

ACS 501

Installation & Start-up Manual

ACS 501 Adjustable Frequency
AC Drives 1 to 75 HP, Series B

ACS 501-04F
EFFECTIVE 6/1/96
SUPERCEDES 7/1/95

ABB Drives



ACS 501 Adjustable Frequency
AC Drives 1 to 75 HP, Series B

Installation & Start-up Manual

ACS 501-04F

EFFECTIVE: 1996-06-01
SUPERCEDES: 1995-07-01

Safety Instructions

General Safety Instructions

Warnings in this manual appear in either of two ways:

- *Dangerous voltage warnings*, preceded by a Dangerous Voltage symbol, indicate the presence of voltages which may cause death or serious injury. These warnings describe procedures to avoid death or serious injury.
- *General warnings*, preceded by a General Warning symbol, indicate situations or conditions which may cause death or serious injury. These warnings describe procedures to avoid death or serious injury.

CAUTIONS inform you of situations or conditions which will damage machinery or cause additional motor-operation down-time if you do not take suggested steps to correct or address such situations or conditions.

Note: Notes provide you with additional and useful information. Although less urgent than cautions and warnings, notes are important and should not be ignored.

Warning Symbols

For your own safety please pay special attention to instructions containing these symbols:



This warning symbol indicates the presence of dangerous voltage. This symbol informs you of high voltage conditions, situations, and locations that may cause death or serious injury if you do not follow precautions and proper steps.



This warning symbol indicates a general warning.



This warning symbol indicates an electrostatic discharge hazard.

**Warnings, Cautions,
and Notes**



WARNING! Your drive contains dangerous voltages when connected to the line power. Always check that the ACS 501 is safe, after disconnecting the power, by measuring the DC bus voltage and line input voltage. Failure to check voltages could cause death or serious injury. Only a qualified electrician should carry out the electrical installation.

Note that the Motor Control Card of the ACS 501 is at DC bus voltage potential.

The DC bus capacitors contain dangerous DC voltage levels ($1.35 \times V_{IN}$). After disconnecting the supply, wait at least five minutes after the display readout on the control panel has disappeared before taking any measurements.

Dangerous external control voltages may be present on the relay outputs of the Control Interface Card and Option Cards.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Table of Contents

Chapter 1 – Introduction

How To Use This Manual	1-1
Intended Audience	1-2
Conventions Used In This Manual	1-2
Control Panel Display	1-2
Control Panel Keys	1-2
Main	1-2
Group	1-2
Parameter	1-2
Press	1-2
Terminal Block	1-3
Warranty and Liability Information	1-3
Related Publications	1-3

Chapter 2 – Overview of the ACS 501

Nameplate Identification	2-1
General Information About Your ACS 501	2-2
Features and Functions	2-2
Control Panel Operation	2-5
Control Panel Display	2-5
Control Panel Keys	2-6
Application Macros Overview	2-8

Chapter 3 – Installation Instructions

Grounding and Ground Faults	3-1
Pre-Installation Planning	3-1
Environment	3-2
Mounting Area	3-3
Installation Site Power	3-5
Conduit Size	3-5
Power Wiring	3-6
Output Power Wiring	3-7
Control Wiring	3-9
Initial Inspection Procedure	3-9
Mechanical Installation	3-10
Power Connections	3-10
Input Wiring	3-10
Output Wiring	3-10
Dynamic Braking	3-10
Insulation Checks	3-12
Terminal Connections	3-13

Table of Contents

Control Connections	3-14
Available Control Locations	3-14
X50	3-15
Control Interface Card SNAT-759 Connections	3-17

Chapter 4 – Start-up Procedure

Safety Precautions	4-1
Installation Inspection	4-2
Start-up Data Parameters	4-3
Keypad Control Tests	4-5
Motor Disconnected from the ACS 501	4-5
Motor Connected to the ACS 501	4-6
Default Drive Parameters	4-7
Customizing Application Macro Parameters	4-7

Chapter 5 – Fault Tracing

Fault Indications	5-1
Fault Resetting	5-1
Fault History	5-2
Fault Erasing	5-2
Fault Tracing	5-3
Warning Messages	5-3
Fault Messages	5-4

Chapter 6 – Service and Maintenance

Electrostatic Discharge Precautions	6-1
Rectifier Tests	6-1
ACS 501 – 002, 003, and 005	6-2
ACS 501 – 007 to 040	6-3
DC Bus Capacitor Tests	6-6
ACS 501 – 002, 003, and 005	6-7
ACS 501 – 007 to 040	6-9
IGBT Module Tests	6-11
ACS 501 – 002, 003, and 005	6-11
ACS 501 – 007 to 040	6-14

Appendix A – ACS 501 Technical Data

Input Power	A-1
Output Power	A-1
Analog Inputs	A-1
Auxiliary Voltage (for Controls)	A-2
Digital Inputs	A-2
Analog Outputs	A-2
Digital Relay Outputs	A-2
Environmental Limits	A-2
Enclosures	A-2

Glossary G-1

Index I-1

This page intentionally left blank.

Chapter 1 – Introduction

This chapter describes the purpose and contents of this manual, describes the intended audience, explains conventions used in this manual, and lists related publications.

How To Use This Manual

The purpose of this manual is to provide you with the information necessary to install, start-up, and service an ACS 501 Adjustable Frequency AC Drive rated 1 to 75 hp. This manual also describes features and functions of the drives and requirements such as external drive control connections, wiring, and cable sizes and routing.

ACS 501 user documentation also includes the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros* which is provided with the drive.

Chapter 1 – Introduction, the chapter you are reading now, introduces you to the *ACS 501 Adjustable Frequency AC Drives 1 to 75 HP Installation & Start-up Manual* and conventions used throughout the manual.

Chapter 2 – Overview of the ACS 501 describes drive components and provides a brief introduction to Control Panel operation, the drive parameter menu system, and drive Application macros.

Chapter 3 – Installation Instructions describes planning for drive installation, new drive inspection, and drive mounting. This chapter also includes requirements and connections for input and output wiring and external control wiring.

Chapter 4 – Start-up Procedure describes safety, installation inspection, how to check default parameters and set start-up parameters, and how to test the drive with the motor disconnected and connected.

Chapter 5 – Fault Tracing describes troubleshooting procedures through fault messages, resetting faults, accessing stored information in the fault history, and tracing faults to their origins.

Chapter 6 – Service and Maintenance describes how to test main electrical drive components such as bridge rectifiers, diodes, bus capacitors, and IGBT modules.

Appendix A – ACS 501 Technical Data lists input and output voltages, amperage, and other useful data for each drive rated 1 to 75 hp.

Glossary lists and defines terms common to all ACS 501 drives.

Index helps you locate the page numbers of topics contained in this manual.

Intended Audience

The audience for this manual has:

- Knowledge of standard electrical wiring practices, electronic components, and electrical schematic symbols.
- Minimal knowledge of ABB product names and terminology.
- No experience or training in installing, operating, or servicing the ACS 501.

The audience for this manual will install, start-up, and service the ACS 501.

Conventions Used In This Manual

Listed below are terms and language conventions used in this manual. These terms and conventions are defined here to help you understand their meanings and applications throughout this manual. For a complete listing of ACS 501 terms, refer to the *Glossary* at the end of this manual.

Control Panel Display

The Control Panel display is an LCD readout of drive functions, drive parameter selections, and other drive information. Letters or numbers appear in the display according to which Control Panel keys you press.

Control Panel Keys

Control Panel keys are flat, labeled, push-button-type devices that allow you to monitor drive functions, select drive parameters, and change drive macros and settings.

Main

A main is the first level of programming. The Mains organize the Parameters into four main functional groups. A Main in this manual is the number corresponding to Group access. All Groups in the 10s range are accessed on the Control Panel through CONTROL CONNECTIONS/MAIN 10. Access Groups in the 20s range through DRIVE PARAMETERS/MAIN 20. Access Groups in the 30s range through PROTECTION PARAMETER/MAIN 30, and access Groups in the 40's range through APPLIC PARAMETERS/MAIN 40.

Group

A Group is a sub-set of a Main. Groups are grouped within Mains according to their 10s, 20s, 30s, or 40s range. For example, Groups numbered 30.1, 30.2, 30.3, and 30.4 are found in PROTECTION PARAMETER/MAIN 30. Parameters are accessed through Groups.

Parameter

A parameter is a sub-set of a Group, selected through the Control Panel keys. Parameters in this manual often are expressed as a number, a decimal (.), another number, a decimal, and another number. The first number at the left represents the Main. The number between the decimals represents the Group, for example, 20.2 (Start/Stop). The number at the right represents a Parameter within that group, for example, 4 (Brake Chopper). In this manual, Parameter 4 in Group 20.2 is expressed as Parameter 20.2.4.

Press

Press a key on the Control Panel to achieve a desired result. In this manual, individual Control Panel keys are enclosed in square brackets. For example, the Setting mode key is expressed as [*]. Refer to *Chapter 2 – Overview of the ACS 501, Control Panel Operation*, for details.

Terminal Block A terminal block is a group of wire connections on a drive. This manual expresses specific terminal blocks and connections as a letter, usually X, a number, a colon (:), and another number. The letter and number to the left of the colon represent the name of the terminal block, for example, X25. The number to the right of the colon represents the terminal connection, for example 16, on the terminal block. In this manual, a terminal connection numbered 16, located on a terminal block named X25, is expressed as X25:16.

Warranty and Liability Information

The warranty for your ABB drive covers manufacturing defects. The manufacturer carries no responsibility for damage due to transport or unpacking.

In no event and under no circumstances shall the manufacturer be liable for damages and failures due to misuse, abuse, improper installation, or abnormal conditions of temperature, dust, or corrosives, or failures due to operation above rated capacities. Nor shall the manufacturer ever be liable for consequential and incidental damages.

The period of manufacturer's warranty is 12 months, and not more than 18 months, from the date of delivery.

Extended warranty may be available with certified start-up. Contact your local distributor for details.

Your local ABB Drives company or distributor may have a different warranty period, which is specified in their sales terms, conditions, and warranty terms.

If you have any questions concerning your ABB drive, contact your local distributor or ABB Drives office.

The technical data and specifications are valid at the time of printing. ABB reserves the right to subsequent alterations.

Related Publications

For related information, refer to the *ABB ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros (ACS 500-05)* and the *ACS 501 with Option Pack Users Manual (ACS 500-08)*.

This page intentionally left blank.

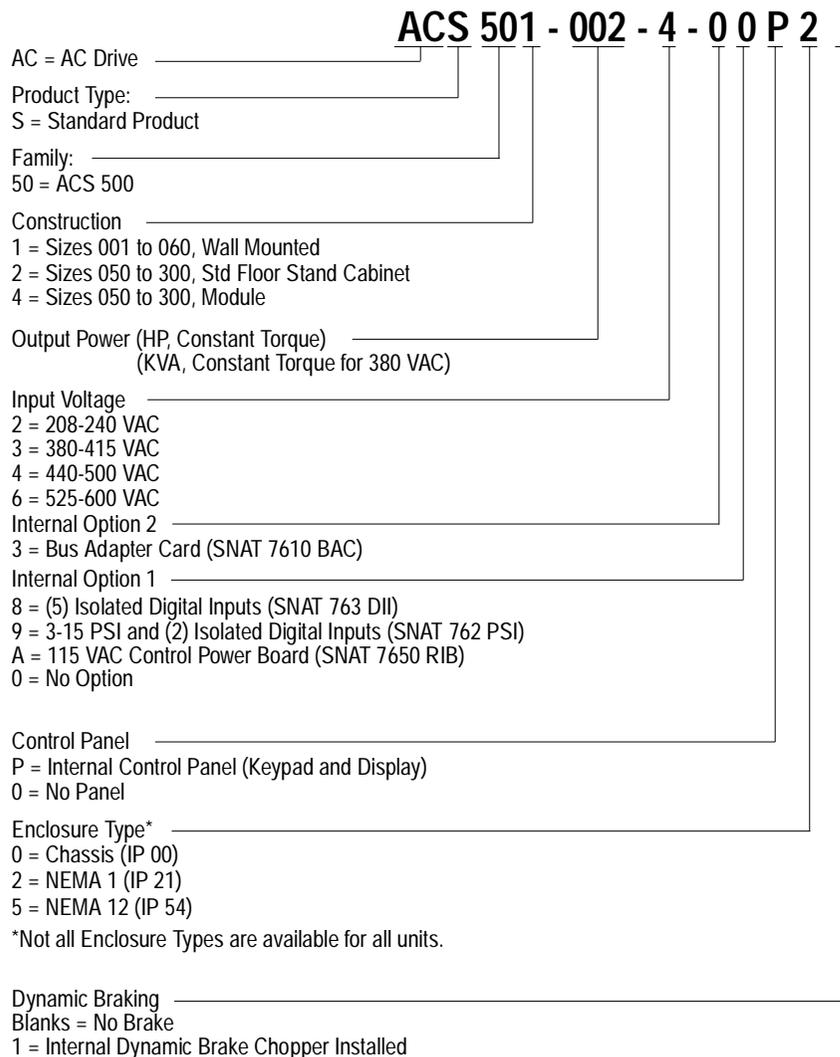
Chapter 2 – Overview of the ACS 501

This chapter describes the features and functions of the ACS 501, and includes illustrations and block diagrams. It also describes the ACS 501 hardware components and the Control Panel displays and keys. The last part of this chapter presents an overview of the Parameters menu system and Application macros.

Nameplate Identification

Figure 2-1 explains the drive code printed on the nameplate, located at the bottom of your drive between the mounting holes.

Figure 2-1 Explanation of ACS 501 Drive Code



General Information About Your ACS 501

Features and Functions

Component Descriptions

A diode bridge converts line power almost entirely to active power. The displacement power factor approaches unity (>0.98) regardless of the speed or load of the connected motors.

The DC-Intermediate Circuit filters the DC-voltage ripple supplied by the Rectifier Stage. This section consists of an inductor and capacitors, as well as a charging circuit. The charging circuit limits the in-rush current when power is applied by directing the current through a resistor. Once the bus is charged, the resistor is shorted with a relay or SCR.

Note: 600 VAC units have an AC choke in place of the DC choke.

Note: The maximum number of chargings in one minute is four. In applications where frequent start/stop is required, electronic start/stop should be used with the unit powered continuously.

The Inverter Stage forms symmetrical three-phase AC voltage from the constant DC voltage supplied by the DC-Intermediate Circuit.

A Motor Control Card controls the Inverter Stage and monitors the operation of the ACS 501.

A Control Interface Card is the link between the operator and the ACS 501. It features a Control Panel with an alphanumeric display and keypad. A terminal block for external control connections is also located on the Control Interface Card.

