	Allows regulation of an external process variable (e.g., pressure, temperature or level). Proportional and integral gain are set with the Proportional and Integral Gain parameters on Adjustments screen under Configuration menu. See “PI Feedback” on page 94 for more explanation.
Manual reference input	Manual reference from a potentiometer for local command. Used as the manual reference in Automatic/manual reference switching.
Logic Inputs LI1, LI2, LI3	The three logic inputs allow the control of specific functions from an external source. The range of values is shown on the Inputs/Outputs screen under the Configuration menu (see page 16).
Freewheel stop	When logic input is high (state 1), and drive controller is commanded to stop, drive controller decelerates with no power applied to the motor. Deceleration time depends on motor speed, machine inertia and resistant torque.
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 (**Ac2**) and Deceleration Ramp 2 (**dE2**), set on the Adjustments screen under the Configuration menu (see page 17). The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.
Automatic/manual reference switching	The drive controller will run from the automatic analog reference at AIC (0-20 mA or 4-20 mA) when logic input set for Automatic/manual reference switching is low (state 0). When the logic input is high (state 1), the drive controller runs from the manual reference at AI (+/-10 V).

Table 19: VW3-A16202 Option Card—Variable Torque
Description of Inputs/Outputs (Continued)

Function	Description
DC injection braking	

⚠ WARNING

NO HOLDING TORQUE.

- **DC injection braking does not provide holding torque at zero speed.**
- **DC injection braking does not function during loss of power or drive controller fault.**
- **When required, use separate brake function for holding torque.**

Failure to observe these precautions can result in death, severe personal injury, or equipment damage.

⚠ CAUTION

MOTOR OVERHEATING.

Application of DC injection braking for long periods of time can cause motor overheating and damage. Protect motor from extended periods of DC injection braking.

Failure to observe this precaution can result in personal injury or equipment damage.

When logic input is high (state 1), DC is injected. The current level can be adjusted with the DC current level parameter (see page 17) between 0.5 and 1.5 times the value of motor thermal overload protection (**ItH**) for a time adjustable with the DC current time parameter (also on the Adjustments screen) between 0 and 5 s. After this time, the current injected is 0.5 times **ItH** until the logic input goes low.

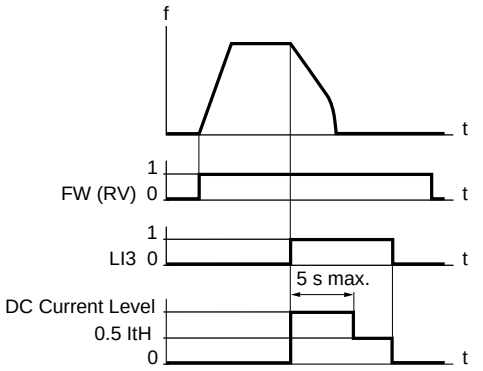


Table 19: VW3-A16202 Option Card—Variable Torque
Description of Inputs/Outputs (Continued)

Function	Description
Logic Output LO	PLC compatible open collector output.
Reference frequency attained	Signals when reference frequency is attained.
Analog Output AO	0-20 mA signal.
Motor frequency	Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (**HSP**).
Relay Output S2A-S2B	Relay output.
High speed attained	Signals when drive controller has attained High Speed (**HSP**).

Adjustments

Availability of Adjustment parameters is a function of the configuration of the drive controller and the option board, if present. The adjustment parameters are accessible through the Adjustments screen under the Configuration menu (page 17).

Table 20: VW3-A16202 Option Card—Variable Torque Adjustments

Parameter	Range	Factory Setting	Description
Speed			
Acceleration **Acc**	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor frequency from zero speed.
Deceleration **dEc**	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor frequency to zero speed.
Low speed **LSP**	0 to **HSP**	0 Hz	Low speed setting.
High speed **HSP**	**LSP** to **tFr**	50 Hz if **FrS**=50 60 Hz if **FrS**=60	High speed setting. This is the frequency which is equal to 10 V on AIV or AI, or 20 mA on AIC.
Jump frequency 1 **JF1**	**LSP** to **HSP**	0.0 Hz	Drive controller reference will not stop on the critical frequency which causes mechanical resonance. **JF1** defines the center of a 2 Hz band.
Jump frequency 2 **JF2**	**LSP** to **HSP**	0.0 Hz	Drive controller reference will not stop on the critical frequency which causes mechanical resonance. **JF2** defines the center of a 2 Hz band.
Acceleration ramp 2 **Ac2**	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is set to Switch to Ramp 2.
Deceleration ramp 2 **DE2**	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input is set to Switch to Ramp 2.
Regulation loop			
V/f ratio **UFr**	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at Low speed.
Frequency loop gain **FLG**	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

⚠ CAUTION

MOTOR MAY STALL.

Inhibiting this function can cause motor to stall if required torque is too high.

Failure to observe this precaution can result in equipment damage.

Table 20: VW3-A16202 Option Card—Variable Torque Adjustments (Continued)

Parameter	Range	Factory Setting	Description
Proportional gain	1 to 100	1.0	When AI is set to PI feedback, this parameter sets the proportional gain. Refer to “PI Feedback” on page 94 for more information.
Integral gain	1 to 100	1.0	When AI is set to PI feedback, this parameter sets the integral gain. Refer to “PI Feedback” on page 94 for more information.
Current			
Thermal overload **Ith**	0.45 In to 1.05 In	0.9 In	Motor thermal overload protection. Adjust to the current value shown on motor nameplate. To suppress motor thermal protection, increase value to the maximum and provide external protection.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe this precaution can result in equipment damage.

⚠ 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 and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

Failure to observe this precaution can result in personal injury or equipment damage.

DC current level **Idc**	0.5 to 1.5 Ith	0.7 Ith	Amount of DC injected at the end of the deceleration ramp and when logic input set for DC braking is high (state 1).
DC current time **tdc**	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the deceleration ramp and when logic input set for DC braking is high (state 1).

OPTION VW3-A16203 HIGH SPEED MOTOR

This section provides information about the parameters for the basic drive controller with option VW3-A16203 (High Speed Motor Card) installed.

V/f Motor Pattern Parameters

V / f Motor Pattern parameters are associated with the volts / frequency ratio supplied to the motor. They are accessible through the V / f Motor Pattern screen under the Configuration menu (see page 15).

Table 21: VW3-A16203 Option Card—High Speed Motors V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 400 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 400 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	N, L	L	Type of volts/frequency ratio: N: Standard applications at constant torque not requiring high voltage boost. L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.
Switching frequency 10 kHz **SFr**	no	no	The switching frequency is 5 kHz.

[1] Factory settings are dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 22: VW3-A16203 Option Card—High Speed Motors Special Functions

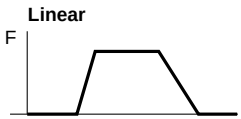
Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no, yes	yes	When set to yes, the deceleration ramp time is automatically adjusted to compensate for load inertia and to avoid an Overbraking fault (**ObF**).
Slip compensation **SLP**	no	no	Slip Compensation disabled.
Automatic DC injection braking	no, f < 0.1 Hz, f < **LSP**	f < 0.1 Hz	When not set to no, DC current will automatically be injected when f < 0.1.Hz or when f < **LSP** depending on the setting.
Automatic restart **Atr**	no	no	When set to no, drive controller will not automatically restart following an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault.

⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe this precaution can result in death, severe personal injury or equipment damage.

Catching a spinning load **FLr**	no, yes	yes	When set to yes, this function allows smooth restarting of the motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, the motor accelerates back up to speed without starting at zero.
Controlled stop on loss of AC supply **StP**	no, yes	no	When set to yes, at loss of input power, deceleration follows a self-adjusting ramp which is a function of the regenerated energy. When set to No, motor coasts to a stop.
Ramps	Linear	Linear	Type of acceleration and deceleration ramp. **Linear** 

Inputs/Outputs

When an option card is installed in an ALTIVAR 16 drive controller, the factory settings of the inputs / outputs can be reassigned if switch 2 on the option card is set to ON. This section lists and describes the inputs / outputs for option VW3-A16203. The inputs / outputs can be reassigned through the Inputs / Outputs screen under the Configuration menu (see page 16). They can be displayed on the Customer I / O screen under the Command / Display menu (see page 21).

Table 23: VW3-A16203 Option Card—High Speed Motors Inputs/Outputs

Terminal	Assignable Functions
AI	* Speed reference summing
LI1	* Jog
LI2	Preset speed 3 * Switch to ramp 2
LI3	Preset speed 4 * Freewheel stop
LO	* 1.1 Ith (motor thermal overload) attained
AO	* Motor frequency Motor current
S2A-S2B	* Reference frequency attained

***** Factory setting

Enabling the serial link (setting either serial link command or serial link frequency to ON in the ATV / Command screen) allows the drive controller to operate independently from the inputs on the option card. Table 24 shows which control input terminal functions of the drive controller are valid regardless of serial link setting and which are disabled when operated in this mode.

Table 24: VW3-A16203 Option Card—High Speed Motors Serial Link Drive Control Hierarchy

Valid Inputs	Disabled When Serial Link Command is Set to ON	Disabled When Serial Link Frequency is Set to ON
Switch to ramp 2		Preset speeds
Freewheel stop		Jog

Table 25: VW3-A16203 Option Card—High Speed Motors
Description of Inputs/Outputs

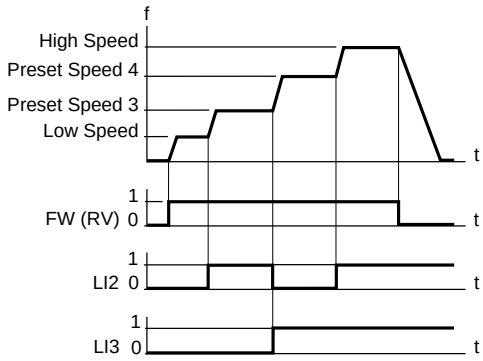
Function	Description
Analog Input AI	± 10 V signal. Note when using AI, the connection between AI and COM must be removed.
Speed reference summing	The +/- 10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Note that although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low speed (**LSP**), 10 V = High speed (**HSP**).
Logic Inputs LI1, LI2, LI3	The three logic inputs allow the control of specific functions from an external source. The range of values is shown on the Inputs/Outputs screen under the Configuration menu (see page 16). Note that Preset Speeds requires two inputs.
Freewheel stop	When logic input is high (state 1), and drive controller is commanded to stop, drive controller decelerates with no power applied to the motor. Deceleration time depends on motor speed, machine inertia and resistant torque.
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 (**Ac2**) and Deceleration Ramp 2 (**dE2**), set on the Adjustments screen under the Configuration menu of the Setup Software (see page 17). The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.
Jog	When the input set for Jog is high (state 1) and a direction command (FW/RV) is present, the drive controller will jog at the frequency set by the Jog parameter under adjustments. Factory set for 5 Hz, this parameter is adjustable between 0 and 10 Hz. When jogging, the acceleration and deceleration ramp rates are 0.1 s. The minimum time between jog pulses is 0.5 s.
Preset Speeds	**LI1** **LI2** **Reference** 0 0 Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card). 1 0 Preset speed 3, factory set at 5 Hz 0 1 Preset speed 4, factory set at 25 Hz 1 1 High speed setting 

Table 25: VW3-A16203 Option Card—High Speed Motors
Description of Inputs/Outputs (Continued)

Function	Description
	Preset Speed 1 is Low Speed (**LSP**) or the value of the reference signal. Drive controller runs at Preset Speed 1 when logic inputs assigned to Preset Speeds are both low (state 0). For Preset Speed input states and timing diagram, see above figure.
	Preset Speed 2 is High Speed (**HSP**). Drive controller runs at Preset Speed 2 when logic inputs assigned to Preset Speeds are both high (state 1).
Preset speed 3	The drive controller will run at Preset Speed 3 when the logic input assigned to Preset Speed 3 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 3 is factory set at 5 Hz, and can be adjusted by changing the Preset Speed 3 parameter on the Adjustments screen under the Configuration menu (see page 17).
Preset speed 4	The drive controller will run at Preset Speed 4 when the logic input assigned to Preset Speed 4 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 4 is factory set at 25 Hz, and can be adjusted by changing the Preset Speed 4 parameter on the Adjustments screen under the Configuration menu (see page 17).
Logic Output LO	Open collector output.
1.1 Ith attained	Signals when 1.1 Ith motor overload protection threshold is attained. Can be used for a pre-alarm or alarm.
Analog Output AO	0-20 mA signal. The range of assignments is shown on the Inputs/Outputs screen (see page 16).
Motor frequency	Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (**HSP**).
Motor current	Analog output of motor current. 0 mA=0 A, 20 mA=1.82 times the permanent output current of the drive controller.
Relay Output S2A-S2B	Relay output.
Reference frequency attained	Relay closes when reference frequency is attained.

Adjustments

Availability of adjustment parameters is a function of the configuration of the drive controller and the option board, if present. The adjustment parameters are accessible through the Adjustments screen under the Configuration menu (page 17).

Table 26: VW3-A16203 Option Card—High Speed Motors Adjustments

Parameter	Range	Factory Setting	Description
Speed			
Acceleration **Acc**	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor frequency from zero speed.
Deceleration **dEc**	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor frequency to zero speed.
Low speed **LSP**	0 to **HSP**	0 Hz	Low speed setting.
High speed **HSP**	**LSP** to **tFr**	50 Hz if **FrS**=50 60 Hz if **FrS**=60	High speed setting. This is the frequency which is equal to 10 V on AIV or AI, or 20 mA on AIC.
Acceleration ramp 2 **Ac2**	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is set to Switch to Ramp 2.
Deceleration ramp 2 **dE2**	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input is set to Switch to Ramp 2.
Jog frequency **JOG**	0.1 to 10 Hz	5 Hz	Frequency at which the drive controller will jog when the input, set for Jog, is high (state 1) and a direction command (FW/RV) is present.
Preset speed 3 **3SP**	**LSP** to **HSP**	5.0 Hz	Used when input is set to Preset Speed 3.
Preset speed 4 **4SP**	**LSP** to **HSP**	25 Hz	Used when input is set to Preset Speed 4.
Regulation loop			
V/f ratio **UFr**	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at low speed.
Frequency loop gain **FLG**	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

⚠ CAUTION

MOTOR MAY STALL.

Inhibiting this function can cause motor to stall if required torque is too high.

Failure to observe this precaution can result in equipment damage.

