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# PC Connection Option VW3-A16104

# for **ALTIVAR™ 16** Drive Controllers

# User's Manual





SQUARE D

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CHAPTER 1—OPTION INSTALLATION AND OPERATION1
INTRODUCTION
INSTALLATION OF OPTION
SOFTWARE FEATURES
Hardware Requirements 4
Screen Layout
Mouse Operation5
Key Operation
INSTALLATION OF SOFTWARE
RUNNING THE SOFTWARE
MENUS
File Menu
New
Open
Save
Save As
Print
Quit
Mode Menu
On-Line
Off-Line
Configuration Menu
Type ATV/Option
V/f Motor Pattern
Special Functions
Aujustments
Command/Display Manu 19
ATV Command 18
Past Faults 21
Customer I/O 21
System Menu
Serial Port
Color
Save Choice
Help Menu
Index
About

CHAPTER 2—PARAMETERS	25
INTRODUCTION	26
BASIC DRIVE CONTROLLER PARAMETERS	27
V/f Motor Pattern Parameters 2	27
Special Functions	28
OPTION VW3-A16201 GENERAL USE	0
V/f Motor Pattern Parameters3	0
Special Functions	51
Inputs/Outputs	3
Adjustments	57
OPTION VW3-A16201 MATERIAL HANDLING	;9
V/t Motor Pattern Parameters	9 9
Special Functions	.U 12
Adjustments 4	.2 19
OPTION VW3-A16202 VARIABLE TOROUE	32
V/f Motor Pattern Parameters	52
Special Functions	53
Inputs/Outputs	54
Adjustments5	8
OPTION VW3-A16203 HIGH SPEED MOTOR	60
V/f Motor Pattern Parameters6	60
Special Functions6	60
Inputs/Outputs	62
Adjustments6	5
OPTION VW3-A16204 GENERAL USE/3-WIRE CONTROL	8
V/t Motor Pattern Parameters	8
Special Functions	99 74
Adjustments 7	' 6
	Ű
CHAPTER 3—FAULTS AND CORRECTIVE ACTION	'9
INTRODUCTION	30
PROCEDURE 1: CHECKING SUPPLY VOLTAGE8	31
Bus Voltage Measurement Procedure	2
PROCEDURE 2: CHECKING PERIPHERAL EQUIPMENT	3
FAULTS	34

-----

APPE	NDIX—PARAMETER SUMMARY	.87
	AUTOMATIC/MANUAL REFERENCE SWITCHING	88
	AUTOMATIC RESTART	88
	BRAKE CONTROL	89
	CATCHING A SPINNING LOAD	90
	CONTROLLED STOP AT LOSS OF AC SUPPLY	90
	DC INJECTION BRAKING	91
	DECELERATION RAMP ADAPTATION	92
	DETECTION OF SPEED ATTAINED	92
	DETECTION OF CURRENT LIMIT ATTAINED	92
	DETECTION OF 1.1 IN ATTAINED.	92
	DETECTION OF 100% THERMAL STATE ATTAINED	92
	FAST STOP	92
	FAULT RESET	93
	FREEWHEEL STOP	93
	FREQUENCY LOOP GAIN	93
	JOG	93
	JUMP FREQUENCIES	93
	MOTOR POWER CHANGE	93
	PI FEEDBACK	94
	PRESET SPEEDS	94
	RAMPS	95
	REDUCE CURRENT LIMIT	95
	START/STOP	95
	SLIP COMPENSATION.	96
	SPEED FEEDBACK	96
	SPEED REFERENCE SUMMING	99
	SWITCH TO RAMP 2	99
	SWITCHING FREQUENCY	99
	+SPEED/-SPEED	99
	+SPEED	99
	-SPEED	99
	VOLTS/FREQUENCY RATIO	99

# LIST OF FIGURES

Figure 1:	Mounting Option VW3-A16104
Figure 2:	Main Menus
Figure 3:	V/f Motor Pattern Sub-menu6
Figure 4:	Adjustments Sub-menu7
Figure 5:	Language Choice Menu8
Figure 6:	Copyright Screen
Figure 7:	Off-Line Warning Screen9
Figure 8:	Main Menus
Figure 9:	File Menu
Figure 10:	Read Configuration Screen12
Figure 11:	Mode Menu
Figure 12:	Configuration Menu 14
Figure 13:	Type ATV/Option Sub-menu
Figure 14:	V/F Motor Pattern Sub-menu
Figure 15:	Special Functions Sub-menu
Figure 16:	Inputs/Outputs Sub-menu16
Figure 17:	Adjustments Sub-menu
Figure 18:	Command/Display Menu
Figure 19:	ATV Command Sub-menu
Figure 20:	Past Faults Sub-menu
Figure 21:	Customer I/O Sub-menu
Figure 22:	System Menu
Figure 23:	Serial Port Sub-menu
Figure 24:	Color Sub-menu
Figure 25:	Help Menu
Figure 26:	Index Screen
Figure 27:	About Screen
Figure 28:	Measuring Bus Capacitor Voltage
Figure A-1:	Brake Control
Figure A-2:	Catching a Spinning Load Timing Diagram90
Figure A-3:	Controlled Stop Timing Diagram
Figure A-4:	DC Injection Braking92
Figure A-5:	Preset Speed
Figure A-6:	Ramp Types95
Figure A-7:	Resistor Network R1 and R297
Figure A-8:	Resistor Network R1, R2 and R398

# LIST OF TABLES

Basic Drive Controller V/f Motor Pattern Parameters	27
Basic Drive Controller Special Functions	28
VW3-A16201 Option Card—General Use V/f Motor Pattern Parameters	30
VW3-A16201 Option Card—General Use Special Functions	31
VW3-A16201 Option Card—General Use	33
VW3-A16201 Option Card—General Use Serial Link Drive Control Hierarchy	34
VW3-A16201 Option Card—General Use Description of Inputs/Outputs	34
VW3-A16201 Option Card—General Use Adjustments	37
VW3-A16201 Option Card—Material Handling V/f Motor Pattern Parameters	39
VW3-A16201 Option Card—Material Handling Special Functions	40
VW3-A16201 Option Card—Material Handling Inputs/Outputs	42
VW3-A16201 Option Card—Material Handling Serial Link Drive Control Hierarchy	43
VW3-A16201 Option Card—Material Handling Description of Inputs/Outputs	
VW3-A16201 Option Card—Material Handling Adjustments	49
VW3-A16202 Option Card—Variable Torque V/f Motor Pattern Parameters	52
VW3-A16202 Option Card—Variable Torque Special Functions	53
VW3-A16202 Option Card—Variable Torque Inputs/Outputs	54
VW3-A16202 Option Card—Variable Torque Serial Link Drive Control Hierarchy	55
VW3-A16202 Option Card—Variable Torque Description of Inputs/Outputs	55
VW3-A16202 Option Card—Variable Torque Adjustments	58
VW3-A16203 Option Card—High Speed Motors V/f Motor Pattern Parameters	
	Basic Drive Controller V/f Motor Pattern Parameters         Basic Drive Controller Special Functions