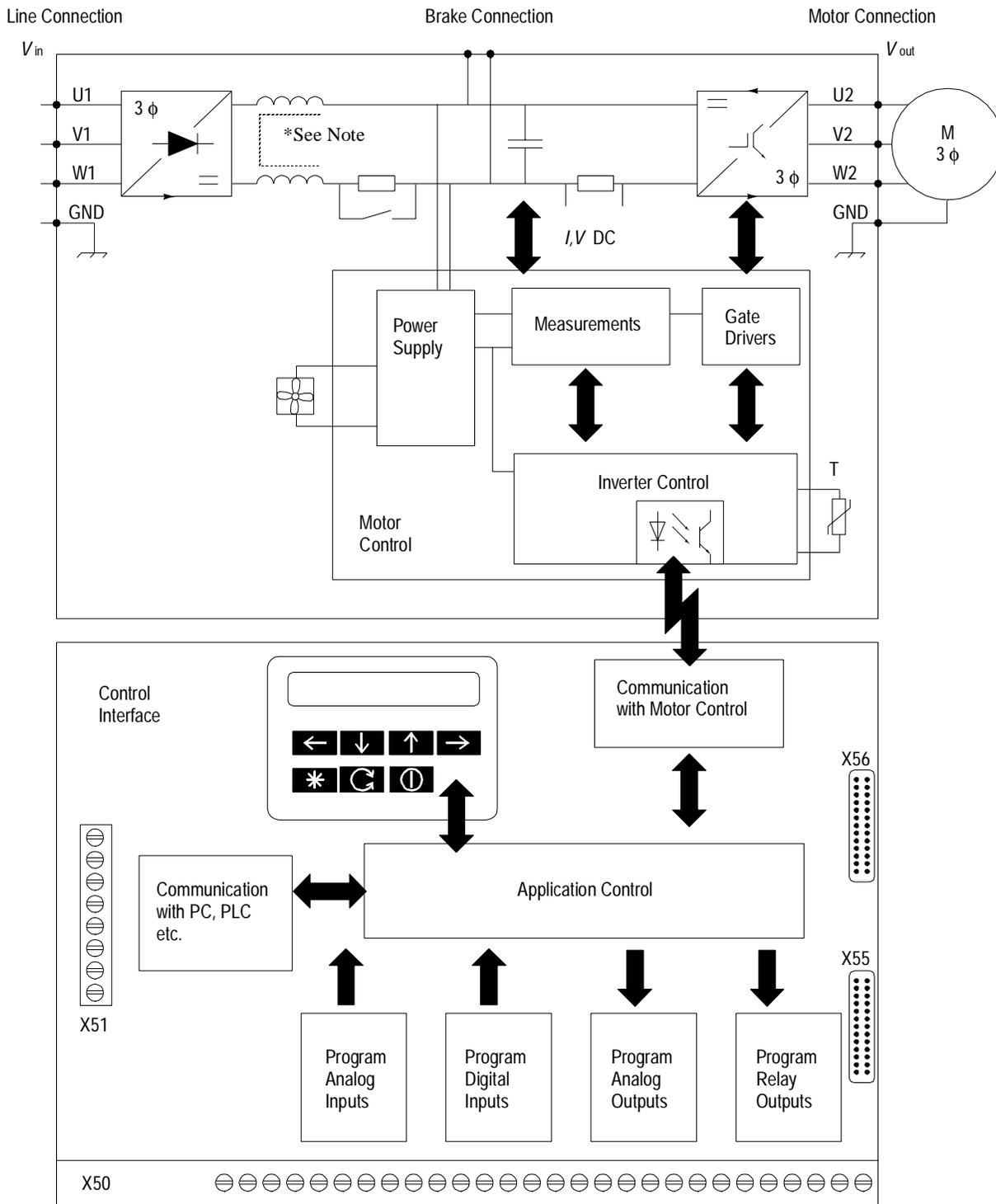
The Control Interface Card is optically isolated from the line potential. The Control Interface Card common is connected to the chassis ground through a 10 megohm resistor.

Figure 2-2 shows a diagram of the hardware components and control functions of the ACS 501.

Table 2-1 Rating Table

Drive Type	Constant Torque			Variable Torque			I_N	Dimension Reference
	hp	Amps (Current Rating of Drive)		hp	Amps (Current Rating of Drive)			
		I_R	I_{IN}		I_{RSQ}	I_{INSQ}		
208/230 VAC								
ACS501-001-2	1.0	4.0	3.6	2.0	7.5	6.8	6.2	R2
ACS501-002-2	2.0	7.5	6.8	3.0	10.6	9.6	10.0	
ACS501-003-2	3.0	10.6	9.6	5.0	16.8	15.2	13.2	R3
ACS501-005-2	5.0	16.8	15.2	7.5	24.2	21.8	18.0	
ACS501-007-2	7.5	24.2	21.8	10.0	30.9	27.8	24.0	R4
ACS501-010-2	10.0	30.9	27.8	15.0	46.2	41.6	31.0	
ACS501-015-2	15.0	46.2	41.6	20.0	59.4	53.5	47.0	R5
ACS501-020-2	20.0	59.4	53.5	25.0	74.8	67.4	62.0	
ACS501-025-2	25.0	74.8	67.4	30.0	88.0	79.2	76.0	R5.5
ACS501-030-2	30.0	88.0	79.2	40.0	114.4	103.0	89.0	
480 VAC								
ACS501-002-4	2.0	3.4	3.1	3.0	4.8	4.3	6.2	R2
ACS501-003-4	3.0	4.8	4.3	5.0	7.6	6.8	7.5	
ACS501-005-4	5.0	7.6	6.8	7.5	11.0	9.9	10.0	
ACS501-007-4	7.5	11.0	9.9	10.0	14.0	12.6	13.2	R3
ACS501-010-4	10.0	14.0	12.6	15.0	21.0	18.9	18.0	
ACS501-015-4	15.0	21.0	18.9	20.0	27.0	24.3	24.0	R4
ACS501-020-4	20.0	27.0	24.3	25.0	34.0	30.6	31.0	
ACS501-025-4	25.0	34.0	30.6	30.0	40.0	36.0	38.0	R5
ACS501-030-4	30.0	40.0	36.0	40.0	52.0	46.8	47.0	
ACS501-040-4	40.0	52.0	46.8	50.0	65.0	58.5	62.0	
ACS501-050-4	50.0	65.0	58.5	60.0	77.0	69.3	76.0	R5.5
ACS501-060-4	60.0	77.0	69.3	75.0	96.0	86.4	89.0	
600 VAC								
ACS501-005-6	5.0	6.1	5.0	7.5	9	7.4	13.2	R3
ACS501-007-6	7.5	9	7.4	10.0	11	9.8	13.2	
ACS501-010-6	10.0	11	9.8	15.0	17	15.1	24.0	R4
ACS501-015-6	15.0	17	15.1	20.0	22	19.5	24.0	
ACS501-020-6	20.0	22	19.5	25.0	27	25.0	31.0	R5
ACS501-025-6	25.0	27	25.0	30.0	32	29.6	38.0	
ACS501-030-6	30.0	32	29.6	40.0	41	37.6	47.0	R5.5
ACS501-040-6	40.0	41	37.6	50.0	52	47.7	62.0	
ACS501-050-6	50.0	52	47.7	60.0	62	53.0	62.0	

Figure 2-2 Diagram of ACS 501 Hardware Components and Control Functions



*Note: 600 volt units have AC choke in place of DC choke.

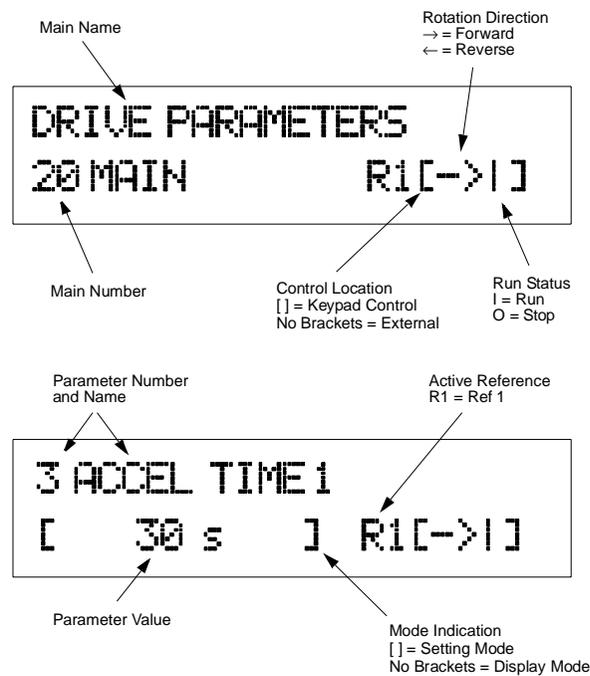
Control Panel Operation

Control Panel Display The Control Panel, located on top of the Control Interface Card, has a 2x20 character alphanumeric LCD and a keypad.

The operation information, parameters and fault indications are displayed in nine languages: English, German, Italian, Spanish, Dutch, French, Danish, Finnish, and Swedish. The language selection is made in Start-up Data, Parameter A (Language).

Figure 2-3 shows control panel display indications.

Figure 2-3 Control Panel Displays



Control Panel Keys Table 2-2 illustrates each Control Panel Key, how the keys are used in this manual's text, and describes the function of each key.

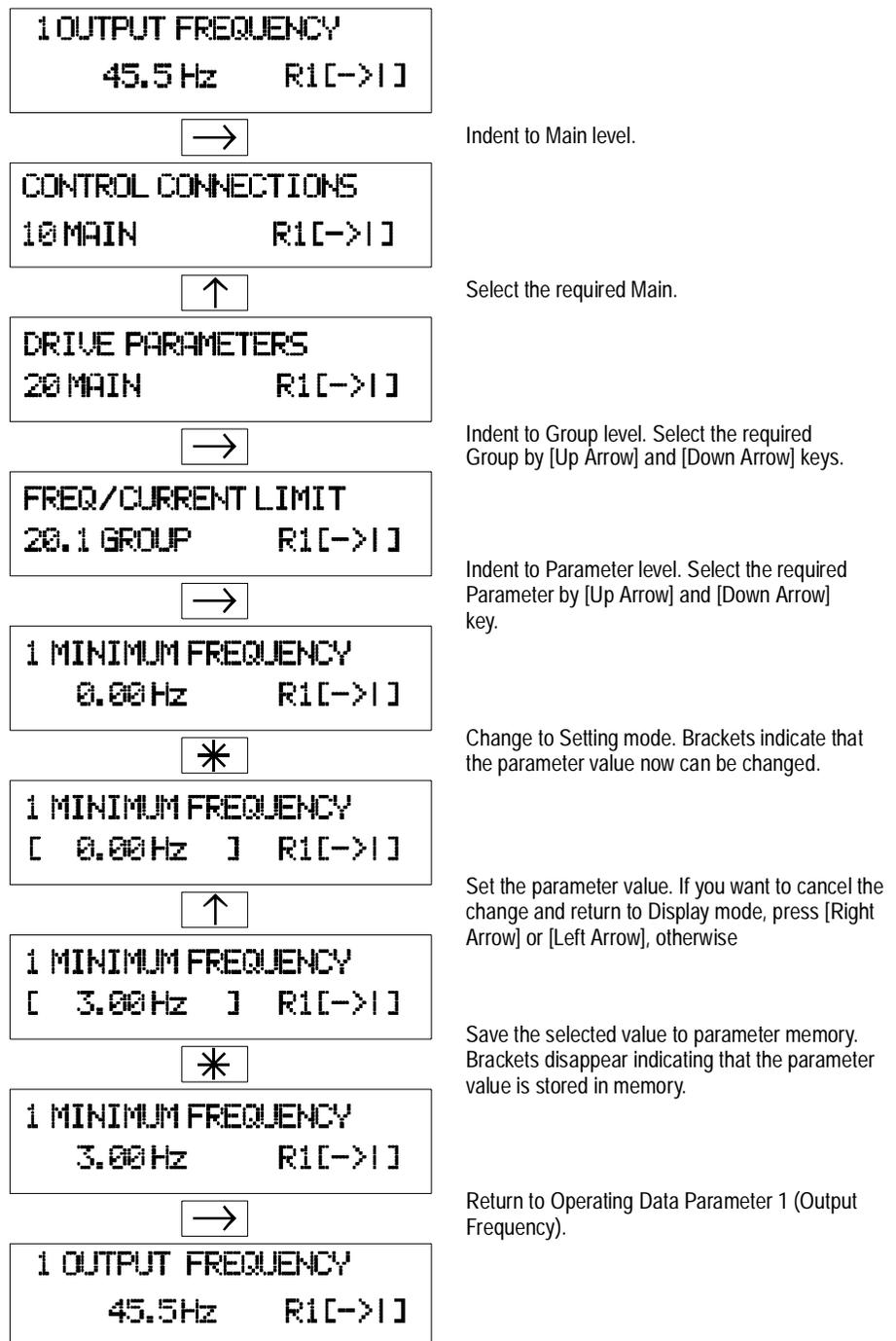
Table 2-2 Control Panel Keys

Control Panel Key	Text Reference	Function
	[*]	Selects the Setting mode and saves the selected parameter value.
 	[Right Arrow] [Left Arrow]	Steps between levels. Selects between Operating Data, Main, Group, and Parameter levels. and In Setting Mode, returns to the Display mode without changing the Parameter value.
 	[Up Arrow] [Down Arrow]	Steps through choices within a level. In Display mode, selects the next/previous Main, Group, or Parameter. and In Setting mode, increases/decreases parameter value.
	[Fwd/Rev]	Changes the rotation direction in Keypad control (refer to Parameter 10.1.3).
	[Start/Stop]	Starts and stops the motor in Keypad control. Resets faults, warnings, and supervision indications.

Note: To accelerate the change of parameter value, press and hold the [Up Arrow] or [Down Arrow] button.

Figure 2-4 shows how to set Parameter 20.1.1 (Minimum Frequency) to 3 Hz.

Figure 2-4 Parameter Settings



Adjusting Display Contrast The contrast of the LCD can be adjusted for optimal viewing. This can be done when the display is in the Main or Group level.

To adjust contrast, press and hold [*] and then press [Up Arrow] or [Down Arrow].

You may need to adjust the display contrast if the ACS 501 has been installed in a location with high ambient temperatures. The factory default setting is optimum for an ambient temperature between 59°F and 86°F (15°C and 30°C).

Application Macros Overview

Application macros are complete sets of default parameter settings for some typical applications. This allows all of the parameters to be set with the touch of a button.

When you select an Application macro, the parameters listed in the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros* are set to a value suitable for a particular application. The parameters which are not included in the Application macro retain the factory settings. If you must adjust the parameter values, refer to the instructions in the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros*.

Chapter 3 – Installation Instructions

This chapter explains how to install the ACS 501 and connect all power, motor, and control wiring. It also describes the initial inspection procedures.

Grounding and Ground Faults

The ACS 501 must always be grounded through a ground conductor connected to the ground terminal.

If the ACS 501 is connected to a system without system ground, the ground fault protection must be capable of starting at ground fault currents containing high frequency and DC components. The ACS 501 ground fault protection guards the variable frequency drive against ground faults occurring in the motor or the motor wiring.

Fault current protective switches do not necessarily operate properly with variable frequency drives. When using such switches their function should be checked at possible ground fault currents arising in a fault situation.

Pre-Installation Planning

The ACS 500 has been short circuit tested in accordance with UL508.

The R3-R5.5 drives are suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical Amperes; R2 unit 20,000/50,000 rms symmetrical Amperes depending on fuse selection, (240 Volts, 500 Volts or 600 Volts maximum for 230 VAC, 480 VAC, and 600 VAC units respectively).

The drive is supplied with fast acting semiconductor fuses with the following interrupting capacities.

Table 3-1 Fuse Interrupting Capacities

Unit	Capacity
R2	20 kA(Farraz)
R2	50 kA (Bussmann)
R3	100 kA
R4	100 kA
R5	100 kA
R5.5	200 kA

Environment These drives are to be used in a heated, indoor controlled environment that is relatively free of moisture and conductive contaminants such as condensation, carbon dust, and the like.

The maximum ambient temperature allowed is 113°F (45°C) for an ACS 501 in a NEMA 1 enclosure for constant torque loads, when the load current is lower than or equal to the continuous rated constant torque current (I_R). The maximum ambient temperature allowed is 104°F (40°C) for an ACS 501 in a NEMA 12 enclosure for constant torque loads; and an ACS 501 in a NEMA 1 enclosure for variable torque loads, when the load current is lower than or equal to the continuous maximum load current (I_{RSQ}).

The cooling air must be clean and free from corrosive materials. When necessary the required cooling should be provided by using clean, dry air.

Table 3-2 Required Cooling Air Volume for ACS 501 Units

Unit	Cooling Air
R2	30 CFM (51 m ³ /hr)
R3	60 CFM (102 m ³ /hr)
R4	240 CFM (406 m ³ /hr)
R5 & R5.5	330 CFM (560 m ³ /hr)

If the cooling air contains dust, clean the cooling surfaces of the unit regularly using compressed air and a brush. If the ACS 501 is in a NEMA 1 enclosure, cover the vents to prevent the dust from entering the unit.

If the heat sink is not cleaned and it is not able to dissipate the expended heat, the ACS 501's thermal protection will operate, causing a fault indication which stops the drive. The ACS 501 can be started again when the temperature of the heat sink has fallen below the tripping level, which is 158°F (70°C).

The temperature of the heat sink can be read from the Control Panel Display, Operating Data Parameter 8 (Drive Temperature).

Mounting Area

Mounting the Control

When mounting the control take the following precautions.

- DO NOT mount in direct sunlight.
- DO NOT mount on surfaces with temperature above 104°F (40°C).
- DO NOT allow the ambient temperature around the ACS 501 to exceed the ambient temperature as stated in *Environment* above.
- Mount the ACS 501 vertically with the factory supplied conduit knockouts at the bottom.
- See Figure 3-1 for the space requirements.
- If units are to be mounted next to each other, each unit must have two inches (50 mm) of clear space, so that a total of four inches (100 mm) between two units is available for proper cooling.
- If units are mounted one above the other, at least 12 inches (300 mm) is required between the units.
- At least three (3) separate grounded conduits are required. One each for input, output, and control wiring.

Figure 3-1 shows the space requirement for adequate cooling of the ACS 501.