Table 26: VW3-A16203 Option Card—High Speed Motors Adjustments (Continued)

Parameter	Range	Factory Setting	Description
Current			
Thermal Overload **Ith**	0.45 In to 1.05 In	0.9 In	Motor thermal overload protection. Adjust to the current value shown on the motor nameplate. To suppress motor thermal protection, increase the value to the maximum and provide external protection.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe this precaution can result in equipment damage.

⚠ 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 and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

Failure to observe this precaution can result in personal injury or equipment damage.

Table 26: VW3-A16203 Option Card—High Speed Motors Adjustments (Continued)

Parameter	Range	Factory Setting	Description
DC current level **Idc**	0.1 to 1.5 Ith	0.7 Ith	Amount of DC injected at the end of the deceleration ramp.
DC current time **tdc**	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the deceleration ramp.

OPTION VW3-A16204 GENERAL USE 3-WIRE CONTROL

This section provides information about the parameters for the basic drive controller with option VW3-A16204 (General Use 3-Wire Control Card) installed.

V/f Motor Pattern Parameters

V / f Motor Pattern parameters are associated with the volts / frequency ratio supplied to the motor. They are accessible through the V / f Motor Pattern screen under the Configuration menu (see page 15).

Table 27: VW3-A16204 Option Card—General Use 3-Wire Control V/f Motor Pattern Parameters

Parameter	Range	Factory Setting	Description
Nominal motor voltage **UnS**	**ATV16U•••M2**: 208, 220, 230, 240V **ATV16U•••N4**: 380, 400, 415, 460V	230V 400/460V [1]	Corresponds to value on motor nameplate.
Nominal motor frequency **FrS**	40 to 200 Hz	50 or 60 Hz [1]	Output frequency selection at rated motor voltage.
Maximum frequency **tFr**	40 to 200 Hz	50 Hz if **FrS**=50 60 Hz if **FrS**=60	Maximum output frequency (Hz). This function extends the frequency range for use above nominal motor frequency, while voltage is held constant. Note that the available torque decreases rapidly.
V/f ratio **UFt**	N,P, L	N	Type of volts/frequency ratio: N: Standard applications at constant torque not requiring high voltage boost. P: Volts/frequency ratio adjusted for quadratic torque applications such as fans or centrifugal pumps. L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.
Switching frequency 10 kHz **SFr**	no, yes	no	Normal setting 5 kHz. Can be increased to 10 kHz for less audible motor noise. When switching frequency is increased to 10 kHz, drive controller must be derated by 20%.

[1] Factory settings are dependent on position of switch 1 on drive controller.

Special Functions

Special Functions allow the motor / drive controller combination to be adapted to the type of application. Depending on the configuration of the drive controller, these may not be accessible. They are available through the Special Functions screen under the Configuration menu (see page 16).

Table 28: VW3-A16204 Option Card—General Use 3-Wire Control Special Functions

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation **brA**	no, yes	yes	If set to yes, deceleration ramp time is automatically adjusted to compensate for load inertia to avoid an Overbraking fault (**ObF**).
Slip compensation **SLP**	no, yes	yes	If set to yes, drive controller maintains a constant speed to the motor for a given reference as the load changes, automatically correcting the frequency. Factory setting is that of a standard asynchronous 4-pole squirrel cage motor of equivalent power. Slip Compensation should be disabled for machines with high inertia, synchronous motors, and variable torque applications.
Automatic DC injection braking	no, f < 0.1 Hz, f < **LSP**	f < 0.1 Hz	If not set to no, DC current will automatically be injected when f < 0.1 Hz or when f < **LSP**, depending on setting.
Automatic restart **Atr**	no, yes	no	Enables drive controller to automatically restart following an Overvoltage (**OSF**), Overload (**OLF**) or Overbraking (**OBF**) fault. For **OSF** and **OBF** faults, drive controller remains disabled for 1 minute after fault appears, causing fault relay of drive controller to engage, then restarts automatically if fault has disappeared. If cause of fault is present at end of 1 minute, drive controller must be reset manually. Drive controller will attempt 5 automatic restarts (one every minute) before it must be manually reset. For **OLF** fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

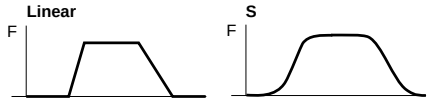
⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury or equipment damage.

Table 28: VW3-A16204 Option Card—General Use 3-Wire Control Special Functions (Continued)

Parameter	Range	Factory Setting	Description
Catching a spinning load **FLr**	no, yes	no	When set to yes, allows smooth restarting of motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, motor accelerates back up to speed without starting at zero.
Controlled stop on loss of AC supply **StP**	no	no	At loss of input power, motor coasts to a stop.
Ramps	Linear, S ramp	Linear	Determines type of acceleration and deceleration ramps. See diagrams below. Linear ramp used when acceleration and deceleration ramp times are greater than 1-2 seconds. S ramp used on applications with shorter ramp times. 
Adjustable current limitation	0.5 to 1.5 In	1.5 In	Maximum output of drive controller is limited to the amount set by this parameter when a logic input is assigned to this function and is high (state 1).

Inputs/Outputs

When an option card is installed in an ALTIVAR 16 drive controller, the factory settings of the inputs / outputs can be reassigned if switch 2 on the option card is set to ON. This section lists and describes the inputs / outputs for option card VW3-A16204, General Use 3-Wire Control. The inputs / outputs can be reassigned through the Inputs / Outputs screen under the Configuration menu (see page 14). The settings can be displayed on the Customer I / O screen under the Command / Display menu (see page 18).

Table 29: VW3-A16204 Option Card—General Use 3-Wire Control Inputs/Outputs

Terminal	Assignable Functions
AI	Speed feedback Speed feedback + deviation detection * Speed reference summing Manual reference
LI1	* Run enable
LI2	Preset speed 3 Fault reset * Freewheel stop Switch to ramp 2 Reduce I limit Jog Automatic/manual reference switching
LI3	Preset speed 4 Fault reset Freewheel stop Switch to ramp 2 Reduce I limit * Jog
LO	* 100% thermal state attained Reference frequency attained I limit attained Low speed attained High speed attained 1.1 Ith (motor thermal overload) attained
AO	* Motor frequency Motor current
S2A-S2B	100% thermal state attained * Reference frequency attained Drive running

* Factory setting

Enabling the serial link (setting either serial link command or serial link frequency to ON in the ATV / Command screen) allows the drive controller to operate independently from the inputs on the option card. Table 6 shows which control input terminal functions of the drive controller are valid regardless of serial link setting and which are disabled when operated in this mode.