v

Table 22:	VW3-A16203 Option Card—High Speed Motors	
	Special Functions	61
Table 23:	VW3-A16203 Option Card—High Speed Motors	
	Inputs/Outputs	62
Table 24:	VW3-A16203 Option Card—High Speed Motors	
	Serial Link Drive Control Hierarchy	62
Table 25:	VW3-A16203 Option Card—High Speed Motors	
	Description of Inputs/Outputs	63
Table 26:	VW3-A16203 Option Card—High Speed Motors	
	Adjustments	65
Table 27:	VW3-A16204 Option Card—General Use/3-Wire Control	
	V/f Motor Pattern Parameters	68
Table 28:	VW3-A16204 Option Card—General Use/3-Wire Control	
	Special Functions	69
Table 29:	VW3-A16204 Option Card—General Use/3-Wire Control	
	Inputs/Outputs	71
Table 30:	VW3-A16204 Option Card—General Use/3-Wire Control	
	Serial Link Drive Control Hierarchy	72
Table 31:	VW3-A16204 Option Card—General Use/3-Wire Control	
	Description of Inputs/Outputs	72
Table 32:	VW3-A16204 Option Card—General Use/3-Wire Control	
	Adjustments	76
Table 33:	Faults	84
Table A-1:	Preset Speeds: LI1 and LI2 Settings	94
		-

## **CHAPTER 1—OPTION INSTALLATION AND OPERATION**

INTRODUCTION
INSTALLATION OF OPTION
SOFTWARE FEATURES
Hardware Requirements
Screen Layout
Mouse Operation
Key Operation
INSTALLATION OF SOFTWARE
RUNNING THE SOFTWARE
MENUS 11
File Menu
New
Open
Save
Save As
Print
Quit
Mode Menu
On-Line
Off-Line
Configuration Menu14
Type ATV/Option14
V/f Motor Pattern15
Special Functions
Inputs/Outputs16
Adjustments
EEPROM Backup
Command/Display Menu18
ATV Command
Past Faults
Customer I/O
System Menu
Serial Port
Color
Save Choice
Help Menu
Index
About

#### INTRODUCTION

The VW3-A16104 PC Connection option is used for configuring ALTIVAR<sup>™</sup> 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.

∎eleme File	ecanique e Moc	ATV16 - le Config	uration /F MOTOR	- OFF-L Command/ PATTERN =	INE Display	System	SQUARE D Help
	Nominal	motor voltage		UnS	230 V		
	Nominal	motor frequen	су	FrS	50	1.0 Hz	
	Maximum	) frequency		tFr	50	1.0 Hz	
	Type of	V/F ratio		UFt	N	U.	
	Switchi	ng frequency 1	0 kHz	SFr	no yes		
Model	:ATV16U09M2	Option:General	Use	F1 Help	F10 EEF	ROM backu	qu

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>.

l <mark>elemecanique</mark> File	Mode	ATV16 - Confi	guration	- OFF-LINE Command/Display System Pagulatian laan	SQUARE D Help
Acceleration Deceleration Low speed High speed JOG frequency	— эреец	Acc dEc LSP HSP JOG	3.0 s 3.0 s 0.0 Hz 50.0 Hz 5.0 Hz	V/F ratio UF Frequency loop gain FL Slip compensation	r 20 G 33 % 1.7 Hz
	_ Current			Brake control	
Thermal overl DC current le DC current ti	oad vel me	ItH Idc tdc	1.9 A 1.3 A 0.5 s		
Model :ATV16U0	9M2 Optio	n:Genera	l Use	F1 Help F10 EEPROM bac	kup

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>.

ATV 16 SETUP SOFTWARE
Copyright 1992 Telemecanique
Version V 1.3
Use of this software can alter the controller operation or performance. The user is responsible for taking the necessary precautions to assure the safety of equipment and personnel. Read and understand the user's manual before attempting to use this software. Failure to observe these precautions can result in equipment damage or severe personal injury.

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 submenus. 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.

<b>D</b> elemecanique	ATV16 -	- (	DFF-LINE	SQUARE D
File	Mode Confi	guration Comr	nand/Display	System Help
New				
Open				
Save				
Save as				
Print				
0				
Quit				
Model	Ontion:	E1	Help F10 FFP	ROM backup

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.

Telemecanique		ATV16 -	- OFF-LINE		SQUARE D
File	Mode	Configuration	Command/Display	System	Help
		Type ATV/Option W/F motor pattern special Functions Inputs / Outputs Adjustments EEPROM backup	F2 F3 F4 F5 F6 F10		
Madal :	Ontion		El Help El0 F	ISTRA Backu	

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

Telemecaniq	ue	ATV16 -	- OFF-LINE		SQUARE D
File	Mode	Configuration	Command/Display	System	Help
	=[1]	Type ATV16/Option	۱		
	Vedel .	ATU1CUOD	42		
	odel :	A171009	42 I		
	Software ver	. :			
	O tion :	General I	Jse 💵		
	Communicatio	n: C1	u 📗		
	umpers:	(•) 50 H: ( ) 60 H:	z (•) 0-20 mA z () 4-20 mA		
		0k	Abort		
-					
Model :ATV1	6U09M2 Option	:General Use	F1 Help F10 EE	PROM backı	чр

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

eleme File	ecanique Mode	ATV16 - Configuration	- OFF-LII Command/D	VE isplay	System	SQUARE D Help
		──── V/F MOTOR F			Ŷ	
	Nominal moto	r voltage	UnS	230 V	L.	
	Nominal moto	r frequency	FrS	50	.0 Hz	
	Maximum freq	uency	tFr	50	.0 Hz	
	Type of V/F	ratio	UFt	Ν	U	
	Switching fr	equency 10 kHz	SFr	no no yes		
Mode1	:ATV16U09M2 Optio	n:General Use	F1 Help	F10 EEF	ROM backu	qu

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

elemecan File	ique ATV16 - Mode Configuration	- OF Comma	FF-LINE and/Display	System	SQUARE D Help
	DEC ramp adaptation	brA	yes		
	Slip Compensation	SLP	yes		
	Auto DC braking f < 0.1Hz or f < LSP		F < 0.1Hz	•	
	Auto restart	Atr	no		
	Catching a spinning load	FLr	no		
	Control stop on AC supply loss failure	StP	no	•	
			linear		
Model :AT	V16U09M2 Option:General Use	F1 H	Help F10 EEF	ROM back	цр

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.