Figure 3-1 ACS 501 Space Requirements

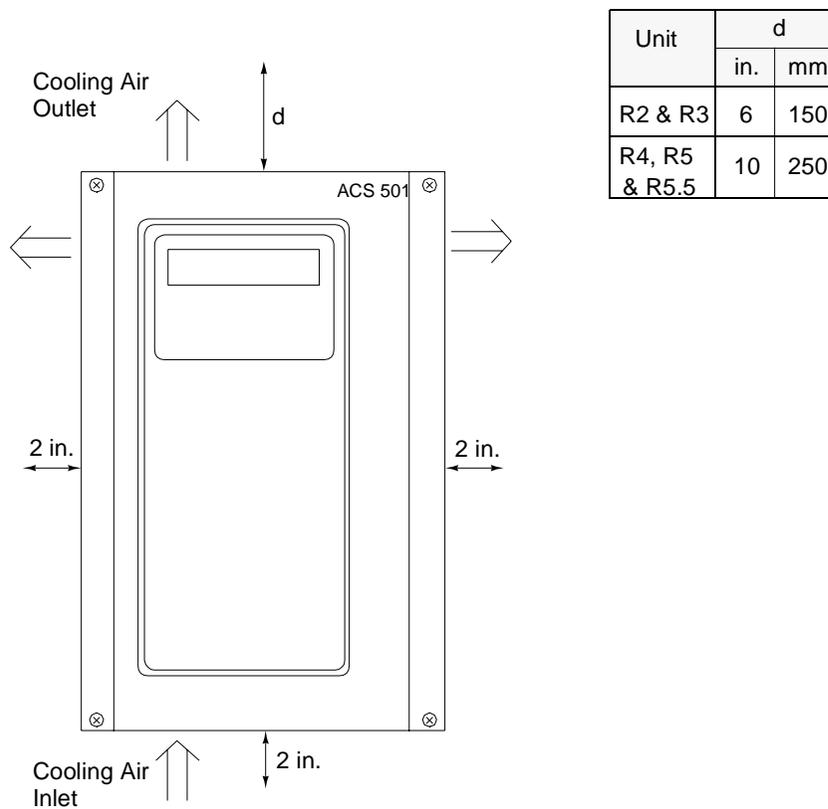


Figure 3-2 shows the ACS 501 with dimensions coded by letters. Table 3-3 lists the actual dimensions for each ACS 501 unit. The table shows dimensions in inches and mm.

Figure 3-2 ACS 501 Dimensions

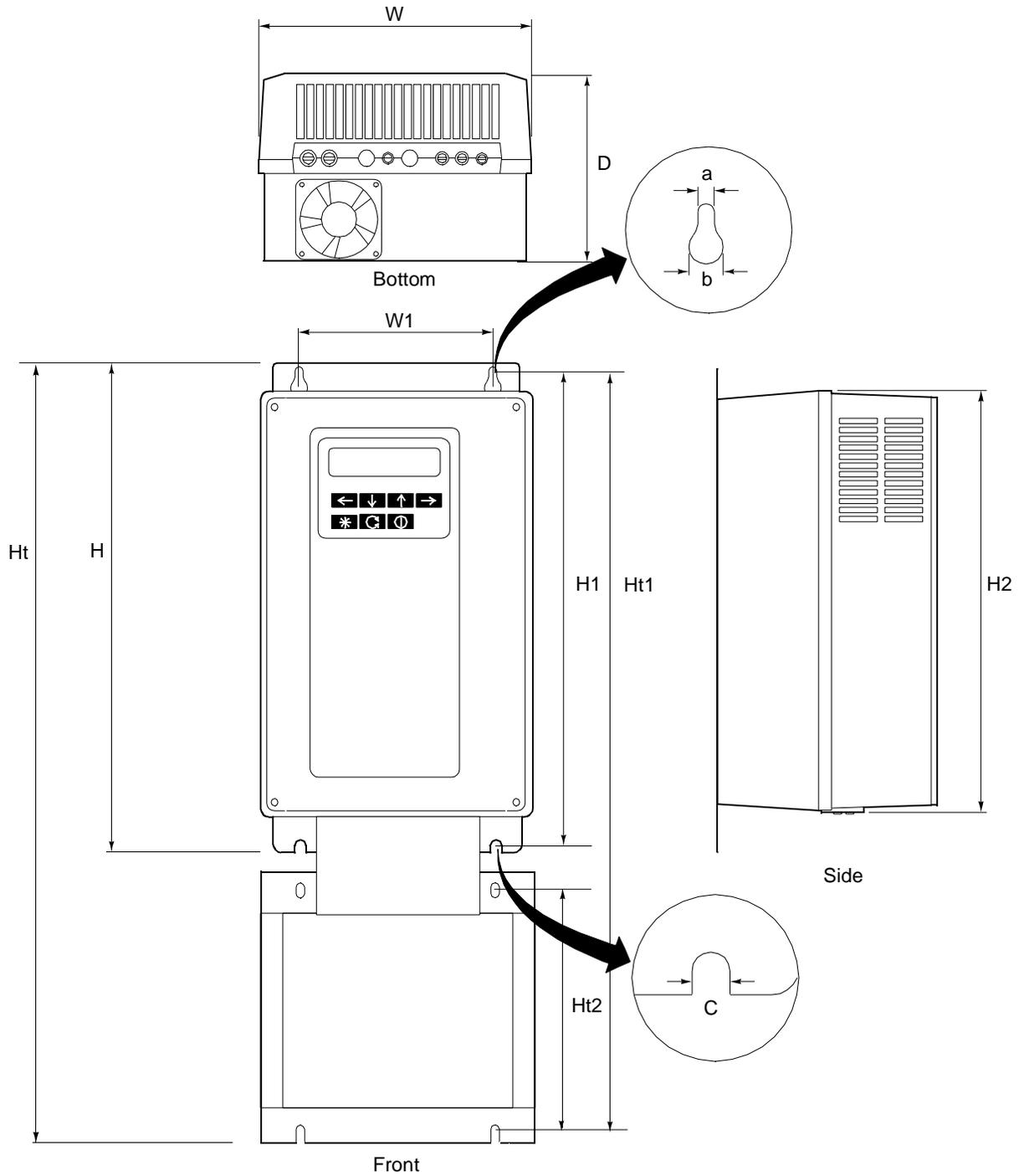


Table 3-3 Dimensions of ACS 501 Units

Dimensions	R2		R3		R4		R5		R5.5	
	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
208 to 600 VAC										
W	7-7/8	200	9-55/64	250	11-13/16	300	13-13/16	351	13-13/16	351
W1	5-29/32	150	6-57/64	175	8-55/64	225	10-27/32	275	10-27/32	275
H	14-17/64	362	16-3/4	425	19-31/32	507	23-3/4	603	23-3/4	603
H1	13-25/32	350	15-3/4	400	18-29/32	480	22-41/64	575	22-41/64	575
H2	12-9/32	312	14-31/32	380	18-7/64	460	21-45/64	551	21-45/64	551
D	7-25/64	188	8-3/16	208	9-13/16	249	10-5/16	262	12-1/16	307
a	15/64	7	5/16	9	5/16	9	5/16	9	5/16	9
b	35/64	14	45/64	18	45/64	18	45/64	18	45/64	18
c	15/64	7	5/16	9	5/16	9	5/16	9	5/16	9
Unit Weight	17 lbs	8 kg	31 lbs	14 kg	54 lbs	25 kg	74 lbs	34 kg	88 lbs	40 kg
Shipping Weight	20 lbs	9 kg	34 lbs	15 kg	60 lbs	27 kg	80 lbs	36 kg	96 lbs	44 kg
525 to 600 VAC - Note that the following dimensions <u>do not</u> apply to the 208 to 500 VAC units.										
Ht			26.9	683	31.2	794	37.0	940	37.0	940
Ht1			25-61/64	659	30-3/16	767	35-61/64	913	35-61/64	913
Ht2			8.4	214	8.8	224	11.0	279	11.0	279

Installation Site Power

The ACS 501 is designed for use on a three-phase system. Four wires (three phase plus a ground wire) are required for the input wiring. Input and output conductors, and branch circuit protection must be sized to local codes.

At least three (3) separate conduits are required; one each for input power, output power, and control wiring.

Conduit Size

Figure 3-3 shows a bottom view of R2 and R3 ACS 501 drives, and conduit sizes to fit wire-entry holes.

Figure 3-3 ACS 501 R2 and R3 Conduit Sizes

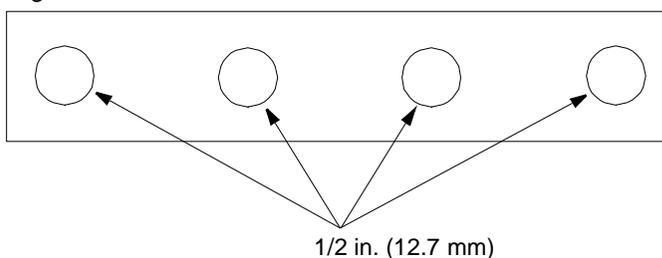


Figure 3-4 shows a bottom view of an ACS 501 R4 drive, and conduit sizes to fit wire-entry holes.

Figure 3-4 ACS 501 R4 Conduit Sizes

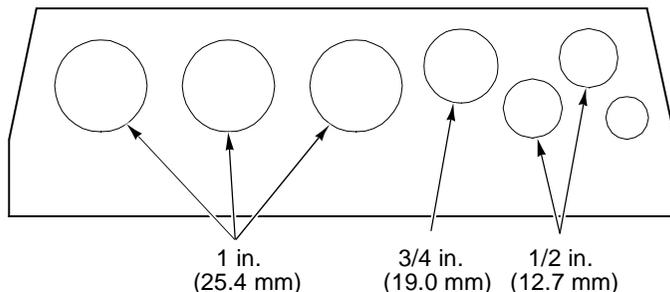
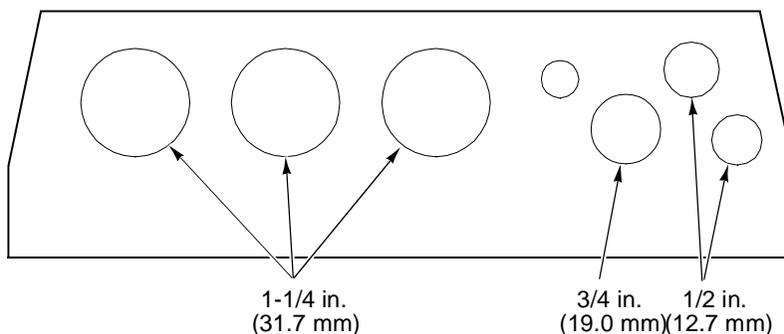


Figure 3-5 shows a bottom view of an ACS 501 R5 drive, and conduit sizes to fit wire-entry holes.

Figure 3-5 ACS 501 R5 & R5.5 Conduit Sizes



Power Wiring

All field wiring shall be copper conductor rated for 140°F (60°C) and torqued to the values in Table 3-4.

Table 3-4 Wire Torque Values

Unit	in.-lbs	Nm
R2 & R3	8.8	1
R4, R5 & R5.5	17.6	2

Table 3-5 indicates the minimum and maximum wire sizes allowable for each size unit.

Table 3-5 Wire Sizes for ACS 501 Units

Drive Type	Unit	Drive Fuse Size	Wire Sizes
ACS501-002-4 – 005-4 ACS501-001-2 – 002-2	R2	16	22 AWG – 10 AWG
ACS501-007-4 – 010-4 ACS501-003-2 – 005-2 ACS501-005-6 – 007-6	R3	30	20 AWG – 8 AWG
ACS501-015-4 ACS501-007-2 ACS501-010-6 – 020-6	R4	50	12 AWG – 8 AWG
ACS501-020-4 ACS501-010-2	R4	50	10 AWG – 6 AWG
ACS501-025-4 ACS501-025-6 – 030-6	R5	80	10 AWG – 6 AWG
ACS501-030-4 ACS501-015-2	R5	80	8 AWG – 0 AWG
ACS501-040-4 ACS501-020-2	R5	100	8 AWG – 0 AWG
ACS501-050-4 – 060-4 ACS501-025-2 – 030-2 ACS501-040-6 – 050-6	R5.5	160	8 AWG – 0 AWG

Table 3-6 lists the specifications for the factory installed, UL Recognized fuses (JFHR2).

Table 3-6 Fuse Specifications

Drive Type	Unit	Rating	Mfg.	Type
ACS501-002-4 – 005-4 ACS501-001-2 – 002-2	R2	16A/500V	Bussmann	FWH 16A6F
			Ferraz	500V FA 6.3 x 32/16
ACS501-007-4 – 010-4 ACS501-003-2 – 005-2 ACS501-005-6 – 007-6	R3	30A/600V	Bussmann	FWC 30A10F
			Ferraz	6,600 CP URL 10.3 x 38/30
ACS501-015-4 – 020-4 ACS501-007-2 – 010-2 ACS501-010-6 – 020-6	R4	50A/700V	Bussmann	FWP 50A14F
		50A/660V	Ferraz	6,600 CP URC 14 x 51/50
ACS501-025-4 – 030-4 ACS501-015-2 ACS501-025-6 – 030-6	R5	80A/700V	Bussmann	FWP 80A22F
		80A/660V	Ferraz	6,600 CP URD 22 x 58/80
ACS501-040-4 ACS501-020-2	R5	100A/700V	Bussmann	FWP 100A22F
		100A/660V	Ferraz	6,600 CP URD 22 x 58/100
ACS501-050-4 – 060-4 ACS501-025-2 – 030-2 ACS501-040-6 – 050-6	R5.5	160A/660V	Bussmann	170M1369

Output Power Wiring

Install the motor wiring away from other wire routes. Avoid long parallel runs with other wires. If motor wires must run parallel to the control wires for a short length, the length must not exceed those outlined in Table 3-7. These maximum lengths also apply to control wires from other systems. Table 3-7 shows the maximum lengths for running control wires parallel to motor wires.

Table 3-7 Maximum Lengths For Parallel Wiring

Distance Between Wires		Maximum Run Length	
ft	m	ft	m
0	0	≤3.28	≤1
.328	0.1	≤32.8	≤10
3.28	1	≤328.0	≤100

The rapid rate of voltage changes causes capacitive coupling between motor wiring and the grounded metallic conduit. This capacitive coupling increases with switching frequency and motor wire length. This phenomenon can cause substantially higher measured current (by the drive) than is actually seen by the motor. This may result in:

- Nuisance overcurrent trips.
- Erroneous current display readings. The current display will read higher than measured current.
- Nuisance activation of current limits or electronic motor overload function (I^2t).

If the motor wire lengths in Table 3-8 must be exceeded, chokes should be installed in the drive output. Contact ABB for more information.

Table 3-8 Maximum Recommended Motor Wire Lengths

Switching Frequency, kHz	Maximum Cable Length	
	Feet	Meters
1	200	61
3	175	53.3
12	100	30.5

Control Wiring

Control wires for ACS 501 should be 16 – 22 AWG shielded, multi-core cables, Belden type 8761 or 8771 or equivalent, rated for 140°F (60°C).

Torque control wiring to 4 in.-lbs (0.5 Nm).

When planning control wiring from ACS 501 and external control devices consider the following:

1. All external control wiring to X50 must be done with shielded cable and must not be run in the same conduit or raceway with any high power wiring. The shield connection must be terminated at the chassis ground lug provided. The other end of the shield should be cut and taped back at the signal source.
2. X50 terminals 2 and 8 are “GND 2” (circuit common). X50 terminals 4, 6, 18, and 20 are also connected to circuit common.
3. These terminals are optically isolated from power and isolated from chassis ground by a 10 megohm resistor. They are not isolated from one another.
4. Refer to the *Control Connections* section description of X50 in this chapter for an outline of control signal requirements when selecting an Application macro.

Initial Inspection Procedure

Check that the drive does not show any signs of damage and that the delivery is complete. In the event of damage, please contact the shipping company or the supplier. If the delivery is not in compliance with the order, contact the supplier immediately.

Note: Do not destroy the packing material. The template printed on the protective cardboard can be used for mounting the ACS 501 on the wall.

If the device is stored before start-up, check that the environmental conditions in the storage room are acceptable:

- Temperature -40°F – +158°F (-40°C – +70°C),
- Relative humidity is less than 95 percent, and
- No condensation.

The warranty covers defects in manufacture. The manufacturer carries no responsibility for damage which occurs during transport or unpacking.