Table 30: VW3-A16204 Option Card—General Use 3-Wire Control Serial Link Drive Control Hierarchy

Valid Inputs	Disabled When Serial Link Command is Set to ON	Disabled When Serial Link Frequency is Set to ON
Fault reset	Start/stop	Preset speed
Freewheel stop		Jog
Switch to ramp 2		
Reduce I limit		

Table 31: VW3-A16204 Option Card—General Use 3-Wire Control Description of Inputs/Outputs

Function	Description
Analog Input AI	± 10 V signal. Note when using AI, the connection between AI and COM must be removed.
Speed feedback	When using a tachogenerator, the signal is connected to AI and the AI input is set for Speed Feedback. This improves speed regulation to 0.1%. The output voltage signal of the tachogenerator must be scaled to limit the voltage to 10 V at AI. Scaling is accomplished by using an external voltage divider circuit. For more information on using a tachogenerator, refer to “Speed Feedback” on page 96.
Speed feedback + deviation detection	This functions the same as Speed Feedback; however, the Speed Feedback Faults Overspeed (**SPF**) and No Tachofeedback (**SPF.**) can be detected. **SPF** is caused by the incorrect adjustment of tachogenerator feedback or machine overload. **SPF.** is caused by the loss of the tachogenerator signal. See chapter 3 for faults and corrective actions. For more information on using a tachogenerator, see “Speed Feedback” on page 96.
Speed reference summing	The ±10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low Speed (**LSP**), 10 V = High Speed (**HSP**).
Manual reference	Manual reference from a potentiometer for local command. Used as the manual reference in automatic/manual reference switching.
Logic Input LI1	LI1 is assigned to Run Enable.
Run enable	LI1 must be high for the drive controller to run. If the drive controller is runnning and LI1 goes low, the drive controller will stop following the normal ramp. With LI1 high, the forward or reverse inputs must momentarily transition to high to start the drive controller. For more information on 3-wire control operation, refer to the option card instruction bulletin, 50006-360-11.

Table 31: VW3-A16204 Option Card—General Use 3-Wire Control Description of Inputs/Outputs (Continued)

Function	Description
Logic Inputs LI2, LI3	These logic inputs allow the control of specific functions from an external source. The full range of values is shown on the Inputs/Outputs screen (seepage 16). *Note: Preset Speeds requires two inputs.*
Fault reset	When the logic input goes high (state 1), the drive controller is reset if the cause of the fault has disappeared. The following faults can be reset: Overvoltage (**OSF**), Overload (**OLF**), Overbraking (**ObF**, **ObF.**), Speed Feedback (**SPF**, **SPF.**) and Serial Link fault (**SLF**). The drive controller is automatically reset after Phase Failure (**PHF**), Undervoltage (**USF**) and Option Card fault (**OPt**) if the cause of the fault has been corrected.
Freewheel stop	When logic input is high (state 1) and drive controller is commanded to stop, drive controller decelerates with no power applied to motor. Deceleration time depends on motor speed, machine inertia and resistant torque.
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 (**Ac2**) and Deceleration Ramp 2 (**dE2**), set on the Adjustments screen (see page 17). The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.
Reduce current limit	Allows reduction of current limit. When the logic input is high (state 1), the maximum output current of the drive controller is reduced to the amount set by the adjustable current limitation parameter on the Special Functions screen (see page 16). This reduces the maximum torque available to the motor. The reduction of current does not change other parameters such as DC Injection or Slip Compensation.
Jog	When the input set for Jog is high (state 1) and a direction command (FW/RV) is present, the drive controller will jog at the frequency set by the Jog parameter on the Adjustments screen (see page 17). Factory set for 5 Hz, this parameter is adjustable between 0 and 10 Hz. When jogging, the acceleration and de-celeration ramp rates are 0.1 s. The minimum time between jog pulses is 0.5 s.
Auto/manual reference switching	The drive controller will run from the automatic analog reference at AIC (0-20 mA or 4-20 mA) when logic input set for Automatic/manual reference switching is low (state 0). When the logic input is high (State 1), the drive controller runs from the manual reference at AI (± 10 V).

Table 31: VW3-A16204 Option Card—General Use 3-Wire Control Description of Inputs/Outputs (Continued)

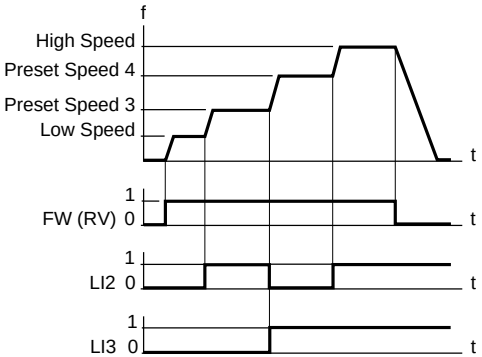
Function	Description
Preset speeds	**LI1** **LI2** **Reference** 0 0 Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card) 1 0 Preset speed 3, factory set at 5 Hz 0 1 Preset speed 4, factory set at 25 Hz 1 1 High speed setting  Preset Speed 1 is Low Speed (**LSP**) or the value of the reference signal. Drive controller runs at Preset Speed 1 when logic inputs assigned to Preset Speeds are both low (state 0). Preset Speed 2 is High Speed (**HSP**). Drive controller runs at Preset Speed 2 when logic inputs assigned to Preset Speeds are both high (state 1).
Preset speed 3	The drive controller will run at Preset Speed 3 when the logic input assigned to Preset Speed 3 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 3 is factory set at 5 Hz, and can be adjusted by changing the Preset Speed 3 parameter on the Adjustments screen under the Configuration menu (see page 17).
Preset speed 4	The drive controller will run at Preset Speed 4 when the logic input assigned to Preset Speed 4 is high (state 1) and a direction command (FW/RV) is present. The value of Preset Speed 4 is factory set at 25 Hz, and can be adjusted by changing the Preset Speed 4 parameter on the Adjustments screen under the Configuration menu (see page 17).
Logic Output LO	PLC compatible collector output. Full range of settings is available from the Inputs/Outputs screen (see page 16).
100% thermal state attained	Signals when 100% thermal state is attained. Can be used for a pre-alarm or alarm.
Reference frequency attained	Signals when reference frequency is attained.
I limit attained	Signals when drive controller is at current limit.
Low speed attained	Signals when drive controller has attained Low Speed (**LSP**).
High speed attained	Signals when drive controller has attained High Speed (**HSP**).
1.1 Ith attained	Signals when 1.1 Ith motor overload protection threshold is attained. Used for a pre-alarm or alarm.

Table 31: VW3-A16204 Option Card—General Use 3-Wire Control Description of Inputs/Outputs (Continued)

Function	Description
Analog Output AO	0-20 mA signal. Full range of settings is available from the Inputs/Outputs screen (see page 16).
Motor frequency	Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (**HSP**).
Motor current	Analog output of motor current. 0 mA = 0A, 20 mA = 1.82 times the permanent output current of the drive controller.
Relay Output S2A-S2B	Relay output. Full range of settings is available from the Inputs/Outputs screen (see page 16).
100% thermal state attained	Relay closes when 100% thermal state is attained. Can be used for a pre-alarm or alarm.
Reference frequency attained	Relay closes when reference frequency is attained.
Drive running	Relay closes when drive is running.

Adjustments

Availability of Adjustment parameters is a function of the configuration of the drive controller and the option board, if present. The adjustment parameters are accessible through the Adjustments screen under the Configuration menu (page 17).