Delemecanique		. A	TV16	-	- OFF-LI	NE	SQUARE D
File	Mod	le	Con	figuration	Command/D	isplay Sy	stem Help
		AI	:	Speed refer	rence summing		
		LI1	:	Fault Reset	t		
		LI2	:	Freewheel s	stop		
		LI3	:	JOG			
		LO	:	100% therma	al attained		
		AO	:	Motor frequ	lency		
				Reference t	frequency atta	ined	
Model :ATV16U	109M2	Option:	Gene	ral Use	F1 Help	F10 EEPROM	backup

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

elemecanique File	Mode	ATV16 - Config	puration	- OFF-LINE Command/Display : Regulation	System	SQUARE D Help
Acceleration Deceleration Low speed High speed JOG frequency	— эреец .	Acc dEc LSP HSP JOG	3.0 s 3.0 s 0.0 Hz 50.0 Hz 5.0 Hz	V/F ratio Frequency loop gain Slip compensation	UFr FLG	20 33 % 1.7 Hz
	- Current			Brake conti		
Thermal overl DC current le DC current ti	oad vel me	ItH Idc tdc	1.9 A 1.3 A 0.5 s			
Model :ATV16U0	9M2 Option	h:General	Use	F1 Help F10 EEPR	JM backu	p

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



**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 submenu (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.

Telemecanique File	A Mode	TV16 - Configurat PA	ion ST FAULT:	- OFF-LI Command/D	NE isplay	System	SQUARE D Help
	LAST FAULT		No faul	t			
		1	No faul	t			
		2	No faul	t			
		3	No faul	t			
		4	No faul	t			
		5	No faul	t			
		6	No faul	t			
	FIRST FAUL	т	No faul	t			
Model :ATV16U0	9M2 Option:	General Use		F1 Help	F10 EEPF	ROM backup	)

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.

eleme	ecanique		ATV16 -	-	OF	F-LINE			-	SQUARE D
File	e Mo	ode	Configuration	termina	omma	and/Dis	spla	y Sy:	stem	Help
	AI	:	Speed reference sum	ning			:	0		
	LI1	:	Fault Reset				:	OFF		
	LI2	:	Freewheel stop				:	OFF		
	LI3	:	JOG				:	OFF		
	LO	:	100% thermal attain	∋d			:	OFF		
	AO	:	Motor frequency				:	0		
	S2A-S2B	3:	Reference frequency	attaine	ed		:	OFF		
Mode 1	:ATV16U09M2	2 Op	tion:General Use	F	11	Help F	10	EEPROM	backu	qu

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.

elemecanique	ATV16	-	- OFF-LINE		SQUARE D
File	Mode Cor	figuration	Command/Disp	lay Syst	tem Help
					Index
					Hour
Model :	Option:		F1 Help F1	.0 EEPROM k	backup

Figure 25: Help Menu

#### Index

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



Figure 26: Index Screen

#### About

The About screen (Fig. 27) shows the Setup Software version number.

ATV 16 SETUP SOFTWARE
Copyright 1992 Telemecanique
Version V 1.3
Use of this software can alter the controller operation or performance. The user is responsible for taking the necessary precautions to assure the safety of equipment and personnel. Read and understand the user's manual before attempting to use this software. Failure to observe these precautions can result in equipment damage or severe personal injury.

Figure 27: About Screen

## **CHAPTER 2—PARAMETERS**

	26
BASIC DRIVE CONTROLLER PARAMETERS.	27
V/f Motor Pattern Parameters	27
Special Functions	28
OPTION VW3-A16201 GENERAL USE	30
V/f Motor Pattern Parameters	30
Special Functions	31
Inputs/Outputs	33
Adjustments	37
OPTION VW3-A16201 MATERIAL HANDLING	39
V/f Motor Pattern Parameters	39
Special Functions	40
Inputs/Outputs	42
Adjustments	49
OPTION VW3-A16202 VARIABLE TORQUE	52
V/f Motor Pattern Parameters	52
Special Functions	53
Inputs/Outputs	54
Adjustments	58
OPTION VW3-A16203 HIGH SPEED MOTOR	60
V/f Motor Pattern Parameters	60
Special Functions	60
Inputs/Outputs	62
Adjustments	65
OPTION VW3-A16204 GENERAL USE/3-WIRE CONTROL	68
V/f Motor Pattern Parameters	68
Special Functions	69
Inputs/Outputs	71
Adjustments	76

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### 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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	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 <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency <b>tFr</b>	40 to 200 Hz	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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	Ν	<ul> <li>Type of volts/frequency ratio:</li> <li>N: Standard applications at constant torque not requiring high voltage boost.</li> <li>P: Quadratic torque applications (pumps, fans).</li> <li>L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.</li> </ul>
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.
Factory setting	is dependent on position of s	witch 1 on drive controller	r.

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

#### **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).

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation <b>brA</b>	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 ( <b>ObF</b> ).
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 < <b>LSP</b>	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 ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault. For <b>OSF</b> and <b>OBF</b> 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 <b>OLF</b> fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

Table 2: Basic Drive Controller Special Functions

# 

### 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 <b>StP</b>	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. Linear S

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#### **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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	ATV16U•••M2: 208, 220, 230, 240V ATV16U•••N4: 380, 400, 415, 460V	230∨ 400/460∨ [1]	Corresponds to value on motor nameplate.
Nominal motor frequency FrS	40 to 200 Hz	50 or 60 Hz <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency <b>tFr</b>	40 to 200 Hz	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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	<ul> <li>Type of volts/frequency ratio:</li> <li>N: Standard applications at constant torque not requiring high voltage boost.</li> <li>L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.</li> </ul>
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%.
<sup>[1]</sup> Factory settings	are dependent on posi	tion of switch 1 on drive of	controller.

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

#### **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).

	i _	i	
Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation <b>brA</b>	no, yes	yes	If set to yes, deceleration ramp time is automatically adjusted to compensate for load inertia to avoid an Overbraking fault ( <b>ObF</b> ).
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 < <b>LSP</b>	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 ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault. For <b>OSF</b> and <b>OBF</b> 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 <b>OLF</b> fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

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

### 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 <b>StP</b>	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 ln	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).