Your local ABB Drives company or distributor may have a different warranty period, which is specified in their sales terms and conditions and warranty terms.

If any questions arise concerning the ACS 501, please contact your Distributor or Local ABB Drives Office.

Mechanical Installation The ACS 501 is mounted on a wall in a vertical position using four mounting notches at the top and bottom of the unit. When choosing the mounting location pay attention to the environmental needs of the ACS 501.

Note: Do not handle or lift the drive using the front cover. Use the bottom for lifting or handling.

To ensure safe installation, check that the surface of the mounting location is flat. Mark the mounting points of the ACS 501 on the wall using the template printed on the protective cardboard package as a guide. The maximum size of the mounting screws is 1/4 in. (6 mm) for 002 – 005 R2 units and 5/16 in. (8 mm) for 007 – 040 R3, R4, and R5 units. Attach the screws to the marked positions. Attach the unit at the mounting notches and tighten the screws.

600 volt units are supplied in two pieces; a base drive, and an ac choke unit. Mount the base drive first as instructed above. Remove the cover of the drive and mount the ac choke unit below by fastening the top to the drive with the screws supplied (screwed into the casting of the drive). Fasten the ac choke unit to the wall at the bottom.

Power Connections **600 volt units only:** Attach the leads from the ac choke to the **input** terminals in the base drive (at the input fuses); and connect the leads from the output terminal block to the output terminals in the drive. All field connections are made to the terminal blocks in the ac choke enclosure.

Input Wiring The ACS 501 is designed for use on a three-phase system. Four wires (three phase plus a ground wire) are required for the input wiring. When sizing wire, always conform to local regulations.



WARNING:

- Do not connect or disconnect input or output power wiring, or control wires, when power is applied.
 - Never connect line voltage to drive output Terminals U_2 , V_2 , and W_2 .
 - Do not make any voltage tolerance tests (Hi Pot or Meggar) on any part of the unit. Disconnect motor wires before taking any measurements in the motor or motor wires.
 - Make sure that power factor correction capacitors are not connected between the drive and the motor.
-

Output Wiring Sizing is the same as for the input wiring.

Dynamic Braking When Dynamic Braking is required, connection is made to the DC bus terminals. Dynamic Braking can be accomplished in two ways.

1. Internal Dynamic Brake Chopper. If the ACS 501 was provided from the factory with dynamic braking, the control logic and power switch for the dynamic braking are built into the drive. The DC bus voltage is present at the DC bus terminals only when the DC bus voltage exceeds the braking

threshold due to regeneration.

To determine if the internal dynamic braking chopper has been supplied, first check the part number as described in Chapter 2. If the internal dynamic braking chopper is supplied, an external resistor load bank is connected to the DC bus terminals.



WARNING! Before connecting a resistor load bank to the DC bus terminals, measure the voltage at the terminals with power applied to the ACS 501. Use a meter rated greater than 1000 VDC. The voltage should be zero volts. If the voltage is $1.35 \times V_{IN}$, the internal braking chopper is not present, **DO NOT CONNECT LOAD BANK RESISTORS.**

Before connecting the brake resistor, make sure that the resistor value is equal to or greater than the value indicated in Table 3-10 or Table 3-11.

Table 3-9 Resistor Values For 230 V

hp	Minimum Brake Resistor Value (Ω)	Peak Power (w)	Average Power (w)
1	25.8	4446	2223
2	16.0	7171	3586
3	12.1	9465	4733
5	8.9	12907	6454
7.5	6.7	17210	8605
10	5.2	22229	11115
15	3.4	33702	16851
20	2.8	41590	20795
25	2.8	46609	23305
30	2.8	60234	30117

Table 3-10 Resistor Values For 480 V

hp	Minimum Brake Resistor Value (Ω)	Peak Power (w)	Average Power (w)
2	51.5	8892	4446
3	42.6	10756	5378
5	31.95	14341	7171
7.5	24.2	18931	9465
10	17.7	25814	12907
15	13.35	34419	17210
20	10.3	44458	22229
25	8.4	54497	27249
30	6.8	67404	33702
40	5.5	83180	41590
50	4.9	93219	46610
60	3.8	120468	60234

Table 3-11 Resistor Values For 600V

hp	Minimum Brake Resistor Value (Ω)	Peak Power (w)	Average Power (w)
5	30	20557	10288
7.5	30	20557	10288
10	15	37412	18706
15	15	37412	18706
20	15	48324	24162
25	8.5	59236	29618
30	8.5	73266	36633
40	6	96648	48324
50	6	96648	48324

- External Dynamic Braking Device. If the internal dynamic brake chopper was not supplied and dynamic braking is required for the application, an external dynamic braking chopper and resistor load bank can be connected to the DC bus terminals.



WARNING! The brake control terminals carry a dangerous DC voltage ($1.35 \times V_{IN}$). No device other than an ABB Drives dynamic braking device may be connected to the positive and negative terminals of Terminal Block X2.

Insulation Checks



WARNING! Do an insulation check of the motor wiring and the motor before connecting the ACS 501 to line power. Before proceeding with the insulation resistance measurements, check that the ACS 501 is disconnected from incoming line power. Failure to disconnect line power could result in death or serious injury.

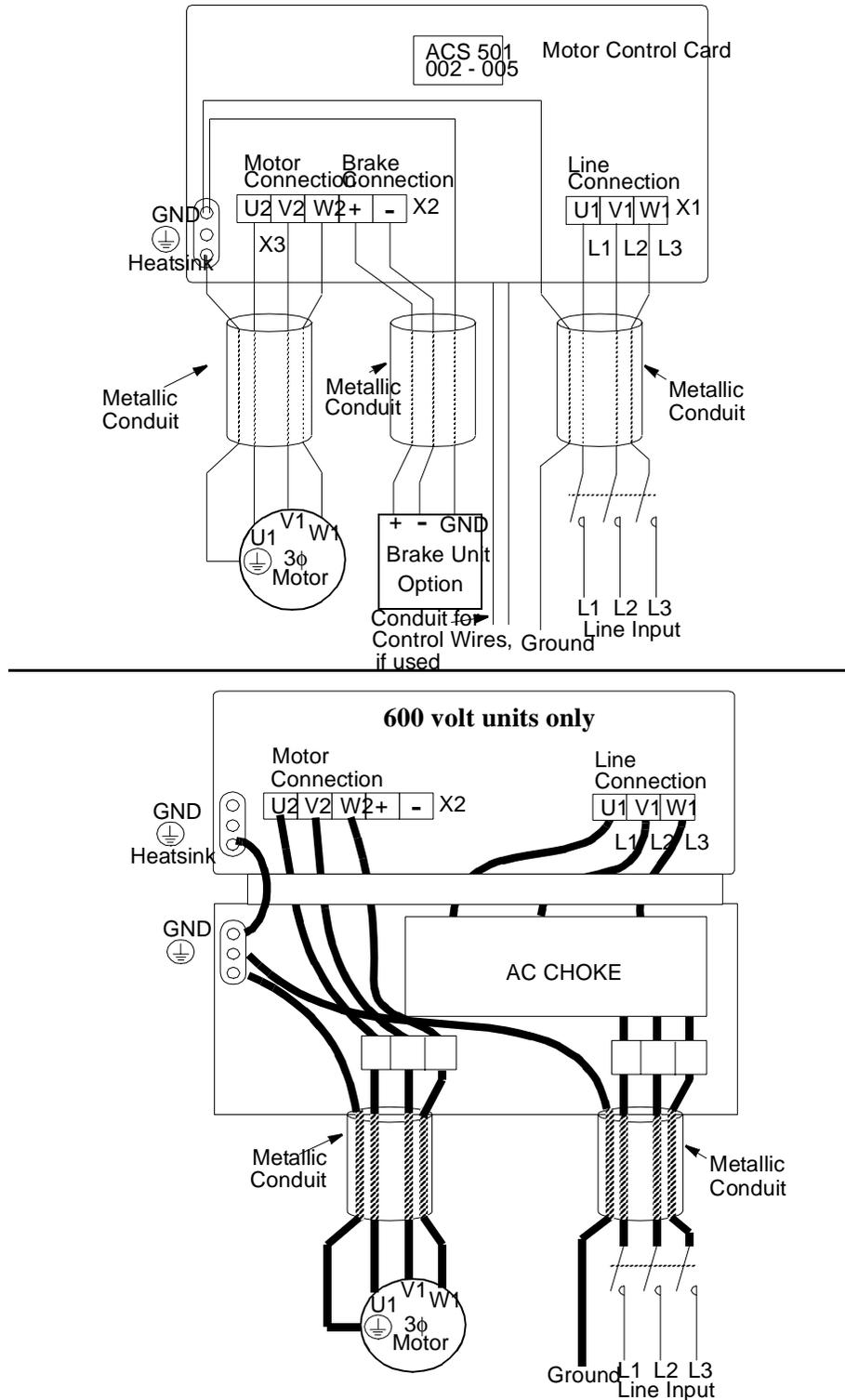
- Check that the motor wires are disconnected from the ACS 501 output on Terminals U_2 , V_2 and W_2 .
- Check that the motor wires are disconnected from the motor and remove bridging connections at the motor.
- Measure the insulation resistances of the motor. The voltage range of the insulation resistance meter must be at least equal to the line voltage, but not exceeding 1000 V. The insulation resistance must be greater than 1 megohm.
- Measure the insulation resistance of the motor wiring between the phases and between each phase and ground. The insulation resistance must be greater than 1 megohm.

Terminal Connections

To connect the power, motor, and control wires remove the front cover of the unit by removing the four screws at the corners.

The line input, brake, and motor power output wiring connections are shown in Figure 3-6.

Figure 3-6 Wiring Connections



Control Connections

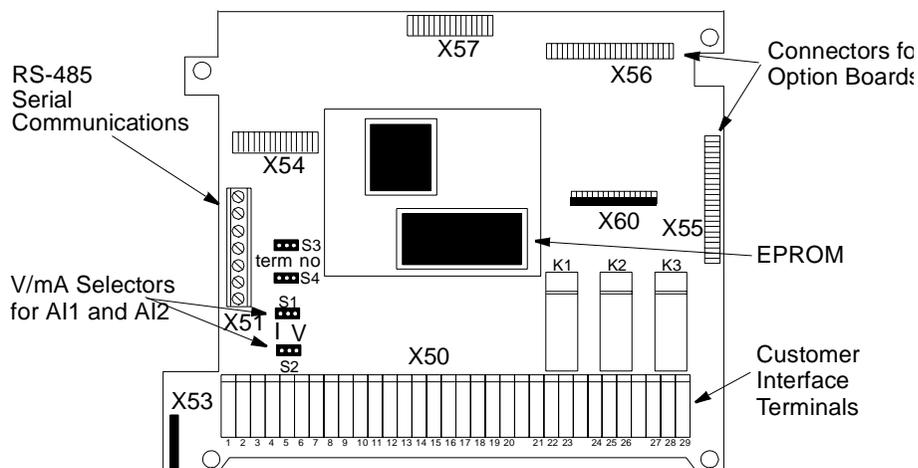
Available Control Locations

The available control locations for the ACS 501 are the:

- ACS Keypad located on the front of the drive.
- X50 screw terminals on the Control Interface Card SNAT-759.

Figure 3-7 shows the control interface card SNAT-759 with terminal and control locations.

Figure 3-7 Control Interface Board Connections



External control devices, for example a PLC or remote operator devices, are connected to Terminal Block X50 according to the connection diagram of each Application macro or according to the programming of the parameters in Main 10, Control Connections. The connection diagrams of Application macros are presented in the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros*. The X50 connection diagram based on factory settings is presented in Figure 3-7 (Control Interface Card SNAT-759 connections). The terminal functions can be altered by means of parameter settings.

X50 Terminal Block X50 can accept wire sizes from 16 – 22 AWG. All connections to terminals X50:1 to X50:20 should be made with shielded cables.

X50:2, 4, 6, 8, 18, and 20 are circuit common. They are optically isolated from the power line potential and from chassis ground by a 10 megohm resistor. The common points are not isolated from each other.

Note: The ACS 501 is shipped with a wire from X50:8 to chassis ground, or with a jumper labeled S9 next to X50. This connects the circuit common to chassis ground. To isolate the circuit common from ground, remove this connection.

Potentiometer A manual speed potentiometer is connected to the reference at X50:1 (+ 10 VDC) and X50:2 (common) and to one of the analog inputs.

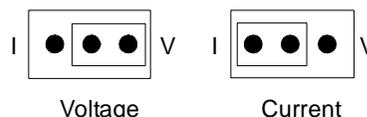
Analog Inputs There are two analog inputs. AI1 is on terminals X50:3 and X50:4. AI2 is on X50:5 and X50:6.

The analog inputs can accept a voltage signal (0 – 10 VDC) or a current signal (0 – 20 mA), as selected by jumpers S1 and S2 (S1 for AI1 and S2 for AI2).

The jumper is placed in the V position for voltage and the I position for current. Figure 3-8 shows jumper positions.

Note: The orientation of the jumpers may be different than the illustration below. Settings should be made based on the identification on the circuit board.

Figure 3-8 Jumper Positions



WARNING! Improper jumper selection may cause drive damage. Be sure to select the correct voltage or current input setting.

Auxiliary 24 VDC An auxiliary +24 VDC supply is available on terminals X50:7 and X50:8. This supply can drive auxiliary devices whose total current draw is less than 200 mA.

Digital Inputs There are six digital inputs, DI1 through DI6 on terminals X50:11 through X50:16 respectively. The digital inputs use 24 VDC logic from terminal X50:10 and are active high.

Analog Outputs There are two analog output signals. AO1 is on terminals X50:17 and X50:18. AO2 is on X50:19 and X50:20. These signals are 0 – 20 mA (or 4 – 20 mA) and can operate into a maximum 500 ohm load.

Digital (Relay) Outputs

There are three relay outputs which are each Form C. Relay RO1 is on terminals X50:21, X50:22, and X50:23; Relay RO2 is on terminals X50:24, X50:25, and X50:26; Relay RO3 is on terminals X50:27, X50:28, and X50:29.

The first terminal for each relay is the normally closed terminal (NC), the second is the common, and the third is the normally open (NO).

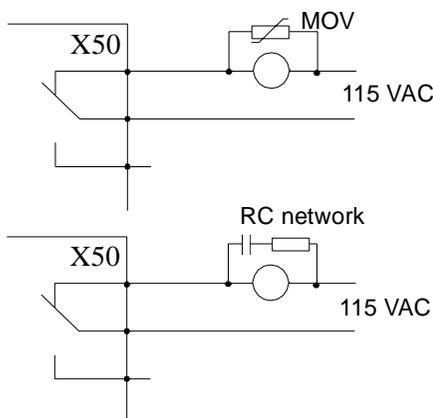
Maximum Switching Voltage: 300 VDC / 250 VAC

Maximum Switching Current/Power: 8 A @ 24 VDC, 0.4 A @ 250 VDC, or 2000 VA @ 250 VAC

Maximum Continuous Current: 2 A rms

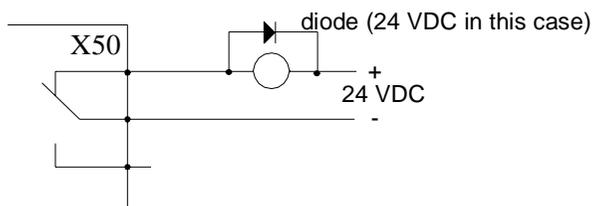
If the relay outputs are used to control inductive loads, such as the coils of relays or contactors, some form of noise suppression must be provided at the load. This is to reduce the electrical noise that could interfere with the electronics in the drive, as well as increase the life of the contacts in the relay.

AC coils should be suppressed with an MOV (metal oxide varistor) or a Series-Connected RC (resistor capacitor) network, as illustrated below:



MOV should be rated 120 VAC - 240 VAC for 115 VAC circuits, 240 VAC - 320 VAC for 230 VAC circuits, minimum 10 joules. Values for the RC Network vary, as they effect the opening and closing time. Contact the contactor manufacturer for recommended values.