Table 32: VW3-A16204 Option Card—General Use 3-Wire Control Adjustments

Parameter	Range	Factory Setting	Description
Speed			
Acceleration **Acc**	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor frequency from zero speed.
Deceleration **dEc**	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor frequency to zero speed.
Low speed **LSP**	0 to **HSP**	0 Hz	Low speed setting.
High speed **HSP**	**LSP** to **tFr**	50 Hz if **FrS**=50 60 Hz if **FrS**=60	High speed setting. This is the frequency which is equal to 10 V on AIV or AI, or 20 mA on AIC.
Jog frequency **JOG**	0.1 to 10 Hz	5 Hz	Frequency at which the drive controller will jog when the input, set for Jog, is high (state 1) and a direction command (FW/RV) is present.
Acceleration ramp 2 **Ac2**	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is set to Switch to Ramp 2.
Deceleration ramp 2 **dE2**	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input is set to Switch to Ramp 2.
Preset speed 3 **3SP**	**LSP** to **HSP**	5.0 Hz	Used when input is set to Preset Speed 3.
Preset speed 4 **4SP**	**LSP** to **HSP**	25 Hz	Used when input is set to Preset Speed 4.
Regulation loop			
V/f ratio **UFr**	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at low speed.
Frequency loop gain **FLG**	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

⚠ CAUTION

MOTOR MAY STALL.

Inhibiting this function can cause motor to stall if required torque is too high.

Failure to observe this precaution can result in equipment damage.

Table 32: VW3-A16204 Option Card—General Use 3-Wire Control Adjustments (Continued)

Parameter	Range	Factory Setting	Description
Current			
Thermal overload **Ith**	0.45 In to 1.05 In	0.9 In	Motor thermal overload protection. Adjust to the current value shown on the motor nameplate. To suppress motor thermal protection, increase value to the maximum and provide external protection.

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:

- **The overload relay must be suitable for operation with direct current flowing in the motor.**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

Failure to observe these precautions can result in equipment damage.

⚠ 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 and loading conditions. Consult motor manufacturer for thermal capability of motor when operated over desired speed range.

Failure to observe this precaution can result in personal injury or equipment damage.

DC current level **Idc**	0.1 to 1.5 Ith	0.7 Ith	Amount of DC injected at the end of the deceleration ramp.
DC current time **tdc**	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the deceleration ramp.
Current limit level	0.5 to1.5 In	1.5 In	Reduction of current limit when input assigned to Reduce Current Limit is high (state 1).

CHAPTER 3—FAULTS AND CORRECTIVE ACTION

INTRODUCTION

Table 33 lists the fault information accessible on the Command / Display menu, the probable causes of the faults, and associated corrective action. When taking corrective action, follow the procedures beginning on page 81.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- **Read and understand these procedures before servicing ATV16 AC drive controllers. Installation, adjustment, repair and maintenance of these drive controllers must be performed by qualified personnel.**
- **Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools while making adjustments.**

Failure to observe these precautions will cause death, personal injury, or electric shock.

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: CHECKING SUPPLY VOLTAGE

Before checking supply voltage, disconnect all power and measure DC bus capacitor voltage by following the procedure below.

DC bus capacitor voltage is measured between the J9+ and J8- terminals of the drive controller. The DC bus capacitors are discharged when input power is removed from the drive controller. To ensure the capacitors are fully discharged, always disconnect all power, wait 1 minute, then test with a DC voltmeter (1000 VDC scale) before wiring, troubleshooting or working inside the drive controller. If no reading is shown on the voltmeter, reduce scale and test again.

The J9+ and J8- terminals are located on the power board, in the general area shown in Figure 28 on page 82. To measure the bus capacitor voltage, follow the Bus Voltage Measurement Procedure on page 82.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN OR EXPLOSION.

- **Read and understand Bus Voltage Measurement Procedure before performing procedure. Measurement of bus capacitor voltage must be performed by qualified personnel.**
- **DO NOT short across 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.**

Failure to observe these precautions will cause death, personal injury or electric shock.

NOTE: On earlier models, the DC bus terminals designated J8- and J9+ in the Bus Voltage Measurement Procedure, are designated as follows:

Catalog No.	J8-	J9+
ATV16U09M2 ATV16U18M2	J211	J212
ATV16U29M2 ATV16U18N4 ATV16U29N4	J104	J105
ATV16U41M2 ATV16U41N4 ATV16U54N4 ATV16U72N4	J110	J112

Bus Voltage Measurement Procedure

1. Disconnect all power from drive controller.
2. Wait 1 minute to allow the DC bus to discharge.
3. Remove all covers.
4. Set the voltmeter to the 1000 VDC scale. Measure the bus capacitor voltage between the J9+ and J8- terminals to verify the DC voltage is less than 45 V. **Do not short across capacitor terminals with voltage present!**
5. If the bus capacitors are not fully discharged, contact your local Square D / Telemecanique representative – **do not operate the drive controller.**
6. Replace all covers.

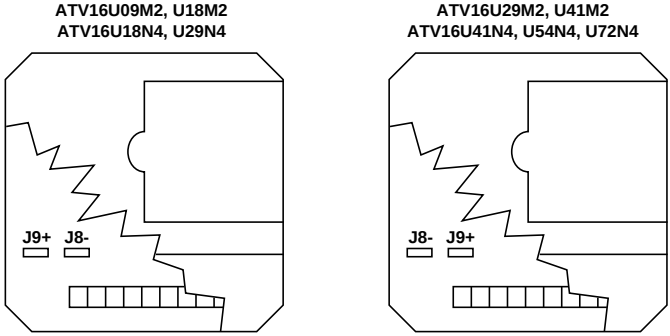


Figure 28: Measuring Bus Capacitor Voltage

After measuring DC bus capacitor voltage, check supply voltage by following the procedure below:

1. Attach meter leads to L1 and L2. Set voltmeter to the 600V AC scale.
2. Reapply power. Voltage should be as follows:

   ATV16U••M2 187.2 VAC<V<264 VAC

   ATV16U••N4 340.0 VAC<V<529 VAC
3. Remove power and repeat procedure for L2 and L3, and L1 and L3 if wired for three phase.
4. When all phases have been measured, remove power. Remove leads, reinstall covers.

PROCEDURE 2: CHECKING PERIPHERAL EQUIPMENT

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

1. A protective device such as fuses or circuit breaker may have tripped.
2. A switching device such as a contactor may not be closing at the correct time.
3. Conductors may require repair or replacement.
4. Connection cables 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 U, V or W. Do not connect the high potential dielectric test equipment or insulation resistance test equipment to the drive controller since the test voltages used may damage the drive controller. Always disconnect the drive controller from the conductors or motor while performing such tests.

⚠ CAUTION

EQUIPMENT DAMAGE HAZARD.

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

Failure to observe these precautions can result in equipment damage.