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	<ul> <li>* 100% thermal state attained Reference frequency attained I limit attained Low speed attained High speed attained</li> <li>1.1 Ith (motor thermal overload) attained</li> </ul>
AO	* Motor frequency Motor current
S2A-S2B	100% thermal state attained * Reference frequency attained
* Factory setting	

Table 5:	VW3-A16201	<b>Option Card—G</b>	ieneral Use	Inputs/Outputs
----------	------------	----------------------	-------------	----------------

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.

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

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

Function	Description
Analog Input Al	$\pm$ 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 ( <b>LSP</b> ), $10 V =$ High Speed ( <b>HSP</b> ).
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 ( <b>Ac2</b> ) and Deceleration Ramp 2 ( <b>dE2</b> ), 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
	<b>Description of Inputs/Outputs (Continued)</b>

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 High Speed Preset Speed 4 Preset Speed 4 Preset Speed 4 Preset Speed 4 Preset Speed 4 Preset Speed 4 Preset Speed 4 Low Speed 4 t LI2 0 LI2 0 LI2 0 LI3 0 LI2 0 LI3 0 LI2 0 LI2 0 LI3 0 LI2 0 LI2 0 LI3 0 LI2 0 LI3 0 LI2 0 LI3 0 LI2 0 LI2 0 LI2 0 LI2 0 LI2 0 LI3 0 LI	
	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. $0 \text{ mA} = 0A$ , $20 \text{ mA} = 1.82$ 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).

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

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

### 

#### 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 Us	se
	Adjustments (Continued)	

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

## 

#### 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.

### 

#### 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	0.1 to 1.5 lth	0.7 lth	Amount of DC injected at the end of the
ldc			deceleration ramp.
DC current time	0.0 to 5.0 s	0.5 s	Length of time DC is injected at the end of the
tdc			deceleration ramp.
Current limit	0.5 to1.5 ln	1.5 ln	Reduction of current limit when input assigned to
level			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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	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 <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency t <b>Fr</b>	40 to 200 Hz	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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	<ul> <li>Type of volts/frequency ratio:</li> <li>N: Standard applications at constant torque not requiring high voltage boost.</li> <li>L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.</li> </ul>
Switching frequency 10 kHz SFr	no	no	The switching frequency is 5 kHz.
Hactory settings	are dependent on position of	of switch 1 on drive contro	blier.

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

#### 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).

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation <b>brA</b>	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="" at="" automatically="" be="" brake="" control),="" dc="" engage="" for="" frequency="" if="" injected="" injected.<="" no,="" not="" point.="" set="" td="" that="" to="" will=""></srf>
Automatic restart Atr	no	no	When set to no, drive controller will not automatically restart following an Overvoltage ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault.

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

### 

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

# 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).

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	<ul> <li>I limit attained</li> <li>Low speed attained</li> <li>1.1 Ith (motor thermal overload) attained</li> </ul>
AO	* Motor frequency Motor current
S2A-S2B	* Brake control
* Factory setting	

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

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	2: VW3-A16201	<b>Option Card—Materia</b>	I Handling
	Serial Link D	rive 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 Al	$\pm$ 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 ( <b>SPF</b> ) and No tachofeedback ( <b>SPF</b> .) can be detected. <b>SPF</b> is caused by the incorrect adjustment of tachogenerator feedback or machine overload. <b>SPF</b> . 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 ( <b>ObF</b> ) 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 ( <b>OSF</b> ), Overload ( <b>OLF</b> ), Overbraking ( <b>ObF</b> , <b>ObF</b> .), Speed Feedback ( <b>SPF</b> , <b>SPF</b> .) and Serial Link fault ( <b>SLF</b> ). The drive controller is automatically reset after Phase Failure ( <b>PHF</b> ), Undervoltage ( <b>USF</b> ) and Option Card fault ( <b>OPt</b> ) 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 ( <b>LSP</b> ). When the input goes low (state 0), the speed is maintained.

Table 13: V	W3-A16201	<b>Option Car</b>	d-Materia	al Handling
D	escription o	of Inputs/Ou	utputs (Cor	ntinued)

Function	Description
Switch to ramp 2	When logic input is high (state 1), the drive controller will follow Acceleration Ramp 2 ( <b>Ac2</b> ) and Deceleration Ramp 2 ( <b>dE2</b> ), 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	<ul> <li>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).</li> <li>Volts/frequency ratio (UFr)</li> <li>Slip compensation</li> <li>DC injection braking</li> <li>Brake release current threshold (lbr)</li> <li>ItH (motor thermal overload protection is inhibited; provide external thermal protection)</li> </ul>

### 

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	L11L12Reference00Low speed setting or reference speed at AIV, AIC (on drive controller) or AI (on option card).10Preset speed 3, factory set at 5 Hz01Preset speed 4, factory set at 25 Hz11High speed setting
	High Speed 4 Preset Speed 3 Low Speed 4 FW (RV) 0 LI2 0 LI3 0 t
	Preset Speed 1 is Low Speed ( <b>LSP</b> ) 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 ( <b>HSP</b> ). 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 1.11th 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. $0 \text{ mA} = 0 \text{ Hz}$ , $20 \text{ mA} = \text{High Speed (HSP)}$ .
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 ( <b>Ibr</b> ) 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.		
	Brake state 0		
	S2A-S2B 0 t1 t1		
	Brake release current threshold (IBr)		
	Brake release frequency threshold Brake engage frequency threshold 1		
	FW (RV) 0 t		
	Adjustments: Brake release frequency threshold Brake release current threshold ( <b>Ibr</b> ) 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	<b>Option Card—Material Handling</b>
Adjustments	

Parameter	Range	Factory Setting	Description
Speed		L	
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 <b>HSP</b>	0 Hz	Low speed setting.
High speed HSP	LSP to tFr	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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 <b>UFr</b>	0 to 100	20	Adjustment of amount of motor torque supplied by the motor at low speed.
Frequency loop gain <b>FLG</b>	0 to 100%	33%	Amount of frequency loop gain for maximizing motor torque.

## 

#### 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 Al 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 ln	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.

## 

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.

### 

#### 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	<b>Option Card—Material Handling</b>
Adjustments	(Continued)

Parameter	Range	Factory Setting	Description
DC current level Idc	0.1 to 1.5 lth	0.7 lth	Amount of DC injected at the end of the deceleration ramp.
DC current time <b>tdc</b>	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 ln	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 <b>LSP</b>	LSP	Frequency threshold which, along with brake release current threshold, initiates the closing of S2A-S2B.
Brake engage frequency	0.0 to <b>LSP</b>	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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	ATV16U•••M 2: 208, 220, 230, 240V ATV16U•••N 4: 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 <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency <b>tFr</b>	40 to 200 Hz	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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 <b>UFt</b>	Ρ	Ρ	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.