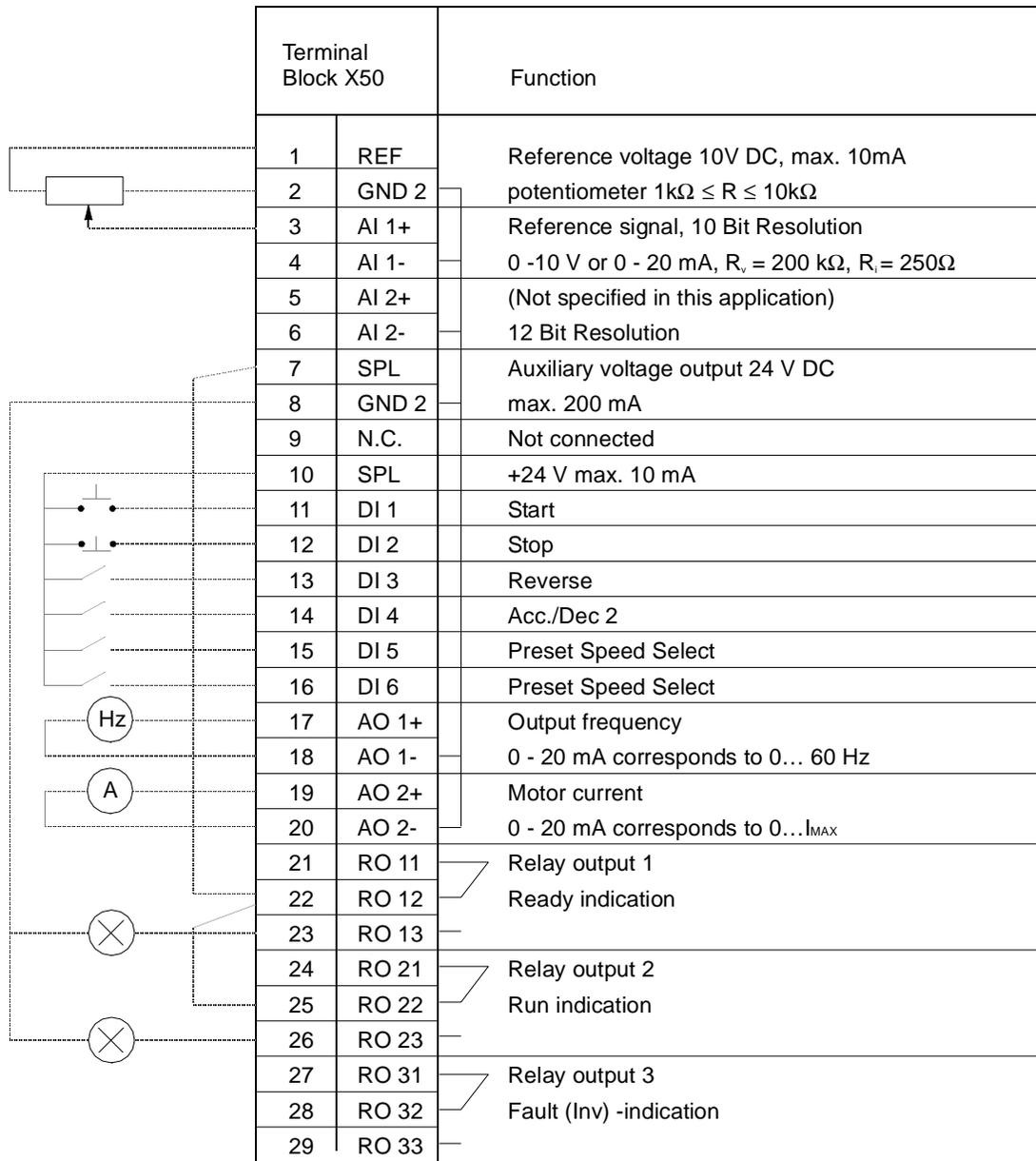
DC coils should be suppressed with a diode, although this is not required because of the small amount of noise generated by these type of circuits. If a diode is used, it should have a voltage rating greater than or equal to the supply voltage, and be connected as shown below:



**Control Interface Card
SNAT-759 Connections**

Figure 3-9 shows Control Interface connections for factory-set parameter values.

Figure 3-9 SNAT-759 Connections and Parameter Values



This page intentionally left blank.

Chapter 4 – Start-up Procedure

This chapter explains how to inspect the installation and how to start-up the ACS 501. Prerequisite information required for start-up was provided in *Chapter 2 – Overview of the ACS 501*.

Safety Precautions

Before start-up, observe the following:

The Motor Control Card (bottom card) is at DC bus potential ($1.35 \times V_{IN}$) when the ACS 501 is connected to supply voltage. This voltage is extremely dangerous and can cause death or serious injury.

When the supply voltage is disconnected from the input terminal block X1, it will take about five minutes before the DC bus capacitors are discharged to a safe voltage.

To ensure that the voltage level is safe, measure the voltage between positive (+) and negative (-) on Terminal Block X2, labeled “Brake.” Meter must be rated for 1000 VDC.

Note: If the internal brake option is installed, measure between the input terminal block X1 and positive (+) on Terminal Block X2. Meter must be rated for 1000 VDC.

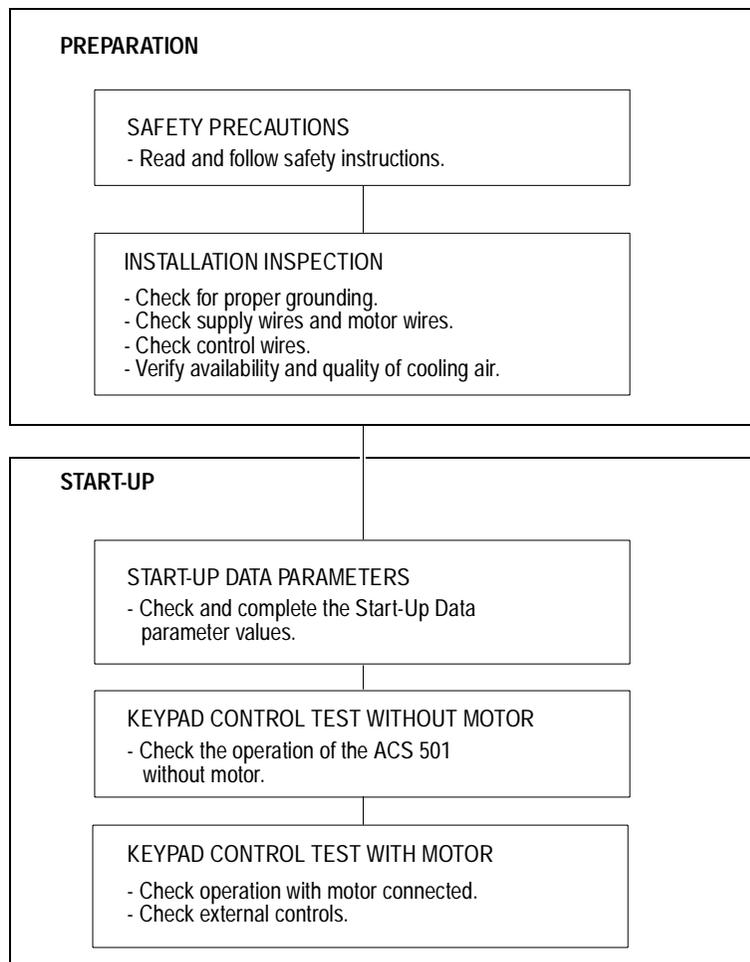
The Control Interface Card and Option Cards are isolated from the main circuit, but dangerous voltages may be present at relay contact terminals. Always check for high voltage at Terminals X50:21 – 29 before working on the Control Interface or Option Cards.



WARNING! When the ACS 501 is connected to the line power, the Motor Terminals U_2 , V_2 , and W_2 are live even if the motor is not running. Do not make any connections when the ACS 501 is connected to the line. Disconnect and lock out power to the drive before servicing the drive. Failure to disconnect power may cause death or serious injury.

Figure 4-1 shows the start-up checklist.

Figure 4-1 Start-up Checklist



Installation Inspection

Inspect the mechanical and electrical installation of the ACS 501 for compliance with the prevailing electrical installation regulations and codes.

Note: Do not connect the motor wires before proceeding with the Keypad Control Test, Motor Disconnected. Refer to Keypad Control Tests in this chapter.

After installation, inspect the following:

- Grounding of the ACS 501 and the motor.
- Supply and motor wires (selection of the wire size, connections).
- Control cables (connections, wire shields grounding, location as far as possible from the power wires).
- Quantity and quality of cooling air for the ACS 501.
- Verify that it is safe to run the motor.
- Connect the ACS 501 to supply voltage. Check that the voltage between $L_1 - L_2$, $L_2 - L_3$, and $L_1 - L_3$ ($U_1 - V_1$, $U_1 - W_1$, and $V_1 - W_1$) is $V_N \pm 10\%$.

Start-up Data Parameters

Power up the ACS 501. The display shows Operating Data Parameter 1 (Output Frequency). Before proceeding with the start-up, check and complete the Start-up Data Parameter values. Do not change parameters at this time except as described in the following steps.

While viewing Parameter 1 (Output Frequency) press and hold [*], then press [Right Arrow]. The display shows Parameter A (Language) in Setting mode.

- A LANGUAGE** Press [Up Arrow] or [Down Arrow] to select your preferred language. The ACS 501 displays all information in the language you select. Press [*] to confirm the selection and move to the next parameter. The available languages are: English, German, Italian, Spanish, Dutch, French, Danish, Finnish, and Swedish.
- B APPLICATIONS** Leave this in the **FACTORY** setting to perform the start-up procedure. If anything other than **FACTORY** displays, press [Up Arrow] or [Down Arrow] to change the parameter to **FACTORY**. Press [*] to confirm the selection and move to the next parameter.
- C APPLIC. RESTORE** This parameter restores all parameters of the current application to factory-set parameter values. Set this to **YES** by pressing [Up Arrow]. Press [*] to confirm the selection and move to the next parameter.
- D SUPPLY VOLTAGE** This parameter offers choices of 440, 460, 480, and 500 VAC for 480-volt units; 380, 400, and 415 VAC for 380-volt units; or 208, 220, 230, and 240 VAC for 230-volt units.
- Press [Up Arrow] or [Down Arrow] to select the voltage value which matches the line voltage providing power to your ACS 501. Press [*] to confirm the selection and move to the next parameter.
- E USER DISPLAY SCALE** This parameter is used to set the scaling factor for Operating Data Parameter 2 (Speed). When set to 0, the speed display will show RPM. When set to 100, the speed display will show %. When set to any other value from 0 – 10000, the display will show this value (minus slip unless slip compensation is ON) when the output frequency is at the frequency set by Start-up Data Parameter I (Motor Base Frequency).
- Press [Up Arrow] or [Down Arrow] to set the desired value of the speed display. Press [*] to confirm the selection and move to the next parameter.
- F MOTOR CURRENT -FLA** This parameter matches the ACS 501 to the rated motor current, adjustable between 0 and 1000 amps. The drive uses this parameter for motor overload protection and current (amperage) information displays.
- Press [Up Arrow] or [Down Arrow] to select the current (amperage) value for your motor. Press [*] to confirm the selection and move to the next parameter.

G MOTOR POWER This parameter matches the motor rated power, adjustable between 0.7 hp and 1340 hp. The drive uses this parameter for motor overload and kWh information displays. The left key switches the display between hp and kWh. To change the display, press and hold the left key for two seconds.

Press [Up Arrow] or [Down Arrow] to select the motor power value for your motor. Press [*] to confirm the selection and move to the next parameter.

H MOTOR POWER FACTOR This parameter matches the motor power factor (at rated speed and load on sinusoidal power), adjustable between 0.10 and 1.0. The drive uses this parameter for motor torque and power information displays.

Press [Up Arrow] or [Down Arrow] to select the motor power factor value for your motor. Press [*] to confirm the selection and move to the next parameter.

I MOTOR BASE FREQUENCY This parameter is used to set the designed frequency of the motor, adjustable from 30 Hz to 500 Hz in 10 Hz increments. Changing this value will automatically set the FWP to the same value.

Press [Up Arrow] or [Down Arrow] to select the base frequency value for your motor. Press [*] to confirm the selection and move to the next parameter.

J MOTOR BASE R.P.M. This parameter is used to set the nameplate speed of the motor and is adjustable from 200 to the maximum 2 pole motor speed based on Start-up Data Parameter I (Motor Base Frequency).

Press [Up Arrow] or [Down Arrow] to set the motor nameplate speed value for your motor. Press [*] to confirm the selection and move to the next parameter.

K MOTOR NOM. VOLTAGE The default is 460 V for 480-volt units, 380 V for 380-volt units, and 230 V for 230-volt units. Changing this parameter automatically changes the Maximum Output Voltage.

Press [Up Arrow] or [Down Arrow] to select the motor rated voltage for your motor. Press [*] to confirm the selection and return to Operating Data Parameter 1 (Output Frequency).

Note: *If the motor rated voltage is lower than the supply voltage, make sure that the motor insulation is rated for the DC bus voltage level which is $V_{IN} \times 110\% \times 1.35 \times 1.3$ minimum (input voltage $\times \pm 10\%$ tolerance \times peak of rectified wave \times overvoltage limit).*

Keypad Control Tests

Motor Disconnected from the ACS 501

After setting the Start-up Data parameters, test the drive as follows:

1. Disconnect and lock out power from the ACS 501, wait at least five minutes after disconnecting power. Verify that the DC Bus voltage is at a safe level by measuring the voltage between positive (+) and negative (-) on Terminal Block X2, labeled “Brake.” Check for zero volts at Terminals X50:21 – 29 before continuing.

Note: If the internal brake option is installed, measure between the input terminal block X1 and positive (+) on terminal block X2. Meter must be rated for 1000 VDC.

2. Disconnect the motor from the ACS 501.
3. Power up the ACS 501.
4. Press [Start/Stop] to issue a start command. The Run Status indicator on the LCD Display displays the symbol “|”.
5. Press [*] to enter setting mode. Press [Up Arrow] until frequency display shows 60 Hz, then press [*] to enter value.
6. Press [Up Arrow] or [Down Arrow] to scroll through and check the Operating Data parameters. Check that Operating Data Parameter 7 (Output Voltage) is equal to the input voltage.

If the drive operates according to these steps, disconnect and lock out power to the ACS 501 to prepare for the next test.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate DC circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-), or between the input Terminal Block X1 and Terminal Block X2:(+) if an internal brake option is installed. Meter must be rated for 1000 VDC. Failure to check voltages may result in death or serious injury.

If the drive does not operate according to these steps, refer to *Chapter 5 – Fault Tracing*.

Motor Connected to the ACS 501

After successfully testing the drive with the motor disconnected, continue testing the drive as follows:

1. Disconnect and lock out power from the ACS 501. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) before continuing.
2. Connect the motor to the ACS 501.
3. Power up the ACS 501.
4. Set Operating Data Parameter 10 (Keypad Ref 1) to 0.5 Hz.
5. Press [Start/Stop] to issue a start command. The Run Status indicator on the LCD Display displays the symbol “|”.
6. Check the monitored values of Operating Data Parameters 1 – 8 for normal drive and motor operation.
7. Return to Operating Data Parameter 1 (Output Frequency).

CAUTION: Check motor rotation direction as soon as the motor begins to move. If motor rotation direction is critical and the motor does not run in the direction indicated by the Rotation Direction indicator on the ACS 501 LCD Display, shut down the drive, disconnect and lock out power to the drive, wait five minutes, and check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-). When the drive has reached zero volts, swap any two motor output wires at Terminals U₂, V₂, and W₂. Incorrect motor rotation direction may cause equipment damage.

8. Slowly increase the frequency value of Parameter 1. Verify that motor speed varies as frequency varies.
9. Increase the Parameter 1 frequency value to 60 Hz and return to Display mode.
10. Measure the output current in all three phases. The current should be balanced, and should not exceed the motor or drive rating.

If the drive operates according to these steps, your ACS 501 is ready to use with pre-set or modified macro adjustments.

If the drive does not operate according to these steps, refer to *Chapter 5 – Fault Tracing*. Repeat the above steps until the drive operates normally.

Default Drive Parameters

Now that you have tested and started the drive using the Factory macro settings, check the Factory macro default drive parameters. Refer to the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros* for additional information about Factory macro default settings.

ACS 501 external control wiring schemes vary according to the macro you choose and the parameter values you change. If you plan to change the ACS 501 macros or parameter values, and if you plan to use an external control device, refer to the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros* for information on control wiring, Application macros, and modifying macro parameters.

To complete the start-up, select the appropriate Application macro, and make any necessary parameter changes. Connect all external wiring based on the configuration selected, and test all external interfacing.

Customizing Application Macro Parameters

At some point during the installation of your ACS 501 you can select one of the pre-set application macros closely suited to your application. You select Application macros from Start-up Data Parameter B (Applications). You also may need to modify the macro to custom-fit your application. For example, if you select the Factory macro for your application, the Factory macro default for Start-up Data Parameter D (Supply Voltage) is 480 V. If your supply voltage is 460 V, you need to change this parameter in the macro accordingly.