FAULTS

Table 33: Faults

Fault	Probable Causes	Corrective Actions
Mains phase failure	• No supply to terminals L1, L2, (L3) • Power fuses blown • Brief input line failure (t≥200 ms)	Check: • Supply Voltage (Procedure 1 on page 81) • Supply fuses or circuit breaker (Procedure 2 on page 83)
Undervoltage	• Supply voltage too low • For ATV16...M2, V≤187 V • For ATV16...N4, V≤340 V • Temporary voltage drop (t≥200 ms)	Check: • Supply voltage (Procedure 1 on page 81) • Connections
Overvoltage	• Supply voltage too high • For ATV16...M2, V≥264 V • For ATV16...N4, V≥529 V	Check: • Supply voltage (Procedure 1 on page 81)
Overload	Thermal trip due to prolonged motor overload	Check: • **ItH** setting and compare with motor In • Load base speed and power rating and compare with operating speed and drive controller/motor power rating • Motor connections (possibility of single phase operation) Wait approximately 7 minutes before resetting.
Overbraking fault (V) **Overbraking fault (I)**	Overbraking due to overvoltage or Overcurrent due to excessive braking or an overhauling load, even with braking option.	Increase deceleration time, optimize gain by decreasing value of Frequency loop gain (**FLG**) and optimize V/f ratio **(UFr**). Add braking option if necessary. Refer to Instruction Bulletin 50006-360-04.
Transient overcurrent	• Short circuit or phase to ground on the output of the drive controller • Overheating of drive controller • Supply voltage transient variations • Current too high during transient duty • Internal short circuit	Switch drive off. Disconnect drive from motor at U, V and W. Check connection cables and motor insulation (Procedure 2 on page 83). Increase acceleration or deceleration time. Check the ambient temperature of the drive controller.
Charge relay fault	Failure of command for capacitor charge relay to close	Replace drive controller.
Internal drive fault	Drive controller does not recognize rating	Disconnect power and wait one minute for capacitors to discharge. Check internal connections in the drive. If fault persists, replace drive controller.
EEPROM memory fault	Problem with EEPROM memory	Replace drive controller.

Table 33: Faults (Continued)

Fault	Probable Causes	Corrective Actions
Serial link fault	Communication loss between an option and the drive controller	Check display option connection. Check connection to PC. Reset drive controller.
Option I/O to be configured	Switch 2 on option card was moved to On in order to reconfigure the I/O.	Reconfigure the I/O with the PC Connection option or return Switch 2 to Off.
Overspeed	Option card fault (VW3-A16201 and VW3-A16204 only) Speed feedback fault	Check: • Feedback signal • Load base speed and power rating and compare with operating speed and drive controller/motor power rating • Tachogenerator connection
No tachofeed-back	Incorrect adjustment of tachogenerator feedback, or machine overload. No tachogenerator signal.	
External fault	Fault relay activated by serial link	Reset fault relay over the serial link in the ATV Command Screen

APPENDIX—PARAMETER SUMMARY

Automatic/Manual Reference Switching

The drive controller will run from the automatic analog reference at AIC on drive controller (0-20 mA or 4-20 mA) when logic input set for Automatic/manual reference switching is low (state 0). When the logic input is high (state 1), the drive controller runs from the manual reference at AI (0-10 V) on option card.

Automatic Restart

Automatic restart enables the drive controller to automatically restart following an overvoltage (**OSF**), overload (**OLF**), or overbraking (**ObF**) fault. For the **OSF** and **ObF** faults, the drive controller remains disabled for 1 minute after the fault appears, causing the fault relay of the drive controller to engage, then it restarts automatically if the cause of the fault has disappeared. If the cause of the fault has not disappeared at the end of 1 minute, the drive controller must be reset manually. The drive controller will attempt 5 automatic restarts (one every minute), before the drive must be manually reset. For the **OLF** fault, the automatic restart is effective as soon as the thermal state drops below 100%, usually about 7 minutes after the fault occurs.

Supply voltage, reference frequency and a direction command (FW or RV) must be maintained.

⚠ WARNING

UNINTENDED EQUIPMENT ACTION.

- **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury, or equipment damage.

Brake Control

For use with a mechanical brake. The S2A-S2B relay on the VW3-A16201 option card is set for brake control. The release and engaging of the mechanical brake follows the graph below. When the brake release frequency threshold and the brake release current threshold (**Ibr**) are reached, the S2A-S2B relay closes. During a time delay of t1, the acceleration ramp is inhibited. This allows the motor to develop sufficient torque to release the brake. For the brake to engage, when the deceleration ramp reaches the brake engage frequency threshold, the S2A-S2B relay opens and the brake engages.

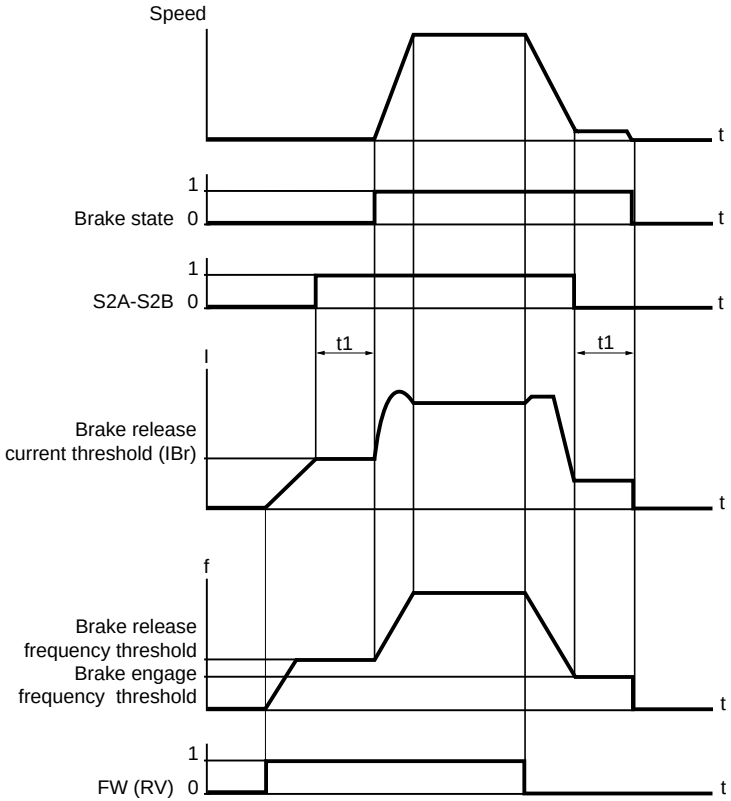


Figure A-1: Brake Control

Adjustments:
Brake release frequency threshold
Brake release current threshold (**Ibr**)
Brake release time delay
Brake engage frequency threshold

Catching a Spinning Load

When set to Yes, this function allows smooth restarting of the motor after a brief input line undervoltage. If the reference signal and a direction command are maintained, the motor accelerates back up to speed without starting at zero.

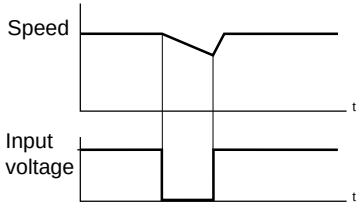


Figure A-2: Catching a Spinning Load Timing Diagram

> **⚠ WARNING**
>
> **UNINTENDED EQUIPMENT ACTION.**
>
> - **Automatic restart and catching a spinning load 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 observe these precautions can result in death, severe personal injury or equipment damage.

Controlled Stop at Loss of AC Supply

When set to Yes, at loss of input power, the deceleration ramp follows a self-adjusting ramp which is a function of the regenerated energy. When set to No, motor coasts to a stop. This function is only available on ATV-16U••N4 units and is not compatible with catching a spinning load.

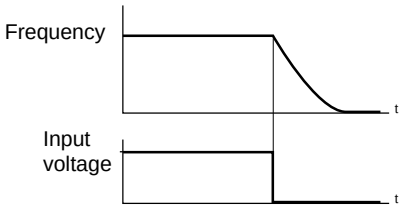


Figure A-3: Controlled Stop Timing Diagram

DC Injection Braking

Automatic DC injection braking: When set to Yes, DC current will automatically be injected when f<0.1 Hz or when f< low speed setting (**LSP**), depending on the setting. When the VW3-A16201 option card set for Material Handling is installed, DC current can be injected when f<SrF (brake engage frequency) and brake control is used.