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

<sup>[1]</sup> 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 <b>brA</b>	no, yes	yes	When set to Yes, the deceleration ramp time is automatically adjusted to compensate for load inertia and to avoid Overbraking fault ( <b>ObF</b> ).
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 <b>Atr</b>	no, yes	yes	Enables drive controller to automatically restart following an Overvoltage ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault. For <b>OSF</b> and <b>OBF</b> 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 <b>OLF</b> fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

### 

#### 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		Automatic/manual reference switching
Switch to ramp 2		
DC injection braking		

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

Function	Description
Analog Input Al	$\pm$ 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 ( <b>LSP</b> ), $10 V = High$ speed ( <b>HSP</b> ).
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 ( <b>Ac2</b> ) and Deceleration Ramp 2 ( <b>dE2</b> ), 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

### 

#### 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.

## 

#### 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	<b>Option Card—Variable</b>	lorque
	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 <b>HSP</b>	0 Hz	Low speed setting.	
High speed <b>HSP</b>	LSP to tFr	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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. <b>JF1</b> 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. <b>JF2</b> 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.	

## 

#### 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 ln to 1.05 ln	0.9 ln	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.

### 

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.

### 

#### 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 ldc	0.5 to 1.5 lth	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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	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 <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency tFr	40 to 400 Hz	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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	<ul> <li>Type of volts/frequency ratio:</li> <li>N: Standard applications at constant torque not requiring high voltage boost.</li> <li>L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.</li> </ul>
Switching frequency 10 kHz SFr	no	no	The switching frequency is 5 kHz.
<sup>[1]</sup> Factory settings are dependent on position of switch 1 on drive controller.			

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

#### **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).

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation <b>brA</b>	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 ( <b>ObF</b> ).
Slip compensation SLP	no	no	Slip Compensation disabled.
Automatic DC injection braking	no, f < 0.1 Hz, f < <b>LSP</b>	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 ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault.

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

### 

#### 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 <b>StP</b>	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.

#### 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).

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	•

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

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 Motor	s
	Description of Inputs/Outputs	

Function	Description
Analog Input Al	$\pm$ 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 ( <b>LSP</b> ), $10 V =$ High speed ( <b>HSP</b> ).
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 ( <b>Ac2</b> ) and Deceleration Ramp 2 ( <b>dE2</b> ), 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 High Speed Preset Speed 4 Preset Speed 4 FW (RV) 0 LI2 0 LI2 0 t LI3 0 LI3 0 LI3 0 LI2 0 LI3 0 LI3 0 LI3 0 LI3 0 LI2 0 LI3 0

Description
Preset Speed 1 is Low Speed ( <b>LSP</b> ) 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 ( <b>HSP</b> ). Drive controller runs at Preset Speed 2 when logic inputs assigned to Preset Speeds are both high (state 1).
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).
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).
Open collector output.
Signals when 1.1 Ith motor overload protection threshold is attained. Can be used for a pre-alarm or alarm.
0-20 mA signal. The range of assignments is shown on the Inputs/Outputs screen (see page 16).
Analog output of motor frequency. 0 mA = 0 Hz, 20 mA = High Speed (HSP).
Analog output of motor current. 0 mA=0 A, 20 mA=1.82 times the permanent output current of the drive controller.
Relay output.
Relay closes when reference frequency is attained.

# Table 25: VW3-A16203 Option Card—High Speed Motors Description of Inputs/Outputs (Continued)
## 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—H	ligh Speed M	otors
	Adjustments			

Parameter	Range	Factory Setting	Description			
Speed	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 <b>HSP</b>	0 Hz	Low speed setting.			
High speed HSP	LSP to tFr	50 Hz if <b>FrS</b> =50 60 Hz if <b>FrS</b> =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 <b>UFr</b>	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.			

## 

## 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	<b>Option Card—High Speed Motors</b>
	Adjustments	(Continued)

Parameter	Range	Factory Setting	Description
Current			
Thermal Overload <b>Ith</b>	0.45 In to 1.05 In	0.9 ln	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.

## 

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.

## 

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.

Parameter	Range	Factory Setting	Description
DC current level Idc	0.1 to 1.5 lth	0.7 lth	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.

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

## **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).

Parameter	Range	Factory Setting	Description
Nominal motor voltage <b>UnS</b>	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 <b>FrS</b>	40 to 200 Hz	50 or 60 Hz <sup>[1]</sup>	Output frequency selection at rated motor voltage.
Maximum frequency t <b>Fr</b>	40 to 200 Hz	50 Hz if <b>FrS=</b> 50 60 Hz if <b>FrS=</b> 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	<ul> <li>Type of volts/frequency ratio:</li> <li>N: Standard applications at constant torque not requiring high voltage boost.</li> <li>P: Volts/frequency ratio adjusted for quadratic torque applications such as fans or centrifugal pumps.</li> <li>L: Constant torque applications for special motors (tapered rotor motors, pole change motors, high torque motors) used in fast cycle applications.</li> </ul>
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%.

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

## 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).

Parameter	Range	Factory Setting	Description
Deceleration ramp adaptation <b>brA</b>	no, yes	yes	If set to yes, deceleration ramp time is automatically adjusted to compensate for load inertia to avoid an Overbraking fault ( <b>ObF</b> ).
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 < <b>LSP</b>	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 ( <b>OSF</b> ), Overload ( <b>OLF</b> ) or Overbraking ( <b>OBF</b> ) fault. For <b>OSF</b> and <b>OBF</b> 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 <b>OLF</b> fault, the restart is effective as soon as the thermal state drops below 100%, usually 7 minutes after fault occurs.

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

## 

## 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 <b>FLr</b>	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 <b>StP</b>	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 ln	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).