To customize the macro for your application you must change certain parameter values. In each macro, certain parameters are more likely to be changed than other parameters, but the application determines which parameters, and in which macro, will require changing.

Note: *If you plan to use an external control device for your drive, you must wire the control to the drive according to the wiring scheme of the macro you select. Refer to the ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros for more information on specific macro external control wiring schemes.*

Refer to the *ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros* for more information on accessing and changing parameters.

Note: *If you use RUN ENABLE Digital Input from the screw terminals, the keypad's START/STOP function becomes disabled until a run enable signal is present.*

Note: *The direction is fixed in FORWARD by Parameter 10.1.3 (Loc/Ext Direction) in the factory default settings for safety purposes. If the application requires reversing, change Parameter 10.1.3 accordingly. If reversing is not required, the digital input programmed for Direction can be reprogrammed for another function.*

This page intentionally left blank.

Chapter 5 – Fault Tracing

This chapter describes the ACS 501 Warning and Fault indications and Fault history. It explains how to trace Warnings and Faults using a table of displayed messages, probable causes, and remedies. The last part of this chapter includes flowcharts for troubleshooting specific faults.

Some faults may require technical support. Contact ABB Technical Support at the following:

- (800) 243-4384
- (414) 785-8500
- Fax: (414) 785-0397

Fault Indications

The ACS 501 continuously monitors itself for faulty operation. If a fault condition should arise, the ACS 501 will display a description of the fault and wait for the operator to acknowledge the fault before resuming operation.

The ACS 501 will also display warning indications, which indicate abnormal operation, but do not cause the drive to stop. If a fault occurs when a warning display is on, the warning will be erased and the fault indication is displayed.

Figure 5-1 shows examples of warning and fault indications.

Figure 5-1 Warning and Fault Indications



Fault Resetting

A fault can be reset either by pressing the Keypad Start/Stop button, activating the digital input selected by Parameter 10.4.2 (Fault Reset Select), or via serial communication (RS 485), or if necessary, switching the input voltage off for a while. If the fault has been corrected, the ACS 501 will resume normal operation. If the fault has not been corrected, the ACS 501 will trip again. For automatic fault reset, refer to Automatic Reset Group 30.2 in *Chapter 5 of the ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros*.

Note: Fault resetting starts the drive, if start command is active.

Some faults require you to cycle the power off and on once before the fault can be cleared. Proper fault reset action is given in Table 5-1.

Fault History

When a fault is detected, it is stored so that it can be reviewed at a later date. The last three faults and warnings are stored in Operating Data Parameters 17 (Last-Recd Fault), 18 (Second-Recd Fault), and 19 (First-Recd Fault).

The faults can be checked for trends that may be useful in preventing future faults. For example, if the last two out of three faults were overvoltage trips, the deceleration time should be longer.

Scrolling through the Fault History parameters does not erase the Fault History. The oldest fault or warning is automatically erased when a new fault or warning occurs.

***Note:** Undervoltage Fault and Supervision Limit Indications are not stored in Fault History. They remain on display until reset by pressing [Start/Stop] or by external fault reset. The source of external fault reset can be set at Parameter 10.4.2 (Fault Reset Select).*

Fault Erasing

You can erase fault messages from the ACS 501 memory. To erase fault messages:

1. Select Operating Data Parameter 17 (Last-Recd Fault).
2. Press [*] to enter Setting Mode.
3. Press [Up Arrow] or [Down Arrow] to erase the fault.
4. Press [*] to accept.
5. Repeat Steps 2 and 3 while viewing Operating Data Parameters 18 and 19.

Fault Tracing

Warning Messages

 = Press once to reset warning.

Warning Message	Possible Cause	Remedy
1 OVER TEMP 	The heat sink temperature is over 149°F (65°C). Restricted air flow caused by dust or improper installation location.	Refer to Figure 5-2 at the end of this chapter.
2 MOT STALL 	Parameter 30.1.8 (Stall Func) is set to WARNING.	Refer to Fault 3 (Mot Stall) in the next section.
3 MOTOR TEMP 	Parameter 30.1.3 (Mot Temp Flt Func) is set to WARNING.	Refer to Fault 4 (Mot Temp) in the next section.
6 UNDER LOAD 	Parameter 30.1.10 (Underload Func) is set to WARNING.	Refer to Fault 7 (Under Load) in the next section.
7 AI < MIN 	Parameter 30.1.2 (AI < Min Func) is set to WARNING.	Refer to Fault 11 (AI < Min) in the next section.
8 EEPROM WR 	Parameter storing to the EEPROM has failed.	<ul style="list-style-type: none"> • Check DC bus voltage. • If voltage is OK, try to store again. • If warning occurs again, try to restore factory settings. • If the warning persists, contact ABB Technical Support.

Fault Messages

 = press once to reset fault.

  = remove power to reset fault.

Fault Message	Possible Cause	Remedy
1 START/STOP 	The start/stop reference from Control Interface Card is different from the start/stop state of the Motor Control Card.	<ul style="list-style-type: none"> • Check the connection between Control Interface and Motor Control Cards. • If the fault persists, contact ABB Technical Support.
2 OVER TEMP 	The heat sink temperature is greater than 158°F (70°C). Restricted air flow caused by dust or improper installation.	Refer to Figure 5-2 at the end of this chapter.
3 MOT STALL 	The ACS 501 has determined that the motor is operating in the stall region. Refer to Parameter 30.1.10 (Stall Time/Freq). The motor is not turning because of increased load torque. Motor may be too small for the application.	<ul style="list-style-type: none"> • Remove the mechanical problem causing increased load torque. • If the motor shaft is rotating and the motor is not overheating, increase stall limit parameters. • Check drive sizing, use larger ACS 501 and motor if necessary.
4 MOTOR TEMP 	The ACS 501 determined that the motor is overheated. Because the temperature rise is calculated from the motor current and not measured directly, the motor may be within temperature rise specification, especially with long motor cables where capacitive currents will increase the current from the drive.	<ul style="list-style-type: none"> • Check the motor temperature. If it is within temperature rise specification, increase Parameter 30.1.5 (Motor Load Curve) and/or Parameter 30.1.4 (Motor Therm Time) and restart. • If the motor temperature is above rated temperature, improve motor cooling or resize the motor.
7 UNDER LOAD 	The motor load has dropped below the Supervision Limit set by Parameters 30.1.12 and 30.1.13.	<ul style="list-style-type: none"> • Fix mechanical problem causing underload. • Check motor load cycle and increase Parameter 30.1.12 (Underload Time) or Parameter 30.1.13 (Underload Curve).

Fault Message	Possible Cause	Remedy
8 OVER CURR1 	The output current has exceeded 265% I_N . This can be caused by a short circuit or ground fault in the motor, motor cable, or in the ACS 501. Too short acceleration time may also cause an overcurrent trip.	<ul style="list-style-type: none"> The number after the notice tells what overcurrent protection circuit has tripped. Refer to Figure 5-3 at the end of this chapter.
9 OVER VOLT 	DC bus voltage has exceeded 135% nominal voltage. Overvoltage is generally caused when the motor runs as a generator in drives where the load inertia is extremely high and the deceleration time is set low.	<ul style="list-style-type: none"> Use longer deceleration time or Use coasting stop function if it is compatible with the application. If short deceleration time is needed, use Dynamic Braking Device.
10 UNDER V 1 	DC bus voltage has gone below 65% of V_N . Most common reason for low voltage trip is failure in the supply voltage, loss of phase, or “brown out” condition.	<ul style="list-style-type: none"> Check supply voltage. If supply voltage was adequate, an internal failure has occurred. Contact ABB Technical Support.
11 AI < MIN 	Analog input is less than the minimum as set by Parameters 10.5.1 and 10.5.5.	Input reference has failed or control wire is broken. Check the reference circuit.
16 PWR RNGE  	Power range programming does not match after replacing the Control Interface or Motor Control Cards.	<ul style="list-style-type: none"> Check the power range programming on Motor Control Card. Remove power, wait one minute, then restore power. If the fault persists, contact ABB Technical Support.
19 IN COMMS 	Failure in serial communication within the Control Interface and/or Motor Control Cards.	<ul style="list-style-type: none"> Check the cabling between Control Interface and Motor Control Cards. If the fault persists, contact ABB Technical support.
20 CON INT  	This fault is related to components in the Control Interface Card.	<ul style="list-style-type: none"> Remove power, wait one minute, then restore power. If the problem persists, call ABB Technical Support. Record the specific fault code, you may be asked for it.

Fault Message	Possible Cause	Remedy
<p>21 MOT CONT</p> 	<p>This fault is related to components in the Motor Control Card.</p>	<ul style="list-style-type: none"> • Remove power, wait one minute, then restore power. • If the problem persists, call ABB Technical Support. Record the specific fault code, you may be asked for it.
<p>22 PAR REST</p> 	<p>Parameter restoring error. Parameter checksum does not match.</p>	<ul style="list-style-type: none"> • Reset fault display (the display is reset allowing the scrolling of parameters, but the fault is not reset). • Check all parameter settings or restore the factor settings. • Remove power, wait one minute, then restore power to check that the fault has disappeared.
<p>23 UNDER V 2</p> 	<p>DC bus voltage does not rise over 85% of V_N during five seconds after connecting the input power.</p>	<ul style="list-style-type: none"> • Check supply voltage. • Call ABB Technical Support.
<p>24 GND FAULT</p> 	<p>Ground Fault has been detected in the motor or motor wiring.</p>	<ul style="list-style-type: none"> • Check the motor and motor wiring for grounds faults.

Figure 5-2 ACS 501 Temperature Warning/Fault Flowchart

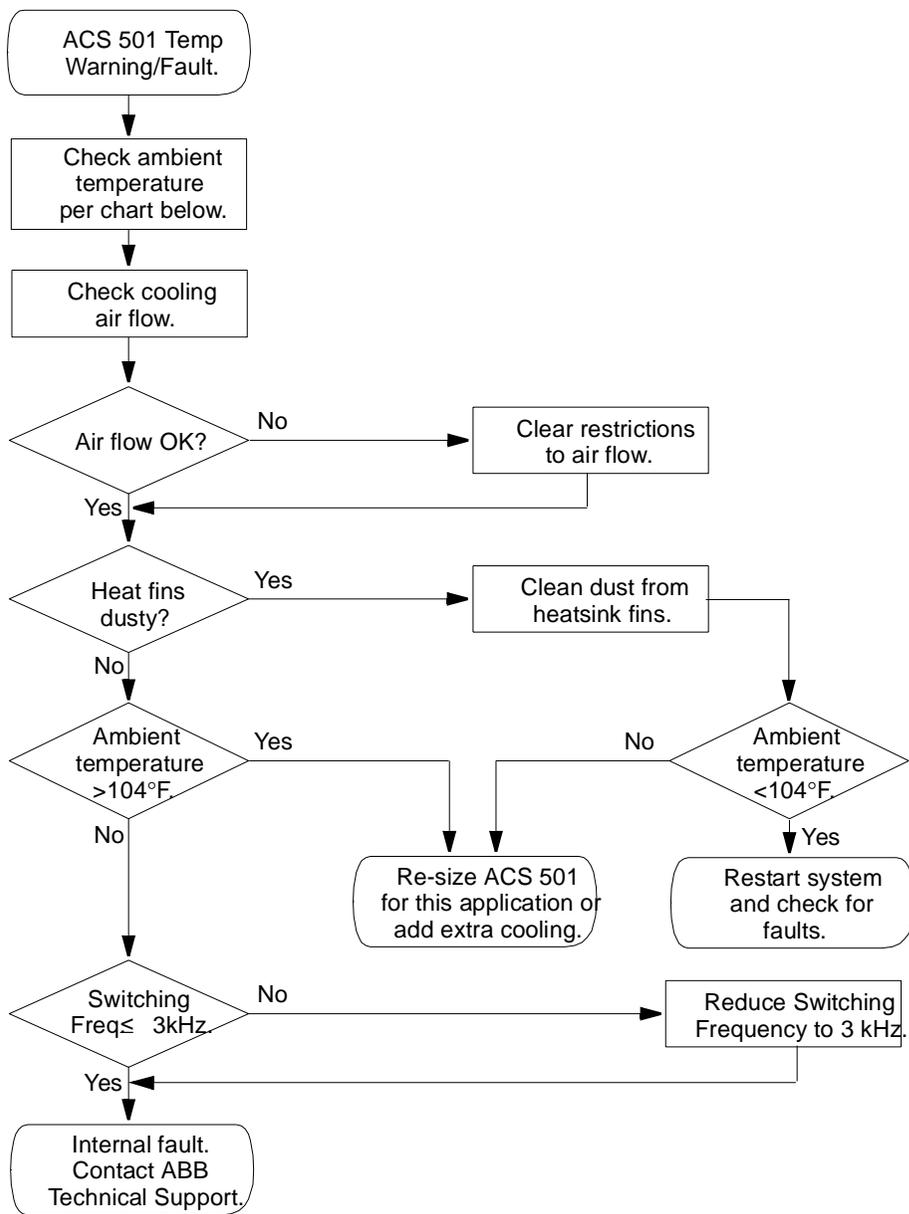
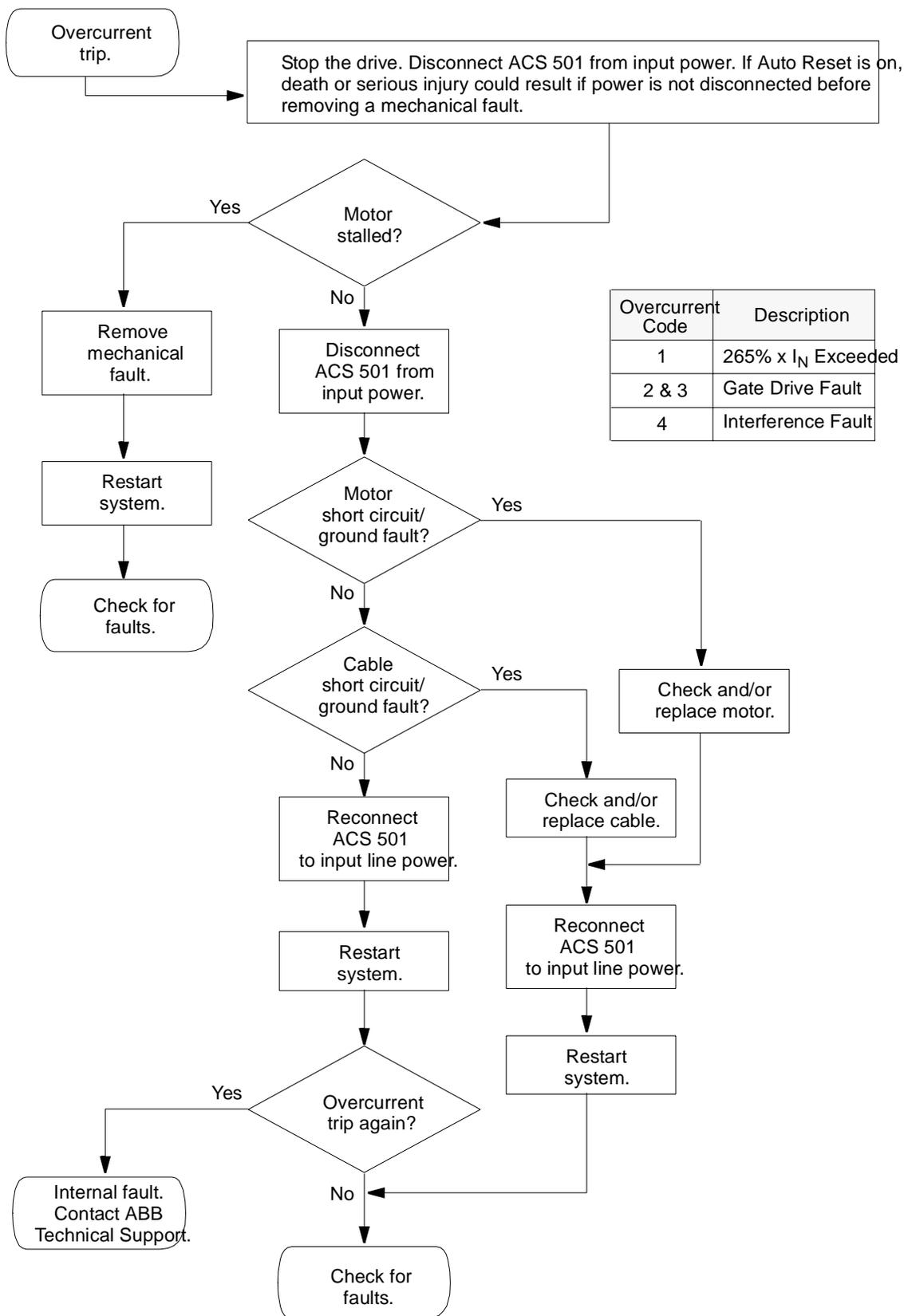


Table 5-1 Fault Message Table

Application Rating	Enclosure Type	
	NEMA 1	NEMA 12
Constant Torque	113°F (45°C)	104°F (40°C)
Variable Torque	104°F (40°C)	

Figure 5-3 Overcurrent Fault Flowchart



Chapter 6 – Service and Maintenance

This chapter explains procedures for servicing ACS 501 components. It also includes spare parts information and general technical data.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Electrostatic Discharge Precautions

Electrostatic Discharge generated by static electricity can damage the complimentary metallic oxide semiconductor devices on various drive boards. It is recommended that you perform these procedures to guard against this type of damage when circuit boards are removed or installed:

- Wear a wrist type grounding strap that is grounded to the chassis.
- Attach the wrist strap before removing the new circuit board or IGBT from the conductive packet.
- Remove components from the drive and immediately insert them into their conductive packets.