⚠ WARNING

NO HOLDING TORQUE.

- **DC injection braking does not provide holding torque at zero speed.**
- **DC injection braking does not function during loss of power or drive controller fault.**
- **When required, use separate brake function for holding torque.**

Failure to observe these precautions can result in death, severe personal injury or equipment damage.

⚠ CAUTION

MOTOR OVERHEATING.

Application of DC injection braking for long periods of time can cause motor overheating and damage. Protect motor from extended periods of DC injection braking.

Failure to observe this precaution can result in personal injury or equipment damage.

By logic input: On the Variable Torque option card VW3-A16202, when the logic input set for DC braking is high (state 1), DC is injected. The current level can be adjusted with the DC current level parameter on the Adjustments screen between 0.5 and 1.5 times the value of motor thermal overload protection (**ItH**) for a time adjustable with the DC current time parameter (also on the Adjustments screen) between 0 and 5 s. After this time, the current injected is 0.5 times **ItH** until the logic input goes low. See Figure A-4, next page.

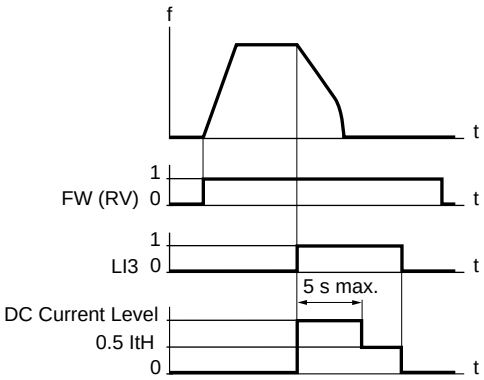


Figure A-4: DC Injection Braking

Deceleration Ramp Adaptation

When this function is set to Yes, the deceleration ramp time is automatically adjusted to compensate for load inertia and to avoid an overbraking fault (**ObF**).

Detection of Speed Attained

Signals when drive controller has attained low speed (**LSP**), high speed (**HSP**) or reference frequency.

Detection of Current Limit Attained

Signals when drive controller is at current limit.

Detection of 1.1 In Attained

Signals when 1.1 Ith motor overload protection threshold is attained. Can be used for a pre-alarm or alarm.

Detection of 100% Thermal State Attained

Signals when 100% thermal state is attained. Can be used for a pre-alarm or alarm.

Fast Stop

When the input set for Fast stop is high (state 1) and the drive controller is commanded to stop, the drive controller will follow the minimum deceleration ramp possible while avoiding an Overbraking (**ObF**) fault. Actual deceleration ramp time is a function of the load.

Fault Reset

When the logic input goes high (state 1), the drive controller is reset if the cause of the fault has disappeared. The following faults can be reset: Overvoltage (**OSF**), Overload (**OLF**), Overbraking (**ObF**, **ObF.**), Speed feedback faults (**SPF**, **SPF.**) and Serial link fault (**SLF**). The drive controller is automatically reset after Phase failure (**PHF**), Undervoltage (**USF**) and option card fault (**OPt**) if the cause of the fault has been corrected.

Freewheel Stop

When logic input is high (state 1), and drive controller is commanded to stop, drive controller decelerates with no power applied to the motor. Deceleration time depends on motor speed, machine inertia and resistant torque.

Frequency Loop Gain

Amount of frequency loop gain for maximizing motor torque. The value is factory set to give adequate performance for most applications.

Jog

When the input set for Jog is high (state 1) and a direction command (FW / RV) is present, the drive controller will jog at the frequency set by the Jog parameter on the Adjustments screen. Factory set for 5 Hz, this parameter is adjustable between 0 and 10 Hz. When jogging, the acceleration and deceleration ramp rates are 0.1 s. The minimum time between jog pulses is 0.5 s.

Jump Frequencies

Drive controller reference will not stop on the critical frequency which causes mechanical resonance. The parameters Jump frequency 1 and Jump frequency 2 define the center of a 2 Hz band.

Motor Power Change

This function is used when one drive runs either of two motors with different ratings. Switching between motors is performed by an appropriate drive output sequence. The switching must be made with the drive disabled. This function allows optimization of both motors. The following parameters are automatically changed by the ratio set by the Motor power ratio parameter on the Adjustments screen:

- Volts / frequency ratio (**UFr**)
- Slip compensation
- DC injection braking
- Brake release current threshold (**Ibr**)
- **ItH** (Motor thermal overload protection is inhibited; provide external thermal protection)

> ⚠ CAUTION
>
> **LOSS OF MOTOR OVERLOAD PROTECTION.**
>
> **When using external overload relays connected to drive controller output, the overload relays must be capable of operation over the expected range of drive controller output frequencies (including direct current). When DC injection braking is used:**
>
> - **The overload relay must be suitable for operation with direct current flowing in the motor.**
> - **Do not use overload relays equipped with current transformers for sensing the motor current.**
>
> Failure to observe these precautions can result in equipment damage.

PI Feedback

PI feedback allows the regulation of an external process variable such as pressure, temperature or level. Proportional and integral gain are set with the Proportional and Integral gain parameters on the Adjustments screen.

To set up the PI feedback, with system in open loop configuration (sensor not connected), adjust High speed setting (HSP) so that maximum flow or pressure is obtained.

Connect sensor.

The values of proportional and integral gain are factory set to give adequate performance for most applications. However, if improved dynamic performance is required, these parameters can be adjusted over the range of 1 to 100 where unity gain corresponds to 1.

Preset Speeds

Table A-1: Preset Speeds: LI1 and LI2 Settings

LI1	LI2	Reference
0	0	Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card).
1	0	Preset speed 3, factory set at 5 Hz.
0	1	Preset speed 4, factory set at 25 Hz.
1	1	High speed setting.

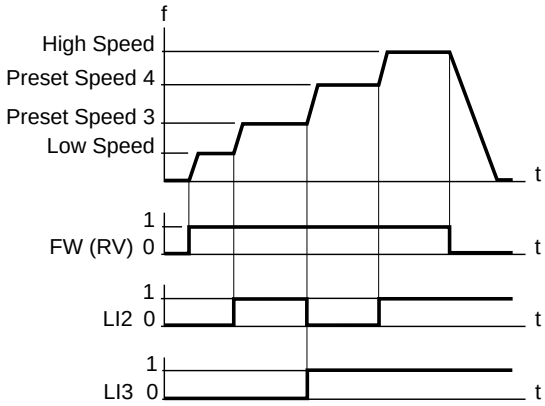


Figure A-5: Preset Speed

Ramps

Type of ramp is dependent on the type of option card. Determines type of acceleration and deceleration ramps, linear or S. The linear ramp is most often used when the acceleration and deceleration ramp times are greater than 1-2 seconds. The S ramp is used on applications with short ramp times.

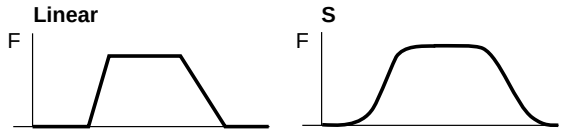


Figure A-6: Ramp Types

Reduce Current Limit

Reduces current limit.