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	<ul> <li>* 100% thermal state attained Reference frequency attained I limit attained Low speed attained High speed attained</li> <li>1.1 Ith (motor thermal overload) attained</li> </ul>
AO	* Motor frequency Motor current
S2A-S2B	100% thermal state attained * Reference frequency attained Drive running
* Factory setting	

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

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 Al	$\pm$ 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 ( <b>SPF</b> ) and No Tachofeedback ( <b>SPF</b> .) can be detected. <b>SPF</b> is caused by the incorrect adjustment of tachogenerator feedback or machine overload. <b>SPF</b> . 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 $\pm 10$ 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 ( <b>LSP</b> ), 10 V = High Speed ( <b>HSP</b> ).
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	L11 must be high for the drive controller to run. If the drive controller is runnning and L11 goes low, the drive controller will stop following the normal ramp. With L11 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). <i>Note: Preset Speeds requires two inputs.</i>
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 ( <b>Ac2</b> ) and Deceleration Ramp 2 ( <b>dE2</b> ), 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 deceleration 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 ( $\pm$ 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
			f
			High Speed
		Pre	eset Speed 4
		Pre	eset Speed 3
			1
			FW (RV) 0 t
			LI2 0 t
			11
			LI3 0 t
	Preset contro are bo	t Speed ller runs th low (s	1 is Low Speed ( <b>LSP</b> ) or the value of the reference signal. Drive at Preset Speed 1 when logic inputs assigned to Preset Speeds state 0).
	Preset when I	Speed 2	2 is High Speed ( <b>HSP</b> ). Drive controller runs at Preset Speed 2 uts assigned to Preset Speeds are both high (state 1).
Preset speed 3	The dr Preset The va chang Config	ive contr Speed 3 alue of P ing the F juration r	roller will run at Preset Speed 3 when the logic input assigned to 3 is high (state 1) and a direction command (FW/RV) is present. reset Speed 3 is factory set at 5 Hz, and can be adjusted by Preset Speed 3 parameter on the Adjustments screen under the menu (see page 17).
Preset speed 4	The dr Preset The va chang Config	ive contr Speed alue of P ing the F juration r	roller will run at Preset Speed 4 when the logic input assigned to 4 is high (state 1) and a direction command (FW/RV) is present. reset Speed 4 is factory set at 25 Hz, and can be adjusted by Preset Speed 4 parameter on the Adjustments screen under the menu (see page 17).
Logic Output LO	PLC c Inputs	ompatibl /Outputs	le collector output. Full range of settings is available from the screen (see page 16).
100% thermal state	Signal	s when	100% thermal state is attained. Can be used for a pre-alarm or
attained	alarm.		
Reference frequency attained	Signal	s when i	reference frequency is attained.
I limit attained	Signal	s when a	drive controller is at current limit.
Low speed attained	Signal	s when a	drive controller has attained Low Speed (LSP).
High speed attained	Signal	s when a	drive controller has attained High Speed (HSP).
1.1 Ith attained	Signal	s when '	1.1 Ith motor overload protection threshold is attained. Used for
	a pre-a	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. $0 \text{ mA} = 0A$ , $20 \text{ mA} = 1.82$ 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	<b>Option Card—General Us</b>	e 3-Wire Control
Adjustments		

Parameter	Range	Factory Setting	Description
Speed			
Acceleration	0.1 to 600 s	3 s	Length of time to accelerate to nominal motor
Acc			frequency from zero speed.
Deceleration	0.1 to 600 s	3 s	Length of time to decelerate from nominal motor
dEc			frequency to zero speed.
Low speed LSP	0 to <b>HSP</b>	0 Hz	Low speed setting.
High speed	LSP to tFr	50 Hz if <b>FrS</b> =50	High speed setting. This is the frequency which is
HSP		60 Hz if <b>FrS</b> =60	equal to 10 V on AIV or AI, or 20 mA on AIC.
Jog frequency	0.1 to 10 Hz	5 Hz	Frequency at which the drive controller will jog
JOG			when the input, set for Jog, is high (state 1) and a
			direction command (FW/RV) is present.
Acceleration	0.1 to 600 s	12 s	Second acceleration ramp rate. Used when input is
ramp 2			set to Switch to Ramp 2.
AC2			
Deceleration	0.1 to 600 s	12 s	Second deceleration ramp rate. Used when input
ramp 2			is set to Switch to Ramp 2.
dE2			
Preset speed 3	LSP to HSP	5.0 HZ	Used when input is set to Preset Speed 3.
35P			
Preset speed 4	LSP to HSP	25 Hz	Used when input is set to Preset Speed 4.
4SP			
Regulation loop	1	1	
V/f ratio	0 to 100	20	Adjustment of amount of motor torque supplied by
UFr			the motor at low speed.
Frequency loop	0 to 100%	33%	Amount of frequency loop gain for maximizing
gain			motor torque.
FLG			

## 

## 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 U	se 3-Wire Control
Adjustments (Continued)	

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

## 

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.

## 

## 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 lth	0.7 lth	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 ln	1.5 ln	Reduction of current limit when input assigned to Reduce Current Limit is high (state 1).

## **CHAPTER 3—FAULTS AND CORRECTIVE ACTION**

INTRODUCTION	. 80
PROCEDURE 1: CHECKING SUPPLY VOLTAGE	. 81
Bus Voltage Measurement Procedure	. 82
PROCEDURE 2: CHECKING PERIPHERAL EQUIPMENT	. 83
FAULTS	. 84

#### 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.

## **A** 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.

## **A** 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	1211	1212
ATV16U18M2	J211	JZIZ
ATV16U29M2		
ATV16U18N4	J104	J105
ATV16U29N4		
ATV16U41M2		
ATV16U41N4	1110	1110
ATV16U54N4	5110	
ATV16U72N4		

#### **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.
- Reapply power. Voltage should be as follows: ATV16U••M2 ATV16U••N4 340.0 VAC<V<264 VAC 340.0 VAC<V<529 VAC</li>
- 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.

## 

#### 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	<ul> <li>No supply to terminals L1, L2, (L3)</li> <li>Power fuses blown</li> <li>Brief input line failure (t≥200 ms)</li> </ul>	Check: • Supply Voltage (Procedure 1 on page 81) • Supply fuses or circuit breaker (Procedure 2 on page 83)
Undervoltage	<ul> <li>Supply voltage too low</li> <li>For ATV16M2, V≤187 V</li> <li>For ATV16N4, V≤340 V</li> <li>Temporary voltage drop (t≥200 ms)</li> </ul>	Check: <ul> <li>Supply voltage (Procedure 1 on page 81)</li> <li>Connections</li> </ul>
Overvoltage	<ul> <li>Supply voltage too high</li> <li>For ATV16M2, V≥264 V</li> <li>For ATV16N4, V≥529 V</li> </ul>	Check: • Supply voltage (Procedure 1 on page 81)
Overload	Thermal trip due to prolonged motor overload	<ul> <li>Check:</li> <li>ItH setting and compare with motor In</li> <li>Load base speed and power rating and compare with operating speed and drive controller/motor power rating</li> <li>Motor connections (possibility of single phase operation)</li> <li>Wait approximately 7 minutes before resetting.</li> </ul>
Overbraking fault (V)	Overbraking due to overvoltage or	Increase deceleration time, optimize gain by decreasing value of Frequency loop gain ( <b>FLG</b> ) and optimize V/f ratio ( <b>UFr</b> ).
Overbraking fault (I)	Overcurrent due to excessive braking or an overhauling load, even with braking option.	Add braking option if necessary. Refer to Instruction Bulletin 50006-360-04.
Transient overcurrent	<ul> <li>Short circuit or phase to ground on the output of the drive controller</li> <li>Overheating of drive controller</li> <li>Supply voltage transient variations</li> <li>Current too high during transient duty</li> <li>Internal short circuit</li> </ul>	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.