Rectifier Tests

The Rectifier Tests are divided into groups according to drive ratings. These tests tell you if the rectifier is the cause of drive malfunction. Use a multimeter to test your rectifier in one of two ways:

- With the diode function, if your meter has one, or
- With a resistance function.

Follow the steps in the Diode Test sections only if your multimeter has a diode test function. If your multimeter does not test diodes, refer to the Resistance Test sections.

**ACS 501 – 002, 003,
and 005**

Diode Test

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed. Failure to check voltage may result in death or serious injury.

-
2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Remove the choke wires from Terminals X6, X7, X8, and X9.
6. Set your multimeter to test diodes. If your multimeter does not have a diode test function, refer to the Resistance Test following this Diode Test.
7. Connect the multimeter negative test probe to Terminal X6 and measure all phase poles U_2 , V_2 , W_2 , of Terminal X1. Meter readings should be approximately 0.5.
8. Change the multimeter test probe polarity. The meter should register infinity.

9. Measure between X6 and X8. The meter should register approximately 0.8 and infinity, accordingly.
10. If your readings differ from the values in Steps 7 – 9, replace the Rectifier Module.

Resistance Test

1. Follow Diode Test Steps 1 – 5, above.
2. Set your multimeter to test resistance. If your multimeter has a diode test function, disregard the Resistance Test and continue with Diode Test Steps 6 – 10 above.
3. Measure the rectifier as in Diode Test Steps 7 – 9 above. The meter should register a range from 100 to 10,000 ohms and infinity, accordingly.
4. Connect the multimeter positive test probe to Terminal X8 and measure each X1 phase pole with the multimeter negative test probe. The meter should register a range from 100 to 10,000 ohms and infinity, accordingly.
5. If your readings differ from these resistance values, replace the Rectifier Module.

ACS 501 – 007 to 040

Diode Test

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed. Failure to check voltage may result in death or serious injury.

2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed.
-



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

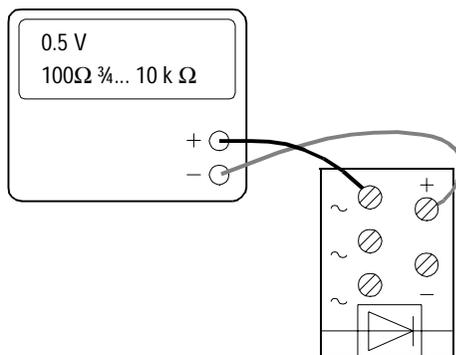
Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

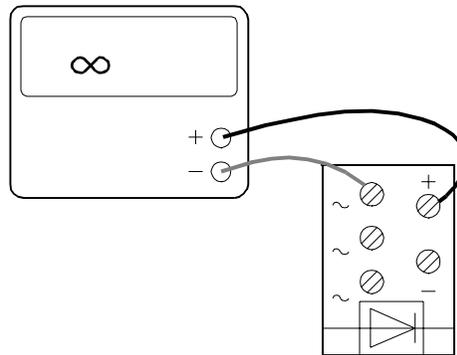
4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Remove all wires from the rectifier terminals.
6. Set your multimeter to test diodes. If your multimeter does not have a diode test function, refer to the Resistance Test following this Diode Test.
7. Connect the multimeter negative test probe to the rectifier positive terminal and measure each rectifier phase pole with the multimeter positive test probe. Meter readings should be approximately 0.5.

Figure 6-1 Positive Rectifier Test



8. Connect the multimeter positive test probe to the rectifier positive terminal and measure each rectifier phase pole with the multimeter negative test probe. The meter should register infinity at each rectifier phase.

Figure 6-2 Negative Rectifier Test

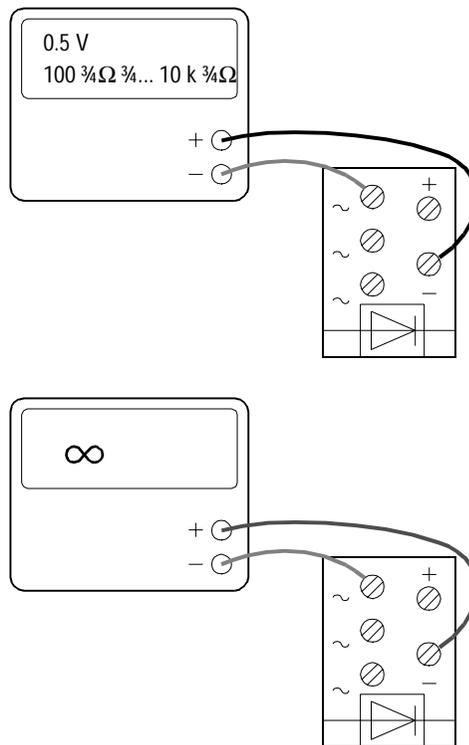


9. Measure between the positive and negative rectifier terminals. The meter should register infinity with the test probes positioned one way, and approximately 0.8 when the test probe positions are switched.
10. If your readings differ from the values in Steps 7 – 9, replace the Rectifier Module.

Resistance Test

1. Follow Diode Test Steps 1 – 5, above.
2. Set your multimeter to test resistance. If your multimeter has a diode test function, disregard the Resistance Test and continue with Diode Test Steps 6 – 10 above.
3. Measure the rectifier as in Diode Test Steps 7 – 10 above. The meter should register a range from 100 to 10,000 ohms and infinity, accordingly.
4. Connect the multimeter positive test probe to the rectifier negative terminal and measure each rectifier phase pole with the multimeter negative test probe. The meter should register a range from 100 to 10,000 ohms and infinity, accordingly.

Figure 6-3 Resistance Test



5. If your readings differ from these resistance values, replace the Rectifier Module.

DC Bus Capacitor Tests

The DC Bus Capacitor Tests are divided into groups according to drive ratings. Each drive rating group requires two separate tests, one for capacitor resistance, and one for capacitor DC insulation. These tests tell you if your DC bus capacitors need replacement.

Damaged electrolytic capacitors may withstand 300 V while not operating at normal power levels. A resistance test, together with a Meggar test for DC insulation, reveals enough information to determine the condition of electrolytic capacitors.

When testing DC bus capacitors, always do the Resistance Test and the Insulation Test.

**ACS 501 – 002, 003,
and 005***Resistance Test*

The DC Bus Capacitors are on the back side of the Motor Control Card, opposite the resistors.

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed. Failure to check voltage may result in death or serious injury.

2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

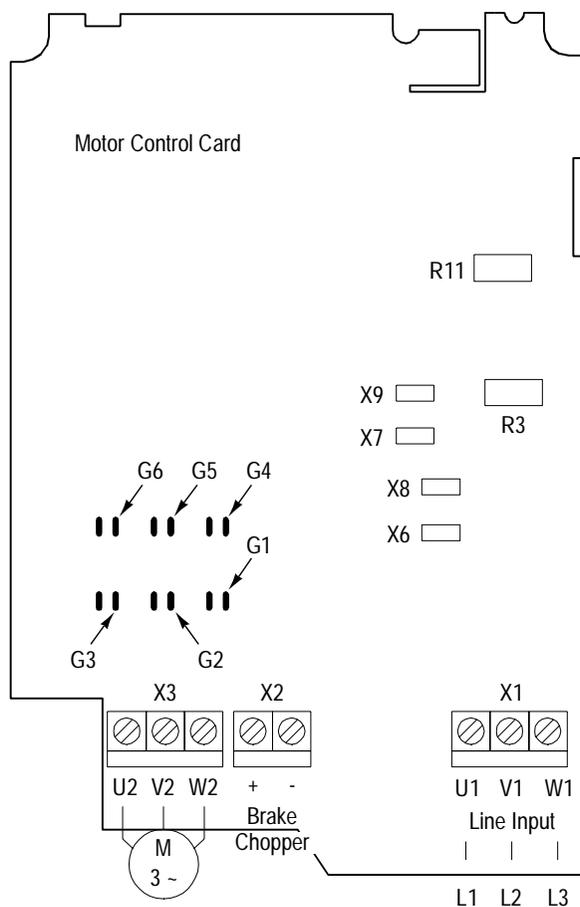
3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Set your multimeter to measure resistance.

Figure 6-4 illustrates the ACS 501- 002, 003, and 005 Motor Control Card.

Figure 6-4 Motor Control Card



6. Measure Motor Control Card resistors R3 and R11. Refer to Table 6-1 for meter readings. Readings within ten percent tolerance of listed values are acceptable.

Table 6-1 Resistance Values

ACS 501 Rating	R3 Value, Ohms	R11 Value, Ohms
002	220k	220k
003	100k	100k
005	100k	100k

7. If your readings differ from the values in the table above, contact ABB Technical Support.

Insulation Test

1. Follow Resistance Test Steps 1 – 4, above.
2. Set the insulation tester to the 500 V DC range and test Capacitors C6 and C8 according to Table 6-2.

Table 6-2 Insulation Test Positions and Values

Drive	Capacitor	Megger (+) Test Probe	Megger (-) Test Probe	Reading, V DC
002	C6	Terminal X7	Card edge side of R3	500
	C8	Card edge side of R3	Terminal X2:(-)	500
003	C6	Terminal X7	Card edge side of R3	500
	C8	Card edge side of R3	Terminal X2:(-)	500
005	C6	Terminal X7	Card edge side of R3	500
	C8	Card edge side of R3	Terminal X2:(-)	500

3. Continue with each measurement until the reading stabilizes or until the reading suddenly falls.
4. If the reading suddenly falls, replace the capacitors. Contact your ABB Technical Support.

ACS 501 – 007 to 040*Resistance Test*

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed. Failure to check voltage may result in death or serious injury.

2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) or between the input terminal block X1 and Terminal Block X2:(+) if an internal brake option is installed.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

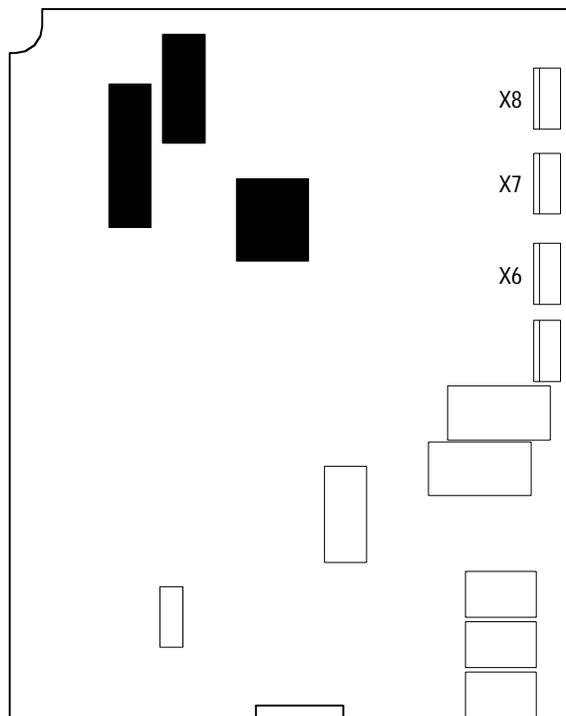
3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Remove all wires from the DC bus capacitors.
6. Set your multimeter to measure resistance.

Figure 6-5 illustrates the ACS 501-007 to 040 Motor Control Card.

Figure 6-5 Motor Control Card



7. Connect the multimeter positive test probe to the DC bus capacitor positive terminal, and the negative test probe to the capacitor negative terminal.
8. The meter should register a small resistance and rise toward infinite resistance.
9. Repeat Steps 7 and 8 for each DC bus capacitor. If the reading remains below 100,000 ohms, replace the capacitor.

10. Continue with the following Insulation Test regardless of your Resistance Test results.

Insulation Test

1. Follow Resistance Test Steps 1 – 5, above.
2. Connect the insulation tester positive test probe to the capacitor positive terminal, and the negative test probe to the negative capacitor terminal.
3. Set the insulation tester to the 500 V DC range.
4. The meter should register a small resistance rising toward infinite resistance.
5. Continue measuring until the meter reading stabilizes or until the reading suddenly falls.
6. Repeat Steps 2 – 5 for each capacitor.
7. If a capacitor reading suddenly falls, replace the capacitor. Contact your ABB service representative.

IGBT Module Tests

The DC Bus Capacitor Tests are divided into groups according to drive ratings.

ACS 501 – 002, 003, and 005

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) before servicing the drive. Failure to check voltage may result in death or serious injury.

2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) before continuing.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Set your multimeter to test diodes.
6. Measure according to Table 6-3 and Table 6-4. Table 6-3 represents meter connections to Terminal Blocks X2 and X3.

Table 6-3 Meter Connections to Terminal Blocks X2 and X3

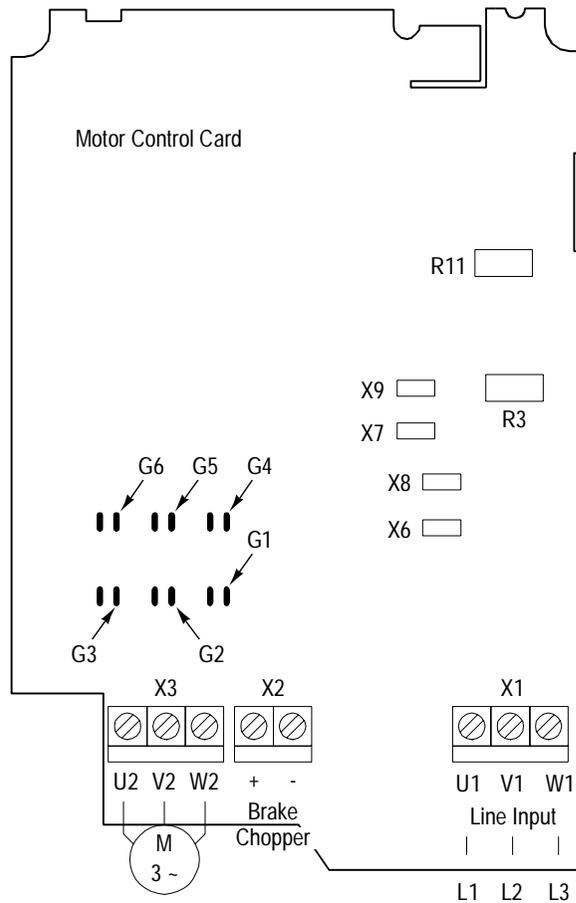
Meter (+) Test Probe	Meter (-) Test Probe	Reading
X3:U2	X2:(+)	0.4
X3:U2	X2:(-)	Over
X3:V2	X2:(+)	0.4
X3:V2	X2:(-)	Over
X3:W2	X2:(+)	0.4
X3:w2	X2:(-)	Over
X2:(+)	X3:U2	0.4
X2:(-)	X3:U2	Over
X2:(+)	X3:V2	0.4
X2:(-)	X3:V2	Over
X2:(+)	X3:W2	0.4
X2:(-)	X3:W2	Over

Table 6-4 represents meter connections to IGBTs on the Motor Control Card. For IGBT locations, refer to Figure 6-6.