Start/Stop

The drive controller changes state when the logic input assigned to this function goes high (state 1). When the drive controller is ready (motor not running), and the logic input goes high, the drive controller starts. The drive controller is stopped when the logic input goes high again. A speed reference and direction command must be present.

Slip Compensation

When set to Yes, drive controller maintains constant speed to the motor for a given reference as the load changes, automatically correcting the frequency. The factory setting is that of a standard asynchronous 4-pole squirrel cage motor of the equivalent power. This value may need to be adjusted. Slip compensation should be disabled in the following cases: machines with high inertia, synchronous motors, variable torque applications.

Speed Feedback

When using a tachogenerator, the signal is connected to AI and the AI input is set for Speed feedback. This improves the speed regulation to 0.1%. The output voltage signal of the tachogenerator must be scaled in order to limit the voltage to 10 V at AI. Scaling is accomplished by using an external voltage divider circuit. A feedback signal of 10 V corresponds to a maximum frequency of 87 Hz.

The analog input AI on the option card is designed to accept a ±10 V signal, however the tachogenerator will output a voltage greater than ±10 V. Therefore, it is necessary to use a voltage divider network to reduce the voltage from the tachogenerator into the drive controller. To calculate the resistor values, follow the example given below. The information required is:

- Volts per rpm for the tachogenerator
- Maximum operating frequency of the drive controller
- Motor rated speed at 60 Hz

1. Determine the maximum voltage given by the tachogenerator.

$$\text{Tachogenerator}\frac{\text{V}}{\text{rpm}} = \frac{50\text{ V}}{1000\text{ rpm}}$$

$$\text{Maximum operating frequency of drive controller} = 80\text{ Hz}$$

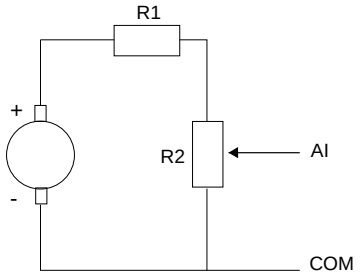
$$\text{Maximum voltage} = \text{Tachogenerator}\frac{\text{V}}{\text{rpm}} \times \frac{\text{Motor rated speed}}{\text{Motor rated frequency}} \times \text{Max motor frequency}$$

$$= \frac{50\text{ V}}{1000\text{ rpm}} \times \frac{1800\text{ rpm}}{60\text{ Hz}} \times 80\text{ Hz}$$

$$= 120\text{ V}$$

2. Now that the maximum voltage is known, the total value of the resistor network R1+R2 can be calculated to limit the maximum current to the desired level. A range between 5 and 20 mA is recommended. Note: for optimal performance with respect to current, refer to manufacturer's specification for their tachogenerator.

   Example using a maximum current of 5 mA:



$$\text{Total resistance} = \frac{\text{Maximum voltage}}{\text{Current}}$$
$$= \frac{120\ \text{V}}{0.005\ \text{A}}$$
$$= 24\ \text{k}\Omega$$

Figure A-7: Resistor Network R1 and R2

3. Determine resistance values:

$$\text{Value of potentiometer R2} = \frac{\text{Total resistance} \times 10\ \text{V}}{\text{Maximum voltage}}$$
$$= \frac{24\ \text{k}\Omega \times 10\ \text{V}}{120\ \text{V}}$$
$$= 2\ \text{k}\Omega$$

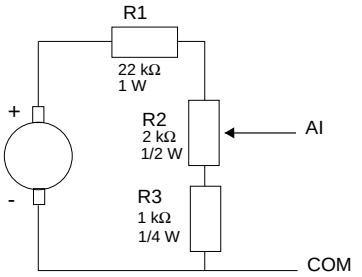
$$\text{Value of R1} = \text{Total resistance} - \text{R2}$$
$$= 24\ \text{k}\Omega - 2\ \text{k}\Omega$$
$$= 22\ \text{k}\Omega$$

4. Note: due to the high voltages present, care must be taken to determine the power dissipation of the resistors using the following equation. For example:

$$\text{Power dissipated for 22 k}\Omega\text{ resistor} = (\text{Current})^2 \times \text{Resistance value}$$
$$= (0.005\ \text{A})^2 \times 22\ \text{k}\Omega$$
$$= 0.55\ \text{W}$$

   Therefore, for this example a minimum 1 W resistor is recommended.

5. To ensure that the potentiometer will have the required adjustment range, it is recommended that a resistor half the value of the potentiometer is added as shown.



$R3 = 1/2\ R2$
$= 1/2 \times 2\ k\Omega$
$= 1\ k\Omega$

Figure A-8: Resistor Network R1, R2 and R3

To set up the tachogenerator:

1. Connect tachogenerator to voltage divider network and drive controller option card terminals AI and COM, as shown.
2. Connect voltmeter to tachogenerator terminals.
3. Adjust potentiometer to minimum.
4. Apply power to drive controller and start motor; run at 10 Hz. Verify that tachogenerator polarity is correct: positive voltage for forward direction and negative voltage for reverse direction. Adjust potentiometer to the correct voltage across the tachogenerator at 10 Hz. For our example it would be:

$$\frac{120\ V}{80\ Hz} \times 10\ Hz = 15\ V$$

5. Run the drive controller at maximum speed. Fine tune the potentiometer to achieve the maximum voltage calculated for the tachogenerator.
6. The value of integral gain is factory set to give adequate performance for most applications. However, if improved dynamic performance is required, this parameter can be adjusted over the range of 1 to 100 where unity gain corresponds to 1.

Speed Reference Summing

The +/- 10 V signal at AI is summed with the signal at AIV or AIC. Thus the reference signal becomes AI + AIV or AI + AIC. Note that although the signal at AI can be negative, the frequency reference is always positive. 0 V = Low speed (**LSP**), 10 V = High speed (**HSP**).

Switch to Ramp 2

When logic input is high (state 1), the drive controller will follow Acceleration ramp 2 (**Ac2**) and Deceleration ramp 2 (**dE2**) set on the Adjustments screen. The switch can be made whether the drive controller is at a constant speed or accelerating or decelerating.

Switching Frequency

The switching frequency of the basic drive controller is 5 kHz. This can be increased to 10 kHz for less audible motor noise. When the switching frequency is increased to 10 kHz, the drive controller must be derated by 20%. Option VW3-A16202 (Variable Torque Option Card) is factory set for 10 kHz and does not require derating.

+Speed/-Speed

Increase or decrease of the speed by using two logic inputs, similar to a motorized potentiometer.

+Speed

When input is high (state 1), frequency increases according to acceleration ramp. The maximum frequency is limited by the reference frequency. When the input goes low (state 0), the speed is maintained.

-Speed

When input is high (state 1), frequency decreases according to deceleration ramp. The minimum frequency is limited by the setting of Low Speed (**LSP**). When the input goes low (state 0), the speed is maintained.

Volts/Frequency Ratio

Type of volts / frequency ratio.

- **N**: Volts / frequency ratio adjusted for constant torque applications (machines with average loads) not requiring high voltage boost.
- **P**: Volts / frequency ratio adjusted for quadratic torque applications such as fans or centrifugal pumps.
- **L**: Volts / frequency ratio adjusted for constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.

Symbols

Numerics

A

B

C

D

E

F

H

I

J

K

L

M

N

O

P

R

S

T

U

V

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