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: <ul> <li>Feedback signal</li> <li>Load base speed and power rating and</li> </ul>
No tachofeed- back	Incorrect adjustment of tachogenerator feedback, or machine overload. No tachogenerator signal.	<ul><li>compare with operating speed and drive controller/motor power rating</li><li>Tachogenerator connection</li></ul>
External fault	Fault relay activated by serial link	Reset fault relay over the serial link in the ATV Command Screen

Table 33: Faults (Continued)

#### **APPENDIX—PARAMETER SUMMARY**

AUTOMATIC/MANUAL REFERENCE SWITCHING	88
AUTOMATIC RESTART	88
BRAKE CONTROL	89
CATCHING A SPINNING LOAD	90
CONTROLLED STOP AT LOSS OF AC SUPPLY	90
DC INJECTION BRAKING	91
DECELERATION RAMP ADAPTATION	92
DETECTION OF SPEED ATTAINED	92
DETECTION OF CURRENT LIMIT ATTAINED	92
DETECTION OF 1.1 IN ATTAINED.	92
DETECTION OF 100% THERMAL STATE ATTAINED	92
FAST STOP	92
FAULT RESET	93
FREEWHEEL STOP	93
FREQUENCY LOOP GAIN	93
JOG	93
JUMP FREQUENCIES	93
MOTOR POWER CHANGE	93
PI FEEDBACK	94
PRESET SPEEDS	94
RAMPS	95
REDUCE CURRENT LIMIT	95
START/STOP	95
SLIP COMPENSATION	96
SPEED FEEDBACK	96
SPEED REFERENCE SUMMING	99
SWITCH TO RAMP 2	99
SWITCHING FREQUENCY	99
+SPEED/-SPEED	99
+SPEED	99
-SPEED	99
VOLTS/FREQUENCY RATIO	99

## 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.

## 

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

## 

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 selfadjusting 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.

## 

## 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.

## 

## 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 **(tH)** 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 **ltH** 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)

## 

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**

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 A-1: Preset Speeds: LI1 and LI2 Settings





## 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  $a\pm 10$  V signal, however the tachogenerator will output a voltage greater than $\pm 10$  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.

$$\Gamma achogenerator \frac{V}{rpm} = \frac{50 V}{1000 rpm}$$

Maximum operating frequency of drive controller = 80 Hz

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

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

= 120 V

 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:



Figure A-7: Resistor Network R1 and R2

3. Determine resistance values:

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

> Value of R1 = Total resistance – R2 = 24 k $\Omega$  – 2 k $\Omega$ = 22 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:

Power dissipated for 22 k $\Omega$  resistor = (Current)<sup>2</sup> × Resistance value = (0.005 A)<sup>2</sup> × 22 k $\Omega$ = 0.55 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.



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:

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

- 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

+speed/- speed 41, 44

# Numerics

1.1 Ith attained general use card 36 general use/3-wire control card 74 high speed motors card 64 material handling card 46
100% thermal state general use card 36

general use/3-wire control card 74–75

# Α

about screen 24 acceleration ramp adjusting 17 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 setting type 16 variable torque card 58 acceleration ramp 2 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58 activate fault control relay 20 adjustable current limitation general use card 32 general use/3-wire control card 70

adjustment parameters general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58 adjustments sub-menu 17, 37, 49, 58, 65, 76, 94 ATV command sub-menu 18 Auto/manual reference

switching 73 automatic DC injection braking basic controller 28 general use card 31 general use/3-wire control card 69 high speed motors card 61 material handling card 40 setting 16 variable torque card 53 automatic restart

- automatic restart basic controller 28 general use card 31 general use/3-wire control card 69 high speed motors card 61 material handling card 40 setting 16 variable torque card 53 automatic/manual reference
- switching summary 88 variable torque card 55

#### В

brake control material handling card 48 summary 89 brake engage frequency 51 brake release current 51 frequency 51 time delay 51

# C

catching a spinning load basic controller 29 general use card 32 general use/3-wire control card 70 high speed motors card 61 material handling card 40 setting 16 variable torque card 54 charge relay fault 84 color sub-menu 23 COM port selection 22 command/display menu 18 communication option 14 computer configuration saving 23 computer screen specifying type used 23 configuration menu 14 control input terminal AI deneral use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal AO deneral use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal LI1

general use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal LI2 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal LI3 general use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal LO general use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 control input terminal S2A-S2B general use card 33 general use/3-wire control card 71 variable torque card 54 control input terminals S2A-S2B high speed motors card 62 material handling card 42 controlled stop on loss of AC supply basic controller 29 general use card 32 general use/3-wire control card 70 high speed motors card 61 material handling card 41 setting 16

variable torque card 54 current limit level general use card 38 general use/3-wire control card 77 customer I/O sub-menu 21, 33, 42, 71

#### D

DC bus capacitor voltage measuring 81-82 DC current level adiusting 17 general use card 38 deneral use/3-wire control card 77 high speed motors card 67 material handling card 51 variable torque card 59 DC current time adjusting 17 general use card 38 general use/3-wire control card 77 high speed motors card 67 material handling card 51 variable torque card 59 DC injection braking summary 91 variable torque card 56 deceleration ramp 90, 92 adjusting 17 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 setting type 16 variable torque card 58 deceleration ramp 2 deneral use card 37

general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58 deceleration ramp adaptation basic controller 28 general use card 31 general use/3-wire control card 69 high speed motors card 61 material handling 40 setting 16 summary 92 variable torque card 53 detection of 1.1 In attained 92 detection of current limit attained 92 detection of speed attained 92 drive catalog number setting 14 drive controller configuration creating 11 file types 12 opening 12 printing 12 saving 12 saving to EEPROM 17 drive controller ready status 20 drive controller software version 14 drive controller switches specifying settings 14 Drive running 75