Table 6-4 Meter Connections

Meter (+) Test Probe	Meter (-) Test Probe	Reading
G1	X3:W2	1.5
G1	X2:(+)	1.5
G2	X3:V2	1.5
G2	X2:(+)	1.5
G3	X3:U2	1.5
G3	X2:(+)	1.5
G4	X3:W2	1.2
G4	X2:(-)	1.2
G5	X3:V2	1.2
G5	X2:(-)	1.2
G6	X3:U2	1.2
G6	X2:(-)	1.2

Figure 6-6 Motor Control Card



7. If your readings differ from the values in the table, contact your ABB Technical Support.

ACS 501 – 007 to 040

1. Disconnect and lock out power from the ACS 501.



WARNING! Wait at least five minutes after disconnecting power from the drive before you attempt to service the drive. Bus capacitors in the intermediate circuit must discharge before servicing the drive. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) before servicing the drive. Failure to check voltage may result in death or serious injury.

2. Check for zero volts at Terminals X50:21 – 29 and X2:(+) and (-) before continuing.



CAUTION: Electrostatic Discharge (ESD) can damage electronic circuits. Do not handle any components without following the proper ESD precautions.

Note: When disconnecting wires from components and terminals, mark the wires to correspond to their component and terminal connections.

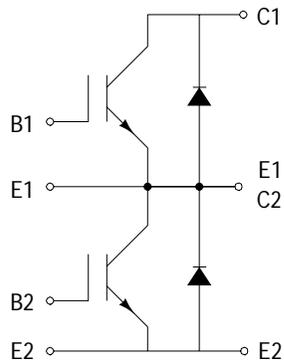
3. Remove all control wiring from the Control Interface Card.

Note: Terminal Block X50 disconnects from the Control Interface Card in three whole sections. To do this, lift the interlocking tabs along the top edge of the three X50 sections and carefully pry the sections straight outward from the Control Interface Card. Mark the sections to correspond with their order of assembly on the Control Interface Card.

4. Remove the screws fastening the left side of the Control Interface Card to the ACS 501 chassis, disconnect the cable from X4 on the Motor Control Card, and swing the Control Interface Card open to access the Motor Control Card.
5. Remove the connections from Motor Control Card Terminals X6, X7, and X8.
6. Remove the control wiring from the Motor Control Card.
7. Remove the Motor Control Card from the chassis to access the IGBTs.

Figure 6-7 illustrates the IGBT schematic diagram and terminals.

Figure 6-7 IGBT Schematic Diagram and Terminals



8. Set your multimeter to test diodes.
9. Test the IGBTs according to Table 6-5.

Table 6-5 IGBT Test Connections and Readings

Meter (+) Test Probe to IGBT Terminal:	Meter (-) Test Probe to IGBT Terminal:	Reading
C	E	Over
E	C	0.35
B	C	Over
B	E	Over

10. Repeat the tests in Step 9 for each IGBT. If your readings differ from the values in Table 6-5, replace the IGBT.

This page intentionally left blank.

Appendix A – ACS 501 Technical Data

Input Power

Voltage: 208/220/230/240 VAC \pm 10% for 230 VAC units
380/400/415 VAC \pm 10% for 380 VAC units
440/460/480/500 VAC \pm 10% for 480 VAC units
525/550/575/600 VAC \pm 10% for 600 VAC units

Frequency: 48 – 63 Hz

Displacement Power Factor: > 0.98

Line Imbalance: $\pm 3\%$ of V_R

Output Power

Voltage: 0 – V_N , three-phase (full voltage at field weakening point)

Frequency: ACS 501, 0 – 500 Hz

ACS 502, 0 – 120 Hz

Frequency Resolution: 0.01 Hz

Continuous Current (constant torque): $1.0 \times I_R$

Continuous Current (variable torque): $1.0 \times I_{RSQ}$

Maximum Current (1 min/every 10 min): $1.5 \times I_N$

Short Time Overload (2 sec/every 1 min): $2.0 \times I_N$

Overcurrent Trip: $3.75 \times I_N$ instantaneous, $2.65 \times I_N$ (RMS)

Field Weakening Point: ACS 501, 30 – 500 Hz

Field Weakening Point: ACS 502, 30 – 180 Hz

Continuous Loadability of Motor: 100% at rated speed (for F class motor)

Modulation Frequency: ACS 501, 1 – 12 kHz

ACS 502, 3 kHz

Analog Inputs

Two programmable analog inputs.

Current Reference: 0 – 20 mA, $R_I = 250$ ohms

- Minimum: 0 mA / 4 mA / 0 – 20 mA
- Maximum: 0 – 20 mA

Voltage Reference: 0 - 10 V, $R_I = 200K$ ohms

- Minimum: 0 V / 2 V / 0 – 10 V
- Maximum: 0 – 10 V

Potentiometer: 1K – 10K ohms

Potentiometer Reference Voltage: 10 V, 10 mA

Resolution: AI1 = 10 Bit; AI2 = 12 Bit

Accuracy:

- Analog Control: $\pm 0.5\%$
- Digital Control: $\pm 0.01\%$

Reference Signal Update: < 20 mSec

**Auxiliary Voltage
(for Controls)**

24 VDC $\pm 10\%$, 200 mA

Digital Inputs

Six programmable digital inputs.

< 4.0 V is logical 0

> 18 V is logical 1

Updating of Start/Stop Signal: < 5 mSec

Updating of Other Signals: < 20 mSec

Analog Outputs

Two programmable analog outputs.

0 – 20 mA or 4 - 20 mA, R_L less than or equal to 500 ohms, floating.

Digital Relay Outputs

Three programmable relay outputs, Form C contacts.

Maximum Switching Voltage: 300 VDC / 250 VAC

Maximum Switching Current/Power: 8 A @ 24 VDC, 0.4 A @ 250 VDC,
or 2000 VA @ 250 VAC

Maximum Continuous Current: 2 A rms

Environmental Limits

Ambient Operating Temperature:

- Constant Torque 32° to 113°F (0° to 45°C) NEMA 1, $f_s = 3$ kHz
- Constant Torque 32° to 104°F (0° to 40°C) NEMA 12, $f_s = 3$ kHz
- Variable Torque 32° to 104°F (0° to 40°C) NEMA 1, $f_s = 3$ kHz

Storage Temperature: - 40°F to + 158°F (-40°C to +70°C)

Relative Humidity: less than 95%, non-condensing

Continuous Vibration Level: less than 0.5 G

Altitude: 3300 ft (1000 m) above sea level, derate 1% for every 330 ft (100 m) above 3300 ft (1000 m)

Enclosures

NEMA 1, NEMA 12, CHASSIS

Analog Input (AI)	<p>An Analog Input is an input to the ACS 501 for a user-supplied DC signal. The signal may be a speed reference or a process feedback. This signal can be from:</p> <ul style="list-style-type: none">• Manual speed pot• DC voltage (0 to 10 VDC)• DC current (0 to 20 mADC) <p>Analog inputs on the ACS 501 Keypad Display are abbreviated AI.</p>
Converter	<p>The ACS 501 series adjustable frequency drive (AFD) uses a three-phase diode bridge to convert the applied AC line voltage to rectified DC.</p>
DC Bus	<p>The DC Bus is comprised of the:</p> <ul style="list-style-type: none">• DC potential source (internal rectifier bridge or external source),• DC link inductor (connecting the DC bus capacitors to the DC potential source), and• DC bus capacitors that, together with the DC link inductor, provide filtration of the DC source potential and provide some buffering between the DC source and the power inverter section. <p>The DC Bus voltage is $1.35 \times \text{Supply Voltage (V}_{IN})$.</p>
Default	<p>A default is a pre-programmed value for a parameter. When you first install and start your ACS 501 drive, all application macro parameter values appearing on the Keypad Display are default settings. You may change these default settings in the process of customizing your drive for your particular drive application.</p>
Digital Input (DI)	<p>The Digital Inputs (DI) receive bistable (two-state On-Off) control signals from the outside world. An example of such would be a two-position Start-Stop selector switch. Digital inputs on the ACS 501 Keypad Display are abbreviated DI.</p>
EEPROM	<p>EEPROM is an acronym for Electrically Erasable Programmable Read Only Memory. The EEPROM is the non-volatile memory that stores all parameters, even when power is removed.</p>
ESD	<p>ESD is an acronym for Electrostatic Discharge. ESD cautions indicate situations in which static electricity can damage circuit boards on the ACS 501 drive. Follow the precautions listed in the <i>Safety</i> section at the beginning of this manual when installing or removing circuit boards.</p>

Field Weakening Point	This is the point at which the output voltage no longer increases as the output frequency is increased. Operation above this point results in reduced motor torque capability while the output kVA remains constant. Refer to Parameter 20.4.4 (Field Weak Point).
Group	A Group is the second of three display levels in ACS 501 programming. Groups group parameters by their functionality, and provide access to them in the same way that Mains provide access to Groups. Groups appear within their respective Mains. For example, if you need to access Group 20.4 or Group 20.3, you must first select Main 20 using specific Keypad procedures. Refer to <i>Chapter 2 – Overview of the ACS 501</i> .
IGBT	An IGBT is a fast switching power transistor. ACS 501 drives use these in the inverter section as part of the process of changing DC voltage to AC voltage.
I_R	This notation abbreviates the constant torque rated output current, in amperes, of an ACS 501.
I_{RSQ}	This notation abbreviates the rated variable drive output current, in amperes, of an ACS 501.
I_N	This notation abbreviates the current which the drive trips and on which settings are based.
Inverter	The inverter changes DC power to AC power for application to the motor windings. Control of the inverter affords variable frequency and voltage to be applied to the motor for control of motor speed and direction.
IR Compensation	IR Compensation is a parameter that provides the motor with extra torque at motor speeds between 0.1 Hz and the set Field Weakening Point. Refer to Parameter 20.4.4 (Field Weak Point) and <i>Field Weakening Point</i> in this glossary.
Joystick Control	Joystick control allows you to use a joystick for external speed and direction drive control through analog input AI1. Refer to Parameter 10.2.2 (External Ref1 Sel).
Line Voltage	Line voltage in this manual means the input voltage that provides power to the ACS 501. Line voltage is connected to the ACS 501 Terminals L ₁ , L ₂ , and L ₃ . Refer to Start-up Data Parameter D (Supply Voltage). Refer to <i>Supply Voltage</i> in this glossary.
Living Zero	The Living Zero function allows the ACS 501 to detect a loss of reference signal. Set Parameter 10.5.1 (Minimum AI1) to a value greater than 0.3 V/0.6 mA for a Living Zero function. You can then supervise the presence of a control signal by setting Parameter 30.1.2 (AI < Min Function) to WARNING or FAULT. A Warning or Fault message will then display if the analog input falls below the set minimum.

Macro	<p>A macro is a pre-programmed set of defaults for all of the parameters, which are typical for the specified application. When you select a macro from Start-up Data Parameter B (Applications), you select the macro that most closely defines the drive functions necessary for your particular application. After selecting the macro, you can modify or customize the macro to specifically conform to your application.</p> <p>Refer to the <i>ACS 500 Adjustable Frequency AC Drives 2 to 350 HP Programming Manual Including Application Macros</i> for information on macro applications, functions, and parameter values.</p>
Main	<p>A Main is the first of four display levels in the ACS 501 programming. Mains provide access to Groups in the same way that Groups provide access to Parameters. For example, to access Main 10 while viewing any of the 28 Operating Data Parameters, press [Right Arrow] on the Control Panel Keypad. From the Main 10 display, press [Up Arrow] to access Main 20, Main 30, and Main 40. Refer to <i>Chapter 2 – Overview of the ACS 501</i>.</p>
Megger Test	<p>A Meggar Test measures an insulation system's resistance. This test passes a low current, high voltage through a capacitor and measures the resistance of the insulation system. Meggar test results are usually expressed in megohms.</p> <hr/> <p>CAUTION: The ACS 501 must not be subjected to testing of this type as damage could result. Any wires connected to the ACS 501 MUST be disconnected from the ACS 501 before being subjected to this type of test.</p> <hr/>
Memory	<p>The ACS 501 memory provides computer storage for program data and instructions.</p>
Multimeter	<p>A multimeter measures electric component functions and values such as voltage (volts), resistance (ohms), and current (amperes). Some multimeters also test the condition of diodes.</p>
Operating Data	<p>Operating Data defines ACS 501 Parameters 1 (Output Frequency) through 28 (Act Value 2 (PFC)) located at the first of four display levels.</p> <p>Many Operating Data parameters simply display information such as drive temperature and motor speed, and some parameter values can be changed according to drive application needs.</p>
Parameter	<p>A Parameter is the last of four display levels in the ACS 501 programming. In most cases, Groups provide access to Parameters, and Parameters allow you to modify macros, change start-up settings, and monitor drive and motor functions. Refer to <i>Chapter 2 – Overview of the ACS 501</i>.</p>
P_R	<p>This notation abbreviates the rated constant torque output power rating of an ACS 501.</p>
P_{RSQ}	<p>This notation abbreviates the rated variable torque output power rating of an ACS 501.</p>

Rectifier	A rectifier is a device that permits current flow in one direction and blocks the flow of current in the other direction. In today's technology, rectifiers are of the silicon diode type. The ACS 501 uses six rectifiers, configured into a three-phase bridge configuration, as the power converter section of the drive.
Slip Compensation	Slip compensation is a feature in the ACS 501 that allows the drive to compensate for motor slip caused by increased load.
Start-up Data	<p>Start-up Data parameters allow you to set certain parameter values prior to starting the ACS 501. You set these parameters according to the language you want the drive to display (such as German, Spanish, or English), the supply voltage providing power to the drive, and so on. In most cases, these parameters are one-time settings made only during the drive installation process.</p> <p>Start-up Data parameters are not accessed through the same display levels as Operating Data parameters, Main level, or Group level. Instead, you must first view Operating Data Parameter 1 (Output Frequency), press and hold [*] on the Control Panel Keypad, then press [Right Arrow]. Only this procedure accesses Start-up Data parameters on the ACS 501.</p>
Supply Voltage	Supply voltage in this manual means the input voltage that provides power to the ACS 501. Supply voltage is connected to ACS 501 Terminals L ₁ , L ₂ , and L ₃ . Refer to Start-up Data Parameter D (Supply Voltage). Refer to <i>Line Voltage</i> and V_{IN} in this glossary.
T_R	This notation abbreviates the rated output torque of the motor.
V_{IN}	This notation abbreviates the input voltage of the drive. Refer to <i>Supply Voltage</i> in this glossary.
V_N	This notation abbreviates the voltage for which the drive is programmed.
V_R	This notation abbreviates the rated input voltage setting, in volts, of an ACS 501.

A		E	
ACS 501 drive		Environment	3-2
inspection prior to installation	3-9	ESD warning	iv
storage before installation	3-9		
Ambient temperature	3-2	F	
Analog inputs	3-15	Fault	
Analog outputs	3-15	erasing	5-2
APPLIC . RESTORE	4-3	history	5-2
Application macros		indications	5-1
customizing	4-7	resetting	5-1
default settings	2-8	warning messages	5-3
overview	2-8	Functions, descriptions	2-2
APPLICATIONS	4-3	Fuse sizes	3-7
Audience, intended	1-2		
		G	
C		General information, component descriptions	2-2
Conduit sizes	3-6	Group, defined	1-2
Control connections			
SNAT-759	3-17	H	
X50	3-14	Hardware components, illustration	2-4
Control function, illustration	2-4		
Control interface card		I	
component description	2-2	Input power	
ESD warning	iv	terminal connections to ACS 501	3-13
Control panel		wire sizes	3-7
display	1-2, 2-5		
keys	1-2, 2-6	K	
LCD display illustration	2-5	Keypad functions	2-6
operation	2-5	Keys, control panel	1-2
table of keypad functions	2-6		
using the keys	1-2	L	
Control wiring		LANGUAGE	4-3
and application macros	3-9	Liability information	1-3
restrictions	3-9		
sizes	3-9	M	
terminals	3-9	Macros,overview	2-8
Conventions used in this manual	1-2	Main, defined	1-2
Cooling requirements	3-2	Mechanical installation	3-10
		Motor	
D		insulation check	3-12
Digital inputs	3-15	output wiring connections from ACS 501	3-14
Digital outputs	3-16	MOTOR BASE FREQUENCY	4-4
Dimensions	3-4	MOTOR BASE R . P . M .	4-4
Display contrast, adjusting	2-8		
Display indications	2-5		
Drive code, nameplate identification	2-1		



ABB Industrial Systems Inc.
16250 West Glendale Drive
New Berlin, WI 53151
Telephone: (414) 785-3416
Fax: (414) 785-0397

ACS 501-04F
EFFECTIVE 6/1/96
SUPERCEDES 7/1/95