## Ε

EEPROM backup 17 memory fault 84 external fault 85

# F

fast stop material handling card 44 summary 92 fault reset general use card 34 general use/3-wire control card 73 material handling card 44 faults 84-85 charge relay 84 displaying 21 **EEPROM memory 84** external 85 internal drive 84 mains phase failure 84 no tachofeedback 85 overbraking 84 overload 84 overspeed 85 overvoltage 84 serial link 85 transient overcurrent 84 undervoltage 84 file menu 11 freewheel stop general use card 34 general use/3-wire control card 73 high speed motors card 63 summary 93 variable torque card 55 frequency loop gain

adjusting 17 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58

## Η

help menu 23 index 24 openina 5 high speed 92 adjusting 17 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58 high speed attained general use card 36 general use/3-wire control card 74 variable torque card 57

I limit attained general use card 36 general use/3-wire control card 74 material handling card 46 index screen 24 inputs/outputs displaying status 20 general use card 33 general use/3-wire control card 71 high speed motors card 62 material handling card 42 variable torque card 54 inputs/outputs sub-menu 16, 33, 42, 54, 62, 71 integral gain material handling card 50 variable torque card 59 internal drive fault 84

# J

jog general use card 35 general use/3-wire control card 73 high speed motors card 63 summary 93 jog frequency general use card 37 general use/3-wire control card 76 high speed motors card 65 jump frequency 1 variable torque card 58 jump frequency 2 variable torque card 58

# Κ

key operation 6

## L

language choice menu 8 low speed 92 adjusting 17 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 variable torque card 58 low speed attained general use card 36 general use/3-wire control card 74 material handling card 46

### Μ

main menus description 11 opening 5-6 mains phase failure 84 mains voltage displaying 20 Manual reference 72 manual reference input variable torque card 55 maximum frequency basic controller 27 general use card 30 general use card/3-wire control card 68 high speed motors card 60 material handling 39 setting 15 variable torque card 52 menus command/display 18 configuration 14 file 11 help 23 mode 13 system 22 mode menu 13 motor current displaying 20 high speed motors card 64 material handling card 47 motor frequency general use card 36

general use/3-wire control card 75 high speed motors card 64 material handling card 47 variable torque card 57 motor power change 45 motor power ratio 51 motor rotation changing direction of from serial link 20

#### Ν

no tachofeedback fault 85 nominal motor frequency basic controller 27 deneral use card 30 general use/3-wire control card 68 high speed motors card 60 material handling 39 setting 15 variable torque card 52 nominal motor voltage basic controller 27 general use card 30 general use/3-wire control card 68 high speed motors card 60 material handling 39 setting 15 variable torque card 52

#### 0

off-line mode 13–14, 17 off-line warning screen 9 on-line mode 13–14 on-line status 9 option card inputs/outputs displaying state of 21 setting 16 viewing status of 18 specifying type 14 option I/O to be configured 85 output frequency displaying 20 overbraking 20 overbraking fault 84 overload 20, 84 overspeed fault 85 overvoltage 20, 84

## Ρ

parameter summary automatic/manual reference switching 88 brake control 89 DC injection braking 91 deceleration ramp adaptation 92 detection of 1.1 In attained 92 detection of current limit attained 92 detection of speed attained 92 fast stop 92 freewheel stop 93 jog 93 ramps 95 reduce current limit 95 slip compensation 96 speed feedback 96 start/stop 95 parameters changing values 5-6 past faults displaving 18 past faults sub-menu 21

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PC connection option kit contents 2 installation 3 peripheral equipment checking 83 PI feedback variable torque card 55 preset speed 3 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 preset speed 4 general use card 37 general use/3-wire control card 76 high speed motors card 65 material handling card 49 preset speeds general use card 35 general use/3-wire control card 74 high speed motors card 63 material handling card 46 proportional gain variable torque card 59

## R

ramps basic controller 29 general use card 32 general use/3-wire control card 70 high speed motors card 61 material handling card 41 summary 95 variable torque card 54 read configuration screen 12 reduce current limit

deneral use card 35 deneral use/3-wire control card 73 summarv 95 reference frequency attained general use card 36 deneral use/3-wire control card 74-75 high speed motors card 64 variable torque card 57 reset fault control relay setting 20 resettable faults 20 resetting drive 20 rotational frequency displaying 20 run commands setting and monitoring 18 Run enable 72 running drive controller from computer 21

#### S

serial link 13 and control input functions general use card 33 general use/3-wire control card 72 high speed motors card 62 material handling card 43 variable torque card 55 controlling drive over 18 fault 20. 85 setting command 19 setting frequency 19 status 20 serial port sub-menu 22 setup software

configuring computer for 22 exiting 12 features 4 runnina 8 screen layout 4 version 9 version number 24 slip compensation 93 basic controller 28 deneral use card 31 general use/3-wire control card 69 high speed motors card 61 material handling 40 material handling card 50 setting 16 summarv 96 variable torque card 53 special functions deneral use card 31 general use/3-wire control card 69 material handling 40 special functions sub-menu 16, 28, 31, 53, 60, 69 speed feedback deneral use card 34 general use/3-wire control card 72 material handling card 44 summarv 96 speed feedback + deviation detection 44 speed feedback fault 20 speed reference setting from serial link 20 speed reference summing general use card 34 general use/3-wire control card 72 high speed motors card 63

material handling card 44 variable torque card 55 start/stop general use card 34 material handling card 44 summary 95 starting from serial link 20 stopping from serial link 20 sub-menus opening 5-6 supply voltage checking 81-82 switch to ramp 2 general use card 34 general use/3-wire control card 73 high speed motors card 63 material handling card 45 variable torque card 55 switching frequency basic controller 27 general use card 30 general use/3-wire control card 68 high speed motors card 60 material handling card 39 setting 15 variable torque card 52 system menu 22

high speed motors card 66 material handling card 50 variable torque card 59 transient overcurrent 84 type ATV/option sub-menu 10, 14 type of volts/frequency ratio setting 15

## U

undervoltage 84

# V

V/f motor pattern sub-menu 15, 27, 30, 39, 52, 60, 68 V/f ratio basic controller 27 general use card 30, 37 general use/3-wire control card 68, 76 high speed motors card 60, 65 material handling 39 material handling card 49 variable torque card 52, 58 volts/frequency ratio 93 adjusting 17

## T

terminal LI2 general use card 33 general use/3-wire control card 71 thermal overload adjusting 17 general use card 38 general use/3-wire control card 77



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